**Mplus Code for Mediation, Moderation and Moderated Mediation Models**


http://www.figureitout.org.uk

This document contains Mplus Code for testing different configuration of mediation, moderation and moderated mediation models, including those corresponding in type to the 76 configuration listed and index by Andrew Hayes in the documentation for his SPSS PROCESS macro. It is recommended that you read his seminal text (Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford Press.) before undertaking such analyses.

**Why Mplus?**

Whilst Mplus requires extra labour and skills, it provides a completely flexible modelling environment that enables you to test unlimited configurations of moderation and mediation, not just the 76 PROCESS models. Specifically, PROCESS is limited to a single primary IV and DV, continuous mediations, either parallel or serial mediation but not both, and dichotomous or continuous outcomes, where the assumptions of standard multiple regression/logistic regression as appropriate are satisfied. Mplus, on the other hand, can handle all of these scenarios, and can also handle models with multiple IVs and DVs, mediators in serial or in parallel, and models with non-normal DVs. Also, unlike PROCESS, it can handle mediation and moderation where the data structure is multilevel, and can incorporate latent variables.

**How do I use the model codes?**

Each of the models have the provided diagrams, model equations, and the Mplus code. The code includes the requisite DEFINE:, ANALYSIS:, MODEL:, and OUTPUT: principal commands, as well as preceding USEVARIABLES: subcommand that lists hypothetical variables. To apply these examples to your data, you will need to write the DATA: and VARIABLE: commands and change the hypothetical variable names (e.g. Y, X, M, Z etc.) to match your variable names.

This code and guidance to mediation and moderation testing is designed for people with some basic previous knowledge of Mplus. Before trying to use this code you need beginner’s Mplus skills, specifically to know how to read your data into Mplus, how missing data is coded and treated, how models are estimated, how different outcome distributions are specified, how the BY, ON, WITH, and XWITH statements, and the
@ and () symbols work, and how MODEL CONSTRAINT: enables functions of parameters to be tested.

If you require Mplus training/consultation, we offer both public and in-house courses, and consultancy: see www.figureitout.org.uk.

**Known potential running issues:**

We have found that, compared to the PROCESS macro, the more complex models can take a considerable amount of time to run (upwards of an hour), especially when bootstrapping is used (we tested the models using a relatively powerful laptop with an 8i processor). Mplus also struggles to fit models (i.e. you get convergence failures) where measures are on scales with a high variance - where this is the case, rescaling predictors e.g. standardising them, usually solves the problem.

**Model Template Selection:**

Model templates 1 to 76 below match the equivalently numbered models associated with Andrew Hayes’ PROCESS macro, albeit with two adaptations:

1) Where Andrew Hayes’ templates specify a model and equation generalised from 1 to multiple mediators, then, for the purposes of providing specific example code in Mplus that matches a diagram, the code and diagrams have been written for a model with 2 mediators in mediator only models (4 and 6) and 1 mediator in moderated mediation models. The code can be edited to include as many mediators as is desired

2) All the models and codes exclude covariates, these can be easily added by specifying them as predictors of the outcome and mediators through adding extra ON statements.

**Further Models added:**

In recognition of models that cannot be fitted by PROCESS, additional models have been added (model 77 onwards). These include mediation with both serial and parallel mediators, moderated serial mediation, and moderated mediation with both serial and parallel mediators. Models will be continually added and updated.

**Acknowledgements:**

These codes were developed by Dr Chris Stride, with assistance from Sarah Gardner (programming/checking), Nick Catley (equation expansion/checking) and Ffion Thomas (diagram drawing, based on the original PROCESS diagrams by Andrew Hayes).
Model Index

All models have one primary IV and one DV. For the purposes of calculation of the indirect effects and conditional effects:

- The primary IV (variable X) is assumed to be continuous or dichotomous
- Moderators (variables W, V, Q, Z) are assumed to be continuous. The adaptation to handle observed dichotomous moderators can be found at the end of this documentation.
- Mediators (variable M, or M1, M2 etc.) are assumed to be continuous
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression. Examples of how to handle an observed dichotomous DV are provided in model 1e.

<table>
<thead>
<tr>
<th>Model number</th>
<th>Arrangement of mediators and moderators</th>
<th>Number of distinct mediators</th>
<th>Number of distinct moderators</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1 moderator [BASIC MODERATION], continuous moderator</td>
<td>0</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>1b</td>
<td>1 moderator [BASIC MODERATION], dichotomous moderator</td>
<td>0</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>1c</td>
<td>1 moderator [BASIC MODERATION], dichotomous moderator (using multigroup method)</td>
<td>0</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>1d</td>
<td>1 moderator [BASIC MODERATION], categorical moderator with &gt; 2 categories</td>
<td>0</td>
<td>1</td>
<td>25</td>
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<tr>
<td>1e</td>
<td>1 moderator [BASIC MODERATION], dichotomous outcome (logistic regression)</td>
<td>0</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>2 moderators, 2-way interactions with predictor only</td>
<td>0</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>2 moderators, all 2-way and 3-way interactions</td>
<td>0</td>
<td>2</td>
<td>37</td>
</tr>
<tr>
<td>4a</td>
<td>1 mediator [BASIC MEDIATION]</td>
<td>1</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td>4b</td>
<td>2 mediators in parallel [BASIC MEDIATION]</td>
<td>1+</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>4c</td>
<td>1 or more mediators, in parallel if multiple (example uses 1) [BASIC MEDIATION], dichotomous mediator</td>
<td>1+</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>4d</td>
<td>1 or more mediators, in parallel if multiple (example uses 1) [BASIC MEDIATION], dichotomous outcome</td>
<td>1+</td>
<td>0</td>
<td>53</td>
</tr>
</tbody>
</table>
5 1 or more mediators, in parallel if multiple, 1 moderator of direct IV-DV path only 1+ 1 57
6 2 or more mediators, in series (example uses 2) 2+ 0 61
7 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of IV-Mediator path only 1+ 1 64
8 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator moderating both the IV-Mediator path and direct IV-DV path 1+ 1 68
9 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path only 1+ 2 72
10 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating both the IV-Mediator path and direct IV-DV path 1+ 2 77
11 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path only, all 2-way and 3-way interactions 1+ 2 82
12 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path and direct IV-DV path, all 2-way and 3-way interactions 1+ 2 87
13 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the IV-Mediator path, 3-way interaction, 1 also moderating direct IV-DV path 1+ 2 93
14 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of Mediator-DV path only 1+ 1 99
15 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of both Mediator-DV and direct IV-DV path 1+ 1 103
16 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path only 1+ 2 108
17 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating both the Mediator-DV and direct IV-DV path 1+ 2 113
18 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path only, all 2-way and 3-way interactions 1+ 2 119
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Total</th>
<th>Use</th>
<th>Notes</th>
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<tbody>
<tr>
<td>19</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path and direct IV-DV path, all 2-way and 3-way interactions</td>
<td>1+</td>
<td>2</td>
<td>124</td>
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<tr>
<td>20</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the Mediator-DV path, 3-way interaction, 1 also moderating direct IV-DV path</td>
<td>1+</td>
<td>2</td>
<td>130</td>
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<tr>
<td>21</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path</td>
<td>1+</td>
<td>2</td>
<td>136</td>
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<tr>
<td>22</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path and direct IV-DV path, 1 moderating the Mediator-DV path</td>
<td>1+</td>
<td>2</td>
<td>141</td>
</tr>
<tr>
<td>23</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path, 1 moderating the Mediator-DV path</td>
<td>1+</td>
<td>3</td>
<td>147</td>
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<tr>
<td>24</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and direct IV-DV path, 1 moderating the Mediator-DV path</td>
<td>1+</td>
<td>3</td>
<td>155</td>
</tr>
<tr>
<td>25</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 moderating the Mediator-DV path</td>
<td>1+</td>
<td>3</td>
<td>164</td>
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<tr>
<td>26</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and direct IV-DV path with all 2-way and 3-way interactions, 1 moderating the Mediator-DV path</td>
<td>1+</td>
<td>3</td>
<td>173</td>
</tr>
<tr>
<td>27</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, one of which also moderates the direct IV-DV path, 1 moderating the Mediator-DV path</td>
<td>1+</td>
<td>3</td>
<td>183</td>
</tr>
<tr>
<td>28</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path and direct IV-DV path</td>
<td>1+</td>
<td>2</td>
<td>192</td>
</tr>
<tr>
<td>29</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path</td>
<td>1+</td>
<td>2</td>
<td>198</td>
</tr>
</tbody>
</table>
path, 1 moderating the Mediator-DV path, both moderating the direct IV-DV path

30 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path, 1 moderating both the Mediator-DV path and the direct IV-DV path

31 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and the direct IV-DV path, 1 moderating both the Mediator-DV path and the direct IV-DV path

32 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 moderating both the Mediator-DV path and the direct IV-DV path

33 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, 1 moderating both the Mediator-DV path and the direct IV-DV path

34 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, one of which also moderates the direct IV-DV path, 1 moderating the Mediator-DV path and the direct IV-DV path

35 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path

36 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating both the Mediator-DV path and the IV-DV path

37 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions

38 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating both the Mediator-DV path and the IV-DV path, with all 2-way and 3-way interactions
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<tbody>
<tr>
<td>39</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>40</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>41</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating both the Mediator-DV path and the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>42</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path all 2-way and 3-way interactions</td>
<td>1+</td>
</tr>
<tr>
<td>43</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions</td>
<td>1+</td>
</tr>
<tr>
<td>44</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>45</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>46</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>47</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions</td>
<td>1+</td>
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</tr>
<tr>
<td>48</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions</td>
<td>1+</td>
</tr>
<tr>
<td>49</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path, with the other 2 moderating the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>50</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>51</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>52</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>53</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions</td>
<td>1+</td>
</tr>
<tr>
<td>54</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions</td>
<td>1+</td>
</tr>
<tr>
<td>55</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions</td>
<td>1+</td>
</tr>
<tr>
<td>56</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path</td>
<td>1+</td>
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path and the direct IV-DV path with all 2-way and 3-way interactions

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<tbody>
<tr>
<td>57</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>58</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 1 moderators, which moderates both the IV-Mediator path and the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>59</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 1 moderators, which moderates all of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>60</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>61</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates both the Mediator-DV path and the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>62</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates the Mediator-DV path, the with the other moderating the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>63</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path and the direct IV-DV path, 1 of which also moderates the Mediator-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>64</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates the IV-Mediator path</td>
<td>1+</td>
</tr>
<tr>
<td>65</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates both the IV-Mediator path and the direct IV-DV path</td>
<td>1+</td>
</tr>
<tr>
<td>66</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the</td>
<td>1+</td>
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</table>
Mediator-DV path, 1 of which also moderates the IV-Mediator path, the with the other moderating the direct IV-DV path

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Value</th>
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<td>67</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path and the direct IV-DV path, 1 of which also moderates the IV-Mediator path</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>68</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 of which also moderates the Mediator-DV path</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>69</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both of the IV-Mediator path and the direct IV-DV path, with all 2-way and 3-way interactions, 1 of which also moderates the Mediator-DV path</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>70</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the IV-Mediator path</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>71</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both of the Mediator-DV path and the direct IV-DV path, with all 2-way and 3-way interactions, 1 of which also moderates the IV-Mediator path</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>72</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both of the IV-Mediator path and the Mediator-DV path, with all 2-way and 3-way interactions</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>73</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating each of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path, with all 2-way and 3-way interactions</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>74</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), IV also moderates the Mediator-DV path</td>
<td>1+</td>
<td>(1)</td>
</tr>
<tr>
<td>75</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path and the Mediator-DV path</td>
<td>1+</td>
<td>2</td>
</tr>
<tr>
<td>76</td>
<td>1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating each of the Mediator-DV path</td>
<td>1+</td>
<td>2</td>
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</table>
IV-Mediator path, the Mediator-DV path and the direct IV-DV path

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<table>
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<tbody>
<tr>
<td>80</td>
<td>3 or more mediators, both in parallel and in series</td>
<td>3+</td>
</tr>
<tr>
<td>81</td>
<td>3 or more mediators, both in parallel and in series</td>
<td>3+</td>
</tr>
<tr>
<td>82</td>
<td>4 or more mediators, both in parallel and in series (parallel serial paths)</td>
<td>4+</td>
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<tr>
<td>83</td>
<td>2 or more mediators in series, 1 moderator, moderating the IV-first mediator path</td>
<td>2+</td>
</tr>
<tr>
<td>84</td>
<td>2 or more mediators in series, 1 moderator, moderating both IV-first mediator path and IV-second mediator path</td>
<td>2+</td>
</tr>
<tr>
<td>85</td>
<td>2 or more mediators in series, 1 moderator, moderating the IV-first mediator path, IV-second mediator path, and the direct IV-DV path</td>
<td>2+</td>
</tr>
<tr>
<td>86</td>
<td>2 or more mediators in series, 1 moderator, moderating the IV-first mediator path and the direct IV-DV path</td>
<td>2+</td>
</tr>
<tr>
<td>87</td>
<td>2 or more mediators in series, 1 moderator, moderating the second mediator-DV path</td>
<td>2+</td>
</tr>
<tr>
<td>88</td>
<td>2 or more mediators in series, 1 moderator, moderating both the first mediator-DV and the second mediator-DV paths</td>
<td>2+</td>
</tr>
<tr>
<td>89</td>
<td>2 or more mediators in series, 1 moderator, moderating the direct IV-DV path, the first mediator-DV path, and the second mediator-DV path</td>
<td>2+</td>
</tr>
<tr>
<td>90</td>
<td>2 or more mediators in series, 1 moderator, moderating both the direct IV-DV path and the second mediator-DV path</td>
<td>2+</td>
</tr>
<tr>
<td>91</td>
<td>2 or more mediators, in series, 1 moderator moderating path between mediators</td>
<td>2+</td>
</tr>
<tr>
<td>92</td>
<td>2 or more mediators in series, 1 moderator, moderating all of the direct IV-DV path, IV-first mediator path, IV-second mediator path, first mediator-DV path, second mediator-DV path, and the path between mediators</td>
<td>2+</td>
</tr>
<tr>
<td>501</td>
<td>1 mediator, multiple focal predictors</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1 mediator, multiple focal outcomes</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>502</td>
<td>1 mediator, predictor has non-linear effect on mediator and outcome</td>
<td>1</td>
</tr>
<tr>
<td>503</td>
<td>3 or more mediators, both in parallel and in series, 2 moderators, 1 moderating paths between predictor and mediator, the second moderating paths between mediators, and between mediator and DV</td>
<td>3+</td>
</tr>
</tbody>
</table>
Model 1a: 1 moderator [BASIC MODERATION]

Continuous moderator

Example Variables: 1 predictor X, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that:

The primary IV (variable X) is continuous or dichotomous

Any moderators (variables W,V,Q,Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for this model at the end of this user guide.

Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous

The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for this model at the bottom of the code (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):
\[ Y = b_0 + b_1X + b_2W + b_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1X + b_2W + b_3XW \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + b_2W) + (b_1 + b_3W)X \]

Hence...
One direct effect of \( X \) on \( Y \), conditional on \( W \):
\[ b_1 + b_3W \]
**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - (not applicable)
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X W Y XW;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
  XW = X*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON X (b1);
  Y ON W (b2);
  Y ON XW (b3);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W SIMP_LO SIMP_MED SIMP_HI);

  LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
  MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
  HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

! Now calc simple slopes for each value of W

  SIMP_LO = b1 + b3*LOW_W;
  SIMP_MED = b1 + b3*MED_W;
  SIMP_HI = b1 + b3*HIGH_W;
```
! Use loop plot to plot model for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = (b0 + b2*LOW_W) + (b1 + b3*LOW_W)*XVAL;
MEDMOD = (b0 + b2*MED_W) + (b1 + b3*MED_W)*XVAL;
HIMOD = (b0 + b2*HIGH_W) + (b1 + b3*HIGH_W)*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
**Model 1b: 1 moderator [BASIC MODERATION], dichotomous moderator**

Example Variables: 1 predictor X, 1 moderator W, 1 outcome Y

**Preliminary notes:**

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- The moderator (variable W) is dichotomous. Handling categorical moderators with > 2 categories is demonstrated in model 1d.
- Any mediators (variable M, or M1, M2, etc.) are continuous and satisfy the assumptions of standard multiple regression. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

**Model Diagram:**

![Model Diagram](image-url)
Model Equation(s):

\[ Y = b_0 + b_1X + b_2W + b_3WX \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1X + b_2W + b_3WX \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + b_2W) + (b_1 + b_3W)X \]

Hence...

One direct effect of \( X \) on \( Y \), conditional on \( W \):

\( b_1 + b_3W \)

so inserting the values of 0 and 1 for moderator \( W \) gives....
when $W = 0$, $Y = b_0 + b_1X$; when $W = 1$, $Y = (b_0 + b_2) + (b_1 + b_3)X$

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - (not applicable)
! Moderator variable(s) - W, dichotomous, coded 0/1
! Outcome variable - Y
USEVARIABLES = X W Y XW;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above
DEFINE:
  XW = X*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
  [Y] (b0);
  Y ON X (b1);
  Y ON W (b2);
  Y ON XW (b3);

! Use model constraint subcommand to test simple slopes
! You need to insert your two moderator values, 0 and 1
MODEL CONSTRAINT:
  NEW(LOW_W HIGH_W SIMP_LO SIMP_HI);
  LOW_W = 0;
  HIGH_W = 1;

! Now calc simple slopes for each value of W
  SIMP_LO = b1 + b3*LOW_W;
  SIMP_HI = b1 + b3*HIGH_W;

! Use loop plot to plot model for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
```
PLOT(LOMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = (b0 + b2*LOW_W) + (b1 + b3*LOW_W)*XVAL;
HIMOD = (b0 + b2*HIGH_W) + (b1 + b3*HIGH_W)*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);

Alternative code:

If you are feeling confident, you could simplify the MODEL CONSTRAINT code to:

MODEL CONSTRAINT:
  NEW(SIM_MOD0 SIM_MOD1);
  SIM_MOD0 = b1;
  SIM_MOD1 = b1 + b3;

! Use loop plot to plot model for values of W = 0, W = 1
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(MOD0 MOD1);
LOOP(XVAL,1,5,0.1);
MOD0 = b0 + b1*XVAL;
MOD1 = (b0 + b2) + (b1 + b3)*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 1c: 1 moderator [BASIC MODERATION], dichotomous moderator (using multigroup method)

Example Variables: 1 predictor X, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- The moderator (variable W) is dichotomous. Handling categorical moderators with > 2 categories is demonstrated in model 1d.
- Any mediators (variable M, or M1, M2, etc.) are continuous and satisfy the assumptions of standard multiple regression. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).
Model Equation(s):
\[ Y = b_0 + b_1X + b_2W + b_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1X + b_2W + b_3XW \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + b_2W) + (b_1 + b_3W)X \]
Hence...

One direct effect of $X$ on $Y$, conditional on $W$:

$$b_1 + b_3W$$

so inserting the values of 0 and 1 for moderator $W$ gives....

when $W = 0$, $Y = b_0 + b_1X$; when $W = 1$, $Y = (b_0 + b_2) + (b_1 + b_3)X$

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - (not applicable)
! Moderator variable(s) - W, dichotomous, coded 0/1
! Outcome variable - Y

USEVARIABLES = X W Y XW;

! Define groups of moderator W
GROUPING = W (0 = GP0 1 = GP1);

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement first state basic regression that is being moderated
MODEL:
   Y ON X;

! Then restate for each group, naming each group's intercept and slope coefficient
! and fixing residual variances equal

MODEL GP0:
   [Y](b0g0);
   Y ON X (b1g0);
   Y (vary);

MODEL GP1:
   [Y](b0g1);
   Y ON X (b1g1);
   Y (vary);

! Use model constraint subcommand to create and test difference in slopes
! Note that slopes for each group provide simple slopes tests already
```
MODEL CONSTRAINT:
    NEW(b3);
    b3 = b1g1 - b1g0;

! Use loop plot to plot model for values of W = 0, W = 1
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

    PLOT(LINEGP0 LINEGP1);
    LOOP(XVAL,1,5,0.1);
    LINEGP0 = b0g0 + b1g0*XVAL;
    LINEGP1 = b0g1 + b1g1*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 1d: 1 moderator [BASIC MODERATION], categorical moderator with > 2 categories

Example Variables: 1 predictor X, 2 dummy variables WD1 and WD2 representing 3 category moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- The moderator (variable W) has 3 categories (1-3), and is therefore represented by two dummy variables WD1, WD2, coded such that when W = 1, then WD1 = 1, WD2 = 0; when W = 2, then WD1 = 0, WD2 = 1; when W = 3 (the reference category), then WD1 = 0, WD2 = 0.
- Any mediators (variable M, or M1, M2, etc.) are continuous and satisfy the assumptions of standard multiple regression. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):
\[ Y = b_0 + b_1X + b_2WD_1 + b_3WD_2 + b_4XWD_1 + b_5XWD_2 \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1X + b_2WD_1 + b_3WD_2 + b_4XWD_1 + b_5XWD_2 \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + b_2WD_1 + b_3WD_2) + (b_1 + b_4WD_1 + b_5WD_2)X \]

Hence...
One direct effect of \( X \) on \( Y \), conditional on \( W \):
\[ b_1 + b_4WD_1 + b_5WD_2 \]
so inserting the values of 0 and 1 for moderator \( W \) gives....
when $W = 1$, then $WD1 = 1$, $WD2 = 0$, hence $Y = (b0 + b2) + (b1 + b4)X$
when $W = 2$, then $WD1 = 0$, $WD2 = 1$, hence $Y = (b0 + b3) + (b1 + b5)X$
when $W = 3$, then $WD1 = 0$, $WD2 = 0$, hence $Y = b0 + b1X$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - (not applicable)
! Moderator variable(s) - W, 3 categories, represented by
dichotomous 0/1 dummy variables WD1, WD2
! Outcome variable - Y
USEVARIABLES = X WD1 WD2 Y XWD1 XWD2;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES
subcommand above
DEFINE:
  XWD1 = X*WD1;
  XWD2 = X*WD2;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using
parentheses
MODEL:
  [Y] (b0);
  Y ON X (b1);
  Y ON WD1 (b2);
  Y ON WD2 (b3);
  Y ON XWD1 (b4);
  Y ON XWD2 (b5);

! Use model constraint subcommand to test simple slopes
! You need to insert your respective dummy variable values, 0
and 1, for each group of W
MODEL CONSTRAINT:
  NEW(SIMP_W1 SIMP_W2 SIMP_W3);

! Now calc simple slopes for each group of W
  SIMP_W1 = b1 + b4;
  SIMP_W2 = b1 + b5;
  SIMP_W3 = b1;
```
! Use loop plot to plot model for values of W = 0, W = 1
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(LINE_W1 LINE_W2 LINE_W3);
LOOP(XVAL,1,5,0.1);

LINE_W1 = (b0 + b2) + (b1 + b4)*XVAL;
LINE_W2 = (b0 + b3) + (b1 + b5)*XVAL;
LINE_W3 = b0 + b1*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 1e: 1 moderator [BASIC MODERATION], dichotomous outcome (logistic regression)

Example Variables: 1 predictor X, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given in model 1b. Handling categorical moderators with > 2 categories is demonstrated in model 1d.
- Any mediators (variable M, or M1, M2, etc.) are continuous and satisfy the assumptions of standard multiple regression. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is dichotomous and satisfies the assumptions of logistic regression.

Model Diagram:
Model Equation(s):
\[ \text{logit}(Y) = b_0 + b_1X + b_2W + b_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( \text{logit}(Y) = a + bX \):
\[ \text{logit}(Y) = b_0 + b_1X + b_2W + b_3XW \]

Hence... grouping terms into form \( \text{logit}(Y) = a + bX \)
\[ \text{logit}(Y) = (b_0 + b_2W) + (b_1 + b_3W)X \]

Hence...
One direct effect of \( X \) on \( \text{logit}(Y) \), conditional on \( W \):
\[ b_1 + b_3W \]

Hence, writing as an odds ratio...
The multiplicative effect of \( X \) on the odds of \( Y \), conditional on \( W \):

\[
\exp(b_1 + b_3W) = \exp(b_1)\times\exp(b_3W)
\]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - (not applicable)
! Moderator variable(s) - W
! Outcome variable - Y - a dichotomous outcome, coded 0/1

USEVARIABLES = X W Y XW;
CATEGORICAL = Y;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above
DEFINE:
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;

! In model statement name each path and intercept using parentheses
MODEL:
    [Y$1] (b0);
    Y ON X (b1);
    Y ON W (b2);
    Y ON XW (b3);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W OR_LO OR_MED OR_HI);
    LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
    MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
    HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

! Now calc conditional odds ratios for each value of W
OR_LO = \exp(b_1 + b_3 \cdot LOW_W);
OR_MED = \exp(b_1 + b_3 \cdot MED_W);
OR_HI = \exp(b_1 + b_3 \cdot HIGH_W);

! Use loop plot to plot predicted probabilities by X conditional on low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(PLOMOD PMEDMOD PHIMOD);
LOOP(XVAL,1,5,0.1);
  PLOMOD = 1/(1 + \exp(-1*((b_0 + b_2 \cdot LOW_W) + (b_1 + b_3 \cdot LOW_W) \cdot XVAL)));
  PMEDMOD = 1/(1 + \exp(-1*((b_0 + b_2 \cdot MED_W) + (b_1 + b_3 \cdot MED_W) \cdot XVAL)));
  PHIMOD = 1/(1 + \exp(-1*((b_0 + b_2 \cdot HIGH_W) + (b_1 + b_3 \cdot HIGH_W) \cdot XVAL)));

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND;
Model 2: 2 moderators, 2-way interactions with predictor only

Example Variables: 1 predictor X, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

The primary IV (variable X) is continuous or dichotomous

Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)

Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous

The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):
\[ Y = b_0 + b_1X + b_2W + b_3Z + b_4XW + b_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1X + b_2W + b_3Z + b_4XW + b_5XZ \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + b_2W + b_3Z) + (b_1 + b_4W + b_5Z)X \]

Hence...
One direct effect of \( X \) on \( Y \), conditional on \( W \) and \( Z \):
\[ b_1 + b_4W + b_5Z \]
Mplus code for the model:

! Predictor variable - X 
! Mediator variable(s) - (not applicable) 
! Moderator variable(s) - W, Z 
! Outcome variable - Y

USEVARIABLES = X W Y XW XZ;

! Create interaction terms 
! Note as new vars they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  XW = X*W;
  XZ = X*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path, and intercept, using parentheses

MODEL:
  [Y] (b0);
  Y ON X (b1);
  Y ON W (b2);
  Y ON Z (b3);
  Y ON XW (b4);
  Y ON XZ (b5);

! Use model constraint subcommand to test simple slopes 
! You need to pick low, medium and high moderator values for both W and Z,
! for example, of 1 SD below mean, mean, 1 SD above mean

! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for simple slopes used below:
! MEW_LOZ = medium value of W and low value of Z, etc.

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_LOZ MEW_LOZ HIW_LOZ
  LOW_MEZ MEW_MEZ HIW_MEZ LOW_HIZ MEW_HIZ HIW_HIZ);

  LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
  MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
chosen high value of W
LOW_Z = #LOWZ;     ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ;     ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ;   ! replace #HIGHZ in the code with your
chosen high value of Z

! Now calc simple slopes for each value of W and Z
LOW_LOZ = b1 + b4*LOW_W + b5*LOW_Z;
MEW_LOZ = b1 + b4*MED_W + b5*LOW_Z;
HIW_LOZ = b1 + b4*HIGH_W + b5*LOW_Z;

LOW_MEZ = b1 + b4*LOW_W + b5*MED_Z;
MEW_MEZ = b1 + b4*MED_W + b5*MED_Z;
HIW_MEZ = b1 + b4*HIGH_W + b5*MED_Z;

LOW_HIZ = b1 + b4*LOW_W + b5*HIGH_Z;
MEW_HIZ = b1 + b4*MED_W + b5*HIGH_Z;
HIW_HIZ = b1 + b4*HIGH_W + b5*HIGH_Z;

! Use loop plot to plot model for all combinations of low,
med, high values of W and Z
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);
PLOW_LOZ = (b0 + b2*LOW_W + b3*LOW_Z) + LOW_LOZ*XVAL;
PMEW_LOZ = (b0 + b2*MED_W + b3*LOW_Z) + MEW_LOZ*XVAL;
PHIW_LOZ = (b0 + b2*HIGH_W + b3*LOW_Z) + HIW_LOZ*XVAL;
PLOW_MEZ = (b0 + b2*LOW_W + b3*MED_Z) + LOW_MEZ*XVAL;
PMEW_MEZ = (b0 + b2*MED_W + b3*MED_Z) + MEW_MEZ*XVAL;
PHIW_MEZ = (b0 + b2*HIGH_W + b3*MED_Z) + HIW_MEZ*XVAL;
PLOW_HIZ = (b0 + b2*LOW_W + b3*HIGH_Z) + LOW_HIZ*XVAL;
PMEW_HIZ = (b0 + b2*MED_W + b3*HIGH_Z) + MEW_HIZ*XVAL;
PHIW_HIZ = (b0 + b2*HIGH_W + b3*HIGH_Z) + HIW_HIZ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 3: 2 moderators, all 2-way and 3-way interactions

Example Variables: 1 predictor X, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W,V,Q,Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):
\[ Y = b_0 + b_1X + b_2W + b_3Z + b_4XW + b_5XZ + b_6WZ + b_7XWZ \]

Albegra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1X + b_2W + b_3Z + b_4XW + b_5XZ + b_6WZ + b_7XWZ \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + b_2W + b_3Z + b_6WZ) + (b_1 + b_4W + b_5Z + b_7WZ)X \]

Hence...
One direct effect of \( X \) on \( Y \), conditional on \( W \) and \( Z \):
\[ b_1 + b_4W + b_5Z + b_7WZ \]
Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - (not applicable)
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X W Y XW XZ WZ XWZ;

! Create interaction terms
! Note that as new vars they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
   XW = X*W;
   XZ = X*Z;
   WZ = W*Z;
   XWZ = X*W*Z;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path, and intercept, using parentheses

MODEL:
   [Y] (b0);
   Y ON X (b1);
   Y ON W (b2);
   Y ON Z (b3);
   Y ON XW (b4);
   Y ON XZ (b5);
   Y ON WZ (b6);
   Y ON XWZ (b7);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values for both W and Z,
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention used below: MEW_LOZ = medium value of W and low value of Z, etc.

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_LOZ MEW_LOZ HIW_LOZ
   LOW_MEZ MEW_MEZ HIW_MEZ LOW_HIZ MEW_HIZ HIW_HIZ);
   LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your 
chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your 
chosen high value of W
LOW_Z = #LOWZ;   ! replace #LOWZ in the code with your 
chosen low value of Z
MED_Z = #MEDZ;   ! replace #MEDZ in the code with your 
chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your 
chosen high value of Z

! Now calc simple slopes for each value of W 
and Z

LOW_LOZ = b1 + b4*LOW_W + b5*LOW_Z + b7*LOW_W*LOW_Z;
MEW_LOZ = b1 + b4*MED_W + b5*LOW_Z + b7*MED_W*LOW_Z;
HIW_LOZ = b1 + b4*HIGH_W + b5*LOW_Z + b7*HIGH_W*LOW_Z;
LOW_MEZ = b1 + b4*LOW_W + b5*MED_Z + b7*LOW_W*MED_Z;
MEW_MEZ = b1 + b4*MED_W + b5*MED_Z + b7*MED_W*MED_Z;
HIW_MEZ = b1 + b4*HIGH_W + b5*MED_Z + b7*HIGH_W*MED_Z;
LOW_HIZ = b1 + b4*LOW_W + b5*HIGH_Z + b7*LOW_W*HIGH_Z;
MEW_HIZ = b1 + b4*MED_W + b5*HIGH_Z + b7*MED_W*HIGH_Z;
HIW_HIZ = b1 + b4*HIGH_W + b5*HIGH_Z + b7*HIGH_W*HIGH_Z;

! Use loop plot to plot model for all combinations of low, 
med, high values of W and Z
! NOTE - values of 1,5 in LOOP() statement need to be replaced 
by 
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ 
PLOW_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);

PLOW_LOZ = (b0 + b2*LOW_W + b3*LOW_Z + b6*LOW_W*LOW_Z) + 
LOW_LOZ*XVAL;
PMEW_LOZ = (b0 + b2*MED_W + b3*LOW_Z + b6*MED_W*LOW_Z) + 
MEW_LOZ*XVAL;
PHIW_LOZ = (b0 + b2*HIGH_W + b3*LOW_Z + b6*HIGH_W*LOW_Z) + 
HIW_LOZ*XVAL;

PLOW_MEZ = (b0 + b2*LOW_W + b3*MED_Z + b6*LOW_W*MED_Z) + 
LOW_MEZ*XVAL;
PMEW_MEZ = (b0 + b2*MED_W + b3*MED_Z + b6*MED_W*MED_Z) + 
MEW_MEZ*XVAL;
PHIW_MEZ = (b0 + b2*HIGH_W + b3*MED_Z + b6*HIGH_W*MED_Z) + 
HIW_MEZ*XVAL;
\[
\begin{align*}
\text{PLOW}_{\text{HIZ}} &= (b_0 + b_2 \cdot \text{LOW}_W + b_3 \cdot \text{HIGH}_Z + b_6 \cdot \text{LOW}_W \cdot \text{HIGH}_Z) + \\
&\quad \text{LOW}_{\text{HIZ}} \cdot \text{XVAL}; \\
\text{PMEW}_{\text{HIZ}} &= (b_0 + b_2 \cdot \text{MED}_W + b_3 \cdot \text{HIGH}_Z + b_6 \cdot \text{MED}_W \cdot \text{HIGH}_Z) + \\
&\quad \text{MEW}_{\text{HIZ}} \cdot \text{XVAL}; \\
\text{PHIW}_{\text{HIZ}} &= (b_0 + b_2 \cdot \text{HIGH}_W + b_3 \cdot \text{HIGH}_Z + b_6 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z) + \\
&\quad \text{HIW}_{\text{HIZ}} \cdot \text{XVAL}; \\
\text{PLOT:} & \quad \text{TYPE} = \text{plot2}; \\
\text{OUTPUT:} & \quad \text{STAND CINT(bcbootstrap);} 
\end{align*}
\]
Model 4a: 1 mediator [BASIC MEDIATION]

Example Variables: 1 predictor X, 1 mediator M, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- The mediator (variable M) is continuous. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + c'X \]
\[ M = a_0 + a_1X \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + c'X \]
\[ M = a_0 + a_1X \]

Hence... substituting in equations for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X) + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1) + (a_1b_1 + c')X \]

Hence...
Indirect effect of $X$ on $Y$:

$a_1b_1$

Direct effect of $X$ on $Y$:

$c'$

Mplus code for the model:

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - none
! Outcome variable - Y

USEVARIABLES = X M Y;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
  Y ON M (b1);
  Y ON X (cdash);  ! direct effect of X on Y
  M ON X (a1);

! Use model constraint to calculate indirect and total effect

MODEL CONSTRAINT:
  NEW(a1b1 TOTAL);
  a1b1 = a1*b1;  ! Indirect effect of X on Y via M
  TOTAL = a1*b1 + cdash;  ! Total effect of X on Y

OUTPUT:
  STAND CINT(bcbootstrap);
```
Editing required for testing indirect effect(s) using alternative MODEL INDIRECT: subcommand:

MODEL INDIRECT: offers an alternative to MODEL CONSTRAINT: for models containing indirect effects, where these are not moderated. To use MODEL INDIRECT: instead, you would edit the code above as follows:

First, you can remove the naming of parameters using parentheses in the MODEL: command, i.e. you just need:

MODEL:
  Y ON X M;
  M ON X;

Second, replace the MODEL CONSTRAINT: subcommand with the following MODEL INDIRECT: subcommand:

  MODEL INDIRECT:
  Y IND X;

Leave the OUTPUT: command unchanged.
Model 4b: 2 mediators in parallel [BASIC MEDIATION]

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous

- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given in model 1b. Handling categorical moderators with > 2 categories is demonstrated in model 1d.

- Any mediators (variable M, or M1, M2, etc.) are continuous and satisfy the assumptions of standard multiple regression. An example of how to handle a dichotomous mediator is given in model 4c.

- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M_1 + b_2 M_2 + c'X \]

\[ M_1 = a_{01} + a_1 X \]

\[ M_2 = a_{02} + a_2 X \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_{01} + a_1 X) + b_2(a_{02} + a_2X) + c'X \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \)
\[ Y = b_0 + a_{01}b_1 + a_1 b_1 X + a_{02}b_2 + a_2 b_2 X + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}b_1 + a_1 b_1 X + a_{02}b_2 + a_2 b_2 X + c'X \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + a_{01}b_1 + a_{02}b_2) + (a_1 b_1 + a_2 b_2 + c')X \]
Hence...

Two indirect effects of X on Y:
\( a_1b_1, a_2b_2 \)

One direct effect of X on Y:
\( c' \)

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - none
! Outcome variable - Y

USEVARIABLES = X M1 M2 Y;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
  Y ON M1 (b1);
  Y ON M2 (b2);
  Y ON X (cdash);  ! direct effect of X on Y
  M1 ON X (a1);
  M2 ON X (a2);

! Use model constraint to calculate specific indirect paths
! and total indirect effect

MODEL CONSTRAINT:
  NEW(a1b1 a2b2 TOTALIND TOTAL);
  a1b1 = a1*b1;  ! Specific indirect effect of X on Y via M1
  a2b2 = a2*b2;  ! Specific indirect effect of X on Y via M2
  TOTALIND = a1*b1 + a2*b2;  ! Total indirect effect of X on Y via M1, M2
  TOTAL = a1*b1 + a2*b2 + cdash;  ! Total effect of X on Y

OUTPUT:
  STAND CINT(bcbootstrap);
```
Editing required for testing indirect effect(s) using alternative MODEL INDIRECT: subcommand

MODEL INDIRECT: offers an alternative to MODEL CONSTRAINT: for models containing indirect effects, where these are not moderated. To use MODEL INDIRECT: instead, you would edit the code above as follows:

First, you can remove the naming of parameters using parentheses in the MODEL: command, i.e. you just need:

\begin{verbatim}
MODEL:
 \hspace{1cm} Y ON X M1 M2;
 \hspace{1cm} M1 M2 ON X;
\end{verbatim}

Second, replace the MODEL CONSTRAINT: subcommand with the following MODEL INDIRECT: subcommand:

\begin{verbatim}
MODEL INDIRECT:
 \hspace{1cm} Y IND M1 X;
 \hspace{1cm} Y IND M2 X;
\end{verbatim}

or just with

\begin{verbatim}
MODEL INDIRECT:
 \hspace{1cm} Y IND X;
\end{verbatim}

Leave the OUTPUT: command unchanged.
Model 4c: 1 or more mediators, in parallel if multiple (example uses 1) [BASIC MEDIATION], dichotomous mediator

Example Variables: 1 predictor X, 1 mediator M, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- The mediator (variable M) is dichotomous.
- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1 M + c'X \]
\[ \logit(M) = a_0 + a_1 X \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + c'X \]
\[ \logit(M) = a_0 + a_1 X \]

The problem we now have is that we are working on different scales across the two equations. Mplus doesn’t automatically acknowledge this (the MODEL INDIRECT command does not yet work in the dichotomous mediator scenario) and adjust for us. So we have to program the method of McKinnon & Dwyer (1993), which adjusts our regression coefficients so that they are on the same scale, to enable the standard decomposition of the total effect into direct and indirect effects i.e. \( a_1^*b_1 + cdash \), to hold. For those who haven’t got access to this paper, the maths is kindly outlined by Nathaniel Kerr...

Specifically:

\[ \text{adjusted } a_1 = \frac{a_1 \cdot \text{SD}(X)}{\sqrt{(a_1^*a_1^* \cdot \text{Var}(X) + \pi^2/3)}} \]
\[ \text{adjusted } b_1 = \frac{b_1 \cdot \text{SD}(M)}{\sqrt{cdash^2 \cdot \text{Var}(X) + b_1^2 \cdot \text{Var}(M) + 2 \cdot b_1 \cdot cdash \cdot \text{Cov}(X,M) + \pi^2/3}}} \]
Hence, when using Mplus, we first need to calculate the sample standard deviations/variances of X and M, and their covariance. This is most easily done by placing these variables into a USEVARIABLES = command, leaving the model section blank, and adding SAMPSTAT; to the output options.

Having calculated those value, you can use the following code...

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - none
! Outcome variable - Y

USEVARIABLES = X M Y;
CATEGORICAL = M;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;

! In model statement name each path using parentheses

MODEL:
  Y ON M (b1);
  Y ON X (cdash);  ! direct effect of X on Y
  M ON X (a1);

! Use model constraint to calculate adjusted indirect effect
! Need to precalculate sample SDs and Covar of X and M, and input as #'d values below

MODEL CONSTRAINT:
  NEW(SDX SDM COVXM pi adjal adjb1 adjind);
  SDX = #SDX;
  SDM = #SDM;
  COVXM = #COVXM;
  pi = 3.141592653589793;

  adjal = a1*SDX/(sqrt((a1*a1*SDX*SDX) + ((pi*pi)/3)));
  adjb1 = b1*SDM/(sqrt((cdash*cdash*SDX*SDX) +
                     (b1*b1*SDM*SDM) +
                     (2*b1*cdash*COVXM) + ((pi*pi)/3)));
  adjind = adjal*adjb1;

OUTPUT:
  STAND CINT(bcbootstrap);
```
Model 4d: 1 or more mediators, in parallel if multiple (example uses 1) [BASIC MEDIATION], dichotomous outcome

Example Variables: 1 predictor X, 1 mediator M, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- The mediator (variable M) is continuous. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is dichotomous and satisfies the assumptions of binary logistic regression.

Model Diagram:
**Statistical Diagram:**

![Diagram showing variables X, M, and logit(Y) with arrows connecting them via parameters a, b, and c'.]

**Model Equation(s):**

\[
\text{logit}(Y) = b_0 + b_1 M + c'X \\
M = a_0 + a_1 X
\]

**Algebra to calculate total, indirect and/or conditional effects by writing model as Y = a + bX:**

\[
\text{logit}(Y) = b_0 + b_1 M + c'X \\
M = a_0 + a_1 X
\]

Hence... substituting in equations for M

\[
\text{logit}(Y) = b_0 + b_1(a_0 + a_1 X) + c'X
\]

Hence... multiplying out brackets

\[
\text{logit}(Y) = b_0 + a_0 b_1 + a_1 b_1 X + c'X
\]

Hence... grouping terms into form Y = a + bX

\[
\text{logit}(Y) = (b_0 + a_0 b_1) + (a_1 b_1 + c')X
\]

Hence...
Indirect effect of X on Y:
a1b1 - or, if expressed as an odds ratio, exp(a1b1)

Direct effect of X on Y:
c' - or, if expressed as an odds ratio, exp(c')

Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - none
! Outcome variable - Y

USEARIABLES = X M Y;
CATEGORICAL = Y;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;

! In model statement name each path using parentheses

MODEL:
  Y ON M (b1);
  Y ON X (cdash);  ! direct effect of X on Y
  M ON X (a1);

! Use model constraint to calculate indirect effect, and odds ratio

MODEL CONSTRAINT:
  NEW(a1b1 ORa1b1);
  a1b1 = a1*b1;  ! Indirect effect of X on Y via M
  ORa1b1 = exp(a1*b1);  ! Odds ratio wrt to indirect effect of X on Y via M

OUTPUT:
  STAND CINT(bcbootstrap);

Editing required for testing indirect effect(s) using alternative MODEL INDIRECT: subcommand

MODEL INDIRECT: offers an alternative to MODEL CONSTRAINT: for models containing indirect effects, where these are not moderated. To use MODEL INDIRECT: instead, you would edit the code above as follows:
First, you can remove the naming of parameters using parentheses in the MODEL: command, i.e. you just need:

MODEL:
   Y ON X M;
   M ON X;

Second, replace the MODEL CONSTRAINT: subcommand with the following MODEL INDIRECT: subcommand:

   MODEL INDIRECT:
      Y IND X;

Leave the OUTPUT: command unchanged.
Model 5: 1 or more mediators, in parallel if multiple, 1 moderator of direct IV-DV path only

Example Variables: 1 predictor X, 1 mediator M, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W,V,Q,Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + c_1'X + c_2'W + c_3'XW \]

\[ M = a_0 + a_1X \]

**Albegra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):**

\[ Y = b_0 + b_1 M + c_1'X + c_2'W + c_3'XW \]

\[ M = a_0 + a_1X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X) + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + c_1'X + c_2'W + c_3'XW \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + c_2'W) + (a_1b_1 + c_1' + c_3'W)X$

Hence...

One indirect effect of $X$ on $Y$: $a_1b_1$

One direct effect of $X$ on $Y$, conditional on $W$: $c_1' + c_3'W$

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M W Y XW;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON X (cdash1);
    Y ON W (cdash2);
    Y ON XW (cdash3);
    [M] (a0);
    M ON X (a1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
```
MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W a1b1 DIR_LO DIR_MED DIR_HI TOT_LO TOT_MED TOT_HI);
    LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
    MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
    HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

! Now calc indirect effect - and conditional direct effects for each value of W
    a1b1 = a1*b1;
    DIR_LO = cdash1 + cdash3*LOW_W;
    DIR_MED = cdash1 + cdash3*MED_W;
    DIR_HI = cdash1 + cdash3*HIGH_W;
    TOT_LO = DIR_LO + a1b1;
    TOT_MED = DIR_MED + a1b1;
    TOT_HI = DIR_HI + a1b1;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
    PLOT(LOMOD MEDMOD HIMOD);
    LOOP(XVAL,1,5,0.1);
    LOMOD = (b0 + a0*b1 + cdash2*LOW_W) + TOT_LO*XVAL;
    MEDMOD = (b0 + a0*b1 + cdash2*MED_W) + TOT_MED*XVAL;
    HIMOD = (b0 + a0*b1 + cdash2*HIGH_W) + TOT_HI*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 6: 2 or more mediators (2 in this example), in series

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W,V,Q,Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + c'X \]
\[ M_1 = a_{01} + a_1X \]
\[ M_2 = a_{02} + a_2X + d_1M_1 \]

Albegra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_{01} + a_1X) + b_2(a_{02} + a_2X + d_1(a_{01} + a_1X)) + c'X \]

Hence... substituting in equations for M1 and M2

\[ Y = b_0 + a_{01}b_1 + a_1b_1X + a_{02}b_2 + a_2b_2X + a_{01}d_1b_2 + a_1d_1b_2X + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_{01}b_1 + a_1b_1X + a_{02}b_2 + a_2b_2X + a_{01}d_1b_2 + a_1d_1b_2X + c'X \]

Hence... grouping terms into form \( Y = a + bX \)
Y = (b0 + a01b1 + a02b2 + a01d1b2) + (a1b1 + a2b2 + a1d1b2 + c')X

Hence... Three indirect effects of X on Y: a1b1, a2b2, a1d1b2
One direct effect of X on Y: c'

Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - none
! Outcome variable - Y
USEVARIABLES = X M1 M2 Y;

ANALYSIS:
TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path using parentheses
MODEL:
Y ON X (cdash); ! direct effect of X on Y
Y ON M1 (b1);
Y ON M2 (b2);
M1 ON X (a1);
M2 ON X (a2);
M2 ON M1 (d1);

! Use model constraint to calculate specific indirect paths and total indirect effect
MODEL CONSTRAINT:
NEW(a1b1 a2b2 a1d1b2 TOTALIND TOTAL);
a1b1 = a1*b1; ! Specific indirect effect of X on Y via M1
a2b2 = a2*b2; ! Specific indirect effect of X on Y via M2
a1d1b2 = a1*d1*b2; ! Specific indirect effect of X on Y via M1 and M2
TOTALIND = a1*b1 + a2*b2 + a1*d1*b2; ! Total indirect effect of X on Y via M1, M2
TOTAL = a1*b1 + a2*b2 + a1*d1*b2 + cdash; ! Total effect of X on Y

OUTPUT:
STAND CINT(bcbootstrap);
Model 7: 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of IV-Mediator path only

Example Variables: 1 predictor X, 1 mediator M, 1 moderator W, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):
\[ Y = b_0 + b_1 M + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1 M + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 XW \]

Hence... substituting in equation for \( M \)
\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 XW) + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0 b_1 + a_1 b_1 X + a_2 b_1 W + a_3 b_1 XW + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W) + (a_1b_1 + a_3b_1W + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$: $a_1b_1 + a_3b_1W = (a_1 + a_3W)b_1$

One direct effect of $X$ on $Y$: $c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X  
! Mediator variable(s) - M  
! Moderator variable(s) - W  
! Outcome variable - Y

USEVARIABLES = X M W Y XW;

! Create interaction terms  
! Note that they have to be placed at end of USEVARIABLES  
! subcommand above

DEFINE:
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON X (cdash);

    [M] (a0);
    M ON X (a1);
    M ON W (a2);
    M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for $W$
! for example, of 1 SD below mean, mean, 1 SD above mean
```
! 1 moderator, 3 values for it
! arbitrary naming convention for conditional indirect and total effects used below:
! MED_Q = medium value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W
IND_LOWW IND_MEDW IND_HIW
TOT_LOWW TOT_MEDW TOT_HIW);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

! Calc conditional indirect effects for each combination of moderator values

IND_LOWW = a1*b1 + a3*b1*LOW_W;
IND_MEDW = a1*b1 + a3*b1*MED_W;
IND_HIW = a1*b1 + a3*b1*HIGH_W;

! Calc conditional total effects for each combination of moderator values

TOT_LOWW = IND_LOWW + cdash;
TOT_MEDW = IND_MEDW + cdash;
TOT_HIW = IND_HIW + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = IND_LOWW*XVAL;
MEDMOD = IND_MEDW*XVAL;
HIMOD = IND_HIW*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 8: 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator moderating both the IV-Mediator path and direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + c_1'X + c_2'W + c_3'XW \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + c_2') + (a_1b_1 + a_3b_1W + c_1' + c_3')X \]

Hence... One indirect effect(s) of \( X \) on \( Y \), conditional on \( W \): \( a_1b_1 + a_3b_1W = (a_1 + a_3W)b_1 \)

One direct effect of \( X \) on \( Y \), conditional on \( W \): \( c_1' + c_3'W \)
**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M W Y XW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON X (cdash1);
    Y ON W (cdash2);
    Y ON XW (cdash3);
    [M] (a0);
    M ON X (a1);
    M ON W (a2);
    M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W
! for example, of 1 SD below mean, mean, 1 SD above mean
! 1 moderator, 3 values for it
! arbitrary naming convention for conditional indirect and total effects used below:
! MED_Q = medium value of Q, etc.

MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W
         IND_LOWW IND_MEDW IND_HIW
```
DIR_LOWW  DIR_MEDW  DIR_HIW
TOT_LOWW  TOT_MEDW  TOT_HIW);  

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W  
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W  
HIGH_W = #HIGH;  ! replace #HIGH in the code with your chosen high value of W  

! Calc conditional indirect effects for each combination of moderator values  
IND_LOW = a1*b1 + a3*b1*LOW_W;  
IND_MED = a1*b1 + a3*b1*MED_W;  
IND_HIW = a1*b1 + a3*b1*HIGH_W;  

! Calc conditional direct effects for each combination of moderator values  
DIR_LOW = cdash1 + cdash3*LOW_W;  
DIR_MEDW = cdash1 + cdash3*MED_W;  
DIR_HIW = cdash1 + cdash3*HIGH_W;  

! Calc conditional total effects for each combination of moderator values  
TOT_LOWW = IND_LOW + DIR_LOW;  
TOT_MEDW = IND_MED + DIR_MEDW;  
TOT_HIW = IND_HIW + DIR_HIW;  

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values  
! Could be edited to show conditional direct or conditional total effects instead  
! NOTE - values of 1,5 in LOOP() statement need to be replaced by  
! logical min and max limits of predictor X used in analysis  

PLOT(LOMOD MEDMOD HIMOD);  
LOOP(XVAL,1,5,0.1);  
LOMOD = IND_LOW*XVAL;  
MEDMOD = IND_MED*XVAL;  
HIMOD = IND_HIW*XVAL;  

PLOT:  
TYPE = plot2;  

OUTPUT:  
STAND CINT(bcbootstrap);
Model 9: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path only

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + c'X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z) + (a_1b_1 + a_4b_1W + a_5b_1Z + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W, Z$:

$a_1b_1 + a_4b_1W + a_5b_1Z = (a_1 + a_4W + a_5Z)b_1$

One direct effect of $X$ on $Y$:

$c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    XW = X*W;
    XZ = X*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON X (cdash);
    [M] (a0);
    M ON X (a1);
    M ON W (a2);
    M ON Z (a3);
    M ON XW (a4);
    M ON XZ (a5);
```
! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
    ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
    ILOW_HIZ IMEW_HIZ IHIW_HIZ
    TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
    TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z

! Calc conditional indirect effects for each combination of moderator values
ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z;
IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z;
IHIIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z;
ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z;
IHIIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z;
ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z;
IHIIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z;

! Calc conditional total effects for each combination of moderator values
TLOW_LOZ = ILOW_LOZ + cdash;
TMEW_LOZ = IMEW_LOZ + cdash;
THIW_LOZ = IHIW_LOZ + cdash;

TLOW_MEZ = ILOW_MEZ + cdash;
TMEW_MEZ = IMEW_MEZ + cdash;
THIW_MEZ = IHIW_MEZ + cdash;

TLOW_HIZ = ILOW_HIZ + cdash;
TMEW_HIZ = IMEW_HIZ + cdash;
THIW_HIZ = IHIW_HIZ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y
! for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
! total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ
PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);
LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;

PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;

PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 10: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating both the IV-Mediator path and direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + c_2'W + c_3'Z) + (a_1b_1 + a_4b_1W + a_5b_1Z + c_1' + c_4'XW + c_5'XZ)X \]

Hence... One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z \): \( a_1b_1 + a_4b_1W + a_5b_1Z = (a_1 + a_4W + a_5Z)b_1 \)
One direct effect of X on Y, conditional on W, Z: $c_1' + c_4'W + c_5'Z$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  XW = X*W;
  XZ = X*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON Z (cdash3);
  Y ON XW (cdash4);
  Y ON XZ (cdash5);

  [M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON Z (a3);
  M ON XW (a4);
  M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.
```
MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
ILOW_HIZ IMEW_HIZ IHIW_HIZ
DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
DLOW_HIZ DMEW_HIZ DHIW_HIZ
TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen
low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen
medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen
low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen
medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
chosen high value of Z

! Calc conditional indirect effects for each combination of
moderator values

ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z;
IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z;
IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z;

ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z;
IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z;

ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z;

! Calc conditional direct effects for each combination of
moderator values

DLOW_LOZ = cdash1 + cdash4*LOW_W + cdash5*LOW_Z;
DMEW_LOZ = cdash1 + cdash4*MED_W + cdash5*LOW_Z;
DHIW_LOZ = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z;

DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z;
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z;
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z;

DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z;
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z;
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z;
! Calc conditional total effects for each combination of moderator values

TLOW_LOZ = ILOW_LOZ + DLOW_LOZ;
TMEW_LOZ = IMEW_LOZ + DMEW_LOZ;
THIW_LOZ = IHIW_LOZ + DHIW_LOZ;

TLOW_MEZ = ILOW_MEZ + DLOW_MEZ;
TMEW_MEZ = IMEW_MEZ + DMEW_MEZ;
THIW_MEZ = IHIW_MEZ + DHIW_MEZ;

TLOW_HIZ = ILOW_HIZ + DLOW_HIZ;
TMEW_HIZ = IMEW_HIZ + DMEW_HIZ;
THIW_HIZ = IHIW_HIZ + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ
     PLOW_HIZ PMEW_HIZ PHIW_HIZ);
LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;

PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;

PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 11: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path only, all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + c'X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_6b_1WZ + a_7b_1XWZ + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + a_6b_1WZ) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W, Z$: $a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ = (a_1 + a_4W + a_5Z + a_7WZ)b_1$

One direct effect of $X$ on $Y$: $c'$

**Mplus code for the model:**

```mplus
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y
USEVARIABLES = X M W Z Y XW XZ WZ XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES
subcommand above
DEFINE:
    XW = X*W;
    XZ = X*Z;
    WZ = W*Z;
    XWZ = X*W*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using
parentheses
MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON X (cdash);
    [M] (a0);
    M ON X (a1);
    M ON W (a2);
    M ON Z (a3);
    M ON XW (a4);
    M ON XZ (a5);
```
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
   ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
   ILOW_HIZ IMEW_HIZ IHIW_HIZ
   TLOW_LOZ TM EW_LOZ THIW_LOZ TLOW_MEZ TM EW_MEZ THIW_MEZ
   TLOW_HIZ TM EW_HIZ THIW_HIZ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen
low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen
medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen
low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen
medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
chosen high value of Z

! Calc conditional indirect effects for each combination of
moderator values

ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
   a7*b1*LOW_W*LOW_Z;
   IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
   a7*b1*MED_W*LOW_Z;
   IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
   a7*b1*HIGH_W*LOW_Z;

ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
   a7*b1*LOW_W*MED_Z;
   IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
   a7*b1*MED_W*MED_Z;
   IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
   a7*b1*HIGH_W*MED_Z;
ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z;

! Calc conditional total effects for each combination of moderator values

TLOW_LOZ = ILOW_LOZ + cdash;
TMEW_LOZ = IMEW_LOZ + cdash;
THIW_LOZ = IHIW_LOZ + cdash;
TLOW_MEZ = ILOW_MEZ + cdash;
TMEW_MEZ = IMEW_MEZ + cdash;
THIW_MEZ = IHIW_MEZ + cdash;
TLOW_HIZ = ILOW_HIZ + cdash;
TMEW_HIZ = IMEW_HIZ + cdash;
THIW_HIZ = IHIW_HIZ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);
LOOP(XVAL,1,5,0.1);
PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
   TYPE = plot2;
OUTPUT:
   STAND CINT(bcbootstrap);
Model 12: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the IV-Mediator path and direct IV-DV path, all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[
Y = b_0 + b_1 M + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ
\]

\[
M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ
\]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[
Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ
\]

Hence... substituting in equation for \( M \)

\[
Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ
\]

Hence... multiplying out brackets

\[
Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_6b_1WZ + a_7b_1XWZ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ
\]
Hence... grouping terms into form $Y = a + bX$

$$Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + a_6b_1WZ + c_2'W + c_3'Z + c_6'WZ) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + c_1' + c_4'W + c_5'Z + c_7'WZ)X$$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $Z$:

$$a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ = (a_1 + a_4W + a_5Z + a_7WZ)b_1$$

One direct effect of $X$ on $Y$, conditional on $W$, $Z$:

$$c_1' + c_4'W + c_5'Z + c_7'WZ$$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ WZ XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    XW = X*W;
    XZ = X*Z;
    WZ = W*Z;
    XWZ = X*W*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON X (cdash1);
    Y ON W (cdash2);
    Y ON Z (cdash3);
    Y ON XW (cdash4);
```
Y ON XZ (cdash5);
Y ON WZ (cdash6);
Y ON XWZ (cdash7);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! For example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! Arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
ILOW_HIZ IMEW_HIZ IHIW_HIZ
DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
DLOW_HIZ DMEW_HIZ DHIW_HIZ
TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW; ! Replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! Replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! Replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ; ! Replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! Replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! Replace #HIGHZ in the code with your chosen high value of Z

! Calc conditional indirect effects for each combination of moderator values
\( ILOW\_LOZ = a1*b1 + a4*b1*LOW\_W + a5*b1*LOW\_Z + a7*b1*LOW\_W*LOW\_Z; \)
\( IMEW\_LOZ = a1*b1 + a4*b1*MED\_W + a5*b1*LOW\_Z + a7*b1*MED\_W*LOW\_Z; \)
\( IHIW\_LOZ = a1*b1 + a4*b1*HIGH\_W + a5*b1*LOW\_Z + a7*b1*HIGH\_W*LOW\_Z; \)
\( ILOW\_MEZ = a1*b1 + a4*b1*LOW\_W + a5*b1*MED\_Z + a7*b1*LOW\_W*MED\_Z; \)
\( IMEW\_MEZ = a1*b1 + a4*b1*MED\_W + a5*b1*MED\_Z + a7*b1*MED\_W*MED\_Z; \)
\( IHIW\_MEZ = a1*b1 + a4*b1*HIGH\_W + a5*b1*MED\_Z + a7*b1*HIGH\_W*MED\_Z; \)
\( ILOW\_HIZ = a1*b1 + a4*b1*LOW\_W + a5*b1*HIGH\_Z + a7*b1*LOW\_W*HIGH\_Z; \)
\( IMEW\_HIZ = a1*b1 + a4*b1*MED\_W + a5*b1*HIGH\_Z + a7*b1*MED\_W*HIGH\_Z; \)
\( IHIW\_HIZ = a1*b1 + a4*b1*HIGH\_W + a5*b1*HIGH\_Z + a7*b1*HIGH\_W*HIGH\_Z; \)

! Calc conditional direct effects for each combination of moderator values

\( DLOW\_LOZ = cdash1 + cdash4*LOW\_W + cdash5*LOW\_Z + cdash7*LOW\_W*LOW\_Z; \)
\( DM EW\_LOZ = cdash1 + cdash4*MED\_W + cdash5*LOW\_Z + cdash7*MED\_W*LOW\_Z; \)
\( DHIW\_LOZ = cdash1 + cdash4*HIGH\_W + cdash5*LOW\_Z + cdash7*HIGH\_W*LOW\_Z; \)
\( DLOW\_MEZ = cdash1 + cdash4*LOW\_W + cdash5*MED\_Z + cdash7*LOW\_W*MED\_Z; \)
\( DMEW\_MEZ = cdash1 + cdash4*MED\_W + cdash5*MED\_Z + cdash7*MED\_W*MED\_Z; \)
\( DHIW\_MEZ = cdash1 + cdash4*HIGH\_W + cdash5*MED\_Z + cdash7*HIGH\_W*MED\_Z; \)
\( DLOW\_HIZ = cdash1 + cdash4*LOW\_W + cdash5*HIGH\_Z + cdash7*LOW\_W*HIGH\_Z; \)
\( DM EW\_HIZ = cdash1 + cdash4*MED\_W + cdash5*HIGH\_Z + cdash7*MED\_W*HIGH\_Z; \)
\( DHIW\_HIZ = cdash1 + cdash4*HIGH\_W + cdash5*HIGH\_Z + cdash7*HIGH\_W*HIGH\_Z; \)

! Calc conditional total effects for each combination of moderator values

\( TLOW\_LOZ = ILOW\_LOZ + DLOW\_LOZ; \)
\( TM EW\_LOZ = IMEW\_LOZ + DM EW\_LOZ; \)
\( THIW\_LOZ = IHIW\_LOZ + DHIW\_LOZ; \)
TLOW_MEZ = ILOW_MEZ + DLOW_MEZ;
TMEW_MEZ = IMEW_MEZ + DMEW_MEZ;
THIW_MEZ = IHIW_MEZ + DHIW_MEZ;
TLOW_HIZ = ILOW_HIZ + DLOW_HIZ;
TMEW_HIZ = IMEW_HIZ + DMEW_HIZ;
THIW_HIZ = IHIW_HIZ + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ
PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 13: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the IV-Mediator path, 3-way interaction, 1 also moderating direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + c_1'X + c_2'W + c_3'XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_6b_1WZ + a_7b_1XWZ + c_1'X + c_2'W + c_3'XW \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0 b_1 + a_2 b_1 W + a_3 b_1 Z + a_6 b_1 WZ + c_2' W) + (a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 WZ + c_1' + c_3' W)X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $Z$:

$a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 WZ = (a_1 + a_4 W + a_5 Z + a_7 WZ)b_1$

One direct effect of $X$ on $Y$, conditional on $W$:

$c_1' + c_3' W$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ WZ XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  XW = X*W;
  XZ = X*Z;
  WZ = W*Z;
  XWZ = X*W*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON XW (cdash3);
```
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
   ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
   ILOW_HIZ IMEW_HIZ IHIW_HIZ
   DIR_LOWW DIR_MEDW DIR_HIW
   TLOW_LOZ TM EW_LOZ THIW_LOZ TLOW_MEZ TM EW_MEZ THIW_MEZ
   TLOW_HIZ TM EW_HIZ THIW_HIZ);
   LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
   HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
   LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
   MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
   HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z
! Calc conditional indirect effects for each combination of moderator values
   ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z;
   IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z;

\[ IHIW\_LOZ = a1*b1 + a4*b1*HIGH\_W + a5*b1*LOW\_Z + a7*b1*HIGH\_W*LOW\_Z; \]
\[ ILOW\_MEZ = a1*b1 + a4*b1*LOW\_W + a5*b1*MED\_Z + a7*b1*LOW\_W*MED\_Z; \]
\[ IMEW\_MEZ = a1*b1 + a4*b1*MED\_W + a5*b1*MED\_Z + a7*b1*MED\_W*MED\_Z; \]
\[ IHIW\_MEZ = a1*b1 + a4*b1*HIGH\_W + a5*b1*MED\_Z + a7*b1*HIGH\_W*MED\_Z; \]
\[ ILOW\_HIZ = a1*b1 + a4*b1*LOW\_W + a5*b1*HIGH\_Z + a7*b1*LOW\_W*HIGH\_Z; \]
\[ IMEW\_HIZ = a1*b1 + a4*b1*MED\_W + a5*b1*HIGH\_Z + a7*b1*MED\_W*HIGH\_Z; \]
\[ IHIW\_HIZ = a1*b1 + a4*b1*HIGH\_W + a5*b1*HIGH\_Z + a7*b1*HIGH\_W*HIGH\_Z; \]

! Calc conditional direct effects for each combination of moderator values

\[ \text{DIR\_LOWW} = \text{cdash1} + \text{cdash3}\_\text{LOW\_W}; \]
\[ \text{DIR\_MEDW} = \text{cdash1} + \text{cdash3}\_\text{MED\_W}; \]
\[ \text{DIR\_HIW} = \text{cdash1} + \text{cdash3}\_\text{HIGH\_W}; \]

! Calc conditional total effects for each combination of moderator values

\[ \text{TLOW\_LOZ} = \text{ILOW\_LOZ} + \text{DIR\_LOWW}; \]
\[ \text{TMEW\_LOZ} = \text{IMEW\_LOZ} + \text{DIR\_MEDW}; \]
\[ \text{THIW\_LOZ} = \text{IHIW\_LOZ} + \text{DIR\_HIW}; \]
\[ \text{TLOW\_MEZ} = \text{ILOW\_MEZ} + \text{DIR\_LOWW}; \]
\[ \text{TMEW\_MEZ} = \text{IMEW\_MEZ} + \text{DIR\_MEDW}; \]
\[ \text{THIW\_MEZ} = \text{IHIW\_MEZ} + \text{DIR\_HIW}; \]
\[ \text{TLOW\_HIZ} = \text{ILOW\_HIZ} + \text{DIR\_LOWW}; \]
\[ \text{TMEW\_HIZ} = \text{IMEW\_HIZ} + \text{DIR\_MEDW}; \]
\[ \text{THIW\_HIZ} = \text{IHIW\_HIZ} + \text{DIR\_HIW}; \]

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

\[ \text{PLOT}(\text{PLOW\_LOZ} \ \text{PMEW\_LOZ} \ \text{PHIW\_LOZ} \ \text{PLOW\_MEZ} \ \text{PMEW\_MEZ} \ \text{PHIW\_MEZ} \ \text{PLOW\_HIZ} \ \text{PMEW\_HIZ} \ \text{PHIW\_HIZ}); \]
\[ \text{LOOP(XVAL,1,5,0.1}); \]
PLow_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;

PLow_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;

PLow_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 14: 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of Mediator-DV path only

Example Variables: 1 predictor X, 1 mediator M, 1 moderator V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):
Y = b0 + b1M + b2V + b3MV + c'X
M = a0 + a1X

Algebra to calculate indirect and/or conditional effects by writing model as Y = a + bX:
Y = b0 + b1(a0 + a1X) + b2V + b3(a0 + a1X)V + c'X
M = a0 + a1X

Hence... substituting in equation for M
Y = b0 + b1(a0 + a1X) + b2V + b3(a0 + a1X)V + c'X

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + b2V + a0b3V + a1b3XV + c'X
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + b_2V + a_0b_3V) + (a_1b_1 + a_1b_3V + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $V$: $a_1b_1 + a_1b_3V = a_1(b_1 + b_3V)$

One direct effect of $X$ on $Y$: $c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - V
! Outcome variable - Y
USEVARIABLES = X M V Y MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MV = M*V;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON V (b2);
    Y ON MV (b3);
    Y ON X (c'dash);
    [M] (a0);
    M ON X (a1);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for V
! for example, of 1 SD below mean, mean, 1 SD above mean
```
! 1 moderator, 3 values for it
! arbitrary naming convention for conditional indirect and
total effects used below:
! MED_Q = medium value of Q, etc.

MODEL CONSTRAINT:
   NEW(LOW_V MED_V HIGH_V
   IND_LOWV IND_MEDV IND_HIV
   TOT_LOWV TOT_MEDV TOT_HIV);

   LOW_V = #LOWV;   ! replace #LOWV in the code with your
   ! chosen low value of V
   MED_V = #MEDV;   ! replace #MEDV in the code with your
   ! chosen medium value of V
   HIGH_V = #HIGHV; ! replace #HIGHV in the code with your
   ! chosen high value of V

! Calc conditional indirect effects for each combination of
moderator values

   IND_LOWV = a1*b1 + a1*b3*LOW_V;
   IND_MEDV = a1*b1 + a1*b3*MED_V;
   IND_HIV = a1*b1 + a1*b3*HIGH_V;

! Calc conditional total effects for each combination of
moderator values

   TOT_LOWV = IND_LOWV + cdash;
   TOT_MEDV = IND_MEDV + cdash;
   TOT_HIV = IND_HIV + cdash;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

   PLOT(LOMOD MEDMOD HIMOD);
   LOOP(XVAL,1,5,0.1);
   LOMOD = IND_LOWV*XVAL;
   MEDMOD = IND_MEDV*XVAL;
   HIMOD = IND_HIV*XVAL;

PLOT:
   TYPE = plot2;

OUTPUT:
   STAND CINT(bcbootstrap);
Model 15: 1 or more mediators, in parallel if multiple (example uses 1), 1 moderator of both Mediator-DV and direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 1 moderator V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'V + c_3'XV \]

\[ M = a_0 + a_1X \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'V + c_3'XV \]

\[ M = a_0 + a_1X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X) + b_2(a_0 + a_1X)V + c_1'X + c_2'V + c_3'XV \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_0b_2V + a_1b_2XV + c_1'X + c_2'V + c_3'XV \]
Hence... grouping terms into form $Y = a + bX$
\[
Y = (b_0 + a_0b_1 + c_2'V + a_0b_2V) + (a_1b_1 + a_1b_2V + c_1' + c_3'V)X
\]

Hence... One indirect effect(s) of $X$ on $Y$, conditional on $V$:
\[
a_1b_1 + a_1b_2V = a_1(b_1 + b_2V)
\]

One direct effect of $X$ on $Y$, conditional on $V$:
\[
c_1' + c_3'V
\]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - V
! Outcome variable - Y
USEVARIABLES = X M V Y MV XV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
   MV = M*V;
   XV = X*V;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
   [Y] (b0);
   Y ON M (b1);
   Y ON MV (b2);
   Y ON X (cdash1);
   Y ON V (cdash2);
   Y ON XV (cdash3);

   [M] (a0);
   M ON X (a1);

! Use model constraint subcommand to test conditional indirect effects
```

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! You need to pick low, medium and high moderator values for V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 1 moderator, 3 values for it
! arbitrary naming convention for conditional indirect and total effects used below:
! MED_Q = medium value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_V MED_V HIGH_V
IND_LOWV IND_MEDV IND_HIV
DIR_LOWV DIR_MEDV DIR_HIV
TOT_LOWV TOT_MEDV TOT_HIV);
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values
IND_LOWV = a1*b1 + a1*b2*LOW_V;
IND_MEDV = a1*b1 + a1*b2*MED_V;
IND_HIV = a1*b1 + a1*b2*HIGH_V;

! Calc conditional direct effects for each combination of moderator values
DIR_LOWV = cdash1 + cdash3*LOW_V;
DIR_MEDV = cdash1 + cdash3*MED_V;
DIR_HIV = cdash1 + cdash3*HIGH_V;

! Calc conditional total effects for each combination of moderator values
TOT_LOWV = IND_LOWV + DIR_LOWV;
TOT_MEDV = IND_MEDV + DIR_MEDV;
TOT_HIV = IND_HIV + DIR_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = IND_LOWV*XVAL;
MEDMOD = IND_MEDV*XVAL;
HIMOD = IND_HIV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 16: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path only

Example Variables: 1 predictor X, 1 mediator M, 2 moderators V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.

- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).

- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.

- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + c'X \]
\[ M = a_0 + a_1 X \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + c'X \]
\[ M = a_0 + a_1 X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X) + b_2V + b_3Q + b_4(a_0 + a_1X)V + b_5(a_0 + a_1X)Q + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + b_2V + b_3Q + a_0b_4V + a_1b_4XV + a_0b_5Q + a_1b_5XQ + c'X \]

Hence... grouping terms into form \( Y = a + bX \)
Y = (b0 + a0b1 + b2V + b3Q + a0b4V + a0b5Q) + (a1b1 + a1b4V + a1b5Q + c')X

Hence...

One indirect effect(s) of X on Y, conditional on V, Q:

\[ a1b1 + a1b4V + a1b5Q = a1(b1 + b4V + b5Q) \]

One direct effect of X on Y:

\[ c' \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - V, Q
! Outcome variable - Y

USEVARIABLES = X M V Q Y MV MQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MQ = M*Q;
  MV = M*V;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON Q (b3);
  Y ON MV (b4);
  Y ON MQ (b5);
  Y ON X (cdash);

  [M] (a0);
  M ON X (a1);

! Use model constraint subcommand to test conditional indirect effects
```
! You need to pick low, medium and high moderator values for V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
 ILOV_LOQ IMEV_LOQ IHIV_LOQ ILOV_MEQ IMEV_MEQ IHIV_MEQ
 ILOV_HIQ IMEV_HIQ IHIV_HIQ
 TLOV_LOQ TMEV_LOQ THIV_LOQ TLOV_MEQ TMEV_MEQ THIV_MEQ
 TLOV_HIQ TMEV_HIQ THIV_HIQ);

LOW_V = #LOWV;   ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;   ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;   ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;   ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values
ILOV_LOQ = a1*b1 + a1*b4*LOW_V + a1*b5*LOW_Q;
IMEV_LOQ = a1*b1 + a1*b4*MED_V + a1*b5*LOW_Q;
IHIV_LOQ = a1*b1 + a1*b4*HIGH_V + a1*b5*LOW_Q;

ILOV_MEQ = a1*b1 + a1*b4*LOW_V + a1*b5*MED_Q;
IMEV_MEQ = a1*b1 + a1*b4*MED_V + a1*b5*MED_Q;
IHIV_MEQ = a1*b1 + a1*b4*HIGH_V + a1*b5*MED_Q;

ILOV_HIQ = a1*b1 + a1*b4*LOW_V + a1*b5*HIGH_Q;
IMEV_HIQ = a1*b1 + a1*b4*MED_V + a1*b5*HIGH_Q;
IHIV_HIQ = a1*b1 + a1*b4*HIGH_V + a1*b5*HIGH_Q;

! Calc conditional total effects for each combination of moderator values
TLOV_LOQ = ILOV_LOQ + cdash;
TMEV_LOQ = IMEV_LOQ + cdash;
THIV_LOQ = IHIV_LOQ + cdash;
TLOV_MEQ = ILOV_MEQ + cdash;
TMEV_MEQ = IMEV_MEQ + cdash;
THIV_MEQ = IHIV_MEQ + cdash;
TLOV_HIQ = ILOV_HIQ + cdash;
TMEV_HIQ = IMEV_HIQ + cdash;
THIV_HIQ = IHIV_HIQ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values! Could be edited to show conditional direct or conditional total effects instead! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(PLOV_LOQ PMEV_LOQ PHIV_LOQ PLOV_MEQ PMEV_MEQ PHIV_MEQ
PHIV_HIQ PMEV_HIQ PHIV_HIQ);
LOOP(XVAL,1,5,0.1);
PLOV_LOQ = ILOV_LOQ*XVAL;
PMEV_LOQ = IMEV_LOQ*XVAL;
PHIV_LOQ = IHIV_LOQ*XVAL;
PLOV_MEQ = ILOV_MEQ*XVAL;
PMEV_MEQ = IMEV_MEQ*XVAL;
PHIV_MEQ = IHIV_MEQ*XVAL;
PLOV_HIQ = ILOV_HIQ*XVAL;
PMEV_HIQ = IMEV_HIQ*XVAL;
PHIV_HIQ = IHIV_HIQ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 17: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating both the Mediator-DV and direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]
\[ M = a_0 + a_1X \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]
\[ M = a_0 + a_1X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X) + b_2(a_0 + a_1X)V + b_3(a_0 + a_1X)Q + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_0b_2V + a_1b_2XV + a_0b_3Q + a_1b_3XQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]
Hence... grouping terms into form Y = a + bX

\[ Y = (b_0 + a_0b_1 + a_0b_2V + a_0b_3Q + c_2'V + c_3'Q) + (a_1b_1 + a_1b_2V + a_1b_3Q + c_1' + c_4'V + c_5'Q)X \]

Hence...

One indirect effect(s) of X on Y, conditional on V, Q:

\[ a_1b_1 + a_1b_2V + a_1b_3Q = a_1(b_1 + b_2V + b_3Q) \]

One direct effect of X on Y, conditional on V, Q:

\[ c_1' + c_4'V + c_5'Q \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - V, Q
! Outcome variable - Y

USEVARIABLES = X M V Q Y MV MQ XV XQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:

MQ = M*Q;
MV = M*V;
XQ = X*Q;
XV = X*V;

ANALYSIS:

TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:

[Y] (b0);
Y ON M (b1);
Y ON MV (b2);
Y ON MQ (b3);

Y ON X (c1);
Y ON V (c2);
```
Y ON Q (cdash3);
Y ON XV (cdash4);
Y ON XQ (cdash5);

[M] (a0);
M ON X (a1);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_V MEDI_V HIGH_V LOW_Q MEDI_Q HIGH_Q
ILOV_LOQ IMEV_LOQ IHIV_LOQ ILOV_MEQ IMEV_MEQ IHIV_MEQ
ILOV_HIQ IMEV_HIQ IHIV_HIQ
DLOV_LOQ DMEV_LOQ DHIV_LOQ DLOV_MEQ DMEV_MEQ DHIV_MEQ
DLOV_HIQ DMEV_HIQ DHIV_HIQ
TLOV_LOQ TMEV_LOQ THIV_LOQ TLOV_MEQ TMEV_MEQ THIV_MEQ
TLOV_HIQ TMEV_HIQ THIV_HIQ);

LOW_V = #LOWV; ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your
chosen high value of V

LOW_Q = #LOWQ; ! replace #LOWQ in the code with your
chosen low value of Q
MED_Q = #MEDQ; ! replace #MEDQ in the code with your
chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your
chosen high value of Q

! Calc conditional indirect effects for each combination of
moderator values

ILOV_LOQ = a1*b1 + a1*b2*LOW_V + a1*b3*LOW_Q;
IMEV_LOQ = a1*b1 + a1*b2*MED_V + a1*b3*LOW_Q;
IHIV_LOQ = a1*b1 + a1*b2*HIGH_V + a1*b3*LOW_Q;

ILOV_MEQ = a1*b1 + a1*b2*LOW_V + a1*b3*MED_Q;
IMEV_MEQ = a1*b1 + a1*b2*MED_V + a1*b3*MED_Q;
IHIV_MEQ = a1*b1 + a1*b2*HIGH_V + a1*b3*MED_Q;
ILOV_HIQ = a1*b1 + a1*b2*LOW_V + a1*b3*HIGH_Q;
IMEV_HIQ = a1*b1 + a1*b2*MED_V + a1*b3*HIGH_Q;
IHIV_HIQ = a1*b1 + a1*b2*HIGH_V + a1*b3*HIGH_Q;

! Calc conditional direct effects for each combination of moderator values

DLOV_LOQ = cdash1 + cdash4*LOW_V + cdash5*LOW_Q;
DMEV_LOQ = cdash1 + cdash4*MED_V + cdash5*LOW_Q;
DHIV_LOQ = cdash1 + cdash4*HIGH_V + cdash5*LOW_Q;
DLOV_MEQ = cdash1 + cdash4*LOW_V + cdash5*MED_Q;
DMEV_MEQ = cdash1 + cdash4*MED_V + cdash5*MED_Q;
DHIV_MEQ = cdash1 + cdash4*HIGH_V + cdash5*MED_Q;
DLOV_HIQ = cdash1 + cdash4*LOW_V + cdash5*HIGH_Q;
DMEV_HIQ = cdash1 + cdash4*MED_V + cdash5*HIGH_Q;
DHIV_HIQ = cdash1 + cdash4*HIGH_V + cdash5*HIGH_Q;

! Calc conditional total effects for each combination of moderator values

TLOV_LOQ = ILOV_LOQ + DLOV_LOQ;
TMEV_LOQ = IMEV_LOQ + DMEV_LOQ;
THIV_LOQ = IHIV_LOQ + DHIV_LOQ;
TLOV_MEQ = ILOV_MEQ + DLOV_MEQ;
TMEV_MEQ = IMEV_MEQ + DMEV_MEQ;
THIV_MEQ = IHIV_MEQ + DHIV_MEQ;
TLOV_HIQ = ILOV_HIQ + DLOV_HIQ;
TMEV_HIQ = IMEV_HIQ + DMEV_HIQ;
THIV_HIQ = IHIV_HIQ + DHIV_HIQ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(PLOV_LOQ PMEV_LOQ PHIV_LOQ PLOV_MEQ PMEV_MEQ PHIV_MEQ
PLOV_HIQ PMEV_HIQ PHIV_HIQ);
LOOP(XVAL,1,5,0.1);

PLOV_LOQ = ILOV_LOQ*XVAL;
PMEV_LOQ = IMEV_LOQ*XVAL;
PHIV_LOQ = IHIV_LOQ*XVAL;
PLOV\_MEQ = ILOV\_MEQ\times XVAL;
PMEV\_MEQ = IMEV\_MEQ\times XVAL;
PHIV\_MEQ = IHIV\_MEQ\times XVAL;
PLOV\_HIQ = ILOV\_HIQ\times XVAL;
PMEV\_HIQ = IMEV\_HIQ\times XVAL;
PHIV\_HIQ = IHIV\_HIQ\times XVAL;

PLOT:
   TYPE = plot2;

OUTPUT:
   STAND CINT(bcbootstrap);
Model 18: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path only, all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 2 moderators V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + b_6VQ + b_7MVQ + c'X \]

\[ M = a_0 + a_1X \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + b_6VQ + b_7MVQ + c'X \]

\[ M = a_0 + a_1X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X) + b_2V + b_3Q + b_4(a_0 + a_1X)V + b_5(a_0 + a_1X)Q + b_6VQ + b_7(a_0 + a_1X)VQ + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + b_2V + b_3Q + a_0b_4V + a_1b_4XV + a_0b_5Q + a_1b_5XQ + b_6VQ + a_0b_7VQ + a_1b_7XVQ + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + b_2V + b_3Q + a_0b_4V + a_0b_5Q + b_6VQ + a_0b_7VQ) + (a_1b_1 + a_1b_4V + a_1b_5Q + a_1b_7VQ + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $V$, $Q$: $a_1b_1 + a_1b_4V + a_1b_5Q + a_1b_7VQ = a_1(b_1 + b_4V + b_5Q + b_7VQ)$

One direct effect of $X$ on $Y$: $c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - V, Q
! Outcome variable - Y

USEVARIABLES = X M V Q Y MV MQ VQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MQ = M*Q;
    MV = M*V;
    VQ = V*Q;
    MVQ = M*V*Q;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON V (b2);
    Y ON Q (b3);
    Y ON MV (b4);
    Y ON MQ (b5);
    Y ON VQ (b6);
    Y ON MVQ (b7);
    Y ON X (cdash);
```
[M] (a0);
M ON X (a1);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
ILOV_LOQ IMEV_LOQ IHIV_LOQ ILOV_MEQ IMEV_MEQ IHIV_MEQ
ILOV_HIQ IMEV_HIQ IHIV_HIQ
TLOV_LOQ TMEV_LOQ THIV_LOQ TLOV_MEQ TMEV_MEQ THIV_MEQ
TLOV_HIQ TMEV_HIQ THIV_HIQ);
LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V
LOW_Q = #LOWQ; ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ; ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values
ILOV_LOQ = a1*b1 + a1*b4*LOW_V + a1*b5*LOW_Q +
a1*b7*LOW_V*LOW_Q;
IMEV_LOQ = a1*b1 + a1*b4*MED_V + a1*b5*LOW_Q +
a1*b7*MED_V*LOW_Q;
IHIV_LOQ = a1*b1 + a1*b4*HIGH_V + a1*b5*LOW_Q +
a1*b7*HIGH_V*LOW_Q;
ILOV_MEQ = a1*b1 + a1*b4*LOW_V + a1*b5*MED_Q +
a1*b7*LOW_V*MED_Q;
IMEV_MEQ = a1*b1 + a1*b4*MED_V + a1*b5*MED_Q +
a1*b7*MED_V*MED_Q;
IHIV_MEQ = a1*b1 + a1*b4*HIGH_V + a1*b5*MED_Q +
a1*b7*HIGH_V*MED_Q;
ILOV_HIQ = a1*b1 + a1*b4*LOW_V + a1*b5*HIGH_Q + a1*b7*LOW_V*HIGH_Q;
IMEV_HIQ = a1*b1 + a1*b4*MED_V + a1*b5*HIGH_Q + a1*b7*MED_V*HIGH_Q;
IHIV_HIQ = a1*b1 + a1*b4*HIGH_V + a1*b5*HIGH_Q + a1*b7*HIGH_V*HIGH_Q;

! Calc conditional total effects for each combination of moderator values

TLOV_LOQ = ILOV_LOQ + cdash;
TMEV_LOQ = IMEV_LOQ + cdash;
THIV_LOQ = IHIV_LOQ + cdash;
TLOV_MEQ = ILOV_MEQ + cdash;
TMEV_MEQ = IMEV_MEQ + cdash;
THIV_MEQ = IHIV_MEQ + cdash;
TLOV_HIQ = ILOV_HIQ + cdash;
TMEV_HIQ = IMEV_HIQ + cdash;
THIV_HIQ = IHIV_HIQ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOV_LOQ PMEV_LOQ PHI_V_LOQ PLOV_MEQ PMEV_MEQ PHIV_MEQ
PLOV_HIQ PMEV_HIQ PHI_HIQ);
LOOP(XVAL,1,5,0.1);
PLOV_LOQ = ILOV_LOQ*XVAL;
PMEV_LOQ = IMEV_LOQ*XVAL;
PHIV_LOQ = IHIV_LOQ*XVAL;
PLOV_MEQ = ILOV_MEQ*XVAL;
PMEV_MEQ = IMEV_MEQ*XVAL;
PHIV_MEQ = IHIV_MEQ*XVAL;
PLOV_HIQ = ILOV_HIQ*XVAL;
PMEV_HIQ = IMEV_HIQ*XVAL;
PHIV_HIQ = IHIV_HIQ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 19: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators both moderating the Mediator-DV path and direct IV-DV path, all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 2 moderators V, Q, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):
\[ Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]
\[ M = a_0 + a_1X \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]
\[ M = a_0 + a_1X \]

Hence... substituting in equation for \( M \)
\[ Y = b_0 + b_1(a_0 + a_1X) + b_2(a_0 + a_1X)V + b_3(a_0 + a_1X)Q + b_4(a_0 + a_1X)VQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_2X + a_0b_3Q + a_1b_3Q + a_0b_4VQ + a_1b_4XVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_0b_2V + a_0b_3Q + a_0b_4VQ + c_2'V + c_3'Q + c_6'VQ) + (a_1b_1 + a_1b_2V + a_1b_3Q + a_1b_4VQ + c_1' + c_4'V + c_5'Q + c_7'VQ)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( V, Q \):

\[ a_1b_1 + a_1b_2V + a_1b_3Q + a_1b_4VQ = a_1(b_1 + b_2V + b_3Q + b_4VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( V, Q \):

\[ c_1' + c_4'V + c_5'Q + c_7'VQ \]

**Mplus code for the model:**

```mplus
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - V, Q
! Outcome variable - Y
USEVARIABLES = X M V Q Y MV MQ XV XQ VQ MVQ XVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MQ = M*Q;
  MV = M*V;
  XQ = X*Q;
  XV = X*V;
  VQ = V*Q;
  MVQ = M*V*Q;
  XVQ = X*V*Q;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
  [Y] (b0);
```
Y ON M (b1);
Y ON MV (b2);
Y ON MQ (b3);
Y ON MVQ (b4);
Y ON X (cdash1);
Y ON V (cdash2);
Y ON Q (cdash3);
Y ON XV (cdash4);
Y ON XQ (cdash5);
Y ON VQ (cdash6);
Y ON XVQ (cdash7);

[M] (a0);
M ON X (a1);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
 ILOV_LOQ IMEV_LOQ IHIQ_LOQ ILOV_MEQ IMEV_MEQ IHIQ_MEQ
 ILOV_HIQ IMEV_HIQ IHIQ_HIQ
 DLOV_LOQ DMEV_LOQ DHIV_LOQ DLOV_MEQ DMEV_MEQ DHIV_MEQ
 DLOV_HIQ DMEV_HIQ DHIV_HIQ
 TLOV_LOQ TMEV_LOQ THIV_LOQ TLOV_MEQ TMEV_MEQ THIV_MEQ
 TLOV_HIQ TMEV_HIQ THIV_HIQ);

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q
! Calc conditional indirect effects for each combination of moderator values

\[
\text{ILOV}_{-}\text{LOQ} = a_1 b_1 + a_1 b_2 \text{LOW}_{-}\text{V} + a_1 b_3 \text{LOW}_{-}\text{Q} + a_1 b_4 \text{LOW}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{IMEV}_{-}\text{LOQ} = a_1 b_1 + a_1 b_2 \text{MED}_{-}\text{V} + a_1 b_3 \text{LOW}_{-}\text{Q} + a_1 b_4 \text{MED}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{IHIV}_{-}\text{LOQ} = a_1 b_1 + a_1 b_2 \text{HIGH}_{-}\text{V} + a_1 b_3 \text{LOW}_{-}\text{Q} + a_1 b_4 \text{HIGH}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{ILOV}_{-}\text{MEQ} = a_1 b_1 + a_1 b_2 \text{LOW}_{-}\text{V} + a_1 b_3 \text{MED}_{-}\text{Q} + a_1 b_4 \text{LOW}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{IMEV}_{-}\text{MEQ} = a_1 b_1 + a_1 b_2 \text{MED}_{-}\text{V} + a_1 b_3 \text{MED}_{-}\text{Q} + a_1 b_4 \text{MED}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{IHIV}_{-}\text{MEQ} = a_1 b_1 + a_1 b_2 \text{HIGH}_{-}\text{V} + a_1 b_3 \text{MED}_{-}\text{Q} + a_1 b_4 \text{HIGH}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{ILOV}_{-}\text{HIQ} = a_1 b_1 + a_1 b_2 \text{LOW}_{-}\text{V} + a_1 b_3 \text{HIGH}_{-}\text{Q} + a_1 b_4 \text{LOW}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

\[
\text{IMEV}_{-}\text{HIQ} = a_1 b_1 + a_1 b_2 \text{MED}_{-}\text{V} + a_1 b_3 \text{HIGH}_{-}\text{Q} + a_1 b_4 \text{MED}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

\[
\text{IHIV}_{-}\text{HIQ} = a_1 b_1 + a_1 b_2 \text{HIGH}_{-}\text{V} + a_1 b_3 \text{HIGH}_{-}\text{Q} + a_1 b_4 \text{HIGH}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

! Calc conditional direct effects for each combination of moderator values

\[
\text{DLOV}_{-}\text{LOQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{LOW}_{-}\text{V} + c_{\text{dash}5} \text{LOW}_{-}\text{Q} + c_{\text{dash}7} \text{LOW}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{DMEV}_{-}\text{LOQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{MED}_{-}\text{V} + c_{\text{dash}5} \text{LOW}_{-}\text{Q} + c_{\text{dash}7} \text{MED}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{DHIV}_{-}\text{LOQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{HIGH}_{-}\text{V} + c_{\text{dash}5} \text{LOW}_{-}\text{Q} + c_{\text{dash}7} \text{HIGH}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{DLOV}_{-}\text{MEQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{LOW}_{-}\text{V} + c_{\text{dash}5} \text{MED}_{-}\text{Q} + c_{\text{dash}7} \text{LOW}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{DMEV}_{-}\text{MEQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{MED}_{-}\text{V} + c_{\text{dash}5} \text{MED}_{-}\text{Q} + c_{\text{dash}7} \text{MED}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{DHIV}_{-}\text{MEQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{HIGH}_{-}\text{V} + c_{\text{dash}5} \text{MED}_{-}\text{Q} + c_{\text{dash}7} \text{HIGH}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{DLOV}_{-}\text{HIQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{LOW}_{-}\text{V} + c_{\text{dash}5} \text{HIGH}_{-}\text{Q} + c_{\text{dash}7} \text{LOW}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

\[
\text{DMEV}_{-}\text{HIQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{MED}_{-}\text{V} + c_{\text{dash}5} \text{HIGH}_{-}\text{Q} + c_{\text{dash}7} \text{MED}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

\[
\text{DHIV}_{-}\text{HIQ} = c_{\text{dash}1} + c_{\text{dash}4} \text{HIGH}_{-}\text{V} + c_{\text{dash}5} \text{HIGH}_{-}\text{Q} + c_{\text{dash}7} \text{HIGH}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

! Calc conditional total effects for each combination of moderator values

\[
\text{DILOV}_{-}\text{LOQ} = a_1 b_1 + a_1 b_2 \text{LOW}_{-}\text{V} + a_1 b_3 \text{LOW}_{-}\text{Q} + a_1 b_4 \text{LOW}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{DIMEV}_{-}\text{LOQ} = a_1 b_1 + a_1 b_2 \text{MED}_{-}\text{V} + a_1 b_3 \text{LOW}_{-}\text{Q} + a_1 b_4 \text{MED}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{DIHIV}_{-}\text{LOQ} = a_1 b_1 + a_1 b_2 \text{HIGH}_{-}\text{V} + a_1 b_3 \text{LOW}_{-}\text{Q} + a_1 b_4 \text{HIGH}_{-}\text{V} \text{LOW}_{-}\text{Q};
\]

\[
\text{DILOV}_{-}\text{MEQ} = a_1 b_1 + a_1 b_2 \text{LOW}_{-}\text{V} + a_1 b_3 \text{MED}_{-}\text{Q} + a_1 b_4 \text{LOW}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{DIMEV}_{-}\text{MEQ} = a_1 b_1 + a_1 b_2 \text{MED}_{-}\text{V} + a_1 b_3 \text{MED}_{-}\text{Q} + a_1 b_4 \text{MED}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{DIHIV}_{-}\text{MEQ} = a_1 b_1 + a_1 b_2 \text{HIGH}_{-}\text{V} + a_1 b_3 \text{MED}_{-}\text{Q} + a_1 b_4 \text{HIGH}_{-}\text{V} \text{MED}_{-}\text{Q};
\]

\[
\text{DILOV}_{-}\text{HIQ} = a_1 b_1 + a_1 b_2 \text{LOW}_{-}\text{V} + a_1 b_3 \text{HIGH}_{-}\text{Q} + a_1 b_4 \text{LOW}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

\[
\text{DIMEV}_{-}\text{HIQ} = a_1 b_1 + a_1 b_2 \text{MED}_{-}\text{V} + a_1 b_3 \text{HIGH}_{-}\text{Q} + a_1 b_4 \text{MED}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]

\[
\text{DIHIV}_{-}\text{HIQ} = a_1 b_1 + a_1 b_2 \text{HIGH}_{-}\text{V} + a_1 b_3 \text{HIGH}_{-}\text{Q} + a_1 b_4 \text{HIGH}_{-}\text{V} \text{HIGH}_{-}\text{Q};
\]
TLOV_LOQ = ILOV_LOQ + DLOV_LOQ;
TMEV_LOQ = IMEV_LOQ + DMEV_LOQ;
THIV_LOQ = IHIV_LOQ + DHIV_LOQ;
TLOV_MEQ = ILOV_MEQ + DLOV_MEQ;
TMEV_MEQ = IMEV_MEQ + DMEV_MEQ;
THIV_MEQ = IHIV_MEQ + DHIV_MEQ;
TLOV_HIQ = ILOV_HIQ + DLOV_HIQ;
TMEV_HIQ = IMEV_HIQ + DMEV_HIQ;
THIV_HIQ = IHIV_HIQ + DHIV_HIQ;

! Use loop plot to plot conditional indirect effect of X on Y
! for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by
! logical min and max limits of predictor X used in analysis

PLOT(PLOV_LOQ PMEV_LOQ PHIV_LOQ PLOV_MEQ PMEV_MEQ
PHIV_MEQ
PLOV_HIQ PMEV_HIQ PHIV_HIQ);
LOOP(XVAL,1,5,0.1);
PLOV_LOQ = ILOV_LOQ*XVAL;
PMEV_LOQ = IMEV_LOQ*XVAL;
PHIV_LOQ = IHIV_LOQ*XVAL;
PLOV_MEQ = ILOV_MEQ*XVAL;
PMEV_MEQ = IMEV_MEQ*XVAL;
PHIV_MEQ = IHIV_MEQ*XVAL;
PLOV_HIQ = ILOV_HIQ*XVAL;
PMEV_HIQ = IMEV_HIQ*XVAL;
PHIV_HIQ = IHIV_HIQ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 20: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the Mediator-DV path, 3-way interaction, 1 also moderating direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2Q + b_3MV + b_4MQ + b_5VQ + b_6MVQ + c_1'X + c_2'V + c_3'XV \]

\[ M = a_0 + a_1X \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2Q + b_3MV + b_4MQ + b_5VQ + b_6MVQ + c_1'X + c_2'V + c_3'XV \]

\[ M = a_0 + a_1X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X) + b_2Q + b_3(a_0 + a_1X)V + b_4(a_0 + a_1X)Q + b_5VQ + b_6(a_0 + a_1X)VQ + c_1'X + c_2'V + c_3'XV \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + b_2Q + a_0b_3V + a_1b_3XV + a_0b_4Q + a_1b_4XQ + b_5VQ + a_0b_6VQ + a_1b_6XVQ + c_1'X + c_2'V + c_3'XV \]
Hence... grouping terms into form \( Y = a + bX \)
\[
Y = (b_0 + a_0b_1 + b_2Q + a_0b_4Q + b_5VQ + a_0b_6VQ + c_2'V) + (a_1b_1 + a_1b_3V + a_1b_4Q + a_1b_6VQ + c_1' + c_3'V)X
\]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( V, Q \):
\[
a_1b_1 + a_1b_3V + a_1b_4Q + a_1b_6VQ = a_1(b_1 + b_3V + b_4Q + b_6VQ)
\]

One direct effect of \( X \) on \( Y \), conditional on \( V \):
\[
c_1' + c_3'V
\]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - V, Q
! Outcome variable - Y
USEVARIABLES = X M V Q Y MV MQ XV VQ MVQ;
! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
   MQ = M*Q;
   MV = M*V;
   XV = X*V;
   VQ = V*Q;
   MVQ = M*V*Q;
ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;
! In model statement name each path and intercept using parentheses
MODEL:
   [Y] (b0);
   Y ON M (b1);
   Y ON Q (b2);
   Y ON MV (b3);
   Y ON MQ (b4);
```
Y ON VQ (b5);
Y ON MVQ (b6);
Y ON X (cdash1);
Y ON V (cdash2);
Y ON XV (cdash3);

[M] (a0);
M ON X (a1);

! Use model constraint subcommand to test conditional indirect
effects
! You need to pick low, medium and high moderator values for V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and
total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
ILOV_LOQ IMEV_LOQ IHIV_LOQ ILOV_MEQ IMEV_MEQ IHIV_MEQ
ILOV_HIQ IMEV_HIQ IHIV_HIQ
DIR_LOWV DIR_MEDV DIR_HIQ
TLOV_LOQ TMEV_LOQ THIV_LOQ TLOV_MEQ TMEV_MEQ THIV_MEQ
TLOV_HIQ TMEV_HIQ THIV_HIQ);

LOW_V = #LOWV;  ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your
chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your
chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your
chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your
chosen high value of Q

! Calc conditional indirect effects for each combination of
moderator values

ILOV_LOQ = a1*b1 + a1*b3*LOW_V + a1*b4*LOW_Q +
a1*b6*LOW_V*LOW_Q;
IMEV_LOQ = a1*b1 + a1*b3*MED_V + a1*b4*LOW_Q +
a1*b6*MED_W*LOW_Q;

THIV_LOQ = a1*b1 + a1*b3*HIGH_V + a1*b4*LOW_Q +
a1*b6*HIGH_W*LOW_Q;
\[ \text{IHIV\_LOQ} = a_1b_1 + a_1b_3\text{HIGH\_V} + a_1b_4\text{LOW\_Q} + a_1b_6\text{HIGH\_V\_LOW\_Q}; \]
\[ \text{ILOV\_MEQ} = a_1b_1 + a_1b_3\text{LOW\_V} + a_1b_4\text{MED\_Q} + a_1b_6\text{LOW\_V\_MED\_Q}; \]
\[ \text{IMEV\_MEQ} = a_1b_1 + a_1b_3\text{MED\_V} + a_1b_4\text{MED\_Q} + a_1b_6\text{MED\_V\_MED\_Q}; \]
\[ \text{IHIV\_MEQ} = a_1b_1 + a_1b_3\text{HIGH\_V} + a_1b_4\text{MED\_Q} + a_1b_6\text{HIGH\_V\_MED\_Q}; \]
\[ \text{ILOV\_HIQ} = a_1b_1 + a_1b_3\text{LOW\_V} + a_1b_4\text{HIGH\_Q} + a_1b_6\text{LOW\_V\_HIGH\_Q}; \]
\[ \text{IMEV\_HIQ} = a_1b_1 + a_1b_3\text{MED\_V} + a_1b_4\text{HIGH\_Q} + a_1b_6\text{MED\_V\_HIGH\_Q}; \]
\[ \text{IHIV\_HIQ} = a_1b_1 + a_1b_3\text{HIGH\_V} + a_1b_4\text{HIGH\_Q} + a_1b_6\text{HIGH\_V\_HIGH\_Q}; \]

! Calc conditional direct effects for each combination of moderator values

\[ \text{DIR\_LOWV} = c_{dash 1} + c_{dash 3}\text{LOW\_V}; \]
\[ \text{DIR\_MEDV} = c_{dash 1} + c_{dash 3}\text{MED\_V}; \]
\[ \text{DIR\_HIV} = c_{dash 1} + c_{dash 3}\text{HIGH\_V}; \]

! Calc conditional total effects for each combination of moderator values

\[ \text{TLOV\_LOQ} = \text{ILOV\_LOQ} + \text{DIR\_LOWV}; \]
\[ \text{TMEV\_LOQ} = \text{IMEV\_LOQ} + \text{DIR\_MEDV}; \]
\[ \text{THIV\_LOQ} = \text{IHIV\_LOQ} + \text{DIR\_HIV}; \]
\[ \text{TLOV\_MEQ} = \text{ILOV\_MEQ} + \text{DIR\_LOWV}; \]
\[ \text{TMEV\_MEQ} = \text{IMEV\_MEQ} + \text{DIR\_MEDV}; \]
\[ \text{THIV\_MEQ} = \text{IHIV\_MEQ} + \text{DIR\_HIV}; \]
\[ \text{TLOV\_HIQ} = \text{ILOV\_HIQ} + \text{DIR\_LOWV}; \]
\[ \text{TMEV\_HIQ} = \text{IMEV\_HIQ} + \text{DIR\_MEDV}; \]
\[ \text{THIV\_HIQ} = \text{IHIV\_HIQ} + \text{DIR\_HIV}; \]

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOV\_LOQ PMEV\_LOQ PHIV\_LOQ PLOV\_MEQ PMEV\_MEQ PHIV\_MEQ
    PLOV\_HIQ PMEV\_HIQ PHIV\_HIQ);
LOOP(XVAL,1,5,0.1);
PLOV_LOQ = ILOV_LOQ*XVAL;
PMEV_LOQ = IMEV_LOQ*XVAL;
PHIV_LOQ = IHIV_LOQ*XVAL;

PLOV_MEQ = ILOV_MEQ*XVAL;
PMEV_MEQ = IMEV_MEQ*XVAL;
PHIV_MEQ = IHIV_MEQ*XVAL;

PLOV_HIQ = ILOV_HIQ*XVAL;
PMEV_HIQ = IMEV_HIQ*XVAL;
PHIV_HIQ = IHIV_HIQ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 21: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
**Statistical Diagram:**

```
M
```

```
Y = b0 + b1M + b2V + b3MV + c'X
M = a0 + a1X + a2W + a3XW

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
```
Y = b0 + b1(a0 + a1X + a2W + a3XW) + b2V + b3(a0 + a1X + a2W + a3XW)V + c'X
M = a0 + a1X + a2W + a3XW

Hence... substituting in equation for M
```
Y = b0 + b1(a0 + a1X + a2W + a3XW) + b2V + b3(a0 + a1X + a2W + a3XW)V + c'X

Hence... multiplying out brackets
```
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1XW + b2V + a0b3V + a1b3XV + a2b3VW + a3b3XWV + c'X
```
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + b_2V + a_0b_3V + a_2b_3VW) + (a_1b_1 + a_3b_1W + a_1b_3V + a_3b_3WV + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$:

$a_1b_1 + a_3b_1W + a_1b_3V + a_3b_3WV = (a_1 + a_3W)(b_1 + b_3V)$

One direct effect of $X$ on $Y$: $c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y
USEVARIABLES = X M W V Y XW MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MV = M*V;
  XW = X*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON MV (b3);
  Y ON X (cdash);
  [M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON XW (a3);
```
Use model constraint subcommand to test conditional indirect effects
You need to pick low, medium and high moderator values for W, V
for example, of 1 SD below mean, mean, 1 SD above mean
2 moderators, 3 values for each, gives 9 combinations
arbitrary naming convention for conditional indirect and total effects used below:
MEV_LOQ = medium value of V and low value of Q, etc.

**MODEL CONSTRAINT:**

NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
ILOW_HIV IMEW_HIV IHIW_HIV
TLOW_LOV TMEW_LOV THIW_LOV TLOW_MEV TMEW_MEV THIW_MEV
TLOW_HIV TMEW_HIV THIW_HIV);

LOW_W = #LOWW;    ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW;    ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW;    ! replace #HIGHW in the code with your
chosen high value of W

LOW_V = #LOWV;    ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV;    ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV;    ! replace #HIGHV in the code with your
chosen high value of V

Calc conditional indirect effects for each combination of
moderator values

ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V +
a3*b3*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b3*LOW_V +
a3*b3*MED_W*LOW_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b3*LOW_V +
a3*b3*HIGH_W*LOW_V;
ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b3*MED_V +
a3*b3*LOW_W*MED_V;
IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b3*MED_V +
a3*b3*MED_W*MED_V;
IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b3*MED_V +
a3*b3*HIGH_W*MED_V;
ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b3*HIGH_V +
a3*b3*LOW_W*HIGH_V;
IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b3*HIGH_V + a3*b3*MED_W*HIGH_V;
IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_V + a3*b3*HIGH_W*HIGH_V;

! Calc conditional total effects for each combination of moderator values

TLOW_LOV = ILOW_LOV + cdash;
TMEW_LOV = IMEW_LOV + cdash;
THIW_LOV = IHIW_LOV + cdash;
TLOW_MEV = ILOW_MEV + cdash;
TMEW_MEV = IMEW_MEV + cdash;
THIW_MEV = IHIW_MEV + cdash;
TLOW_HIV = ILOW_HIV + cdash;
TMEW_HIV = IMEW_HIV + cdash;
THIW_HIV = IHIW_HIV + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV PHIW_MEV
PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL, 1, 5, 0.1);
PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;
PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 22: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path and direct IV-DV path, 1 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'XW \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'XW \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2V + b_3(a_0 + a_1X + a_2W + a_3XW)V + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + b_2V + a_0b_3V + a_1b_3XV + a_2b_3WW + a_3b_3XWV + c_1'X + c_2'W + c_3'XW \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b0 + a0b1 + a2b1W + b2V + a0b3V + a2b3W + c2'W) + (a1b1 + a3b1W + a1b3V + a3b3W + c1' + c3'W)X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$:

$a1b1 + a3b1W + a1b3V + a3b3WV = (a1 + a3W)(b1 + b3V)$

One direct effect of $X$ on $Y$, conditional on $W$:

$c1' + c3'W$

**Mplus code for the model:**

```plaintext
! Predictor variable - X 
! Mediator variable(s) - M 
! Moderator variable(s) - W, V 
! Outcome variable - Y

USEVARIABLES = X M W V Y XW MV;

! Create interaction terms 
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MV = M*V;
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON V (b2);
    Y ON MV (b3);
    Y ON X (cdash1);
    Y ON W (cdash2);
    Y ON XW (cdash3);
```
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
 ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
 ILOW_HIV IMEW_HIV IHIW_HIV
 DIR_LOWW DIR_MEDW DIR_HIW
 TLOW_LOV TMEW_LOV THIW_LOV TLOW_MEV TMEW_MEV THIW_MEV
 TLOW_HIV TMEW_HIV THIW_HIV);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values
 ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V + a3*b3*LOW_W*LOW_V;
 IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b3*LOW_V + a3*b3*MED_W*LOW_V;
 IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b3*LOW_V + a3*b3*HIGH_W*LOW_V;
 ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b3*MED_V + a3*b3*LOW_W*MED_V;
 IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b3*MED_V + a3*b3*MED_W*MED_V;

\[ a_3b_3M_{ED_W}\cdot M_{ED_V}; \]
\[ I_{HIW\_MEV} = a_1b_1 + a_3b_1H_{IGH_W} + a_1b_3M_{ED_V} + a_3b_3H_{IGH_W}\cdot M_{ED_V}; \]
\[ I_{LOW\_HIV} = a_1b_1 + a_3b_1L_{OW_W} + a_1b_3H_{IGH_V} + a_3b_3L_{OW_W}\cdot H_{IGH_V}; \]
\[ IM_{EW\_HIV} = a_1b_1 + a_3b_1M_{ED_W} + a_1b_3H_{IGH_V} + a_3b_3M_{ED_W}\cdot H_{IGH_V}; \]
\[ I_{HIW\_HIV} = a_1b_1 + a_3b_1H_{IGH_W} + a_1b_3H_{IGH_W} + a_3b_3H_{IGH_W}\cdot H_{IGH_V}; \]

! Calc conditional direct effects for each combination of moderator values

\[ DIR_{LOWW} = cdash_1 + cdash_3L_{OW_W}; \]
\[ DIR_{MEDW} = cdash_1 + cdash_3M_{ED_W}; \]
\[ DIR_{HIW} = cdash_1 + cdash_3H_{IGH_W}; \]

! Calc conditional total effects for each combination of moderator values

\[ T_{LOW\_LOV} = I_{LOW\_LOV} + DIR_{LOWW}; \]
\[ T_{MEW\_LOV} = I_{MEW\_LOV} + DIR_{MEDW}; \]
\[ T_{HIW\_LOV} = I_{HIW\_LOV} + DIR_{HIW}; \]
\[ T_{LOW\_MEV} = I_{LOW\_MEV} + DIR_{LOWW}; \]
\[ T_{MEW\_MEV} = I_{MEW\_MEV} + DIR_{MEDW}; \]
\[ T_{HIW\_MEV} = I_{HIW\_MEV} + DIR_{HIW}; \]
\[ T_{LOW\_HIV} = I_{LOW\_HIV} + DIR_{LOWW}; \]
\[ T_{MEW\_HIV} = I_{MEW\_HIV} + DIR_{MEDW}; \]
\[ T_{HIW\_HIV} = I_{HIW\_HIV} + DIR_{HIW}; \]

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values

! Could be edited to show conditional direct or conditional total effects instead

! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

\[ PLOT(P_{LOW\_LOV} \ PH_{MEW\_LOV} \ PH_{IHW\_LOV} \ P_{LOW\_MEV} \ PH_{MEW\_MEV} \ PH_{IHW\_MEV} \ P_{LOW\_HIV} \ PH_{MEW\_HIV} \ PH_{IHW\_HIV}); \]
\[ LOOP(XVAL,1,5,0.1); \]
\[ P_{LOW\_LOV} = I_{LOW\_LOV}\cdot XVAL; \]
\[ P_{MEW\_LOV} = I_{MEW\_LOV}\cdot XVAL; \]
\[ P_{HIW\_LOV} = I_{HIW\_LOV}\cdot XVAL; \]
PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 23: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path, 1 moderating the Mediator-DV path

Example Variables: 1 predictor $X$, 1 mediator $M$, 3 moderators $W$, $Z$, $V$, 1 outcome $Y$

Preliminary notes:
The code below assumes that
- The primary IV (variable $X$) is continuous or dichotomous.
- Any moderators (variables $W$, $V$, $Q$, $Z$) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable $M$, or $M_1$, $M_2$, etc.) are assumed to be continuous.
- The DV (variable $Y$) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)V + c'X \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)V + c'X \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + b2V + a0b3V + a1b3X + a2b3VW + a3b3V + a4b3XVW + a5b3XZV + c'X

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a3b1Z + b2V + a0b3V + a2b3VW + a3b3V + a4b3XVW + a5b3XZV) + (a1b1 + a4b1W + a5b1Z + a1b3V + a4b3VW + a5b3ZV + c')X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V:

a1b1 + a4b1W + a5b1Z + a1b3V + a4b3VW + a5b3ZV = (a1 + a4W + a5Z)(b1 + b3V)

One direct effect of X on Y:

c'

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y

USEVARIABLES = X M W Z V Y XW XZ MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MV = M*V;
    XW = X*W;
    XZ = X*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON V (b2);
    Y ON MV (b3);
```
Y ON X (cdash);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWVMQL = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V)
    ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
    ILWHZLV IMWHZLV IHWHZLV ILWMZMV IMWMZMV IHWMZMV
    ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
    ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
    ILWHZHV IMWHZHV IHWHZHV ILWHZHV IMWHZHV IHWHZHV
    TLWLZLV TMWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV
    TLWHZLV TMWHZLV THWHZLV TLWHZLV TMWHZLV THWHZLV
    TLWLZMV TMWLZMV THWLZMV TLWMZMV TMWMZMV THWMZMV
    TLWHZMV TMWHZMV THWHZMV TLWHZMV TMWHZMV THWHZMV
    TLWLZHV TMWLZHV THWLZHV TLWMZHV TMWMZHV THWMZHV
    TLWHZHV TMWHZHV THWHZHV TMWHZHV THWHZHV THWHZHV);

    LOW_W = #LOWW;    ! replace #LOWW in the code with your
chosen low value of W
    MED_W = #MEDW;    ! replace #MEDW in the code with your
chosen medium value of W
    HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
chosen high value of W

    LOW_Z = #LOWZ;    ! replace #LOWZ in the code with your
chosen low value of Z
    MED_Z = #MEDZ;    ! replace #MEDZ in the code with your
chosen medium value of Z
    HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your
chosen high value of Z
LOW_V = #LOWV;  ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your
chosen high value of V

! Calc conditional indirect effects for each combination of
moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*LOW_W + a5*b3*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*MED_W + a5*b3*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*HIGH_W + a5*b3*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*LOW_W + a5*b3*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*MED_W + a5*b3*MED_Z*LOW_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*HIGH_W + a5*b3*MED_Z*LOW_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*LOW_W + a5*b3*HIGH_Z*LOW_V;
IMWHZLV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b3*LOW_V
+ a4*b3*LOW_V*MED_W + a5*b3*HIGH_Z*LOW_V;
IHWHZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a1*b3*LOW_V +
a4*b3*LOW_V*HIGH_W + a5*b3*HIGH_Z*LOW_V;
ILWLZMV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b3*MED_V
+ a4*b3*MED_V*LOW_W + a5*b3*LOW_Z*MED_V;
IMWLZMV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b3*MED_V
+ a4*b3*MED_V*MED_W + a5*b3*LOW_Z*MED_V;
IHWLZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b3*MED_V
+ a4*b3*MED_V*HIGH_W + a5*b3*LOW_Z*MED_V;
ILWMZMV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b3*MED_V + a4*b3*MED_V*LOW_W + a5*b3*MED_Z*MED_V;
IMWMZMV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b3*MED_V + a4*b3*MED_V*MED_W + a5*b3*MED_Z*MED_V;
IHWMZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b3*MED_V + a4*b3*MED_V*HIGH_W + a5*b3*MED_Z*MED_V;
ILWHZMV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b3*MED_V + a4*b3*MED_V*LOW_W + a5*b3*MED_Z*MED_V;
IMWHZMV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b3*MED_V + a4*b3*MED_V*MED_W + a5*b3*MED_Z*MED_V;
IHWHZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b3*MED_V + a4*b3*MED_V*HIGH_W + a5*b3*HIGH_Z*MED_V;
ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b3*HIGH_V + a4*b3*HIGH_V*LOW_W + a5*b3*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b3*HIGH_V + a4*b3*HIGH_V*MED_W + a5*b3*LOW_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b3*HIGH_V + a4*b3*HIGH_V*HIGH_W + a5*b3*LOW_Z*HIGH_V;
ILWMZHNV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b3*MED_V + a4*b3*MED_V*LOW_W + a5*b3*MED_Z*MED_V;
IMWMZHNV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b3*MED_V + a4*b3*MED_V*MED_W + a5*b3*MED_Z*MED_V;
IHWMZHNV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b3*MED_V + a4*b3*MED_V*HIGH_W + a5*b3*MED_Z*MED_V;
ILWHZHNV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b3*MED_V + a4*b3*MED_V*LOW_W + a5*b3*MED_Z*MED_V;
IMWHZHNV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b3*MED_V + a4*b3*MED_V*MED_W + a5*b3*MED_Z*MED_V;
IHWHZHNV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b3*MED_V + a4*b3*MED_V*HIGH_W + a5*b3*HIGH_Z*MED_V;
! Calc conditional total effects for each combination of moderator values

TLWLZLV = ILWLZLV + cdash;
TMWLZLV = IMWLZLV + cdash;
THWLZLV = IHWLZLV + cdash;
TLWMZLV = ILWMZLV + cdash;
TMWMZLV = IMWMZLV + cdash;
THWMZLV = IHWMZLV + cdash;
TLWHZLV = ILWHZLV + cdash;
TMWHZLV = IMWHZLV + cdash;
THWHZLV = IHWHZLV + cdash;
TLWLZMV = ILWLZMV + cdash;
TMWLZMV = IMWLZMV + cdash;
THWLZMV = IHWLZMV + cdash;
TLWMZMV = ILWMZMV + cdash;
TMWMZMV = IMWMZMV + cdash;
THWMZMV = IHWMZMV + cdash;
TLWHZMV = ILWHZMV + cdash;
TMWHZMV = IMWHZMV + cdash;
THWHZMV = IHWHZMV + cdash;
TLWLZHVL = ILWLZHVL + cdash;
TMWLZHVL = IMWLZHVL + cdash;
THWLZHVL = IHWLZHVL + cdash;
TLWMZHVL = ILWMZHVL + cdash;
TMWMZHVL = IMWMZHVL + cdash;
THWMZHVL = IHWMZHVL + cdash;
TLWHZHVL = ILWHZHVL + cdash;
TMWHZHVL = IMWHZHVL + cdash;
THWHZHVL = IHWHZHVL + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV PLWHZLV PMWHZLV PHWHZLV PLWLZMV PMWLZMV PHWLZMV PLWMZMV PMWMZMV PHWMZMV PLWHZMV PMWHZMV PHWHZMV
PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV PLWHZHV PMWHZHV PHWHZHV)

LOOP(XVAL,1,5,0.1);

PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;

PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;

PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;

PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;

PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;

PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;

PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 24: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV- Mediator path and direct IV-DV path, 1 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)V + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + b_2V + a_0b_3V + a_1b_3XV + a_2b_3VW + a_3b_3ZV + a_4b_3XVW + a_5b_3XZV + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]
Hence... grouping terms into form \( Y = a + bX \)

\[
Y = (b0 + a0b1 + a2b1W + a3b1Z + b2V + a0b3V + a2b3VW + a3b3ZV + c2'W + c3'Z) + (a1b1 + a4b1W + a5b1Z + a1b3V + a4b3VW + a5b3ZV + c1' + c4'W + c5'Z)X
\]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V \):

\[
a1b1 + a4b1W + a5b1Z + a1b3V + a4b3VW + a5b3ZV = (a1 + a4W + a5Z)(b1 + b3V)
\]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):

\[
c1' + c4'W + c5'Z
\]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y
USEVARIABLES = X M W Z V Y XW XZ MV;
! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES
subcommand above
DEFINE:
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;
! In model statement name each path and intercept using
parentheses
MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON V (b2);
    Y ON MV (b3);
    Y ON X (cdash1);
    Y ON W (cdash2);
```
Y ON Z (cdash3);
Y ON XW (cdash4);
Y ON XZ (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V)
   ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
   ILWHZLV IMWHZLV IHWHZLV
   ILWLMV IMWLMV IHWLMV ILWLMV IMWLMV IHWLMV
   ILWHM V IMWHMV IHWHMV
   ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
   ILWHZHV IMWHZHV IHWHZHV
   DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
   DLOW_HIZ DMEW_HIZ DHIW_HIZ
   TLWLZLV TMWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV
   TLWHZLV TMWHZLV THWHZLV
   TLWLZMV TMWLZMV THWLZMV TLWMZMV TMWMZMV THWMZMV
   TLWHZMV TMWHZMV THWHZMV
   TLWLZHV TMWLZHV THWLZHV TLWMZHV TMWMZHV THWMZHV
   TLWHZHV TMWHZHV THWHZHV);

   LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
   HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
   LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*LOW_W + a5*b3*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*MED_W + a5*b3*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*HIGH_W + a5*b3*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*LOW_W + a5*b3*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*MED_W + a5*b3*MED_Z*LOW_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*HIGH_W + a5*b3*MED_Z*LOW_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*LOW_W + a5*b3*HIGH_Z*LOW_V;
IMWHZLV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b3*LOW_V +
         a4*b3*LOW_V*MED_W + a5*b3*HIGH_Z*LOW_V;
IHWHZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
         a1*b3*LOW_V +
         a4*b3*LOW_V*HIGH_W + a5*b3*HIGH_Z*LOW_V;
ILWLZMV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b3*MED_V +
         a4*b3*MED_V*LOW_W + a5*b3*LOW_Z*MED_V;
IMWLZMV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b3*MED_V +
         a4*b3*MED_V*MED_W + a5*b3*LOW_Z*MED_V;
IHWLZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b3*MED_V +
         a4*b3*MED_V*HIGH_W + a5*b3*LOW_Z*MED_V;
\[ a_4 \cdot b_3 \cdot \text{MED}_V \cdot \text{MED}_W + a_5 \cdot b_3 \cdot \text{LOW}_Z \cdot \text{MED}_V; \]
\[ \text{IHWLZMV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_1 \cdot b_3 \cdot \text{MED}_V + a_4 \cdot b_3 \cdot \text{MED}_V \cdot \text{HIGH}_W + a_5 \cdot b_3 \cdot \text{LOW}_Z \cdot \text{MED}_V; \]
\[ \text{ILWMZMV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{LOW}_W + a_5 \cdot b_1 \cdot \text{MED}_Z + a_1 \cdot b_3 \cdot \text{MED}_V + a_4 \cdot b_3 \cdot \text{MED}_V \cdot \text{LOW}_W + a_5 \cdot b_3 \cdot \text{MED}_Z \cdot \text{MED}_V; \]
\[ \text{IHWMZMV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{MED}_Z + a_1 \cdot b_3 \cdot \text{MED}_V + a_4 \cdot b_3 \cdot \text{MED}_V \cdot \text{HIGH}_W + a_5 \cdot b_3 \cdot \text{MED}_Z \cdot \text{MED}_V; \]
\[ \text{ILWHZMV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{LOW}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_3 \cdot \text{MED}_V + a_4 \cdot b_3 \cdot \text{MED}_V \cdot \text{LOW}_W + a_5 \cdot b_3 \cdot \text{HIGH}_Z \cdot \text{MED}_V; \]
\[ \text{IMWHZMV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{MED}_Z + a_1 \cdot b_3 \cdot \text{MED}_V + a_4 \cdot b_3 \cdot \text{MED}_V \cdot \text{MED}_W + a_5 \cdot b_3 \cdot \text{MED}_Z \cdot \text{MED}_V; \]
\[ \text{IHWHZMV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{MEDI}_Z + a_1 \cdot b_3 \cdot \text{MED}_V + a_4 \cdot b_3 \cdot \text{MED}_V \cdot \text{HIGH}_W + a_5 \cdot b_3 \cdot \text{MEDI}_Z \cdot \text{MED}_V; \]
\[ \text{ILWLZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{LOW}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_3 \cdot \text{HIGH}_V + a_4 \cdot b_3 \cdot \text{HIGH}_V \cdot \text{LOW}_W + a_5 \cdot b_3 \cdot \text{LOW}_Z \cdot \text{HIGH}_V; \]
\[ \text{IMWLZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_1 \cdot b_3 \cdot \text{HIGH}_V + a_4 \cdot b_3 \cdot \text{HIGH}_V \cdot \text{MED}_W + a_5 \cdot b_3 \cdot \text{MED}_Z \cdot \text{HIGH}_V; \]
\[ \text{IHWLZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_1 \cdot b_3 \cdot \text{HIGH}_V + a_4 \cdot b_3 \cdot \text{HIGH}_V \cdot \text{HIGH}_W + a_5 \cdot b_3 \cdot \text{LOW}_Z \cdot \text{HIGH}_V; \]
\[ \text{ILWMZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{LOW}_W + a_5 \cdot b_1 \cdot \text{MED}_Z + a_1 \cdot b_3 \cdot \text{HIGH}_V + a_4 \cdot b_3 \cdot \text{HIGH}_V \cdot \text{LOW}_W + a_5 \cdot b_3 \cdot \text{MED}_Z \cdot \text{HIGH}_V; \]
\[ \text{IMWMZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{MED}_Z + a_1 \cdot b_3 \cdot \text{HIGH}_V + a_4 \cdot b_3 \cdot \text{HIGH}_V \cdot \text{MED}_W + a_5 \cdot b_3 \cdot \text{MEDI}_Z \cdot \text{HIGH}_V; \]
\[ \text{IHWMZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{MED}_Z + a_1 \cdot b_3 \cdot \text{HIGH}_V + a_4 \cdot b_3 \cdot \text{HIGH}_V \cdot \text{HIGH}_W + a_5 \cdot b_3 \cdot \text{MED}_Z \cdot \text{HIGH}_V; \]
\[ \text{ILWHZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{LOW}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_3 \cdot \text{HIGH}_V + a_4 \cdot b_3 \cdot \text{HIGH}_V \cdot \text{LOW}_W + a_5 \cdot b_3 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V; \]
\[ a_1b_3^{\text{HIGH}_V} + a_4b_3^{\text{HIGH}_V\text{MED}_W} + a_5b_3^{\text{HIGH}_Z\text{HIGH}_V}; \]
\[ \text{IHWHZHV} = a_1b_1 + a_4b_1^{\text{HIGH}_W} + a_5b_1^{\text{HIGH}_Z} + a_1b_3^{\text{HIGH}_V} + a_4b_3^{\text{HIGH}_V\text{HIGH}_W} + a_5b_3^{\text{HIGH}_Z\text{HIGH}_V}; \]

! Calc conditional direct effects for each combination of moderator values

\[
\begin{align*}
\text{DLOW\_LOZ} &= \text{cdash1} + \text{cdash4}\text{\text{*LOW}_W} + \text{cdash5}\text{\text{*LOW}_Z}; \\
\text{DMEW\_LOZ} &= \text{cdash1} + \text{cdash4}\text{\text{*MED}_W} + \text{cdash5}\text{\text{*LOW}_Z}; \\
\text{DHIW\_LOZ} &= \text{cdash1} + \text{cdash4}\text{\text{*HIGH}_W} + \text{cdash5}\text{\text{*LOW}_Z}; \\
\text{DLOW\_MEZ} &= \text{cdash1} + \text{cdash4}\text{\text{*LOW}_W} + \text{cdash5}\text{\text{*MED}_Z}; \\
\text{DMEW\_MEZ} &= \text{cdash1} + \text{cdash4}\text{\text{*MED}_W} + \text{cdash5}\text{\text{*MED}_Z}; \\
\text{DHIW\_MEZ} &= \text{cdash1} + \text{cdash4}\text{\text{*HIGH}_W} + \text{cdash5}\text{\text{*MED}_Z}; \\
\text{DLOW\_HIZ} &= \text{cdash1} + \text{cdash4}\text{\text{*LOW}_W} + \text{cdash5}\text{\text{*HIGH}_Z}; \\
\text{DMEW\_HIZ} &= \text{cdash1} + \text{cdash4}\text{\text{*MED}_W} + \text{cdash5}\text{\text{*HIGH}_Z}; \\
\text{DHIW\_HIZ} &= \text{cdash1} + \text{cdash4}\text{\text{*HIGH}_W} + \text{cdash5}\text{\text{*HIGH}_Z}; 
\end{align*}
\]

! Calc conditional total effects for each combination of moderator values

\[
\begin{align*}
\text{TLWLZLV} &= \text{ILWLZLV} + \text{DLOW\_LOZ}; \\
\text{TMWLZLV} &= \text{IMWLZLV} + \text{DMEW\_LOZ}; \\
\text{THWLZLV} &= \text{IHWLZLV} + \text{DHIW\_LOZ}; \\
\text{TLWMZLV} &= \text{ILWMZLV} + \text{DLOW\_MEZ}; \\
\text{TMWMZLV} &= \text{IMWMZLV} + \text{DMEW\_MEZ}; \\
\text{THWMZLV} &= \text{IHWMZLV} + \text{DHIW\_MEZ}; \\
\text{TLWHZLV} &= \text{ILWHZLV} + \text{DLOW\_HIZ}; \\
\text{TMWHZLV} &= \text{IMWHZLV} + \text{DMEW\_HIZ}; \\
\text{THWHZLV} &= \text{IHWHZLV} + \text{DHIW\_HIZ}; \\
\text{TLWLZMV} &= \text{ILWLZMV} + \text{DLOW\_LOZ}; \\
\text{TMWLZMV} &= \text{IMWLZMV} + \text{DMEW\_LOZ}; \\
\text{THWLZMV} &= \text{IHWLZMV} + \text{DHIW\_LOZ}; \\
\text{TLWMZMV} &= \text{ILWMZMV} + \text{DLOW\_MEZ}; \\
\text{TMWMZMV} &= \text{IMWMZMV} + \text{DMEW\_MEZ}; \\
\text{THWMZMV} &= \text{IHWMZMV} + \text{DHIW\_MEZ}; \\
\text{TLWHZMV} &= \text{ILWHZMV} + \text{DLOW\_HIZ}; \\
\text{TMWHZMV} &= \text{IMWHZMV} + \text{DMEW\_HIZ}; \\
\text{THWHZMV} &= \text{IHWHZMV} + \text{DHIW\_HIZ}; \\
\text{TLWLZHV} &= \text{ILWLZHV} + \text{DLOW\_LOZ}; \\
\text{TMWLZHV} &= \text{IMWLZHV} + \text{DMEW\_LOZ}; \\
\text{THWLZHV} &= \text{IHWLZHV} + \text{DHIW\_LOZ}; 
\end{align*}
\]
TLWMZHV = ILWMZHV + DLOW_MEZ;
TMWMZHV = IMWMZHV + DMEW_MEZ;
THWMZHV = IHWMZHV + DHIW_MEZ;

TLWHZHV = ILWHZHV + DLOW_HIZ;
TMWHZHV = IMWHZHV + DMEW_HIZ;
THWHZHV = IHWHZHV + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y
! for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
! total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWHZLV PMWHZLV PHWHZLV
PLWLZMV PMWLZMV PHWLZMV PLWMZMV PMWMZMV PHWMZMV
PLWHZMV PMWHZMV PHWHZMV
PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV
PLWHZHV PMWHZHV PHWHZHV);

LOOP(XVAL,1,5,0.1);

PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;

PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;

PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;

PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;

PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;

PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;
PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;

PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 25: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:

*The code below assumes that*

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + c'X \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + a6b1WZ + a7b1XZW + b2V + a0b3V + a1b3XV + a2b3WV + a3b3ZV + a4b3XWV + a5b3XZV + a6b3WZV + a7b3XWZV + c’X

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a3b1Z + a6b1WZ + b2V + a0b3V + a2b3WV + a3b3ZV + a6b3WZV) + (a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b3V + a4b3WV + a5b3ZV + a7b3WZV + c’)X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V:

a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b3V + a4b3WV + a5b3ZV + a7b3WZV = (a1 + a4W + a5Z + a7WZ)(b1 + b3V)

One direct effect of X on Y:

c’

Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y

USEVARIABLES = X M W Z V Y XW XZ WZ MV XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
    WZ = W*Z;
    XWZ = X*W*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
[Y] (b0);
Y ON M (b1);
Y ON V (b2);
Y ON MV (b3);
Y ON X (cdash);
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V
    ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
    ILWHZLV IMWHZLV IHWHZLV
    ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
    ILWHZMV IMWHZMV IHWHZMV
    ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
    ILWHZHV IMWHZHV IHWHZHV
    TLWLZLV TMWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV
    TLWHZLV TMWHZLV THWHZLV
    TLWLZMV TMWLZMV THWLZMV TLWMZMV TMWMZMV THWMZMV
    TLWHZMV TMWHZMV THWHZMV
    TLWLZHV TMWLZHV THWLZHV TLWMZHV TMWMZHV THWMZHV
    TLWHZHV TMWHZHV THWHZHV);

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W
LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b3*LOW_V + a4*b3*LOW_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*LOW_W*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b3*LOW_V + a4*b3*MED_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*MED_W*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b3*LOW_V + a4*b3*HIGH_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*HIGH_W*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b3*LOW_V + a4*b3*LOW_W*LOW_V + a5*b3*MED_Z*LOW_V + a7*b3*LOW_W*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b3*LOW_V + a4*b3*MED_W*LOW_V + a5*b3*MED_Z*LOW_V + a7*b3*MED_W*MED_Z*LOW_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b3*LOW_V + a4*b3*HIGH_W*LOW_V + a5*b3*MED_Z*LOW_V + a7*b3*HIGH_W*MED_Z*LOW_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b3*LOW_V + a4*b3*LOW_W*LOW_V + a5*b3*HIGH_Z*LOW_V + a7*b3*LOW_W*HIGH_Z*LOW_V;
\[
\begin{align*}
\text{IMWHZLV} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + \\
a_7 b_1 \text{MED}_W \text{HIGH}_Z + \\
a_1 b_3 \text{LOW}_V + a_4 b_3 \text{MED}_W \text{LOW}_V + a_5 b_3 \text{HIGH}_Z \text{LOW}_V + \\
a_7 b_3 \text{MED}_W \text{HIGH}_Z \text{LOW}_V; \\
\text{IHWHZLV} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + \\
a_7 b_1 \text{HIGH}_W \text{HIGH}_Z + \\
a_1 b_3 \text{LOW}_V + a_4 b_3 \text{HIGH}_W \text{LOW}_V + a_5 b_3 \text{HIGH}_Z \text{LOW}_V + \\
a_7 b_3 \text{HIGH}_W \text{HIGH}_Z \text{LOW}_V; \\
\text{ILWLZMV} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + \\
a_7 b_1 \text{LOW}_W \text{LOW}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{LOW}_W \text{MED}_V + a_5 b_3 \text{LOW}_Z \text{MED}_V + \\
a_7 b_3 \text{LOW}_W \text{LOW}_Z \text{MED}_V; \\
\text{IMWLZMV} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + \\
a_7 b_1 \text{MED}_W \text{LOW}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{LOW}_W \text{MED}_V + a_5 b_3 \text{LOW}_Z \text{MED}_V + \\
a_7 b_3 \text{MED}_W \text{LOW}_Z \text{MED}_V; \\
\text{IHWLZMV} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + \\
a_7 b_1 \text{HIGH}_W \text{LOW}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{HIGH}_W \text{MED}_V + a_5 b_3 \text{LOW}_Z \text{MED}_V + \\
a_7 b_3 \text{HIGH}_W \text{LOW}_Z \text{MED}_V; \\
\text{ILWMZMV} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + \\
a_7 b_1 \text{LOW}_W \text{MED}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{LOW}_W \text{MED}_V + a_5 b_3 \text{MED}_Z \text{MED}_V + \\
a_7 b_3 \text{LOW}_W \text{MED}_Z \text{MED}_V; \\
\text{IMWMZMV} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + \\
a_7 b_1 \text{MED}_W \text{MED}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{MED}_W \text{MED}_V + a_5 b_3 \text{MED}_Z \text{MED}_V + \\
a_7 b_3 \text{MED}_W \text{MED}_Z \text{MED}_V; \\
\text{IHWMZMV} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + \\
a_7 b_1 \text{HIGH}_W \text{MED}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{HIGH}_W \text{MED}_V + a_5 b_3 \text{MED}_Z \text{MED}_V + \\
a_7 b_3 \text{HIGH}_W \text{MED}_Z \text{MED}_V; \\
\text{ILWHZMV} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + \\
a_7 b_1 \text{LOW}_W \text{HIGH}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{LOW}_W \text{MED}_V + a_5 b_3 \text{HIGH}_Z \text{MED}_V + \\
a_7 b_3 \text{LOW}_W \text{HIGH}_Z \text{MED}_V; \\
\text{IMWHZMV} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + \\
a_7 b_1 \text{MED}_W \text{HIGH}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{MED}_W \text{MED}_V + a_5 b_3 \text{HIGH}_Z \text{MED}_V + \\
a_7 b_3 \text{MED}_W \text{HIGH}_Z \text{MED}_V; \\
\text{IHWHZMV} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + \\
a_7 b_1 \text{HIGH}_W \text{HIGH}_Z + \\
a_1 b_3 \text{MED}_V + a_4 b_3 \text{HIGH}_W \text{MED}_V + a_5 b_3 \text{HIGH}_Z \text{MED}_V + \\
a_7 b_3 \text{HIGH}_W \text{HIGH}_Z \text{MED}_V; \\
\end{align*}
\]
ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
    a7*b1*LOW_W*LOW_Z +
    a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_V + a5*b3*LOW_Z*HIGH_V +
    a7*b3*LOW_W*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
    a7*b1*MED_W*LOW_Z +
    a1*b3*HIGH_V + a4*b3*MED_W*HIGH_V + a5*b3*LOW_Z*HIGH_V +
    a7*b3*MED_W*LOW_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
    a7*b1*HIGH_W*LOW_Z +
    a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_V + a5*b3*LOW_Z*HIGH_V +
    a7*b3*HIGH_W*LOW_Z*HIGH_V;

ILWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
    a7*b1*LOW_W*MED_Z +
    a1*b3*HIGH_V + a4*b3*LOW_W*MED_Z + a5*b3*MED_Z*HIGH_V +
    a7*b3*LOW_W*MED_Z*MED_Z;
IMWMZHV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
    a7*b1*MED_W*MED_Z +
    a1*b3*HIGH_V + a4*b3*MED_W*MED_Z + a5*b3*MED_Z*HIGH_V +
    a7*b3*MED_W*MED_Z*MED_Z;
IHWMZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
    a7*b1*HIGH_W*MED_Z +
    a1*b3*HIGH_V + a4*b3*HIGH_W*MED_Z + a5*b3*MED_Z*HIGH_V +
    a7*b3*HIGH_W*MED_Z*MED_Z;

ILWHZHV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
    a7*b1*LOW_W*HIGH_Z +
    a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_Z + a5*b3*MED_Z*HIGH_V +
    a7*b3*LOW_W*MED_Z*HIGH_V;
IMWHZHV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
    a7*b1*MED_W*HIGH_Z +
    a1*b3*HIGH_V + a4*b3*MED_W*HIGH_Z + a5*b3*MED_Z*HIGH_V +
    a7*b3*MED_W*MED_Z*HIGH_V;
IHWHZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
    a7*b1*HIGH_W*HIGH_Z +
    a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_Z + a5*b3*MED_Z*HIGH_V +
    a7*b3*HIGH_W*MED_Z*HIGH_V;

! Calc conditional total effects for each combination of
  moderator values
TLWLZLV = ILWLZLV + cdash;
TMWLZLV = IMWLZLV + cdash;
THWLZLV = IHWLZLV + cdash;

TLWMZLV = ILWMZLV + cdash;
TMWMZLV = IMWMZLV + cdash;
THWMZLV = IHWMZLV + cdash;

TLWHZLV = ILWHZLV + cdash;
TMWHZLV = IMWHZLV + cdash;
THWHZLV = IHWHZLV + cdash;

TLWLZMV = ILWLZMV + cdash;
TMWLZMV = IMWLZMV + cdash;
THWLZMV = IHWLZMV + cdash;

TLWMZMV = ILWMZMV + cdash;
TMWMZMV = IMWMZMV + cdash;
THWMZMV = IHWMZMV + cdash;

TLWHZMV = ILWHZMV + cdash;
TMWHZMV = IMWHZMV + cdash;
THWHZMV = IHWHZMV + cdash;

TLWLZHV = ILWLZHV + cdash;
TMWLZHV = IMWLZHV + cdash;
THWLZHV = IHWLZHV + cdash;

TLWMZHV = ILWMZHV + cdash;
TMWMZHV = IMWMZHV + cdash;
THWMZHV = IHWMZHV + cdash;

TLWHZHV = ILWHZHV + cdash;
TMWHZHV = IMWHZHV + cdash;
THWHZHV = IHWHZHV + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWHZLV PMWHZLV PHWHZLV
PLWLZMV PMWLZMV PHWLZMV PLWMZMV PMWMZMV PHWMZMV
PLWHZMV PMWHZMV PHWHZMV
PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV
PLWHZHV PMWHZHV PHWHZHV);
LOOP(XVAL,1,5,0.1);
PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;

PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;

PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;

PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;

PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;

PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;

PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;

PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 26: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and direct IV-DV path with all 2-way and 3-way interactions, 1 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]
Hence... multiplying out brackets

\[ Y = b_0 + a_{0b_1} + a_{1b_1}X + a_{2b_1}W + a_{3b_1}Z + a_{4b_1}XW + a_{5b_1}XZ + a_{6b_1}WZ + a_{7b_1}XWZ + b_2V + a_{0b_3} + a_{1b_3}XV + a_{2b_3}WV + a_{3b_3}ZV + a_{4b_3}XWV + a_{5b_3}XZV + a_{6b_3}WZV + a_{7b_3}XWZV + c_{1'}, c_{2'}, c_{3'}, c_{4'}, c_{5'}, c_{6'}, c_{7'}, W, Z, V \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{0b_1} + a_{2b_1}W + a_{3b_1}Z + a_{6b_1}WZ + a_{7b_1}XWZ + b_2V + a_{0b_3} + a_{2b_3}WV + a_{3b_3}ZV + a_{6b_3}WZV + c_{2'} + c_{3'}Z + c_{6'}WZ) + (a_{1b_1} + a_{4b_1}W + a_{5b_1}Z + a_{7b_1}WZ + a_{1b_3} + a_{4b_3}X + a_{5b_3}Z + a_{6b_3}WZV + c_{1'} + c_{4'}W + c_{5'}Z + c_{7'}WZ)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V \):

\[ a_{1b_1} + a_{4b_1}W + a_{5b_1}Z + a_{7b_1}WZ + a_{1b_3} + a_{4b_3}X + a_{5b_3}Z + a_{6b_3}WZV = (a_1 + a_4W + a_5Z + a_7WZ)(b_1 + b_3V) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):

\[ c_{1'} + c_{4'}W + c_{5'}Z + c_{7'}WZ \]

Mplus code for the model:

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y
USEVARIABLES = X M W Z V Y XW XZ WZ MV XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES
subcommand above
DEFINE:
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
    WZ = W*Z;
    XWZ = X*W*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;
```

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! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON MV (b3);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON Z (cdash3);
  Y ON XW (cdash4);
  Y ON XZ (cdash5);
  Y ON WZ (cdash6);
  Y ON XWZ (cdash7);

  [M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON Z (a3);
  M ON XW (a4);
  M ON XZ (a5);
  M ON WZ (a6);
  M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVQLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V
  ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
  ILWHZLV IMWHZLV IHWHZLV
  ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
  ILWHZMV IMWHZMV IHWHZMV
  ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
  ILWHZHV IMWHZHV IHWHZHV
  DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
  DLOW_HIZ DMEW_HIZ DHIW_HIZ
  TLWLZLV TMWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z +
  a1*b3*LOW_V + a4*b3*LOW_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*LOW_W*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z +
  a1*b3*LOW_V + a4*b3*MED_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*MED_W*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z +
  a1*b3*LOW_V + a4*b3*HIGH_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*HIGH_W*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z +
  a1*b3*LOW_V + a4*b3*LOW_W*LOW_V + a5*b3*MED_Z*LOW_V + a7*b3*LOW_W*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z +
  a1*b3*LOW_V + a4*b3*MED_W*LOW_V + a5*b3*MED_Z*MED_V + a7*b3*MED_W*MED_Z*MED_V;
ILWWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z +
  a1*b3*LOW_V + a4*b3*LOW_W*LOW_V + a5*b3*MED_Z*LOW_V + a7*b3*LOW_W*MED_Z*LOW_V;
IMWWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z +
  a1*b3*LOW_V + a4*b3*MED_W*LOW_V + a5*b3*MED_Z*MED_V + a7*b3*MED_W*MED_Z*MED_V;
\[ a7*b3*\text{MED}_W*\text{MED}_Z*\text{LOW}_V; \]
\[ \text{IHWMZLV} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b3*\text{HIGH}_W*\text{MED}_Z + \]
\[ a1*b3*\text{LOW}_V + a4*b3*\text{HIGH}_W*\text{LOW}_V + a5*b3*\text{MED}_Z*\text{LOW}_V + \]
\[ a7*b3*\text{HIGH}_W*\text{MED}_Z*\text{LOW}_V; \]
\[ \text{ILWHZLV} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{HIGH}_Z + \]
\[ a7*b3*\text{LOW}_V*\text{HIGH}_Z + \]
\[ a1*b3*\text{LOW}_V + a4*b3*\text{LOW}_W*\text{LOW}_V + a5*b3*\text{HIGH}_Z*\text{LOW}_V + \]
\[ a7*b3*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_V; \]
\[ \text{IMWHZLV} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{HIGH}_Z + \]
\[ a7*b3*\text{MED}_W*\text{HIGH}_Z + \]
\[ a1*b3*\text{LOW}_V + a4*b3*\text{MED}_W*\text{LOW}_V + a5*b3*\text{HIGH}_Z*\text{LOW}_V + \]
\[ a7*b3*\text{MED}_W*\text{MED}_Z*\text{LOW}_V; \]
\[ \text{IHWHZLV} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{HIGH}_Z + \]
\[ a7*b3*\text{HIGH}_W*\text{HIGH}_Z*\text{LOW}_V; \]
\[ \text{ILWLZMV} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{LOW}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{LOW}_Z + \]
\[ a1*b3*\text{MED}_V + a4*b3*\text{LOW}_W*\text{MED}_V + a5*b3*\text{LOW}_Z*\text{MED}_V + \]
\[ a7*b3*\text{LOW}_W*\text{LOW}_Z*\text{MED}_V; \]
\[ \text{IMWLZMV} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{LOW}_Z + \]
\[ a7*b1*\text{MED}_W*\text{LOW}_Z + \]
\[ a1*b3*\text{MED}_V + a4*b3*\text{MED}_W*\text{MED}_V + a5*b3*\text{LOW}_Z*\text{MED}_V + \]
\[ a7*b3*\text{MED}_W*\text{LOW}_Z*\text{MED}_V; \]
\[ \text{IHWLZMV} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{LOW}_Z + \]
\[ a7*b3*\text{HIGH}_W*\text{LOW}_Z*\text{MED}_V; \]
\[ \text{ILWMZMV} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{MED}_Z + \]
\[ a1*b3*\text{MED}_V + a4*b3*\text{LOW}_W*\text{MED}_V + a5*b3*\text{MED}_Z*\text{MED}_V + \]
\[ a7*b3*\text{LOW}_W*\text{MED}_Z*\text{MED}_V; \]
\[ \text{IMWMZMV} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{MED}_W*\text{MED}_Z + \]
\[ a1*b3*\text{MED}_V + a4*b3*\text{MED}_W*\text{MED}_V + a5*b3*\text{MED}_Z*\text{MED}_V + \]
\[ a7*b3*\text{MED}_W*\text{MED}_Z*\text{MED}_V; \]
\[ \text{IHWMZMV} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b3*\text{HIGH}_W*\text{MED}_Z*\text{MED}_V; \]
\[ \text{ILWHZMV} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{HIGH}_Z + \]
\[ a7*b3*\text{LOW}_W*\text{HIGH}_Z*\text{MED}_V; \]
IMWHZMV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b3*MED_V + a4*b3*MED_W*MED_V + a5*b3*HIGH_Z*MED_V +
a7*b3*MED_W*HIGH_Z*MED_V;
IHWHZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b3*MED_V + a4*b3*HIGH_W*MED_V + a5*b3*HIGH_Z*MED_V +
a7*b3*HIGH_W*HIGH_Z*MED_V;

ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_V + a5*b3*LOW_Z*HIGH_V +
a7*b3*LOW_W*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b3*HIGH_V + a4*b3*MED_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*MED_W*MED_Z*HIGH_V;

ILWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*LOW_W*MED_Z*HIGH_V;
IMWMZHV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b3*HIGH_V + a4*b3*MED_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*MED_W*MED_Z*HIGH_V;

IHWMZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*HIGH_W*MED_Z*HIGH_V;

ILWHZHV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_V + a5*b3*HIGH_Z*HIGH_V +
a7*b3*LOW_W*HIGH_Z*HIGH_V;
IMWHZHV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b3*HIGH_V + a4*b3*MED_W*HIGH_V + a5*b3*HIGH_Z*HIGH_V +
a7*b3*MED_W*HIGH_Z*HIGH_V;
IHWHZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +

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\[ a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_V + a5*b3*HIGH_Z*HIGH_V + a7*b3*HIGH_W*HIGH_Z*HIGH_V; \]

! Calc conditional direct effects for each combination of moderator values

\[
DLOW_LOZ = cdash1 + cdash4*LOW_W + cdash5*LOW_Z + cdash7*LOW_W*LOW_Z;
\]
\[
DMEW_LOZ = cdash1 + cdash4*MED_W + cdash5*LOW_Z + cdash7*MED_W*LOW_Z;
\]
\[
DHIW_LOZ = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z + cdash7*HIGH_W*LOW_Z;
\]
\[
DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z + cdash7*LOW_W*MED_Z;
\]
\[
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z + cdash7*MED_W*MED_Z;
\]
\[
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z + cdash7*HIGH_W*MED_Z;
\]
\[
DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z + cdash7*LOW_W*HIGH_Z;
\]
\[
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z + cdash7*MED_W*HIGH_Z;
\]
\[
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z + cdash7*HIGH_W*HIGH_Z;
\]

! Calc conditional total effects for each combination of moderator values

\[
TLWLZLV = ILWLZLV + DLOW_LOZ;
\]
\[
TMWLZLV = IMWLZLV + DMEW_LOZ;
\]
\[
THWLZLV = IHWLZLV + DHIW_LOZ;
\]
\[
TLWMZLV = ILWMZLV + DLOW_MEZ;
\]
\[
TMWMZLV = IMWMZLV + DMEW_MEZ;
\]
\[
THWMZLV = IHWMZLV + DHIW_MEZ;
\]
\[
TLWHZLV = ILWHZLV + DLOW_HIZ;
\]
\[
TMWHZLV = IMWHZLV + DMEW_HIZ;
\]
\[
THWHZLV = IHWHZLV + DHIW_HIZ;
\]
\[
TLWLZMV = ILWLZMV + DLOW_LOZ;
\]
\[
TMWLZMV = IMWLZMV + DMEW_LOZ;
\]
\[
THWLZMV = IHWLZMV + DHIW_LOZ;
\]
\[
TLWMZMV = ILWMZMV + DLOW_MEZ;
\]
\[
TMWMZMV = IMWMZMV + DMEW_MEZ;
\]
\[
THWMZMV = IHWMZMV + DHIW_MEZ;
\]
TLWHZMV = ILWHZMV + DLOW_HIZ;
TMWHZMV = IMWHZMV + DMEW_HIZ;
THWHZMV = IHWHZMV + DHIW_HIZ;
TLWLZHV = ILWLZHV + DLOW_LOZ;
TMWLZHV = IMWLZHV + DMEW_LOZ;
THWLZHV = IHWLZHV + DHIW_LOZ;
TLWMZHV = ILWMZHV + DLOW_MEZ;
TMWMZHV = IMWMZHV + DMEW_MEZ;
THWMZHV = IHWMZHV + DHIW_MEZ;
TLWHZHV = ILWHZHV + DLOW_HIZ;
TMWHZHV = IMWHZHV + DMEW_HIZ;
THWHZHV = IHWHZHV + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWLZLV PMWLZLV PHWLZLV PLWLZMV PMWLZMV PHWLZMV
PLWLZHV PMWLZHV PHWLZHV PLWLZHV PMWLZHV PHWLZHV
PLWLZHV PMWLZHV PHWLZHV PLWLZHV PMWLZHV PHWLZHV);
LOOP(XVAL,1,5,0.1);

PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;
PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;
PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;
PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;
PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;
PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;

PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;

PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 27: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, one of which also moderates the direct IV-DV path, 1 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3MV + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + a6b1WZ + a7b1XWZ + b2V + a0b3V + a1b3XV + a2b3WV + a3b3ZV + a4b3XWV + a5b3XZV + a6b3WZV + a7b3XWZV + c1'X + c2'W + c3'XW

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a3b1Z + a6b1WZ + b2V + a0b3V + a2b3WV + a3b3ZV + a6b3WZV + c2'W) + (a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b3V + a4b3WV + a5b3ZV + a7b3WZV + c1' + c3'W)X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V:

a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b3V + a4b3WV + a5b3ZV + a7b3WZV = (a1 + a4W + a5Z + a7WZ)(b1 + b3V)

One direct effect of X on Y, conditional on W:

c1' + c3'W

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y

USEVARIABLES = X M W Z V Y XW XZ WZ MV XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MV = M*V;
  XW = X*W;
  XZ = X*Z;
  WZ = W*Z;
  XWZ = X*W*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
```
MODEL:

\[
[Y] (b0);
Y ON M (b1);
Y ON V (b2);
Y ON MV (b3);
Y ON X (cdash1);
Y ON W (cdash2);
Y ON XW (cdash3);
\]

\[
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);
\]

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWVMLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V
ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV ILWHZLV IMWHZLV IHWHZLV
ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV ILWHZMV IMWHZMV IHWHZMV
ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV ILWHZHV IMWHZHV IHWHZHV
DIR_LOWW DIR_MEDW DIR_HIW
TLWLZLV TMWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV TLWHZLV TMWHZLV THWHZLV
TLWLZMV TMWLZMV THWLZMV TLWMZMV TMWMZMV THWMZMV TLWHZMV TMWHZMV THWHZMV
TLWLZHV TMWLZHV THWLZHV TLWMZHV TMWMZHV THWMZHV TLWHZHV TMWHZHV THWHZHV
);

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b3*LOW_V + a4*b3*LOW_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*LOW_W*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b3*LOW_V + a4*b3*MED_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*MED_W*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b3*LOW_V + a4*b3*HIGH_W*LOW_V + a5*b3*LOW_Z*LOW_V + a7*b3*HIGH_W*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b3*LOW_V + a4*b3*LOW_W*MED_V + a5*b3*MED_Z*MED_V + a7*b3*LOW_W*MED_Z*MED_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b3*LOW_V + a4*b3*MED_W*MED_V + a5*b3*MED_Z*MED_V + a7*b3*MED_W*MED_Z*MED_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b3*LOW_V + a4*b3*HIGH_W*MED_V + a5*b3*MED_Z*MED_V + a7*b3*HIGH_W*MED_Z*MED_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z +
\[ a_1*b_3*{\text{LOW}}_V + a_4*b_3*{\text{LOW}}_W*{\text{LOW}}_V + a_5*b_3*{\text{HIGH}}_Z*{\text{LOW}}_V + \\
a_7*b_3*{\text{LOW}}_W*{\text{HIGH}}_Z*{\text{LOW}}_V; \]
\[ \text{IMWHZLV} = a_1*b_1 + a_4*b_1*{\text{MED}}_W + a_5*b_1*{\text{HIGH}}_Z + \\
a_7*b_1*{\text{MED}}_W*{\text{HIGH}}_Z + \]
\[ a_1*b_3*{\text{LOW}}_V + a_4*b_3*{\text{MED}}_W*{\text{LOW}}_V + a_5*b_3*{\text{HIGH}}_Z*{\text{LOW}}_V + \\
a_7*b_3*{\text{MED}}_W*{\text{HIGH}}_Z*{\text{LOW}}_V; \]
\[ \text{IHWHZLV} = a_1*b_1 + a_4*b_1*{\text{HIGH}}_W + a_5*b_1*{\text{HIGH}}_Z + \\
a_7*b_1*{\text{HIGH}}_W*{\text{HIGH}}_Z + \]
\[ a_1*b_3*{\text{LOW}}_V + a_4*b_3*{\text{HIGH}}_W*{\text{LOW}}_V + a_5*b_3*{\text{HIGH}}_Z*{\text{LOW}}_V + \\
a_7*b_3*{\text{HIGH}}_W*{\text{HIGH}}_Z*{\text{LOW}}_V; \]
\[ \text{ILWLZMV} = a_1*b_1 + a_4*b_1*{\text{LOW}}_W + a_5*b_1*{\text{LOW}}_Z + \\
a_7*b_1*{\text{LOW}}_W*{\text{LOW}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{LOW}}_W*{\text{MED}}_V + a_5*b_3*{\text{LOW}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{LOW}}_W*{\text{LOW}}_Z*{\text{MED}}_V; \]
\[ \text{IMWLZMV} = a_1*b_1 + a_4*b_1*{\text{MED}}_W + a_5*b_1*{\text{LOW}}_Z + \\
a_7*b_1*{\text{MED}}_W*{\text{LOW}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{LOW}}_W*{\text{MED}}_V + a_5*b_3*{\text{LOW}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{LOW}}_W*{\text{LOW}}_Z*{\text{MED}}_V; \]
\[ \text{IHWLZMV} = a_1*b_1 + a_4*b_1*{\text{HIGH}}_W + a_5*b_1*{\text{LOW}}_Z + \\
a_7*b_1*{\text{HIGH}}_W*{\text{LOW}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{HIGH}}_W*{\text{MED}}_V + a_5*b_3*{\text{LOW}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{HIGH}}_W*{\text{LOW}}_Z*{\text{MED}}_V; \]
\[ \text{ILWMZMV} = a_1*b_1 + a_4*b_1*{\text{LOW}}_W + a_5*b_1*{\text{MED}}_Z + \\
a_7*b_1*{\text{LOW}}_W*{\text{MED}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{LOW}}_W*{\text{MED}}_V + a_5*b_3*{\text{MED}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{LOW}}_W*{\text{MED}}_Z*{\text{MED}}_V; \]
\[ \text{IMWMZMV} = a_1*b_1 + a_4*b_1*{\text{MED}}_W + a_5*b_1*{\text{MED}}_Z + \\
a_7*b_1*{\text{MED}}_W*{\text{MED}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{LOW}}_W*{\text{MED}}_V + a_5*b_3*{\text{MED}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{LOW}}_W*{\text{MED}}_Z*{\text{MED}}_V; \]
\[ \text{IHWMZMV} = a_1*b_1 + a_4*b_1*{\text{HIGH}}_W + a_5*b_1*{\text{MED}}_Z + \\
a_7*b_1*{\text{HIGH}}_W*{\text{MED}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{HIGH}}_W*{\text{MED}}_V + a_5*b_3*{\text{MED}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{HIGH}}_W*{\text{MED}}_Z*{\text{MED}}_V; \]
\[ \text{ILWHZMV} = a_1*b_1 + a_4*b_1*{\text{LOW}}_W + a_5*b_1*{\text{HIGH}}_Z + \\
a_7*b_1*{\text{LOW}}_W*{\text{HIGH}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{LOW}}_W*{\text{MED}}_V + a_5*b_3*{\text{HIGH}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{LOW}}_W*{\text{HIGH}}_Z*{\text{MED}}_V; \]
\[ \text{IMWHZMV} = a_1*b_1 + a_4*b_1*{\text{MED}}_W + a_5*b_1*{\text{HIGH}}_Z + \\
a_7*b_1*{\text{MED}}_W*{\text{HIGH}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{MED}}_W*{\text{MED}}_V + a_5*b_3*{\text{HIGH}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{MED}}_W*{\text{HIGH}}_Z*{\text{MED}}_V; \]
\[ \text{IHWHZMV} = a_1*b_1 + a_4*b_1*{\text{HIGH}}_W + a_5*b_1*{\text{HIGH}}_Z + \\
a_7*b_1*{\text{HIGH}}_W*{\text{HIGH}}_Z + \]
\[ a_1*b_3*{\text{MED}}_V + a_4*b_3*{\text{HIGH}}_W*{\text{MED}}_V + a_5*b_3*{\text{HIGH}}_Z*{\text{MED}}_V + \\
a_7*b_3*{\text{HIGH}}_W*{\text{HIGH}}_Z*{\text{MED}}_V; \]
ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_V + a5*b3*LOW_Z*HIGH_V +
a7*b3*LOW_W*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b3*HIGH_V + a4*b3*MED_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*MED_W*MED_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_V + a5*b3*LOW_Z*HIGH_V +
a7*b3*LOW_W*LOW_Z*HIGH_V;
ILWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*LOW_W*MED_Z*HIGH_V;
IMWMZHV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b3*HIGH_V + a4*b3*MED_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*MED_W*MED_Z*HIGH_V;
IHWMZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*HIGH_W*MED_Z*HIGH_V;
ILWHZHV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b3*HIGH_V + a4*b3*LOW_W*HIGH_V + a5*b3*HIGH_Z*HIGH_V +
a7*b3*LOW_W*HIGH_Z*HIGH_V;
IMWHZHV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b3*HIGH_V + a4*b3*MED_W*HIGH_V + a5*b3*MED_Z*HIGH_V +
a7*b3*MED_W*MED_Z*HIGH_V;
IHWHZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_V + a5*b3*HIGH_Z*HIGH_V +
a7*b3*HIGH_W*HIGH_Z*HIGH_V;

! Calc conditional direct effects for each combination of moderator values
DIR_LOWW = cdash1 + cdash3*LOW_W;
DIR_MEDW = cdash1 + cdash3*MED_W;
DIR_HIW = cdash1 + cdash3*HIGH_W;

! Calc conditional total effects for each combination of modifier values

TLWLZLV = ILWLZLV + DIR_LOWW;
TMWLZLV = IMWLZLV + DIR_MEDW;
THWLZLV = IHWLZLV + DIR_HIW;

TLWMZLV = ILWMZLV + DIR_LOWW;
TMWMZLV = IMWMZLV + DIR_MEDW;
THWMZLV = IHWMZLV + DIR_HIW;

TLWHZLV = ILWHZLV + DIR_LOWW;
TMWHZLV = IMWHZLV + DIR_MEDW;
THWHZLV = IHWHZLV + DIR_HIW;

TLWLZMV = ILWLZMV + DIR_LOWW;
TMWLZMV = IMWLZMV + DIR_MEDW;
THWLZMV = IHWLZMV + DIR_HIW;

TLWMZMV = ILWMZMV + DIR_LOWW;
TMWMZMV = IMWMZMV + DIR_MEDW;
THWMZMV = IHWMZMV + DIR_HIW;

TLWHZMV = ILWHZMV + DIR_LOWW;
TMWHZMV = IMWHZMV + DIR_MEDW;
THWHZMV = IHWHZMV + DIR_HIW;

TLWLZH = ILWLZH + DIR_LOWW;
TMWLZH = IMWLZH + DIR_MEDW;
THWLZH = IHWLZH + DIR_HIW;

TLWMZH = ILWMZH + DIR_LOWW;
TMWMZH = IMWMZH + DIR_MEDW;
THWMZH = IHWMZH + DIR_HIW;

TLWHZH = ILWHZH + DIR_LOWW;
TMWHZH = IMWHZH + DIR_MEDW;
THWHZH = IHWHZH + DIR_HIW;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE — values of 1, 5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWHZLV PMWHZLV PHWHZLV

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PLWLZMV PMWLZMV PHWLZMV PLWMZMV PMWMZMV PHWMZMV
PLWHZMV PMWHZMV PHWHZMV
PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV
PLWHZHV PMWHZHV PHWHZHV);

LOOP(XVAL,1,5,0.1);

PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;

PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;

PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;

PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;

PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;

PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;

PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;

PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 28: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path and direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'V + c_3'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'V + c_3'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)V + c_1'X + c_2'V + c_3'XV \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + a_0b_2V + a_1b_2XV + a_2b_2WV + a_3b_2XWV + c_1'X + c_2'V + c_3'XV \]
Hence... grouping terms into form \( Y = a + bX \)
\[
Y = (b_0 + a_0b_1 + a_2b_1W + a_0b_2V + a_2b_2WV + c_2'V) + (a_1b_1 + a_3b_1W + a_1b_2V + a_3b_2WV + c_1' + c_3'V)X
\]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V \):
\[
a_1b_1 + a_3b_1W + a_1b_2V + a_3b_2WV = (a_1 + a_3W)(b_1 + b_2V)
\]

One direct effect of \( X \) on \( Y \), conditional on \( V \):
\[
c_1' + c_3'V
\]

**Mplus code for the model:**

```plaintext
! Predictor variable - \( X \)
! Mediator variable(s) - \( M \)
! Moderator variable(s) - \( W, V \)
! Outcome variable - \( Y \)

USEVARIABLES = X M W V Y XW XV MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MV = M*V;
    XW = X*W;
    XV = X*V;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON MV (b2);
    Y ON X (cdash1);
    Y ON V (cdash2);
    Y ON XV (cdash3);
```
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
    ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
    ILOW_HIV IMEW_HIV IHIW_HIV
    DIR_LOWV DIR_MEDV DIR_HIV
    TLOW_LOV TMEW_LOV THIW_LOV TLOW_MEV TMEW_MEV THIW_MEV
    TLOW_HIV TMEW_HIV THIW_HIV);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V + a3*b2*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V + a3*b2*MED_W*LOW_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V + a3*b2*HIGH_W*LOW_V;
ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V + a3*b2*LOW_W*MED_V;
IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b2*MED_V + a3*b2*MED_W*MED_V;
a3*b2*MED_W*MED_V;
IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
a3*b2*HIGH_W*MED_V;
ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b2*HIGH_V +
a3*b2*LOW_W*HIGH_V;
IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V +
a3*b2*MED_W*HIGH_V;
IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V +
a3*b2*HIGH_W*HIGH_V;

! Calc conditional direct effects for each combination of
moderator values

DIR_LOWV = cdash1 + cdash3*LOW_V;
DIR_MEDV = cdash1 + cdash3*MED_V;
DIR_HIV = cdash1 + cdash3*HIGH_V;

! Calc conditional total effects for each combination of
moderator values

TLOW_LOV = ILOW_LOV + DIR_LOWV;
TMEW_LOV = IMEW_LOV + DIR_LOWV;
THIW_LOV = IHIW_LOV + DIR_LOWV;
TLOW_MEV = ILOW_MEV + DIR_MEDV;
TMEW_MEV = IMEW_MEV + DIR_MEDV;
THIW_MEV = IHIW_MEV + DIR_MEDV;
TLOW_HIV = ILOW_HIV + DIR_HIV;
TMEW_HIV = IMEW_HIV + DIR_HIV;
THIW_HIV = IHIW_HIV + DIR_HIV;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV
PHIW_MEV
PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL,1,5,0.1);
PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;
PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 29: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, 1 moderating the IV-Mediator path, 1 moderating the Mediator-DV path, both moderating the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)V + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + a_0b_2V + a_1b_2 XV + a_2b_2WV + a_3b_2XWV + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + a_0b_2V + a_2b_2WV + c_2'W + c_3'V) + (a_1b_1 + a_3b_1W + a_1b_2V + a_3b_2WV + c_1' + c_4'W + c_5'V)X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$:

$a_1b_1 + a_3b_1W + a_1b_2V + a_3b_2WV = (a_1 + a_3W)(b_1 + b_2V)$

One direct effect of $X$ on $Y$, conditional on $W$, $V$:

$c_1' + c_4'W + c_5'V$

**Mplus code for the model:**

```mplus
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y

USEVARIABLES = X M W V Y XW XV MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MV = M*V;
    XW = X*W;
    XV = X*V;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON MV (b2);
    Y ON X (cdash1);
    Y ON W (cdash2);
    Y ON V (cdash3);
```
Y ON XW (cdash4);
Y ON XV (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
 ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
 ILOW_HIV IMEW_HIV IHIW_HIV
 DLOW_LOV DMEW_LOV DHIW_LOV DLOW_MEV DMEW_MEV DHIW_MEV
 DLOW_HIV DMEW_HIV DHIW_HIV
 TLOW_LOV TMEW_LOV THIW_LOV TLOW_MEV TMEW_MEV THIW_MEV
 TLOW_HIV TMEW_HIV THIW_HIV);

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

  ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V +
a3*b2*LOW_W*LOW_V;
  IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V +
a3*b2*MED_W*LOW_V;
  IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V +
a3*b2*HIGH_W*LOW_V;
    ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V + a3*b2*LOW_W*MED_V;
    IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b2*MED_V + a3*b2*MED_W*MED_V;
    IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V + a3*b2*HIGH_W*MED_V;

    ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b2*HIGH_V + a3*b2*LOW_W*HIGH_V;
    IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V + a3*b2*MED_W*HIGH_V;
    IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V + a3*b2*HIGH_W*HIGH_V;

! Calc conditional direct effects for each combination of moderator values

    DLOW_LOV = cdash1 + cdash4*LOW_W + cdash5*LOW_V;
    DMEW_LOV = cdash1 + cdash4*MED_W + cdash5*LOW_V;
    DHIW_LOV = cdash1 + cdash4*HIGH_W + cdash5*LOW_V;

    DLOW_MEV = cdash1 + cdash4*LOW_W + cdash5*MED_V;
    DMEW_MEV = cdash1 + cdash4*MED_W + cdash5*MED_V;
    DHIW_MEV = cdash1 + cdash4*HIGH_W + cdash5*MED_V;

    DLOW_HIV = cdash1 + cdash4*LOW_W + cdash5*HIGH_V;
    DMEW_HIV = cdash1 + cdash4*MED_W + cdash5*HIGH_V;
    DHIW_HIV = cdash1 + cdash4*HIGH_W + cdash5*HIGH_V;

! Calc conditional total effects for each combination of moderator values

    TLOW_LOV = ILOW_LOV + DLOW_LOV;
    TMEW_LOV = IMEW_LOV + DMEW_LOV;
    THIW_LOV = IHIW_LOV + DHIW_LOV;

    TLOW_MEV = ILOW_MEV + DLOW_MEV;
    TMEW_MEV = IMEW_MEV + DMEW_MEV;
    THIW_MEV = IHIW_MEV + DHIW_MEV;

    TLOW_HIV = ILOW_HIV + DLOW_HIV;
    TMEW_HIV = IMEW_HIV + DMEW_HIV;
    THIW_HIV = IHIW_HIV + DHIW_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical_min and max limits of predictor X used in analysis
\begin{verbatim}
PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV PHIW_MEV PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL,1,5,0.1);
PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;
PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
\end{verbatim}
Model 30: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path, 1 moderating both the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 M V + c_1' X + c_2' V + c_3' X V \]

\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z) + b_2(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z)V + c_1' X + c_2' V + c_3' X V \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z) + b_2(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z)V + c_1' X + c_2' V + c_3' X V \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0 b_1 + a_1 b_1 X + a_2 b_1 W + a_3 b_1 Z + a_4 b_1 X W + a_5 b_1 X Z + a_0 b_2 V + a_1 b_2 X V + a_2 b_1 W V + a_3 b_2 Z V + a_4 b_2 X W V + a_5 b_2 X Z V + c_1' X + c_2' V + c_3' X V \]
Hence... grouping terms into form $Y = a + bX$

\[ Y = (b_0 + a_{0b1} + a_{2b1}W + a_{3b1}Z + a_{0b2}V + a_{2b1}WV + a_{3b2}ZV + c_{2'}V) + (a_{1b1} + a_{4b1}W + a_{5b1}Z + a_{1b2}V + a_{4b2}WV + a_{5b2}ZV + c_{1'} + c_{3'}V)X \]

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $Z$, $V$:

\[ a_{1b1} + a_{4b1}W + a_{5b1}Z + a_{1b2}V + a_{4b2}WV + a_{5b2}ZV = (a_1 + a_4W + a_5Z) (b_1 + b_2V) \]

One direct effect of $X$ on $Y$, conditional on $V$: $c_1' + c_3'V$

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y

USEVARIABLES = X M W Z V Y XW XZ XV MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES
! subcommand above

DEFINE:
  MV = M*V;
  XW = X*W;
  XZ = X*Z;
  XV = X*V;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON MV (b2);
  Y ON X (cdash1);
  Y ON V (cdash2);
  Y ON XV (cdash3);
```
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMLVQ = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V
    ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
    ILWHZLV IMWHZLV IHWZHVLV
    ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
    ILWHZMV IMWHZMV IHWZHVMV
    ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
    ILWHZHV IMWHZHV IHWZHHV
    DIR_LOWV DIR_MEDV DIR_HIV
    TLWLZLV TMWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV
    TLWHZLV TMWHZLV THWHZLV
    TLWLZMV TMWLZMV THWLZMV TLWMZMV TMWMZMV THWMZMV
    TLWHZMV TMWHZMV THWHZMV
    TLWLZHV TMWLZHV THWLZHV TLWMZHV TMWMZHV THWMZHV
    TLWHZHV TMWHZHV THWHZHV);

    LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
    MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
    HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
    LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
    MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
    HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*LOW_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*LOW_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*LOW_V;
IMWHZLV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*MED_W*HIGH_V + a5*b2*HIGH_Z*LOW_V;
IHWHZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*HIGH_W*HIGH_V + a5*b2*HIGH_Z*LOW_V;
ILWLZMV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V;
IMWLZMV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V;
IHWLZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V;
IHWHZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V;
ILWMZMV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V;
IMWMZMV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V;
IHWMZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V;
ILWHZMV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V;
IMWHZMV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V;
IHWHZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V;
ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V;
ILWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V;
IMWMZHV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V;
IHWMZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V;
ILWHZHV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V;
IMWHZHV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V;
IHWHZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V;
! Calc conditional direct effects for each combination of moderator values

    DIR_LOWV = cdash1 + cdash3*LOW_V;
    DIR_MEDV = cdash1 + cdash3*MED_V;
    DIR_HIV = cdash1 + cdash3*HIGH_V;

! Calc conditional total effects for each combination of moderator values

    TLWLZLV = ILWLZLV + DIR_LOWV;
    TMWLZLV = IMWLZLV + DIR_LOWV;
    THWLZLV = IHWLZLV + DIR_LOWV;
    TLWMZLV = ILWMZLV + DIR_LOWV;
    TMWMZLV = IMWMZLV + DIR_LOWV;
    THWMZLV = IHWMZLV + DIR_LOWV;
    TLWHZLV = ILWHZLV + DIR_LOWV;
    TMWHZLV = IMWHZLV + DIR_LOWV;
    THWHZLV = IHWHZLV + DIR_LOWV;

    TLWLZMV = ILWLZMV + DIR_MEDV;
    TMWLZMV = IMWLZMV + DIR_MEDV;
    THWLZMV = IHWLZMV + DIR_MEDV;
    TLWMZMV = ILWMZMV + DIR_MEDV;
    TMWMZMV = IMWMZMV + DIR_MEDV;
    THWMZMV = IHWMZMV + DIR_MEDV;
    TLWHZMV = ILWHZMV + DIR_MEDV;
    TMWHZMV = IMWHZMV + DIR_MEDV;
    THWHZMV = IHWHZMV + DIR_MEDV;

    TLWLZHV = ILWLZHV + DIR_HIV;
    TMWLZHV = IMWLZHV + DIR_HIV;
    THWLZHV = IHWLZHV + DIR_HIV;
    TLWMZHV = ILWMZHV + DIR_HIV;
    TMWMZHV = IMWMZHV + DIR_HIV;
    THWMZHV = IHWMZHV + DIR_HIV;
    TLWHZHV = ILWHZHV + DIR_HIV;
    TMWHZHV = IMWHZHV + DIR_HIV;
    THWHZHV = IHWHZHV + DIR_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV PLWHZLV PMWHZLV PHWHZLV PLWLZMV PMWLZMV PHWLZMV PLWMZMV PMWMZMV PHWMZMV PLWHZMV PMWHZMV PHWHZMV PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV PLWHZHV PMWHZHV PHWHZHV);

LOOP(XVAL,1,5,0.1);

PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;

PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;

PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;

PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;

PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;

PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;

PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;

PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:

TYPE = plot2;

OUTPUT:

STAND CINT(bcbootstrap);
Model 31: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and the direct IV-DV path, 1 moderating both the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 MV + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'V + c_7'XV \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'V + c_7'XV \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'V + c_7'XV \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0 b_1 + a_1 b_1 X + a_2 b_1 W + a_3 b_1 Z + a_4 b_1 XW + a_5 b_1 XZ + a_0 b_2 V + a_1 b_2 XV + a_2 b_2 WV + a_3 b_2 ZV + a_4 b_2 XWV + a_5 b_2 XZV + c_1' X + c_2' W + c_3' Z + c_4' XW + c_5' XZ + c_6' V + c_7' XV \]

Hence... grouping terms into form \( Y = a + b X \)

\[ Y = (b_0 + a_0 b_1 + a_2 b_1 W + a_3 b_1 Z + a_0 b_2 V + a_2 b_2 WV + a_3 b_2 ZV + c_2' W + c_3' Z + c_6' V) + (a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_1 b_2 V + a_4 b_2 WV + a_5 b_2 ZV + c_1' + c_4' W + c_5' Z + c_7' V) X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V \):

\[ a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_1 b_2 V + a_4 b_2 WV + a_5 b_2 ZV = (a_1 + a_4 W + a_5 Z)(b_1 + b_2 V) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z, V \):

\[ c_1' + c_4' W + c_5' Z + c_7' V \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y

USEVARIABLES = X M W Z V Y XW XZ XV MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
    XV = X*V;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);```
Y ON M (b1);
Y ON MV (b2);
Y ON X (cdash1);
Y ON W (cdash2);
Y ON Z (cdash3);
Y ON XW (cdash4);
Y ON XZ (cdash5);
Y ON V (cdash6);
Y ON XV (cdash7);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V
ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
ILWHZLV IMWHZLV IHWHZLV
ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
ILWHZMV IMWHZMV IHWMZMV
ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
ILWHZHV IMWHZHV IHWMZHV
DLWLZLV DMWLZLV DHWLZLV DLWMZLV DMWMZLV DHWMZLV
DLWHZLV DMWHZLV DWHHZLV
DLWLZMV DMWLZMV DHWLZMV DLWMZMV DMWMZMV DHWMZMV
DLWHZMV DMWHZMV DWHMZMV
DLWLZHV DMWLZHV DHWLZHV DLWMZHV DMWMZHV DHWMZHV
DLWHZHV DMWHZHV DWHHZHV
TLWLZLV TMWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV
TLWHZLV TMWHZLV THWHZLV
TLWLZMV TMWLZMV THWLZMV TLWMZMV TMWMZMV THWMZMV
TLWHZMV TMWHZMV THWHZMV
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W
LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V
+ a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V
+ a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*LOW_V
+ a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V
+ a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V
+ a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V
+ a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_V
+ a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V;
IMWHZLV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V;
IHWHZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V;
ILWLZMV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V;
IMWLZMV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V;
IHWLZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V;
ILWMZMV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V;
IMWMZMV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V;
IHWMZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V;
ILWHZMV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V;
IMWHZMV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V;
IHWHZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V;
ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V;
ILWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V;
IMWMZHV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V;
IHWMZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V;
\( a_4 b_2 \text{LOW}_{W} \text{HIGH}_{V} + a_5 b_2 \text{MED}_{Z} \text{HIGH}_{V}; \)
\( \text{IMWMZHV} = a_1 b_1 + a_4 b_1 \text{MED}_{W} + a_5 b_1 \text{MED}_{Z} + a_1 b_2 \text{HIGH}_{V} + \)
\( a_4 b_2 \text{MED}_{W} \text{HIGH}_{V} + a_5 b_2 \text{MED}_{Z} \text{HIGH}_{V}; \)
\( \text{IHWMZHJV} = a_1 b_1 + a_4 b_1 \text{HIGH}_{W} + a_5 b_1 \text{MED}_{Z} + a_1 b_2 \text{HIGH}_{V} + \)
\( a_4 b_2 \text{HIGH}_{W} \text{HIGH}_{V} + a_5 b_2 \text{MED}_{Z} \text{HIGH}_{V}; \)
\( \text{ILWHZHV} = a_1 b_1 + a_4 b_1 \text{LOW}_{W} + a_5 b_1 \text{HIGH}_{Z} + a_1 b_2 \text{HIGH}_{V} + \)
\( a_4 b_2 \text{LOW}_{W} \text{HIGH}_{V} + a_5 b_2 \text{HIGH}_{Z} \text{HIGH}_{V}; \)
\( \text{ILWHZHV} = a_1 b_1 + a_4 b_1 \text{LOW}_{W} + a_5 b_1 \text{HIGH}_{Z} + a_1 b_2 \text{HIGH}_{V} + \)
\( a_4 b_2 \text{LOW}_{W} \text{HIGH}_{V} + a_5 b_2 \text{HIGH}_{Z} \text{HIGH}_{V}; \)
\( \text{IHWHZHV} = a_1 b_1 + a_4 b_1 \text{HIGH}_{W} + a_5 b_1 \text{HIGH}_{Z} + a_1 b_2 \text{HIGH}_{V} + \)
\( a_4 b_2 \text{HIGH}_{W} \text{HIGH}_{V} + a_5 b_2 \text{HIGH}_{Z} \text{HIGH}_{V}; \)

! Calc conditional direct effects for each combination of moderator values

\( \text{DLWLZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{LOW}_{W} + c_{\text{dash}} 5 \text{LOW}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DMWLZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{MED}_{W} + c_{\text{dash}} 5 \text{LOW}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DHWLZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{HIGH}_{W} + c_{\text{dash}} 5 \text{LOW}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DLWMZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{LOW}_{W} + c_{\text{dash}} 5 \text{MED}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DMWMZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{MED}_{W} + c_{\text{dash}} 5 \text{MED}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DHWMZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{HIGH}_{W} + c_{\text{dash}} 5 \text{MED}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DLWHZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{LOW}_{W} + c_{\text{dash}} 5 \text{HIGH}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DMWHZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{MED}_{W} + c_{\text{dash}} 5 \text{HIGH}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DHWHZLV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{HIGH}_{W} + c_{\text{dash}} 5 \text{HIGH}_{Z} + c_{\text{dash}} 7 \text{LOW}_{V}; \)
\( \text{DLWLZMV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{LOW}_{W} + c_{\text{dash}} 5 \text{LOW}_{Z} + c_{\text{dash}} 7 \text{MED}_{V}; \)
\( \text{DMWLZMV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{MED}_{W} + c_{\text{dash}} 5 \text{LOW}_{Z} + c_{\text{dash}} 7 \text{MED}_{V}; \)
\( \text{DHWLZMV} = c_{\text{dash}} 1 + c_{\text{dash}} 4 \text{HIGH}_{W} + c_{\text{dash}} 5 \text{LOW}_{Z} + c_{\text{dash}} 7 \text{MED}_{V}; \)
\[ DLWMZMV = \text{cdash1} + \text{cdash4}*\text{LOW}_W + \text{cdash5}*\text{MED}_Z + \text{cdash7}*\text{MED}_V; \]
\[ DMWMZMV = \text{cdash1} + \text{cdash4}*\text{MED}_W + \text{cdash5}*\text{MED}_Z + \text{cdash7}*\text{MED}_V; \]
\[ DHWMZMV = \text{cdash1} + \text{cdash4}*\text{HIGH}_W + \text{cdash5}*\text{MED}_Z + \text{cdash7}*\text{MED}_V; \]
\[ DLWHZMV = \text{cdash1} + \text{cdash4}*\text{LOW}_W + \text{cdash5}*\text{HIGH}_Z + \text{cdash7}*\text{MED}_V; \]
\[ DMWHZMV = \text{cdash1} + \text{cdash4}*\text{MED}_W + \text{cdash5}*\text{HIGH}_Z + \text{cdash7}*\text{MED}_V; \]
\[ DHWHZMV = \text{cdash1} + \text{cdash4}*\text{HIGH}_W + \text{cdash5}*\text{HIGH}_Z + \text{cdash7}*\text{MED}_V; \]
\[ DLWLZHV = \text{cdash1} + \text{cdash4}*\text{LOW}_W + \text{cdash5}*\text{LOW}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DMWLZHV = \text{cdash1} + \text{cdash4}*\text{MED}_W + \text{cdash5}*\text{LOW}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DHWLZHV = \text{cdash1} + \text{cdash4}*\text{HIGH}_W + \text{cdash5}*\text{LOW}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DLWMZHV = \text{cdash1} + \text{cdash4}*\text{LOW}_W + \text{cdash5}*\text{MED}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DMWMZHV = \text{cdash1} + \text{cdash4}*\text{MED}_W + \text{cdash5}*\text{MED}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DHWMZHV = \text{cdash1} + \text{cdash4}*\text{HIGH}_W + \text{cdash5}*\text{MED}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DLWHZHV = \text{cdash1} + \text{cdash4}*\text{LOW}_W + \text{cdash5}*\text{HIGH}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DMWHZHV = \text{cdash1} + \text{cdash4}*\text{MED}_W + \text{cdash5}*\text{HIGH}_Z + \text{cdash7}*\text{HIGH}_V; \]
\[ DHWHZHV = \text{cdash1} + \text{cdash4}*\text{HIGH}_W + \text{cdash5}*\text{HIGH}_Z + \text{cdash7}*\text{HIGH}_V; \]

! Calc conditional total effects for each combination of moderator values

\[ TLWLZLV = \text{ILWLZLV} + \text{DLWLZLV}; \]
\[ TMWLZLV = \text{IMWLZLV} + \text{DMWLZLV}; \]
\[ THWLZLV = \text{IHWLZLV} + \text{DHWLZLV}; \]
\[ TLWMZLV = \text{ILWMZLV} + \text{DLWMZLV}; \]
\[ TMWMZLV = \text{IMWMZLV} + \text{DMWMZLV}; \]
\[ THWMZLV = \text{IHWMZLV} + \text{DHWMZLV}; \]
\[ TLWHZLV = \text{ILWHZLV} + \text{DLWHZLV}; \]
\[ TMWHZLV = \text{IMWHZLV} + \text{DMWHZLV}; \]
\[ THWHZLV = \text{IHWZLV} + \text{DHWHZLV}; \]
\[
\begin{align*}
\text{TLWLZMV} &= \text{ILWLZMV} + \text{DLWLZMV}; \\
\text{TMWLZMV} &= \text{IMWLZMV} + \text{DMWLZMV}; \\
\text{THWLZMV} &= \text{IHWLZMV} + \text{DHWLZMV}; \\
\text{TLWMZMV} &= \text{ILWMZMV} + \text{DLWMZMV}; \\
\text{TMWMZMV} &= \text{IMWMZMV} + \text{DMWMZMV}; \\
\text{THWMZMV} &= \text{IHWMZMV} + \text{DHWMZMV}; \\
\text{TLWHZMV} &= \text{ILWHZMV} + \text{DLWHZMV}; \\
\text{TMWHZMV} &= \text{IMWHZMV} + \text{DMWHZMV}; \\
\text{THWHZMV} &= \text{IHWHZMV} + \text{DHWHZMV}; \\
\text{TLWLZHV} &= \text{ILWLZHV} + \text{DLWLZHV}; \\
\text{TMWLZHV} &= \text{IMWLZHV} + \text{DMWLZHV}; \\
\text{THWLZHV} &= \text{IHWLZHV} + \text{DHWLZHV}; \\
\text{TLWMZHV} &= \text{ILWMZHV} + \text{DLWMZHV}; \\
\text{TMWMZHV} &= \text{IMWMZHV} + \text{DMWMZHV}; \\
\text{THWMZHV} &= \text{IHWMZHV} + \text{DHWMZHV}; \\
\text{TLWHZHV} &= \text{ILWHZHV} + \text{DLWHZHV}; \\
\text{TMWHZHV} &= \text{IMWHZHV} + \text{DMWHZHV}; \\
\text{THWHZHV} &= \text{IHWHZHV} + \text{DHWHZHV}; \\
\end{align*}
\]

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

```
PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV P
PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV
PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV
PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
)
LOOP(XVAL,1,5,0.1);
```

```
PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;
PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;
PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;
```
PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;

PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;

PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZH = ILWLZH*XVAL;
PMWLZH = IMWLZH*XVAL;
PHWLZH = IHWLZH*XVAL;

PLWMZH = ILWMZH*XVAL;
PMWMZH = IMWMZH*XVAL;
PHWMZH = IHWMZH*XVAL;

PLWHZH = ILWHZH*XVAL;
PMWHZH = IMWHZH*XVAL;
PHWHZH = IHWHZH*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 32: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 moderating both the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'V + c_3'XV \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MV + c_1'X + c_2'V + c_3'XV \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + c_1'X + c_2'V + c_3'XV \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_6b_1WZ + a_7b_1XWZ + a_0b_2 + a_1b_2XV + a_2b_2WV + a_3b_2ZV + a_4b_2XWV + a_5b_2XZV + a_6b_2WZV + a_7b_2XWZV + c_1'X + c_2'V + c_3'XV \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + a_6b_1WZ + a_0b_2 + a_2b_2WV + a_3b_2ZV + a_6b_2WZV + c_2'V) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + a_1b_2V + a_4b_2WV + a_5b_2ZV + a_7b_2WZV + c_1' + c_3')X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V \):

\[ a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + a_1b_2V + a_4b_2WV + a_5b_2ZV + a_7b_2WZV = (a_1 + a_4W + a_5Z + a_7WZ)(b_1 + b_2V) \]

One direct effect of \( X \) on \( Y \), conditional on \( V \):

\[ c_1' + c_3'V \]

**Mplus code for the model:**

```mplus
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y
USEVARIABLES = X M W Z V Y XW XZ WZ XV MV XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MV = M*V;
  XW = X*W;
  XZ = X*Z;
  XV = X*V;
  WZ = W*Z;
  XWZ = X*W*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
```
MODEL:

[Y] (b0);
Y ON M (b1);
Y ON MV (b2);

Y ON X (cdash1);
Y ON V (cdash2);
Y ON XV (cdash3);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V)

ILWLZLV IMWLZLV IHWLZLV ILWM2LV IMWM2LV IHWM2LV
ILWHZLV IMWHZLV IHWHZLV
ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
ILWHZMV IMWHZMV IHWHZMV
ILWLZHV IMWLZHV IHWLZHV ILWM2HV IMWM2HV IHWM2HV
ILWHZHV IMWHZHV IHWHZHV
DIR_LOWV DIR_MEDV DIR_HIV
TLWLZLV TMWLZLV THWLZLV TLWM2LV TMWM2LV THWM2LV
TLWHZLV TMWHZLV THWHZLV
TLWLZMV TMWLZMV THWLZMV TLWM2MV TMWM2MV THWM2MV
TLWHZMV TMWHZMV THWHZMV
TLWLZHV TMWLZHV THWLZHV TLWM2HV TMWM2HV THWM2HV
TLWHZHV TMWHZHV THWHZHV)

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
chosen high value of W
LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your
chosen high value of Z
LOW_V = #LOWV;  ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your
chosen high value of V

! Calc conditional indirect effects for each combination of
moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*LOW_W*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*MED_W*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*HIGH_W*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*LOW_W*MED_Z + a5*b2*MED_Z*LOW_V +
a7*b2*LOW_W*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*LOW_V + a4*b2*MED_W*MED_Z + a5*b2*MED_Z*LOW_V +
a7*b2*MED_W*MED_Z*LOW_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*MED_Z + a5*b2*MED_Z*LOW_V +
a7*b2*HIGH_W*MED_Z*LOW_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
...
a7*b2*LOW_W*HIGH_Z*LOW_V;
IMWHZLV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*LOW_W*HIGH_Z*LOW_V;
IHWHZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*HIGH_W*HIGH_Z*LOW_V;

ILWLZMV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*LOW_W*LOW_Z*MED_V;
IMWLZMV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*MED_Z +
a1*b2*LOW_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V;
IHWLZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*HIGH_W*HIGH_Z*MED_V;

ILWMZMV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*LOW_W*MED_Z*MED_V;
IMWMZMV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*LOW_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V;
IHWMZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*HIGH_W*MED_Z*MED_V;

ILWHZMV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*LOW_W*HIGH_Z*MED_V;
IMWHZMV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*MED_Z +
a1*b2*LOW_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V;
IHWHZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*HIGH_W*HIGH_Z*MED_V;
ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z +
        a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*LOW_W*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z +
        a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*MED_W*LOW_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z +
        a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*HIGH_W*LOW_Z*HIGH_V;
ILWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z +
        a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a7*b2*LOW_W*MED_Z*HIGH_V;
IMWMZHV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z +
        a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a7*b2*MED_W*MED_Z*HIGH_V;
IHWMZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z +
        a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a7*b2*HIGH_W*MED_Z*HIGH_V;
ILWHZHV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z +
        a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a7*b2*LOW_W*HIGH_Z*HIGH_V;
IMWHZHV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
        a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a7*b2*MED_W*HIGH_Z*HIGH_V;
IHWHZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z +
        a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a7*b2*HIGH_W*HIGH_Z*HIGH_V;

! Calc conditional direct effects for each combination of moderator values
DIR_LOWV = cdash1 + cdash3*LOW_V;
DIR_MEDV = cdash1 + cdash3*MED_V;
DIR_HIV = cdash1 + cdash3*HIGH_V;

! Calc conditional total effects for each combination of moderator values

TLWLZLV = IWLWLZLV + DIR_LOWV;
TMWLZLV = IMWLZLV + DIR_LOWV;
THWLZLV = IHWLZLV + DIR_LOWV;

TLWMZLV = IWLWMZLV + DIR_LOWV;
TMWMZLV = IMWMZLV + DIR_LOWV;
THWMZLV = IHWMZLV + DIR_LOWV;

TLWLZMV = IWLWLZMV + DIR_MEDV;
TMWLZMV = IMWLZMV + DIR_MEDV;
THWLZMV = IHWLZMV + DIR_MEDV;

TLWMZMV = IWLWMZMV + DIR_MEDV;
TMWMZMV = IMWMZMV + DIR_MEDV;
THWMZMV = IHWMZMV + DIR_MEDV;

TLWLZHV = IWLWLZHV + DIR_HIV;
TMWLZHV = IMWLZHV + DIR_HIV;
THWLZHV = IHWLZHV + DIR_HIV;

TLWMZHV = IWLWMZHV + DIR_HIV;
TMWMZHV = IMWMZHV + DIR_HIV;
THWMZHV = IHWMZHV + DIR_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWHZLV PMWHZLV PHWHZLV

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LOOP(XVAL,1,5,0.1);

PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;

PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;

PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;

PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;

PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;

PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;

PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;

PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;

PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:
  TYPE = plot2;
OUTPUT:
  STAND CINT(bcbootstrap);
Model 33: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, 1 moderating both the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 MV + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ + c_8'V + c_9'XV \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ + c_8'V + c_9'XV \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ + c_8'V + c_9'XV \]
Hence... multiplying out brackets

\[ Y = b_0 + a_{0b1} + a_{1b1}X + a_{2b1}W + a_{3b1}Z + a_{4b1}XW + a_{5b1}XZ + a_{6b1}WZ + a_{7b1}XWZ + a_{0b2}V + a_{1b2}XV + a_{2b2}WV + a_{3b2}ZV + a_{4b2}XWV + a_{5b2}XZV + a_{6b2}WZV + a_{7b2}XWZV + c_{1'}X + c_{2'}W + c_{3'}Z + c_{4'}XW + c_{5'}XZ + c_{6'}WZ + c_{7'}XWZ + c_{8'}V + c_{9'}XV \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{0b1} + a_{2b1}W + a_{3b1}Z + a_{6b1}WZ + a_{0b2}V + a_{2b2}WV + a_{3b2}ZV + a_{6b2}WZV + c_{2'}W + c_{3'}Z + c_{6'}WZ + c_{8'}V) + (a_{1b1} + a_{4b1}W + a_{5b1}Z + a_{7b1}WZ + a_{1b2}V + a_{4b2}WV + a_{5b2}ZV + a_{7b2}WZV + c_{1'} + c_{4'}W + c_{5'}Z + c_{7'}WZ + c_{9'}V)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V \):

\[ a_{1b1} + a_{4b1}W + a_{5b1}Z + a_{7b1}WZ + a_{1b2}V + a_{4b2}WV + a_{5b2}ZV + a_{7b2}WZV = (a_{1} + a_{4}W + a_{5}Z + a_{7}WZ)(b_{1} + b_{2}V) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z, V \):

\[ c_{1'} + c_{4'}W + c_{5'}Z + c_{7'}WZ + c_{9'}V \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y

USEVARIABLES = X M W Z V Y XW XZ WZ XV MV XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:

MV = M*V;
XW = X*W;
XZ = X*Z;
XV = X*V;
WZ = W*Z;
XWZ = X*W*Z;

ANALYSIS:

TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;
```
! In model statement name each path and intercept using parentheses

MODEL:
[Y] (b0);
Y ON M (b1);
Y ON MV (b2);
Y ON X (cdash1);
Y ON W (cdash2);
Y ON Z (cdash3);
Y ON XW (cdash4);
Y ON XZ (cdash5);
Y ON WZ (cdash6);
Y ON XWZ (cdash7);
Y ON V (cdash8);
Y ON XV (cdash9);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVQLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V
ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
ILWHZLV IMWHZLV IHWHZLV
ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
ILWHZMV IMWHZMV IHWHZMV
ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
ILWHZHV IMWHZHV IHWHZHV
DLWLZLV DMWLZLV DHWLZLV DLWMZLV DMWMZLV DHWMZLV
DLWHZLV DMWHZLV DHWHZLV
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;   ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_Z = #LOWZ;   ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;   ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV;   ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;   ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z +
    a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z +
    a1*b2*MED_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*MED_W*MED_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z +
    a1*b2*HIGH_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a7*b2*HIGH_W*HIGH_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z +
    a1*b2*LOW_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*LOW_W*MED_Z*MED_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*MED_Z +
    a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*MED_W*MED_Z*MED_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*MED_Z +
    a1*b2*HIGH_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V;
\[ a1 \cdot b2 \cdot \text{LOW}_V + a4 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_V + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{LOW}_V + a7 \cdot b2 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{LOW}_V; \]
\[ \text{IMWMZLV} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{MED}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{MED}_W \cdot \text{MED}_Z + a1 \cdot b2 \cdot \text{LOW}_V + a4 \cdot b2 \cdot \text{MED}_W \cdot \text{LOW}_V + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{LOW}_V + a7 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{LOW}_V; \]
\[ \text{IMWHZLV} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{MED}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{MED}_W \cdot \text{MED}_Z + a1 \cdot b2 \cdot \text{LOW}_V + a4 \cdot b2 \cdot \text{MED}_W \cdot \text{LOW}_V + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{LOW}_V + a7 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{LOW}_V; \]
\[ \text{IHWHZLV} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{MED}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{MED}_W \cdot \text{MED}_Z + a1 \cdot b2 \cdot \text{LOW}_V + a4 \cdot b2 \cdot \text{MED}_W \cdot \text{LOW}_V + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{LOW}_V + a7 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{LOW}_V; \]
\[ \text{ILWHZLV} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{LOW}_W + a5 \cdot b1 \cdot \text{HIGH}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{HIGH}_Z + a1 \cdot b2 \cdot \text{LOW}_V + a4 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_V + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{LOW}_V + a7 \cdot b2 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{LOW}_V; \]
\[ \text{IMWLZMV} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{LOW}_W + a5 \cdot b1 \cdot \text{LOW}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{LOW}_Z + a1 \cdot b2 \cdot \text{MED}_V + a4 \cdot b2 \cdot \text{LOW}_W \cdot \text{MED}_V + a5 \cdot b2 \cdot \text{LOW}_Z \cdot \text{MED}_V + a7 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_Z \cdot \text{MED}_V; \]
\[ \text{IMWLZMV} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{MED}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{MED}_W \cdot \text{MED}_Z + a1 \cdot b2 \cdot \text{MED}_V + a4 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_V + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{MED}_V + a7 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{MED}_V; \]
\[ \text{IHWMZMV} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{LOW}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{MED}_Z + a1 \cdot b2 \cdot \text{MED}_V + a4 \cdot b2 \cdot \text{LOW}_W \cdot \text{MED}_V + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{MED}_V + a7 \cdot b2 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_V; \]
ILWHZMV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*LOW_W*HIGH_Z*MED_V;
IMWHZMV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*MED_W*HIGH_Z*MED_V;
IHWHZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*HIGH_W*HIGH_Z*MED_V;

ILWLZHV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*LOW_W*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*HIGH_W*LOW_Z*HIGH_V;

ILWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V;
IMWMZHV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*HIGH_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V;
IHWMZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*HIGH_W*MED_Z*HIGH_V;

ILWHZHV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V +
a7*b2*LOW_W*HIGH_Z*HIGH_V;
IMWHZHV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V +
a7*b2*MED_W*HIGH_Z*HIGH_V;
\[ a_7 \cdot b_2 \cdot \text{MED}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V; \]
\[ \text{IHWHZHV} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_7 \cdot b_1 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z + a_1 \cdot b_2 \cdot \text{HIGH}_V + a_4 \cdot b_2 \cdot \text{HIGH}_W \cdot \text{HIGH}_V + a_5 \cdot b_2 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_7 \cdot b_2 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V; \]

! Calc conditional direct effects for each combination of moderator values

\[ \text{DLWLZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{LOW}_W + \text{cdash}_5 \cdot \text{LOW}_Z + \text{cdash}_7 \cdot \text{LOW}_W \cdot \text{LOW}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DMWLZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{MED}_W + \text{cdash}_5 \cdot \text{LOW}_Z + \text{cdash}_7 \cdot \text{MED}_W \cdot \text{LOW}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DHWLZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{HIGH}_W + \text{cdash}_5 \cdot \text{LOW}_Z + \text{cdash}_7 \cdot \text{HIGH}_W \cdot \text{LOW}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DLWMZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{LOW}_W + \text{cdash}_5 \cdot \text{MED}_Z + \text{cdash}_7 \cdot \text{LOW}_W \cdot \text{MED}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DMWMZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{MED}_W + \text{cdash}_5 \cdot \text{MED}_Z + \text{cdash}_7 \cdot \text{MED}_W \cdot \text{MED}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DHWMZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{HIGH}_W + \text{cdash}_5 \cdot \text{MED}_Z + \text{cdash}_7 \cdot \text{HIGH}_W \cdot \text{MED}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DLWHZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{LOW}_W + \text{cdash}_5 \cdot \text{HIGH}_Z + \text{cdash}_7 \cdot \text{LOW}_W \cdot \text{HIGH}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DMWHZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{MED}_W + \text{cdash}_5 \cdot \text{HIGH}_Z + \text{cdash}_7 \cdot \text{MED}_W \cdot \text{HIGH}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DHWHZLV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{HIGH}_W + \text{cdash}_5 \cdot \text{HIGH}_Z + \text{cdash}_7 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z + \text{cdash}_9 \cdot \text{LOW}_V; \]
\[ \text{DLWLZMV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{LOW}_W + \text{cdash}_5 \cdot \text{LOW}_Z + \text{cdash}_7 \cdot \text{LOW}_W \cdot \text{LOW}_Z + \text{cdash}_9 \cdot \text{MED}_V; \]
\[ \text{DMWLZMV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{MED}_W + \text{cdash}_5 \cdot \text{LOW}_Z + \text{cdash}_7 \cdot \text{MED}_W \cdot \text{LOW}_Z + \text{cdash}_9 \cdot \text{MED}_V; \]
\[ \text{DHWLZMV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{HIGH}_W + \text{cdash}_5 \cdot \text{LOW}_Z + \text{cdash}_7 \cdot \text{HIGH}_W \cdot \text{LOW}_Z + \text{cdash}_9 \cdot \text{MED}_V; \]
\[ \text{DLWHZMV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{LOW}_W + \text{cdash}_5 \cdot \text{HIGH}_Z + \text{cdash}_7 \cdot \text{LOW}_W \cdot \text{HIGH}_Z + \text{cdash}_9 \cdot \text{MED}_V; \]
\[ \text{DMWHZMV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{MED}_W + \text{cdash}_5 \cdot \text{HIGH}_Z + \text{cdash}_7 \cdot \text{MED}_W \cdot \text{HIGH}_Z + \text{cdash}_9 \cdot \text{MED}_V; \]
\[ \text{DHWHZMV} = \text{cdash}_1 + \text{cdash}_4 \cdot \text{HIGH}_W + \text{cdash}_5 \cdot \text{HIGH}_Z + \text{cdash}_7 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z + \text{cdash}_9 \cdot \text{MED}_V; \]
cdash7*HIGH_W*LOW_Z +
cdash9*MED_V;

DLWMZMV = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash9*MED_V;
DMWMZMV = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash9*MED_V;
DHWMZMV = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
cdash7*HIGH_W*MED_Z +
cdash9*MED_V;

DLWHZMV = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash9*MED_V;
DMWHZMV = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash9*MED_V;
DHWHZMV = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
cdash7*HIGH_W*MED_Z +
cdash9*MED_V;

DLWLZHV = cdash1 + cdash4*LOW_W + cdash5*LOW_Z +
cdash7*LOW_W*LOW_Z +
cdash9*HIGH_V;
DMWLZHV = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
cdash7*MED_W*LOW_Z +
cdash9*HIGH_V;
DHWLZHV = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
cdash7*HIGH_W*LOW_Z +
cdash9*HIGH_V;

DLWMZHV = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash9*MED_V;
DMWMZHV = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash9*MED_V;
DHWMZHV = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
cdash7*HIGH_W*MED_Z +
cdash9*MED_V;

DLWHZHV = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z +
cdash7*LOW_W*HIGH_Z +
cdash9*HIGH_V;
DMWHZHVV = cdash1 + cdash4*MED_W + cdash5*HIGH_Z +
cdash7*MED_W*HIGH_Z +
cdash9*HIGH_V;
DHWHZHV = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
cdash7*HIGH_W*HIGH_Z +
cdash9*HIGH_V;
DHWHZHJV = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z + 
cdash7*HIGH_W*HIGH_Z + 
cdash9*HIGH_V;

! Calc conditional total effects for each combination of 
moderator values

TLWLZLV = ILWLZLV + DLWLZLV;
TMWLZLV = IMWLZLV + DMWLZLV;
THWLZLV = IHWLZLV + DHWLZLV;

TLWMZLV = ILWMZLV + DLWMZLV;
TMWMZLV = IMWMZLV + DMWMZLV;
THWMZLV = IHWMZLV + DHWMZLV;

TLWHZLV = ILWHZLV + DLWHZLV;
TMWHZLV = IMWHZLV + DMWHZLV;
THWHZLV = IHWHZLV + DHWHZLV;

TLWLZMV = ILWLZMV + DLWLZMV;
TMWLZMV = IMWLZMV + DMWLZMV;
THWLZMV = IHWLZMV + DHWLZMV;

TLWMZMV = ILWMZMV + DLWMZMV;
TMWMZMV = IMWMZMV + DMWMZMV;
THWMZMV = IHWMZMV + DHWMZMV;

TLWHZMV = ILWHZMV + DLWHZMV;
TMWHZMV = IMWHZMV + DMWHZMV;
THWHZMV = IHWHZMV + DHWHZMV;

TLWLZHV = ILWLZHV + DLWLZHV;
TMWLZHV = IMWLZHV + DMWLZHV;
THWLZHV = IHWLZHV + DHWLZHV;

TLWMZHV = ILWMZHV + DLWMZHV;
TMWMZHV = IMWMZHV + DMWMZHV;
THWMZHV = IHWMZHV + DHWMZHV;

TLWHZHV = ILWHZHV + DLWHZHV;
TMWHZHV = IMWHZHV + DMWHZHV;
THWHZHV = IHWHZHV + DHWHZHV;

! Use loop plot to plot conditional indirect effect of X on Y 
for each combination of low, med, high moderator values 
! Could be edited to show conditional direct or conditional 
total effects instead 
! NOTE - values of 1,5 in LOOP() statement need to be replaced 
by 
! logical min and max limits of predictor X used in analysis 

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV 
PLWHZLV PMWHZLV PHWHZLV
LOOP(XVAL,1,5,0.1);
PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;
PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;
PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;
PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;
PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;
PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;
PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;
PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;
PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 34: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 2 moderating the IV-Mediator path with all 2-way and 3-way interactions, one of which also moderates the direct IV-DV path, 1 moderating the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, Z, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[
Y = b_0 + b_1M + b_2MV + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'XV
\]

\[
M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ
\]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[
Y = b_0 + b_1(M + a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)
\]

\[
M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ
\]

Hence... substituting in equation for \( M \)

\[
Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)
\]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + a6b1WZ + a7b1XWZ + a0b2V + a1b2XV + a2b2WV + a3b2ZV + a4b2XWV + a5b2XZV + a6b2WZV + a7b2XWZV + c1'X + c2'W + c3'XW + c4'V + c5'XV

Hence... grouping terms into form Y = a + bX
Y = (b0 + a0b1 + a2b1W + a3b1Z + a6b1WZ + a0b2V + a2b2WV + a3b2ZV + a6b2WZV + c2'W + c4'V) + (a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b2V + a4b2WV + a5b2ZV + a7b2WZV + c1' + c3'W + c5'V)X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V: a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b2V + a4b2WV + a5b2ZV + a7b2WZV = (a1 + a4W + a5Z + a7WZ)(b1 + b2V)

One direct effect of X on Y, conditional on W, V: c1' + c3'W + c5'V

Mplus code for the model:

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V
! Outcome variable - Y
USEVARIABLES = X M W Z V Y XW XZ WZ XV MV XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
MV = M*V;
XW = X*W;
XZ = X*Z;
XV = X*V;
WZ = W*Z;
XWZ = X*W*Z;

ANALYSIS:
TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
[Y] (b0);
Y ON M (b1);
Y ON MV (b2);
```
Y ON X (cdash1);
Y ON W (cdash2);
Y ON XW (cdash3);
Y ON V (cdash4);
Y ON XV (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect
effects
! You need to pick low, medium and high moderator values for
W, Z, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and
total effects used below:
! HWMLV = high value of W, medium value of V and low value of
! Q, etc.
MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V
HIGH_V
ILWLZLV IMWLZLV IHWLZLV ILWMZLV IMWMZLV IHWMZLV
ILWHZLV IMWHZLV IHWHZLV
ILWLZMV IMWLZMV IHWLZMV ILWMZMV IMWMZMV IHWMZMV
ILWHZMV IMWHZMV IHWHZMV
ILWLZHV IMWLZHV IHWLZHV ILWMZHV IMWMZHV IHWMZHV
ILWHZHV IMWHZHV IHWHZHV
DLOW_LOV DMEW_LOV DHIW_LOV DLOW_MEV DMEW_MEV DHIW_MEV
DLOW_HIV DMEW_HIV DHIW_HIV
TLWLZLV TMLWLZLV THWLZLV TLWMZLV TMWMZLV THWMZLV
TLWHZLV TMWHZLV THWHZLV
TLWLZMV TMLWLZMV THWLZMV TLWMZMV TMWMZMV THWMZMV
TLWHZMV TMWHZMV THWHZMV
TLWLZHV TMLWLZHV THWLZHV TLWMZHV TMWMZHV THWMZHV
TLWHZHV TMWHZHV THWHZHV);

LOW_W = #LOWW; ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W
LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILWLZLV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
          a7*b1*LOW_W*LOW_Z +
          a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V +
          a7*b2*LOW_W*LOW_Z*LOW_V;
IMWLZLV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
          a7*b1*MED_W*LOW_Z +
          a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V +
          a7*b2*MED_W*LOW_Z*LOW_V;
IHWLZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
          a7*b1*HIGH_W*LOW_Z +
          a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V +
          a7*b2*HIGH_W*LOW_Z*LOW_V;
ILWMZLV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
          a7*b1*LOW_W*MED_Z +
          a1*b2*LOW_V + a4*b2*LOW_W*MED_Z + a5*b2*LOW_Z*MED_Z +
          a7*b2*LOW_W*MED_Z*LOW_V;
IMWMZLV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
          a7*b1*MED_W*MED_Z +
          a1*b2*LOW_V + a4*b2*MED_W*MED_Z + a5*b2*MED_Z*MED_Z +
          a7*b2*MED_W*MED_Z*LOW_V;
IHWMZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
          a7*b1*HIGH_W*MED_Z +
          a1*b2*LOW_V + a4*b2*HIGH_W*MED_Z + a5*b2*HIGH_Z*MED_Z +
          a7*b2*HIGH_W*MED_Z*LOW_V;
ILWHZLV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
          a7*b1*LOW_W*HIGH_Z +
          a1*b2*LOW_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
          a7*b2*LOW_W*HIGH_Z*LOW_V;
IMWHZLV = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
          a7*b1*MED_W*HIGH_Z +
          a1*b2*LOW_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
          a7*b2*MED_W*HIGH_Z*LOW_V;
\[ a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V; \]
\[ IHWHZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a7*b2*HIGH_W*HIGH_Z*LOW_V; \]
\[ ILWLZMV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*LOW_W*LOW_Z*MED_V; \]
\[ IMWLZMV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*MED_W*LOW_Z*MED_V; \]
\[ IHWLZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*HIGH_W*LOW_Z*MED_V; \]
\[ ILWMZMV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*LOW_W*MED_Z*MED_V; \]
\[ IMWMZMV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*LOW_W*LOW_Z*HIGH_V; \]
\[ IHWMZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V; \]
\[ ILWLZHVV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V; \]
\[ IHWHZLV = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a7*b2*HIGH_W*HIGH_Z*LOW_V; \]
\[ ILWLZMV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*LOW_W*LOW_Z*MED_V; \]
\[ IMWLZMV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*MED_W*LOW_Z*MED_V; \]
\[ IHWLZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*HIGH_W*LOW_Z*MED_V; \]
\[ ILWMZMV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*LOW_W*MED_Z*MED_V; \]
\[ IMWMZMV = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*LOW_W*LOW_Z*HIGH_V; \]
\[ IHWMZMV = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V; \]
\[ ILWLZHVV = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V; \]
a7*b2*LOW_W*LOW_Z*HIGH_V;
IMWLZHV = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*MED_W*LOW_Z*HIGH_V;
IHWLZHV = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*HIGH_W*LOW_Z*HIGH_V;

IMWMZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V;
IWMWZHV = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V;

ILWHZHV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V +
a7*b2*LOW_W*HIGH_Z*HIGH_V;
IMWZH HV = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V +
a7*b2*MED_W*HIGH_Z*HIGH_V;

! Calc conditional direct effects for each combination of moderator values

DLOW_LOV = cdash1 + cdash3*LOW_W + cdash5*LOW_V;
DMEW_LOV = cdash1 + cdash3*MED_W + cdash5*LOW_V;
DHIW_LOV = cdash1 + cdash3*HIGH_W + cdash5*LOW_V;

DLOW_MEV = cdash1 + cdash3*LOW_W + cdash5*MED_V;
DMEW_MEV = cdash1 + cdash3*MED_W + cdash5*MED_V;
DHIW_MEV = cdash1 + cdash3*HIGH_W + cdash5*MED_V;

DLOW_HIV = cdash1 + cdash3*LOW_W + cdash5*HIGH_V;
DMEW_HIV = cdash1 + cdash3*MED_W + cdash5*HIGH_V;
DHIW_HIV = cdash1 + cdash3*HIGH_W + cdash5*HIGH_V;

! Calc conditional total effects for each combination of moderator values

TLWLZLV = ILWLZLV + DLOW_LOV;
TMWLZLV = IMWLZLV + DMEW_LOV;
THWLZLV = IHWLZLV + DHIW_LOV;

TLWMZLV = ILWMZLV + DLOW_LOV;
TMWMZLV = IMWMZLV + DMEW_LOV;
THWMZLV = IHWMZLV + DHIW_LOV;

TLWHZLV = ILWHZLV + DLOW_LOV;
TMWHZLV = IMWHZLV + DMEW_LOV;
THWHZLV = IHWHZLV + DHIW_LOV;

TLWLZMV = ILWLZMV + DLOW_MEV;
TMWLZMV = IMWLZMV + DMEW_MEV;
THWLZMV = IHWLZMV + DHIW_MEV;

TLWMZMV = ILWMZMV + DLOW_MEV;
TMWMZMV = IMWMZMV + DMEW_MEV;
THWMZMV = IHWMZMV + DHIW_MEV;

TLWHZMV = ILWHZMV + DLOW_MEV;
TMWHZMV = IMWHZMV + DMEW_MEV;
THWHZMV = IHWHZMV + DHIW_MEV;

TLWLZHV = ILWLZHV + DLOW_HIV;
TMWLZHV = IMWLZHV + DMEW_HIV;
THWLZHV = IHWLZHV + DHIW_HIV;

TLWMZHV = ILWMZHV + DLOW_HIV;
TMWMZHV = IMWMZHV + DMEW_HIV;
THWMZHV = IHWMZHV + DHIW_HIV;

TLWHZHV = ILWHZHV + DLOW_HIV;
TMWHZHV = IMWHZHV + DMEW_HIV;
THWHZHV = IHWHZHV + DHIW_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be
replaced ! by logical min and max limits of predictor X used in analysis

PLOT(PLWLZLV PMWLZLV PHWLZLV PLWMZLV PMWMZLV PHWMZLV
PLWHZLV PMWHZLV PHWHZLV
PLWLZMV PMWLZMV PHWLZMV PLWMZMV PMWMZMV PHWMZMV
PLWHZMV PMWHZMV PHWHZMV
PLWLZHV PMWLZHV PHWLZHV PLWMZHV PMWMZHV PHWMZHV
PLWHZHV PMWHZHV PHWHZHV)

LOOP(XVAL,1,5,0.1);

PLWLZLV = ILWLZLV*XVAL;
PMWLZLV = IMWLZLV*XVAL;
PHWLZLV = IHWLZLV*XVAL;
PLWMZLV = ILWMZLV*XVAL;
PMWMZLV = IMWMZLV*XVAL;
PHWMZLV = IHWMZLV*XVAL;
PLWHZLV = ILWHZLV*XVAL;
PMWHZLV = IMWHZLV*XVAL;
PHWHZLV = IHWHZLV*XVAL;
PLWLZMV = ILWLZMV*XVAL;
PMWLZMV = IMWLZMV*XVAL;
PHWLZMV = IHWLZMV*XVAL;
PLWMZMV = ILWMZMV*XVAL;
PMWMZMV = IMWMZMV*XVAL;
PHWMZMV = IHWMZMV*XVAL;
PLWHZMV = ILWHZMV*XVAL;
PMWHZMV = IMWHZMV*XVAL;
PHWHZMV = IHWHZMV*XVAL;
PLWLZHV = ILWLZHV*XVAL;
PMWLZHV = IMWLZHV*XVAL;
PHWLZHV = IHWLZHV*XVAL;
PLWMZHV = ILWMZHV*XVAL;
PMWMZHV = IMWMZHV*XVAL;
PHWMZHV = IHWMZHV*XVAL;
PLWHZHV = ILWHZHV*XVAL;
PMWHZHV = IMWHZHV*XVAL;
PHWHZHV = IHWHZHV*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 35: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2V + b_3Q + b_4(a_0 + a_1X + a_2W + a_3XW)V + b_5(a_0 + a_1X + a_2W + a_3XW)Q + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + b_2V + b_3Q + a_0b_4V + a_1b_4XV + a_2b_4WV + a_3b_4XWV + a_0b_5Q + a_1b_5XQ + a_2b_5WQ + a_3b_5XWQ + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + b_2V + b_3Q + a_0b_4V + a_2b_4WV + a_0b_5Q + a_2b_5WQ) +$
$(a_1b_1 + a_3b_1W + a_1b_4V + a_3b_4WV + a_1b_5Q + a_3b_5WQ + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$, $Q$:

$a_1b_1 + a_3b_1W + a_1b_4V + a_3b_4WV + a_1b_5Q + a_3b_5WQ = (a_1 + a_3W)(b_1 + b_4V + b_5Q)$

One direct effect of $X$ on $Y$:

$c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y
USEVARIABLES = X M W V Q Y XW MV MQ;

! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MQ = M*Q;
  MV = M*V;
  XW = X*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON Q (b3);
  Y ON MV (b4);
  Y ON MQ (b5);
```
Y ON X (cdash);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW (LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVQLQ ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMWMVMQ IHWVMQ
ILWLVHQ IMWLVHQ IHWLHQ ILWMVHQ IMWMVHQ IHWMVHQ ILWHVHQ IMWHVHQ IWHMVQ IMWHMVQ IWHMVQ
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ TLWLVMQ TMWLVMQ THWLVMQ TLWMVMQ TMWMVMQ THWMVMQ
TLWLVHQ TMWLVHQ THWLVHQ TLWMVHQ TMWMVHQ THWMVHQ TLWHVHQ TMWHVHQ THWHVHQ)

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V
LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V + 
a3*b4*LOW_W*LOW_V + 
a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q;
IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V + 
a3*b4*MED_W*LOW_V + 
a1*b5*LOW_Q + a3*b5*MED_W*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V + 
a3*b4*HIGH_W*LOW_V + 
a1*b5*LOW_Q + a3*b5*HIGH_W*LOW_Q;
ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V + 
a3*b4*LOW_W*MED_V + 
a1*b5*LOW_Q + a3*b5*LOW_W*MED_Q;
IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V + 
a3*b4*MED_W*MED_V + 
a1*b5*MED_Q + a3*b5*MED_W*MED_Q;
IHWMVQL = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V + 
a3*b4*HIGH_W*MED_V + 
a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q;

ILWMVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*LOW_W*MED_V +
a1*b5*MED_Q + a3*b5*LOW_W*MED_Q;
IMWVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*MED_W*MED_V +
a1*b5*MED_Q + a3*b5*MED_W*MED_Q;
IHWMVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V +
a3*b4*HIGH_W*MED_V +
a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q;
ILWHVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
a3*b4*LOW_W*HIGH_V +
a1*b5*MED_Q + a3*b5*LOW_W*MED_Q;
IMWHVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
a3*b4*MED_W*HIGH_V +
a1*b5*MED_Q + a3*b5*MED_W*MED_Q;
IHWHVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V +
a3*b4*HIGH_W*HIGH_V +
a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q;
ILWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V +
a3*b4*LOW_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*HIGH_Q;
IMWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V +
a3*b4*MED_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*MED_W*HIGH_Q;
IHWLVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V +
a3*b4*HIGH_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*HIGH_Q;
ILWMVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*LOW_W*MED_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*MED_Q;
IMWMVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*MED_W*MED_V +
a1*b5*HIGH_Q + a3*b5*MED_W*MED_Q;
IHWMVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V +
a3*b4*HIGH_W*MED_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*MED_Q;
ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
a3*b4*LOW_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*HIGH_Q;
IMWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
a3*b4*MED_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*MED_W*HIGH_Q;
IHWHVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V +
a3*b4*HIGH_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*HIGH_Q;
! Calc conditional total effects for each combination of moderator values

TLWLVLQ = ILWLVLQ + cdash;
TMWLVLQ = IMWLVLQ + cdash;
THWLVLQ = IHWLVLQ + cdash;
TLWMVLQ = ILWMVLQ + cdash;
TMWMVLQ = IMWMVLQ + cdash;
THWMVLQ = IHWMVLQ + cdash;
TLWHVLQ = ILWHVLQ + cdash;
TMWHVLQ = IMWHVLQ + cdash;
THWHVLQ = IHWHVLQ + cdash;
TLWLVMQ = ILWLVMQ + cdash;
TMWLVMQ = IMWLVMQ + cdash;
THWLVMQ = IHWLVMQ + cdash;
TLWMVMQ = ILWMVMQ + cdash;
TMWMVMQ = IMWMVMQ + cdash;
THWMVMQ = IHWMVMQ + cdash;
TLWHVMQ = ILWHVMQ + cdash;
TMWHVMQ = IMWHVMQ + cdash;
THWHVMQ = IHWHVMQ + cdash;
TLWLVHQ = ILWLVHQ + cdash;
TMWLVHQ = IMWLVHQ + cdash;
THWLVHQ = IHWLVHQ + cdash;
TLWMVHQ = ILWMVHQ + cdash;
TMWMVHQ = IMWMVHQ + cdash;
THWMVHQ = IHWMVHQ + cdash;
TLWHVHQ = ILWHVHQ + cdash;
TMWHVHQ = IMWHVHQ + cdash;
THWHVHQ = IHWHVHQ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWLVLQ PMWLVLQ PHWLVLQ
PLWLVMQ PMWLVMQ PHWLVMQ PLWMVMQ PMWMVMQ PHWMVMQ
PLWLVMQ PMWLVMQ PHWLVMQ
PLWHVHQ = IHWHVHQ + cdash;
LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMLWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMVLQ = ILWMVLQ*XVAL;
PMLWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMLWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMLWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWMVMQ = ILWMVMQ*XVAL;
PMLWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMLWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMLWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMLWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 36: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating both the Mediator-DV path and the IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 MV + b_3 MQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 MV + b_3 MQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)V + b_3(a_0 + a_1X + a_2W + a_3XW)Q + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + a_0b_2V + a_1b_2XV + a_2b_2WV + a_3b_2XWV + a_0b_3 + a_1b_3XQ + a_2b_3WQ + a_3b_3XWQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + a_0b_2V + a_2b_2WV + a_0b_3 + a_2b_3WQ + c_2'V + c_3'Q) + (a_1b_1 + a_3b_1W + a_1b_2V + a_3b_2WV + a_1b_3Q + a_3b_3WQ + c_1' + c_4'V + c_5'Q)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V, Q \):

\[ a_1b_1 + a_3b_1W + a_1b_2V + a_3b_2WV + a_1b_3Q + a_3b_3WQ = (a_1 + a_3W) (b_1 + b_2V + b_3Q) \]

One direct effect of \( X \) on \( Y \), conditional on \( V, Q \):

\[ c_1' + c_4'V + c_5'Q \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y
USEVARIABLES = X M W V Q Y XW XV XQ MV MQ;

DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XQ = X*Q;
    XV = X*V;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
    [Y] (b0);
```
Y ON M (b1);
Y ON MV (b2);
Y ON MQ (b3);
Y ON X (cdash1);
Y ON V (cdash2);
Y ON Q (cdash3);
Y ON XV (cdash4);
Y ON XQ (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMLVQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
ILWHVLQ IMWHVLQ IHWHVLQ
ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMWMVMQ IHWMVMQ
ILWHVMQ IMWHVMQ IHWHVMQ
ILWLVHQ IMWLVHQ IHWLVHQ ILWMVHQ IMWMVHQ IHWMVHQ
ILWHVHQ IMWHVHQ IHWHVHQ
DLOV_LOQ DMEV_LOQ DHIV_LOQ DLOV_MEQ DMEV_MEQ DHIV_MEQ
DLOV_HIQ DMEV_HIQ DHIV_HIQ
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ
TLWLVMQ TMWLVMQ THWLVMQ TLWMVMQ TMWMVMQ THWMVMQ
TLWHVMQ TMWHVMQ THWHVMQ
TLWLVHQ TMWLVHQ THWLVHQ TLWMVHQ TMWMVHQ THWMVHQ
TLWHVHQ TMWHVHQ THWHVHQ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V
LOW_Q = #LOWQ; ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ; ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V + a3*b2*LOW_W*LOW_V + a1*b3*LOW_Q + a3*b3*LOW_W*LOW_Q;
IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V + a3*b2*MED_W*LOW_V + a1*b3*LOW_Q + a3*b3*MED_W*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V + a3*b2*HIGH_W*LOW_V + a1*b3*LOW_Q + a3*b3*HIGH_W*LOW_Q;
ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V + a3*b2*LOW_W*MED_V + a1*b3*LOW_Q + a3*b3*LOW_W*MED_Q;
IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V + a3*b2*MED_W*MED_V + a1*b3*L
IHWMVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V + a3*b2*HIGH_W*MED_V + a1*b3*LOW_Q + a3*b3*HIGH_W*MED_Q;
ILWHVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*HIGH_V + a3*b2*LOW_W*HIGH_V + a1*b3*LOW_Q + a3*b3*LOW_W*HIGH_Q;
IMWHVLQ = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V + a3*b2*MED_W*HIGH_V + a1*b3*LOW_Q + a3*b3*MED_W*HIGH_Q;
IHWHVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V + a3*b2*HIGH_W*HIGH_V + a1*b3*LOW_Q + a3*b3*HIGH_W*LOW_Q;
ILWLVMQ = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V +
    a3*b2*LOW_W*LOW_V +
    a1*b3*MED_Q + a3*b3*LOW_W*MED_Q;
IMWLVMQ = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V +
    a3*b2*MED_W*LOW_V +
    a1*b3*MED_Q + a3*b3*MED_W*MED_Q;
IHWLVMQ = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V +
    a3*b2*HIGH_W*LOW_V +
    a1*b3*MED_Q + a3*b3*HIGH_W*MED_Q;
ILWVMVQ = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V +
    a3*b2*LOW_W*MED_V +
    a1*b3*MED_Q + a3*b3*LOW_W*MED_Q;
IMWVMVQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
    a3*b2*MED_W*MED_V +
    a1*b3*MED_Q + a3*b3*MED_W*MED_Q;
IHWVMVQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
    a3*b2*HIGH_W*MED_V +
    a1*b3*MED_Q + a3*b3*HIGH_W*MED_Q;
ILWHVMQ = a1*b1 + a3*b1*LOW_W + a1*b2*HIGH_V +
    a3*b2*LOW_W*HIGH_V +
    a1*b3*MED_Q + a3*b3*LOW_W*MED_Q;
IMWHVMQ = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V +
    a3*b2*MED_W*HIGH_V +
    a1*b3*MED_Q + a3*b3*MED_W*MED_Q;
IHWWHVMQ = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V +
    a3*b2*HIGH_W*MED_V +
    a1*b3*MED_Q + a3*b3*HIGH_W*HIGH_Q;
ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V +
    a3*b2*LOW_W*LOW_V +
    a1*b3*HIGH_Q + a3*b3*LOW_W*HIGH_Q;
IMWHVHQ = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V +
    a3*b2*MED_W*LOW_V +
    a1*b3*HIGH_Q + a3*b3*MED_W*HIGH_Q;
IHWLVHQ = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V +
    a3*b2*HIGH_W*LOW_V +
    a1*b3*HIGH_Q + a3*b3*HIGH_W*HIGH_Q;
ILWMVHQ = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V +
    a3*b2*LOW_W*MED_V +
    a1*b3*HIGH_Q + a3*b3*LOW_W*HIGH_Q;
IMWMVHQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
    a3*b2*MED_W*MED_V +
    a1*b3*HIGH_Q + a3*b3*MED_W*HIGH_Q;
IHWMVHQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
    a3*b2*HIGH_W*MED_V +
    a1*b3*HIGH_Q + a3*b3*HIGH_W*HIGH_Q;
ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b2*HIGH_V + a3*b2*LOW_W*HIGH_V + a1*b3*HIGH_Q + a3*b3*LOW_W*HIGH_Q;

IMWHVHQ = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V + a3*b2*MED_W*HIGH_V + a1*b3*HIGH_Q + a3*b3*MED_W*HIGH_Q;

IHWHVHQ = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V + a3*b2*HIGH_W*HIGH_V + a1*b3*HIGH_Q + a3*b3*HIGH_W*HIGH_Q;

! Calc conditional direct effects for each combination of moderator values

DLOV_LOQ = cdash1 + cdash4*LOW_V + cdash5*LOW_Q;
DMEV_LOQ = cdash1 + cdash4*MED_W + cdash5*LOW_Q;
DHIV_LOQ = cdash1 + cdash4*HIGH_V + cdash5*LOW_Q;

DLOV_MEQ = cdash1 + cdash4*LOW_V + cdash5*MED_Q;
DMEV_MEQ = cdash1 + cdash4*MED_W + cdash5*MED_Q;
DHIV_MEQ = cdash1 + cdash4*HIGH_V + cdash5*MED_Q;

DLOV_HIQ = cdash1 + cdash4*LOW_V + cdash5*HIGH_Q;
DMEV_HIQ = cdash1 + cdash4*MED_W + cdash5*HIGH_Q;
DHIV_HIQ = cdash1 + cdash4*HIGH_V + cdash5*HIGH_Q;

! Calc conditional total effects for each combination of moderator values

TLWLVLQ = ILWLVLQ + DLOV_LOQ;
TMWLVLQ = IMWLVLQ + DLOV_LOQ;
THWLVLQ = IHWLVLQ + DLOV_LOQ;

TLWMVLQ = ILWMVLQ + DMEV_LOQ;
TMWMVLQ = IMWMVLQ + DMEV_LOQ;
THWMVLQ = IHWMVLQ + DMEV_LOQ;

TLWHVLQ = ILWHVLQ + DHIV_LOQ;
TMWHVLQ = IMWHVLQ + DHIV_LOQ;
THWHVLQ = IHWHLVLQ + DHIV_LOQ;

TLWLVMQ = ILWLVMQ + DLOV_MEQ;
TMWLVMQ = IMWLVMQ + DLOV_MEQ;
THWLVMQ = IHWLVMQ + DLOV_MEQ;

TLWMVMQ = ILWMVMQ + DMEV_MEQ;
TMWMVMQ = IMWMVMQ + DMEV_MEQ;
THWMVMQ = IHWVMMQ + DMEV_MEQ;

TLWHVMQ = ILWHVMQ + DHIV_MEQ;
TMWHVMQ = IMWHVMQ + DHIV_MEQ;
THWHVMQ = IHWHLVMQ + DHIV_MEQ;
TLWLVHQ = ILWLVHQ + DLOV_HIQ;
TMWLVHQ = IMWLVHQ + DLOV_HIQ;
THWLVHQ = IHWLVHQ + DLOV_HIQ;

TLWVMHQ = ILWVMHQ + DMEV_HIQ;
TMWVMHQ = IMWVMHQ + DMEV_HIQ;
THWVMHQ = IHWVMHQ + DMEV_HIQ;

TLWHVHQ = ILWHVHQ + DHIV_HIQ;
TMWHVHQ = IMWHVHQ + DHIV_HIQ;
THWHVHQ = IHWHVHQ + DHIV_HIQ;

! Use loop plot to plot conditional indirect effect of X on Y
! for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
! total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWHLQ PMWHLQ PWHLHLQ
PLWVMQ PMWVMQ PHWVMQ PLWVMQ PMWVMQ PHWVMQ
PLWHVLQ PMWHVLQ PHWHVLQ PLWHVLQ PMWHVLQ PHWHVLQ
PLWHVLQ PMWHVLQ PHWHVLQ PLWHVLQ PMWHVLQ PHWHVLQ

LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMLQ = ILWMLQ*XVAL;
PMWMLQ = IMWMLQ*XVAL;
PHWMLQ = IHWMLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWVMQ = ILWVMQ*XVAL;
PMWVMQ = IMWVMQ*XVAL;
PHWVMQ = IHWVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;
PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLMVMHQ = ILMVMHQ*XVAL;
PMMVMHQ = IMMVMHQ*XVAL;
PHMVMHQ = IHMVMHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

**PLOT:**
TYPE = plot2;

**OUTPUT:**
STAND CINT(bcbootstrap);
Model 37: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + b_6VQ + b_7MVQ + c'X \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(M) + b_2V + b_3Q + b_4(M)V + b_5(M)Q + b_6VQ + b_7(M)VQ + c'X \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2V + b_3Q + b_4(a_0 + a_1X + a_2W + a_3XW)V + b_5(a_0 + a_1X + a_2W + a_3XW)Q + b_6VQ + b_7(a_0 + a_1X + a_2W + a_3XW)VQ + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + b_2V + b_3Q + a_0b_4V + a_1b_4XV + a_2b_4WV + a_3b_4XWV + a_0b_5Q + a_1b_5XQ + a_2b_5WQ + a_3b_5XWQ + b_6VQ + a_0b_7VQ + a_1b_7XVQ + a_2b_7WVQ + a_3b_7XWVQ + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + b_2V + b_3Q + a_0b_4V + a_2b_4WV + a_0b_5Q + a_2b_5WQ + b_6VQ + a_0b_7VQ + a_2b_7WVQ) + (a_1b_1 + a_3b_1W + a_1b_4V + a_3b_4WV + a_1b_5Q + a_3b_5WQ + a_1b_7VQ + a_3b_7WVQ + c')X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V, Q \):

\[ a_1b_1 + a_3b_1W + a_1b_4V + a_3b_4WV + a_1b_5Q + a_3b_5WQ + a_1b_7VQ + a_3b_7WVQ = (a_1 + a_3W)(b_1 + b_4V + b_5Q + b_7VQ) \]

One direct effect of \( X \) on \( Y \):

\[ c' \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y

USEVARIABLES = X M W V Q Y XW VQ MV MQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MQ = M*Q;
  MV = M*V;
  XW = X*W;
  VQ = V*Q;
  MVQ = M*V*Q;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
```
MODEL:
[Y] (b0);
Y ON M (b1);
Y ON V (b2);
Y ON Q (b3);
Y ON MV (b4);
Y ON MQ (b5);
Y ON VQ (b6);
Y ON MVQ (b7);
Y ON X (cdash);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
        ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
        ILWHVLQ IMWHVLQ IHWHVLQ
        ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMWMVMQ IHWMVMQ
        ILWHVMQ IMWHVMQ IHWHVMQ
        ILWLVHQ IMWLVHQ IHWLVHQ ILWMVHQ IMWMVHQ IHWMVHQ
        ILWHVHQ IMWHVHQ IHWHVHQ
        TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
        TLWHVLQ TMWHVLQ THWHVLQ
        TLWLVMQ TMWLVMQ THWLVMQ TLWMVMQ TMWMVMQ THWMVMQ
        TLWHVMQ TMWHVMQ THWHVMQ
        TLWLVHQ TMWLVHQ THWLVHQ TLWMVHQ TMWMVHQ THWMVHQ
        TLWHVHQ TMWHVHQ THWHVHQ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
c chosen high value of W

LOW_V = #LOWV;  ! replace #LOWV in the code with your
chosen low value of V

MED_V = #MEDV;  ! replace #MEDV in the code with your
chosen medium value of V

HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your
chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your
chosen low value of Q

MED_Q = #MEDQ;  ! replace #MEDQ in the code with your
chosen medium value of Q

HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your
chosen high value of Q

! Calc conditional indirect effects for each combination of
moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V +
    a3*b4*LOW_W*LOW_V +
    a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q + a1*b7*LOW_V*LOW_Q +
    a3*b7*LOW_W*LOW_V*LOW_Q;

ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
    a3*b4*LOW_W*MED_V +
    a1*b5*LOW_Q + a3*b5*LOW_W*MED_V + a1*b7*LOW_V*MED_Q +
    a3*b7*LOW_W*MED_V*LOW_Q;

ILWHVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
    a3*b4*LOW_W*HIGH_V +
    a1*b5*LOW_Q + a3*b5*LOW_W*HIGH_V + a1*b7*LOW_V*HIGH_Q +
    a3*b7*LOW_W*HIGH_V*LOW_Q;

IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V +
    a3*b4*MED_W*LOW_V +
    a1*b5*MED_Q + a3*b5*MED_W*LOW_Q + a1*b7*MED_V*LOW_Q +
    a3*b7*MED_W*LOW_V*LOW_Q;

IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V +
    a3*b4*MED_W*MED_V +
    a1*b5*MED_Q + a3*b5*MED_W*MED_V + a1*b7*MED_V*MED_Q +
    a3*b7*MED_W*MED_V*LOW_Q;

IMWHVLQ = a1*b1 + a3*b1*MED_W + a1*b4*HIGH_V +
    a3*b4*MED_W*HIGH_V +
    a1*b5*MED_Q + a3*b5*MED_W*HIGH_V + a1*b7*MED_V*HIGH_Q +
    a3*b7*MED_W*HIGH_V*LOW_Q;

IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V +
    a3*b4*HIGH_W*LOW_V +
    a1*b5*HIGH_Q + a3*b5*HIGH_W*LOW_Q + a1*b7*HIGH_V*LOW_Q +
    a3*b7*HIGH_W*LOW_V*LOW_Q;

IHWMVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V +
    a3*b4*HIGH_W*MED_V +
    a1*b5*HIGH_Q + a3*b5*HIGH_W*MED_V + a1*b7*HIGH_V*MED_Q +
    a3*b7*HIGH_W*MED_V*LOW_Q;

IHWHVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V +
    a3*b4*HIGH_W*HIGH_V +
    a1*b5*HIGH_Q + a3*b5*HIGH_W*HIGH_V + a1*b7*HIGH_V*HIGH_Q +
    a3*b7*HIGH_W*HIGH_V*LOW_Q;
IMWHVLQ = a1*b1 + a3*b1*MED_W + a1*b4*HIGH_V + a3*b4*MED_W*HIGH_V + 
    a1*b5*LOW_Q + a3*b5*MED_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*MED_W*HIGH_V*LOW_Q;
IHWHVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V + a3*b4*HIGH_W*HIGH_V + 
    a1*b5*LOW_Q + a3*b5*HIGH_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*HIGH_W*HIGH_V*LOW_Q;
ILWLVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V + a3*b4*LOW_W*LOW_V + 
    a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q + a1*b7*LOW_V*MED_Q + a3*b7*LOW_W*LOW_V*MED_Q;
IMWLVMQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V + a3*b4*MED_W*LOW_V + 
    a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q + a1*b7*LOW_V*MED_Q + a3*b7*LOW_W*LOW_V*MED_Q;
IHWLVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V + a3*b4*HIGH_W*LOW_V + 
    a1*b5*LOW_Q + a3*b5*HIGH_W*LOW_Q + a1*b7*LOW_V*MED_Q + a3*b7*HIGH_W*LOW_V*MED_Q;
ILWMVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V + a3*b4*LOW_W*MED_V + 
    a1*b5*LOW_Q + a3*b5*LOW_W*MED_V + a1*b7*LOW_V*MED_Q + a3*b7*LOW_W*MED_V*MED_Q;
IMWMVMQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V + a3*b4*MED_W*MED_V + 
    a1*b5*LOW_Q + a3*b5*MED_W*MED_V + a1*b7*MED_V*MED_Q + a3*b7*MED_W*MED_V*MED_Q;
IHWMVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V + a3*b4*HIGH_W*MED_V + 
    a1*b5*LOW_Q + a3*b5*HIGH_W*MED_V + a1*b7*MED_V*MED_Q + a3*b7*HIGH_W*MED_V*MED_Q;
ILWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V +
a3*b4*LOW_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*HIGH_Q + a1*b7*LOW_V*HIGH_Q +
a3*b7*LOW_W*LOW_V*HIGH_Q;
IMWLVHQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V +
a3*b4*MED_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*MED_W*HIGH_Q + a1*b7*LOW_V*HIGH_Q +
a3*b7*MED_W*LOW_V*HIGH_Q;
IHWLVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V +
a3*b4*HIGH_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*HIGH_Q + a1*b7*LOW_V*HIGH_Q +
a3*b7*HIGH_W*LOW_V*HIGH_Q;

ILWMVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*LOW_W*MED_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*MED_V + a1*b7*MED_V*HIGH_Q +
a3*b7*LOW_W*MED_V*HIGH_Q;
IMWMVHQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V +
a3*b4*MED_W*MED_V +
a1*b5*HIGH_Q + a3*b5*MED_W*MED_V + a1*b7*MED_V*HIGH_Q +
a3*b7*MED_W*MED_V*HIGH_Q;
IHWMVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V +
a3*b4*HIGH_W*MED_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*MED_V + a1*b7*MED_V*HIGH_Q +
a3*b7*HIGH_W*MED_V*HIGH_Q;

ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
a3*b4*LOW_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*HIGH_V + a1*b7*HIGH_V*HIGH_Q +
a3*b7*LOW_W*HIGH_V*HIGH_Q;
IMWHVHQ = a1*b1 + a3*b1*MED_W + a1*b4*HIGH_V +
a3*b4*MED_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*MED_W*HIGH_V + a1*b7*HIGH_V*HIGH_Q +
a3*b7*MED_W*HIGH_V*HIGH_Q;
IHWHVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V +
a3*b4*HIGH_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*HIGH_V + a1*b7*HIGH_V*HIGH_Q +
a3*b7*HIGH_W*HIGH_V*HIGH_Q;

! Calc conditional total effects for each combination of moderator values
\begin{verbatim}
TLWLVLQ = ILWLVLQ + cdash;
TMWLVLQ = IMWLVLQ + cdash;
THWLVLQ = IHWLVLQ + cdash;

TLWMVLQ = ILWMVLQ + cdash;
TMWMVLQ = IMWMVLQ + cdash;
THWMVLQ = IHWMVLQ + cdash;

TLWLVMQ = ILWLVMQ + cdash;
TMWLVMQ = IMWLVMQ + cdash;
THWLVMQ = IHWLVMQ + cdash;

TLWMVMQ = ILWMVMQ + cdash;
TMWMVMQ = IMWMVMQ + cdash;
THWMVMQ = IHWMVMQ + cdash;

TLWLVHQ = ILWLVHQ + cdash;
TMWLVHQ = IMWLVHQ + cdash;
THWLVHQ = IHWLVHQ + cdash;

TLWMVHQ = ILWMVHQ + cdash;
TMWMVHQ = IMWMVHQ + cdash;
THWMVHQ = IHWMVHQ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y
! for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWHVLQ PMWHVLQ PHWHVLQ
PLWLVMQ PMWLVMQ PHWLVMQ PLWMVMQ PMWMVMQ PHWMVMQ
PLWHVMQ PMWHVMQ PHWHVMQ
PLWLVHQ PMWLVHQ PHWLVHQ PLWMVHQ PMWMVHQ PHWMVHQ
PLWHVHQ PMWHVHQ PHWHVHQ);

LOOP(XVAL,1,5,0.1);
\end{verbatim}
PLWLVLQ = ILWLVLQ*XVAL;
PMLWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMVLQ = ILWMVLQ*XVAL;
PMMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWLVLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWLVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMLWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLMVMQ = ILMVMQ*XVAL;
PMMVMQ = IMMVMQ*XVAL;
PHMVMQ = IHMVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWLVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMLWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLMVHQ = ILMVHQ*XVAL;
PMMMVHQ = IMMVHQ*XVAL;
PHMVHQ = IHHMVHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWLHVFQ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 38: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating both the Mediator-DV path and the IV-DV path, with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)V + b_3(a_0 + a_1X + a_2W + a_3XW)Q + b_4(a_0 + a_1X + a_2W + a_3XW)VQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]
Hence... multiplying out brackets

\[ Y = b_0 + a_{01}X + a_{21}W + a_{31}XW + a_{02}V + a_{12}XV + a_{22}WV + a_{32}XWV + a_{03}Q + a_{13}XQ + a_{23}WQ + a_{33}XWQ + a_{04}VQ + a_{14}XVQ + a_{24}WVQ + a_{34}XWVQ + c_{1}'X + c_{2}'V + c_{3}'Q + c_{4}'XV + c_{5}'XQ + c_{6}'VQ + c_{7}'XVQ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01} + a_{21}W + a_{02}Q + a_{03}Q + a_{04}VQ + a_{24}WVQ + c_{2}'V + c_{3}'Q + c_{6}'VQ) + (a_{11}X + a_{31}XW + a_{02}XV + a_{32}WV + a_{33}WQ + a_{04}XQ + a_{24}XWQ + c_{1}X + c_{4}'V + c_{5}'X + c_{7}'XVQ)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V, Q \):

\[ a_{11} + a_{31}X + a_{02}XV + a_{32}WV + a_{33}WQ + a_{04}XQ + a_{24}XWQ + c_{1} + c_{4}'V + c_{5}'X + c_{7}'XVQ = (a_{1} + a_{3}W)(b_{1} + b_{2}V + b_{3}Q + b_{4}VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( V, Q \):

\[ c_{1}' + c_{4}'V + c_{5}'Q + c_{7}'VQ \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y

USEVARIABLES = X M W V Q Y XW XV XQ VQ MV MQ XVQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XQ = X*Q;
    XV = X*V;
    VQ = V*Q;
    MVQ = M*V*Q;
    XVQ = X*V*Q;

ANALYSIS:
    TYPE = GENERAL;
```

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ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON MV (b2);
  Y ON MQ (b3);
  Y ON MVQ (b4);
  Y ON X (cdash1);
  Y ON V (cdash2);
  Y ON Q (cdash3);
  Y ON XV (cdash4);
  Y ON XQ (cdash5);
  Y ON VQ (cdash6);
  Y ON XVQ (cdash7);

  [M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean

! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
ILWHVLQ IMWHVLQ IHWHVLQ
ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMWMVMQ IHWMVMQ
ILWHVMQ IMWHVMQ IHWHVMQ
ILWLVHQ IMWLVHQ IHWLVHQ ILWMVHQ IMWMVHQ IHWMVHQ
ILWHVHQ IMWHVHQ IHWHVHQ
DLOV_LOQ DMEV_LOQ DHIV_LOQ DLOV_MEQ DMEV_MEQ DHIV_MEQ
DLOV_HIQ DMEV_HIQ DHIV_HIQ
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V +
         a3*b2*LOW_W*LOW_V +
         a1*b3*LOW_Q + a3*b3*LOW_W*LOW_Q + a1*b4*LOW_V*LOW_Q +
         a3*b4*LOW_W*LOW_V*LOW_Q;
IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V +
         a3*b2*MED_W*LOW_V +
         a1*b3*LOW_Q + a3*b3*MED_W*LOW_Q + a1*b4*LOW_V*LOW_Q +
         a3*b4*MED_W*LOW_V*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V +
         a3*b2*HIGH_W*LOW_V +
         a1*b3*LOW_Q + a3*b3*HIGH_W*LOW_Q + a1*b4*LOW_V*LOW_Q +
         a3*b4*HIGH_W*LOW_V*LOW_Q;
ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V +
         a3*b2*LOW_W*MED_V +
         a1*b3*LOW_Q + a3*b3*LOW_W*MED_Q + a1*b4*MED_V*MED_Q +
         a3*b4*LOW_W*MED_V*MED_Q;
IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
         a3*b2*MED_W*MED_V +
         a1*b3*LOW_Q + a3*b3*MED_W*LOW_Q + a1*b4*MED_V*LOW_Q +
         a3*b4*MED_W*MED_V*LOW_Q;
IHWMVQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
         a3*b2*HIGH_W*MED_V +
         a1*b3*LOW_Q + a3*b3*MED_W*MED_Q + a1*b4*MED_V*MED_Q +
         a3*b4*MED_W*MED_V*MED_Q;

IMWHVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
         a3*b2*MED_W*HIGH_V +
         a1*b3*MED_Q + a3*b3*MED_W*MED_V + a1*b4*MED_V*MED_Q +
         a3*b4*MED_W*MED_V*MED_Q;
IWHMVQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
         a3*b2*MED_W*MED_V +
         a1*b3*MED_Q + a3*b3*MED_W*MED_V + a1*b4*MED_V*MED_Q +
         a3*b4*MED_W*MED_V*MED_Q;
IMWHMVQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
         a3*b2*MED_W*MED_V +
         a1*b3*MED_Q + a3*b3*MED_W*MED_V + a1*b4*MED_V*MED_Q +
         a3*b4*MED_W*MED_V*MED_Q;
IWHMVQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
         a3*b2*MED_W*MED_V +
         a1*b3*MED_Q + a3*b3*MED_W*MED_V + a1*b4*MED_V*MED_Q +
         a3*b4*MED_W*MED_V*MED_Q;
IMWHMVQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
         a3*b2*MED_W*MED_V +
         a1*b3*MED_Q + a3*b3*MED_W*MED_V + a1*b4*MED_V*MED_Q +
         a3*b4*MED_W*MED_V*MED_Q;
IWHMVQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
         a3*b2*MED_W*MED_V +
         a1*b3*MED_Q + a3*b3*MED_W*MED_V + a1*b4*MED_V*MED_Q +
         a3*b4*MED_W*MED_V*MED_Q;

\[ a3 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_V \cdot \text{LOW}_Q; \]
\[ \text{IHWMVLQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{HIGH}_W + a1 \cdot b2 \cdot \text{MED}_V + a3 \cdot b2 \cdot \text{HIGH}_W \cdot \text{MED}_V \]
\[ a1 \cdot b3 \cdot \text{LOW}_Q + a3 \cdot b3 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{LOW}_Q + a3 \cdot b4 \cdot \text{HIGH}_W \cdot \text{MED}_V \cdot \text{LOW}_Q; \]
\[ \text{ILWHVLQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{LOW}_W + a1 \cdot b2 \cdot \text{HIGH}_V + a3 \cdot b2 \cdot \text{LOW}_W \cdot \text{HIGH}_V + a1 \cdot b3 \cdot \text{LOW}_Q + a3 \cdot b3 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{LOW}_Q + a3 \cdot b4 \cdot \text{HIGH}_W \cdot \text{MED}_V \cdot \text{LOW}_Q; \]
\[ \text{IMWHVLQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{MED}_W + a1 \cdot b2 \cdot \text{HIGH}_V + a3 \cdot b2 \cdot \text{MED}_W \cdot \text{HIGH}_V + a1 \cdot b3 \cdot \text{LOW}_Q + a3 \cdot b3 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{LOW}_Q + a3 \cdot b4 \cdot \text{HIGH}_W \cdot \text{MED}_V \cdot \text{LOW}_Q; \]
\[ \text{IHWHVLQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{HIGH}_W + a1 \cdot b2 \cdot \text{HIGH}_V + a3 \cdot b2 \cdot \text{HIGH}_W \cdot \text{HIGH}_V + a1 \cdot b3 \cdot \text{LOW}_Q + a3 \cdot b3 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{LOW}_Q + a3 \cdot b4 \cdot \text{HIGH}_W \cdot \text{MED}_V \cdot \text{LOW}_Q; \]
\[ \text{ILWLVMQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{LOW}_W + a1 \cdot b2 \cdot \text{LOW}_V + a3 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_V + a1 \cdot b3 \cdot \text{MED}_Q + a3 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Q + a1 \cdot b4 \cdot \text{LOW}_V \cdot \text{MED}_Q + a3 \cdot b4 \cdot \text{LOW}_W \cdot \text{LOW}_V \cdot \text{MED}_Q; \]
\[ \text{IMWLVMQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{MED}_W + a1 \cdot b2 \cdot \text{LOW}_V + a3 \cdot b2 \cdot \text{MED}_W \cdot \text{LOW}_V + a1 \cdot b3 \cdot \text{MED}_Q + a3 \cdot b3 \cdot \text{MED}_W \cdot \text{LOW}_V + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{MED}_Q + a3 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{IHWLVMQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{HIGH}_W + a1 \cdot b2 \cdot \text{LOW}_V + a3 \cdot b2 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a1 \cdot b3 \cdot \text{MED}_Q + a3 \cdot b3 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{MED}_Q + a3 \cdot b4 \cdot \text{HIGH}_W \cdot \text{LOW}_V \cdot \text{MED}_Q; \]
\[ \text{ILWMVMQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{LOW}_W + a1 \cdot b2 \cdot \text{MED}_V + a3 \cdot b2 \cdot \text{LOW}_W \cdot \text{MED}_V + a1 \cdot b3 \cdot \text{MED}_Q + a3 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Q + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{MED}_Q + a3 \cdot b4 \cdot \text{LOW}_W \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{IMWMVMQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{MED}_W + a1 \cdot b2 \cdot \text{MED}_V + a3 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_V + a1 \cdot b3 \cdot \text{MED}_Q + a3 \cdot b3 \cdot \text{MED}_W \cdot \text{MED}_Q + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{MED}_Q + a3 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{IHWMVMQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{HIGH}_W + a1 \cdot b2 \cdot \text{MED}_V + a3 \cdot b2 \cdot \text{HIGH}_W \cdot \text{MED}_V + a1 \cdot b3 \cdot \text{MED}_Q + a3 \cdot b3 \cdot \text{HIGH}_W \cdot \text{MED}_Q + a1 \cdot b4 \cdot \text{MED}_V \cdot \text{MED}_Q + a3 \cdot b4 \cdot \text{HIGH}_W \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{ILWHVMQ} = a1 \cdot b1 + a3 \cdot b1 \cdot \text{LOW}_W + a1 \cdot b2 \cdot \text{HIGH}_V + a3 \cdot b2 \cdot \text{LOW}_W \cdot \text{HIGH}_V + a1 \cdot b3 \cdot \text{MED}_Q + a3 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Q + a1 \cdot b4 \cdot \text{HIGH}_V \cdot \text{MED}_Q + a3 \cdot b4 \cdot \text{LOW}_W \cdot \text{HIGH}_V \cdot \text{MED}_Q; \]
IMWHVMQ = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V +
a3*b2*MED_W*HIGH_V +
a1*b3*MED_Q + a3*b3*MED_W*MED_Q + a1*b4*HIGH_V*MED_Q +
a3*b4*MED_W*HIGH_V*MED_Q;

IHWHVMQ = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V +
a3*b2*HIGH_W*HIGH_V +
a1*b3*MED_Q + a3*b3*HIGH_W*MED_Q + a1*b4*HIGH_V*MED_Q +
a3*b4*HIGH_W*HIGH_V*MED_Q;

ILWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V +
a3*b2*LOW_W*LOW_V +
a1*b3*HIGH_Q + a3*b3*LOW_W*HIGH_Q + a1*b4*LOW_V*HIGH_Q +
a3*b4*LOW_W*LOW_V*HIGH_Q;

IMWLVHQ = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V +
a3*b2*LOW_W*LOW_V +
a1*b3*HIGH_Q + a3*b3*LOW_W*HIGH_Q + a1*b4*LOW_V*HIGH_Q +
a3*b4*LOW_W*LOW_V*HIGH_Q;

IMWHMVMQ = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V +
a3*b2*MED_W*HIGH_V +
a1*b3*MED_Q + a3*b3*MED_W*MED_Q + a1*b4*HIGH_V*MED_Q +
a3*b4*MED_W*HIGH_V*MED_Q;

IHWHMVMQ = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V +
a3*b2*HIGH_W*HIGH_V +
a1*b3*MED_Q + a3*b3*HIGH_W*MED_Q + a1*b4*HIGH_V*MED_Q +
a3*b4*HIGH_W*HIGH_V*MED_Q;
\[ a_1b_3^{*}H_{\text{HIGH}} + a_3b_3^{*}H_{\text{HIGH}}W_{\text{HIGH}} + a_1b_4^{*}H_{\text{HIGH}}V_{\text{HIGH}} + a_3b_4^{*}H_{\text{HIGH}}W_{\text{HIGH}}V_{\text{HIGH}}; \]

! Calc conditional direct effects for each combination of moderator values

\[
\begin{align*}
\text{DLOV\_LOQ} &= \text{cdash}_1 + \text{cdash}_4^{*}L_{\text{LOW}}V + \text{cdash}_5^{*}L_{\text{LOW}}Q + \\
\text{DMEV\_LOQ} &= \text{cdash}_1 + \text{cdash}_4^{*}M_{\text{MED}}W + \text{cdash}_5^{*}L_{\text{LOW}}Q + \\
\text{DHIV\_LOQ} &= \text{cdash}_1 + \text{cdash}_4^{*}H_{\text{HIGH}}V + \text{cdash}_5^{*}L_{\text{LOW}}Q + \\
\text{DLOV\_MEQ} &= \text{cdash}_1 + \text{cdash}_4^{*}L_{\text{LOW}}V + \text{cdash}_5^{*}M_{\text{MED}}Q + \\
\text{DMEV\_MEQ} &= \text{cdash}_1 + \text{cdash}_4^{*}M_{\text{MED}}W + \text{cdash}_5^{*}M_{\text{MED}}Q + \\
\text{DHIV\_MEQ} &= \text{cdash}_1 + \text{cdash}_4^{*}H_{\text{HIGH}}V + \text{cdash}_5^{*}M_{\text{MED}}Q + \\
\text{DLOV\_HIQ} &= \text{cdash}_1 + \text{cdash}_4^{*}L_{\text{LOW}}V + \text{cdash}_5^{*}H_{\text{HIGH}}Q + \\
\text{DMEV\_HIQ} &= \text{cdash}_1 + \text{cdash}_4^{*}M_{\text{MED}}W + \text{cdash}_5^{*}H_{\text{HIGH}}Q + \\
\text{DHIV\_HIQ} &= \text{cdash}_1 + \text{cdash}_4^{*}H_{\text{HIGH}}V + \text{cdash}_5^{*}H_{\text{HIGH}}Q + \\
\end{align*}
\]

! Calc conditional total effects for each combination of moderator values

\[
\begin{align*}
\text{TLWLVLQ} &= \text{ILWLVLQ} + \text{DLOV\_LOQ}; \\
\text{TMWLVLQ} &= \text{IMWLVLQ} + \text{DLOV\_LOQ}; \\
\text{THWLVLQ} &= \text{IHWLVLQ} + \text{DLOV\_LOQ}; \\
\text{TLWMVLQ} &= \text{ILWMVLQ} + \text{DMEV\_LOQ}; \\
\text{TMWMVLQ} &= \text{IMWMVLQ} + \text{DMEV\_LOQ}; \\
\text{THWMVLQ} &= \text{IHWMVLQ} + \text{DMEV\_LOQ}; \\
\text{TLWHVLQ} &= \text{ILWHVLQ} + \text{DHIV\_LOQ}; \\
\text{TMWHVLQ} &= \text{IMWHVLQ} + \text{DHIV\_LOQ}; \\
\text{THWHVLQ} &= \text{IHWHVLQ} + \text{DHIV\_LOQ}; \\
\text{TLWLVMQ} &= \text{ILWLVMQ} + \text{DLOV\_MEQ}; \\
\text{TMWLVMQ} &= \text{IMWLVMQ} + \text{DLOV\_MEQ}; \\
\text{THWLVMQ} &= \text{IHWLVMQ} + \text{DLOV\_MEQ}; \\
\text{TLWMVMQ} &= \text{ILWMVMQ} + \text{DMEV\_MEQ}; \\
\text{TMWMVMQ} &= \text{IMWMVMQ} + \text{DMEV\_MEQ}; \\
\text{THWMVMQ} &= \text{IHWMVMQ} + \text{DMEV\_MEQ};
\end{align*}
\]
TLWHVMQ = ILWHVMQ + DHIV_MEQ;
TMWHVMQ = IMWHVMQ + DHIV_MEQ;
THWHVMQ = IHWHVMQ + DHIV_MEQ;

TLWLVLHQ = ILWLVLHQ + DLOV_HIQ;
TMWLVLHQ = IMWLVLHQ + DLOV_HIQ;
THWLVLHQ = IHWLVLHQ + DLOV_HIQ;

TLWMVHQ = ILWMVHQ + DMEV_HIQ;
TMWMVHQ = IMWMVHQ + DMEV_HIQ;
THWMVHQ = IHWMVHQ + DMEV_HIQ;

TLWHVHQ = ILWHVHQ + DHIV_HIQ;
TMWHVHQ = IMWHVHQ + DHIV_HIQ;
THWHVHQ = IHWHVHQ + DHIV_HIQ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values!
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWHVLQ PMWHVLQ PHWHVLQ
PLWLVMQ PMWLVMQ PHWLVMQ PLWMVMQ PMWMVMQ PHWMVMQ
PLWHVMQ PMWHVMQ PHWHVMQ
PLWLVHQ PMWLVHQ PHWLVHQ PLWMVHQ PMWMVHQ PHWMVHQ
PLWHVHQ PMWHVHQ PHWHVHQ);

LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMVLQ = ILWMVLQ*XVAL;
PMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWMVMQ = ILWMVMQ*XVAL;
PMWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;
PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLWMVHQ = ILWMVHQ*XVAL;
PMWMVHQ = IMWMVHQ*XVAL;
PHWMVHQ = IHWMVHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 39: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating the IV-Mediator path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2Q + b_3MV + b_4MQ + b_5VQ + b_6MVQ + c_1'X + c_2'V + c_3'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2Q + b_3(a_0 + a_1X + a_2W + a_3XW)V + b_4(a_0 + a_1X + a_2W + a_3XW)Q + b_5VQ + b_6(a_0 + a_1X + a_2W + a_3XW)VQ + c_1'X + c_2'V + c_3'XV \]

Hence... substituting in equation for \( M \)

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}X + a_{11}W + a_{21}XW + b_2Q + a_{03}V + a_{13}XV + a_{23}WV + b_5VQ + a_{04}Q + a_{14}XQ + a_{24}WQ + a_{06}VQ + a_{16}XVQ + a_{26}WVQ + a_{36}XWVQ + c_1'X + c_2'V + c_3'XV \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01} + a_{21}W + b_2Q + a_{03}V + a_{23}WV + a_{04}Q + a_{24}WQ + b_5VQ + a_{06}VQ + a_{26}WVQ + c_2'V) + (a_{11} + a_{13}V + a_{14}Q + a_{16}VQ + a_{36}WVQ + c_1')X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V, Q \):

\[ a_{11} + a_{31}W + a_{13}V + a_{33}WV + a_{14}Q + a_{34}WQ + a_{16}VQ + a_{36}WVQ = (a_{11} + a_{31}W)(b_{11} + b_{13}V + b_{14}Q + b_{16}VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( V \):

\[ c_1' + c_3'V \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y

USEVARIABLES = X M W V Q Y XW XV VQ MV MQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XV = X*V;
    VQ = V*Q;
    MVQ = M*V*Q;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
```
MODEL:
[Y] (b0);
Y ON M (b1);
Y ON Q (b2);
Y ON MV (b3);
Y ON MQ (b4);
Y ON VQ (b5);
Y ON MVQ (b6);
Y ON X (cdash1);
Y ON V (cdash2);
Y ON XV (cdash3);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
ILWHVLQ IMWHVLQ IHWHVLQ
ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMWMVMQ IHWMVMQ
ILWHVMQ IMWHVMQ IHWHVMQ
ILWLVHQ IMWLVHQ IHWLVHQ ILWMVHQ IMWMVHQ IHWMVHQ
ILWHVHQ IMWHVHQ IHWHVHQ
DIR_LOWW DIR_MEDV DIR_HIV
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ
TLWLVMQ TMWLVMQ THWLVMQ TLWMVMQ TMWMVMQ THWMVMQ
TLWHVMQ TMWHVMQ THWHVMQ
TLWLVHQ TMWLVHQ THWLVHQ TLWMVHQ TMWMVHQ THWMVHQ
TLWHVHQ TMWHVHQ THWHVHQ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your
chosen medium value of $W$

$HIGH_W = \#HIGHW; \quad \text{! replace } \#HIGHW \text{ in the code with your chosen high value of } W$

$LOW_V = \#LOWV; \quad \text{! replace } \#LOWV \text{ in the code with your chosen low value of } V$

$MED_V = \#MEDV; \quad \text{! replace } \#MEDV \text{ in the code with your chosen medium value of } V$

$HIGH_V = \#HIGHV; \quad \text{! replace } \#HIGHV \text{ in the code with your chosen high value of } V$

$LOW_Q = \#LOWQ; \quad \text{! replace } \#LOWQ \text{ in the code with your chosen low value of } Q$

$MED_Q = \#MEDQ; \quad \text{! replace } \#MEDQ \text{ in the code with your chosen medium value of } Q$

$HIGH_Q = \#HIGHQ; \quad \text{! replace } \#HIGHQ \text{ in the code with your chosen high value of } Q$

! Calc conditional indirect effects for each combination of moderator values

\[
ILWLVLQ = a_1b_1 + a_3b_1*LOW_W + a_1b_3*LOW_V + a_3b_3*LOW_W*LOW_V + a_1b_4*LOW_Q + a_3b_4*LOW_W*LOW_Q + a_1b_6*LOW_V*LOW_Q + a_3b_6*LOW_W*LOW_V*LOW_Q;
\]

\[
IMWLVLQ = a_1b_1 + a_3b_1*MED_W + a_1b_3*LOW_V + a_3b_3*MED_W*LOW_V + a_1b_4*LOW_Q + a_3b_4*MED_W*LOW_Q + a_1b_6*MED_V*LOW_Q + a_3b_6*MED_W*MED_V*LOW_Q;
\]

\[
IHWLVLQ = a_1b_1 + a_3b_1*HIGH_W + a_1b_3*LOW_V + a_3b_3*HIGH_W*LOW_V + a_1b_4*LOW_Q + a_3b_4*HIGH_W*LOW_Q + a_1b_6*HIGH_V*LOW_Q + a_3b_6*HIGH_W*HIGH_V*LOW_Q;
\]

\[
ILWMVLQ = a_1b_1 + a_3b_1*LOW_W + a_1b_3*MED_V + a_3b_3*LOW_W*MED_V + a_1b_4*LOW_Q + a_3b_4*LOW_W*LOW_Q + a_1b_6*MED_V*LOW_Q + a_3b_6*LOW_W*MED_V*LOW_Q;
\]

\[
IMWMVLQ = a_1b_1 + a_3b_1*MED_W + a_1b_3*MED_V + a_3b_3*MED_W*MED_V + a_1b_4*LOW_Q + a_3b_4*MED_W*LOW_Q + a_1b_6*MED_V*LOW_Q + a_3b_6*MED_W*MED_V*LOW_Q;
\]

\[
IHWMVLQ = a_1b_1 + a_3b_1*HIGH_W + a_1b_3*MED_V + a_3b_3*HIGH_W*MED_V + a_1b_4*LOW_Q + a_3b_4*HIGH_W*LOW_Q + a_1b_6*HIGH_V*LOW_Q + a_3b_6*HIGH_W*HIGH_V*LOW_Q;
\]

\[
ILWHVLQ = a_1b_1 + a_3b_1*LOW_W + a_1b_3*HIGH_V + a_3b_3*LOW_W*HIGH_V + a_1b_4*LOW_Q + a_3b_4*LOW_W*LOW_Q + a_1b_6*HIGH_V*LOW_Q + a_3b_6*HIGH_W*HIGH_V*LOW_Q;
\]
a3*b6*LOW_W*HIGH_V*LOW_Q;
IMWHLVQ = a1*b1 + a3*b1*MED_W + a1*b3*HIGH_V +
a3*b3*MED_W*HIGH_V +
a1*b4*LOW_Q + a3*b4*LOW_W*LOW_Q + a1*b6*HIGH_V*LOW_Q +
a3*b6*HIGH_W*HIGH_V*LOW_Q;
IHWHVLQ = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_V +
a3*b3*HIGH_W*HIGH_V +
a1*b4*LOW_Q + a3*b4*HIGH_W*LOW_Q + a1*b6*HIGH_V*LOW_Q +
a3*b6*HIGH_W*HIGH_V*LOW_Q;

ILWLVQM = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V +
a3*b3*LOW_W*LOW_V +
a1*b4*MED_Q + a3*b4*LOW_W*MED_Q + a1*b6*LOW_V*MED_Q +
a3*b6*LOW_W*LOW_V*MED_Q;
IMWLVQM = a1*b1 + a3*b1*MED_W + a1*b3*LOW_V +
a3*b3*MED_W*LOW_V +
a1*b4*MED_Q + a3*b4*MED_W*MED_Q + a1*b6*LOW_V*MED_Q +
a3*b6*MED_W*LOW_V*MED_Q;
IHWLVMQ = a1*b1 + a3*b1*HIGH_W + a1*b3*LOW_V +
a3*b3*HIGH_W*LOW_V +
a1*b4*MED_Q + a3*b4*HIGH_W*MED_Q + a1*b6*LOW_V*MED_Q +
a3*b6*HIGH_W*LOW_V*MED_Q;

ILWVMQ = a1*b1 + a3*b1*LOW_W + a1*b3*MED_V +
a3*b3*LOW_W*MED_V +
a1*b4*MED_Q + a3*b4*LOW_W*MED_Q + a1*b6*MED_V*MED_Q +
a3*b6*LOW_W*MED_V*MED_Q;
IMWVMQ = a1*b1 + a3*b1*MED_W + a1*b3*MED_V +
a3*b3*MED_W*MED_V +
a1*b4*MED_Q + a3*b4*MED_W*MED_Q + a1*b6*MED_V*MED_Q +
a3*b6*MED_W*MED_V*MED_Q;
IHWMVMQ = a1*b1 + a3*b1*HIGH_W + a1*b3*MED_V +
a3*b3*HIGH_W*MED_V +
a1*b4*MED_Q + a3*b4*HIGH_W*MED_Q + a1*b6*MED_V*MED_Q +
a3*b6*HIGH_W*MED_V*MED_Q;

ILWHVMQ = a1*b1 + a3*b1*LOW_W + a1*b3*HIGH_V +
a3*b3*LOW_W*HIGH_V +
a1*b4*MED_Q + a3*b4*LOW_W*MED_Q + a1*b6*HIGH_V*MED_Q +
a3*b6*LOW_W*HIGH_V*MED_Q;
IMWHVMQ = a1*b1 + a3*b1*MED_W + a1*b3*HIGH_V +
a3*b3*MED_W*HIGH_V +
a1*b4*MED_Q + a3*b4*MED_W*MED_Q + a1*b6*HIGH_V*MED_Q +
a3*b6*MED_W*HIGH_V*MED_Q;
IHWHVMQ = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_V +
a3*b3*HIGH_W*HIGH_V +
a1*b4*MED_Q + a3*b4*HIGH_W*MED_Q + a1*b6*HIGH_V*MED_Q +
a3*b6*HIGH_W*HIGH_V*MED_Q;
ILWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V +
a3*b3*LOW_W*LOW_V +
a1*b4*HIGH_Q + a3*b4*LOW_W*HIGH_Q + a1*b6*LOW_V*HIGH_Q +
a3*b6*LOW_W*LOW_V*HIGH_Q;
IMWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V +
a3*b3*MED_W*LOW_V +
a1*b4*HIGH_Q + a3*b4*MED_W*HIGH_Q + a1*b6*LOW_V*HIGH_Q +
a3*b6*MED_W*LOW_V*HIGH_Q;
IHWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V +
a3*b3*HIGH_W*LOW_V +
a1*b4*HIGH_Q + a3*b4*HIGH_W*HIGH_Q + a1*b6*LOW_V*HIGH_Q +
a3*b6*HIGH_W*LOW_V*HIGH_Q;
ILWMVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*MED_V +
a3*b3*LOW_W*MED_V +
a1*b4*HIGH_Q + a3*b4*LOW_W*MED_V + a1*b6*MED_V*HIGH_Q +
a3*b6*MED_W*MED_V*HIGH_Q;
IMWMVHQ = a1*b1 + a3*b1*MED_W + a1*b3*MED_V +
a3*b3*MED_W*MED_V +
a1*b4*HIGH_Q + a3*b4*MED_W*MED_V + a1*b6*MED_V*HIGH_Q +
a3*b6*MED_W*MED_V*HIGH_Q;
IHWMVHQ = a1*b1 + a3*b1*MED_W + a1*b3*MED_V +
a3*b3*MED_W*MED_V +
a1*b4*HIGH_Q + a3*b4*MED_W*MED_V + a1*b6*MED_V*HIGH_Q +
a3*b6*MED_W*MED_V*HIGH_Q;
ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*HIGH_V +
a3*b3*LOW_W*HIGH_V +
a1*b4*HIGH_Q + a3*b4*LOW_W*HIGH_V + a1*b6*HIGH_V*HIGH_Q +
a3*b6*LOW_W*HIGH_V*HIGH_Q;
IMWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*HIGH_V +
a3*b3*MED_W*HIGH_V +
a1*b4*HIGH_Q + a3*b4*MED_W*HIGH_V + a1*b6*HIGH_V*HIGH_Q +
a3*b6*MED_W*HIGH_V*HIGH_Q;
IHWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*HIGH_V +
a3*b3*HIGH_W*HIGH_V +
a1*b4*HIGH_Q + a3*b4*HIGH_W*HIGH_V + a1*b6*HIGH_V*HIGH_Q +
a3*b6*HIGH_W*HIGH_V*HIGH_Q;

! Calc conditional direct effects for each combination of moderator values
DIR_LOWV = cdash1 + cdash3*LOW_V;
DIR_MEDV = cdash1 + cdash3*MED_V;
DIR_HIV = cdash1 + cdash3*HIGH_V;

! Calc conditional total effects for each combination of moderator values

TLWLVLQ = ILWLVLQ + DIR_LOWV;
TMWLVLQ = IMWLVLQ + DIR_LOWV;
THWLVLQ = IHWLVLQ + DIR_LOWV;

TLWMVLQ = ILWMVLQ + DIR_MEDV;
TMWMVLQ = IMWMVLQ + DIR_MEDV;
THWMVLQ = IHWMVLQ + DIR_MEDV;

TLWHVLQ = ILWHVLQ + DIR_HIV;
TMWHVLQ = IMWHVLQ + DIR_HIV;
THWHVLQ = IHWHVLQ + DIR_HIV;

TLWLVMQ = ILWLVMQ + DIR_LOWV;
TMWLVMQ = IMWLVMQ + DIR_LOWV;
THWLVMQ = IHWLVMQ + DIR_LOWV;

TLWMVMQ = ILWMVMQ + DIR_MEDV;
TMWMVMQ = IMWMVMQ + DIR_MEDV;
THWMVMQ = IHWMVMQ + DIR_MEDV;

TLWHVMQ = ILWHVMQ + DIR_HIV;
TMWHVMQ = IMWHVMQ + DIR_HIV;
THWHVMQ = IHWHVMQ + DIR_HIV;

TLWLVHQ = ILWLVHQ + DIR_LOWV;
TMWLVHQ = IMWLVHQ + DIR_LOWV;
THWLVHQ = IHWLVHQ + DIR_LOWV;

TLWMVHQ = ILWMVHQ + DIR_MEDV;
TMWMVHQ = IMWMVHQ + DIR_MEDV;
THWMVHQ = IHWMVHQ + DIR_MEDV;

TLWHVHQ = ILWHVHQ + DIR_HIV;
TMWHVHQ = IMWHVHQ + DIR_HIV;
THWHVHQ = IHWHVHQ + DIR_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWHVLQ PMWHVLQ PHWHVLQ

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LOOP (XVAL, 1, 5, 0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMVLQ = ILWMVLQ*XVAL;
PMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWMVMQ = ILWMVMQ*XVAL;
PMWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLWMVHQ = ILWMVHQ*XVAL;
PMWMVHQ = IMWMVHQ*XVAL;
PHWMVHQ = IHWMVHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 40: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):
\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1(M + MV + MQ + MVW) + b_2V + b_3Q + b_4(MV + MQ + MVW)V + b_5(MV + MQ + MVW)Q + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets
$Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + b_2V + b_3Q + a_0b_4V + a_1b_4XV + a_2b_4WV + a_3b_4XWV + a_0b_5Q + a_1b_5XQ + a_2b_5WQ + a_3b_5XWQ + c_1'X + c_2'WX$

Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + b_2V + b_3Q + a_0b_4V + a_2b_4WV + a_0b_5Q + a_2b_5WQ + c_2'W) + (a_1b_1 + a_3b_1W + a_1b_4V + a_3b_4WV + a_1b_5Q + a_3b_5WQ + c_1' + c_3'W)X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$, $Q$: $a_1b_1 + a_3b_1W + a_1b_4V + a_3b_4WV + a_1b_5Q + a_3b_5WQ = (a_1 + a_3W)(b_1 + b_4V + b_5Q)$

One direct effect of $X$ on $Y$, conditional on $W$: $c_1' + c_3'W$

Mplus code for the model:

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y
USEVARIABLES = X M W V Q Y XW MV MQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MQ = M*Q;
  MV = M*V;
  XW = X*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON Q (b3);
  Y ON MV (b4);
  Y ON MQ (b5);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON XW (cdash3);
```
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWVMLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q
HIGH_Q
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
ILWHLQL Q IMWHLQL Q IWHQLQL Q ILWMVLQ IMWMVLQ IHWMVLQ
ILWHVLQ IMWHVLQ IHWHLQ IMWHVLQ IHWHLQ IMWHVLQ
ILWLQL Q IMWLQL Q IHWQLQ IMWLQL Q IHWQLQ IMWLQL Q
ILWHVLQ IMWHVLQ IHWHLQ IMWHVLQ IHWHLQ IMWHVLQ
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
ILWHVLQ IMWHVLQ IHWHLQ IMWHVLQ IHWHLQ IMWHVLQ
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
ILWHVLQ IMWHVLQ IHWHLQ IMWHVLQ IHWHLQ IMWHVLQ
DIR_LOW_W DIR_MED_W DIR_HI_W
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ TLWMVLQ TMWMVLQ THWMVLQ

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V
LOW_Q = #LOWQ; ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V +
a3*b4*LOW_W*LOW_V +
a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q;
IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V +
a3*b4*MED_W*LOW_V +
a1*b5*LOW_Q + a3*b5*MED_W*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V +
a3*b4*HIGH_W*LOW_V +
a1*b5*LOW_Q + a3*b5*HIGH_W*LOW_Q;

ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*LOW_W*MED_V +
a1*b5*LOW_Q + a3*b5*LOW_W*MED_Q;
IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V +
a3*b4*MED_W*MED_V +
a1*b5*MED_Q + a3*b5*MED_W*MED_Q;
IHWWMVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V +
a3*b4*HIGH_W*MED_V +
a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q;

ILWHVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
a3*b4*LOW_W*HIGH_V +
a1*b5*LOW_Q + a3*b5*LOW_W*HIGH_Q;
IMWHVLQ = a1*b1 + a3*b1*MED_W + a1*b4*HIGH_V +
a3*b4*MED_W*HIGH_V +
a1*b5*MED_Q + a3*b5*MED_W*HIGH_Q;
IHWWHVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V +
a3*b4*HIGH_W*HIGH_V +
a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q;

ILWLVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V +
a3*b4*LOW_W*LOW_V +
a1*b5*MED_Q + a3*b5*LOW_W*MED_Q;
IMWLVMQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V +
a3*b4*MED_W*LOW_V +
a1*b5*MED_Q + a3*b5*MED_W*MED_Q;
IHWLVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V +
a3*b4*HIGH_W*LOW_V +
a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q;

ILWVMVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*LOW_W*MED_V +
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times LOW_W \times MED_Q; \)
\( IMWVMMQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times MED_W \times MED_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times MED_W \times MED_Q; \)
\( IHWMVMQ = a_1 \times b_1 + a_3 \times b_1 \times HIGH_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times HIGH_W \times MED_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times HIGH_W \times MED_Q; \)
\( ILWHVMQ = a_1 \times b_1 + a_3 \times b_1 \times LOW_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times LOW_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times LOW_W \times MED_Q; \)
\( IMWVMMQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times MED_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times MED_W \times MED_Q; \)
\( IHWHVMQ = a_1 \times b_1 + a_3 \times b_1 \times HIGH_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times HIGH_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times HIGH_W \times MED_Q; \)
\( ILWVLVHQ = a_1 \times b_1 + a_3 \times b_1 \times LOW_W + a_1 \times b_4 \times LOW_V + \)
\( a_3 \times b_4 \times LOW_W \times LOW_V + \)
\( a_1 \times b_5 \times HIGH_Q + a_3 \times b_5 \times LOW_W \times HIGH_Q; \)
\( IMWVLVHQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times LOW_V + \)
\( a_3 \times b_4 \times MED_W \times LOW_V + \)
\( a_1 \times b_5 \times HIGH_Q + a_3 \times b_5 \times MED_W \times HIGH_Q; \)
\( IHWVLVHQ = a_1 \times b_1 + a_3 \times b_1 \times HIGH_W + a_1 \times b_4 \times LOW_V + \)
\( a_3 \times b_4 \times HIGH_W \times LOW_V + \)
\( a_1 \times b_5 \times HIGH_Q + a_3 \times b_5 \times HIGH_W \times HIGH_Q; \)
\( ILHMVHQ = a_1 \times b_1 + a_3 \times b_1 \times LOW_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times LOW_W \times MED_V + \)
\( a_1 \times b_5 \times HIGH_Q + a_3 \times b_5 \times LOW_W \times HIGH_Q; \)
\( IMHMVHQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times MED_W \times MED_V + \)
\( a_1 \times b_5 \times HIGH_Q + a_3 \times b_5 \times MED_W \times HIGH_Q; \)
\( IHHMVHQ = a_1 \times b_1 + a_3 \times b_1 \times HIGH_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times HIGH_W \times MED_V + \)
\( a_1 \times b_5 \times HIGH_Q + a_3 \times b_5 \times LOW_W \times HIGH_Q; \)
\( IMWLVHQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times MED_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times MED_W \times MED_Q; \)
\( IHWLVHQ = a_1 \times b_1 + a_3 \times b_1 \times LOW_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times LOW_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times LOW_W \times MED_Q; \)
\( IMWLVHQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times MED_W \times MED_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times MED_W \times MED_Q; \)
\( IHWLVHQ = a_1 \times b_1 + a_3 \times b_1 \times HIGH_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times HIGH_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times HIGH_W \times MED_Q; \)
\( ILWHVHQ = a_1 \times b_1 + a_3 \times b_1 \times LOW_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times LOW_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times LOW_W \times MED_Q; \)
\( IMWHVHQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times MED_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times MED_W \times MED_Q; \)
\( IHWHVHQ = a_1 \times b_1 + a_3 \times b_1 \times HIGH_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times HIGH_W \times MED_Q + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times HIGH_W \times MED_Q; \)
\( ILWHVHQ = a_1 \times b_1 + a_3 \times b_1 \times LOW_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times LOW_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times LOW_W \times MED_Q; \)
\( IMWHVHQ = a_1 \times b_1 + a_3 \times b_1 \times MED_W + a_1 \times b_4 \times MED_V + \)
\( a_3 \times b_4 \times MED_W \times HIGH_V + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times MED_W \times MED_Q; \)
\( IHWHVHQ = a_1 \times b_1 + a_3 \times b_1 \times HIGH_W + a_1 \times b_4 \times HIGH_V + \)
\( a_3 \times b_4 \times HIGH_W \times MED_Q + \)
\( a_1 \times b_5 \times MED_Q + a_3 \times b_5 \times HIGH_W \times MED_Q; \)
! Calc conditional direct effects for each combination of moderator values

   DIR_LOW = cdash1 + cdash3*LOW_W;
   DIR_MED = cdash1 + cdash3*MED_W;
   DIR_HIW = cdash1 + cdash3*HIGH_W;

! Calc conditional total effects for each combination of moderator values

   TLWLVLQ = ILWLVLQ + DIR_LOW;
   TMWLVLQ = IMWLVLQ + DIR_MED;
   THWLVLQ = IHWLVLQ + DIR_HI;

   TLWMVLQ = ILWMVLQ + DIR_LOW;
   TMWMVLQ = IMWMVLQ + DIR_MED;
   THWMVLQ = IHWMVQ + DIR_HI;

   TLWLVLQ = ILWLVLQ + DIR_LOW;
   TMWLVLQ = IMWLVLQ + DIR_MED;
   THWLVLQ = IHWLVLQ + DIR_HI;

   TLWLVMQ = ILWLVMQ + DIR_LOW;
   TMWLVMQ = IMWLVMQ + DIR_MED;
   THWLVMQ = IHWLVMQ + DIR_HI;

   TLWMVMQ = ILWMVMQ + DIR_LOW;
   TMWMVMQ = IMWMVMQ + DIR_MED;
   THWMVMQ = IHWVMQ + DIR_HI;

   TLWHVLQ = ILWHVLQ + DIR_LOW;
   TMWHVLQ = IMWHVLQ + DIR_MED;
   THWHVLQ = IHWHLQ + DIR_HI;

   TLWLVMQ = ILWLVMQ + DIR_LOW;
   TMWLVMQ = IMWLVMQ + DIR_MED;
   THWLVMQ = IHWLVMQ + DIR_HI;

   TLWHVMQ = ILWHVMQ + DIR_LOW;
   TMWHVMQ = IMWHVMQ + DIR_MED;
   THWHVMQ = IHWHLQ + DIR_HI;

   TLWLHQ = ILWLHQ + DIR_LOW;
   TMWLHQ = IMWLHQ + DIR_MED;
   THWLHQ = IHWHLQ + DIR_HI;

   TLWMHQ = ILWMHQ + DIR_LOW;
   TMWMHQ = IMWMHQ + DIR_MED;
   THWMHQ = IHWHLQ + DIR_HI;

   TLWHHQ = ILWHHQ + DIR_LOW;
   TMWHHQ = IMWHHQ + DIR_MED;
   THWHHQ = IHWHLQ + DIR_HI;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ PLWHVLQ PMWHVLQ PHWHVLQ PLWLVMQ PMWLVMQ PHWLVMQ PLWMVMQ PMWMVMQ PHWMVMQ PLWHVMQ PMWHVMQ PHWHVMQ PLWLVHQ PMWLVHQ PHWLVHQ PLWMVHQ PMWMVHQ PHWMVHQ PLWHVHQ PMWHVHQ PHWHVHQ);

LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;
PLWMVLQ = ILWMVLQ*XVAL;
PMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;
PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;
PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;
PLWMVMQ = ILWMVMQ*XVAL;
PMWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;
PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;
PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;
PLWMVHQ = ILWMVHQ*XVAL;
PMWMVHQ = IMWMVHQ*XVAL;
PHWMVHQ = IHWMVHQ*XVAL;
PLWHVHQ = ILWHVHQ*XVAL;
PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 41: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating both the Mediator-DV path and the direct IV-DV path.

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'Q + c_6'XV + c_7'XQ \]

\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)V + b_3(a_0 + a_1X + a_2W + a_3XW)Q + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'Q + c_6'XV + c_7'XQ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)V + b_3(a_0 + a_1X + a_2W + a_3XW)Q + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'Q + c_6'XV + c_7'XQ \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1W + a2b1X + a0b2V + a1b2XV + a2b2WV + a3b2XWV + a0b3Q + a2b3QX + a2b3WQ + a3b3XWQ + c1’X + c2’W + c3’XW + c4’V + c5’Q + c6’XV + c7’XQ

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a0b2V + a2b2WV + a0b3Q + a2b3WQ + c2’W + c4’V + c5’Q) + (a1b1 + a3b1W + a1b2V + a3b2WV + a1b3Q + a3b3WQ + c1’ + c3’W + c6’V + c7’Q)X

Hence...

One indirect effect(s) of X on Y, conditional on W, V, Q:

\[ a1b1 + a3b1W + a1b2V + a3b2WV + a1b3Q + a3b3WQ = (a1 + a3W)(b1 + b2V + b3Q) \]

One direct effect of X on Y, conditional on W, V, Q:

\[ c1’ + c3’W + c6’V + c7’Q \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y

USEVARIABLES = X M W V Q Y XW XV XQ MV MQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MQ = M*Q;
  MV = M*V;
  XW = X*W;
  XQ = X*Q;
  XV = X*V;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
```
MODEL:
[Y] (b0);
Y ON M (b1);
Y ON MV (b2);
Y ON MQ (b3);
Y ON X (cdash1);
Y ON W (cdash2);
Y ON XW (cdash3);
Y ON V (cdash4);
Y ON Q (cdash5);
Y ON XV (cdash6);
Y ON XQ (cdash7);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q)
HIGH_Q
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVQ
ILWHVLQ IMWHVLQ IHWHLQ ILWMVLQ IMWMVLQ IHWMVQ
ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMWMVMQ IHWVMQ
ILWHVMQ IMWHVMQ IHWVMQ ILWMVMQ IMWMVMQ IHWVMQ
ILWLVHQ IMWLVHQ IHWLHQ ILWMVHQ IMWMVQ IHWVHQ
ILWHVHQ IMWHVHQ IHWVHQ ILWMVHQ IMWMVQ IHWVHQ
DLWLVLQ DMWLVLQ DHWLVLQ DLWMVLQ DMWMVLQ DHWMVLQ
DLWHVLQ DMWHVLQ DHWHVLQ DLWMVLQ DMWMVLQ DHWMVLQ
DLWLVMQ DMWLVMQ DHWLVMQ DLWMVMQ DMWMVMQ DHWMVMQ
DLWHVMQ DMWHVMQ DHWHVMQ DLWMVMQ DMWMVMQ DHWMVMQ
DLWLVHQ DMWLVHQ DHWLVHQ DLWMVHQ DMWMVQ DHWMVQ
DLWHVHQ DMWHVHQ DHWHVQ DLWMVHQ DMWMVQ DHWMVQ
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWLVMQ TMWLVMQ THWLVMQ TLWMVMQ TMWMVMQ THWMVMQ
LOW_W = #LOWW;  ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
chosen high value of W

LOW_V = #LOWV;  ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your
chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your
chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your
chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your
chosen high value of Q

! Calc conditional indirect effects for each combination of
moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V +
a3*b2*LOW_W*LOW_V +
a1*b3*LOW_Q + a3*b3*LOW_W*LOW_Q;
IMWLV = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V +
a3*b2*MED_W*LOW_V +
a1*b3*MED_Q + a3*b3*MED_W*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V +
a3*b2*HIGH_W*LOW_V +
a1*b3*HIGH_Q + a3*b3*HIGH_W*LOW_Q;
ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V +
a3*b2*LOW_W*MED_V +
a1*b3*LOW_Q + a3*b3*LOW_W*MED_Q;
IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
a3*b2*MED_W*MED_V +
a1*b3*MED_Q + a3*b3*MED_W*MED_Q;
IHWMVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
a3*b2*HIGH_W*MED_V +
a1*b3*HIGH_Q + a3*b3*HIGH_W*MED_Q;
ILWHVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*HIGH_V +
a3*b2*LOW_W*HIGH_V +
\[
\begin{align*}
& a_1 b_3 \text{LOW}_Q + a_3 b_3 \text{LOW}_W \text{LOW}_Q; \\
& \text{IMWHVLQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_2 \text{HIGH}_V + \\
& a_3 b_2 \text{MED}_W \text{HIGH}_V + \\
& a_1 b_3 \text{LOW}_Q + a_3 b_3 \text{MED}_W \text{LOW}_Q; \\
& \text{IHWHVLQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_2 \text{HIGH}_V + \\
& a_3 b_2 \text{HIGH}_W \text{HIGH}_V + \\
& a_1 b_3 \text{LOW}_Q + a_3 b_3 \text{HIGH}_W \text{LOW}_Q; \\
& \text{ILWLVMQ} = a_1 b_1 + a_3 b_1 \text{LOW}_W + a_1 b_2 \text{LOW}_V + \\
& a_3 b_2 \text{LOW}_W \text{LOW}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{LOW}_W \text{MED}_Q; \\
& \text{IMWLVMQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_2 \text{LOW}_V + \\
& a_3 b_2 \text{MED}_W \text{LOW}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{MED}_W \text{MED}_Q; \\
& \text{IHWLVMQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_2 \text{LOW}_V + \\
& a_3 b_2 \text{HIGH}_W \text{LOW}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{HIGH}_W \text{MED}_Q; \\
& \text{ILWMVMQ} = a_1 b_1 + a_3 b_1 \text{LOW}_W + a_1 b_2 \text{MED}_V + \\
& a_3 b_2 \text{LOW}_W \text{MED}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{LOW}_W \text{MED}_Q; \\
& \text{IMWMVMQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_2 \text{MED}_V + \\
& a_3 b_2 \text{MED}_W \text{MED}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{MED}_W \text{MED}_Q; \\
& \text{IHWMVMQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_2 \text{MED}_V + \\
& a_3 b_2 \text{HIGH}_W \text{MED}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{HIGH}_W \text{MED}_Q; \\
& \text{ILWHVMQ} = a_1 b_1 + a_3 b_1 \text{LOW}_W + a_1 b_2 \text{HIGH}_V + \\
& a_3 b_2 \text{LOW}_W \text{HIGH}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{LOW}_W \text{MED}_Q; \\
& \text{IMWHVMQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_2 \text{HIGH}_V + \\
& a_3 b_2 \text{MED}_W \text{HIGH}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{MED}_W \text{MED}_Q; \\
& \text{IHWHVMQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_2 \text{HIGH}_V + \\
& a_3 b_2 \text{HIGH}_W \text{HIGH}_V + \\
& a_1 b_3 \text{MED}_Q + a_3 b_3 \text{HIGH}_W \text{MED}_Q; \\
& \text{ILWLVHQ} = a_1 b_1 + a_3 b_1 \text{LOW}_W + a_1 b_2 \text{LOW}_V + \\
& a_3 b_2 \text{LOW}_W \text{LOW}_V + \\
& a_1 b_3 \text{HIGH}_Q + a_3 b_3 \text{LOW}_W \text{HIGH}_Q; \\
& \text{IMWLVHQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_2 \text{LOW}_V + \\
& a_3 b_2 \text{MED}_W \text{LOW}_V + \\
& a_1 b_3 \text{HIGH}_Q + a_3 b_3 \text{MED}_W \text{HIGH}_Q; \\
& \text{IHWLVHQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_2 \text{LOW}_V + \\
& a_3 b_2 \text{HIGH}_W \text{LOW}_V + \\
& a_1 b_3 \text{HIGH}_Q + a_3 b_3 \text{HIGH}_W \text{HIGH}_Q;
\end{align*}
\]
ILWMVHQ = a1*b1 + a3*b1*LOW_W + a1*b2*MED_V +
a3*b2*LOW_W*MED_V +
a1*b3*HIGH_Q + a3*b3*LOW_W*HIGH_Q;
IMWMVHQ = a1*b1 + a3*b1*MED_W + a1*b2*MED_V +
a3*b2*MED_W*MED_V +
a1*b3*HIGH_Q + a3*b3*MED_W*HIGH_Q;
IHWMVHQ = a1*b1 + a3*b1*HIGH_W + a1*b2*MED_V +
a3*b2*HIGH_W*MED_V +
a1*b3*HIGH_Q + a3*b3*HIGH_W*HIGH_Q;
ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b2*HIGH_V +
a3*b2*LOW_W*HIGH_V +
a1*b3*HIGH_Q + a3*b3*LOW_W*HIGH_Q;
IMWHVHQ = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V +
a3*b2*MED_W*HIGH_V +
a1*b3*HIGH_Q + a3*b3*MED_W*HIGH_Q;
IHWHVHQ = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V +
a3*b2*HIGH_W*HIGH_V +
a1*b3*HIGH_Q + a3*b3*HIGH_W*HIGH_Q;

! Calc conditional direct effects for each combination of
moderator values

DLWLVLQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*LOW_Q;
DMWLVLQ = cdash1 + cdash3*MED_W + cdash6*LOW_V +
cdash7*LOW_Q;
DHWLVLQ = cdash1 + cdash3*HIGH_W + cdash6*LOW_V +
cdash7*LOW_Q;
DLWMVLQ = cdash1 + cdash3*LOW_W + cdash6*MED_V +
cdash7*LOW_Q;
DMWMVLQ = cdash1 + cdash3*MED_W + cdash6*MED_V +
cdash7*LOW_Q;
DHWMVQ = cdash1 + cdash3*HIGH_W + cdash6*MED_V +
cdash7*LOW_Q;
DLWHVLQ = cdash1 + cdash3*LOW_W + cdash6*HIGH_V +
cdash7*LOW_Q;
DMWHVLQ = cdash1 + cdash3*MED_W + cdash6*HIGH_V +
cdash7*LOW_Q;
DHWHVQ = cdash1 + cdash3*HIGH_W + cdash6*HIGH_V +
cdash7*LOW_Q;
DLWLVMQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*MED_Q;
DMWLVMQ = cdash1 + cdash3*MED_W + cdash6*LOW_V +
cdash7*MED_Q;
DHWLVMQ = cdash1 + cdash3*HIGH_W + cdash6*LOW_V +
cdash7*MED_Q;
\[
\begin{align*}
DLWMVMQ &= \text{cdash1} + \text{cdash3} \times \text{LOW}_W + \text{cdash6} \times \text{MED}_V + \\
&\quad \text{cdash7} \times \text{MED}_Q; \\
DMWMVMQ &= \text{cdash1} + \text{cdash3} \times \text{MED}_W + \text{cdash6} \times \text{MED}_V + \\
&\quad \text{cdash7} \times \text{MED}_Q; \\
DHWMVMQ &= \text{cdash1} + \text{cdash3} \times \text{HIGH}_W + \text{cdash6} \times \text{MED}_V + \\
&\quad \text{cdash7} \times \text{MED}_Q; \\
DLWHVMQ &= \text{cdash1} + \text{cdash3} \times \text{LOW}_W + \text{cdash6} \times \text{HIGH}_V + \\
&\quad \text{cdash7} \times \text{MED}_Q; \\
DMWHVMQ &= \text{cdash1} + \text{cdash3} \times \text{MED}_W + \text{cdash6} \times \text{HIGH}_V + \\
&\quad \text{cdash7} \times \text{MED}_Q; \\
DHWHVMQ &= \text{cdash1} + \text{cdash3} \times \text{HIGH}_W + \text{cdash6} \times \text{HIGH}_V + \\
&\quad \text{cdash7} \times \text{MED}_Q; \\
DLWLVHQ &= \text{cdash1} + \text{cdash3} \times \text{LOW}_W + \text{cdash6} \times \text{LOW}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DMWLVHQ &= \text{cdash1} + \text{cdash3} \times \text{MED}_W + \text{cdash6} \times \text{LOW}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DHWLVHQ &= \text{cdash1} + \text{cdash3} \times \text{HIGH}_W + \text{cdash6} \times \text{LOW}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DLWMVHQ &= \text{cdash1} + \text{cdash3} \times \text{LOW}_W + \text{cdash6} \times \text{MED}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DMWMVHQ &= \text{cdash1} + \text{cdash3} \times \text{MED}_W + \text{cdash6} \times \text{MED}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DHWMVHQ &= \text{cdash1} + \text{cdash3} \times \text{HIGH}_W + \text{cdash6} \times \text{MED}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DLWHVHQ &= \text{cdash1} + \text{cdash3} \times \text{LOW}_W + \text{cdash6} \times \text{HIGH}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DMWHVHQ &= \text{cdash1} + \text{cdash3} \times \text{MED}_W + \text{cdash6} \times \text{HIGH}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
DHWHVHQ &= \text{cdash1} + \text{cdash3} \times \text{HIGH}_W + \text{cdash6} \times \text{HIGH}_V + \\
&\quad \text{cdash7} \times \text{HIGH}_Q; \\
\end{align*}
\]

! Calc conditional total effects for each combination of moderator values

\[
\begin{align*}
TLWLVLQ &= \text{ILWLVLQ} + \text{DLWLVLQ}; \\
TMWLVLQ &= \text{IMWLVLQ} + \text{DMWLVLQ}; \\
THWLVLQ &= \text{IHWLVLQ} + \text{DHWLVLQ}; \\
TLWMVLQ &= \text{ILWMVLQ} + \text{DLWMVLQ}; \\
TMWMVLQ &= \text{IMWMVLQ} + \text{DMWMVLQ}; \\
THWMVLQ &= \text{IHWMVQL} + \text{DHWMVLQ}; \\
TLWHVLQ &= \text{ILWHVLQ} + \text{DLWHVLQ}; \\
TMWHVLQ &= \text{IMWHVLQ} + \text{DMWHVLQ}; \\
THWHVLQ &= \text{IHWHVQL} + \text{DHWHVLQ}; \\
\end{align*}
\]
TLWLVMQ = ILWLVMQ + DLWLVMQ;
TMWLVMQ = IMWLVMQ + DMWLVMQ;
THWLVMQ = IHWLVMQ + DHWLVMQ;
TLWVMVMQ = ILWVMVMQ + DLWVMVMQ;
TMWVMVMQ = IMWVMVMQ + DMWVMVMQ;
THWVMVMQ = IHWVMVMQ + DHWVMVMQ;
TLWVHQ = ILWVHQ + DLWVHQ;
TMWVHQ = IMWVHQ + DMWVHQ;
THWVHQ = IHWVHQ + DHWVHQ;
TLWMVHQ = ILWMVHQ + DLWMVHQ;
TMWMVHQ = IMWMVHQ + DMWMVHQ;
THWMVHQ = IHWMVHQ + DHWMVHQ;
TLWLVHQ = ILWLVHQ + DLWLVHQ;
TMWLVHQ = IMWLVHQ + DMWLVHQ;
THWLVHQ = IHWLVHQ + DHWLVHQ;
TLWHLQ = ILWHLQ + DLWHLQ;
TMWLHLQ = IMWLHLQ + DMWLHLQ;
THWLHLQ = IHWLHLQ + DHWLHLQ;
TLWVMHLQ = ILWVMHLQ + DLWVMHLQ;
TMWVMHLQ = IMWVMHLQ + DMWVMHLQ;
THWVMHLQ = IHWVMHLQ + DHWVMHLQ;
TLWVHHLQ = ILWVHHLQ + DLWVHHLQ;
TMWVHHLQ = IMWVHHLQ + DMWVHHLQ;
THWVHHLQ = IHWVHHLQ + DHWVHHLQ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWVLQ PMWVLQ PHWVLQ PLWLVMQ PMWLVMQ PHWLVMQ PLWVMQ PMWVMQ PHWVMQ
PLWLVHQ PMWLVHQ PHWLVHQ PLWMVHQ PMWMVHQ PHWMVHQ PLWVHQ PMWVHQ PHWVHQ
PLWHLQ PMWHLQ PHWHLQ PLWHLQ PMWHLQ PHWHLQ PLWHLQ PMWHLQ PHWHLQ);
LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;
PLWMVLQ = ILWMVLQ*XVAL;
PMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;
PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;
PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWMVMQ = ILWMVMQ*XVAL;
PMWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLWMVHQ = ILWMVHQ*XVAL;
PMWMVHQ = IMWMVHQ*XVAL;
PHWMVHQ = IHWMVHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

PLOT:
   TYPE = plot2;

OUTPUT:
   STAND CINT(bcbootstrap);
Model 42: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.

- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).

- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.

- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
**Model Equation(s):**

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + b_6 VQ + b_7 MVQ + c_1'X + c_2'W + c_3'XW \]

\[ M = a_0 + a_1 X + a_2 W + a_3 XW \]

**Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):**

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + b_6 VQ + b_7 MVQ + c_1'X + c_2'W + c_3'XW \]

\[ M = a_0 + a_1 X + a_2 W + a_3 XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 XW) + b_2 V + b_3 Q + b_4(a_0 + a_1 X + a_2 W + a_3 XW)V + b_5(a_0 + a_1 X + a_2 W + a_3 XW)Q + b_6 VQ + b_7(a_0 + a_1 X + a_2 W + a_3 XW)VQ + c_1'X + c_2'W + c_3'XW \]
Hence... multiplying out brackets

\[ Y = b_0 + a_{01}X + a_{12}W + a_{31}XW + b_{2}V + b_{3}Q + a_{0}b_{4}V + a_{1}b_{4}XV + a_{2}b_{4}WV + a_{3}b_{4}XWV + b_{5}V + b_{3}Q + a_{0}b_{5}V + a_{1}b_{5}XQ + a_{2}b_{5}WQ + a_{3}b_{5}XWQ + b_{6}VQ + a_{0}b_{7}VQ + a_{1}b_{7}XVQ + a_{2}b_{7}WVQ + a_{3}b_{7}XWVQ + c_{1}'X + c_{2}'W + c_{3}'XW \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01} + a_{12}W + b_{2}V + b_{3}Q + a_{0}b_{4} + a_{1}b_{4}V + a_{2}b_{4}WV + a_{3}b_{4}XWV + b_{5}V + b_{3}Q + a_{0}b_{5} + a_{1}b_{5}XQ + a_{2}b_{5}WQ + a_{3}b_{5}XWQ + b_{6}VQ + a_{0}b_{7} + a_{1}b_{7}XVQ + a_{2}b_{7}WVQ + a_{3}b_{7}XWVQ + c_{2}'W) + (a_{1} + a_{3}W)(b_{1} + b_{4}V + b_{5}Q + b_{7}VQ) \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V, Q \):

\[ a_{11} + a_{31}W + a_{14}V + a_{34}WV + a_{15}Q + a_{35}WQ + a_{17}VQ + a_{37}WVQ = (a_{1} + a_{3}W)(b_{1} + b_{4}V + b_{5}Q + b_{7}VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( W \):

\[ c_{1}' + c_{3}'W \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y

USEVARIABLES = X M W V Q Y XW VQ MV MQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    VQ = V*Q;
    MVQ = M*V*Q;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;
```
MODEL:
[Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON Q (b3);
  Y ON MV (b4);
  Y ON MQ (b5);
  Y ON VQ (b6);
  Y ON MVQ (b7);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON XW (cdash3);
[M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
  NEW (LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
IWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IWMWLQ IHWMVLQ
ILWLVLQ IMWLVLQ IHWLVLQ
ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IWMVMQ IHWMVMQ
ILWHVMQ IMWHVMQ IHWHVMQ
ILWLVHQ IMWLVHQ IHWLVHQ ILWMVHQ IWMVHQ IHWMVHQ
ILWHVHQ IMWHVHQ IHWHVHQ
DIR_LOWW DIR_MEDW DIR_HIW
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMWMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ
TLWLVMQ TMWLVMQ THWLVMQ TLWMVMQ TMWMVMQ THWMVMQ
TLWHVMQ TMWHVMQ THWHVMQ
TLWLVHQ TMWLVHQ THWLVHQ TLWMVHQ TMWMVHQ THWMVHQ
TLWHVHQ TMWHVHQ THWHVHQ);
LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ; ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ; ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V + a3*b4*LOW_W*LOW_V + a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q + a1*b7*LOW_V*LOW_Q + a3*b7*LOW_W*LOW_V*LOW_Q;
IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V + a3*b4*MED_W*LOW_V + a1*b5*LOW_Q + a3*b5*MED_W*LOW_Q + a1*b7*MED_V*LOW_Q + a3*b7*MED_W*MED_V*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V + a3*b4*HIGH_W*LOW_V + a1*b5*LOW_Q + a3*b5*HIGH_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*HIGH_W*LOW_V*LOW_Q;
ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V + a3*b4*LOW_W*MED_V + a1*b5*LOW_Q + a3*b5*LOW_W*MED_Q + a1*b7*MED_V*LOW_Q + a3*b7*MED_W*MED_V*LOW_Q;
IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V + a3*b4*MED_W*MED_V + a1*b5*MED_Q + a3*b5*MED_W*MED_Q + a1*b7*MED_V*MED_Q + a3*b7*MED_W*MED_V*MED_Q;
IHWMVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V + a3*b4*HIGH_W*MED_V + a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q + a1*b7*MED_V*MED_Q + a3*b7*HIGH_W*MED_V*MED_Q;
ILWHVLQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V + a3*b4*LOW_W*HIGH_V + a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*LOW_W*HIGH_V*LOW_Q;
IMWHVLQ = a1*b1 + a3*b1*MED_W + a1*b4*HIGH_V + a3*b4*MED_W*HIGH_V + a1*b5*LOW_Q + a3*b5*MED_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*MED_W*HIGH_V*LOW_Q;
IHWHVLQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V + a3*b4*HIGH_W*HIGH_V + a1*b5*LOW_Q + a3*b5*HIGH_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*HIGH_W*HIGH_V*LOW_Q;

ILWLVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V + a3*b4*LOW_W*LOW_V + a1*b5*MED_Q + a3*b5*LOW_W*MED_Q + a1*b7*LOW_V*MED_Q + a3*b7*LOW_W*LOW_V*MED_Q;
IMWLVMQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V + a3*b4*MED_W*LOW_V + a1*b5*MED_Q + a3*b5*MED_W*MED_Q + a1*b7*LOW_V*MED_Q + a3*b7*MED_W*LOW_V*MED_Q;
IHWLVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V + a3*b4*HIGH_W*LOW_V + a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q + a1*b7*LOW_V*MED_Q + a3*b7*HIGH_W*LOW_V*MED_Q;
ILWMVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V + a3*b4*LOW_W*MED_V + a1*b5*MED_Q + a3*b5*LOW_W*MED_Q + a1*b7*MED_V*MED_Q + a3*b7*LOW_W*MED_V*MED_Q;
IMWMVMQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V + a3*b4*MED_W*MED_V + a1*b5*MED_Q + a3*b5*MED_W*MED_Q + a1*b7*MED_V*MED_Q + a3*b7*MED_W*MED_V*MED_Q;
IHWMVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V + a3*b4*HIGH_W*MED_V + a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q + a1*b7*MED_V*MED_Q + a3*b7*HIGH_W*MED_V*MED_Q;

ILWHVMQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V + a3*b4*LOW_W*HIGH_V + a1*b5*LOW_Q + a3*b5*LOW_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*LOW_W*HIGH_V*LOW_Q;
IMWHVMQ = a1*b1 + a3*b1*MED_W + a1*b4*HIGH_V + a3*b4*MED_W*HIGH_V + a1*b5*LOW_Q + a3*b5*MED_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*MED_W*HIGH_V*LOW_Q;
IHWHVMQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V + a3*b4*HIGH_W*HIGH_V + a1*b5*LOW_Q + a3*b5*HIGH_W*LOW_Q + a1*b7*HIGH_V*LOW_Q + a3*b7*HIGH_W*HIGH_V*LOW_Q;
a1*b5*MED_Q + a3*b5*HIGH_W*MED_Q + a1*b7*HIGH_V*MED_Q + a3*b7*HIGH_W*HIGH_V*MED_Q;

ILWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_V +
a3*b4*LOW_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*HIGH_Q + a1*b7*LOW_V*HIGH_Q +
a3*b7*LOW_W*LOW_V*HIGH_Q;
IMWLVHQ = a1*b1 + a3*b1*MED_W + a1*b4*LOW_V +
a3*b4*MED_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*MED_W*HIGH_Q + a1*b7*LOW_V*HIGH_Q +
a3*b7*MED_W*LOW_V*HIGH_Q;
IHWLVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*LOW_V +
a3*b4*HIGH_W*LOW_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*HIGH_Q + a1*b7*LOW_V*HIGH_Q +
a3*b7*HIGH_W*LOW_V*HIGH_Q;

ILWMVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*MED_V +
a3*b4*LOW_W*MED_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*MED_Q + a1*b7*MED_V*MED_Q +
a3*b7*MED_W*MED_V*HIGH_Q;
IMWMVHQ = a1*b1 + a3*b1*MED_W + a1*b4*MED_V +
a3*b4*MED_W*MED_V +
a1*b5*HIGH_Q + a3*b5*MED_W*MED_Q + a1*b7*MED_V*MED_Q +
a3*b7*MED_W*MED_V*MED_Q;
IHWMVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*MED_V +
a3*b4*HIGH_W*MED_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*MED_Q + a1*b7*MED_V*MED_Q +
a3*b7*HIGH_W*MED_V*MED_Q;

ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b4*HIGH_V +
a3*b4*LOW_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*LOW_W*HIGH_Q + a1*b7*HIGH_V*HIGH_Q +
a3*b7*LOW_W*HIGH_V*HIGH_Q;
IMWHVHQ = a1*b1 + a3*b1*MED_W + a1*b4*HIGH_V +
a3*b4*MED_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*MED_W*HIGH_Q + a1*b7*HIGH_V*HIGH_Q +
a3*b7*MED_W*HIGH_V*HIGH_Q;
IHWHVHQ = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_V +
a3*b4*HIGH_W*HIGH_V +
a1*b5*HIGH_Q + a3*b5*HIGH_W*HIGH_Q + a1*b7*HIGH_V*HIGH_Q +
a3*b7*HIGH_W*HIGH_V*HIGH_Q;

! Calc conditional direct effects for each combination of moderator values
DIR_LOW = cdash1 + cdash3*LOW_W;
DIR_MED = cdash1 + cdash3*MED_W;
DIR_HI = cdash1 + cdash3*HIGH_W;

! Calc conditional total effects for each combination of moderator values
TLWLVLQ = ILWLVLQ + DIR_LOW;
TMWLVLQ = IMWLVLQ + DIR_MED;
THWLVLQ = IHWLVLQ + DIR_HI;
TLMWMLQ = ILWMVLQ + DIR_LOW;
TMWMLQ = IMWMVLQ + DIR_MED;
THWMLQ = IHWMVLQ + DIR_HI;
TLWHVLQ = ILWHVLQ + DIR_LOW;
TMWHVLQ = IMWHVLQ + DIR_MED;
THWHVLQ = IHWHVLQ + DIR_HI;
TLWLVMQ = ILWLVMQ + DIR_LOW;
TMWLVMQ = IMWLVMQ + DIR_MED;
THWLVMQ = IHWLVMQ + DIR_HI;
TLMWVMQ = ILWMVMQ + DIR_LOW;
TMWVMQ = IMWMVMQ + DIR_MED;
THWVMQ = IHWMVMQ + DIR_HI;
TLWHVMQ = ILWHVMQ + DIR_LOW;
TMWHVMQ = IMWHVMQ + DIR_MED;
THWHVMQ = IHWHVMQ + DIR_HI;
TLWLHVQ = ILWLHVQ + DIR_LOW;
TMWLHVQ = IMWLHVQ + DIR_MED;
THWLHVQ = IHWLHVQ + DIR_HI;
TLMWVHQ = ILMWVHQ + DIR_LOW;
TMWVHQ = IMMWVHQ + DIR_MED;
THMWVHQ = IHMWVHQ + DIR_HI;
TLWHVHQ = ILWHVHQ + DIR_LOW;
TMWHVHQ = IMWHVHQ + DIR_MED;
THWHVHQ = IHWHVHQ + DIR_HI;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMLQ PHWMLQ PLWHVLQ PMWHVLQ PHWHVLQ)
LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMVLQ = ILWMVLQ*XVAL;
PMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWMVMQ = ILWMVMQ*XVAL;
PMWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 43: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[
Y = b_0 + b_1 M + b_2 M V + b_3 M Q + b_4 M V Q + c_1'X + c_2'W + c_3'X W + c_4'V + c_5'Q + c_6'X V + c_7'X Q + c_8'V Q + c_9'X V Q
\]

\[
M = a_0 + a_1 X + a_2 W + a_3 X W
\]

Algebra to calculate indirect and/or conditional effects by writing model as \(Y = a + bX\):

\[
Y = b_0 + b_1 M + b_2 M V + b_3 M Q + b_4 M V Q + c_1'X + c_2'W + c_3'X W + c_4'V + c_5'Q + c_6'X V + c_7'X Q + c_8'V Q + c_9'X V Q
\]

\[
M = a_0 + a_1 X + a_2 W + a_3 X W
\]

Hence... substituting in equation for \(M\)

\[
Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 X W) + b_2(a_0 + a_1 X + a_2 W + a_3 X W)V + b_3(a_0 + a_1 X + a_2 W + a_3 X W)Q + b_4(a_0 + a_1 X + a_2 W + a_3 X W)V Q + c_1'X + c_2'W + c_3'X W + c_4'V + c_5'Q + c_6'X V + c_7'X Q + c_8'V Q + c_9'X V Q
\]
Hence... multiplying out brackets

\[ Y = b_0 + a_{01}X + a_{11}W + a_{21}XW + a_{02}V + a_{12}XV + a_{22}WV + a_{32}XWV + a_{03}Q + a_{13}XQ + a_{23}WQ + a_{33}XWQ + c_{1}X + c_{2}W + c_{3}XW + c_{4}V + c_{5}Q + c_{6}XV + c_{7}XQ + c_{8}VQ + c_{9}XVQ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01} + a_{11}W + a_{02} + a_{22}WV + a_{03}Q + a_{23}WQ + a_{04}VQ + a_{24}WVQ + c_{2}W + c_{4}V + c_{5}Q + c_{8}VQ) + (a_{11} + a_{12}V + a_{13}WQ + a_{14}VQ + c_{1} + c_{3}W + c_{6}V + c_{7}Q + c_{9}VQ)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V, Q \):

\[ a_{11} + a_{31}W + a_{12}V + a_{32}WV + a_{13}Q + a_{33}WQ + a_{14}VQ + a_{34}WVQ = (a_{1} + a_{3}W)(b_{1} + b_{2}V + b_{3}Q + b_{4}VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, V, Q \):

\[ c_{1} + c_{3}W + c_{6}V + c_{7}Q + c_{9}VQ \]

**Mplus code for the model:**

```mplus
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y
USEVARIABLES = X M W V Q Y XW XV XQ VQ MV MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XQ = X*Q;
    XV = X*V;
    VQ = V*Q;
    MVQ = M*V*Q;
    XVQ = X*V*Q;

ANALYSIS:
    TYPE = GENERAL;
```

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ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON MV (b2);
  Y ON MQ (b3);
  Y ON MVQ (b4);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON XW (cdash3);
  Y ON V (cdash4);
  Y ON Q (cdash5);
  Y ON XV (cdash6);
  Y ON XQ (cdash7);
  Y ON VQ (cdash8);
  Y ON XVQ (cdash9);
  [M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMVLQ = high value of W, medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
  ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMWMVLQ IHWMVLQ
  ILWHVLQ IMWHVLQ IHWHLQ
  ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMWMVMQ IHWVMQ
  ILWHVMQ IMWHVMQ IHWHVMQ
  ILWLVHQ IMWLVHQ IHWLVHQ ILWMVHQ IMWMVHQ IHWMVQ
  ILWHVHQ IMWHVHQ IHWHVMQ
  DLWLVLQ DMWLVLQ DHWLVLQ DLWMVLQ DMWMVLQ DHWMVLQ
  DLWHVLQ DMWHVLQ DHWHVLQ DLWMVLQ DMWMVLQ DHWMVLQ
  DLMWVLQ DLWMVLQ DLWMVLQ)
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V
LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_V +
a3*b2*LOW_W*LOW_V +
a1*b3*LOW_Q + a3*b3*LOW_W*LOW_Q + a1*b4*LOW_V*LOW_Q +
a3*b4*LOW_W*LOW_V*LOW_Q;
IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b2*LOW_V +
a3*b2*MED_W*LOW_V +
a1*b3*LOW_Q + a3*b3*MED_W*LOW_Q + a1*b4*LOW_V*LOW_Q +
a3*b4*MED_W*LOW_V*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b2*LOW_V +
a3*b2*HIGH_W*LOW_V +
a1*b3*LOW_Q + a3*b3*HIGH_W*LOW_Q + a1*b4*LOW_V*LOW_Q +
a3*b4*HIGH_W*LOW_V*LOW_Q;
\[\begin{align*}
ILWMVLQ &= a_1b_1 + a_3b_1\cdot LOW_\cdot W + a_1b_2\cdot MED_\cdot V + \\
a_3b_2\cdot LOW_\cdot W\cdot MED_\cdot V + \\
a_1b_3\cdot LOW_\cdot Q + a_3b_3\cdot LOW_\cdot W\cdot LOW_\cdot Q + a_1b_4\cdot MED_\cdot V\cdot LOW_\cdot Q + \\
a_3b_4\cdot LOW_\cdot W\cdot MED_\cdot V\cdot LOW_\cdot Q; \\
IMWMVLQ &= a_1b_1 + a_3b_1\cdot MED_\cdot W + a_1b_2\cdot MED_\cdot V + \\
a_3b_2\cdot MED_\cdot W\cdot MED_\cdot V + \\
a_1b_3\cdot LOW_\cdot Q + a_3b_3\cdot MED_\cdot W\cdot LOW_\cdot Q + a_1b_4\cdot MED_\cdot V\cdot LOW_\cdot Q + \\
a_3b_4\cdot MED_\cdot W\cdot MED_\cdot V\cdot LOW_\cdot Q; \\
IHWMVLQ &= a_1b_1 + a_3b_1\cdot HIGH_\cdot W + a_1b_2\cdot MED_\cdot V + \\
a_3b_2\cdot HIGH_\cdot W\cdot MED_\cdot V + \\
a_1b_3\cdot LOW_\cdot Q + a_3b_3\cdot HIGH_\cdot W\cdot LOW_\cdot Q + a_1b_4\cdot MED_\cdot V\cdot LOW_\cdot Q + \\
a_3b_4\cdot HIGH_\cdot W\cdot MED_\cdot V\cdot LOW_\cdot Q; \\
ILWHVLQ &= a_1b_1 + a_3b_1\cdot LOW_\cdot W + a_1b_2\cdot HIGH_\cdot V + \\
a_3b_2\cdot LOW_\cdot W\cdot HIGH_\cdot V + \\
a_1b_3\cdot LOW_\cdot Q + a_3b_3\cdot LOW_\cdot W\cdot LOW_\cdot Q + a_1b_4\cdot HIGH_\cdot V\cdot LOW_\cdot Q + \\
a_3b_4\cdot LOW_\cdot W\cdot HIGH_\cdot V\cdot LOW_\cdot Q; \\
imwhvlq &= a_1b_1 + a_3b_1\cdot MED_\cdot W + a_1b_2\cdot HIGH_\cdot V + \\
a_3b_2\cdot MED_\cdot W\cdot HIGH_\cdot V + \\
a_1b_3\cdot LOW_\cdot Q + a_3b_3\cdot MED_\cdot W\cdot LOW_\cdot Q + a_1b_4\cdot HIGH_\cdot V\cdot LOW_\cdot Q + \\
a_3b_4\cdot MED_\cdot W\cdot MED_\cdot V\cdot LOW_\cdot Q; \\
iwhvlq &= a_1b_1 + a_3b_1\cdot HIGH_\cdot W + a_1b_2\cdot HIGH_\cdot V + \\
a_3b_2\cdot HIGH_\cdot W\cdot HIGH_\cdot V + \\
a_1b_3\cdot LOW_\cdot Q + a_3b_3\cdot HIGH_\cdot W\cdot LOW_\cdot Q + a_1b_4\cdot HIGH_\cdot V\cdot LOW_\cdot Q + \\
a_3b_4\cdot HIGH_\cdot W\cdot HIGH_\cdot V\cdot LOW_\cdot Q; \\
ilwlvmq &= a_1b_1 + a_3b_1\cdot LOW_\cdot W + a_1b_2\cdot LOW_\cdot V + \\
a_3b_2\cdot LOW_\cdot W\cdot LOW_\cdot V + \\
a_1b_3\cdot MED_\cdot Q + a_3b_3\cdot LOW_\cdot W\cdot MED_\cdot Q + a_1b_4\cdot LOW_\cdot V\cdot MED_\cdot Q + \\
a_3b_4\cdot LOW_\cdot W\cdot LOW_\cdot V\cdot MED_\cdot Q; \\
imwlvmq &= a_1b_1 + a_3b_1\cdot MED_\cdot W + a_1b_2\cdot LOW_\cdot V + \\
a_3b_2\cdot MED_\cdot W\cdot LOW_\cdot V + \\
a_1b_3\cdot MED_\cdot Q + a_3b_3\cdot MED_\cdot W\cdot MED_\cdot Q + a_1b_4\cdot LOW_\cdot V\cdot MED_\cdot Q + \\
a_3b_4\cdot MED_\cdot W\cdot LOW_\cdot V\cdot MED_\cdot Q; \\
iwhlvmq &= a_1b_1 + a_3b_1\cdot HIGH_\cdot W + a_1b_2\cdot LOW_\cdot V + \\
a_3b_2\cdot HIGH_\cdot W\cdot LOW_\cdot V + \\
a_1b_3\cdot MED_\cdot Q + a_3b_3\cdot HIGH_\cdot W\cdot MED_\cdot Q + a_1b_4\cdot LOW_\cdot V\cdot MED_\cdot Q + \\
a_3b_4\cdot HIGH_\cdot W\cdot LOW_\cdot V\cdot MED_\cdot Q; \\
ilwmvmq &= a_1b_1 + a_3b_1\cdot LOW_\cdot W + a_1b_2\cdot MED_\cdot V + \\
a_3b_2\cdot LOW_\cdot W\cdot MED_\cdot V + \\
a_1b_3\cdot MED_\cdot Q + a_3b_3\cdot LOW_\cdot W\cdot MED_\cdot Q + a_1b_4\cdot MED_\cdot V\cdot MED_\cdot Q + \\
a_3b_4\cdot LOW_\cdot W\cdot MED_\cdot V\cdot MED_\cdot Q; \\
imwmvmq &= a_1b_1 + a_3b_1\cdot MED_\cdot W + a_1b_2\cdot MED_\cdot V + \\
a_3b_2\cdot MED_\cdot W\cdot MED_\cdot V + \\
a_1b_3\cdot MED_\cdot Q + a_3b_3\cdot MED_\cdot W\cdot MED_\cdot Q + a_1b_4\cdot MED_\cdot V\cdot MED_\cdot Q + \\
a_3b_4\cdot MED_\cdot W\cdot MED_\cdot V\cdot MED_\cdot Q; \\
iwhmvmq &= a_1b_1 + a_3b_1\cdot HIGH_\cdot W + a_1b_2\cdot MED_\cdot V + \\
a_3b_2\cdot HIGH_\cdot W\cdot MED_\cdot V + 
\end{align*}\]
\[a1*b3*\text{MED}_Q + a3*b3*\text{HIGH}_W*\text{MED}_Q + a1*b4*\text{MED}_V*\text{MED}_Q + a3*b4*\text{HIGH}_W*\text{MED}_V*\text{MED}_Q;\]

\[\text{ILWHVMQ} = a1*b1 + a3*b1*\text{LOW}_W + a1*b2*\text{HIGH}_V + a3*b2*\text{LOW}_W*\text{HIGH}_V + a1*b3*\text{MED}_Q + a3*b3*\text{LOW}_W*\text{MED}_Q + a1*b4*\text{HIGH}_V*\text{MED}_Q + a3*b4*\text{LOW}_W*\text{HIGH}_V*\text{MED}_Q;\]

\[\text{IMWHVMQ} = a1*b1 + a3*b1*\text{LOW}_W + a1*b2*\text{HIGH}_V + a3*b2*\text{MED}_W*\text{HIGH}_V + a1*b3*\text{MED}_Q + a3*b3*\text{LOW}_W*\text{MED}_Q + a1*b4*\text{HIGH}_V*\text{MED}_Q + a3*b4*\text{LOW}_W*\text{HIGH}_V*\text{MED}_Q;\]

\[\text{IHWHVMQ} = a1*b1 + a3*b1*\text{HIGH}_W + a1*b2*\text{HIGH}_V + a3*b2*\text{HIGH}_W*\text{HIGH}_V + a1*b3*\text{MED}_Q + a3*b3*\text{HIGH}_W*\text{MED}_Q + a1*b4*\text{HIGH}_V*\text{MED}_Q + a3*b4*\text{HIGH}_W*\text{HIGH}_V*\text{MED}_Q;\]

\[\text{ILWLVHQ} = a1*b1 + a3*b1*\text{LOW}_W + a1*b2*\text{LOW}_V + a3*b2*\text{LOW}_W*\text{LOW}_V + a1*b3*\text{HIGH}_Q + a3*b3*\text{LOW}_W*\text{HIGH}_Q + a1*b4*\text{LOW}_V*\text{HIGH}_Q + a3*b4*\text{LOW}_W*\text{LOW}_V*\text{HIGH}_Q;\]

\[\text{IMWLVHQ} = a1*b1 + a3*b1*\text{LOW}_W + a1*b2*\text{LOW}_V + a3*b2*\text{MED}_W*\text{LOW}_V + a1*b3*\text{HIGH}_Q + a3*b3*\text{MED}_W*\text{HIGH}_Q + a1*b4*\text{LOW}_V*\text{HIGH}_Q + a3*b4*\text{MED}_W*\text{LOW}_V*\text{HIGH}_Q;\]

\[\text{IHWLVHQ} = a1*b1 + a3*b1*\text{HIGH}_W + a1*b2*\text{LOW}_V + a3*b2*\text{HIGH}_W*\text{LOW}_V + a1*b3*\text{HIGH}_Q + a3*b3*\text{HIGH}_W*\text{HIGH}_Q + a1*b4*\text{LOW}_V*\text{HIGH}_Q + a3*b4*\text{HIGH}_W*\text{LOW}_V*\text{HIGH}_Q;\]

\[\text{ILWMVHQ} = a1*b1 + a3*b1*\text{LOW}_W + a1*b2*\text{MED}_V + a3*b2*\text{LOW}_W*\text{MED}_V + a1*b3*\text{HIGH}_Q + a3*b3*\text{LOW}_W*\text{HIGH}_Q + a1*b4*\text{MED}_V*\text{HIGH}_Q + a3*b4*\text{LOW}_W*\text{MED}_V*\text{HIGH}_Q;\]

\[\text{IMWMVHQ} = a1*b1 + a3*b1*\text{LOW}_W + a1*b2*\text{MED}_V + a3*b2*\text{MED}_W*\text{MED}_V + a1*b3*\text{HIGH}_Q + a3*b3*\text{MED}_W*\text{HIGH}_Q + a1*b4*\text{MED}_V*\text{HIGH}_Q + a3*b4*\text{MED}_W*\text{MED}_V*\text{HIGH}_Q;\]

\[\text{IHWMVHQ} = a1*b1 + a3*b1*\text{HIGH}_W + a1*b2*\text{MED}_V + a3*b2*\text{HIGH}_W*\text{MED}_V + a1*b3*\text{HIGH}_Q + a3*b3*\text{HIGH}_W*\text{HIGH}_Q + a1*b4*\text{MED}_V*\text{HIGH}_Q + a3*b4*\text{HIGH}_W*\text{MED}_V*\text{HIGH}_Q;\]

\[\text{ILWHVHQ} = a1*b1 + a3*b1*\text{LOW}_W + a1*b2*\text{HIGH}_V + a3*b2*\text{LOW}_W*\text{HIGH}_V + a1*b3*\text{HIGH}_Q + a3*b3*\text{LOW}_W*\text{HIGH}_Q + a1*b4*\text{HIGH}_V*\text{HIGH}_Q + a3*b4*\text{LOW}_W*\text{HIGH}_V*\text{HIGH}_Q;\]
IMWHVHQ = a1*b1 + a3*b1*MED_W + a1*b2*HIGH_V +
a3*b2*MED_W*HIGH_V +
a1*b3*HIGH_Q + a3*b3*MED_W*HIGH_Q + a1*b4*HIGH_V*HIGH_Q +
a3*b4*MED_W*HIGH_V*HIGH_Q;
IHWHVHQ = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_V +
a3*b2*HIGH_W*HIGH_V +
a1*b3*HIGH_Q + a3*b3*HIGH_W*HIGH_Q + a1*b4*HIGH_V*HIGH_Q +
a3*b4*HIGH_W*HIGH_V*HIGH_Q;

! Calc conditional direct effects for each combination of
moderator values

DLWLVLQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*LOW_Q +
cdash9*LOW_V*LOW_Q;
DMWLVLQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*LOW_Q +
cdash9*LOW_V*LOW_Q;
DHWLVLQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*LOW_Q +
cdash9*LOW_V*LOW_Q;
DLWMVLQ = cdash1 + cdash3*LOW_W + cdash6*MED_V +
cdash7*LOW_Q +
cdash9*MED_V*LOW_Q;
DMWMVLQ = cdash1 + cdash3*LOW_W + cdash6*MED_V +
cdash7*LOW_Q +
cdash9*MED_V*LOW_Q;
DHWMVLQ = cdash1 + cdash3*LOW_W + cdash6*MED_V +
cdash7*LOW_Q +
cdash9*MED_V*LOW_Q;
DLWHVLQ = cdash1 + cdash3*LOW_W + cdash6*HIGH_V +
cdash7*LOW_Q +
cdash9*HIGH_V*LOW_Q;
DMWHVLQ = cdash1 + cdash3*LOW_W + cdash6*HIGH_V +
cdash7*LOW_Q +
cdash9*HIGH_V*LOW_Q;
DHWHVLQ = cdash1 + cdash3*LOW_W + cdash6*HIGH_V +
cdash7*LOW_Q +
cdash9*HIGH_V*LOW_Q;
DLWLVMQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*MED_Q +
cdash9*LOW_V*MED_Q;
DMWLVMQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*MED_Q +
cdash9*LOW_V*MED_Q;
DHWLVMQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V +
cdash7*MED_Q +
cdash9*LOW_V*MED_Q;
\[ cdash9*LOW_V*MED_Q; \]
\[ DHWLVMQ = cdash1 + cdash3*HIGH_W + cdash6*LOW_V + \]
\[ cdash7*MED_Q + \]
\[ cdash9*LOW_V*MED_Q; \]
\[ DLWMVMQ = cdash1 + cdash3*LOW_W + cdash6*MED_V + \]
\[ cdash7*MED_Q + \]
\[ cdash9*MED_V*MED_Q; \]
\[ DMWMVMQ = cdash1 + cdash3*MED_W + cdash6*MED_V + \]
\[ cdash7*MED_Q + \]
\[ cdash9*MED_V*MED_Q; \]
\[ DHWMVMQ = cdash1 + cdash3*HIGH_W + cdash6*MED_V + \]
\[ cdash7*MED_Q + \]
\[ cdash9*MED_V*MED_Q; \]
\[ DLWLVHQ = cdash1 + cdash3*LOW_W + cdash6*LOW_V + \]
\[ cdash7*HIGH_Q + \]
\[ cdash9*LOW_V*HIGH_Q; \]
\[ DMWLVHQ = cdash1 + cdash3*MED_W + cdash6*LOW_V + \]
\[ cdash7*HIGH_Q + \]
\[ cdash9*LOW_V*HIGH_Q; \]
\[ DHWLVHQ = cdash1 + cdash3*HIGH_W + cdash6*LOW_V + \]
\[ cdash7*HIGH_Q + \]
\[ cdash9*LOW_V*HIGH_Q; \]
\[ DLWLVHQ = cdash1 + cdash3*LOW_W + cdash6*MED_V + \]
\[ cdash7*HIGH_Q + \]
\[ cdash9*MED_V*HIGH_Q; \]
\[ DMLWVHQ = cdash1 + cdash3*MED_W + cdash6*MED_V + \]
\[ cdash7*HIGH_Q + \]
\[ cdash9*MED_V*HIGH_Q; \]
\[ DMLWVHQ = cdash1 + cdash3*MED_W + cdash6*MED_V + \]
\[ cdash7*HIGH_Q + \]
\[ cdash9*MED_V*HIGH_Q; \]
\[ DMLWVHQ = cdash1 + cdash3*MED_W + cdash6*MED_V + \]
\[ cdash7*HIGH_Q + \]
\[ cdash9*MED_V*HIGH_Q; \]
\[ DMLWVHQ = cdash1 + cdash3*MED_W + cdash6*MED_V + \]
cdash7*HIGH_Q +
    cdash9*HIGH_V*HIGH_Q;
DHWHVHQ = cdash1 + cdash3*HIGH_W + cdash6*HIGH_V +
    cdash7*HIGH_Q +
    cdash9*HIGH_V*HIGH_Q;

! Calc conditional total effects for each combination of
moderator values

TLWLVLQ = ILWLVLQ + DLWLVLQ;
TMWLVLQ = IMWLVLQ + DMWLVLQ;
THWLVLQ = IHWLVLQ + DHWLVLQ;
TLWMVLQ = ILWMVLQ + DLWMVLQ;
TMWMVLQ = IMWMVLQ + DMWMVLQ;
THWMVLQ = IHWMVLQ + DHWMVLQ;
TLWHVLQ = ILWHVLQ + DLWHVLQ;
TMWHVLQ = IMWHVLQ + DMWHVLQ;
THWHVLQ = IHWVLQ + DHWHVLQ;
TLWLVMQ = ILWLVMQ + DLWLVMQ;
TMWLVMQ = IMWLVMQ + DMWLVMQ;
THWLVMQ = IHWLVMQ + DHWLVMQ;
TLWMVMQ = ILWMVMQ + DLWMVMQ;
TMWMVMQ = IMWMVMQ + DMWMVMQ;
THWMVMQ = IHWVMQ + DHWMVMQ;
TLWHVMQ = ILWHVMQ + DLWHVMQ;
TMWHVMQ = IMWHVMQ + DMWHVMQ;
THWHVMQ = IHWHVHQ + DHWHVMQ;
TLWLVHQ = ILWLVHQ + DLWLVHQ;
TMWLVHQ = IMWLVHQ + DMWLVHQ;
THWLVHQ = IHWLVHQ + DHWLVHQ;
TLWMVHQ = ILWMVHQ + DLWMVHQ;
TMWMVHQ = IMWMVHQ + DMWMVHQ;
THWMVHQ = IHWMVHQ + DHWMVHQ;
TLWHVHQ = ILWHVHQ + DLWHVHQ;
TMWHVHQ = IMWHVHQ + DMWHVHQ;
THWHVHQ = IHWHVHQ + DHWHVHQ;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! logical min and max limits of predictor X used in analysis
PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWHVLQ PMWHVLQ PHWHVLQ
PLWLVMQ PMWLVMQ PHWLVMQ PLWMVMQ PMWMVMQ PHWMVMQ
PLWHVMQ PMWHVMQ PHWHVMQ
PLWLVHQ PMWLVHQ PHWLVHQ PLWMVHQ PMWMVHQ PHWMVHQ
PLWHVHQ PMWHVHQ PHWHVHQ);

LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMVLQ = ILWMVLQ*XVAL;
PMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWMVMQ = ILWMVMQ*XVAL;
PMWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLWMVHQ = ILWMVHQ*XVAL;
PMWMVHQ = IMWMVHQ*XVAL;
PHWMVHQ = IHWMVHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 44: 1 or more mediators, in parallel if multiple (example uses 1), 3 moderators, 1 moderating both the IV-Mediator path and the direct IV-DV path, 2 moderating the Mediator-DV path with all 2-way and 3-way interactions, 1 of which also moderates the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 3 moderators W, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2Q + b_3MV + b_4MQ + b_5VQ + b_6MVQ + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2Q + b_3(a_0 + a_1X + a_2W + a_3XW)Q + b_4(a_0 + a_1X + a_2W + a_3XW)Q + b_5VQ + b_6(a_0 + a_1X + a_2W + a_3XW)VQ + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'XV \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1M + b_2Q + b_3MV + b_4MQ + b_5VQ + b_6MVQ + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'XV \]
Hence... multiplying out brackets

\[ Y = b_0 + a_{01} + a_{11}X + a_{21}W + a_{31}XW + b_2Q + a_{03}V + a_{13}XV + a_{23}WV + a_{33}XWV + a_{04}Q + a_{14}XQ + a_{24}WQ + a_{34}XWQ + a_{05}V + a_{15}XV + a_{25}WV + a_{35}XWV + a_{06}Q + a_{16}XQ + a_{26}WQ + a_{36}XWQ + b_5VQ + a_{07}VQ + a_{17}XVQ + a_{27}WVQ + a_{37}XWVQ + c_{1}^1X + c_{2}^1W + c_{3}^1XW + c_{4}^1V + c_{5}^1XV \]

Hence... grouping terms into form \( Y = a \cdot bX \)

\[ Y = (b_0 + a_{01} + a_{21}W + b_2Q + a_{03}V + a_{23}WV + a_{04}Q + a_{24}WQ + b_5VQ + a_{05}V + a_{25}WVQ + c_{2}^1 + c_{3}^1X + c_{4}^1 + c_{5}^1XV)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W \), \( V \), \( Q \):

\[ a_{11} + a_{31}W + a_{13}V + a_{33}WV + a_{14}Q + a_{34}WQ + a_{16}VQ + a_{36}WVQ = (a_{1} + a_{3}W)(b_{1} + b_{3}V + b_{4}Q + b_{6}VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( W \), \( V \):

\[ c_{1}^1 + c_{3}^1W + c_{5}^1V \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V, Q
! Outcome variable - Y
USEVARIABLES = X M W V Q Y XW XV VQ MV MQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XV = X*V;
    VQ = V*Q;
    MVQ = M*V*Q;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;
```
! In model statement name each path and intercept using parentheses

MODEL:
[Y] (b0);
Y ON M (b1);
Y ON Q (b2);
Y ON MV (b3);
Y ON MQ (b4);
Y ON VQ (b5);
Y ON MVQ (b6);
Y ON X (cdash1);
Y ON W (cdash2);
Y ON XW (cdash3);
Y ON V (cdash4);
Y ON XV (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 3 moderators, 3 values for each, gives 27 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HWMLQ = high value of W, medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V LOW_Q MED_Q
HIGH_Q
ILWLVLQ IMWLVLQ IHWLVLQ ILWMVLQ IMVMVLQ IHWMVLQ
ILWHVLQ IMWHVLQ IHWHLQ
ILWLVMQ IMWLVMQ IHWLVMQ ILWMVMQ IMVMVMQ IHWVMQ
ILWHVLMQ IMWHVLMQ IHWHLQ
ILWLVHQ IMWLVHQ IHWLVHQ ILWMVHQ IMVMVHQ IHWVMQ
ILWHVHQL IMWHVHQL IHWVHQ
DLOW_LOV DMEW_LOV DHIW_LOV DLOW_MEV DMEW_MEV DHIW_MEV
DLOW_HIV DMEW_HIV DHIW_HIV
TLWLVLQ TMWLVLQ THWLVLQ TLWMVLQ TMVMVLQ THWMVLQ
TLWHVLQ TMWHVLQ THWHVLQ
TLWLVMQ TMWLVMQ THWLVMQ TLWMVMQ TMVMVMQ THWMVMQ
TLWHVMQ TMWHVMQ THWHVMQ

337
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILWLVLQ = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V + a3*b3*LOW_W*LOW_V + a1*b4*LOW_Q + a3*b4*LOW_W*LOW_Q + a1*b6*LOW_V*LOW_Q + a3*b6*LOW_W*LOW_V*LOW_Q;
IMWLVLQ = a1*b1 + a3*b1*MED_W + a1*b3*LOW_V + a3*b3*MED_W*LOW_V + a1*b4*LOW_Q + a3*b4*MED_W*LOW_Q + a1*b6*LOW_V*LOW_Q + a3*b6*MED_W*LOW_V*LOW_Q;
IHWLVLQ = a1*b1 + a3*b1*HIGH_W + a1*b3*LOW_V + a3*b3*HIGH_W*LOW_V + a1*b4*LOW_Q + a3*b4*HIGH_W*LOW_Q + a1*b6*LOY_V*LOW_Q + a3*b6*HIGH_W*LOW_V*LOW_Q;

ILWMVLQ = a1*b1 + a3*b1*LOW_W + a1*b3*MED_V + a3*b3*LOW_W*MED_V + a1*b4*LOW_Q + a3*b4*LOW_W*MED_Q + a1*b6*LOW_V*MED_Q + a3*b6*LOW_W*MED_V*LOW_Q;
IMWMVLQ = a1*b1 + a3*b1*MED_W + a1*b3*MED_V + a3*b3*MED_W*MED_V + a1*b4*LOW_Q + a3*b4*MED_W*MED_Q + a1*b6*MED_V*MED_Q + a3*b6*MED_W*MED_V*MED_Q;
IHWMVLQ = a1*b1 + a3*b1*HIGH_W + a1*b3*MED_V + a3*b3*HIGH_W*MED_V +
\[ a_1 b_4 \text{LOW}_Q + a_3 b_4 \text{HIGH}_W \text{LOW}_Q + a_1 b_6 \text{MED}_V \text{LOW}_Q + a_3 b_6 \text{HIGH}_W \text{MED}_V \text{LOW}_Q; \]

\[ \text{ILWHVLQ} = a_1 b_1 + a_3 b_1 \text{LOW}_W + a_1 b_3 \text{HIGH}_V + a_3 b_3 \text{LOW}_W \text{HIGH}_V; \]

\[ a_1 b_4 \text{LOW}_Q + a_3 b_4 \text{LOW}_W \text{LOW}_Q + a_1 b_6 \text{HIGH}_V \text{LOW}_Q + a_3 b_6 \text{LOW}_W \text{HIGH}_V \text{LOW}_Q; \]

\[ \text{IMWHVLQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_3 \text{HIGH}_V + a_3 b_3 \text{MED}_W \text{HIGH}_V; \]

\[ a_1 b_4 \text{LOW}_Q + a_3 b_4 \text{MED}_W \text{LOW}_Q + a_1 b_6 \text{HIGH}_V \text{LOW}_Q + a_3 b_6 \text{MED}_W \text{HIGH}_V \text{LOW}_Q; \]

\[ \text{IHWHVLQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_3 \text{HIGH}_V + a_3 b_3 \text{HIGH}_W \text{HIGH}_V; \]

\[ a_1 b_4 \text{LOW}_Q + a_3 b_4 \text{HIGH}_W \text{LOW}_Q + a_1 b_6 \text{HIGH}_V \text{LOW}_Q + a_3 b_6 \text{HIGH}_W \text{HIGH}_V \text{LOW}_Q; \]

\[ \text{ILWLVMQ} = a_1 b_1 + a_3 b_1 \text{LOW}_W + a_1 b_3 \text{LOW}_V + a_3 b_3 \text{LOW}_W \text{LOW}_V; \]

\[ a_1 b_4 \text{MED}_Q + a_3 b_4 \text{LOW}_W \text{MED}_Q + a_1 b_6 \text{LOW}_V \text{MED}_Q + a_3 b_6 \text{LOW}_W \text{LOW}_V \text{MED}_Q; \]

\[ \text{IMWLVMQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_3 \text{LOW}_V + a_3 b_3 \text{MED}_W \text{LOW}_V; \]

\[ a_1 b_4 \text{MED}_Q + a_3 b_4 \text{MED}_W \text{MED}_Q + a_1 b_6 \text{LOW}_V \text{MED}_Q + a_3 b_6 \text{MED}_W \text{LOW}_V \text{MED}_Q; \]

\[ \text{IHWLVMQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_3 \text{LOW}_V + a_3 b_3 \text{HIGH}_W \text{LOW}_V; \]

\[ a_1 b_4 \text{MED}_Q + a_3 b_4 \text{HIGH}_W \text{MED}_Q + a_1 b_6 \text{LOW}_V \text{MED}_Q + a_3 b_6 \text{HIGH}_W \text{LOW}_V \text{MED}_Q; \]

\[ \text{ILWMVMQ} = a_1 b_1 + a_3 b_1 \text{LOW}_W + a_1 b_3 \text{MED}_V + a_3 b_3 \text{LOW}_W \text{MED}_V; \]

\[ a_1 b_4 \text{MED}_Q + a_3 b_4 \text{LOW}_W \text{MED}_Q + a_1 b_6 \text{MED}_V \text{MED}_Q + a_3 b_6 \text{LOW}_W \text{MED}_V \text{MED}_Q; \]

\[ \text{IMWMVMQ} = a_1 b_1 + a_3 b_1 \text{MED}_W + a_1 b_3 \text{MED}_V + a_3 b_3 \text{MED}_W \text{MED}_V; \]

\[ a_1 b_4 \text{MED}_Q + a_3 b_4 \text{HIGH}_W \text{MED}_Q + a_1 b_6 \text{MED}_V \text{MED}_Q + a_3 b_6 \text{HIGH}_W \text{MED}_V \text{MED}_Q; \]

\[ \text{IHWMVMQ} = a_1 b_1 + a_3 b_1 \text{HIGH}_W + a_1 b_3 \text{MED}_V + a_3 b_3 \text{HIGH}_W \text{MED}_V + a_1 b_4 \text{MED}_Q + a_3 b_4 \text{HIGH}_W \text{MED}_Q + a_1 b_6 \text{HIGH}_V \text{MED}_Q + a_3 b_6 \text{HIGH}_W \text{MED}_V \text{MED}_Q; \]
a3*b6*MED_W*HIGH_V*MED_Q;
IHWHVMQ = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_V +
 a3*b3*HIGH_W*HIGH_V +
a1*b4*MED_Q + a3*b4*HIGH_W*MED_Q + a1*b6*HIGH_V*MED_Q +
a3*b6*HIGH_W*HIGH_V*MED_Q;

ILWLVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_V +
a3*b3*LOW_W*LOW_V +
a1*b4*HIGH_Q + a3*b4*LOW_W*HIGH_Q + a1*b6*LOW_V*HIGH_Q +
a3*b6*LOW_W*LOW_V*HIGH_Q;
IMWLVHQ = a1*b1 + a3*b1*MED_W + a1*b3*LOW_V +
a3*b3*MED_W*LOW_V +
a1*b4*HIGH_Q + a3*b4*MED_W*HIGH_Q + a1*b6*LOW_V*HIGH_Q +
a3*b6*MED_W*LOW_V*HIGH_Q;

IMWHVHQ = a1*b1 + a3*b1*MED_W + a1*b3*MED_V +
a3*b3*MED_W*MED_V +
a1*b4*HIGH_Q + a3*b4*MED_W*MED_V + a1*b6*MED_V*MED_Q +
a3*b6*MED_W*MED_V*MED_Q;
IHWMVHQ = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_V +
a3*b3*HIGH_W*HIGH_V +
a1*b4*HIGH_Q + a3*b4*HIGH_W*HIGH_Q + a1*b6*HIGH_V*HIGH_Q +
a3*b6*HIGH_W*HIGH_V*HIGH_Q;

ILWHVHQ = a1*b1 + a3*b1*LOW_W + a1*b3*HIGH_V +
a3*b3*LOW_W*HIGH_V +
a1*b4*HIGH_Q + a3*b4*LOW_W*HIGH_V + a1*b6*HIGH_V*HIGH_Q +
a3*b6*LOW_W*HIGH_V*HIGH_Q;
IMWHVHQ = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_V +
a3*b3*HIGH_W*HIGH_V +
a1*b4*HIGH_Q + a3*b4*HIGH_W*HIGH_Q + a1*b6*HIGH_V*HIGH_Q +
a3*b6*HIGH_W*HIGH_V*HIGH_Q;
! Calc conditional direct effects for each combination of moderator values

DLOW_LOV = cdash1 + cdash3*LOW_W + cdash5*LOW_V;
DMEW_LOV = cdash1 + cdash3*MED_W + cdash5*LOW_V;
DHIW_LOV = cdash1 + cdash3*HIGH_W + cdash5*LOW_V;

DLOW_MEV = cdash1 + cdash3*LOW_W + cdash5*MED_V;
DMEW_MEV = cdash1 + cdash3*MED_W + cdash5*MED_V;
DHIW_MEV = cdash1 + cdash3*HIGH_W + cdash5*MED_V;

DLOW_HIV = cdash1 + cdash3*LOW_W + cdash5*HIGH_V;
DMEW_HIV = cdash1 + cdash3*MED_W + cdash5*HIGH_V;
DHIW_HIV = cdash1 + cdash3*HIGH_W + cdash5*HIGH_V;

! Calc conditional total effects for each combination of moderator values

TLWLVLQ = ILWLVLQ + DLOW_LOV;
TMWLVLQ = IMWLVLQ + DMEW_LOV;
THWLVLQ = IHWLVLQ + DHIW_LOV;

TLWMVLQ = ILWMVLQ + DLOW_MEV;
TMWMVLQ = IMWMVLQ + DMEW_MEV;
THWMVLQ = IHWMVLQ + DHIW_MEV;

TLWHLVLQ = ILWLVMQ + DLOW_HIV;
TMWHLVLQ = IMWHVLQ + DMEW_HIV;
THWHLVLQ = IHWHVLQ + DHIW_HIV;

TLWLVMQ = ILWLVMQ + DLOW_LOV;
TMWLVMQ = IMWLVMQ + DMEW_LOV;
THWLVMQ = IHWLVMQ + DHIW_LOV;

TLWMVMQ = ILWMVMQ + DLOW_MEV;
TMWMVMQ = IMWMVMQ + DMEW_MEV;
THWMVMQ = IHWMVMQ + DHIW_MEV;

TLWHVMQ = ILWHVMQ + DLOW_HIV;
TMWHVMQ = IMWHVMQ + DMEW_HIV;
THWHVMQ = IHWHVMQ + DHIW_HIV;

TLWLVHQ = ILWLVHQ + DLOW_LOV;
TMWLVHQ = IMWLVHQ + DMEW_LOV;
THWLVHQ = IHWLVHQ + DHIW_LOV;

TLWMVHQ = ILWMVHQ + DLOW_MEV;
TMWMVHQ = IMWMVHQ + DMEW_MEV;
THWMVHQ = IHWMVHQ + DHIW_MEV;

TLWHVHQ = ILWHVHQ + DLOW_HIV;
TMWHVHQ = IMWHVHQ + DMEW_HIV;
THWHVHQ = IHWHVHQ + DHIW_HIV;
! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLWLVLQ PMWLVLQ PHWLVLQ PLWMVLQ PMWMVLQ PHWMVLQ
PLWHVLQ PMWHVLQ PHWHVLQ
PLWLVMQ PMWLVMQ PHWLVMQ PLWMVMQ PMWMVMQ PHWMVMQ
PLWHVMQ PMWHVMQ PHWHVMQ
PLWLVHQ PMWLVHQ PHWLVHQ PLWMVHQ PMWMVHQ PHWMVHQ
PLWHVHQ PMWHVHQ PHWHVHQ);

LOOP(XVAL,1,5,0.1);

PLWLVLQ = ILWLVLQ*XVAL;
PMWLVLQ = IMWLVLQ*XVAL;
PHWLVLQ = IHWLVLQ*XVAL;

PLWMVLQ = ILWMVLQ*XVAL;
PMWMVLQ = IMWMVLQ*XVAL;
PHWMVLQ = IHWMVLQ*XVAL;

PLWHVLQ = ILWHVLQ*XVAL;
PMWHVLQ = IMWHVLQ*XVAL;
PHWHVLQ = IHWHVLQ*XVAL;

PLWLVMQ = ILWLVMQ*XVAL;
PMWLVMQ = IMWLVMQ*XVAL;
PHWLVMQ = IHWLVMQ*XVAL;

PLWMVMQ = ILWMVMQ*XVAL;
PMWMVMQ = IMWMVMQ*XVAL;
PHWMVMQ = IHWMVMQ*XVAL;

PLWHVMQ = ILWHVMQ*XVAL;
PMWHVMQ = IMWHVMQ*XVAL;
PHWHVMQ = IHWHVMQ*XVAL;

PLWLVHQ = ILWLVHQ*XVAL;
PMWLVHQ = IMWLVHQ*XVAL;
PHWLVHQ = IHWLVHQ*XVAL;

PLWMVHQ = ILWMVHQ*XVAL;
PMWMVHQ = IMWMVHQ*XVAL;
PHWMVHQ = IHWMVHQ*XVAL;

PLWHVHQ = ILWHVHQ*XVAL;
PMWHVHQ = IMWHVHQ*XVAL;
PHWHVHQ = IHWHVHQ*XVAL;
PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 45: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[
Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + c'X \\
M = a_0 + a_1W + a_2Z + a_3X + a_4XW + a_5XZ
\]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[
Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + c'X \\
M = a_0 + a_1W + a_2Z + a_3X + a_4XW + a_5XZ
\]

Hence... substituting in equation for \( M \)

\[
Y = b_0 + b_1(a_0 + a_1W + a_2Z + a_3X + a_4XW + a_5XZ) + b_2V + b_3Q + b_4(a_0 + a_1W + a_2Z + a_3X + a_4XW + a_5XZ)V + b_5(a_0 + a_1W + a_2Z + a_3X + a_4XW + a_5XZ)Q + c'X
\]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1W + a_2b_1Z + a_3b_1X + a_4b_1XW + a_5b_1XZ + b_2V + b_3Q + a_0b_4V + a_1b_4WV + a_2b_4ZW + a_3b_4XV + a_4b_4XWV + a_5b_4XZV + a_0b_5Q + a_1b_5WQ + a_2b_5ZQ + a_3b_5XQ + a_4b_5XWQ + a_5b_5XZQ + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_1b_1W + a_2b_1Z + b_2V + b_3Q + a_0b_4V + a_1b_4WV + a_2b_4ZW + a_0b_5Q + a_1b_5WQ + a_2b_5ZQ) + (a_3b_1 + a_4b_1W + a_5b_1Z + a_3b_4V + a_4b_4WV + a_5b_4ZV + a_3b_5Q + a_4b_5WQ + a_5b_5ZQ + c')X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V, Q \):

\[ a_3b_1 + a_4b_1W + a_5b_1Z + a_3b_4V + a_4b_4WV + a_5b_4ZV + a_3b_5Q + a_4b_5WQ + a_5b_5ZQ = (a_3 + a_4W + a_5Z)(b_1 + b_4V + b_5Q) \]

One direct effect of \( X \) on \( Y \):

\[ c' \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y

USEARIABLES = X M W Z V Q Y XW XZ MV MQ;

! Create interaction terms
! Note that they have to be placed at end of USEAILABLES subcommand above

DEFINE:
   MQ = M*Q;
   MV = M*V;
   XW = X*W;
   XZ = X*Z;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
   [Y] (b0);
```
Y ON M (b1);
Y ON V (b2);
Y ON Q (b3);
Y ON MV (b4);
Y ON MQ (b5);
Y ON X (cdash);

[M] (a0);
M ON W (a1);
M ON Z (a2);
M ON X (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)
   ILLLL IMLLL IHLLL ILMLL IHLLL ILHLL IMHLL IHHLL
   ILLML IMLML IHLML ILMML IHMLM ILHML IMHML IHHML
   ILLHL IMLHL IHLHL ILMHL IHHLH ILHHL IMHHL IHHHL
   ILLLM IMLLM IHLLM ILMLM IHLLM IHLLM IMHLM IHHLM
   ILLMM IMLMM IHLMM ILMMM IHMMM IHLMM IMHMM IHHMM
   ILLHM IMLHM IHLHM ILMHM IHHMH IHLHM IMHHM IHHHM
   ILLHH IMLHH IHLHH ILMHH IHHHH IHLHH IMHHH IHHHH
   TLLLL TMLLL THLLL TLMLL TMLLL TLHLL TMHLL THHLL
   TLLML TMLML THLML TLMML TMMLL TMLML TMHML THHML
   TLLHL TMLHL THLHL TLMHL TMHHL TMLHL TMHLM THHLM
   TLLLM TMLLM THLLM TLMLM TMHLM TMLLM TMHLM THHLM
   TLLMM TMLMM THLMM TLMMM TMHMH TMLMM TMHMM THHMM
   TLLHM TMLHM THLHM TMHMH TMHMH TMHMH THHHM
   TLLHH TMLHH THLHH TLMHH TMHHH TMLHH TMHHH THHHH);
LOW_W = #LOWW;  ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your
chosen high value of Z

LOW_V = #LOWV;  ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your
chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your
chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your
chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your
chosen high value of Q

! Calc conditional indirect effects for each combination of
moderator values

ILLLL = a3*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a3*b4*LOW_V +
a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a3*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;
IMLLL = a3*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a3*b4*LOW_V +
a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*LOW_Q +
a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IHLLL = a3*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a3*b4*LOW_V +
a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a3*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;
ILMLL = a3*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a3*b4*LOW_V +
a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IMMLL = a3*b1 + a4*b1*MED_W + a5*b1*MED_Z + a3*b4*LOW_V +
a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*LOW_Q +
a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IHMLL = a3*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a3*b4*LOW_V +
a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

ILHLL = a3*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a3*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IMHLL = a3*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a3*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IHHLL = a3*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a3*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

ILLML = a3*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a3*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

IMLML = a3*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a3*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V + a3*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

IHLML = a3*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a3*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

ILMML = a3*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a3*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

IMMML = a3*b1 + a4*b1*MED_W + a5*b1*MED_Z + a3*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

IHMML = a3*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a3*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

ILHML = a3*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IMHML = a3*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V + a3*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IHHML = a3*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;
a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

ILLHL = a3*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a3*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

IMLHL = a3*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a3*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

IMHLH = a3*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a3*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

ILMHL = a3*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a3*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

IMMHL = a3*b1 + a4*b1*MED_W + a5*b1*MED_Z + a3*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

IHMHL = a3*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a3*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

ILHHL = a3*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a3*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IMHHL = a3*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a3*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IHHHL = a3*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a3*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a3*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

ILLLM = a3*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a3*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a3*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*LOW_Z*MED_Q;

IMLLM = a3*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a3*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a3*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*LOW_Z*MED_Q;
IHLLM = a3*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a3*b4*LOW_V + 
a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V + a3*b5*MED_Q + 
a4*b5*HIGH_W*MED_Q + a5*b5*LOW_Z*MED_Q;

ILMLM = a3*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a3*b4*LOW_V + 
a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*MED_Q + 
a4*b5*LOW_W*MED_Q + a5*b5*MED_Z*MED_Q;

IMMLM = a3*b1 + a4*b1*MED_W + a5*b1*MED_Z + a3*b4*LOW_V + 
a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*MED_Q + 
a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;

IHMLM = a3*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a3*b4*LOW_V + 
a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*MED_Q + 
a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q;

ILHLM = a3*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a3*b4*LOW_V + 
a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a3*b5*MED_Q + 
a4*b5*LOW_W*MED_Q + a5*b5*HIGH_Z*MED_Q;

IMHLM = a3*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a3*b4*LOW_V + 
a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a3*b5*MED_Q + 
a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;

IHHLM = a3*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a3*b4*LOW_V + 
a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a3*b5*MED_Q + 
a4*b5*HIGH_W*MED_Q + a5*b5*HIGH_Z*MED_Q;

ILLMM = a3*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a3*b4*MED_V + 
a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V + a3*b5*MED_Q + 
a4*b5*LOW_W*MED_Q + a5*b5*LOW_Z*MED_Q;

IMLMM = a3*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a3*b4*MED_V + 
a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*MED_Q + 
a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;

IHLMM = a3*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a3*b4*MED_V + 
a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + a3*b5*MED_Q + 
a4*b5*HIGH_W*MED_Q + a5*b5*LOW_Z*MED_Q;

ILMMM = a3*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a3*b4*MED_V + 
a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*MED_Q + 
a4*b5*LOW_W*MED_Q + a5*b5*MED_Z*MED_Q;

IMMMM = a3*b1 + a4*b1*MED_W + a5*b1*MED_Z + a3*b4*MED_V + 
a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*MED_Q + 
a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;

IHMNM = a3*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a3*b4*MED_V + 
a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*MED_Q + 
a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q;
a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V + a3*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q;

ILHMM = a3*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V + a3*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*HIGH_Z*MED_Q;

IMHMM = a3*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V + a3*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*HIGH_Z*MED_Q;

IHHMM = a3*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a3*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*HIGH_Z*MED_Q;

ILLHM = a3*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a3*b4*MED_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*MED_Z*MED_Q;

IMLHM = a3*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a3*b4*MED_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;

IHLHM = a3*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a3*b4*MED_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q;

ILMHM = a3*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a3*b4*MED_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*MED_Z*MED_Q;

IMMHM = a3*b1 + a4*b1*MED_W + a5*b1*MED_Z + a3*b4*MED_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;

IHMHM = a3*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a3*b4*MED_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q;

ILHHM = a3*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*HIGH_Z*MED_Q;

IMHHM = a3*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a3*b4*MED_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a3*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;
\[a4 \cdot b5 \cdot M_E D\_W \cdot M_ED\_Q + a5 \cdot b5 \cdot H I G H\_Z \cdot M_ED\_Q;\]

\[IHHHM = a3 \cdot b1 + a4 \cdot b1 \cdot H I G H\_W + a5 \cdot b1 \cdot H I G H\_Z + a3 \cdot b4 \cdot H I G H\_V\]

\[+ a4 \cdot b4 \cdot H I G H\_W \cdot H I G H\_V + a5 \cdot b4 \cdot H I G H\_Z \cdot H I G H\_V + a3 \cdot b5 \cdot M_ED\_Q\]

\[+ a4 \cdot b5 \cdot H I G H\_W \cdot M_ED\_Q + a5 \cdot b5 \cdot H I G H\_Z \cdot M_ED\_Q;\]

\[I L L L H = a3 \cdot b1 + a4 \cdot b1 \cdot L O W\_W + a5 \cdot b1 \cdot L O W\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot L O W\_W \cdot L O W\_V + a5 \cdot b4 \cdot L O W\_Z \cdot L O W\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot L O W\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot L O W\_Z \cdot H I G H\_Q;\]

\[I M L L H = a3 \cdot b1 + a4 \cdot b1 \cdot M_E D\_W + a5 \cdot b1 \cdot L O W\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot M_E D\_W \cdot L O W\_V + a5 \cdot b4 \cdot M_E D\_Z \cdot L O W\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot M_E D\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot M_E D\_Z \cdot H I G H\_Q;\]

\[I H L L H = a3 \cdot b1 + a4 \cdot b1 \cdot H I G H\_W + a5 \cdot b1 \cdot L O W\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot H I G H\_W \cdot L O W\_V + a5 \cdot b4 \cdot H I G H\_Z \cdot L O W\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot H I G H\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot H I G H\_Z \cdot H I G H\_Q;\]

\[I L M L H = a3 \cdot b1 + a4 \cdot b1 \cdot L O W\_W + a5 \cdot b1 \cdot M_E D\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot L O W\_W \cdot M_E D\_V + a5 \cdot b4 \cdot L O W\_Z \cdot M_E D\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot L O W\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot L O W\_Z \cdot H I G H\_Q;\]

\[I M L M H = a3 \cdot b1 + a4 \cdot b1 \cdot M_E D\_W + a5 \cdot b1 \cdot M_E D\_Z + a3 \cdot b4 \cdot M_E D\_V + a4 \cdot b4 \cdot M_E D\_W \cdot M_E D\_V + a5 \cdot b4 \cdot M_E D\_Z \cdot M_E D\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot M_E D\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot M_E D\_Z \cdot H I G H\_Q;\]

\[I H L M H = a3 \cdot b1 + a4 \cdot b1 \cdot H I G H\_W + a5 \cdot b1 \cdot M_E D\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot H I G H\_W \cdot L O W\_V + a5 \cdot b4 \cdot H I G H\_Z \cdot L O W\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot H I G H\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot H I G H\_Z \cdot H I G H\_Q;\]

\[I L L M H = a3 \cdot b1 + a4 \cdot b1 \cdot L O W\_W + a5 \cdot b1 \cdot H I G H\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot L O W\_W \cdot H I G H\_V + a5 \cdot b4 \cdot L O W\_Z \cdot H I G H\_V + a3 \cdot b5 \cdot M_E D\_Q + a4 \cdot b5 \cdot L O W\_W \cdot M_E D\_Q + a5 \cdot b5 \cdot L O W\_Z \cdot M_E D\_Q;\]

\[I M L H H = a3 \cdot b1 + a4 \cdot b1 \cdot H I G H\_W + a5 \cdot b1 \cdot H I G H\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot H I G H\_W \cdot L O W\_V + a5 \cdot b4 \cdot H I G H\_Z \cdot L O W\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot H I G H\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot H I G H\_Z \cdot H I G H\_Q;\]

\[I L L H H = a3 \cdot b1 + a4 \cdot b1 \cdot L O W\_W + a5 \cdot b1 \cdot H I G H\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot L O W\_W \cdot H I G H\_V + a5 \cdot b4 \cdot L O W\_Z \cdot H I G H\_V + a3 \cdot b5 \cdot M_E D\_Q + a4 \cdot b5 \cdot L O W\_W \cdot M_E D\_Q + a5 \cdot b5 \cdot L O W\_Z \cdot M_E D\_Q;\]

\[I M L H H = a3 \cdot b1 + a4 \cdot b1 \cdot M_E D\_W + a5 \cdot b1 \cdot L O W\_Z + a3 \cdot b4 \cdot M_E D\_V + a4 \cdot b4 \cdot M_E D\_W \cdot M_E D\_V + a5 \cdot b4 \cdot M_E D\_Z \cdot M_E D\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot M_E D\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot M_E D\_Z \cdot H I G H\_Q;\]

\[I H L H H = a3 \cdot b1 + a4 \cdot b1 \cdot H I G H\_W + a5 \cdot b1 \cdot L O W\_Z + a3 \cdot b4 \cdot L O W\_V + a4 \cdot b4 \cdot H I G H\_W \cdot L O W\_V + a5 \cdot b4 \cdot H I G H\_Z \cdot L O W\_V + a3 \cdot b5 \cdot H I G H\_Q + a4 \cdot b5 \cdot H I G H\_W \cdot H I G H\_Q + a5 \cdot b5 \cdot H I G H\_Z \cdot H I G H\_Q;\]
ILMMH = $a_3 b_1 + a_4 b_1 \cdot \text{LOW}_W + a_5 b_1 \cdot \text{MED}_Z + a_3 b_4 \cdot \text{MED}_V + a_4 b_4 \cdot \text{LOW}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{MED}_Z \cdot \text{MED}_V + a_3 b_5 \cdot \text{HIGH}_Q + a_4 b_5 \cdot \text{LOW}_W \cdot \text{HIGH}_Q + a_5 b_5 \cdot \text{MED}_Z \cdot \text{HIGH}_Q$;

ILMMH = $a_3 b_1 + a_4 b_1 \cdot \text{LOW}_W + a_5 b_1 \cdot \text{MED}_Z + a_3 b_4 \cdot \text{MED}_V + a_4 b_4 \cdot \text{LOW}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{MED}_Z \cdot \text{MED}_V + a_3 b_5 \cdot \text{HIGH}_Q + a_4 b_5 \cdot \text{LOW}_W \cdot \text{HIGH}_Q + a_5 b_5 \cdot \text{MED}_Z \cdot \text{HIGH}_Q$;

ILMHH = $a_3 b_1 + a_4 b_1 \cdot \text{LOW}_W + a_5 b_1 \cdot \text{MED}_Z + a_3 b_4 \cdot \text{MED}_V + a_4 b_4 \cdot \text{LOW}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{MED}_Z \cdot \text{MED}_V + a_3 b_5 \cdot \text{HIGH}_Q + a_4 b_5 \cdot \text{LOW}_W \cdot \text{HIGH}_Q + a_5 b_5 \cdot \text{MED}_Z \cdot \text{HIGH}_Q$;
\[ a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q; \]
\[ \text{IHMHH} = a_3 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_3 b_4 \text{HIGH}_V \]
\[ + a_4 b_4 \text{HIGH}_W \text{HIGH}_V + a_5 b_4 \text{MED}_Z \text{HIGH}_V + a_3 b_5 \text{HIGH}_Q \]
\[ + a_4 b_5 \text{HIGH}_W \text{HIGH}_Q; \]
\[ \text{ILHHH} = a_3 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_3 b_4 \text{HIGH}_V \]
\[ + a_4 b_4 \text{LOW}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + a_3 b_5 \text{HIGH}_Q \]
\[ + a_4 b_5 \text{LOW}_W \text{HIGH}_Q; \]
\[ \text{IMHHH} = a_3 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_3 b_4 \text{HIGH}_V \]
\[ + a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + a_3 b_5 \text{HIGH}_Q \]
\[ + a_4 b_5 \text{MED}_W \text{HIGH}_Q; \]
\[ \text{IHHHH} = a_3 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_3 b_4 \text{HIGH}_V \]
\[ + a_4 b_4 \text{HIGH}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + a_3 b_5 \text{HIGH}_Q \]
\[ + a_4 b_5 \text{HIGH}_W \text{HIGH}_Q; \]

! Calc conditional total effects for each combination of moderator values

\[ TLLLL = ILLLL + \text{cdash}; \]
\[ TMLLL = IMLLL + \text{cdash}; \]
\[ THLLL = IHLLL + \text{cdash}; \]
\[ TLMLL = ILMLL + \text{cdash}; \]
\[ TMMLL = IMMLL + \text{cdash}; \]
\[ THMLL = IHMLL + \text{cdash}; \]
\[ TLHLL = ILHLL + \text{cdash}; \]
\[ TMHLL = IMHLL + \text{cdash}; \]
\[ THHLL = IHHLL + \text{cdash}; \]
\[ TLLML = ILLML + \text{cdash}; \]
\[ TMLML = IMLML + \text{cdash}; \]
\[ THMLL = IHMLL + \text{cdash}; \]
\[ TLHML = ILHML + \text{cdash}; \]
\[ TMHML = IMHML + \text{cdash}; \]
\[ THHML = IHHML + \text{cdash}; \]
TLLHL = ILLHL + cdash;
TMLHL = IMLHL + cdash;
THLHL = IHLHL + cdash;
TLMHL = ILMHL + cdash;
TMMHL = IMMHL + cdash;
THMHL = IHMHL + cdash;
TLHHL = ILHHL + cdash;
TMHHL = IMHHL + cdash;
THHHL = IHHHL + cdash;
TLLLM = ILLLM + cdash;
TMLLM = IMLLM + cdash;
THLLM = IMLLM + cdash;
TLMLM = IMLLM + cdash;
TMMLM = IMMML + cdash;
THMLM = IHMLM + cdash;
TLHLM = ILHLM + cdash;
TMHLM = IMHLM + cdash;
THHLM = IHHLM + cdash;
TLLMM = ILLMM + cdash;
TMLMM = IMLMM + cdash;
THLMM = IMLMM + cdash;
TLMMM = IMLMM + cdash;
TMMMM = IMMMM + cdash;
THMMM = IHMMM + cdash;
TLHMM = ILHMM + cdash;
TMHMM = IMHMM + cdash;
THHMM = IHHMM + cdash;
TLLHM = ILLLH + cdash;
TMLHM = IMLLH + cdash;
THLLH = IMLLH + cdash;
TLMHM = IMLHM + cdash;
TMMHM = IMMHM + cdash;
THMHM = IHMHM + cdash;
TLHHM = ILHHM + cdash;
TMHHM = IMHHM + cdash;
THHHM = IHHHM + cdash;
TLLLH = ILLLH + cdash;
TMLLH = IMLLH + cdash;
THLLH = IMLLH + cdash;
TLMLH = ILMLH + cdash;
TMMLH = IMMLH + cdash;
THMLH = IHMLH + cdash;

TLHLH = ILHLH + cdash;
TMHLH = IMHLH + cdash;
THHLH = IHHLH + cdash;

TLLMH = ILLMH + cdash;
TMLMH = IMLMH + cdash;
THLMH = IHLMH + cdash;

TLMGH = ILMGH + cdash;
TMMGH = IMMGH + cdash;
THMGH = IHMGH + cdash;

TLLHH = ILLHH + cdash;
TMLHH = IMLHH + cdash;
THLHH = IHLHH + cdash;

TLMHH = ILMHH + cdash;
TMMHH = IMMHH + cdash;
THMHH = IHHHH + cdash;

TLHHH = ILHHH + cdash;
TMHHH = IMHHH + cdash;
THHHH = IHHHH + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values!
! Could be edited to show conditional direct or conditional total effects instead!
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLL L PLL PHLL PL LL PLL PM LL PLL PH LL PLL PH LL
PLL PLML PMLML PHML PLML PLML PMML PLML PMML PHML PLML PMML PLML PHML
PLL PMLL PMLL PHML PLLM PLML PLML PMML PLML PMML PHML PLML PMML PLML PHML
PLL PMML PMML PLLM PMML PMML PMML PMML PMML PMML PMML PMML PMML PMML
PLL PMMH PMMH PLLM PMMH PLLM PMMH PLLM PMMH PMMH PLLM PMMH PLLM PMMH
PLL PMHMPM HMPHMPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM
PLL PHLHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM
PLL PHLHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM
PLL PHLHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM
PLL PHLHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM
PLL PHLHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM
PLL PHLHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM
PLL PHLHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM PMPHPM)

LOOP(XVAL,1,5,0.1);
PLL = PLL*XVAL;
PML = PML*XVAL;
PHL = PHL*XVAL;
PLM = PLM*XVAL;
PMH = PMH*XVAL;
PHH = PHH*XVAL;
PLL = PLL*XVAL;
PML = PML*XVAL;
PHL = PHL*XVAL;
PLM = PLM*XVAL;
PMH = PMH*XVAL;
PHH = PHH*XVAL;
PLL = PLL*XVAL;
PML = PML*XVAL;
PHL = PHL*XVAL;
PLM = PLM*XVAL;
PMH = PMH*XVAL;
PHH = PHH*XVAL;
PLL = PLL*XVAL;
PML = PML*XVAL;
PHL = PHL*XVAL;
PLM = PLM*XVAL;
PMH = PMH*XVAL;
PHH = PHH*XVAL;
PLL = PLL*XVAL;
PML = PML*XVAL;
PHL = PHL*XVAL;
PLM = PLM*XVAL;
PMH = PMH*XVAL;
PHH = PHH*XVAL;
PLL = PLL*XVAL;
PML = PML*XVAL;
PHL = PHL*XVAL;
PLM = PLM*XVAL;
PMH = PMH*XVAL;
PHH = PHH*XVAL;
PLL = PLL*XVAL;
PML = PML*XVAL;
PHL = PHL*XVAL;
PLM = PLM*XVAL;
PMH = PMH*XVAL;
PHH = PHH*XVAL;
PLMM = ILMMM*XVAL;
PMMM = IMMMM*XVAL;
PHMM = IHHMM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHHM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHHM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLHLM = ILHLM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLL = IHLLL*XVAL;

PLLHM = ILLHM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLL = IHLLL*XVAL;

PLHLM = ILHLM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLL = IHLLL*XVAL;

PLLMM = ILLMM*XM;
PLHHH = ILHHH*XVAL;
PMHHH = IMHHH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 46: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[
Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 M V + b_5 M Q + c'X \\
M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z + a_6 W Z + a_7 X W Z
\]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[
Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 M V + b_5 M Q + c'X \\
M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z + a_6 W Z + a_7 X W Z
\]

Hence... substituting in equation for \( M \)

\[
Y = b_0 + b_1 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z + a_6 W Z + a_7 X W Z) + b_2 V + b_3 Q \\
+ b_4 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z + a_6 W Z + a_7 X W Z) V \\
+ b_5 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z + a_6 W Z + a_7 X W Z) Q + c'X
\]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + a6b1WZ + a7b1XWZ + b2V + b3Q + a0b4V + a1b4V + a2b4W + a3b4ZV + a4b4XWV + a5b4XZV + a6b4WZV + a7b4XWZV + a0b5Q + a1b5XQ + a2b5WQ + a3b5ZQ + a4b5XWQ + a5b5XZQ + a6b5WZQ + a7b5XWZQ + c'X

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a3b1Z + a6b1WZ + b2V + b3Q + a0b4V + a2b4W + a3b4V + a6b4WV + a7b4XWZV + a0b5Q + a1b5Q + a2b5WQ + a3b5ZQ + a6b5WZQ) + (a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b4V + a4b4WV + a5b4ZV + a7b4WZV + a1b5Q + a4b5WQ + a5b5ZQ + a7b5WZQ + c'X)

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V, Q:

a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b4V + a4b4WV + a5b4ZV + a7b4WZV + a1b5Q + a4b5WQ + a5b5ZQ + a7b5WZQ = (a1 + a4W + a5Z + a7WZ)(b1 + b4V + b5Q)

One direct effect of X on Y:

c'}

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y

USEVARIABLES = X M W Z V Q Y XW XZ WZ MV MQ XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MQ = M*Q;
  MV = M*V;
  XW = X*W;
  XZ = X*Z;
  WZ = W*Z;
  XWZ = X*W*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;
```
In model statement name each path and intercept using parentheses

**MODEL:**

\[
\begin{align*}
[Y] & (b0); \\
Y & ON M (b1); \\
Y & ON V (b2); \\
Y & ON Q (b3); \\
Y & ON MV (b4); \\
Y & ON MQ (b5); \\
Y & ON X (cdash); \\
[M] & (a0); \\
M & ON X (a1); \\
M & ON W (a2); \\
M & ON Z (a3); \\
M & ON XW (a4); \\
M & ON XZ (a5); \\
M & ON WZ (a6); \\
M & ON XWZ (a7);
\end{align*}
\]

Use model constraint subcommand to test conditional indirect effects

You need to pick low, medium and high moderator values for W, Z, V, Q

for example, of 1 SD below mean, mean, 1 SD above mean

4 moderators, 3 values for each, gives 81 combinations

arbitrary naming convention for conditional indirect and total effects used below:

HHML = high value of W, high value of Z, medium value of V and low value of Q.

**MODEL CONSTRAINT:**

```
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)
```

```
ILLLL IMLLL IHLLL ILMLL IHMLL ILHLL IMHLL IHHLL
ILLML IMLML IHLML ILMML IHMLM ILHML IMHLM IHHLM
ILLLM IMLLM IHLLM ILMLM IHLML ILHML IMHLM IHHLM
ILLMM IMLMM IHLMM ILMMM IHMMM ILHMM IMHMM IHHMM
ILLHM IMLHM IHLHM ILMHM IHMMH ILHMM IMHMM IHHMM
ILLH IMLHL IHLHL ILMHL IHMLH ILHML IMHLM IHHLM
ILLNH IMLNL IHLNL ILMNL IHMNL ILHNH IHNHL NNHNL
ILLNH IMLNL IHLNL ILMNL IHMNL ILHNH IHNHL NNHNL
IHNH ILMNL IHLNL ILMNL IHMNL ILHNH IHNHL NNHNL
```

```
TLLLL TCLLL TLLLH TLHLL TLLHL THLLH TLHHL TLLHL THHHL
TLLML TCLML TLLMH TLMML TMMLL TMLML TMLML TMMLL THHHL
TLLHL TMLHL TLLHL TLMHL TMMLH TMLHL TMLHL TMMLH THHHL
TLLLM TMLLM TLLLM TMLLM TMLML TMLML TMLML TMLML THHHL
```
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*LOW_W*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q;
IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*MED_W*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_W*LOW_Z*LOW_Q + a7*b5*MED_W*LOW_Z*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*HIGH_W*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_W*LOW_Z*LOW_Q + a7*b5*HIGH_W*LOW_Z*LOW_Q;
ILMLL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
+ a7*b1*LOW_W*MED_Z + 
+ a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + 
+ a7*b4*MED_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + 
+ a5*b5*MED_Z*LOW_Q + a7*b5*LOW_W*MED_Z*LOW_Q;

IMMLL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
+ a7*b1*MED_W*MED_Z + 
+ a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + 
+ a7*b4*MED_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + 
+ a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q;

IHMLL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + 
+ a7*b1*HIGH_W*MED_Z + 
+ a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + 
+ a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + 
+ a5*b5*HIGH_Z*LOW_Q + a7*b5*HIGH_W*MED_Z*LOW_Q;

ILHLL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + 
+ a7*b1*LOW_W*HIGH_Z + 
+ a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + 
+ a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + 
+ a5*b5*MED_Z*LOW_Q + a7*b5*HIGH_W*MED_Z*LOW_Q;

IMHLL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + 
+ a7*b1*MED_W*HIGH_Z + 
+ a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V + 
+ a7*b4*MED_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + 
+ a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q;

IHHLL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + 
+ a7*b1*HIGH_W*HIGH_Z + 
+ a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + 
+ a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + 
+ a5*b5*MED_Z*LOW_Q + a7*b5*HIGH_W*MED_Z*LOW_Q;

ILLML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
+ a7*b1*LOW_W*LOW_Z + 
+ a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*LOW_V + 
+ a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*MED_Z*LOW_Q + a4*b5*LOW_W*MED_Q + 
+ a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q;
\[ a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_7 b_5 \text{LOW}_W \text{LOW}_Z \text{LOW}_Q; \]
\[ \text{IMML} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{MED}_W \text{MED}_V + a_5 b_4 \text{LOW}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{MED}_W \text{LOW}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + a_4 b_5 \text{MED}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{LOW}_Z \text{LOW}_Q; \]
\[ \text{IHLML} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{HIGH}_W \text{MED}_V + a_5 b_4 \text{LOW}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{LOW}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_7 b_5 \text{HIGH}_W \text{LOW}_Z \text{LOW}_Q; \]
\[ \text{ILMML} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + \]
\[ a_7 b_1 \text{LOW}_W \text{MED}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{LOW}_W \text{MED}_V + a_5 b_4 \text{MED}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{LOW}_W \text{MED}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + a_4 b_5 \text{LOW}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{LOW}_W \text{MED}_Z \text{LOW}_Q; \]
\[ \text{IMMML} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{MED}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{MED}_W \text{MED}_V + a_5 b_4 \text{MED}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{MED}_W \text{MED}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + a_4 b_5 \text{MED}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{MED}_Z \text{LOW}_Q; \]
\[ \text{IHMML} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{MED}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{HIGH}_W \text{MED}_V + a_5 b_4 \text{MED}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{MED}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{HIGH}_W \text{MED}_Z \text{LOW}_Q; \]
\[ \text{ILHML} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + \]
\[ a_7 b_1 \text{LOW}_W \text{HIGH}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{LOW}_W \text{MED}_V + a_5 b_4 \text{HIGH}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{LOW}_W \text{HIGH}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{LOW}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + a_7 b_5 \text{LOW}_W \text{HIGH}_Z \text{LOW}_Q; \]
\[ \text{IMHML} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{HIGH}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{MED}_W \text{MED}_V + a_5 b_4 \text{HIGH}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{MED}_W \text{HIGH}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{MED}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{HIGH}_Z \text{LOW}_Q; \]
\[ \text{IHHML} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{HIGH}_Z + \]
\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{HIGH}_W \text{MED}_V + a_5 b_4 \text{HIGH}_Z \text{MED}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{HIGH}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{HIGH}_Z \text{LOW}_Q; \]
\[ a7*b4*HIGH_W*HIGH_Z*MED_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q + a7*b5*HIGH_W*HIGH_Z*LOW_Q; \]

\[ ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q; \]

\[ IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a7*b4*MED_W*LOW_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q; \]

\[ IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q; \]

\[ IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q; \]

\[ IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q; \]
a4*b5*LOW_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*LOW_W*HIGH_Z*LOW_Q;
IMHHL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
a7*b4*MED_W*HIGH_Z*HIGH_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*MED_W*HIGH_Z*LOW_Q;
IHHL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
a7*b4*HIGH_W*HIGH_Z*HIGH_V + a1*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*HIGH_W*HIGH_Z*LOW_Q;
IIHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q;
IMLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*MED_W*LOW_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
a5*b5*LOW_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q;
IHLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*HIGH_W*LOW_Z*LOW_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q +
a5*b5*LOW_Z*MED_Q + a7*b5*HIGH_W*LOW_Z*MED_Q;
ILML = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q;
IMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q + a7*b5*HIGH_W*MED_Z*MED_Q;

ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*LOW_W*HIGH_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a7*b5*LOW_W*HIGH_Z*MED_Q;

IMHLM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*MED_W*HIGH_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a7*b5*MED_W*HIGH_Z*MED_Q;

IHHLM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*HIGH_W*HIGH_Z*LOW_V + a1*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a7*b5*HIGH_W*HIGH_Z*MED_Q;

ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V + a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q;

IMLMM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V + a7*b4*MED_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q;

IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*LOW_Z*MED_Q + a7*b5*HIGH_W*LOW_Z*MED_Q;

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\[
IMMMM = a_1b_1 + a_4b_1MED_W + a_5b_1MED_Z + \\
a_1b_4MED_V + a_4b_4MED_W*MED_V + a_5b_4MED_Z*MED_V + \\
a_7b_4MED_W*MED_Z*MED_V + a_1b_5MED_Q + a_4b_5MED_W*MED_Q + \\
a_5b_5MED_Z*MED_Q + a_7b_5MED_W*MED_Z*MED_Q;
\]

\[
IMHMM = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*HIGH_Z + \\
a_1b_4MED_V + a_4b_4*HIGH_W*MED_V + a_5b_4*HIGH_Z*MED_V + \\
a_7b_4*HIGH_W*MED_Z*MED_V + a_1b_5MED_Q + \\
a_4b_5*HIGH_W*MED_Q + \\
a_5b_5*HIGH_Z*MED_Q + a_7b_5*HIGH_W*MED_Z*MED_Q;
\]

\[
IHMMM = a_1b_1 + a_4b_1*LOW_W + a_5b_1*HIGH_Z + \\
a_1b_4MED_V + a_4b_4*LOW_W*MED_V + a_5b_4*HIGH_Z*MED_V + \\
a_7b_4*LOW_W*MED_Z*MED_V + a_1b_5MED_Q + \\
a_4b_5*LOW_W*MED_Q + \\
a_5b_5*LOW_Z*MED_Q + a_7b_5*LOW_W*HIGH_Z*MED_Q;
\]

\[
IHHMM = a_1b_1 + a_4b_1*MED_W + a_5b_1*HIGH_Z + \\
a_1b_4MED_V + a_4b_4*MED_W*MED_V + a_5b_4*HIGH_Z*MED_V + \\
a_7b_4*MED_W*MED_Z*MED_V + a_1b_5*MED_Q + \\
a_4b_5*MED_W*MED_Q + \\
a_5b_5*MED_Z*MED_Q + a_7b_5*MED_W*HIGH_Z*MED_Q;
\]

\[
IHMHMM = a_1b_1 + a_4b_1*LOW_W + a_5b_1*LOW_Z + \\
a_1b_4MED_V + a_4b_4*LOW_W*MED_V + a_5b_4*LOW_Z*MED_V + \\
a_7b_4*LOW_W*LOW_Z*MED_V + a_1b_5*MED_Q + \\
a_4b_5*LOW_W*MED_Q + \\
a_5b_5*LOW_Z*MED_Q + a_7b_5*LOW_W*LOW_Z*MED_Q;
\]

\[
IMLHM = a_1b_1 + a_4b_1*MED_W + a_5b_1*LOW_Z + \\
a_1b_4MED_V + a_4b_4*MED_W*MED_V + a_5b_4*LOW_Z*MED_V + \\
a_7b_4*MED_W*LOW_Z*MED_V + a_1b_5*MED_Q + \\
a_4b_5*MED_W*MED_Q + \\
a_5b_5*MED_Z*MED_Q + a_7b_5*MED_W*LOW_Z*MED_Q;
\]

\[
IHLHM = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*LOW_Z + \\
a_1b_4*HIGH_V + a_4b_4*LOW_W*HIGH_V + a_5b_4*LOW_Z*HIGH_V + \\
a_7b_4*LOW_W*LOW_Z*HIGH_V + a_1b_5*MED_Q + \\
a_4b_5*LOW_W*MED_Q + \\
a_5b_5*LOW_Z*MED_Q + a_7b_5*LOW_W*LOW_Z*MED_Q;
\]

\[
IHHLM = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*LOW_Z + \\
a_1b_4*HIGH_V + a_4b_4*HIGH_W*HIGH_V + a_5b_4*LOW_Z*HIGH_V + \\
a_7b_4*HIGH_W*LOW_Z*HIGH_V + a_1b_5*MED_Q + \\
a_4b_5*HIGH_W*MED_Q + \\
a_5b_5*HIGH_Z*MED_Q + a_7b_5*HIGH_W*HIGH_Z*MED_Q;
\]

\[
ILLHM = a_1b_1 + a_4b_1*LOW_W + a_5b_1*LOW_Z + \\
a_1b_4*HIGH_V + a_4b_4*LOW_W*HIGH_V + a_5b_4*LOW_Z*HIGH_V + \\
a_7b_4*LOW_W*LOW_Z*HIGH_V + a_1b_5*MED_Q + \\
a_4b_5*LOW_W*MED_Q + \\
a_5b_5*LOW_Z*MED_Q + a_7b_5*LOW_W*LOW_Z*MED_Q;
\]

\[
IHLHM = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*LOW_Z + \\
a_1b_4*HIGH_V + a_4b_4*HIGH_W*HIGH_V + a_5b_4*LOW_Z*HIGH_V + \\
a_7b_4*HIGH_W*LOW_Z*HIGH_V + a_1b_5*MED_Q + \\
a_4b_5*HIGH_W*MED_Q + \\
a_5b_5*HIGH_Z*MED_Q + a_7b_5*HIGH_W*HIGH_Z*MED_Q;
\]
\[ a_1*b_4*HIGH_V + a_4*b_4*HIGH_W*HIGH_V + a_5*b_4*LOW_Z*HIGH_V + a_7*b_4*HIGH_W*LOW_Z*HIGH_V + a_5*b_5*LOW_Z*MED_Q + a_7*b_5*HIGH_W*LOW_Z*MED_Q; \]

\[ ILMHM = a_1*b_1 + a_4*b_1*LOW_W + a_5*b_1*MED_Z + a_7*b_1*LOW_W*MED_Z + a_1*b_4*HIGH_V + a_4*b_4*LOW_W*HIGH_V + a_5*b_4*MED_Z*HIGH_V + a_7*b_4*LOW_W*MED_Z*HIGH_V + a_1*b_5*MED_Q + a_4*b_5*LOW_W*MED_Q + a_5*b_5*MED_Z*MED_Q + a_7*b_5*LOW_W*MED_Z*MED_Q; \]

\[ ILMHM = a_1*b_1 + a_4*b_1*LOW_W + a_5*b_1*MED_Z + a_7*b_1*LOW_W*MED_Z + a_1*b_4*HIGH_V + a_4*b_4*LOW_W*HIGH_V + a_5*b_4*MED_Z*HIGH_V + a_7*b_4*LOW_W*MED_Z*HIGH_V + a_1*b_5*MED_Q + a_4*b_5*LOW_W*MED_Q + a_5*b_5*MED_Z*MED_Q + a_7*b_5*LOW_W*MED_Z*MED_Q; \]

\[ ILMHM = a_1*b_1 + a_4*b_1*LOW_W + a_5*b_1*MED_Z + a_7*b_1*LOW_W*MED_Z + a_1*b_4*HIGH_V + a_4*b_4*LOW_W*HIGH_V + a_5*b_4*MED_Z*HIGH_V + a_7*b_4*LOW_W*MED_Z*HIGH_V + a_1*b_5*MED_Q + a_4*b_5*LOW_W*MED_Q + a_5*b_5*MED_Z*MED_Q + a_7*b_5*LOW_W*MED_Z*MED_Q; \]

\[ IMHM = a_1*b_1 + a_4*b_1*MED_W + a_5*b_1*MED_Z + a_7*b_1*MED_W*MED_Z + a_1*b_4*HIGH_V + a_4*b_4*MED_W*HIGH_V + a_5*b_4*MED_Z*HIGH_V + a_7*b_4*MED_W*MED_Z*HIGH_V + a_1*b_5*MED_Q + a_4*b_5*MED_W*MED_Q + a_5*b_5*MED_Z*MED_Q + a_7*b_5*MED_W*MED_Z*MED_Q; \]

\[ IMHM = a_1*b_1 + a_4*b_1*MED_W + a_5*b_1*MED_Z + a_7*b_1*MED_W*MED_Z + a_1*b_4*HIGH_V + a_4*b_4*MED_W*HIGH_V + a_5*b_4*MED_Z*HIGH_V + a_7*b_4*MED_W*MED_Z*HIGH_V + a_1*b_5*MED_Q + a_4*b_5*MED_W*MED_Q + a_5*b_5*MED_Z*MED_Q + a_7*b_5*MED_W*MED_Z*MED_Q; \]

\[ IMHM = a_1*b_1 + a_4*b_1*MED_W + a_5*b_1*MED_Z + a_7*b_1*MED_W*MED_Z + a_1*b_4*HIGH_V + a_4*b_4*MED_W*HIGH_V + a_5*b_4*MED_Z*HIGH_V + a_7*b_4*MED_W*MED_Z*HIGH_V + a_1*b_5*MED_Q + a_4*b_5*MED_W*MED_Q + a_5*b_5*MED_Z*MED_Q + a_7*b_5*MED_W*MED_Z*MED_Q; \]
ILLLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*LOW_W*LOW_Z*HIGH_Q;
IMLLH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*MED_W*LOW_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*HIGH_Q;
IHLLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*HIGH_W*LOW_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q;
ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q;
IMMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*MED_W*MED_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q;
IHMLH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*HIGH_W*MED_Z*HIGH_Q;
ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*LOW_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*MED_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*MED_W*HIGH_Z*HIGH_Q;
IHLH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*HIGH_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q;

ILLMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*HIGH_Q +

a4*b5*LOW_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*LOW_W*LOW_Z*HIGH_Q;
IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*MED_W*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*HIGH_Q;

IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q;

ILMMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V +
a7*b4*LOW_W*MED_Z*MED_V + a1*b5*HIGH_Q +

a4*b5*LOW_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q;
IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V +
a7*b4*MED_W*MED_Z*MED_V + a1*b5*HIGH_Q +

a4*b5*MED_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q;
IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V +
a7*b4*HIGH_W*MED_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*HIGH_W*MED_Z*HIGH_Q;

ILHMH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V +
a7*b4*LOW_W*HIGH_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q;
IMHMH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V +
a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*MED_W*HIGH_Z*HIGH_Q;
IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V +
a7*b4*HIGH_W*HIGH_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q;
ILLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*LOW_W*LOW_Z*HIGH_Q;
IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*MED_W*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*LOW_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q;
IHLHH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q;
ILMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*LOW_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*MED_Z +
a5*b5*MED_Z*MED_Z + a7*b5*LOW_W*MED_Z*MED_Z;
IMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*MED_W*MED_Z +
a5*b5*HIGH_Q + a7*b5*HIGH_Z*HIGH_Q;

IHMHH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
    a7*b1*HIGH_W*MED_Z +
    a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
    a7*b4*HIGH_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
    a4*b5*HIGH_W*HIGH_Q +
    a5*b5*MED_Z*HIGH_Q + a7*b5*HIGH_W*MED_Z*HIGH_Q;

ILHHH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
    a7*b1*LOW_W*HIGH_Z +
    a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
    a7*b4*LOW_W*HIGH_Z*HIGH_V + a1*b5*HIGH_Q +
    a4*b5*LOW_W*HIGH_Q +
    a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q;

IMHHH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
    a7*b1*MED_W*HIGH_Z +
    a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
    a7*b4*MED_W*HIGH_Z*HIGH_V + a1*b5*HIGH_Q +
    a4*b5*MED_W*HIGH_Q +
    a5*b5*HIGH_Z*HIGH_Q + a7*b5*MED_W*HIGH_Z*HIGH_Q;

IHHHH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
    a7*b1*HIGH_W*HIGH_Z +
    a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_W*HIGH_Q +
    a7*b4*HIGH_W*HIGH_Q + a1*b5*HIGH_Z +
    a4*b5*HIGH_Z*HIGH_Q +
    a5*b5*HIGH_W*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q;

! Calc conditional total effects for each combination of moderator values

TLLLL = ILLLL + cdash;
TMLLL = IMLLL + cdash;
THLLL = IHLLL + cdash;
TLMLL = IMLML + cdash;
TMMLL = IMMLL + cdash;
THMLL = IHMLL + cdash;
TLHLL = IHLML + cdash;
TMHLL = IMHLL + cdash;
THHLL = IHHLL + cdash;
TLLML = IMLML + cdash;
TMLML = IMLML + cdash;
THLML = IHLML + cdash;
TLMML = ILMML + cdash;
TMMML = IMMML + cdash;
THMML = IHMML + cdash;

TLHML = ILHML + cdash;
TMHML = IMHML + cdash;
THHML = IHHML + cdash;

TLLHL = ILLHL + cdash;
TMLHL = IMLHL + cdash;
THLHL = IHLHL + cdash;

TLMHL = ILMHL + cdash;
TMMHL = IMMHL + cdash;
THMHHL = IHMHL + cdash;

TLHHL = ILHHL + cdash;
TMHHL = IMHHL + cdash;
THHHL = IHHHL + cdash;

TLLLM = ILLLM + cdash;
TMLLM = IMLLM + cdash;
THLLM = IHLLM + cdash;

TLMLM = ILMLM + cdash;
TMMLM = IMMML + cdash;
THMLM = IHMLM + cdash;

TLHLM = ILHLM + cdash;
TMHLM = IMHLM + cdash;
THHLM = IHHLM + cdash;

TLLMM = ILLMM + cdash;
TMLMM = IMLMM + cdash;
THLMM = IHLMM + cdash;

TLMMM = ILMMM + cdash;
TMMMM = IMMMM + cdash;
THMMM = IHMMM + cdash;

TLHMM = ILHMM + cdash;
TMHMM = IMHMM + cdash;
THHMM = IHHMM + cdash;

TLLHM = ILLHM + cdash;
TMLHM = IMLHM + cdash;
THLHM = IHLHM + cdash;

TLMHM = ILMHM + cdash;
TMMHM = IMMHM + cdash;
THMHM = IHMHM + cdash;

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\[ TLHHM = ILHHM + cdash; \]
\[ TMHHM = IMHHM + cdash; \]
\[ THHHM = IHHHM + cdash; \]
\[ TLLLH = ILLLH + cdash; \]
\[ TMLLH = IMLLH + cdash; \]
\[ THLLH = IHLLH + cdash; \]
\[ TLMLH = ILMLH + cdash; \]
\[ TMMLH = IMMLH + cdash; \]
\[ THMLH = IHMLH + cdash; \]
\[ TLHLH = ILHLH + cdash; \]
\[ TMHLH = IMHLH + cdash; \]
\[ THHLH = IHHLH + cdash; \]
\[ TLLLH = ILLLH + cdash; \]
\[ TMLMH = IMLMH + cdash; \]
\[ THLMLH = ILMLH + cdash; \]
\[ TMLMH = IMLMH + cdash; \]
\[ THMLH = IHMLH + cdash; \]
\[ TLHLH = ILHLH + cdash; \]
\[ TMHLH = IMHLH + cdash; \]
\[ THHLH = IHHLH + cdash; \]

\[ TLLLH = ILLLH + cdash; \]
\[ TMLLH = IMLLH + cdash; \]
\[ THLLH = IHLLH + cdash; \]
\[ TLMLH = ILMLH + cdash; \]
\[ TMMLH = IMMLH + cdash; \]
\[ THMLH = IHMLH + cdash; \]
\[ TLHLH = ILHLH + cdash; \]
\[ TMHLH = IMHLH + cdash; \]
\[ THHLH = IHHLH + cdash; \]
\[ TLLLH = ILLLH + cdash; \]
\[ TMLLH = IMLLH + cdash; \]
\[ THLLH = IHLLH + cdash; \]
\[ TLMLH = ILMLH + cdash; \]
\[ TMMLH = IMMLH + cdash; \]
\[ THMLH = IHMLH + cdash; \]
\[ TLHLH = ILHLH + cdash; \]
\[ TMHLH = IMHLH + cdash; \]
\[ THHLH = IHHLH + cdash; \]

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1, 5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLLPL PMLLP PHLLP PLLPL PMLLP PHLLL PLHLL PMHLL PHHLL
PLLML PMLML PLHML PLLML PMMLP PHMLL PHHML
PLLHL PMLHL PLHHL PLMHL PHMHL PLHHL PMHHL PHHHL

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LOOP(XVAL, 1, 5, 0.1);

PLLLL = ILLLL*XVAL;
PMLLL = IMLLL*XVAL;
PHLLL = IHLLL*XVAL;

PLMLL = IMLLL*XVAL;
PMMLL = IMMLL*XVAL;
PHMLL = IHMLL*XVAL;

PLHLL = IILHLL*XVAL;
PMHLL = IMHLL*XVAL;
PHHLL = IHHLL*XVAL;

PLLML = ILLL*XVAL;
PMLML = IMLML*XVAL;
PHLML = IHLML*XVAL;

PLMML = ILMML*XVAL;
PMMML = IMMML*XVAL;
PHMML = IHMML*XVAL;

PLHML = IILHML*XVAL;
PMHML = IMHML*XVAL;
PHHML = IHHML*XVAL;

PLLHL = ILLL*XVAL;
PMLHL = IMLHL*XVAL;
PHLHL = IHLHL*XVAL;

PLMHL = ILMHL*XVAL;
PMMHL = IMMHL*XVAL;
PHMHL = IHMHL*XVAL;

PLHHL = IILHHL*XVAL;
PMHHL = IMHHL*XVAL;
PHHHL = IHHHL*XVAL;

PLLMM = ILLLM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLM = IHLHM*XVAL;

PLMLM = ILMLM*XVAL;
PMMLM = IMMML*XVAL;
PHMLM = IHMML*XVAL;

PLHLM = IILHLM*XVAL;
PMHLM = IMHLM*XVAL;
PHHLM = IHHLM*XVAL;
\[
\begin{align*}
\text{PLHLM} &= \text{ILHLM} \times \text{XVAL}; \\
\text{PMHLM} &= \text{IMHLM} \times \text{XVAL}; \\
\text{PHHLM} &= \text{IHHLM} \times \text{XVAL}; \\
\text{PLLMM} &= \text{ILLMM} \times \text{XVAL}; \\
\text{PMLMM} &= \text{IMLMM} \times \text{XVAL}; \\
\text{PHHLM} &= \text{IHLMM} \times \text{XVAL}; \\
\text{PLHMM} &= \text{ILMMM} \times \text{XVAL}; \\
\text{PMMHM} &= \text{IMMMM} \times \text{XVAL}; \\
\text{PHHHM} &= \text{IHHMM} \times \text{XVAL}; \\
\text{PLLHM} &= \text{ILLHM} \times \text{XVAL}; \\
\text{PMLHM} &= \text{IMLHM} \times \text{XVAL}; \\
\text{PHHLM} &= \text{IHLHM} \times \text{XVAL}; \\
\text{PLHMM} &= \text{ILMHM} \times \text{XVAL}; \\
\text{PMLLM} &= \text{IMMLM} \times \text{XVAL}; \\
\text{PHHLM} &= \text{IHHLM} \times \text{XVAL}; \\
\text{PMLLM} &= \text{IMLHM} \times \text{XVAL}; \\
\end{align*}
\]
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PHLHH = IHLHH*XVAL;
PLMHH = ILMHH*XVAL;
PMMHH = IMMHH*XVAL;
PHMHH = IHMHH*XVAL;
PLHHH = ILHHH*XVAL;
PMHHH = IMHHH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 47: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + b_6 VQ + b_7 MVQ + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + b_6 VQ + b_7 MVQ + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ) + b_2 V + b_3 Q + b_4 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ) V + b_5 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ) Q + b_6 VQ + b_7 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ) VQ + c'X \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + b2V + b3Q +
a0b4V + a1b4XV + a2b4WV + a3b4ZV + a4b4XWV + a5b4XZV + a0b5Q + a1b5XQ +
a2b5WQ + a3b5ZQ + a4b5XWQ + a5b5XZQ + b6VQ + a0b7VQ + a1b7XVQ +
a2b7WVQ + a3b7ZVQ + a4b7XWVQ + a5b7XZVQ + c'X

Hence... grouping terms into form \( Y = a + bX \)

\[
Y = (b0 + a0b1 + a2b1W + a3b1Z + b2V + b3Q + a0b4V + a2b4WV + a3b4ZV +
a0b5Q + a2b5WQ + a3b5ZQ + b6VQ + a0b7VQ + a2b7WVQ + a3b7ZVQ) + (a1b1 +
a4b1W + a5b1Z + a1b4V + a4b4WV + a5b4ZV + a1b5Q + a4b5WQ + a5b5ZQ +
a1b7VQ + a4b7WVQ + a5b7ZVQ + c')X
\]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V, Q \):

\[
a1b1 + a4b1W + a5b1Z + a1b4V + a4b4WV + a5b4ZV + a1b5Q + a4b5WQ +
a5b5ZQ + a1b7VQ + a4b7WVQ + a5b7ZVQ = (a1 + a4W + a5Z) (b1 + b4V + b5Q +
b7VQ)
\]

One direct effect of \( X \) on \( Y \):

\[
c'
\]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y

USEVARIABLES = X M W Z V Q Y XW XZ VQ MV MQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES
! subcommand above

DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
    VQ = V*Q;
    MVQ = M*V*Q;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;
```
! In model statement name each path and intercept using parentheses

MODEL:

[Y] (b0);
Y ON M (b1);
Y ON V (b2);
Y ON Q (b3);
Y ON MV (b4);
Y ON MQ (b5);
Y ON VQ (b6);
Y ON MVQ (b7);

Y ON X (cdash);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V)

ILLLL IMLLL IHLLL ILMLL IMMLL IHMLL ILHLL IMHLL IHHLL
ILLML IMLML IHLML ILMML IMMLL IHMLL ILHML IMHML IHHML
ILLLM IMLLM IHLLM ILMML IMMLL IHMLL ILHML IMHML IHHML
ILLMM IMLMM IHLMM ILMMM IMMMM IHMMM ILHMM IMHMM IHHMM
ILLHM IMLHM IHLHM ILMHM IMHMH IHMMH ILHMM IMHMM IHHMM
ILLHH IMLHH IHLHH ILMHH IMMHH IHMHH ILHMH IHHHH
TLLLL TLMLL TLLML TLMLL TMMLL TMLML TLMLL TMMLL THLML
TLLML TMLML TLMLL TLMLL TMMLL TMLML TLMLL TMMLL THHML
TLLHL TMLHL TLLHL TLMLL TMMLL TMMLL TLMLL TMMLL THHHL
TLLML TMLML TLMLL TLMLL TMMLL TMMLL TLMLL TMMLL THHLM

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a1*b7*LOW_V*LOW_Q + a4*b7*LOW_W*LOW_V*LOW_Q + a5*b7*LOW_Z*LOW_V*LOW_Q;
IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a1*b7*LOW_V*LOW_Q + a4*b7*MED_W*LOW_V*LOW_Q + a5*b7*LOW_Z*LOW_V*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a1*b7*LOW_V*LOW_Q + a4*b7*HIGH_W*LOW_V*LOW_Q + a5*b7*LOW_Z*LOW_V*LOW_Q;
\[ a_4 b_5 \text{HIGH}_W \text{LOW}_Q + a_5 b_5 \text{LOW}_Z \text{LOW}_Q + \\
 a_1 b_7 \text{LOW}_V \text{LOW}_Q + \\
a_4 b_7 \text{HIGH}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{LOW}_Z \text{LOW}_V \text{LOW}_Q; \\
\]

ILMLL = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{LOW}_W \text{LOW}_Q + a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_1 b_7 \text{LOW}_V \text{LOW}_Q + \\
a_4 b_7 \text{LOW}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{MED}_Z \text{LOW}_V \text{LOW}_Q; \\
\]

IMMLL = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{MED}_W \text{LOW}_Q + a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_1 b_7 \text{LOW}_V \text{LOW}_Q + \\
a_4 b_7 \text{MED}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{MED}_Z \text{LOW}_V \text{LOW}_Q; \\
\]

ILHLL = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{LOW}_W \text{LOW}_Q + a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_1 b_7 \text{LOW}_V \text{LOW}_Q + \\
a_4 b_7 \text{LOW}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{MED}_Z \text{LOW}_V \text{LOW}_Q; \\
\]

IMHLL = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{MED}_W \text{LOW}_Q + a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_1 b_7 \text{LOW}_V \text{LOW}_Q + \\
a_4 b_7 \text{MED}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{HIGH}_Z \text{LOW}_V \text{LOW}_Q; \\
\]

INMML = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{HIGH}_W \text{LOW}_Q + a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_1 b_7 \text{LOW}_V \text{LOW}_Q + \\
a_4 b_7 \text{HIGH}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{MED}_Z \text{LOW}_V \text{LOW}_Q; \\
\]

IHHLL = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{HIGH}_W \text{LOW}_Q + a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + a_1 b_7 \text{LOW}_V \text{LOW}_Q + \\
a_4 b_7 \text{HIGH}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{HIGH}_Z \text{LOW}_V \text{LOW}_Q; \\
\]

ILLML = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{MED}_V + \\
a_4 b_4 \text{LOW}_W \text{MED}_V + a_5 b_4 \text{LOW}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{LOW}_W \text{LOW}_Q + a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_1 b_7 \text{MED}_V \text{LOW}_Q + \\
a_4 b_7 \text{LOW}_W \text{MED}_V \text{LOW}_Q + a_5 b_7 \text{LOW}_Z \text{MED}_V \text{LOW}_Q; \\
\]

IMLML = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{MED}_V + \\
a_4 b_4 \text{MED}_W \text{MED}_V + a_5 b_4 \text{LOW}_Z \text{MED}_V + a_1 b_5 \text{LOW}_Q + \\
a_4 b_5 \text{MED}_W \text{LOW}_Q + a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_1 b_7 \text{MED}_V \text{LOW}_Q + \\
a_4 b_7 \text{MED}_W \text{LOW}_V \text{LOW}_Q + a_5 b_7 \text{LOW}_Z \text{MED}_V \text{LOW}_Q; \\
\]

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\[
a_{4}b_{7}\text{MED}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{LOW}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
IHLML = \(a_{1}b_{1} + a_{4}b_{1}\text{HIGH}_{W} + a_{5}b_{1}\text{LOW}_{Z} + a_{1}b_{4}\text{MED}_{V}\)

\[\]
\[
a_{4}b_{4}\text{HIGH}_{W}\text{MED}_{V} + a_{5}b_{4}\text{LOW}_{Z}\text{MED}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{HIGH}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{LOW}_{Z}\text{LOW}_{Q} +
\]
\[
a_{1}b_{7}\text{MED}_{V}\text{LOW}_{Q} +
\]
\[
a_{4}b_{7}\text{HIGH}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{LOW}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
ILMMML = \(a_{1}b_{1} + a_{4}b_{1}\text{LOW}_{W} + a_{5}b_{1}\text{MED}_{Z} + a_{1}b_{4}\text{MED}_{V} +
\]
\[
a_{4}b_{4}\text{LOW}_{W}\text{MED}_{V} + a_{5}b_{4}\text{MED}_{Z}\text{MED}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{LOW}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{MED}_{Z}\text{LOW}_{Q} + a_{1}b_{7}\text{MED}_{V}\text{LOW}_{Q} +
\]
\[
a_{4}b_{7}\text{LOW}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{MED}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
IMMML = \(a_{1}b_{1} + a_{4}b_{1}\text{MED}_{W} + a_{5}b_{1}\text{MED}_{Z} + a_{1}b_{4}\text{MED}_{V} +
\]
\[
a_{4}b_{4}\text{MED}_{W}\text{MED}_{V} + a_{5}b_{4}\text{MED}_{Z}\text{MED}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{MED}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{MED}_{Z}\text{LOW}_{Q} + a_{1}b_{7}\text{MED}_{V}\text{LOW}_{Q} +
\]
\[
a_{4}b_{7}\text{MED}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{MED}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
IMHMM = \(a_{1}b_{1} + a_{4}b_{1}\text{HIGH}_{W} + a_{5}b_{1}\text{MED}_{Z} + a_{1}b_{4}\text{MED}_{V} +
\]
\[
a_{4}b_{4}\text{HIGH}_{W}\text{MED}_{V} + a_{5}b_{4}\text{MED}_{Z}\text{MED}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{HIGH}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{MED}_{Z}\text{LOW}_{Q} + a_{1}b_{7}\text{MED}_{V}\text{LOW}_{Q} +
\]
\[
a_{4}b_{7}\text{HIGH}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{MED}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
IHMMML = \(a_{1}b_{1} + a_{4}b_{1}\text{LOW}_{W} + a_{5}b_{1}\text{HIGH}_{Z} + a_{1}b_{4}\text{MED}_{V} +
\]
\[
a_{4}b_{4}\text{LOW}_{W}\text{MED}_{V} + a_{5}b_{4}\text{HIGH}_{Z}\text{MED}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{LOW}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{HIGH}_{Z}\text{LOW}_{Q} + a_{1}b_{7}\text{MED}_{V}\text{LOW}_{Q} +
\]
\[
a_{4}b_{7}\text{LOW}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{HIGH}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
IIHML = \(a_{1}b_{1} + a_{4}b_{1}\text{MED}_{W} + a_{5}b_{1}\text{HIGH}_{Z} + a_{1}b_{4}\text{MED}_{V} +
\]
\[
a_{4}b_{4}\text{MED}_{W}\text{MED}_{V} + a_{5}b_{4}\text{HIGH}_{Z}\text{MED}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{MED}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{HIGH}_{Z}\text{LOW}_{Q} + a_{1}b_{7}\text{MED}_{V}\text{LOW}_{Q} +
\]
\[
a_{4}b_{7}\text{MED}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{HIGH}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
IHHML = \(a_{1}b_{1} + a_{4}b_{1}\text{HIGH}_{W} + a_{5}b_{1}\text{HIGH}_{Z} + a_{1}b_{4}\text{MED}_{V} +
\]
\[
a_{4}b_{4}\text{HIGH}_{W}\text{MED}_{V} + a_{5}b_{4}\text{HIGH}_{Z}\text{MED}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{HIGH}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{HIGH}_{Z}\text{LOW}_{Q} + a_{1}b_{7}\text{MED}_{V}\text{LOW}_{Q} +
\]
\[
a_{4}b_{7}\text{HIGH}_{W}\text{MED}_{V}\text{LOW}_{Q} + a_{5}b_{7}\text{HIGH}_{Z}\text{MED}_{V}\text{LOW}_{Q};
\]
IHLMHL = \(a_{1}b_{1} + a_{4}b_{1}\text{LOW}_{W} + a_{5}b_{1}\text{LOW}_{Z} + a_{1}b_{4}\text{HIGH}_{V} +
\]
\[
a_{4}b_{4}\text{LOW}_{W}\text{HIGH}_{V} + a_{5}b_{4}\text{LOW}_{Z}\text{HIGH}_{V} + a_{1}b_{5}\text{LOW}_{Q} +
\]
\[
a_{4}b_{5}\text{LOW}_{W}\text{LOW}_{Q} + a_{5}b_{5}\text{LOW}_{Z}\text{LOW}_{Q} + a_{1}b_{7}\text{HIGH}_{V}\text{LOW}_{Q} +
\]
an\*b7*LOW_W*HIGH_V*LOW_Q + a5\*b7*LOW_Z*HIGH_V*LOW_Q;
IMLHL = a1\*b1 + a4\*b1*MED_W + a5\*b1*LOW_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*MED_W*HIGH_V & + a5\*b4*LOW_Z*HIGH_V + a1\*b5*LOW_Q + \\
an\*b5*MED_W*LOW_Q & + a5\*b5*LOW_Z*LOW_Q +
\end{align*}

a1\*b7*HIGH_V*LOW_Q +
\begin{align*}
an\*b7*MED_W*HIGH_V*LOW_Q & + a5\*b7*LOW_Z*HIGH_V*LOW_Q;
IHLHL = a1\*b1 + a4\*b1*HIGH_W + a5\*b1*LOW_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*HIGH_W*HIGH_V & + a5\*b4*LOW_Z*HIGH_V + a1\*b5*LOW_Q + \\
an\*b5*HIGH_W*LOW_Q & + a5\*b5*LOW_Z*LOW_Q +
\end{align*}

a1\*b7*HIGH_V*LOW_Q +
\begin{align*}
an\*b7*MED_W*HIGH_V*LOW_Q & + a5\*b7*LOW_Z*HIGH_V*LOW_Q;
IMHL = a1\*b1 + a4\*b1*LOW_W + a5\*b1*MED_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*LOW_W*HIGH_V & + a5\*b4*MED_Z*HIGH_V + a1\*b5*LOW_Q + \\
an\*b5*LOW_W*LOW_Q & + a5\*b5*MED_Z*LOW_Q +
\end{align*}

a1\*b7*HIGH_V*LOW_Q +
\begin{align*}
an\*b7*LOW_W*HIGH_V*LOW_Q & + a5\*b7*MED_Z*HIGH_V*LOW_Q;
IMMH = a1\*b1 + a4\*b1*LOW_W + a5\*b1*MED_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*LOW_W*HIGH_V & + a5\*b4*MED_Z*HIGH_V + a1\*b5*LOW_Q + \\
an\*b5*LOW_W*LOW_Q & + a5\*b5*MED_Z*LOW_Q +
\end{align*}

a1\*b7*HIGH_V*LOW_Q +
\begin{align*}
an\*b7*MED_W*HIGH_V*LOW_Q & + a5\*b7*LOW_Z*HIGH_V*LOW_Q;
IMMHL = a1\*b1 + a4\*b1*LOW_W + a5\*b1*MED_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*LOW_W*HIGH_V & + a5\*b4*MED_Z*HIGH_V + a1\*b5*LOW_Q + \\
an\*b5*LOW_W*LOW_Q & + a5\*b5*MED_Z*LOW_Q +
\end{align*}

a1\*b7*HIGH_V*LOW_Q +
\begin{align*}
an\*b7*LOW_W*HIGH_V*LOW_Q & + a5\*b7*MED_Z*HIGH_V*LOW_Q;
IHMHL = a1\*b1 + a4\*b1*LOW_W + a5\*b1*HIGH_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*LOW_W*HIGH_V & + a5\*b4*HIGH_Z*HIGH_V + a1\*b5*LOW_Q + \\
an\*b5*LOW_W*LOW_Q & + a5\*b5*HIGH_Z*LOW_Q +
\end{align*}

a1\*b7*HIGH_V*LOW_Q +
\begin{align*}
an\*b7*LOW_W*HIGH_V*LOW_Q & + a5\*b7*HIGH_Z*HIGH_V*LOW_Q;
IMHHL = a1\*b1 + a4\*b1*LOW_W + a5\*b1*HIGH_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*LOW_W*HIGH_V & + a5\*b4*HIGH_Z*HIGH_V + a1\*b5*LOW_Q + \\
an\*b5*LOW_W*LOW_Q & + a5\*b5*HIGH_Z*LOW_Q +
\end{align*}

a1\*b7*HIGH_V*LOW_Q +
\begin{align*}
an\*b7*LOW_W*HIGH_V*LOW_Q & + a5\*b7*HIGH_Z*HIGH_V*LOW_Q;
IHHL = a1\*b1 + a4\*b1*LOW_W + a5\*b1*HIGH_Z + a1\*b4*HIGH_V
 +
\begin{align*}
an\*b4\*LOW_W*HIGH_V & + a5\*b4*HIGH_Z*HIGH_V + a1\*b5*LOW_Q +
\end{align*}

\begin{align*}
a &= \text{LOW}_W, \text{LOW}_Z, \text{LOW}_Q, \text{MED}_W, \text{MED}_Z, \text{MED}_Q, \text{HIGH}_W, \text{HIGH}_Z, \text{HIGH}_Q.
\end{align*}
\[ + \quad a_4 b_5 \text{HIGH}_W \text{LOW}_Q + a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + \\
\] \[ + \quad a_1 b_7 \text{HIGH}_V \text{LOW}_Q + \\
\]
\[ a_4 b_7 \text{HIGH}_W \text{HIGH}_V \text{LOW}_Q + a_5 b_7 \text{HIGH}_Z \text{HIGH}_V \text{LOW}_Q; \]

Illlm = \[a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{LOW}_W \text{MED}_Q + a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_1 b_7 \text{LOW}_V \text{MED}_Q \]

Imllm = \[a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{MED}_W \text{MED}_Q + a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_1 b_7 \text{LOW}_V \text{MED}_Q \]

Illumm = \[a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{HIGH}_W \text{MED}_Q + a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_1 b_7 \text{LOW}_V \text{MED}_Q \]

Ilmlmm = \[a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{MED}_W \text{MED}_Q + a_5 b_5 \text{MED}_Z \text{MED}_Q + a_1 b_7 \text{MED}_V \text{MED}_Q \]

Ilhllm = \[a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{LOW}_W \text{MED}_Q + a_5 b_5 \text{HIGH}_Z \text{MED}_Q + a_1 b_7 \text{LOW}_V \text{MED}_Q \]

Ilmlhm = \[a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{MED}_W \text{MED}_Q + a_5 b_5 \text{HIGH}_Z \text{MED}_Q + a_1 b_7 \text{MED}_V \text{MED}_Q \]

Imhllm = \[a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{HIGH}_W \text{MED}_Q + a_5 b_5 \text{HIGH}_Z \text{MED}_Q + a_1 b_7 \text{MED}_V \text{MED}_Q \]

Immlhm = \[a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{LOW}_W \text{MED}_Q + a_5 b_5 \text{MED}_Z \text{MED}_Q + a_1 b_7 \text{LOW}_V \text{MED}_Q \]

Imhmlm = \[a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + \\
a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{HIGH}_W \text{MED}_Q + a_5 b_5 \text{HIGH}_Z \text{MED}_Q + a_1 b_7 \text{MED}_V \text{MED}_Q \]
\[ a_1 b_7 \cdot \text{LOW}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{MED}_W \cdot \text{LOW}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{HIGH}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q; \]
\[ \text{IHHLM} = a_1 b_1 + a_4 b_1 \cdot \text{HIGH}_W + a_5 b_1 \cdot \text{HIGH}_Z + a_1 b_4 \cdot \text{LOW}_V + \]
\[ a_4 b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a_5 b_4 \cdot \text{HIGH}_Z \cdot \text{LOW}_V + a_1 b_5 \cdot \text{MED}_Q + \]
\[ a_4 b_5 \cdot \text{HIGH}_W \cdot \text{MED}_Q + a_5 b_5 \cdot \text{HIGH}_Z \cdot \text{MED}_Q + \]
\[ a_1 b_7 \cdot \text{LOW}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{HIGH}_W \cdot \text{LOW}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{HIGH}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q; \]
\[ \text{ILLMM} = a_1 b_1 + a_4 b_1 \cdot \text{LOW}_W + a_5 b_1 \cdot \text{LOW}_Z + a_1 b_4 \cdot \text{MED}_V + \]
\[ a_4 b_4 \cdot \text{LOW}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{LOW}_Z \cdot \text{MED}_V + a_1 b_5 \cdot \text{MED}_Q + \]
\[ a_4 b_5 \cdot \text{LOW}_W \cdot \text{MED}_Q + a_5 b_5 \cdot \text{LOW}_Z \cdot \text{MED}_Q + \]
\[ a_1 b_7 \cdot \text{MED}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{LOW}_W \cdot \text{MED}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{LOW}_Z \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{IMLMM} = a_1 b_1 + a_4 b_1 \cdot \text{MED}_W + a_5 b_1 \cdot \text{LOW}_Z + a_1 b_4 \cdot \text{MED}_V + \]
\[ a_4 b_4 \cdot \text{MED}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{LOW}_Z \cdot \text{MED}_V + a_1 b_5 \cdot \text{MED}_Q + \]
\[ a_4 b_5 \cdot \text{MED}_W \cdot \text{MED}_Q + a_5 b_5 \cdot \text{LOW}_Z \cdot \text{MED}_Q + \]
\[ a_1 b_7 \cdot \text{MED}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{HIGH}_W \cdot \text{MED}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{LOW}_Z \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{IHLMM} = a_1 b_1 + a_4 b_1 \cdot \text{HIGH}_W + a_5 b_1 \cdot \text{LOW}_Z + a_1 b_4 \cdot \text{MED}_V + \]
\[ a_4 b_4 \cdot \text{HIGH}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{LOW}_Z \cdot \text{MED}_V + a_1 b_5 \cdot \text{MED}_Q + \]
\[ a_4 b_5 \cdot \text{HIGH}_W \cdot \text{MED}_Q + a_5 b_5 \cdot \text{LOW}_Z \cdot \text{MED}_Q + \]
\[ a_1 b_7 \cdot \text{MED}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{LOW}_W \cdot \text{MED}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{MED}_Z \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{ILMMM} = a_1 b_1 + a_4 b_1 \cdot \text{LOW}_W + a_5 b_1 \cdot \text{MED}_Z + a_1 b_4 \cdot \text{MED}_V + \]
\[ a_4 b_4 \cdot \text{LOW}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{MED}_Z \cdot \text{MED}_V + a_1 b_5 \cdot \text{MED}_Q + \]
\[ a_4 b_5 \cdot \text{LOW}_W \cdot \text{MED}_Q + a_5 b_5 \cdot \text{MED}_Z \cdot \text{MED}_Q + \]
\[ a_1 b_7 \cdot \text{MED}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{HIGH}_W \cdot \text{MED}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{MED}_Z \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{IHMMM} = a_1 b_1 + a_4 b_1 \cdot \text{HIGH}_W + a_5 b_1 \cdot \text{MED}_Z + a_1 b_4 \cdot \text{MED}_V + \]
\[ a_4 b_4 \cdot \text{HIGH}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{MED}_Z \cdot \text{MED}_V + a_1 b_5 \cdot \text{MED}_Q + \]
\[ a_4 b_5 \cdot \text{HIGH}_W \cdot \text{MED}_Q + a_5 b_5 \cdot \text{MED}_Z \cdot \text{MED}_Q + \]
\[ a_1 b_7 \cdot \text{MED}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{LOW}_W \cdot \text{MED}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{MED}_Z \cdot \text{MED}_V \cdot \text{MED}_Q; \]
\[ \text{ILHMM} = a_1 b_1 + a_4 b_1 \cdot \text{LOW}_W + a_5 b_1 \cdot \text{HIGH}_Z + a_1 b_4 \cdot \text{MED}_V + \]
\[ a_4 b_4 \cdot \text{LOW}_W \cdot \text{MED}_V + a_5 b_4 \cdot \text{HIGH}_Z \cdot \text{MED}_V + a_1 b_5 \cdot \text{MED}_Q + \]
\[ a_4 b_5 \cdot \text{LOW}_W \cdot \text{MED}_Q + a_5 b_5 \cdot \text{HIGH}_Z \cdot \text{MED}_Q + \]
\[ a_1 b_7 \cdot \text{MED}_V \cdot \text{MED}_Q + \]
\[ a_4 b_7 \cdot \text{LOW}_W \cdot \text{MED}_V \cdot \text{MED}_Q + a_5 b_7 \cdot \text{HIGH}_Z \cdot \text{MED}_V \cdot \text{MED}_Q; \]
IMHMM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b4*MED_V
+ a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q + a5*b5*HIGH_Z*MED_Q +
a1*b7*MED_V*MED_Q +
a4*b7*MED_W*MED_V*MED_Q + a5*b7*HIGH_Z*MED_V*MED_Q;
IHHMM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*MED_V
+ a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q + a5*b5*HIGH_Z*MED_Q +
a1*b7*HIGH_V*MED_Q +
a4*b7*HIGH_W*MED_V*MED_Q + a5*b7*HIGH_Z*MED_V*MED_Q;
ILLHM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*HIGH_V
+ a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*LOW_W*MED_Q + a5*b5*LOW_Z*MED_Q +
a1*b7*LOW_V*MED_Q +
a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*LOW_Z*HIGH_V*MED_Q;
IMLHM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*HIGH_V
+ a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q + a5*b5*LOW_Z*MED_Q +
a1*b7*MED_V*MED_Q +
a4*b7*MED_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q;
IHLHM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*HIGH_V
+ a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q + a5*b5*LOW_Z*MED_Q +
a1*b7*HIGH_V*MED_Q +
a4*b7*HIGH_W*HIGH_V*MED_Q + a5*b7*LOW_Z*HIGH_V*MED_Q;
ILMHM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V
+ a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*LOW_W*MED_Q + a5*b5*MED_Z*MED_Q +
a1*b7*LOW_V*MED_Q +
a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q;
IMMHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*HIGH_V
+ a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q +
a1*b7*MED_V*MED_Q +
a4*b7*MED_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q;
IHMHM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*HIGH_V
+ a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q +
a1*b7*HIGH_V*MED_Q +
a4*b7*HIGH_W*HIGH_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q;
IMHMM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b4*MED_V
+ a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q + a5*b5*HIGH_Z*MED_Q +
a1*b7*MED_V*MED_Q +
a4*b7*MED_W*MED_V*MED_Q + a5*b7*HIGH_Z*MED_V*MED_Q;
\[ a1*b7*HIGH_V*MED_Q + a4*b7*HIGH_W*HIGH_V*MED_Q + a5*b7*MED_Z*HIGH_V*MED_Q; \]
\[ ILHMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*HIGH_Z*MED_Q; \]
\[ IMHHM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*HIGH_Z*MED_Q; \]
\[ IHHHM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*HIGH_W*HIGH_V*MED_Q + a5*b7*HIGH_Z*MED_Q; \]
\[ ILLLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q + a1*b7*LOW_V*HIGH_Q + a4*b7*LOW_W*LOW_V*HIGH_Q + a5*b7*LOW_Z*LOW_V*HIGH_Q; \]
\[ IMLLH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q + a1*b7*MED_Q + a4*b7*MED_W*MED_Q + a5*b7*MED_Z*MED_Q; \]
\[ IHLLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q + a1*b7*MED_Q + a4*b7*MED_W*MED_Q + a5*b7*MED_Z*MED_Q; \]
\[ IMLHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q; \]
\[ IMMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q; \]
a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
IHMLH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*LOW_V +
a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
a1*b7*LOW_V*HIGH_Q +
a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*LOW_V +
a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q +
a1*b7*LOW_V*HIGH_Q +
a4*b7*LOW_W*LOW_V*HIGH_Q + a5*b7*HIGH_Z*LOW_V*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b4*LOW_V +
a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q +
a1*b7*LOW_V*HIGH_Q +
a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*HIGH_Z*LOW_V*HIGH_Q;
IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*MED_V +
a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*MED_W*MED_V + a5*b5*MED_Z*MED_V + a1*b7*MED_V*HIGH_Q +
a4*b7*MED_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q;
IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*MED_V +
a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q + a5*b5*LOW_Z*MED_V +
a1*b7*MED_V*HIGH_Q +
a4*b7*HIGH_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q;
ILMMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*MED_V +
"..."
IMMMH = a_1 b_1 + a_4 b_1 M_{ED, W} + a_5 b_1 M_{ED, Z} + a_1 b_4 M_{ED, V} + a_4 b_4 M_{ED, W} M_{ED, V} + a_5 b_4 M_{ED, Z} M_{ED, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 M_{ED, W} M_{HIGH, Q} + a_5 b_5 M_{ED, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 M_{ED, W} M_{V} M_{HIGH, Q} + a_5 b_7 M_{ED, Z} M_{V} M_{HIGH, Q};

IHMMH = a_1 b_1 + a_4 b_1 H_{HIGH, W} + a_5 b_1 M_{ED, Z} + a_1 b_4 M_{ED, V} + a_4 b_4 H_{HIGH, W} M_{ED, V} + a_5 b_4 M_{ED, Z} M_{ED, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 H_{HIGH, W} M_{HIGH, Q} + a_5 b_5 M_{ED, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 H_{HIGH, W} M_{V} M_{HIGH, Q} + a_5 b_7 M_{ED, Z} M_{V} M_{HIGH, Q};

ILHMH = a_1 b_1 + a_4 b_1 L_{LOW, W} + a_5 b_1 H_{HIGH, Z} + a_1 b_4 M_{ED, V} + a_4 b_4 L_{LOW, W} M_{ED, V} + a_5 b_4 H_{HIGH, Z} M_{ED, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 L_{LOW, W} M_{HIGH, Q} + a_5 b_5 H_{HIGH, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 L_{LOW, W} M_{V} M_{HIGH, Q} + a_5 b_7 H_{HIGH, Z} M_{V} M_{HIGH, Q};

IMHMH = a_1 b_1 + a_4 b_1 M_{ED, W} + a_5 b_1 H_{HIGH, Z} + a_1 b_4 M_{ED, V} + a_4 b_4 M_{ED, W} M_{ED, V} + a_5 b_4 H_{HIGH, Z} M_{ED, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 M_{ED, W} M_{HIGH, Q} + a_5 b_5 H_{HIGH, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 M_{ED, W} M_{V} M_{HIGH, Q} + a_5 b_7 H_{HIGH, Z} M_{V} M_{HIGH, Q};

IHHMH = a_1 b_1 + a_4 b_1 H_{HIGH, W} + a_5 b_1 H_{HIGH, Z} + a_1 b_4 M_{ED, V} + a_4 b_4 H_{HIGH, W} M_{ED, V} + a_5 b_4 H_{HIGH, Z} M_{ED, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 H_{HIGH, W} M_{HIGH, Q} + a_5 b_5 H_{HIGH, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 H_{HIGH, W} M_{V} M_{HIGH, Q} + a_5 b_7 H_{HIGH, Z} M_{V} M_{HIGH, Q};

ILLHH = a_1 b_1 + a_4 b_1 L_{LOW, W} + a_5 b_1 L_{LOW, Z} + a_1 b_4 H_{HIGH, V} + a_4 b_4 L_{LOW, W} H_{HIGH, V} + a_5 b_4 L_{LOW, Z} H_{HIGH, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 L_{LOW, W} M_{HIGH, Q} + a_5 b_5 L_{LOW, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 L_{LOW, W} M_{V} M_{HIGH, Q} + a_5 b_7 L_{LOW, Z} M_{V} M_{HIGH, Q};

IMLHH = a_1 b_1 + a_4 b_1 M_{ED, W} + a_5 b_1 L_{LOW, Z} + a_1 b_4 H_{HIGH, V} + a_4 b_4 M_{ED, W} H_{HIGH, V} + a_5 b_4 L_{LOW, Z} H_{HIGH, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 M_{ED, W} M_{HIGH, Q} + a_5 b_5 L_{LOW, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 M_{ED, W} M_{V} M_{HIGH, Q} + a_5 b_7 L_{LOW, Z} M_{V} M_{HIGH, Q};

IHLHH = a_1 b_1 + a_4 b_1 H_{HIGH, W} + a_5 b_1 L_{LOW, Z} + a_1 b_4 H_{HIGH, V} + a_4 b_4 H_{HIGH, W} H_{HIGH, V} + a_5 b_4 L_{LOW, Z} H_{HIGH, V} + a_1 b_5 M_{HIGH, Q} + a_4 b_5 H_{HIGH, W} M_{HIGH, Q} + a_5 b_5 L_{LOW, Z} M_{HIGH, Q} + a_1 b_7 M_{V} M_{HIGH, Q} + a_4 b_7 H_{HIGH, W} M_{V} M_{HIGH, Q} + a_5 b_7 L_{LOW, Z} M_{V} M_{HIGH, Q};
a1*b7*HIGH_V*HIGH_Q +
a4*b7*HIGH_W*HIGH_V*HIGH_Q + a5*b7*LOW_Z*HIGH_V*HIGH_Q;

ILMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V
+
a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +
a4*b7*LOW_W*HIGH_V*HIGH_Q + a5*b7*MED_Z*HIGH_V*HIGH_Q;

IMHHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V
+
a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +
a4*b7*LOW_W*HIGH_V*HIGH_Q + a5*b7*MED_Z*HIGH_V*HIGH_Q;

IHMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V
+
a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +

IHHHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V
+
a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +

IMMMM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V
+
a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +

! Calc conditional total effects for each combination of moderator values
TLLLL = ILLLL + cdash;
TMLLL = IMLLL + cdash;
THLLL = IHLLL + cdash;

TLMLL = ILMLL + cdash;
TMMLL = IMMLL + cdash;
THMLL = IHMLL + cdash;

TLHLL = ILHLL + cdash;
TMHLL = IMHLL + cdash;
THHLL = IHHLL + cdash;

tLMLL = IMLML + cdash;
TMLML = IMLML + cdash;
THLML = IHLML + cdash;

TLMML = ILMML + cdash;
TMMML = IMMML + cdash;
THMML = IHMML + cdash;

TLHML = ILHML + cdash;
TMHML = IMHML + cdash;
THHML = IHHML + cdash;

TLLHL = ILLHL + cdash;
TMLHL = IMLHL + cdash;
THLHL = IHLHL + cdash;

TLMLH = IMLHL + cdash;
TMMHL = IMMHL + cdash;
THMHL = IHMHL + cdash;

TLHML = ILHML + cdash;
TMHML = IMHML + cdash;
THHML = IHHML + cdash;

TLLLM = ILLLM + cdash;
TMLLM = IMLLM + cdash;
THLLM = IHLLM + cdash;

TLMLM = ILMLM + cdash;
TMMLM = IMMML + cdash;
THMLM = IHMLM + cdash;

TLHLM = ILHLM + cdash;
TMHLM = IMHLM + cdash;
THHLM = IHHLM + cdash;

TLLMM = ILLMM + cdash;
TMLMM = IMLMM + cdash;
THLMM = IHLMM + cdash;
TLMMM = ILMMM + cdash;
TMMMM = IMMMM + cdash;
THMMM = IHMMM + cdash;
TLHMM = ILHMM + cdash;
TMHMM = IMHMM + cdash;
THHMM = IHHMM + cdash;
TLLHM = ILLHM + cdash;
TMLHM = IMMLH + cdash;
THLHM = IHLHM + cdash;
TLMHM = ILMHM + cdash;
TMHMM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TMLHM = IMLHM + cdash;
TMMHM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TMLHM = IMLHM + cdash;
TMHMM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TMLHM = IMLHM + cdash;
TMHMM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TMLHM = IMLHM + cdash;
TMHMM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TMLHM = IMLHM + cdash;
TMHMM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TMLHM = IMLHM + cdash;
TMHMM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TMLHM = IMLHM + cdash;
TMHMM = IMMHH + cdash;
THHMM = IHHHM + cdash;
TLHHH = ILHHH + cdash;
TMHHH = IMHHH + cdash;
THHHH = IHHHH + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLLLL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL
PLLML PMLML PHLML PLMLM PMMLM PHMLM PLHML PMHML PHHML
PLLHL PMLHL PHLHL PLMLH PMMLH PHMLH PLHML PMHML PHHML
PLLHM PMLHM PHLHM PLMLM PMMLM PHMLM PLHML PMHML PHHML
PLLHH PMLHH PHLHH PLMLH PMMLH PHMLH PLHHL PMHHL PHHHL
PLLML PMLML PHLML PLMLM PMMLM PHMLM PLHML PMHML PHHML
PLLHL PMLHL PHLHL PLMLH PMMLH PHMLH PLHML PMHML PHHML
PLLHM PMLHM PHLHM PLMLM PMMLM PHMLM PLHML PMHML PHHML
PLLHH PMLHH PHLHH PLMLH PMMLH PHMLH PLHHL PMHHL PHHHH);
PLMHL = ILMHL*XVAL;
PMMHL = IIMHL*XVAL;
PHMHL = IIMHL*XVAL;

PLHHL = ILHHL*XVAL;
PMHHL = IIMHL*XVAL;
PHHHL = IHHHL*XVAL;

PLLLM = ILLLM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLM = IHLLM*XVAL;

PLMLM = IMLLM*XVAL;
PMMM = IMMLM*XVAL;
PHMLM = IHMLM*XVAL;

PLHLM = ILHLM*XVAL;
PMHLM = IIMHL*XVAL;
PHHLM = IHHHL*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMHMH*XVAL;
PHMHM = IHMHM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMHMH*XVAL;
PHMHM = IHMHM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMHMH*XVAL;
PHMHM = IHMHM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMHMH*XVAL;
PHMHM = IHMHM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMHMH*XVAL;
PHMHM = IHMHM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMHMH*XVAL;
PHMHM = IHMHM*XVAL;

PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMHMH*XVAL;
PHMHM = IHMHM*XVAL;
PLHLH = ILHLH*XVAL;
PMHLH = IMHLH*XVAL;
PHHLH = IHHLH*XVAL;
PLLMH = ILLMH*XVAL;
PMLMH = IMLMH*XVAL;
PILMH = IHLMH*XVAL;
PLLMM = ILMMH*XVAL;
PMLMM = IMLMH*XVAL;
PHLMH = IHLMH*XVAL;
PLMMH = ILMMH*XVAL;
PMMMH = IMM MH*XVAL;
PHMMH = IHM MH*XVAL;
PLHMH = ILH MH*XVAL;
PMHMH = IMH MH*XVAL;
PILMH = IHLMH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PILHH = IHLHH*XVAL;
PLLMM = ILMHH*XVAL;
PMLMM = IMLHH*XVAL;
PHLMH = IHLMH*XVAL;
PLMMH = ILMHH*XVAL;
PMMMH = IMM HH*XVAL;
PHMMH = IHM HH*XVAL;
PHLHH = IHLHH*XVAL;
PLHMM = ILMHH*XVAL;
PHHMH = IHMHH*XVAL;
PLHHH = ILHHH*XVAL;
PMHHH = IHH HH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 48: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + b_6 VQ + b_7 MVQ + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + b_6 VQ + b_7 MVQ + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ \]

Hence... substituting in equation for \( M \)
\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ) + b_2 V + b_3 Q + b_4(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)V + b_5(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)Q + b_6 VQ + b_7(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)VQ + c'X \]

Hence... multiplying out brackets
Y = \sum_{i=0}^{7} a_i b_i + b_0 + a_0 b_1 + a_1 b_1 X + a_2 b_1 W + a_3 b_1 Z + a_4 b_1 XW + a_5 b_1 WZ + a_6 b_1 XZVQ + a_7 b_1 XWZQ + b_2 V + b_3 Q + a_0 b_4 V + a_1 b_4 XV + a_2 b_4 WV + a_3 b_4 ZV + a_4 b_4 XWV + a_5 b_4 XZV + a_6 b_4 WZV + a_7 b_4 XWZV + a_0 b_5 Q + a_1 b_5 XQ + a_2 b_5 WQ + a_3 b_5 ZQ + a_4 b_5 XWQ + a_5 b_5 XZQ + a_6 b_5 WZQ + a_7 b_5 XWZQ + a_0 b_6 VQ + a_1 b_6 XVQ + a_2 b_6 WVQ + a_3 b_6 ZVQ + a_4 b_6 XWVQ + a_5 b_6 XZVQ + a_6 b_6 WZVQ + a_7 b_6 XWZVQ + c'X

Hence... grouping terms into form Y = a + bX

Y = \sum_{i=0}^{7} a_i b_i + b_0 + a_0 b_1 + a_2 b_1 W + a_3 b_1 Z + a_6 b_1 WZ + b_2 V + b_3 Q + a_0 b_4 V + a_2 b_4 WV + a_3 b_4 ZV + a_6 b_4 WZV + b_6 VQ + a_0 b_7 VQ + a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 WZ + a_1 b_4 V + a_4 b_4 WV + a_5 b_4 ZV + a_7 b_4 WZV + b_1 VQ + a_0 b_6 VQ + a_1 b_6 XVQ + a_2 b_6 WVQ + a_3 b_6 ZVQ + a_6 b_6 WZVQ + c'X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V, Q:

\sum_{i=0}^{7} a_i b_i + a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 WZ + a_1 b_4 V + a_4 b_4 WV + a_5 b_4 ZV + a_7 b_4 WZV + a_1 b_5 Q + a_4 b_5 WQ + a_5 b_5 ZQ + a_7 b_5 WZQ + a_1 b_7 VQ + a_4 b_7 WVQ + a_5 b_7 ZVQ + a_7 b_7 WZVQ = (a_1 + a_4 W + a_5 Z + a_7 WZ)(b_1 + b_4 V + b_5 Q + b_7 VQ)

One direct effect of X on Y:

c'

Mplus code for the model:

```
USEVARIABLES = X M W Z V Q Y XW XZ WZ VQ MV MQ XWZ MVQ;
DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
    WZ = W*Z;
    VQ = V*Q;
    MVQ = M*V*Q;
    XWZ = X*W*Z;
```

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ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
   [Y] (b0);
   Y ON M (b1);
   Y ON V (b2);
   Y ON Q (b3);
   Y ON MV (b4);
   Y ON MQ (b5);
   Y ON VQ (b6);
   Y ON MVQ (b7);
   Y ON X (cdash);
   [M] (a0);
   M ON X (a1);
   M ON W (a2);
   M ON Z (a3);
   M ON XW (a4);
   M ON XZ (a5);
   M ON WZ (a6);
   M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)
   ILLLL IMLLL IHLLL ILMLL IMMLL IHMLL ILHLL IMLHL IMHHL IHHLL
   ILLML IMLML IHLML ILMML IMMMML IHMLM ILHML IMHML IHHML
   ILLHL IMLHL IHLHL ILMHL IMMLHL IHMLHL ILHML IMHML IHHML
   ILLLM IMLLM IHLLM ILMLM IMMLM IHLHM IMLHM IHHLM
   ILLMM IMLMM IHLMM ILMMM IMMMMM IHMMM ILHMM IMHMM IHHMM
   ILLHM IMLHM IHLHM ILMHM IMMMH IHHMH IMHMM IHHMM
   ILLHM IMLHM IHLHM ILMHM IMMMH IHHMH IMHMM IHHMM
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W  
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W  
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W  
LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z  
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z  
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z  
LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V  
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V  
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V  
LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q  
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q  
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q  

! Calc conditional indirect effects for each combination of moderator values  
ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*LOW_W*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q +
\[
\begin{align*}
\text{IMLLL} &= a_1 b_1 + a_4 b_1 \cdot \text{MED}_W + a_5 b_1 \cdot \text{LOW}_Z + \\
&+ a_7 b_1 \cdot \text{MED}_W \cdot \text{LOW}_Z + \\
&+ a_1 b_4 \cdot \text{LOW}_V + a_4 b_4 \cdot \text{MED}_W \cdot \text{LOW}_V + a_5 b_4 \cdot \text{LOW}_Z \cdot \text{LOW}_V + \\
&+ a_7 b_4 \cdot \text{MED}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_1 b_5 \cdot \text{LOW}_Q + a_4 b_5 \cdot \text{MED}_W \cdot \text{LOW}_Q + \\
&+ a_5 b_5 \cdot \text{LOW}_Z \cdot \text{LOW}_Q + a_7 b_5 \cdot \text{MED}_W \cdot \text{LOW}_Z \cdot \text{LOW}_Q + \\
\text{IHLLL} &= a_1 b_1 + a_4 b_1 \cdot \text{HIGH}_W + a_5 b_1 \cdot \text{LOW}_Z + \\
&+ a_7 b_1 \cdot \text{HIGH}_W \cdot \text{LOW}_Z + \\
&+ a_1 b_4 \cdot \text{LOW}_V + a_4 b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a_5 b_4 \cdot \text{LOW}_Z \cdot \text{LOW}_V + \\
&+ a_7 b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_1 b_5 \cdot \text{LOW}_Q + a_4 b_5 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + \\
&+ a_5 b_5 \cdot \text{LOW}_Z \cdot \text{LOW}_Q + a_7 b_5 \cdot \text{HIGH}_W \cdot \text{LOW}_Z \cdot \text{LOW}_Q + \\
\text{ILMLL} &= a_1 b_1 + a_4 b_1 \cdot \text{LOW}_W + a_5 b_1 \cdot \text{MED}_Z + \\
&+ a_7 b_1 \cdot \text{LOW}_W \cdot \text{MED}_Z + \\
&+ a_1 b_4 \cdot \text{LOW}_V + a_4 b_4 \cdot \text{LOW}_W \cdot \text{LOW}_V + a_5 b_4 \cdot \text{MED}_Z \cdot \LOW_V + \\
&+ a_7 b_4 \cdot \LOW_W \cdot \MED_Z \cdot \LOW_V + a_1 b_5 \cdot \LOW_Q + a_4 b_5 \cdot \LOW_W \cdot \LOW_Q + \\
&+ a_5 b_5 \cdot \MED_Z \cdot \LOW_Q + a_7 b_5 \cdot \LOW_W \cdot \MED_Z \cdot \LOW_Q + \\
\text{IMMLL} &= a_1 b_1 + a_4 b_1 \cdot \MED_W + a_5 b_1 \cdot \MED_Z + \\
&+ a_7 b_1 \cdot \MED_W \cdot \MED_Z + \\
&+ a_1 b_4 \cdot \LOW_V + a_4 b_4 \cdot \MED_W \cdot \LOW_V + a_5 b_4 \cdot \MED_Z \cdot \LOW_V + \\
&+ a_7 b_4 \cdot \MED_W \cdot \MED_Z \cdot \LOW_V + a_1 b_5 \cdot \LOW_Q + a_4 b_5 \cdot \MED_W \cdot \LOW_Q + \\
&+ a_5 b_5 \cdot \MED_Z \cdot \LOW_Q + a_7 b_5 \cdot \MED_W \cdot \MED_Z \cdot \LOW_Q + \\
\text{IHMLL} &= a_1 b_1 + a_4 b_1 \cdot \HIGH_W + a_5 b_1 \cdot \MED_Z + \\
&+ a_7 b_1 \cdot \HIGH_W \cdot \MED_Z + \\
&+ a_1 b_4 \cdot \LOW_V + a_4 b_4 \cdot \HIGH_W \cdot \LOW_V + a_5 b_4 \cdot \MED_Z \cdot \LOW_V + \\
&+ a_7 b_4 \cdot \HIGH_W \cdot \MED_Z \cdot \LOW_V + a_1 b_5 \cdot \LOW_Q + a_4 b_5 \cdot \HIGH_W \cdot \LOW_Q + \\
&+ a_5 b_5 \cdot \MED_Z \cdot \LOW_Q + a_7 b_5 \cdot \HIGH_W \cdot \MED_Z \cdot \LOW_Q + \\
&+ a_1 b_7 \cdot \LOW_V \cdot \LOW_Q + \\
&+ a_4 b_7 \cdot \LOW_W \cdot \LOW_V \cdot \LOW_Q + a_5 b_7 \cdot \LOW_Z \cdot \LOW_V \cdot \LOW_Q + \\
&+ a_7 b_7 \cdot \LOW_W \cdot \LOW_Z \cdot \LOW_V \cdot \LOW_Q;
\end{align*}
\]
$$a_4*b_7*\text{HIGH}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{MED}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{HIGH}_W*\text{MED}_Z*\text{LOW}_V*\text{LOW}_Q;$$

\[
\text{ILHLL} = a_1*b_1 + a_4*b_1*\text{LOW}_W + a_5*b_1*\text{HIGH}_Z + a_7*b_1*\text{LOW}_W*\text{HIGH}_Z + a_1*b_4*\text{LOW}_V + a_4*b_4*\text{LOW}_W*\text{LOW}_V + a_5*b_4*\text{HIGH}_Z*\text{LOW}_V + a_7*b_4*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_V + a_1*b_5*\text{LOW}_Q + a_4*b_5*\text{LOW}_W*\text{LOW}_Q + a_5*b_5*\text{HIGH}_Z*\text{LOW}_Q + a_7*b_5*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_Q + a_1*b_7*\text{LOW}_V*\text{LOW}_Q + a_4*b_7*\text{LOW}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{HIGH}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_V*\text{LOW}_Q; \\
\text{IMHLL} = a_1*b_1 + a_4*b_1*\text{MED}_W + a_5*b_1*\text{HIGH}_Z + a_7*b_1*\text{MED}_W*\text{HIGH}_Z + a_1*b_4*\text{LOW}_V + a_4*b_4*\text{LOW}_W*\text{LOW}_V + a_5*b_4*\text{HIGH}_Z*\text{LOW}_V + a_7*b_4*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_V + a_1*b_5*\text{LOW}_Q + a_4*b_5*\text{LOW}_W*\text{LOW}_Q + a_5*b_5*\text{HIGH}_Z*\text{LOW}_Q + a_7*b_5*\text{MED}_W*\text{HIGH}_Z*\text{LOW}_Q + a_1*b_7*\text{LOW}_V*\text{LOW}_Q + a_4*b_7*\text{LOW}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{HIGH}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{MED}_W*\text{HIGH}_Z*\text{LOW}_V*\text{LOW}_Q; \\
\text{IHHLL} = a_1*b_1 + a_4*b_1*\text{HIGH}_W + a_5*b_1*\text{HIGH}_Z + a_7*b_1*\text{HIGH}_W*\text{HIGH}_Z + a_1*b_4*\text{LOW}_V + a_4*b_4*\text{HIGH}_W*\text{LOW}_V + a_5*b_4*\text{HIGH}_Z*\text{LOW}_V + a_7*b_4*\text{HIGH}_W*\text{HIGH}_Z*\text{LOW}_V + a_1*b_5*\text{LOW}_Q + a_4*b_5*\text{HIGH}_W*\text{LOW}_Q + a_5*b_5*\text{HIGH}_Z*\text{LOW}_Q + a_7*b_5*\text{HIGH}_W*\text{HIGH}_Z*\text{LOW}_Q + a_1*b_7*\text{LOW}_V*\text{LOW}_Q + a_4*b_7*\text{HIGH}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{HIGH}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{HIGH}_W*\text{HIGH}_Z*\text{LOW}_V*\text{LOW}_Q; \\
\text{ILLML} = a_1*b_1 + a_4*b_1*\text{LOW}_W + a_5*b_1*\text{LOW}_Z + a_7*b_1*\text{MED}_W*\text{LOW}_Z + a_1*b_4*\text{MED}_V + a_4*b_4*\text{LOW}_W*\text{MED}_V + a_5*b_4*\text{LOW}_Z*\text{MED}_V + a_7*b_4*\text{LOW}_W*\text{LOW}_Z*\text{MED}_V + a_1*b_5*\text{LOW}_Q + a_4*b_5*\text{LOW}_W*\text{LOW}_Q + a_5*b_5*\text{LOW}_Z*\text{LOW}_Q + a_7*b_5*\text{LOW}_W*\text{LOW}_Z*\text{LOW}_Q + a_1*b_7*\text{MED}_V*\text{LOW}_Q + a_4*b_7*\text{LOW}_W*\text{MED}_V*\text{LOW}_Q + a_5*b_7*\text{LOW}_Z*\text{MED}_V*\text{LOW}_Q + a_7*b_7*\text{LOW}_W*\text{LOW}_Z*\text{MED}_V*\text{LOW}_Q; \\
\text{IMLML} = a_1*b_1 + a_4*b_1*\text{MED}_W + a_5*b_1*\text{LOW}_Z + a_7*b_1*\text{MED}_W*\text{LOW}_Z + a_1*b_4*\text{HIGH}_V + a_4*b_4*\text{LOW}_W*\text{HIGH}_V + a_5*b_4*\text{MED}_V*\text{LOW}_V + a_7*b_4*\text{LOW}_W*\text{LOW}_Z*\text{MED}_V + a_1*b_5*\text{LOW}_Q + a_4*b_5*\text{MED}_W*\text{LOW}_Q + a_5*b_5*\text{MED}_Z*\text{LOW}_Q + a_7*b_5*\text{LOW}_W*\text{LOW}_Z*\text{MED}_Q + a_1*b_7*\text{MED}_V*\text{LOW}_Q + a_4*b_7*\text{MED}_W*\text{MED}_V*\text{LOW}_Q + a_5*b_7*\text{LOW}_Z*\text{MED}_V*\text{LOW}_Q + a_7*b_7*\text{LOW}_W*\text{LOW}_Z*\text{MED}_V*\text{LOW}_Q; \\
\text{ILMLM} = a_1*b_1 + a_4*b_1*\text{HIGH}_W + a_5*b_1*\text{LOW}_Z + a_7*b_1*\text{MED}_W*\text{LOW}_Z + a_1*b_4*\text{LOW}_V + a_4*b_4*\text{MED}_V*\text{LOW}_V + a_5*b_4*\text{MED}_W*\text{LOW}_V + a_7*b_4*\text{LOW}_W*\text{LOW}_Z*\text{MED}_V + a_1*b_5*\text{LOW}_Q + a_4*b_5*\text{MED}_W*\text{LOW}_Q + a_5*b_5*\text{MED}_Z*\text{LOW}_Q + a_7*b_5*\text{LOW}_W*\text{LOW}_Z*\text{MED}_Q + a_1*b_7*\text{LOW}_V*\text{LOW}_Q + a_4*b_7*\text{MED}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{MED}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{MED}_W*\text{LOW}_Z*\text{MED}_Q + a_1*b_7*\text{LOW}_V*\text{LOW}_Q + a_4*b_7*\text{MED}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{MED}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{MED}_W*\text{LOW}_Z*\text{MED}_Q + a_1*b_7*\text{LOW}_V*\text{LOW}_Q + a_4*b_7*\text{MED}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{MED}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{MED}_W*\text{LOW}_Z*\text{MED}_Q + a_1*b_7*\text{LOW}_V*\text{LOW}_Q + a_4*b_7*\text{MED}_W*\text{LOW}_V*\text{LOW}_Q + a_5*b_7*\text{MED}_Z*\text{LOW}_V*\text{LOW}_Q + a_7*b_7*\text{MED}_W*\text{LOW}_Z*\text{MED}_Q.$$
\[ a7*b7*\text{MED}_W*\text{LOW}_Z*\text{MED}_V*\text{LOW}_Q; \]
\[ \text{IHLML} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{LOW}_Z + \]
\[ a7*b1*\text{HIGH}_W*\text{LOW}_Z + \]
\[ a1*b4*\text{MED}_V + a4*b4*\text{HIGH}_W*\text{MED}_V + a5*b4*\text{LOW}_Z*\text{MED}_V + \]
\[ a7*b4*\text{HIGH}_W*\text{LOW}_Z*\text{MED}_V + a1*b5*\text{LOW}_Q + \]
\[ a4*b5*\text{HIGH}_W*\text{LOW}_Q + \]
\[ a5*b5*\text{LOW}_Z*\text{LOW}_Q + a7*b5*\text{HIGH}_W*\text{LOW}_Z*\text{LOW}_Q + \]
\[ a1*b7*\text{MED}_V*\text{LOW}_Q + \]
\[ a4*b7*\text{HIGH}_W*\text{MED}_V*\text{LOW}_Q + a5*b7*\text{LOW}_Z*\text{MED}_V*\text{LOW}_Q + \]
\[ a7*b7*\text{HIGH}_W*\text{LOW}_Z*\text{MED}_V*\text{LOW}_Q; \]
\[ \text{ILMML} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{MED}_Z + \]
\[ a1*b4*\text{MED}_V + a4*b4*\text{LOW}_W*\text{MED}_V + a5*b4*\text{MED}_Z*\text{MED}_V + \]
\[ a7*b4*\text{LOW}_W*\text{MED}_Z*\text{MED}_V + a1*b5*\text{LOW}_Q + a4*b5*\text{LOW}_W*\text{LOW}_Q + \]
\[ a5*b5*\text{MED}_Z*\text{LOW}_Q + a7*b5*\text{LOW}_W*\text{MED}_Z*\text{LOW}_Q + \]
\[ a1*b7*\text{MED}_V*\text{LOW}_Q + \]
\[ a4*b7*\text{LOW}_W*\text{MED}_V*\text{LOW}_Q + a5*b7*\text{MED}_Z*\text{MED}_V*\text{LOW}_Q + \]
\[ a7*b7*\text{LOW}_W*\text{MED}_Z*\text{MED}_V*\text{LOW}_Q; \]
\[ \text{IMMML} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{MED}_W*\text{MED}_Z + \]
\[ a1*b4*\text{MED}_V + a4*b4*\text{MED}_W*\text{MED}_V + a5*b4*\text{MED}_Z*\text{MED}_V + \]
\[ a7*b4*\text{MED}_W*\text{MED}_Z*\text{MED}_V + a1*b5*\text{LOW}_Q + a4*b5*\text{MED}_W*\text{LOW}_Q + \]
\[ a5*b5*\text{MED}_Z*\text{LOW}_Q + a7*b5*\text{MED}_W*\text{MED}_Z*\text{LOW}_Q + \]
\[ a1*b7*\text{MED}_V*\text{LOW}_Q + \]
\[ a4*b7*\text{MED}_W*\text{MED}_V*\text{LOW}_Q + a5*b7*\text{MED}_Z*\text{MED}_V*\text{LOW}_Q + \]
\[ a7*b7*\text{MED}_W*\text{MED}_Z*\text{MED}_V*\text{LOW}_Q; \]
\[ \text{IHMML} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{HIGH}_W*\text{MED}_Z + \]
\[ a1*b4*\text{MED}_V + a4*b4*\text{HIGH}_W*\text{MED}_V + a5*b4*\text{MED}_Z*\text{MED}_V + \]
\[ a7*b4*\text{HIGH}_W*\text{MED}_Z*\text{MED}_V + a1*b5*\text{LOW}_Q + \]
\[ a4*b5*\text{HIGH}_W*\text{LOW}_Q + \]
\[ a5*b5*\text{MED}_Z*\text{LOW}_Q + a7*b5*\text{HIGH}_W*\text{MED}_Z*\text{LOW}_Q + \]
\[ a1*b7*\text{MED}_V*\text{LOW}_Q + \]
\[ a4*b7*\text{HIGH}_W*\text{MED}_V*\text{LOW}_Q + a5*b7*\text{MED}_Z*\text{MED}_V*\text{LOW}_Q + \]
\[ a7*b7*\text{HIGH}_W*\text{MED}_Z*\text{MED}_V*\text{LOW}_Q; \]
\[ \text{ILHML} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{HIGH}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{HIGH}_Z + \]
\[ a1*b4*\text{MED}_V + a4*b4*\text{LOW}_W*\text{MED}_V + a5*b4*\text{HIGH}_Z*\text{MED}_V + \]
\[ a7*b4*\text{LOW}_W*\text{HIGH}_Z*\text{MED}_V + a1*b5*\text{LOW}_Q + \]
\[ a4*b5*\text{LOW}_W*\text{LOW}_Q + \]
\[ a5*b5*\text{HIGH}_Z*\text{LOW}_Q + a7*b5*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_Q + \]
\[ a1*b7*\text{MED}_V*\text{LOW}_Q + \]
\[ a4*b7*\text{LOW}_W*\text{MED}_V*\text{LOW}_Q + a5*b7*\text{HIGH}_Z*\text{MED}_V*\text{LOW}_Q + \]
\[ a7*b7*\text{LOW}_W*\text{HIGH}_Z*\text{MED}_V*\text{LOW}_Q; \]
IMHML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V +
a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*MED_W*HIGH_Z*LOW_Q +
a1*b7*MED_V*LOW_Q +
a4*b7*MED_W*MED_V*LOW_Q + a5*b7*HIGH_Z*MED_V*LOW_Q +
a7*b7*MED_W*HIGH_Z*MED_V*LOW_Q;

IHHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V +
a7*b4*HIGH_W*HIGH_Z*MED_V + a1*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*HIGH_W*HIGH_Z*LOW_Q +
a1*b7*MED_V*LOW_Q +
a4*b7*HIGH_W*MED_V*LOW_Q + a5*b7*HIGH_Z*MED_V*LOW_Q +
a7*b7*HIGH_W*HIGH_Z*MED_V*LOW_Q;

ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q +
a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q +
a1*b7*HIGH_V*LOW_Q +
a4*b7*LOW_W*HIGH_V*LOW_Q + a5*b7*LOW_Z*HIGH_V*LOW_Q +
a7*b7*LOW_W*LOW_Z*HIGH_V*LOW_Q;

IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*MED_W*LOW_Z*HIGH_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q +
a5*b5*LOW_Z*LOW_Q + a7*b5*MED_W*LOW_Z*LOW_Q +
a1*b7*HIGH_V*LOW_Q +
a4*b7*MED_W*HIGH_V*LOW_Q + a5*b7*MED_W*LOW_Z*HIGH_V +
a7*b7*MED_W*LOW_Z*LOW_Q*HIGH_V;

IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q +
a5*b5*LOW_Z*LOW_Q + a7*b5*HIGH_W*LOW_Z*LOW_Q +
a1*b7*HIGH_V*LOW_Q +
a4*b7*HIGH_W*HIGH_V*LOW_Q + a5*b7*HIGH_W*LOW_Z*LOW_Q +
a7*b7*HIGH_W*LOW_Z*LOW_Q*HIGH_V;
ILMHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
a7*b1*LOW_W*MED_Z + 
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + 
a7*b4*LOW_W*MED_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*LOW_W*LOW_Q + 
a5*b5*MED_Z*LOW_Q + a7*b5*LOW_W*MED_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*LOW_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q + 
a7*b7*LOW_W*MED_Z*HIGH_V*LOW_Q;
IMMHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
a7*b1*MED_W*MED_Z + 
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + 
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*MED_W*LOW_Q + 
a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*MED_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q + 
a7*b7*MED_W*MED_Z*HIGH_V*LOW_Q;
IHMHL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + 
a7*b1*HIGH_W*MED_Z + 
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + 
a7*b4*HIGH_W*MED_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*HIGH_W*LOW_Q + 
a5*b5*MED_Z*LOW_Q + a7*b5*HIGH_W*MED_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*HIGH_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q + 
a7*b7*HIGH_W*MED_Z*HIGH_V*LOW_Q;
ILHHL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + 
a7*b1*LOW_W*HIGH_Z + 
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + 
a7*b4*LOW_W*HIGH_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*LOW_W*LOW_Q + 
a5*b5*HIGH_Z*LOW_Q + a7*b5*LOW_W*HIGH_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*LOW_W*HIGH_V*LOW_Q + a5*b7*HIGH_Z*HIGH_V*LOW_Q + 
a7*b7*LOW_W*HIGH_Z*HIGH_V*LOW_Q;
IMHHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
a7*b1*MED_W*MED_Z + 
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + 
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*MED_W*LOW_Q + 
a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*MED_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q + 
a7*b7*MED_W*MED_Z*HIGH_V*LOW_Q;
\[ a_7 \cdot b_7 \cdot \text{MED}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{LOW}_Q; \]
\[ \text{IHHHL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_7 \cdot b_1 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z + a_1 \cdot b_4 \cdot \text{HIGH}_V + a_4 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{HIGH}_V + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_7 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + a_4 \cdot b_5 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{HIGH}_Z \cdot \text{LOW}_Q + a_7 \cdot b_5 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{HIGH}_V \cdot \text{LOW}_Q + a_4 \cdot b_7 \cdot \text{HIGH}_W \cdot \text{HIGH}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{LOW}_Q + a_7 \cdot b_7 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{LOW}_Q; \]
\[ \text{ILLLM} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{LOW}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_7 \cdot b_1 \cdot \text{LOW}_W \cdot \text{LOW}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + a_4 \cdot b_4 \cdot \text{LOW}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_7 \cdot b_4 \cdot \text{LOW}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{MED}_Q + a_4 \cdot b_5 \cdot \text{LOW}_W \cdot \text{MED}_Q + a_5 \cdot b_5 \cdot \text{LOW}_Z \cdot \text{MED}_Q + a_7 \cdot b_5 \cdot \text{LOW}_W \cdot \text{LOW}_Z \cdot \text{MED}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{MED}_Q + a_4 \cdot b_7 \cdot \text{LOW}_W \cdot \text{LOW}_V \cdot \text{MED}_Q + a_5 \cdot b_7 \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q + a_7 \cdot b_7 \cdot \text{LOW}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q; \]
\[ \text{IMLLM} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_7 \cdot b_1 \cdot \text{MED}_W \cdot \text{LOW}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + a_4 \cdot b_4 \cdot \text{MED}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_7 \cdot b_4 \cdot \text{MED}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{MEDI}_Q + a_4 \cdot b_5 \cdot \text{MED}_W \cdot \text{MEDI}_Q + a_5 \cdot b_5 \cdot \text{LOW}_Z \cdot \text{MEDI}_Q + a_7 \cdot b_5 \cdot \text{MED}_W \cdot \text{LOW}_Z \cdot \text{MEDI}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{MEDI}_Q + a_4 \cdot b_7 \cdot \text{MED}_W \cdot \text{LOW}_V \cdot \text{MEDI}_Q + a_5 \cdot b_7 \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MEDI}_Q + a_7 \cdot b_7 \cdot \text{MED}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MEDI}_Q; \]
\[ \text{IHLLM} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_7 \cdot b_1 \cdot \text{HIGH}_W \cdot \text{LOW}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + a_4 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_7 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{MED}_Q + a_4 \cdot b_5 \cdot \text{HIGH}_W \cdot \text{MED}_Q + a_5 \cdot b_5 \cdot \text{LOW}_Z \cdot \text{MED}_Q + a_7 \cdot b_5 \cdot \text{HIGH}_W \cdot \text{LOW}_Z \cdot \text{MED}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{MED}_Q + a_4 \cdot b_7 \cdot \text{HIGH}_W \cdot \text{LOW}_V \cdot \text{MED}_Q + a_5 \cdot b_7 \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q + a_7 \cdot b_7 \cdot \text{HIGH}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q; \]
\[ \text{ILMLM} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{LOW}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_7 \cdot b_1 \cdot \text{LOW}_W \cdot \text{LOW}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + a_4 \cdot b_4 \cdot \text{LOW}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_7 \cdot b_4 \cdot \text{LOW}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{MED}_Q + a_4 \cdot b_5 \cdot \text{LOW}_W \cdot \text{MED}_Q + a_5 \cdot b_5 \cdot \text{LOW}_Z \cdot \text{MED}_Q + a_7 \cdot b_5 \cdot \text{LOW}_W \cdot \text{LOW}_Z \cdot \text{MED}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{MED}_Q + a_4 \cdot b_7 \cdot \text{LOW}_W \cdot \text{LOW}_V \cdot \text{MED}_Q + a_5 \cdot b_7 \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q + a_7 \cdot b_7 \cdot \text{LOW}_W \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{MED}_Q.
\[ a7*b7*LOW_W*MED_Z*LOW_V*MED_Q; \]
\[ IMMLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Q + a1*b7*LOW_V*MED_Q; \]
\[ IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Q; \]
\[ ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*LOW_W*HIGH_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Q; \]
\[ IMHLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*MED_W*HIGH_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a7*b5*HIGH_W*MED_Q; \]
\[ IHHLM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a7*b5*HIGH_W*MED_Q; \]
ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
+ a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q +
al*b7*MED_V*MED_Q +
a4*b7*LOW_W*MED_V*MED_Q + a5*b7*LOW_Z*MED_V*MED_Q +
a7*b7*LOW_W*LOW_Z*MED_V*MED_Q;

IMLMM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*MED_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
+ a5*b5*LOW_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q +
al*b7*MED_V*MED_Q +
a4*b7*MED_W*MED_V*MED_Q + a5*b7*LOW_Z*MED_V*MED_Q +
a7*b7*LOW_W*LOW_Z*MED_V*MED_Q;

IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*HIGH_W*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
+ a5*b5*LOW_Z*MED_Q + a7*b5*HIGH_W*LOW_Z*MED_Q +
al*b7*MED_V*MED_Q +
a4*b7*HIGH_W*MED_V*MED_Q + a5*b7*LOW_Z*MED_V*MED_Q +
a7*b7*HIGH_W*LOW_Z*MED_V*MED_Q;

ILMMM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V +
a7*b4*LOW_W*MED_Z*MED_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
+ a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q +
al*b7*MED_V*MED_Q +
a4*b7*LOW_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q +
a7*b7*LOW_W*MED_Z*MED_V*MED_Q;

IMMMM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V +
a7*b4*MED_W*MED_Z*MED_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
+ a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q +
al*b7*MED_V*MED_Q +
a4*b7*MED_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q +
a7*b7*MED_W*MED_Z*MED_V*MED_Q;

IHMMM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +

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\[ a_1 b_4 \text{MED}_V + a_4 b_4 \text{HIGH}_W \text{MED}_V + a_5 b_4 \text{MED}_Z \text{MED}_V + a_7 b_4 \text{HIGH}_W \text{MED}_Z \text{MED}_V + a_1 b_5 \text{MED}_Q + \\
\text{a4\_b5\_HIGH\_W\_MED\_Q} + \\
\text{a5\_b5\_MED\_Z\_MED\_Q} + a_7 b_5 \text{HIGH}_W \text{MED}_Z \text{MED}_Q + \\
\text{a1\_b7\_MED\_V\_MED\_Q} + \\
\text{a4\_b7\_HIGH\_W\_MED\_V\_MED\_Q} + a_5 b_7 \text{MED}_Z \text{MED}_V \text{MED}_Q + \\
\text{a7\_b7\_HIGH\_W\_MED\_Z\_MED\_V\_MED\_Q;}
\]

ILHMM = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z \\
\text{a7\_b1\_LOW\_W\_HIGH\_Z} + \\
a_1 b_4 \text{MED}_V + a_4 b_4 \text{LOW}_W \text{MED}_V + a_5 b_4 \text{HIGH}_Z \text{MED}_V + \\
a_7 b_4 \text{LOW}_W \text{HIGH}_Z \text{MED}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{MED}_W \text{MED}_Q + \\
a_5 b_5 \text{HIGH}_Z \text{MED}_Q + a_7 b_5 \text{LOW}_W \text{HIGH}_Z \text{MED}_Q + \\
a_1 b_7 \text{MED}\_V\_MED\_Q + \\
a_4 b_7 \text{LOW}_W \text{MED}_V \text{MED}_Q + a_5 b_7 \text{HIGH}_Z \text{MED}_V \text{MED}_Q + \\
a_7 b_7 \text{LOW}_W \text{HIGH}_Z \text{MED}_V \text{MED}_Q; \]

IMHMM = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z \\
\text{a7\_b1\_MED\_W\_HIGH\_Z} + \\
a_1 b_4 \text{MED}_V + a_4 b_4 \text{MED}_W \text{MED}_V + a_5 b_4 \text{HIGH}_Z \text{MED}_V + \\
a_7 b_4 \text{MED}_W \text{HIGH}_Z \text{MED}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{MED}_W \text{MED}_Q + \\
a_5 b_5 \text{HIGH}_Z \text{MED}_Q + a_7 b_5 \text{MED}_W \text{HIGH}_Z \text{MED}_Q + \\
a_1 b_7 \text{MED}\_V\_MED\_Q + \\
a_4 b_7 \text{MED}_W \text{MED}_V \text{MED}_Q + a_5 b_7 \text{HIGH}_Z \text{MED}_V \text{MED}_Q + \\
a_7 b_7 \text{MED}_W \text{HIGH}_Z \text{MED}_V \text{MED}_Q; \]

IHHMM = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z \\
\text{a7\_b1\_HIGH\_W\_HIGH\_Z} + \\
a_1 b_4 \text{MED}_V + a_4 b_4 \text{HIGH}_W \text{MED}_V + a_5 b_4 \text{HIGH}_Z \text{MED}_V + \\
a_7 b_4 \text{HIGH}_W \text{HIGH}_Z \text{MED}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{HIGH}_W \text{MED}_Q + \\
a_5 b_5 \text{HIGH}_Z \text{MED}_Q + a_7 b_5 \text{HIGH}_W \text{HIGH}_Z \text{MED}_Q + \\
a_1 b_7 \text{MED}\_V\_MED\_Q + \\
a_4 b_7 \text{HIGH}_W \text{MED}_V \text{MED}_Q + a_5 b_7 \text{HIGH}_Z \text{MED}_V \text{MED}_Q + \\
a_7 b_7 \text{HIGH}_W \text{HIGH}_Z \text{MED}_V \text{MED}_Q; \]

ILLHM = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z \\
\text{a7\_b1\_LOW\_W\_LOW\_Z} + \\
a_1 b_4 \text{HIGH}_V + a_4 b_4 \text{LOW}_W \text{HIGH}_V + a_5 b_4 \text{LOW}_Z \text{HIGH}_V + \\
a_7 b_4 \text{LOW}_W \text{LOW}_Z \text{HIGH}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{LOW}_W \text{MED}_Q + \\
a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_7 b_5 \text{LOW}_W \text{LOW}_Z \text{MED}_Q + \\
a_1 b_7 \text{HIGH}_V \text{MED}_Q + \\
a_4 b_7 \text{LOW}_W \text{HIGH}_V \text{MED}_Q + a_5 b_7 \text{LOW}_Z \text{HIGH}_V \text{MED}_Q + \\
a_7 b_7 \text{LOW}_W \text{LOW}_Z \text{HIGH}_V \text{MED}_Q; \]

IMLHM = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z \\
\text{a7\_b1\_MED\_W\_LOW\_Z} + \\
a_1 b_4 \text{HIGH}_V + a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{LOW}_Z \text{HIGH}_V + \\
a_7 b_4 \text{MED}_W \LOW\_Z \text{HIGH}_V + a_1 b_5 \text{MED}_Q + \\
a_4 b_5 \text{LOW}_W \text{MED}_Q + \\
a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_7 b_5 \text{LOW}_W \text{LOW}_Z \text{MED}_Q + \\
a_1 b_7 \text{HIGH}_V \text{MED}_Q + \\
a_4 b_7 \text{LOW}_W \text{HIGH}_V \text{MED}_Q + a_5 b_7 \text{LOW}_Z \text{HIGH}_V \text{MED}_Q + \\
a_7 b_7 \text{LOW}_W \text{LOW}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ a7*b4*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b5*\text{MED}_Q + \]
\[ a4*b5*\text{MED}_W*\text{MED}_Q + \]
\[ a5*b5*\text{LOW}_Z*\text{MED}_Q + a7*b5*\text{MED}_W*\text{LOW}_Z*\text{MED}_Q + \]
\[ a1*b7*\text{HIGH}_V*\text{MED}_Q + \]
\[ a4*b7*\text{MED}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{LOW}_Z*\text{HIGH}_V*\text{MED}_Q + \]
\[ a7*b7*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_V*\text{MED}_Q; \]
\[ \text{ILHLM} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{LOW}_Z + \]
\[ a7*b1*\text{HIGH}_W*\text{LOW}_Z + \]
\[ a1*b4*\text{HIGH}_V + a4*b4*\text{HIGH}_W*\text{HIGH}_V + a5*b4*\text{LOW}_Z*\text{HIGH}_V + \]
\[ a7*b4*\text{HIGH}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b5*\text{MED}_Q + \]
\[ a4*b5*\text{HIGH}_W*\text{MED}_Q + \]
\[ a5*b5*\text{LOW}_Z*\text{MED}_Q + a7*b5*\text{HIGH}_W*\text{LOW}_Z*\text{MED}_Q + \]
\[ a1*b7*\text{HIGH}_V*\text{MED}_Q + \]
\[ a4*b7*\text{HIGH}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{LOW}_Z*\text{HIGH}_V*\text{MED}_Q + \]
\[ a7*b7*\text{HIGH}_W*\text{LOW}_Z*\text{HIGH}_V*\text{MED}_Q; \]
\[ \text{ILMHM} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{MED}_Z + \]
\[ a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + \]
\[ a7*b4*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{MED}_Q + \]
\[ a4*b5*\text{LOW}_W*\text{MED}_Q + \]
\[ a5*b5*\text{MED}_Z*\text{MED}_Q + a7*b5*\text{LOW}_W*\text{MED}_Z*\text{MED}_Q + \]
\[ a1*b7*\text{HIGH}_V*\text{MED}_Q + \]
\[ a4*b7*\text{LOW}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + \]
\[ a7*b7*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q; \]
\[ \text{IMMMHM} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{MED}_Z + \]
\[ a1*b4*\text{HIGH}_V + a4*b4*\text{MED}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + \]
\[ a7*b4*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{MED}_Q + \]
\[ a4*b5*\text{MED}_W*\text{MED}_Q + \]
\[ a5*b5*\text{MED}_Z*\text{MED}_Q + a7*b5*\text{MED}_W*\text{MED}_Z*\text{MED}_Q + \]
\[ a1*b7*\text{HIGH}_V*\text{MED}_Q + \]
\[ a4*b7*\text{MED}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + \]
\[ a7*b7*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q; \]
\[ \text{IMHMM} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{MED}_W*\text{MED}_Z + \]
\[ a1*b4*\text{HIGH}_V + a4*b4*\text{MED}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + \]
\[ a7*b4*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{MED}_Q + \]
\[ a4*b5*\text{MED}_W*\text{MED}_Q + \]
\[ a5*b5*\text{MED}_Z*\text{MED}_Q + a7*b5*\text{MED}_W*\text{MED}_Z*\text{MED}_Q + \]
\[ a1*b7*\text{HIGH}_V*\text{MED}_Q + \]
\[ a4*b7*\text{MED}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + \]
\[ a7*b7*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q; \]
\[ \text{IMMHH} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{MED}_W*\text{MED}_Z + \]
\[ a1*b4*\text{HIGH}_V + a4*b4*\text{MED}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + \]
\[ a7*b4*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{MED}_Q + \]
\[ a4*b5*\text{MED}_W*\text{MED}_Q + \]
\[ a5*b5*\text{MED}_Z*\text{MED}_Q + a7*b5*\text{MED}_W*\text{MED}_Z*\text{MED}_Q + \]
\[ a1*b7*\text{HIGH}_V*\text{MED}_Q + \]
\[ a4*b7*\text{MED}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + \]
\[ a7*b7*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q; \]
\[ \text{ILHHM} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{HIGH}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{HIGH}_Z + \]
\[ a1*b4*\text{LOW}_W*\text{MED}_Q + a7*b4*\text{LOW}_W*\text{MED}_Z + a1*b5*\text{HIGH}_W + a5*b5*\text{MED}_Q + a7*b5*\text{MED}_W*\text{MED}_Q; \]
\[ \text{ILHLM} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{LOW}_Z + a7*b1*\text{LOW}_Z*\text{MED}_Q + a1*b5*\text{MED}_Q + a4*b5*\text{MED}_W*\text{MED}_Q + a5*b5*\text{LOW}_Z*\text{MED}_Q + a7*b5*\text{LOW}_Z*\text{MED}_Q + a1*b7*\text{HIGH}_V*\text{MED}_Q + a4*b7*\text{MED}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + a7*b7*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + \]
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a7*b4*LOW_W*HIGH_Z*HIGH_V + a1*b5*MED_Q + a4*b5*MED_W*HIGH_V + a5*b5*MED_W*HIGH_Z*HIGH_V + a7*b5*MED_W*HIGH_Z*HIGH_V;
IMHHM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_W*HIGH_Z*HIGH_V + a7*b4*MED_W*HIGH_Z*HIGH_V;
IHHHM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a7*b4*HIGH_W*HIGH_Z*HIGH_V + a1*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a7*b5*HIGH_W*HIGH_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*LOW_W*HIGH_Z*MED_Q + a7*b7*LOW_W*HIGH_Z*HIGH_V*MED_Q;
ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*LOW_W*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q + a7*b5*LOW_W*LOW_Z*HIGH_Q + a1*b7*LOW_V*HIGH_Q + a4*b7*LOW_W*LOW_V*HIGH_Q + a5*b7*LOW_W*LOW_Z*LOW_V*HIGH_Q + a7*b7*LOW_W*LOW_Z*LOW_V*HIGH_Q;
IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*MED_W*LOW_Z *LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*LOW_Z + a5*b5*LOW_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*LOW_V*HIGH_Q + a1*b7*LOW_V*HIGH_Q + a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*MED_W*LOW_Z*LOW_V*HIGH_Q + a7*b7*MED_W*LOW_Z*LOW_V*HIGH_Q;
IHLHH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*MED_W*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*LOW_Z + a5*b5*LOW_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*LOW_V*HIGH_Q + a1*b7*LOW_V*HIGH_Q + a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*MED_W*LOW_Z*LOW_V*HIGH_Q + a7*b7*MED_W*LOW_Z*LOW_V*HIGH_Q;
\[a7*b1*HIGH_W*LOW_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*HIGH_W*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q + a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*LOW_Z*LOW_V*HIGH_Q + a7*b7*HIGH_W*LOW_Z*LOW_V*HIGH_Q; \]

\[ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q + a4*b7*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q + a7*b7*LOW_W*MED_Z*LOW_V*HIGH_Q; \]

\[IMMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q + a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q + a7*b7*MED_W*MED_Z*LOW_V*HIGH_Q; \]

\[IHMLH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q + a7*b5*HIGH_W*MED_Z*HIGH_Q + a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q + a7*b7*HIGH_W*MED_Z*LOW_V*HIGH_Q; \]

\[ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*LOW_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q + a4*b7*LOW_V*LOW_V*HIGH_Q + a5*b7*HIGH_Z*LOW_V*HIGH_Q + a7*b7*LOW_W*HIGH_Z*LOW_V*HIGH_Q; \]

\[IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*MED_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q + a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q + a7*b7*MED_W*MED_Z*LOW_V*HIGH_Q; \]
\[ a_1b_4\text{LOW}_V + a_4b_4\text{MED}_W\text{LOW}_V + a_5b_4\text{HIGH}_Z\text{LOW}_V + a_7b_4\text{MED}_W\text{HIGH}_Z\text{LOW}_V + a_1b_5\text{HIGH}_Q + \\
\quad a_4b_5\text{MED}_W\text{HIGH}_Q + \\
\quad a_5b_5\text{HIGH}_Z\text{HIGH}_Q + a_7b_5\text{MED}_W\text{HIGH}_Z\text{HIGH}_Q + \\
\quad a_1b_7\text{LOW}_W\text{HIGH}_Q + \\
\quad a_4b_7\text{MED}_W\text{LOW}_W\text{HIGH}_Q + a_5b_7\text{MED}_W\text{LOW}_Z\text{HIGH}_Q + a_7b_7\text{MED}_W\text{LOW}_Z\text{LOW}_W\text{HIGH}_Q; \]

\[ \text{IHHLH} = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{HIGH}_Z + a_7b_1\text{MED}_W\text{HIGH}_Z\text{LOW}_W\text{HIGH}_Q; \]

\[ \text{ILLMH} = a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{LOW}_Z + a_7b_1\text{MED}_W\text{LOW}_Z\text{LOW}_Z\text{HIGH}_Q; \]

\[ \text{IMLMH} = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{LOW}_Z + a_7b_1\text{MED}_W\text{LOW}_Z\text{LOW}_Z\text{HIGH}_Q; \]

\[ \text{IHLMH} = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{LOW}_Z + a_7b_1\text{MED}_W\text{LOW}_Z\text{LOW}_Z\text{HIGH}_Q; \]

\[ \text{ILMMH} = a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{MED}_Z + a_7b_1\text{MED}_W\text{LOW}_Z\text{LOW}_Z\text{HIGH}_Q; \]
\[
\begin{align*}
&420 \\
a_7b_4*LOW_W*MED_Z*MED_V + a_1b_5*HIGH_Q + \\
a_4b_5*LOW_W*HIGH_Q + \\
a_5b_5*MED_Z*HIGH_Q + a_7b_5*LOW_W*MED_Z*HIGH_Q + \\
a_1b_7*MED_V*HIGH_Q + \\
a_4b_7*LOW_W*MED_V*HIGH_Q + a_5b_7*MED_Z*MED_V*HIGH_Q + \\
a_7b_7*LOW_W*MED_Z*MED_V*HIGH_Q; \\
IMMMH = a_1b_1 + a_4b_1*MED_W + a_5b_1*MED_Z + \\
a_7b_1*MED_W*MED_Z + \\
a_1b_4*MED_V + a_4b_4*LOW_W*MED_V + a_5b_4*HIGH_Z*MED_V + \\
a_7b_4*MED_W*MED_Z*MED_V + a_1b_5*HIGH_Q + \\
a_4b_5*MED_W*HIGH_Q + \\
a_5b_5*MED_Z*HIGH_Q + a_7b_5*LOW_W*MED_Z*HIGH_Q + \\
a_1b_7*MED_V*HIGH_Q + \\
a_4b_7*MED_W*MED_V*HIGH_Q + a_5b_7*MED_Z*MED_V*HIGH_Q + \\
a_7b_7*MED_W*MED_Z*MED_V*HIGH_Q; \\
IHMMH = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*MED_Z + \\
a_7b_1*HIGH_W*MED_Z + \\
a_1b_4*MED_V + a_4b_4*HIGH_W*MED_V + a_5b_4*MED_Z*MED_V + \\
a_7b_4*HIGH_W*MED_Z*MED_V + a_1b_5*HIGH_Q + \\
a_4b_5*HIGH_W*HIGH_Q + \\
a_5b_5*MED_Z*HIGH_Q + a_7b_5*HIGH_W*MED_Z*HIGH_Q + \\
a_1b_7*MED_V*HIGH_Q + \\
a_4b_7*HIGH_W*MED_V*HIGH_Q + a_5b_7*MED_Z*MED_V*HIGH_Q + \\
a_7b_7*HIGH_W*MED_Z*MED_V*HIGH_Q; \\
ILHMM = a_1b_1 + a_4b_1*LOW_W + a_5b_1*HIGH_Z + \\
a_7b_1*LOW_W*HIGH_Z + \\
a_1b_4*MED_V + a_4b_4*LOW_W*MED_V + a_5b_4*HIGH_Z*MED_V + \\
a_7b_4*LOW_W*HIGH_Z*MED_V + a_1b_5*HIGH_Q + \\
a_4b_5*LOW_W*HIGH_Q + \\
a_5b_5*HIGH_Z*HIGH_Q + a_7b_5*LOW_W*HIGH_Z*HIGH_Q + \\
a_1b_7*LOW_W*HIGH_Q + \\
a_4b_7*LOW_W*MED_V*HIGH_Q + a_5b_7*HIGH_Z*MED_V*HIGH_Q + \\
a_7b_7*LOW_W*HIGH_Z*MED_V*HIGH_Q; \\
IMHMM = a_1b_1 + a_4b_1*MED_W + a_5b_1*HIGH_Z + \\
a_7b_1*MED_W*HIGH_Z + \\
a_1b_4*MED_V + a_4b_4*MED_W*MED_V + a_5b_4*HIGH_Z*MED_V + \\
a_7b_4*MED_W*HIGH_Z*MED_V + a_1b_5*HIGH_Q + \\
a_4b_5*MED_W*HIGH_Q + \\
a_5b_5*HIGH_Z*HIGH_Q + a_7b_5*MED_W*HIGH_Z*HIGH_Q + \\
a_1b_7*MED_V*HIGH_Q + \\
a_4b_7*MED_W*MED_V*HIGH_Q + a_5b_7*HIGH_Z*MED_V*HIGH_Q + \\
a_7b_7*MED_W*HIGH_Z*MED_V*HIGH_Q; \\
IHMMH = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*HIGH_Z + \\
a_7b_1*HIGH_W*HIGH_Z + \\
a_1b_4*MED_V + a_4b_4*HIGH_W*MED_V + a_5b_4*HIGH_Z*MED_V + \\
a_7b_4*HIGH_W*HIGH_Z*MED_V + a_1b_5*HIGH_Q + \\
a_4b_5*HIGH_W*HIGH_Q + \\
\end{align*}
\]
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q +
\[ a1*b7*\text{MED}_V*\text{HIGH}_Q + a4*b7*\text{HIGH}_W*\text{MED}_V*\text{HIGH}_Q + a5*b7*\text{HIGH}_Z*\text{MED}_V*\text{HIGH}_Q + a7*b7*\text{HIGH}_W*\text{HIGH}_Z*\text{MED}_V*\text{HIGH}_Q; \]

\[
\text{ILLHH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{LOW}_Z + a7*b1*\text{LOW}_W*\text{LOW}_Z + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V + a5*b4*\text{LOW}_Z*\text{HIGH}_V + a7*b4*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b5*\text{HIGH}_Q + a4*b5*\text{LOW}_W*\text{HIGH}_Q + a5*b5*\text{LOW}_Z*\text{HIGH}_Q + a7*b5*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_Q + a1*b7*\text{HIGH}_V*\text{HIGH}_Q + a4*b7*\text{LOW}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b7*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q + a7*b7*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q;
\]

\[
\text{IMLHH} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{LOW}_Z + a7*b1*\text{LOW}_W*\text{LOW}_Z + a1*b4*\text{HIGH}_V + a4*b4*\text{MED}_W*\text{HIGH}_V + a5*b4*\text{LOW}_Z*\text{HIGH}_V + a7*b4*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b5*\text{MED}_Q + a4*b5*\text{LOW}_W*\text{MED}_Q + a5*b5*\text{LOW}_Z*\text{MED}_Q + a7*b5*\text{LOW}_W*\text{LOW}_Z*\text{MED}_Q + a1*b7*\text{HIGH}_V*\text{MED}_Q + a4*b7*\text{LOW}_W*\text{HIGH}_V*\text{MED}_Q + a5*b7*\text{LOW}_Z*\text{HIGH}_V*\text{MED}_Q + a7*b7*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_V*\text{MED}_Q;
\]

\[
\text{IHLHH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{LOW}_Z + a7*b1*\text{LOW}_W*\text{LOW}_Z + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V + a5*b4*\text{LOW}_Z*\text{HIGH}_V + a7*b4*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b5*\text{HIGH}_Q + a4*b5*\text{LOW}_W*\text{HIGH}_Q + a5*b5*\text{LOW}_Z*\text{HIGH}_Q + a7*b5*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_Q + a1*b7*\text{HIGH}_V*\text{HIGH}_Q + a4*b7*\text{LOW}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b7*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q + a7*b7*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V + a5*b4*\text{LOW}_Z*\text{HIGH}_V + a7*b4*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b5*\text{HIGH}_Q + a4*b5*\text{LOW}_W*\text{HIGH}_Q;
\]

\[
\text{ILMHH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + a7*b1*\text{LOW}_W*\text{MED}_Z + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + a7*b4*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{HIGH}_Q + a4*b5*\text{LOW}_W*\text{HIGH}_Q + a5*b5*\text{MED}_Z*\text{HIGH}_Q + a7*b5*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_Q + a1*b7*\text{HIGH}_V*\text{HIGH}_Q + a4*b7*\text{LOW}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q + a7*b7*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]

\[
\text{IMMMHH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + a7*b1*\text{LOW}_W*\text{MED}_Z + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + a7*b4*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{HIGH}_Q + a4*b5*\text{LOW}_W*\text{HIGH}_Q + a5*b5*\text{MED}_Z*\text{HIGH}_Q + a7*b5*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_Q + a1*b7*\text{HIGH}_V*\text{HIGH}_Q + a4*b7*\text{LOW}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q + a7*b7*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]

\[
\text{IMMMHH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + a7*b1*\text{LOW}_W*\text{MED}_Z + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + a7*b4*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{HIGH}_Q + a4*b5*\text{LOW}_W*\text{HIGH}_Q + a5*b5*\text{MED}_Z*\text{HIGH}_Q + a7*b5*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_Q + a1*b7*\text{HIGH}_V*\text{HIGH}_Q + a4*b7*\text{LOW}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b7*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q + a7*b7*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]
\[a_1b_1 + a_4b_1 + a_5b_1 + a_7b_1 + a_1b_4 + a_4b_4 + a_5b_4 + a_7b_4 + a_1b_5 + a_4b_5 + a_5b_5 + a_7b_5 + a_1b_7 + a_4b_7 + a_5b_7 + a_7b_7;\]

\[IHMHH = a_1b_1 + a_4b_1 + a_5b_1 + a_7b_1 + a_1b_4 + a_4b_4 + a_5b_4 + a_7b_4 + a_1b_5 + a_4b_5 + a_5b_5 + a_7b_5 + a_1b_7 + a_4b_7 + a_5b_7 + a_7b_7;\]

\[ILHHH = a_1b_1 + a_4b_1 + a_5b_1 + a_7b_1 + a_1b_4 + a_4b_4 + a_5b_4 + a_7b_4 + a_1b_5 + a_4b_5 + a_5b_5 + a_7b_5 + a_1b_7 + a_4b_7 + a_5b_7 + a_7b_7;\]

\[IMHHH = a_1b_1 + a_4b_1 + a_5b_1 + a_7b_1 + a_1b_4 + a_4b_4 + a_5b_4 + a_7b_4 + a_1b_5 + a_4b_5 + a_5b_5 + a_7b_5 + a_1b_7 + a_4b_7 + a_5b_7 + a_7b_7;\]
Calc conditional total effects for each combination of moderator values

TLLLL = ILLLL + cdash;
TMLLL = IMLLL + cdash;
THLLL = IHLLL + cdash;
TLMLL = ILMLL + cdash;
TMMLL = IMMLL + cdash;
THMLL = IHMLL + cdash;
TLHLL = ILHLL + cdash;
TMHLL = IMHLL + cdash;
THHLL = IHHLL + cdash;
TLLML = ILLML + cdash;
TMLML = IMLML + cdash;
THLML = IHLML + cdash;
TLMML = ILMLM + cdash;
TMMML = IMMML + cdash;
THMML = IHMML + cdash;
TLHML = ILHML + cdash;
TMHML = IMHML + cdash;
THHML = IHHML + cdash;
TLLHL = ILLHL + cdash;
TMLHL = IMLHL + cdash;
THLHL = IHLHL + cdash;
TLMHL = ILHML + cdash;
TMMHL = IMMHL + cdash;
THMHL = IHMHL + cdash;
TLHHL = ILHHL + cdash;
TMHHL = IMHHL + cdash;
THHHL = IHHHL + cdash;
TLLLM = ILLLM + cdash;
TMLLM = IMLLM + cdash;
THLLM = IHLLM + cdash;
TLMLM = ILMLM + cdash;
TMMLM = IMMLM + cdash;
THMLM = IHMLM + cdash;
TLHLM = ILHLM + cdash;
TMHLM = IMHLM + cdash;
THHLM = IHHLM + cdash;

TLLMM = ILLMM + cdash;
TMLMM = IMLMM + cdash;
THLMM = IHLMM + cdash;
TLMMM = ILMMM + cdash;
TMMMM = IMMMM + cdash;
THMMM = IHMMM + cdash;
TLMHM = ILMHM + cdash;
TMHMM = IMHMM + cdash;
THHMM = IHHMM + cdash;
TLLHM = ILLHM + cdash;
TMLHM = IMLHM + cdash;
THLHM = IHLHM + cdash;
TLMHM = ILMHM + cdash;
TMHMM = IMHMM + cdash;
THHMM = IHHMM + cdash;
TLLMH = ILLMH + cdash;
TMLMH = IMLMH + cdash;
THLMH = IHLMH + cdash;
TLMMH = ILMHM + cdash;
TMMMH = IMMMM + cdash;
THMMH = IHMMM + cdash;
TLLHH = ILLHH + cdash;
TMLHH = IMLHH + cdash;
THLHH = IHLHH + cdash;
TLMHH = ILMHM + cdash;
TMHMM = IMHMM + cdash;
THHMM = IHHMM + cdash;
TMLHH = IMLHH + cdash;
TMHHM = IMHMM + cdash;
THHMM = IHHMM + cdash;
TLMHH = ILMHH + cdash;
TMMHH = IMMHH + cdash;
THMHH = IHMHH + cdash;
TLHHH = ILHHH + cdash;
TMHHH = IMHHH + cdash;
THHHH = IHHHH + cdash;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by
! logical min and max limits of predictor X used in analysis

\textbf{PLOT(PLLLL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL);}

\begin{verbatim}
LOOP(XVAL,1,5,0.1);
PLLLL = ILLL*XVAL;
PMLLL = IMLLL*XVAL;
PHLLL = IHLLL*XVAL;

PLMLL = IMLLL*XVAL;
PMMLL = IMMLL*XVAL;
PHMLL = IHMLL*XVAL;

PLHLL = ILLHL*XVAL;
PMHLL = IMHLL*XVAL;
PHHLL = IHHLL*XVAL;

PLLML = ILLML*XVAL;
PMLML = IMLML*XVAL;
PHMLL = IHMLL*XVAL;

PLHML = ILLHL*XVAL;
PMHML = IMHML*XVAL;
PHHML = IHHML*XVAL;
\end{verbatim}
PLLHL = ILLHL*XVAL;
PMLHL = IMLHL*XVAL;
PMLHL = IMLHL*XVAL;
PLMHL = ILMHL*XVAL;
PMMLHL = IMMHL*XVAL;
PHMHL = IHMHL*XVAL;
PLHHL = ILHHL*XVAL;
PMHHL = IMHHL*XVAL;
PMMHL = IMMHL*XVAL;
PLMHL = ILMHL*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PLMLM = IMLLM*XVAL;
PHLLM = IHLLM*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PLMLM = IMLLM*XVAL;
PHHLM = IHHLM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PLHLM = ILHLM*XVAL;
PMLHM = IMLHM*XVAL;
PLHLM = ILHLM*XVAL;
PLMHL = ILMHL*XVAL;
PMMLM = IMMML*XVAL;
PHMLM = IHMLM*XVAL;
PLMLM = IMLLM*XVAL;
PMLML = IMLML*XVAL;
PLMLM = IMLLM*XVAL;
PHHLM = IHHLM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PLHLM = ILHLM*XVAL;
PMLHM = IMLHM*XVAL;
PLHLM = ILHLM*XVAL;
PLLHL = ILLHL*XVAL;
PMLHL = IMLHL*XVAL;
PMLHL = IMLHL*XVAL;
PLMHL = ILMHL*XVAL;
PMMLHL = IMMHL*XVAL;
PHMHL = IHMHL*XVAL;
PLHHL = ILHHL*XVAL;
PMHHL = IMHHL*XVAL;
PMMHL = IMMHL*XVAL;
PLMHL = ILMHL*XVAL;
PLMLH = ILMLH*XVAL;
PMMLH = IMMLH*XVAL;
PHMLH = IHMLH*XVAL;
PLHLH = ILHLH*XVAL;
PMHLH = IMHLH*XVAL;
PHHLH = IHHLH*XVAL;
PLLMH = ILLMH*XVAL;
PMLMH = IMLMH*XVAL;
PHLMH = IHLMH*XVAL;
PLMMH = ILMMH*XVAL;
PMMMH = IMMMH*XVAL;
PHMMH = IHMMH*XVAL;
PLHMH = ILHMH*XVAL;
PMMHMH = IMHHH*XVAL;
PHHMM = IHMMH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PMLHH = IMLHH*XVAL;
PLMHH = ILMHH*XVAL;
PMMHH = ILMHH*XVAL;
PHMHH = IHMMH*XVAL;
PLHHH = ILMHH*XVAL;
PMMHH = ILMHH*XVAL;
PHHHH = IHMMH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 49: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path, with the other 2 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 MV + b_5 MQ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ) + b_2 V + b_3 Q + b_4(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ)V + b_5(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ)Q + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0 b_1 + a_1 b_1 X + a_2 b_1 W + a_3 b_1 Z + a_4 b_1 XW + a_5 b_1 XZ + b_2 V + b_3 Q + a_0 b_4 V + a_1 b_4 XV + a_2 b_4 WV + a_3 b_4 ZV + a_4 b_4 XWV + a_5 b_4 XZV + a_0 b_5 Q + a_1 b_5 XQ \]
+ a2b5WQ + a3b5ZQ + a4b5XWQ + a5b5XZQ + c1'X + c2'W + c3'Z + c4'XW + c5'XZ

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a3b1Z + b2V + b3Q + a0b4V + a2b4WV + a3b4ZV + a0b5Q + a2b5WQ + a3b5ZQ + c2'W + c3'Z) + (a1b1 + a4b1W + a5b1Z + a1b4V + a4b4WV + a5b4ZV + a1b5Q + a4b5WQ + a5b5ZQ + c1' + c4'W + c5'Z)X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V, Q:

a1b1 + a4b1W + a5b1Z + a1b4V + a4b4WV + a5b4ZV + a1b5Q + a4b5WQ + a5b5ZQ = (a1 + a4W + a5Z)(b1 + b4V + b5Q)

One direct effect of X on Y, conditional on W, Z: c1' + c4'W + c5'Z

Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y

USEVARIABLES = X M W Z V Q Y XW XZ MV MQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MQ = M*Q;
  MV = M*V;
  XW = X*W;
  XZ = X*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON Q (b3);
Y ON MV (b4);
Y ON MQ (b5);
Y ON X (cdash1);
Y ON W (cdash2);
Y ON Z (cdash3);
Y ON XW (cdash4);
Y ON XZ (cdash5);
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean

! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)
ILLLL IMLLL IHLLL ILMLL IMLLL IHLML IHMLL IMLHL ILHML IMHML IHHML
ILLML IMLML IHLML ILMML IMMLL IHLML IHMLL IMLHL ILHML IMHML IHHML
ILLHL IMLHL IHLHL ILMHL IMMLL IHLML IHMLL IMLHL ILHML IMHML IHHML
ILLLM IMLLM IHLLM ILMLM IMMLM IHLML IHMLM IMLML IMLHL IMLHL IMLHL
ILLMM IMLMM IHLMM ILMMM IMMMM IHLMM IMHMM ILMHM ILMHM ILMHM ILMHM
ILLHH IMLHH IHLHH ILMHH IMMMH ILMHM ILMHM ILMHM ILMHM ILMHM ILMHM
ILLHH IMLHH IHLHH ILMHH IMHHH ILMHM ILMHM ILMHM ILMHM ILMHM ILMHM
DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
DLOW_HIZ DMEW_HIZ DHIW_HIZ
TLLLL TLMLL TMLLL TMMLL THLLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
TLLLL TLMLL TMLLL TMMLL TMMLL TLHLL TMHLL TTHLL
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;
IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a4*b4*HIGH_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;
ILMLL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IMMLL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IMHML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IHMLL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*LOW_V
+ a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
ILHLL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*LOW_V
+ a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a1*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;
IMHLL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*LOW_V
+ a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*LOW_V
+ a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a1*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;
ILLML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*MED_V +
a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;
IMLML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*MED_V +
a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;
IHLML = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*MED_V +
a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;
ILMML = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*MED_V +
a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*MED_V +
a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
IHMML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*MED_V +
a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*LOW_Q +
a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q;
ILHML = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*MED_V +
a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;
IMHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*MED_V +
a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

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IHHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*LOW_Q + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q;

ILMHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

IMMHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

IHMHL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q;

ILHHL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IMHHL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

IHHHL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q;

ILLLM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q + a5*b5*LOW_Z*MED_Q;

IMLLM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q;
\[ \begin{align*}
a_4b_4&MED_W*LOW_V + a_5b_4&LOW_Z*LOW_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&LOW_Z*MED_Q; \\
IHLLM &= a_1b_1 + a_4b_1*HIGH_W + a_5b_1*LOW_Z + a_1b_4*LOW_V \\
&+ a_4b_4*HIGH_W*LOW_V + a_5b_4&LOW_Z*LOW_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&LOW_Z*MED_Q; \\
ILMLM &= a_1b_1 + a_4b_1*LOW_W + a_5b_1&MED_Z + a_1b_4*LOW_V \\
&+ a_4b_4&LOW_W*LOW_V + a_5b_4&MED_Z*LOW_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&MED_Z*MED_Q; \\
immlm &= a_1b_1 + a_4b_1*MED_W + a_5b_1&MED_Z + a_1b_4*LOW_V \\
&+ a_4b_4*MED_W*LOW_V + a_5b_4&MED_Z*LOW_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&MED_Z*MED_Q; \\
Ihmlm &= a_1b_1 + a_4b_1*HIGH_W + a_5b_1*MED_Z + a_1b_4*LOW_V \\
&+ a_4b_4*HIGH_W*LOW_V + a_5b_4&MED_Z*LOW_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&MED_Z*MED_Q; \\
ilhlm &= a_1b_1 + a_4b_1*LOW_W + a_5b_1*HIGH_Z + a_1b_4*LOW_V \\
&+ a_4b_4&LOW_W*LOW_V + a_5b_4*HIGH_Z*LOW_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&HIGH_Z*MED_Q; \\
imlmm &= a_1b_1 + a_4b_1*MED_W + a_5b_1*LOW_Z + a_1b_4*MED_V \\
&+ a_4b_4&MED_W*MED_V + a_5b_4&LOW_Z*MED_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&MED_Z*MED_Q; \\
immm &= a_1b_1 + a_4b_1*LOW_W + a_5b_1&MED_Z + a_1b_4*MED_V \\
&+ a_4b_4&LOW_W*MED_V + a_5b_4&MED_Z*MED_V + a_1b_5&MED_Q + \\
a_4b_5&MED_W*MED_Q + a_5b_5&MED_Z*MED_Q; \\
imhmm &= a_1b_1 + a_4b_1*HIGH_W + a_5b_1*MED_Z + a_1b_4*MED_V 
\end{align*} \]
\[a_4 b_4^* \text{HIGH}_W \ast \text{MED}_V + a_5 b_4^* \text{MED}_Z \ast \text{MED}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{HIGH}_W \ast \text{MED}_Q + a_5 b_5^* \text{MED}_Z \ast \text{MED}_Q; \]
\[\text{ILHMM} = a_1 b_1 + a_4 b_1^* \text{LOW}_W + a_5 b_1^* \text{HIGH}_Z + a_1 b_4^* \text{MED}_V \]
\[a_4 b_4^* \text{LOW}_W \ast \text{MED}_V + a_5 b_4^* \text{HIGH}_Z \ast \text{MED}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{LOW}_W \ast \text{MED}_Q + a_5 b_5^* \text{HIGH}_Z \ast \text{MED}_Q; \]
\[\text{IMHMM} = a_1 b_1 + a_4 b_1^* \text{MED}_W + a_5 b_1^* \text{HIGH}_Z + a_1 b_4^* \text{MED}_V \]
\[a_4 b_4^* \text{MED}_W \ast \text{MED}_V + a_5 b_4^* \text{HIGH}_Z \ast \text{MED}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{MED}_W \ast \text{MED}_Q + a_5 b_5^* \text{HIGH}_Z \ast \text{MED}_Q; \]
\[\text{IHHMM} = a_1 b_1 + a_4 b_1^* \text{HIGH}_W + a_5 b_1^* \text{HIGH}_Z + a_1 b_4^* \text{MED}_V \]
\[a_4 b_4^* \text{HIGH}_W \ast \text{MED}_V + a_5 b_4^* \text{HIGH}_Z \ast \text{MED}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{HIGH}_W \ast \text{MED}_Q + a_5 b_5^* \text{HIGH}_Z \ast \text{MED}_Q; \]
\[\text{ILLHM} = a_1 b_1 + a_4 b_1^* \text{LOW}_W + a_5 b_1^* \text{LOW}_Z + a_1 b_4^* \text{HIGH}_V \]
\[a_4 b_4^* \text{LOW}_W \ast \text{HIGH}_V + a_5 b_4^* \text{LOW}_Z \ast \text{HIGH}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{LOW}_W \ast \text{MED}_Q + a_5 b_5^* \text{LOW}_Z \ast \text{MED}_Q; \]
\[\text{IMLHM} = a_1 b_1 + a_4 b_1^* \text{MED}_W + a_5 b_1^* \text{LOW}_Z + a_1 b_4^* \text{HIGH}_V \]
\[a_4 b_4^* \text{ED}_W \ast \text{HIGH}_V + a_5 b_4^* \text{LOW}_Z \ast \text{HIGH}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{MED}_W \ast \text{MED}_Q + a_5 b_5^* \text{LOW}_Z \ast \text{MED}_Q; \]
\[\text{IHLHM} = a_1 b_1 + a_4 b_1^* \text{HIGH}_W + a_5 b_1^* \text{LOW}_Z + a_1 b_4^* \text{HIGH}_V \]
\[a_4 b_4^* \text{HIGH}_W \ast \text{HIGH}_V + a_5 b_4^* \text{LOW}_Z \ast \text{HIGH}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{HIGH}_W \ast \text{MED}_Q + a_5 b_5^* \text{LOW}_Z \ast \text{MED}_Q; \]
\[\text{ILMHH} = a_1 b_1 + a_4 b_1^* \text{LOW}_W + a_5 b_1^* \text{MED}_Z + a_1 b_4^* \text{HIGH}_V \]
\[a_4 b_4^* \text{LOW}_W \ast \text{HIGH}_V + a_5 b_4^* \text{MED}_Z \ast \text{HIGH}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{LOW}_W \ast \text{MED}_Q + a_5 b_5^* \text{MED}_Z \ast \text{MED}_Q; \]
\[\text{IMMHH} = a_1 b_1 + a_4 b_1^* \text{MED}_W + a_5 b_1^* \text{MED}_Z + a_1 b_4^* \text{HIGH}_V \]
\[a_4 b_4^* \text{MED}_W \ast \text{HIGH}_V + a_5 b_4^* \text{MED}_Z \ast \text{HIGH}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{MED}_W \ast \text{MED}_Q + a_5 b_5^* \text{MED}_Z \ast \text{MED}_Q; \]
\[\text{IHMHM} = a_1 b_1 + a_4 b_1^* \text{HIGH}_W + a_5 b_1^* \text{MED}_Z + a_1 b_4^* \text{HIGH}_V \]
\[a_4 b_4^* \text{HIGH}_W \ast \text{HIGH}_V + a_5 b_4^* \text{MED}_Z \ast \text{HIGH}_V + a_1 b_5^* \text{MED}_Q + a_4 b_5^* \text{HIGH}_W \ast \text{MED}_Q + a_5 b_5^* \text{MED}_Z \ast \text{MED}_Q; \]
\[ a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + a_1 b_5 \text{MED}_Q + a_4 b_5 \text{MED}_W \text{MED}_Q + a_5 b_5 \text{HIGH}_Z \text{MED}_Q; \]

IHHHM = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{HIGH}_V \]

+ \[ a_4 b_4 \text{HIGH}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + a_1 b_5 \text{MED}_Q \]

+ \[ a_4 b_5 \text{HIGH}_W \text{MED}_Q + a_5 b_5 \text{HIGH}_Z \text{MED}_Q; \]

ILLLH = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q; \]

IMLLH = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q; \]

IHLLH = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{HIGH}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q; \]

ILMLH = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q; \]

IMMLH = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{MED}_W \text{MED}_Q + a_5 b_4 \text{MED}_Z \text{MED}_Q + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q; \]

IHMLH = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{HIGH}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q; \]

ILHLH = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{HIGH}_Z \text{HIGH}_Q; \]

IMHLH = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{LOW}_V + a_4 b_4 \text{MED}_W \text{MED}_Q + a_5 b_4 \text{MED}_Z \text{MED}_Q + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q; \]
IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q;

ILMMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

ILHMH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q;

IMHMH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q;

IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q;

ILLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q;

IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

IHLHH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q;

ILMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

IHMHH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

IMHMH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a1*b5*HIGH_Q + a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q;

IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*HIGH_Q + a4*b5*HIGH_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q;
\[ a_4b_4 \text{MED}_W \text{HIGH}_V + a_5b_4 \text{MED}_Z \text{HIGH}_V + a_1b_5 \text{HIGH}_Q +
\]
\[ a_4b_5 \text{MED}_W \text{HIGH}_Q + a_5b_5 \text{MED}_Z \text{HIGH}_Q; \]
\[ \text{IHMHH} = a_1b_1 + a_4b_1 \text{HIGH}_W + a_5b_1 \text{MED}_Z + a_1b_4 \text{HIGH}_V +
\]
\[ a_4b_4 \text{HIGH}_W \text{HIGH}_V + a_5b_4 \text{MED}_Z \text{HIGH}_V + a_1b_5 \text{HIGH}_Q +
\]
\[ a_4b_5 \text{HIGH}_W \text{HIGH}_Q + a_5b_5 \text{MED}_Z \text{HIGH}_Q; \]
\[ \text{ILHHH} = a_1b_1 + a_4b_1 \text{LOW}_W + a_5b_1 \text{HIGH}_Z + a_1b_4 \text{HIGH}_V +
\]
\[ a_4b_4 \text{LOW}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{HIGH}_Q +
\]
\[ a_4b_5 \text{LOW}_W \text{HIGH}_Q + a_5b_5 \text{HIGH}_Z \text{HIGH}_Q; \]
\[ \text{IMHHH} = a_1b_1 + a_4b_1 \text{MED}_W + a_5b_1 \text{HIGH}_Z + a_1b_4 \text{HIGH}_V +
\]
\[ a_4b_4 \text{MED}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{HIGH}_Q +
\]
\[ a_4b_5 \text{MED}_W \text{HIGH}_Q + a_5b_5 \text{HIGH}_Z \text{HIGH}_Q; \]
\[ \text{IHHHH} = a_1b_1 + a_4b_1 \text{HIGH}_W + a_5b_1 \text{HIGH}_Z + a_1b_4 \text{HIGH}_V +
\]
\[ a_4b_4 \text{HIGH}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{HIGH}_Q +
\]
\[ a_4b_5 \text{HIGH}_W \text{HIGH}_Q + a_5b_5 \text{HIGH}_Z \text{HIGH}_Q; \]

! Calc conditional direct effects for each combination of moderator values
\[
\text{DLOW}\_\text{LOZ} = \text{cdash}_1 + \text{cdash}_4 \text{LOW}_W + \text{cdash}_5 \text{LOW}_Z;
\]
\[
\text{DMEW}\_\text{LOZ} = \text{cdash}_1 + \text{cdash}_4 \text{MED}_W + \text{cdash}_5 \text{LOW}_Z;
\]
\[
\text{DHIW}\_\text{LOZ} = \text{cdash}_1 + \text{cdash}_4 \text{HIGH}_W + \text{cdash}_5 \text{LOW}_Z;
\]
\[
\text{DLOW}\_\text{MEZ} = \text{cdash}_1 + \text{cdash}_4 \text{LOW}_W + \text{cdash}_5 \text{MED}_Z;
\]
\[
\text{DMEW}\_\text{MEZ} = \text{cdash}_1 + \text{cdash}_4 \text{MED}_W + \text{cdash}_5 \text{MED}_Z;
\]
\[
\text{DHIW}\_\text{MEZ} = \text{cdash}_1 + \text{cdash}_4 \text{HIGH}_W + \text{cdash}_5 \text{MED}_Z;
\]
\[
\text{DLOW}\_\text{HIZ} = \text{cdash}_1 + \text{cdash}_4 \text{LOW}_W + \text{cdash}_5 \text{HIGH}_Z;
\]
\[
\text{DMEW}\_\text{HIZ} = \text{cdash}_1 + \text{cdash}_4 \text{MED}_W + \text{cdash}_5 \text{HIGH}_Z;
\]
\[
\text{DHIW}\_\text{HIZ} = \text{cdash}_1 + \text{cdash}_4 \text{HIGH}_W + \text{cdash}_5 \text{HIGH}_Z;
\]

! Calc conditional total effects for each combination of moderator values
\[
\text{TLLLL} = \text{ILLLL} + \text{DLOW}\_\text{LOZ};
\]
\[
\text{TMLLL} = \text{IMLLL} + \text{DMEW}\_\text{LOZ};
\]
\[
\text{THLLL} = \text{IHLLL} + \text{DHIW}\_\text{LOZ};
\]
\[
\text{TLMLL} = \text{ILMLL} + \text{DLOW}\_\text{MEZ};
\]
\[
\text{TMMLL} = \text{IMMLL} + \text{DMEW}\_\text{MEZ};
\]
\[
\text{THMLL} = \text{IHMLL} + \text{DHIW}\_\text{MEZ};
\]
TLHLL = ILHLL + DLOW_HIZ;
TMHLL = IMHLL + DM EW_HIZ;
THHLL = IHHLL + DHIW_HIZ;
TLLML = ILLML + DLOW_LOZ;
TMLML = IMLML + DM EW_LOZ;
THLML = IHLML + DHIW_LOZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMML + DM EW_MEZ;
THMLM = IHMLM + DHIW_MEZ;
TLHML = ILHML + DLOW_HIZ;
TMHML = IMHML + DM EW_HIZ;
THHML = IHHML + DHIW_HIZ;
TLLHL = ILLHL + DLOW_LOZ;
TMLHL = IMLHL + DM EW_LOZ;
THLHL = IHLHL + DHIW_LOZ;
TLHHL = ILHHL + DLOW_HIZ;
TMHHL = IMHHL + DM EW_HIZ;
THHHL = IHHHL + DHIW_HIZ;
TLLL = ILLL + DLOW_LOZ;
TMLL = IMLL + DM EW_LOZ;
THLL = IHLL + DHIW_LOZ;
TLML = ILML + DLOW_MEZ;
TMML = IMM + DM EW_MEZ;
THML = IHML + DHIW_MEZ;
TLHLM = ILHLM + DLOW_HIZ;
TMHLM = IMHLM + DM EW_HIZ;
THHLM = IHHLM + DHIW_HIZ;
TLLLM = ILLLM + DLOW_LOZ;
TMLLM = IMLLM + DM EW_LOZ;
THLLM = IHLLM + DHIW_LOZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMML + DM EW_MEZ;
THMLM = IHMLM + DHIW_MEZ;
TLHLM = ILHLM + DLOW_HIZ;
TMHLM = IMHLM + DM EW_HIZ;
THHLM = IHHLM + DHIW_HIZ;
TLLMM = ILLMM + DLOW_LOZ;
TMLMM = IMLMM + DM EW_LOZ;
THLMM = IHLMM + DHIW_LOZ;
TLMM = ILMM + DLOW_MEZ;
TMMM = IMM + DM EW_MEZ;
THMM = IHMM + DHIW_MEZ;
TLHMM = ILHMM + DLOW_HIZ;
TMHMM = IMHMM + DM EW_HIZ;
THHMM = IHHMM + DHIW_HIZ;
TLLHM = ILLHM + DLOW_LOZ;
TMLHM = IMLHM + DMEW_LOZ;
THLHM = IHLHM + DHIW_LOZ;
TLMHM = ILMHM + DLOW_MEZ;
TMMHM = IMMHM + DMEW_MEZ;
THMHM = IHMHM + DHIW_MEZ;
TLHHM = ILHHM + DLOW_HIZ;
TMHHM = IMHHM + DMEW_HIZ;
THHHM = IHHHM + DHIW_HIZ;
TLLLH = ILLLH + DLOW_LOZ;
TMLLH = IMLLH + DMEW_LOZ;
THLLH = IHLLH + DHIW_LOZ;
TLMLH = ILMLH + DLOW_MEZ;
TMMLH = IMMLH + DMEW_MEZ;
THMLH = IHMLH + DHIW_MEZ;
TLLLH = ILLLH + DLOW_HIZ;
TMLLH = IMLLH + DMEW_HIZ;
THLLH = IHLLH + DHIW_HIZ;
TLMHM = ILMHM + DLOW_MEZ;
TMMHM = IMMHM + DMEW_MEZ;
THMMH = IHMHM + DHIW_MEZ;
TLLHH = ILLHH + DLOW_LOZ;
TMLHH = IMLHH + DMEW_LOZ;
THLHH = IHLHH + DHIW_LOZ;
TLMHH = ILMHH + DLOW_MEZ;
TMMHH = IMMHH + DMEW_MEZ;
THMHH = IHMHH + DHIW_MEZ;
TLHHH = ILHHH + DLOW_HIZ;
TMHHH = IMHHH + DMEW_HIZ;
THHHH = IHHHH + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
  total effects instead
! NOTE – values of 1,5 in LOOP() statement need to be replaced
by logical min and max limits of predictor X used in analysis

PLOT(PLLLL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL
PLHLL PLHLM PHLML PLMLM PMMLM PHMLM PLHLM PMHLM PHHLM
PLHLM PMLMM PHLMH PLMMH PMMMH PHMMH PMLMM PMHMM PHHMM
PLMMH PMLHM PHLHM PLHMH PMHHH PHHHH PHLHM PMLHH PHLHH
PLHLL PHHLL PLLHL PMHLL PHHLL PLHHL PMHHL PHHHL
PLHHH PHLHH PLLHH PLMHH PHMHH PMHHH PHHHL
PMLLH PMLML PHMLM PLMLM PMMLM PHMLM PMLLM PMHLM PHHLM
PMLHM PMLLH PHLHLM PLHLH PMHLH PHHLH PMHLM PLHHH PHHHH);
PLLMM = ILLLM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLM = IHLLM*XVAL;
PLMLM = IMLLM*XVAL;
PMMLM = IMMLM*XVAL;
PHMLM = IHMLM*XVAL;
PLHLM = IHLLM*XVAL;
PMHLM = IMHLM*XVAL;
PHHLM = IHHLM*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PHLMM = IHLMM*XVAL;
PLMMM = ILMMM*XVAL;
PMMMM = IMMMM*XVAL;
PHMMM = IHMMM*XVAL;
PLHMM = IHLHM*XVAL;
PMLMM = IMLHM*XVAL;
PHHMM = IHHHM*XVAL;
PLLH = ILLH*XVAL;
PMLH = IMLH*XVAL;
PHLH = IHLH*XVAL;
PLML = IMLL*XVAL;
PMLM = IMLM*XVAL;
PHML = IHML*XVAL;
PLHM = IHLH*XVAL;
PMLH = IMLH*XVAL;
PHHL = IHHH*XVAL;
PLLH = ILLH*XVAL;
PMLH = IMLH*XVAL;
PHHL = IHHH*XVAL;
PLLL = ILLL*XVAL;
PMLL = IMLL*XVAL;
PPLL = ILLL*XVAL;
PLML = IMLL*XVAL;
PMLM = IMLM*XVAL;
PHML = IHML*XVAL;
PLHM = IHLH*XVAL;
PMLH = IMLH*XVAL;
PHHH = IHHH*XVAL;
PLLL = ILLL*XVAL;
PMLL = IMLL*XVAL;
PPLM = ILLM*XVAL;
PLML = IMLL*XVAL;
PMLM = IMLM*XVAL;
PHML = IHML*XVAL;
PLHM = IHLH*XVAL;
PMLH = IMLH*XVAL;
PHHH = IHHH*XVAL;

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PLMMH = ILMMH*XVAL;
PMMMH = IMMHH*XVAL;
PHMMH = IHMMH*XVAL;
PLHMH = ILHMH*XVAL;
PMHMH = IMHMH*XVAL;
PHHMH = IHHMH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PMLHH = IMLHH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PMLHH = IMLHH*XVAL;
PMLHH = IMLHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 50: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)Q + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_2 + a_2b_1X + a_3b_1W + a_4b_1XW + a_5b_1XZ + a_0b_2V + a_2b_2V + a_3b_2VV + a_4b_2WV + a_5b_2WVZ + a_0b_3Q + a_1b_3Q + a_2b_3QW + a_3b_3QWZ + a_4b_3QWZ + a_5b_3QWZ + \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + a_0b_1 + a_1b_2 + a_2b_1 + a_3b_1W + a_4b_2WV + a_5b_2WVZ + a_0b_3Q + a_1b_3Q + a_2b_3QW + a_3b_3QWZ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ) + (a_1b_1 + a_4b_1 + a_5b_1 + a_1b_2 + a_4b_2 + a_5b_2 + a_1b_3 + a_4b_3 + a_5b_3 + c_1 + c_4V + c_5Q)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V, Q \):
\[ a_1b_1 + a_4b_1W + a_5b_1Z + a_1b_2V + a_4b_2WV + a_5b_2WVZ + a_1b_3Q + a_4b_3WQ + a_5b_3QZ = (a_1 + a_4W + a_5Z)(b_1 + b_2V + b_3Q) \]

One direct effect of \( X \) on \( Y \), conditional on \( V, Q \):
\[ c_1' + c_4'V + c_5'Q \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y

USEVARIABLES = X M W Z V Q Y XW XZ XV XQ MV MQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:

MQ = M*Q;
MV = M*V;
XW = X*W;
XZ = X*Z;
XQ = X*Q;
XV = X*V;

ANALYSIS:

TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
```
MODEL:

[Y] (b0);
Y ON M (b1);
Y ON MV (b2);
Y ON MQ (b3);
Y ON X (cdash1);
Y ON V (cdash2);
Y ON Q (cdash3);
Y ON XV (cdash4);
Y ON XQ (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_Q)

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_Q)

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LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z

LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ; ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ; ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*LOW_Z*LOW_Q;
IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*LOW_Z*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*LOW_Z*LOW_Q;
ILMLL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q;
IMLLL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q;
a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q;
IMMLL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q;
IHMLL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*LOW_Q +
a4*b3*HIGH_W*LOW_Q + a5*b3*MED_Z*LOW_Q;
IMHLL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*MED_W*LOW_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*MED_W*MED_V + a5*b3*MED_Z*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*HIGH_W*MED_V + a5*b3*MED_Z*LOW_Q;
IMMLM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*MED_V +
a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*LOW_Q +
a4*b3*LOW_W*LOW_Q + a5*b3*LOW_Z*MED_Q;
IMLML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V +
a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*MED_V;
IMLML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V +
a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*MED_V;
IMHML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*HIGH_W*MED_V + a5*b3*MED_Z*LOW_Q;
IMHML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*HIGH_W*MED_V + a5*b3*MED_Z*LOW_Q;
IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V +
a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*MED_W*MED_V + a5*b3*MED_Z*MED_V;
IMHMML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*HIGH_W*MED_V + a5*b3*MED_Z*LOW_Q;
IMHMML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*HIGH_W*MED_V + a5*b3*MED_Z*LOW_Q;
IMHMMML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_V +
a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_V +
a4*b3*MED_W*MED_V + a5*b3*MED_Z*MED_V;

\[ + a_4 b_2 MED_W MED_V + a_5 b_2 HIGH_Z MED_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]

\[ IHHML = a_1 b_1 + a_4 b_1 HIGH_W + a_5 b_1 HIGH_Z + a_1 b_2 MED_V +
\] 
\[ a_4 b_2 HIGH_W MED_V + a_5 b_2 HIGH_Z MED_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 HIGH_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]

\[ ILLHL = a_1 b_1 + a_4 b_1 LOW_W + a_5 b_1 LOW_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 LOW_W HIGH_V + a_5 b_2 LOW_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 LOW_W LOW_Q + a_5 b_3 LOW_Z LOW_Q;\]

\[ IMLHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 LOW_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 LOW_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 LOW_Z LOW_Q;\]

\[ IHLHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 LOW_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 LOW_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 LOW_Z LOW_Q;\]

\[ ILMHL = a_1 b_1 + a_4 b_1 LOW_W + a_5 b_1 MED_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 LOW_W HIGH_V + a_5 b_2 MED_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 LOW_W LOW_Q + a_5 b_3 MED_Z LOW_Q;\]

\[ IMMHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 MED_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 MED_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 MED_Z LOW_Q;\]

\[ IMLHHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 HIGH_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 HIGH_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]

\[ IHHHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 HIGH_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 HIGH_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]

\[ IHHHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 HIGH_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 HIGH_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]

\[ IHHHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 HIGH_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 HIGH_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]

\[ IHHHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 HIGH_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 HIGH_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]

\[ IHHHL = a_1 b_1 + a_4 b_1 MED_W + a_5 b_1 HIGH_Z + a_1 b_2 HIGH_V +
\] 
\[ a_4 b_2 MED_W HIGH_V + a_5 b_2 HIGH_Z HIGH_V + a_1 b_3 LOW_Q +
\] 
\[ a_4 b_3 MED_W LOW_Q + a_5 b_3 HIGH_Z LOW_Q;\]
ILLLM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IMLLM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IHLLM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*LOW_Z*MED_Q;
ILMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*MED_Q;
IMMLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q;
ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
IMHLM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IMLMM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*LOW_Z*MED_Q;
ILMMM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*MED_Q;
IMMMM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IHMMM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q;
ILHMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
IMHMM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
IHHMM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
ILLHM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IMLHM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IHLHM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IMMHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*MED_W*MED_Q + a5*b2*MED_Z*MED_Q + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IHMHM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*HIGH_W*MED_Q + a5*b2*MED_Z*MED_Q + a1*b3*MED_Q + a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q;
ILHHM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*HIGH_V + a4*b2*LOW_W*MED_Q + a5*b2*MED_Z*MED_Q + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
IMHHM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*HIGH_V+
+ a4*b2*MED_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
IHHHM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*HIGH_V +
+ a4*b2*HIGH_W*HIGH_V + a5*b2*MED_W*HIGH_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*HIGH_Z*MED_Q;
IMHHM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*LOW_Z*MED_Q;
ILLLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IMLLH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IHLLH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IMMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IHMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_V +
+ a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*LOW_W*MED_Q + a5*b3*LOW_Z*MED_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V +
+ a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
IHHLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V +
+ a4*b2*LOW_W*LOW_V + a5*b2*MED_W*LOW_V + a1*b3*HIGH_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q;
ILLMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*MED_V +
+ a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*HIGH_Q +
+ a4*b3*LOW_W*MED_V + a5*b3*LOW_Z*MED_V + a1*b3*HIGH_Q +
\[ a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q; \]
\[ IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q; \]
\[ IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q; \]
\[ IMLMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ ILMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ ILMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
\[ IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*HIGH_Q; \]
a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q;
IMMHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q;
IHMHHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q;
ILHHH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q;
IMHHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q;
IHHHH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q;

! Calc conditional direct effects for each combination of moderator values
DLOV_LOQ = cdash1 + cdash4*LOW_V + cdash5*LOW_Q;
DMEV_LOQ = cdash1 + cdash4*MED_W + cdash5*LOW_Q;
DHIV_LOQ = cdash1 + cdash4*HIGH_V + cdash5*LOW_Q;
DLOV_MEQ = cdash1 + cdash4*LOW_V + cdash5*MED_Q;
DMEV_MEQ = cdash1 + cdash4*MED_W + cdash5*MED_Q;
DHIV_MEQ = cdash1 + cdash4*HIGH_V + cdash5*MED_Q;
DLOV_HIQ = cdash1 + cdash4*LOW_V + cdash5*HIGH_Q;
DMEV_HIQ = cdash1 + cdash4*MED_W + cdash5*HIGH_Q;
DHIV_HIQ = cdash1 + cdash4*HIGH_V + cdash5*HIGH_Q;

! Calc conditional total effects for each combination of moderator values
TLLLL = ILLLL + DLOV_LOQ;
TMLLL = IMLLL + DLOV_LOQ;
THLLL = IHLLL + DLOV_LOQ;
TLHMM = ILHMM + DMEV_MEQ;
TMMHM = IMHMM + DMEV_MEQ;
THHMM = IHHMM + DMEV_MEQ;
TLLHM = ILLHM + DHIV_MEQ;
TMLHM = IMLHM + DHIV_MEQ;
THLHM = IHLHM + DHIV_MEQ;
TLMHM = ILMHM + DHIV_MEQ;
TMHHM = IMHHM + DHIV_MEQ;
THHMH = IHHHM + DHIV_MEQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLLH = IMLLH + DLOV_HIQ;
THLLH = IHLLH + DLOV_HIQ;
TLMLH = ILMLH + DLOV_HIQ;
TMMLH = IMMLH + DLOV_HIQ;
THMLH = IHMLH + DLOV_HIQ;
TLHLH = ILHLH + DLOV_HIQ;
TMHLH = IMHLH + DLOV_HIQ;
THHLH = IHHLH + DLOV_HIQ;
TLLMH = ILLMH + DMEV_HIQ;
TMLMH = IMLMH + DMEV_HIQ;
THLMH = IHLMH + DMEV_HIQ;
TLMMH = ILMMH + DMEV_HIQ;
TMMMH = IMMMH + DMEV_HIQ;
THMMH = IHMMH + DMEV_HIQ;
TLHHH = ILHHH + DHIV_HIQ;
TMLHH = IMLHH + DHIV_HIQ;
THLHH = IHLHH + DHIV_HIQ;
TLMHH = ILMHH + DHIV_HIQ;
TMMHH = IMMHH + DHIV_HIQ;
THMHH = IHMHH + DHIV_HIQ;
TLHHH = ILHHH + DHIV_HIQ;
TMLHH = IMLHH + DHIV_HIQ;
THLHH = IHLHH + DHIV_HIQ;
TLMHH = ILMHH + DHIV_HIQ;
TMMHH = IMMHH + DHIV_HIQ;
THMHH = IHMHH + DHIV_HIQ;
TLHHH = ILHHH + DHIV_HIQ;
TMLHH = IMLHH + DHIV_HIQ;
THLHH = IHLHH + DHIV_HIQ;
TLMHH = ILMHH + DHIV_HIQ;
TMMHH = IMMHH + DHIV_HIQ;
THMHH = IHMHH + DHIV_HIQ;
TLHHH = ILHHH + DHIV_HIQ;
TMLHH = IMLHH + DHIV_HIQ;
THLHH = IHLHH + DHIV_HIQ;
TLMHH = ILMHH + DHIV_HIQ;
TMMHH = IMMHH + DHIV_HIQ;
THMHH = IHMHH + DHIV_HIQ;
TLHHH = ILHHH + DHIV_HIQ;
Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values. Could be edited to show conditional direct or conditional total effects instead. 

NOTE: values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis.

```
PLLLL = ILLL*XVAL;
PMLLL = IMLLL*XVAL;
PHLLL = IHLLL*XVAL;
PLMLL = ILMLL*XVAL;
PMMLL = IMMML*XVAL;
PHMLL = IHMLL*XVAL;
PLHLL = ILHLL*XVAL;
PMHLL = IMHLL*XVAL;
PHHLL = IHHLL*XVAL;
PLLML = ILLML*XVAL;
PMLML = IMLML*XVAL;
PHLML = IHLML*XVAL;
PLMML = ILMML*XVAL;
PMMML = IMMML*XVAL;
PHMML = IHMML*XVAL;
PLHML = ILHML*XVAL;
PMLHML = IMLHML*XVAL;
PHLHML = IHLHML*XVAL;
PLMLH = ILMHL*XVAL;
PMLMHL = IMLMHL*XVAL;
PHMLH = IHMLH*XVAL;
PLHML = ILHML*XVAL;
PMLHH = IMLHH*XVAL;
```

PLHHL = ILHHL*XVAL;
PMHHL = IMHHL*XVAL;
PHHHL = IHHHL*XVAL;
PLLLM = ILLL*L*XVAL;
PMLLM = IMLLM*XVAL;
PHLLM = IHLLM*XVAL;
PLMLM = ILMLM*XVAL;
PMLLM = IMMLM*XVAL;
PHMLM = IHMLM*XVAL;
PLHLM = ILHLM*XVAL;
PMHLM = IMHLM*XVAL;
PHHLM = IHHLM*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PHLMM = IHLMM*XVAL;
PLMMM = ILMMM*XVAL;
PMMM = IMM*XVAL;
PHMM = IHM*XVAL;
PLHMM = ILHMM*XVAL;
PMMH = IMHMM*XVAL;
PHHM = IHHMM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;
PLMMH = ILMHM*XVAL;
PMMHM = IMHMM*XVAL;
PHMM = IHHMM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;
PLMHM = ILHMM*XVAL;
PMMHM = IMHMM*XVAL;
PHHM = IHHMM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;
PLHMM = ILHMM*XVAL;
PMMH = IMHMM*XVAL;
PHH = IHM*XVAL;
PLLH = ILLLH*XVAL;
PMLLH = IMLLH*XVAL;
PHELH = IHLH*XVAL;
PLMLH = ILMLH*XVAL;
PMLH = IMMLH*XVAL;
PHML = IHMMLH*XVAL;
PLHLH = ILHHL*XVAL;
PMLHL = IMHLH*XVAL;
PHHLH = IHHHL*XVAL;
PLLMH = ILLMH*XVAL;
PMLMH = IMLMH*XVAL;
PHLMH = IHLMH*XVAL;
PLMMH = ILMMH*XVAL;
PMMMH = IIMMH*XVAL;
PHMMH = IHMMH*XVAL;
PLHMH = ILHMH*XVAL;
PMHMH = IIMHMH*XVAL;
PHHMH = IHHMH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PHLHH = IHLHH*XVAL;
PLMHH = ILMH*XVAL;
PMMHH = IIMHH*XVAL;
PHMHH = IHMH*XVAL;
PLHHH = ILH*XVAL;
PMHHH = IIMHH*XVAL;
PHHHH = IHHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 51: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2V + b_3Q + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + b_5(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2V + b_3Q + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)Q + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]
Hence... multiplying out brackets

\[ Y = b_0 + a_0 b_1 + a_1 b_1 X + a_2 b_1 W + a_3 b_1 Z + a_5 b_1 X Z + a_6 b_1 W Z + a_7 b_1 X W Z + b_2 V + b_3 Q + a_0 b_4 V + a_1 b_4 X V + a_2 b_4 W V + a_3 b_4 Z V + a_4 b_4 X W V + a_5 b_4 X Z V + a_6 b_4 W Z V + a_7 b_4 X W Z V + a_0 b_5 Q + a_1 b_5 X Q + a_2 b_5 W Q + a_3 b_5 Z Q + a_4 b_5 X W Q + a_5 b_5 X Z Q + a_6 b_5 W Z Q + a_7 b_5 X W Z Q + c_1' X + c_2' W + c_3' Z + c_4' X W + c_5' X Z + c_6' W Z + c_7' X W Z \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0 b_1 + a_2 b_1 W + a_3 b_1 Z + a_6 b_1 W Z + b_2 V + b_3 Q + a_0 b_4 V + a_2 b_4 W V + a_3 b_4 Z V + a_6 b_4 W Z V + a_0 b_5 Q + a_2 b_5 W Q + a_3 b_5 Z Q + a_6 b_5 W Z Q + c_2' W + c_3' Z + c_6' W Z) + (a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 W Z + a_1 b_4 V + a_4 b_4 W V + a_5 b_4 Z V + a_7 b_4 W Z V + a_1 b_5 Q + a_4 b_5 W Q + a_5 b_5 Z Q + a_7 b_5 W Z Q + c_1' + c_4' W + c_5' Z + c_7' W Z)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V, Q \):

\[ a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 W Z + a_1 b_4 V + a_4 b_4 W V + a_5 b_4 Z V + a_7 b_4 W Z V + a_1 b_5 Q + a_4 b_5 W Q + a_5 b_5 Z Q + a_7 b_5 W Z Q = (a_1 + a_4 W + a_5 Z + a_7 W Z) (b_1 + b_4 V + b_5 Q) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):

\[ c_1' + c_4' W + c_5' Z + c_7' W Z \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y
USEVARIABLES = X M W Z V Q Y XW XZ WZ MV MQ XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
    WZ = W*Z;
    XWZ = X*W*Z;
```
ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
[Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON Q (b3);
  Y ON MV (b4);
  Y ON MQ (b5);

  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON Z (cdash3);
  Y ON XW (cdash4);
  Y ON XZ (cdash5);
  Y ON WZ (cdash6);
  Y ON XWZ (cdash7);

[M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON Z (a3);
  M ON XW (a4);
  M ON XZ (a5);
  M ON WZ (a6);
  M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V
  HIGH_V LOW_Q MED_Q HIGH_Q
  ILLLL IMLLL ILHLL IMLLL IHHLL ILHLL IMHLL IHHLL
  ILLML IMMLL ILMLL IMMML IHHML ILMML ILMML IHHML IHHML
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;   ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ;   ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;   ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z

LOW_V = #LOWV;   ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;   ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;   ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;   ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values
\[ I L L L L = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{LOW}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{LOW}_W \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + a_4 b_5 \text{LOW}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_7 b_5 \text{LOW}_W \text{LOW}_Z \text{LOW}_Q; \]
\[ I M L L L = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{MED}_W \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + a_4 b_5 \text{MED}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{LOW}_Z \text{LOW}_Q; \]
\[ I H L L L = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{LOW}_Q + a_7 b_5 \text{HIGH}_W \text{LOW}_Z \text{LOW}_Q; \]
\[ I L M L L = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + \]
\[ a_7 b_1 \text{LOW}_W \text{MED}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{LOW}_W \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + a_4 b_5 \text{LOW}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{LOW}_W \text{MED}_Z \text{LOW}_Q; \]
\[ I M M L L = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{MED}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{MED}_W \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + a_4 b_5 \text{MED}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{MED}_Z \text{LOW}_Q; \]
\[ I H M L L = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{MED}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{MED}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{MED}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{HIGH}_W \text{MED}_Z \text{LOW}_Q; \]
\[ I L H L L = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + \]
\[ a_7 b_1 \text{LOW}_W \text{HIGH}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{LOW}_W \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{LOW}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + a_7 b_5 \text{LOW}_W \text{HIGH}_Z \text{LOW}_Q; \]
\[ I M H L L = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{HIGH}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{HIGH}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{MED}_W \text{HIGH}_Z \text{LOW}_V + a_1 b_5 \text{LOW}_Q + \]
\[a4*b5*MED_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q + a7*b5*MED_W*HIGH_Z*LOW_Q;\]
\[\text{IHLL} = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*HIGH_W*HIGH_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q + a7*b5*HIGH_W*HIGH_Z*LOW_Q;\]
\[\text{ILLML} = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V + a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q;\]
\[\text{IMLML} = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V + a7*b4*MED_W*LOW_Z*MED_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*MED_W*LOW_Z*LOW_Q;\]
\[\text{IHLML} = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*HIGH_W*LOW_Z*LOW_Q;\]
\[\text{ILMML} = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + a7*b4*LOW_W*MED_Z*MED_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*LOW_W*MED_Z*LOW_Q;\]
\[\text{IMMML} = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + a7*b4*MED_W*MED_Z*MED_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q;\]
\[\text{IHMML} = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V + a7*b4*HIGH_W*MED_Z*MED_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*HIGH_W*MED_Z*LOW_Q;\]
\[\text{ILHML} = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*HIGH_W*HIGH_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q + a7*b5*HIGH_W*HIGH_Z*LOW_Q;\]
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V + 
a7*b4*LOW_W*HIGH_Z*MED_V + a1*b5*LOW_Q + 
a4*b5*LOW_W*LOW_Q + 
a5*b5*HIGH_Z*LOW_Q + a7*b5*LOW_W*HIGH_Z*LOW_Q; 
IMHML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + 
a7*b1*MED_W*HIGH_Z + 
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V + 
a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*LOW_Q + 
a4*b5*MED_W*LOW_Q + 
a5*b5*HIGH_Z*LOW_Q + a7*b5*MED_W*HIGH_Z*LOW_Q; 
IMHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + 
a7*b1*HIGH_W*HIGH_Z + 
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + 
a7*b4*HIGH_W*HIGH_Z*MED_V + a1*b5*LOW_Q + 
a4*b5*HIGH_W*LOW_Q + 
a5*b5*HIGH_Z*LOW_Q + a7*b5*HIGH_W*HIGH_Z*LOW_Q; 
ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*LOW_W*LOW_Z + 
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + 
a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*LOW_W*LOW_Q + 
a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q; 
IMHML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*MED_W*LOW_Z + 
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + 
a7*b4*MED_W*LOW_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*MED_W*LOW_Q + 
a5*b5*LOW_Z*LOW_Q + a7*b5*MED_W*LOW_Z*LOW_Q; 
IMHML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*HIGH_W*LOW_Z + 
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + 
a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*HIGH_W*LOW_Q + 
a5*b5*LOW_Z*LOW_Q + a7*b5*HIGH_W*LOW_Z*LOW_Q; 
IMHML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*HIGH_W*LOW_Z + 
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + 
a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*HIGH_W*LOW_Q + 

\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{MED}_Z \text{LOW}_Q; \]
\[ \text{IHMH}L = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{MED}_Z + \]
\[ a_1 b_4 \text{HIGH}_V + a_4 b_4 \text{HIGH}_W \text{HIGH}_V + a_5 b_4 \text{MED}_Z \text{HIGH}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{MED}_Z \text{HIGH}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{MED}_Z \text{LOW}_Q + a_7 b_5 \text{HIGH}_W \text{MED}_Z \text{LOW}_Q; \]
\[ \text{ILH}H\text{L} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + \]
\[ a_7 b_1 \text{LOW}_W \text{HIGH}_Z + \]
\[ a_1 b_4 \text{HIGH}_V + a_4 b_4 \text{LOW}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + \]
\[ a_7 b_4 \text{LOW}_W \text{HIGH}_Z \text{HIGH}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{LOW}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + a_7 b_5 \text{MED}_W \text{HIGH}_Z \text{LOW}_Q; \]
\[ \text{IMH}H\text{L} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{HIGH}_Z + \]
\[ a_1 b_4 \text{HIGH}_V + a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + \]
\[ a_7 b_4 \text{MED}_W \text{HIGH}_Z \text{HIGH}_V + a_1 b_5 \text{LOW}_Q + \]
\[ a_4 b_5 \text{MED}_W \text{LOW}_Q + \]
\[ a_5 b_5 \text{HIGH}_Z \text{LOW}_Q + a_7 b_5 \text{HIGH}_W \text{HIGH}_Z \text{LOW}_Q; \]
\[ \text{IL}H\text{L} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{LOW}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{LOW}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{LOW}_W \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + a_4 b_5 \text{LOW}_W \text{MED}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_7 b_5 \text{LOW}_W \text{LOW}_Z \text{MED}_Q; \]
\[ \text{IML}L = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{MED}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{MED}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{MED}_W \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_7 b_5 \text{MED}_W \text{LOW}_Z \text{MED}_Q; \]
\[ \text{I}H\text{L} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \]
\[ a_5 b_5 \text{LOW}_Z \text{MED}_Q + a_7 b_5 \text{MED}_W \text{LOW}_Z \text{MED}_Q; \]
\[ \text{IL} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + \]
\[ a_7 b_1 \text{HIGH}_W \text{LOW}_Z + \]
\[ a_1 b_4 \text{LOW}_V + a_4 b_4 \text{HIGH}_W \text{LOW}_V + a_5 b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7 b_4 \text{HIGH}_W \text{LOW}_Z \text{LOW}_V + a_1 b_5 \text{MED}_Q + \]
a4*b5*HIGH_W*MED_Q +
a5*b5*LOW_Z*MED_Q + a7*b5*HIGH_W*LOW_Z*MED_Q;
ILMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_W*LOW_V +
   + a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q;
IMMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_W*LOW_V +
   + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_W*LOW_V +
   + a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q;
IMLMM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_W*LOW_V +
   + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
IHMLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_W*LOW_V +
   + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
IMHLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_W*LOW_V +
   + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
IHHLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_W*LOW_V +
   + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
ILLMM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_W*LOW_V +
   + a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
   + a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V +
  a7*b4*MED_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q
  +
  a5*b5*LOW_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q;
IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
  a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V +
  a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q +
  a5*b5*LOW_Z*MED_Q + a7*b5*HIGH_W*LOW_Z*MED_Q;
ILMMM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
  a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V +
  a7*b4*LOW_W*MED_Z*MED_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q
  +
  a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q;
IMMMM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
  a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V +
  a7*b4*MED_W*MED_Z*MED_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q
  +
  a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;
IHMMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
  a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V +
  a7*b4*LOW_W*HIGH_Z*MED_V + a1*b5*MED_Q +
a4*b5*LOW_W*MED_Q +
  a5*b5*HIGH_Z*MED_Q + a7*b5*LOW_W*HIGH_Z*MED_Q;
IMHMM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
  a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V +
  a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q +
  a5*b5*HIGH_Z*MED_Q + a7*b5*MED_W*HIGH_Z*MED_Q;
IHHMM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
  a7*b1*HIGH_W*HIGH_Z +
  a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V +
  a7*b4*HIGH_W*HIGH_Z*MED_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q +
  a5*b5*HIGH_Z*MED_Q + a7*b5*HIGH_W*HIGH_Z*MED_Q;
ILLHM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*LOW_W*MED_Q +
a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q;

IMLHM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*MED_W*LOW_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q;

IHLHM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q +
a5*b5*HIGH_W*MED_Z + a7*b5*HIGH_W*LOW_Z*MED_Q;

ILMHM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*LOW_W*MED_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*LOW_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q;

IMMHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q;

IHMHM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*HIGH_W*MED_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*HIGH_W*MED_Q +
a5*b5*HIGH_W*MED_Z + a7*b5*HIGH_W*LOW_Z*MED_Q;

ILHHM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
a7*b4*LOW_W*HIGH_Z*HIGH_V + a1*b5*MED_Q +
a4*b5*LOW_W*MED_Q +
a5*b5*HIGH_Z*MED_Q + a7*b5*LOW_W*HIGH_Z*MED_Q;

IMHHM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*MED_Q + a5*b1*MED_Z*MED_Q + a7*b1*MED_W*MED_Z*MED_Q;
a7*b1*MED_W*HIGH_Z + 
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + 
a7*b4*MED_W*HIGH_Z*HIGH_V + a1*b5*MED_Q + 
a4*b5*MED_W*MED_Q + 
a5*b5*HIGH_Z*MED_Q + a7*b5*MED_W*HIGH_Z*MED_Q; 
IHHHM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + 
a7*b1*HIGH_W*HIGH_Z + 
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + 
a7*b4*HIGH_W*HIGH_Z*HIGH_V + a1*b5*MED_Q + 
a4*b5*MED_W*MED_Q + 
a5*b5*HIGH_Z*MED_Q + a7*b5*MED_W*HIGH_Z*MED_Q; 

ILLLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*LOW_W*LOW_Z + 
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + 
a7*b4*LOW_W*LOW_Z*LOW_V + a1*b5*HIGH_Q + 
a4*b5*LOW_W*MED_Q + 
a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q; 
IMLLH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + 
a7*b1*MED_W*LOW_Z + 
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + 
a7*b4*MED_W*LOW_Z*LOW_V + a1*b5*MED_Q + 
a4*b5*MED_W*HIGH_Q + 
a5*b5*LOW_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*HIGH_Q; 

IHLLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + 
a7*b1*HIGH_W*LOW_Z + 
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + 
a7*b4*HIGH_W*LOW_Z*LOW_V + a1*b5*HIGH_Q + 
a4*b5*HIGH_W*MED_Q + 
a5*b5*LOW_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q; 

ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
a7*b1*LOW_W*MED_Z + 
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + 
a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*HIGH_Q + 
a4*b5*LOW_W*MED_Q + 
a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q; 
IMMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
a7*b1*MED_W*MED_Z + 
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + 
a7*b4*MED_W*MED_Z*LOW_V + a1*b5*HIGH_Q + 
a4*b5*MED_W*HIGH_Q + 
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q; 

IHMLH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + 
a7*b1*HIGH_W*MED_Z + 
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + 
a7*b4*MED_W*MED_Z*LOW_V + a1*b5*HIGH_Q + 
a4*b5*MED_W*HIGH_Q + 
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q;
\[
\begin{align*}
a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*HIGH_Q + \\
a4*b5*HIGH_W*HIGH_Q + \\
a5*b5*MED_Z*HIGH_Q + a7*b5*HIGH_W*MED_Z*HIGH_Q; \\
ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + \\
a7*b1*LOW_W*HIGH_Z + \\
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + \\
a7*b4*LOW_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q + \\
a4*b5*LOW_W*HIGH_Q + \\
a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q; \\
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + \\
a7*b1*MED_W*HIGH_Z + \\
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V + \\
a7*b4*MED_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q + \\
a4*b5*MED_W*HIGH_Q + \\
a5*b5*HIGH_Z*HIGH_Q + a7*b5*MED_W*HIGH_Z*HIGH_Q; \\
IHHLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + \\
a7*b1*LOW_W*LOW_Z + \\
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V + \\
a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*HIGH_Q + \\
a4*b5*LOW_W*HIGH_Q + \\
a5*b5*LOW_Z*HIGH_Q + a7*b5*LOW_W*LOW_Z*HIGH_Q; \\
IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + \\
a7*b1*MED_W*LOW_Z + \\
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V + \\
a7*b4*MED_W*LOW_Z*MED_V + a1*b5*HIGH_Q + \\
a4*b5*MED_W*HIGH_Q + \\
a5*b5*LOW_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*HIGH_Q; \\
IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + \\
a7*b1*HIGH_W*LOW_Z + \\
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + \\
a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*HIGH_Q + \\
a4*b5*HIGH_W*HIGH_Q + \\
a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q; \\
ILMMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + \\
a7*b1*LOW_W*MED_Z + \\
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + \\
a7*b4*LOW_W*MED_Z*MED_V + a1*b5*HIGH_Q + \\
a4*b5*LOW_W*HIGH_Q + \\
a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q; \\
IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
\end{align*}
\]
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_W*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*LOW_W*LOW_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_Z;

IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_W*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_W*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z;

IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*LOW_W*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_W*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z;

IMHMH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_W*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z;

IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_W*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z;

ILLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*LOW_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_W*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z;

IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V +

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a4*b5*HIGH_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q;

ILMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*LOW_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q;

IMMHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q;

IHMHH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*HIGH_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*HIGH_W*MED_Z*HIGH_Q;

ILHHH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
a7*b4*LOW_W*HIGH_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q;

IMHHH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q;

IHHHH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
a7*b4*HIGH_W*HIGH_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q;

! Calc conditional direct effects for each combination of moderator values
DLOW_LOZ = cdash1 + cdash4*LOW_W + cdash5*LOW_Z + cdash7*LOW_W*LOW_Z;
DMEW_LOZ = cdash1 + cdash4*MED_W + cdash5*LOW_Z + cdash7*MED_W*LOW_Z;
DHIW_LOZ = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z + cdash7*HIGH_W*LOW_Z;

DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z + cdash7*LOW_W*MED_Z;
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z + cdash7*MED_W*MED_Z;
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z + cdash7*HIGH_W*MED_Z;

DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z + cdash7*LOW_W*HIGH_Z;
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z + cdash7*MED_W*HIGH_Z;
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z + cdash7*HIGH_W*HIGH_Z;

! Calc conditional total effects for each combination of moderator values

TLLLL = ILLLL + DLOW_LOZ;
TMLLL = IMLLL + DMEW_LOZ;
THLLL = IHLLL + DHIW_LOZ;

TLMLL = ILMLL + DLOW_MEZ;
TMMLL = IMMLL + DMEW_MEZ;
THMLL = IHMLL + DHIW_MEZ;

TLHLL = ILHLL + DLOW_HIZ;
TMHLL = IMHLL + DMEW_HIZ;
THHLL = IHHLL + DHIW_HIZ;

TLLML = ILLML + DLOW_LOZ;
TMLML = IMLML + DMEW_LOZ;
THLLL = IHLLL + DHIW_LOZ;

TLMML = ILMML + DLOW_MEZ;
TMMLL = IMMLL + DMEW_MEZ;
THMLL = IHMLL + DHIW_MEZ;

TLHML = ILHML + DLOW_HIZ;
TMHML = IMHML + DMEW_HIZ;
THHML = IHHML + DHIW_HIZ;

TLLHL = ILLHL + DLOW_LOZ;
TMLHL = IMLHL + DMEW_LOZ;
THLHL = IHLHL + DHIW_LOZ;
\[ TLMHL = ILMHL + DLOW\_MEZ; \]
\[ TMMHL = IMMHL + DMEW\_MEZ; \]
\[ THMHL = IHMHL + DHIW\_MEZ; \]
\[ TLHHL = ILHHL + DLOW\_HIZ; \]
\[ TMHHL = IMHHL + DMEW\_HIZ; \]
\[ THHHL = IHHHL + DHIW\_HIZ; \]
\[ TLLLM = ILLLM + DLOW\_LOZ; \]
\[ TMLLM = IMLLM + DMEW\_LOZ; \]
\[ THLLM = IHLLM + DHIW\_LOZ; \]
\[ TLHLM = ILHLM + DLOW\_MEZ; \]
\[ TMHLM = IMHLM + DMEW\_MEZ; \]
\[ THMLM = IHMLM + DHIW\_MEZ; \]
\[ TLHLM = ILHLM + DLOW\_HIZ; \]
\[ TMHLM = IMHLM + DMEW\_HIZ; \]
\[ THHLM = IHHLM + DHIW\_HIZ; \]
\[ TLLLM = ILLLM + DLOW\_LOZ; \]
\[ TMLLM = IMLLM + DMEW\_LOZ; \]
\[ THLLM = IHLLM + DHIW\_LOZ; \]
\[ TLHLM = ILHLM + DLOW\_MEZ; \]
\[ TMHLM = IMHLM + DMEW\_MEZ; \]
\[ THMLM = IHMLM + DHIW\_MEZ; \]
\[ TLHLM = ILHLM + DLOW\_HIZ; \]
\[ TMHLM = IMHLM + DMEW\_HIZ; \]
\[ THHLM = IHHLM + DHIW\_HIZ; \]
\[ TLLLM = ILLLM + DLOW\_LOZ; \]
\[ TMLLM = IMLLM + DMEW\_LOZ; \]
\[ THLLM = IHLLM + DHIW\_LOZ; \]
\[ TLHLM = ILHLM + DLOW\_MEZ; \]
\[ TMHLM = IMHLM + DMEW\_MEZ; \]
\[ THMLM = IHMLM + DHIW\_MEZ; \]
\[ TLHLM = ILHLM + DLOW\_HIZ; \]
\[ TMHLM = IMHLM + DMEW\_HIZ; \]
\[ THHLM = IHHLM + DHIW\_HIZ; \]
\[ TLLLM = ILLLM + DLOW\_LOZ; \]
\[ TMLLM = IMLLM + DMEW\_LOZ; \]
\[ THLLM = IHLLM + DHIW\_LOZ; \]
\[ TLHLM = ILHLM + DLOW\_MEZ; \]
\[ TMHLM = IMHLM + DMEW\_MEZ; \]
\[ THMLM = IHMLM + DHIW\_MEZ; \]
TLHLH = ILHLH + DLOW_HIZ;
TMHLH = IMHLH + DMEW_HIZ;
THHLH = IHHLH + DHIW_HIZ;

TLLMH = ILLMH + DLOW_LOZ;
TMLMH = IMLMH + DMEW_LOZ;
THLMH = IHLMH + DHIW_LOZ;

TLMMH = ILMMH + DLOW_MEZ;
TMMMH = IMMMH + DMEW_MEZ;
THMMH = IHMMH + DHIW_MEZ;

TLHMH = ILHMH + DLOW_HIZ;
TMHMH = IMHMH + DMEW_HIZ;
THHMH = IHHMH + DHIW_HIZ;

TLLMHL = ILLMHL + DLOW_LOZ;
TMLMHL = IMLMHL + DMEW_LOZ;
THLMHL = IHLMHL + DHIW_LOZ;

TLMMHL = ILMMHL + DLOW_MEZ;
TMMMHL = IMMMHL + DMEW_MEZ;
THMMHL = IHMMHL + DHIW_MEZ;

TLHHHL = ILHHHL + DLOW_HIZ;
TMHHHL = IMHHHL + DMEW_HIZ;
THHHH = IHHHH + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y
! for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
! total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by
! logical min and max limits of predictor X used in analysis
PLOT(PLLLL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL

PLML PMLML PHLML PLMML PMMML PHMML PLHML PMHML PHHML
PLLHL PMLHL PHLHL PLMHL PMMHL PHMHL PLHHL PMHHL PHHHL
PLLLM PMLLM PHLLM PLMLM PMMLM PHMLM PLHLM PMHLM PHHLM
PLLMM PMLMM PHLMM PLMLM PMMML PHMML PLHML PMHML PHHMM
PLLHH PMLHH PHLHH PLMHH PMMHH PHMHH PLHHH PMHHH PHHHH
PLLHHL PMLHHL PHLHHL PLMLH PMMLH PHMLH PLHHL PMHHL PHHHL
PLLMMH PMLMMH PHLMMH PLMLMH PMMMLH PHMMLH PLHMLH PMHMLH PHHMLH
PLLHHH PMLHHH PHLHHH PLMLHH PMMHHH PHMHHH PLHHHH PMHHHH PHHHHH);

LOOP(XVAL,1,5,0.1);

PLLLL = ILLL*XVAL;
PMLLL = IMLLL*XVAL;
PHLLL = IHLLLL*XVAL;
PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PPLHM = IHLHM*XVAL;
PLMHM = ILMHM*XVAL;
PMHM = IMMHM*XVAL;
PHHM = IHHHM*XVAL;
PLHLM = ILHLM*XVAL;
PMLLM = IMLLM*XVAL;
PPLLM = IHLLM*XVAL;
PLMML = ILMML*XVAL;
PMML = IMLML*XVAL;
PHML = IHHML*XVAL;
PLHLM = ILHLM*XVAL;
PMLLM = IMLML*XVAL;
PPLLM = IHLLM*XVAL;
PLMML = ILMML*XVAL;
PMML = IMLML*XVAL;
PHML = IHHML*XVAL;
PLHLM = ILHLM*XVAL;
PMLLM = IMLLM*XVAL;
PPLLM = IHLLM*XVAL;
PLMML = ILMML*XVAL;
PMML = IMLML*XVAL;
PHML = IHHML*XVAL;
PLHHM = ILHMM*XVAL;
PMLLM = IMLLM*XVAL;
PPLLM = IHLLM*XVAL;
PLMML = ILMML*XVAL;
PMML = IMLML*XVAL;
PHML = IHHML*XVAL;
PLLHH = ILLLH*XVAL;
PMLHH = IMLHH*XVAL;
PPLHH = IHLHH*XVAL;
PLMHL = ILMHL*XVAL;
PMHL = IMLHL*XVAL;
PHHL = IHHHL*XVAL;
PLLML = ILLLH*XVAL;
PMLML = IMLML*XVAL;
PPLML = IHLML*XVAL;
PLMML = ILMML*XVAL;
PMML = IMLML*XVAL;
PHML = IHHML*XVAL;
PLLHH = ILLLH*XVAL;
PMLHH = IMLHH*XVAL;
PPLHH = IHLHH*XVAL;
PLMHL = ILMHL*XVAL;
PMHL = IMLHL*XVAL;
PHHL = IHHHL*XVAL;
PLLHL = ILLLH*XVAL;
PMLHL = IMLHL*XVAL;
PPLHL = IHLHL*XVAL;
PLMHL = ILMHL*XVAL;
PMHL = IMLHL*XVAL;
PHHL = IHHHL*XVAL;
PLLML = ILLLH*XVAL;
PMLML = IMLML*XVAL;
PPLML = IHLML*XVAL;
PLMML = ILMML*XVAL;
PMML = IMLML*XVAL;
PHML = IHHML*XVAL;
PPLHH = ILLLH*XVAL;
PMLHH = IMLHH*XVAL;
PPLHH = IHLHH*XVAL;
PLMHL = ILMHL*XVAL;
PMHL = IMLHL*XVAL;
PHHL = IHHHL*XVAL;
PPLHL = ILLLH*XVAL;
PMLHL = IMLHL*XVAL;
PPLHL = IHLHL*XVAL;
PLMHL = ILMHL*XVAL;
PMHL = IMLHL*XVAL;
PHHL = IHHHL*XVAL;
PPLHH = ILLLH*XVAL;
PMLHH = IMLHH*XVAL;
PPLHH = IHLHH*XVAL;
PLMHL = ILMHL*XVAL;
PMHL = IMLHL*XVAL;
PHHL = IHHHL*XVAL;
PPLHH = ILLLH*XVAL;
PMLHH = IMLHH*XVAL;
PPLHH = IHLHH*XVAL;
PLMHL = ILMHL*XVAL;
PMHL = IMLHL*XVAL;
PHHL = IHHHL*XVAL;
PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 52: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 M V + b_3 M Q + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 M V + b_3 M Q + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)Q + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1WX + a5b1WZ + a7b1WZX + a6b1V + a1b2XY + a2b2WV + a3b2ZV + a4b2XVW + a5b2XZV + a6b2WZV + a7b2WZXV + a6b3WZQ + a7b3WZQ + c1'X + c2'V + c3'Q + c4'XV + c5'XQ

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a3b1Z + a6b1WZ + a0b2V + a2b2WV + a3b2ZV + a6b2WZV + a0b3Q + a2b3WQ + a3b3ZQ + a6b3WZQ + c2'V + c3'Q) + (a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b2V + a4b2WV + a5b2ZV + a7b2WZV + a1b3Q + a4b3WQ + a5b3ZQ + a7b3WZQ + c1' + c4'V + c5'Q)X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V, Q:

a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b2V + a4b2WV + a5b2ZV + a7b2WZV + a1b3Q + a4b3WQ + a5b3ZQ + a7b3WZQ = (a1 + a4W + a5Z + a7WZ)(b1 + b2V + b3Q)

One direct effect of X on Y, conditional on V, Q:

c1' + c4'V + c5'Q

Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y
USEVARIABLES = X M W Z V Q Y XW XZ WZ XV XQ MV MQ XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MQ = M*Q;
    MV = M*V;
    XW = X*W;
    XZ = X*Z;
    XQ = X*Q;
    XV = X*V;
    WZ = W*Z;
    XWZ = X*W*Z;

ANALYSIS:
    TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
[Y] (b0);
Y ON M (b1);
Y ON MV (b2);
Y ON MQ (b3);
Y ON X (cdash1);
Y ON V (cdash2);
Y ON Q (cdash3);
Y ON XV (cdash4);
Y ON XQ (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
!
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
ILLLL IMLLL IHLLL IMLL
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W 
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W 
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W 

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z 
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z 
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z 

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V 
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V 
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V 

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q 
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q 
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q 

! Calc conditional indirect effects for each combination of moderator values 

ILLHH IMLHH IHLHH ILMHH IHMHH ILHHH IMHHH IHHHH
DLOV_LOQ DMEV_LOQ DHIV_LOQ DLOV_MEQ DMEV_MEQ DHIV_MEQ
DLOV_HIQ DMEV_HIQ DHIV_HIQ
TLLLL TMLLL THLLL TLMLL TMMLL THMLL TLHLL TMHLL THHLL
TLLLML TMLML TLMLML TMMLML THMLML TLHML TMHML THHML
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TLLHH TMLHH TLMLHH TMMLHH THMLHH TMLHHH THHHH

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q;
IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*MED_W*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*HIGH_W*LOW_Z*LOW_V + a1*b3*LOW_Q +
a4*b3*HIGH_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q;
ILMLL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*LOW_W*MED_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q +
a5*b3*MED_Z*LOW_Q + a7*b3*LOW_W*MED_Z*LOW_Q;
IMMLL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*MED_W*MED_Z*LOW_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q +
a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q;
IHMLL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*HIGH_W*MED_Z*LOW_V + a1*b3*LOW_Q +
a4*b3*HIGH_W*LOW_Q +
a5*b3*MED_Z*LOW_Q + a7*b3*HIGH_W*MED_Z*LOW_Q;
ILHLL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*LOW_W*HIGH_Z*LOW_V + a1*b3*LOW_Q +
a4*b3*LOW_W*LOW_Q +
a5*b3*HIGH_Z*LOW_Q + a7*b3*LOW_W*HIGH_Z*LOW_Q;
IMHLL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q +
a5*b3*HIGH_Z*LOW_Q + a7*b3*MED_W*HIGH_Z*LOW_Q;
IHHLL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*HIGH_W*HIGH_Z*LOW_V + a1*b3*LOW_Q +
a4*b3*HIGH_W*LOW_Q +
a5*b3*HIGH_Z*LOW_Q + a7*b3*HIGH_W*HIGH_Z*LOW_Q;
a4*b3*HIGH_W*LOW_Q +
a5*b3*HIGH_Z*LOW_Q + a7*b3*HIGH_W*HIGH_Z*LOW_Q;

ILLML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q;

IMLML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*MED_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q;

IHLML = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q +
a5*b3*HIGH_Z*LOW_Q + a7*b3*HIGH_W*HIGH_Z*LOW_Q;

ILMML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q;

IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
IMHML = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V +
IHMML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V +
IHML = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V +
IMML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
\[ a1 \cdot b2 \cdot MED_V + a4 \cdot b2 \cdot MED_W \cdot MED_V + a5 \cdot b2 \cdot HIGH_Z \cdot MED_V + \\
a7 \cdot b2 \cdot MED_W \cdot HIGH_Z \cdot MED_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot MED_W \cdot LOW_Q + \\
a5 \cdot b3 \cdot HIGH_Z \cdot LOW_Q + a7 \cdot b3 \cdot MED_W \cdot HIGH_Z \cdot LOW_Q; \\
IHHML = a1 \cdot b1 + a4 \cdot b1 \cdot HIGH_W + a5 \cdot b1 \cdot HIGH_Z + \\
a7 \cdot b1 \cdot HIGH_W \cdot HIGH_Z + \\
a1 \cdot b2 \cdot MED_V + a4 \cdot b2 \cdot HIGH_W \cdot MED_V + a5 \cdot b2 \cdot HIGH_Z \cdot MED_V + \\
a7 \cdot b2 \cdot HIGH_W \cdot HIGH_Z \cdot MED_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot HIGH_W \cdot LOW_Q + \\
a5 \cdot b3 \cdot HIGH_Z \cdot LOW_Q + a7 \cdot b3 \cdot HIGH_W \cdot HIGH_Z \cdot LOW_Q; \\
ILLHL = a1 \cdot b1 + a4 \cdot b1 \cdot LOW_W + a5 \cdot b1 \cdot LOW_Z + \\
a7 \cdot b1 \cdot LOW_W \cdot LOW_Z + \\
a1 \cdot b2 \cdot HIGH_V + a4 \cdot b2 \cdot LOW_W \cdot HIGH_V + a5 \cdot b2 \cdot LOW_Z \cdot HIGH_V + \\
a7 \cdot b2 \cdot LOW_W \cdot LOW_Z \cdot HIGH_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot LOW_W \cdot LOW_Q + \\
a5 \cdot b3 \cdot LOW_Z \cdot LOW_Q + a7 \cdot b3 \cdot MED_W \cdot LOW_Z \cdot LOW_Q; \\
IMLHL = a1 \cdot b1 + a4 \cdot b1 \cdot MED_W + a5 \cdot b1 \cdot LOW_Z + \\
a7 \cdot b1 \cdot MED_W \cdot LOW_Z + \\
a1 \cdot b2 \cdot HIGH_V + a4 \cdot b2 \cdot MED_W \cdot HIGH_V + a5 \cdot b2 \cdot LOW_Z \cdot HIGH_V + \\
a7 \cdot b2 \cdot MED_W \cdot LOW_Z \cdot HIGH_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot MED_W \cdot LOW_Q + \\
a5 \cdot b3 \cdot LOW_Z \cdot LOW_Q + a7 \cdot b3 \cdot MED_W \cdot LOW_Z \cdot LOW_Q; \\
IHLHL = a1 \cdot b1 + a4 \cdot b1 \cdot HIGH_W + a5 \cdot b1 \cdot LOW_Z + \\
a7 \cdot b1 \cdot HIGH_W \cdot LOW_Z + \\
a1 \cdot b2 \cdot HIGH_V + a4 \cdot b2 \cdot HIGH_W \cdot HIGH_V + a5 \cdot b2 \cdot LOW_Z \cdot HIGH_V + \\
a7 \cdot b2 \cdot HIGH_W \cdot LOW_Z \cdot HIGH_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot LOW_W \cdot LOW_Q + \\
a5 \cdot b3 \cdot MED_Z \cdot LOW_Q + a7 \cdot b3 \cdot LOW_W \cdot MED_Z \cdot LOW_Q; \\
ILMHL = a1 \cdot b1 + a4 \cdot b1 \cdot LOW_W + a5 \cdot b1 \cdot MED_Z + \\
a7 \cdot b1 \cdot LOW_W \cdot MED_Z + \\
a1 \cdot b2 \cdot HIGH_V + a4 \cdot b2 \cdot LOW_W \cdot HIGH_V + a5 \cdot b2 \cdot MED_Z \cdot HIGH_V + \\
a7 \cdot b2 \cdot LOW_W \cdot MED_Z \cdot HIGH_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot LOW_W \cdot MED_Z + \\
a5 \cdot b3 \cdot MED_Z \cdot LOW_Q + a7 \cdot b3 \cdot LOW_W \cdot MED_Z \cdot LOW_Q; \\
IMMHL = a1 \cdot b1 + a4 \cdot b1 \cdot MED_W + a5 \cdot b1 \cdot MED_Z + \\
a7 \cdot b1 \cdot MED_W \cdot MED_Z + \\
a1 \cdot b2 \cdot HIGH_V + a4 \cdot b2 \cdot MED_W \cdot HIGH_V + a5 \cdot b2 \cdot MED_Z \cdot HIGH_V + \\
a7 \cdot b2 \cdot MED_W \cdot MED_Z \cdot HIGH_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot MED_W \cdot LOW_Q + \\
a5 \cdot b3 \cdot MED_Z \cdot LOW_Q + a7 \cdot b3 \cdot MED_W \cdot MED_Z \cdot LOW_Q; \\
IHMHL = a1 \cdot b1 + a4 \cdot b1 \cdot HIGH_W + a5 \cdot b1 \cdot MED_Z + \\
a7 \cdot b1 \cdot HIGH_W \cdot MED_Z + \\
a1 \cdot b2 \cdot HIGH_V + a4 \cdot b2 \cdot HIGH_W \cdot HIGH_V + a5 \cdot b2 \cdot MED_Z \cdot HIGH_V + \\
a7 \cdot b2 \cdot HIGH_W \cdot MED_Z \cdot HIGH_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot MED_W \cdot MED_Z + \\
a5 \cdot b3 \cdot MED_Z \cdot MED_Z + a7 \cdot b3 \cdot MED_W \cdot MED_Z \cdot MED_Z; \\
IHML = a1 \cdot b1 + a4 \cdot b1 \cdot HIGH_W + a5 \cdot b1 \cdot MED_Z + \\
a7 \cdot b1 \cdot HIGH_W \cdot MED_Z + \\
a1 \cdot b2 \cdot HIGH_V + a4 \cdot b2 \cdot HIGH_W \cdot HIGH_V + a5 \cdot b2 \cdot MED_Z \cdot HIGH_V + \\
a7 \cdot b2 \cdot HIGH_W \cdot MED_Z \cdot HIGH_V + a1 \cdot b3 \cdot LOW_Q + \\
a4 \cdot b3 \cdot MED_Z \cdot MED_Z + \\
a5 \cdot b3 \cdot MED_Z \cdot MED_Z + a7 \cdot b3 \cdot MED_W \cdot MED_Z \cdot MED_Z;
\text{ILHHL} = a_1b_1 + a_4b_1*LOW_W + a_5b_1*HIGH_Z + \\
\quad a_7b_1*HIGH_V + a_1b_2*LOW_W*HIGH_V + a_5b_1*HIGH_Z*HIGH_V + \\
\quad a_7b_2*LOW_W*HIGH_Z*HIGH_V + a_1b_3*LOW_Q + \\
\quad a_4b_3*LOW_W*LOW_Q + \\
\quad a_5b_3*HIGH_Z*LOW_Q + a_7b_3*HIGH_W*HIGH_Z*LOW_Q; \\
\text{IMHHL} = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*HIGH_Z + \\
\quad a_7b_1*HIGH_W*HIGH_Z + \\
\quad a_1b_2*HIGH_V + a_4b_2*MED_W*HIGH_V + a_5b_1*HIGH_Z*HIGH_V + \\
\quad a_7b_2*MED_W*HIGH_Z*HIGH_V + a_1b_3*LOW_Q + \\
\quad a_4b_3*MED_W*LOW_Q + \\
\quad a_5b_3*HIGH_Z*LOW_Q + a_7b_3*HIGH_W*HIGH_Z*LOW_Q; \\
\text{IHHHL} = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*HIGH_Z + \\
\quad a_7b_1*HIGH_W*HIGH_Z + \\
\quad a_1b_2*HIGH_V + a_4b_2*HIGH_W*HIGH_V + a_5b_1*HIGH_Z*HIGH_V + \\
\quad a_7b_2*HIGH_W*HIGH_Z*HIGH_V + a_1b_3*LOW_Q + \\
\quad a_4b_3*HIGH_W*LOW_Q + \\
\quad a_5b_3*HIGH_Z*LOW_Q + a_7b_3*HIGH_W*HIGH_Z*LOW_Q; \\
\text{ILLLM} = a_1b_1 + a_4b_1*LOW_W + a_5b_1*LOW_Z + \\
\quad a_7b_1*LOW_W*LOW_Z + \\
\quad a_1b_2*LOW_V + a_4b_2*LOW_W*LOW_V + a_5b_2*LOW_Z*LOW_V + \\
\quad a_7b_2*LOW_W*LOW_Z*LOW_V + a_1b_3*MED_Q + a_4b_3*LOW_W*MED_Q + \\
\quad a_5b_3*LOW_Z*MED_Q + a_7b_3*LOW_W*LOW_Z*MED_Q; \\
\text{IMLLM} = a_1b_1 + a_4b_1*MED_W + a_5b_1*LOW_Z + \\
\quad a_7b_1*MED_W*LOW_Z + \\
\quad a_1b_2*LOW_V + a_4b_2*MED_W*LOW_V + a_5b_2*LOW_Z*LOW_V + \\
\quad a_7b_2*MED_W*LOW_Z*LOW_V + a_1b_3*MED_Q + a_4b_3*MED_W*MED_Q + \\
\quad a_5b_3*MED_Z*MED_Q + a_7b_3*MED_W*LOW_Z*MED_Q; \\
\text{IHLLM} = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*LOW_Z + \\
\quad a_7b_1*HIGH_W*LOW_Z + \\
\quad a_1b_2*LOW_V + a_4b_2*HIGH_W*LOW_V + a_5b_2*LOW_Z*LOW_V + \\
\quad a_7b_2*HIGH_W*LOW_Z*LOW_V + a_1b_3*MED_Q + a_4b_3*HIGH_W*MED_Q + \\
\quad a_5b_3*HIGH_Z*MED_Q + a_7b_3*HIGH_W*LOW_Z*MED_Q; \\
\text{ILMLM} = a_1b_1 + a_4b_1*LOW_W + a_5b_1*MED_Z + \\
\quad a_7b_1*LOW_W*MED_Z + \\
\quad a_1b_2*LOW_V + a_4b_2*LOW_W*LOW_V + a_5b_2*MED_Z*LOW_V + \\
\quad a_7b_2*LOW_W*MED_Z*LOW_V + a_1b_3*MED_Q + a_4b_3*LOW_W*MED_Q + \\
\quad a_5b_3*MED_W*MED_Q + a_7b_3*LOW_W*MED_Z*MED_Q;
IMMLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +

a7*b1*MED_W*MED_Z +

a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q +

a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q;

IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +

a7*b1*HIGH_W*MED_Z +

a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*HIGH_W*MED_Z*LOW_V + a1*b3*MED_Q +

a4*b3*MED_W*MED_Q +

a5*b3*MED_Z*MED_Q + a7*b3*HIGH_W*MED_Z*MED_Q;

ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +

a7*b1*LOW_W*HIGH_Z +

a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*LOW_W*HIGH_Z*LOW_V + a1*b3*MED_Q +

a4*b3*MED_W*MED_Q +

a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q;

IMHLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +

a7*b1*MED_W*MED_Z +

a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q +

a4*b3*MED_Z*MED_Q +

a5*b3*MED_W*MED_Z + a7*b3*LOW_W*MED_Z*MED_Q;

IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +

a7*b1*HIGH_W*LOW_Z +

a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*HIGH_W*MED_Z*LOW_V + a1*b3*MED_Q +

a4*b3*MED_W*MED_Q +

a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q;

ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +

a7*b1*LOW_W*HIGH_Z +

a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q +

a4*b3*MED_W*MED_Q +

a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q;

IMHLM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +

a7*b1*HIGH_W*LOW_Z +

a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q +

a4*b3*MED_W*MED_Q +

a5*b3*LLOW_W*MED_Z*MED_Q + a7*b3*HIGH_W*LOW_Z*MED_Q;

IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +

a7*b1*HIGH_W*LOW_Z +

a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*MED_V +

a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q +

a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q;

IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +

a7*b1*HIGH_W*LOW_Z +

a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V +

a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q +
a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*MED_Q + 
a4*b3*HIGH_W*MED_Q + 
a5*b3*LOW_Z*MED_Q + a7*b3*HIGH_W*LOW_Z*MED_Q;
ILMM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
a7*b1*LOW_W*MED_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + 
a7*b2*LOW_W*MED_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + 
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q;
IMMMM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
a7*b1*LOW_W*MED_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + 
a7*b2*LOW_W*MED_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + 
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q;
ILHMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + 
a7*b1*LOW_W*HIGH_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + 
a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*MED_Q + 
a4*b3*LOW_W*MED_Q + 
a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q;
IMHMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + 
a7*b1*LOW_W*HIGH_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + 
a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*MED_Q + 
a4*b3*LOW_W*MED_Q + 
a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q;
IHHMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + 
a7*b1*LOW_W*HIGH_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + 
a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*MED_Q + 
a4*b3*LOW_W*MED_Q + 
a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q;
ILLHM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*LOW_W*LOW_Z + 
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b3*MED_Q + 
a4*b3*LOW_W*MED_Q + 
a5*b3*LOW_Z*MED_Q + a7*b3*LOW_W*LOW_Z*MED_Q;
IMLHM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q;
IHLHM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*HIGH_W*LOW_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*HIGH_W*LOW_Z*MED_Q;
ILMHM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q;
IMMHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q;
IHMHM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_W*HIGH_V +
a7*b2*HIGH_W*LOW_W*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q;
ILHHM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q;
IMHHM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q;
IHHHM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +

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\[a_7b_1*\text{HIGH}_W*\text{HIGH}_Z + a_1b_2*\text{HIGH}_V + a_4b_2*\text{HIGH}_W*\text{HIGH}_V + a_5b_2*\text{HIGH}_Z*\text{HIGH}_V + a_7b_2*\text{HIGH}_W*\text{HIGH}_Z*\text{HIGH}_V + a_1b_3*\text{MED}_Q + a_4b_3*\text{MED}_Q + a_5b_3*\text{MED}_Q + a_7b_3*\text{HIGH}_W*\text{HIGH}_Z*\text{MED}_Q; \]

\[\text{ILLLH} = a_1b_1 + a_4b_1*\text{LOW}_W + a_5b_1*\text{LOW}_Z + a_7b_1*\text{LOW}_W*\text{LOW}_Z + a_1b_2*\text{LOW}_V + a_4b_2*\text{LOW}_W*\text{LOW}_V + a_5b_2*\text{LOW}_Z*\text{LOW}_V + a_7b_2*\text{LOW}_W*\text{LOW}_Z*\text{LOW}_V + a_1b_3*\text{HIGH}_Q + a_4b_3*\text{LOW}_W*\text{HIGH}_Q + a_5b_3*\text{LOW}_Z*\text{HIGH}_Q + a_7b_3*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_Q; \]

\[\text{IMLLH} = a_1b_1 + a_4b_1*\text{MED}_W + a_5b_1*\text{LOW}_Z + a_7b_1*\text{MED}_W*\text{LOW}_Z + a_1b_2*\text{LOW}_V + a_4b_2*\text{MED}_W*\text{LOW}_V + a_5b_2*\text{LOW}_Z*\text{LOW}_V + a_7b_2*\text{MED}_W*\text{LOW}_Z*\text{LOW}_V + a_1b_3*\text{HIGH}_Q + a_4b_3*\text{LOW}_W*\text{HIGH}_Q + a_5b_3*\text{LOW}_Z*\text{HIGH}_Q + a_7b_3*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_Q; \]

\[\text{IHLLH} = a_1b_1 + a_4b_1*\text{HIGH}_W + a_5b_1*\text{LOW}_Z + a_7b_1*\text{HIGH}_W*\text{LOW}_Z + a_1b_2*\text{LOW}_V + a_4b_2*\text{HIGH}_W*\text{LOW}_V + a_5b_2*\text{LOW}_Z*\text{LOW}_V + a_7b_2*\text{HIGH}_W*\text{LOW}_Z*\text{LOW}_V + a_1b_3*\text{HIGH}_Q + a_4b_3*\text{HIGH}_W*\text{HIGH}_Q + a_5b_3*\text{LOW}_Z*\text{HIGH}_Q + a_7b_3*\text{HIGH}_W*\text{LOW}_Z*\text{HIGH}_Q; \]

\[\text{ILMLH} = a_1b_1 + a_4b_1*\text{LOW}_W + a_5b_1*\text{MED}_Z + a_7b_1*\text{LOW}_W*\text{MED}_Z + a_1b_2*\text{LOW}_V + a_4b_2*\text{LOW}_W*\text{LOW}_V + a_5b_2*\text{MED}_Z*\text{LOW}_V + a_7b_2*\text{LOW}_W*\text{MED}_Z*\text{LOW}_V + a_1b_3*\text{HIGH}_Q + a_4b_3*\text{LOW}_W*\text{HIGH}_Q + a_5b_3*\text{LOW}_Z*\text{HIGH}_Q + a_7b_3*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_Q; \]

\[\text{IMMLH} = a_1b_1 + a_4b_1*\text{MED}_W + a_5b_1*\text{MED}_Z + a_7b_1*\text{MED}_W*\text{MED}_Z + a_1b_2*\text{LOW}_V + a_4b_2*\text{MED}_W*\text{LOW}_V + a_5b_2*\text{MED}_Z*\text{LOW}_V + a_7b_2*\text{MED}_W*\text{MED}_Z*\text{LOW}_V + a_1b_3*\text{HIGH}_Q + a_4b_3*\text{MED}_W*\text{HIGH}_Q + a_5b_3*\text{MED}_Z*\text{HIGH}_Q + a_7b_3*\text{MED}_W*\text{MED}_Z*\text{HIGH}_Q; \]

\[\text{IHMLH} = a_1b_1 + a_4b_1*\text{HIGH}_W + a_5b_1*\text{MED}_Z + a_7b_1*\text{HIGH}_W*\text{MED}_Z + a_1b_2*\text{LOW}_V + a_4b_2*\text{HIGH}_W*\text{LOW}_V + a_5b_2*\text{MED}_Z*\text{LOW}_V + a_7b_2*\text{HIGH}_W*\text{MED}_Z*\text{LOW}_V + a_1b_3*\text{HIGH}_Q + a_4b_3*\text{HIGH}_W*\text{HIGH}_Q + a_5b_3*\text{MED}_Z*\text{HIGH}_Q + a_7b_3*\text{MED}_W*\text{MED}_Z*\text{HIGH}_Q; \]

\[\text{ILHLH} = a_1b_1 + a_4b_1*\text{LOW}_W + a_5b_1*\text{HIGH}_Z + a_7b_1*\text{LOW}_W*\text{HIGH}_Z + a_1b_2*\text{LOW}_V + a_4b_2*\text{LOW}_W*\text{LOW}_V + a_5b_2*\text{HIGH}_Z*\text{LOW}_V + a_7b_2*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_V + a_1b_3*\text{HIGH}_Q + a_4b_3*\text{LOW}_W*\text{HIGH}_Q + a_5b_3*\text{LOW}_Z*\text{HIGH}_Q + a_7b_3*\text{LOW}_W*\text{LOW}_Z*\text{HIGH}_Q; \]
a4*b3*LOW_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*LOW_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
        a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
        a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
        a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
        a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
        a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z +
    a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
        a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q;
\[ a_1 b_2 \text{MED}_V + a_4 b_2 \text{HIGH}_W \text{MED}_V + a_5 b_2 \text{MED}_Z \text{MED}_V + a_7 b_2 \text{HIGH}_W \text{MED}_Z \text{MED}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{HIGH}_W \text{HIGH}_Q + a_5 b_3 \text{MED}_Z \text{HIGH}_Q + a_7 b_3 \text{HIGH}_W \text{MED}_Z \text{HIGH}_Q; \]

ILHMH = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_7 b_1 \text{HIGH}_W \text{HIGH}_Q + a_1 b_2 \text{MED}_V + a_4 b_2 \text{LOW}_W \text{MED}_V + a_5 b_2 \text{HIGH}_Z \text{MED}_V + a_7 b_2 \text{LOW}_W \text{HIGH}_Z \text{MED}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{LOW}_W \text{HIGH}_Q + a_5 b_3 \text{HIGH}_Z \text{HIGH}_Q + a_7 b_3 \text{LOW}_W \text{HIGH}_Z \text{HIGH}_Q; \]

IMHMH = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_7 b_1 \text{MED}_W \text{HIGH}_Q + a_1 b_2 \text{MED}_V + a_4 b_2 \text{MED}_W \text{MED}_V + a_5 b_2 \text{HIGH}_Z \text{MED}_V + a_7 b_2 \text{MED}_W \text{HIGH}_Z \text{MED}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{MED}_W \text{HIGH}_Q + a_5 b_3 \text{HIGH}_Z \text{HIGH}_Q + a_7 b_3 \text{MED}_W \text{HIGH}_Z \text{HIGH}_Q; \]

IHHMH = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_7 b_1 \text{HIGH}_W \text{HIGH}_Q + a_1 b_2 \text{MED}_V + a_4 b_2 \text{HIGH}_W \text{MED}_V + a_5 b_2 \text{HIGH}_Z \text{MED}_V + a_7 b_2 \text{HIGH}_W \text{HIGH}_Z \text{MED}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{HIGH}_W \text{HIGH}_Q + a_5 b_3 \text{HIGH}_Z \text{HIGH}_Q + a_7 b_3 \text{HIGH}_W \text{HIGH}_Z \text{HIGH}_Q; \]

ILLHH = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_7 b_1 \text{LOW}_W \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{LOW}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_7 b_2 \text{LOW}_W \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{LOW}_W \text{HIGH}_Q + a_5 b_3 \text{LOW}_Z \text{HIGH}_Q + a_7 b_3 \text{LOW}_W \text{LOW}_Z \text{HIGH}_Q; \]

IMLHH = \[ a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_7 b_1 \text{MED}_W \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{MED}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_7 b_2 \text{MED}_W \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{MED}_W \text{HIGH}_Q + a_5 b_3 \text{LOW}_Z \text{HIGH}_Q + a_7 b_3 \text{MED}_W \text{LOW}_Z \text{HIGH}_Q + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{MED}_W \text{HIGH}_V + a_5 b_2 \text{MED}_Z \text{HIGH}_V + a_7 b_2 \text{MED}_W \text{MED}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{MED}_W \text{HIGH}_Q + a_5 b_3 \text{MED}_Z \text{HIGH}_Q + a_7 b_3 \text{MED}_W \text{MED}_Z \text{HIGH}_Q; \]

IHLHH = \[ a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_7 b_1 \text{HIGH}_W \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{HIGH}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_7 b_2 \text{HIGH}_W \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{HIGH}_W \text{HIGH}_Q + a_5 b_3 \text{HIGH}_Z \text{HIGH}_Q + a_7 b_3 \text{HIGH}_W \text{LOW}_Z \text{HIGH}_Q; \]

ILMHH = \[ a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_7 b_1 \text{LOW}_W \text{MED}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{LOW}_W \text{HIGH}_V + a_5 b_2 \text{MED}_Z \text{HIGH}_V + a_7 b_2 \text{LOW}_W \text{MED}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{LOW}_W \text{HIGH}_Q + a_5 b_3 \text{MED}_Z \text{HIGH}_Q + a_7 b_3 \text{LOW}_W \text{MED}_Z \text{HIGH}_Q; \]

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a5*b3*MED_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q;  
IMMHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
a7*b1*MED_W*MED_Z + 
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + 
a7*b2*MED_W*HIGH_Q + 
a5*b3*MED_Z*HIGH_Q + a7*b3*MED_W*MED_Z*HIGH_Q;  
IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + 
a7*b1*HIGH_W*MED_Z + 
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + 
a7*b2*HIGH_W*MED_Z*HIGH_V + 
a1*b3*HIGH_V + a4*b3*HIGH_W*HIGH_V + a5*b3*HIGH_Z*HIGH_V + 
a7*b3*LOW_W*MED_Z*HIGH_V;  
IMHHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
a7*b1*MED_W*MED_Z + 
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + 
a7*b2*MED_W*HIGH_Q + 
a5*b3*MED_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q;  
ILHHHH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + 
a7*b1*LOW_W*HIGH_Z + 
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*LOW_W*HIGH_Q + 
a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q;  
! Calc conditional direct effects for each combination of 
moderator values  
DLOV_LOQ = cdash1 + cdash4*LOW_V + cdash5*LOW_Q;  
DMEV_LOQ = cdash1 + cdash4*MED_W + cdash5*LOW_Q;  
DHIV_LOQ = cdash1 + cdash4*HIGH_V + cdash5*LOW_Q;  
DLOV_MEQ = cdash1 + cdash4*LOW_V + cdash5*MED_Q;  
DMEV_MEQ = cdash1 + cdash4*MED_W + cdash5*MED_Q;  
DHIV_MEQ = cdash1 + cdash4*HIGH_V + cdash5*MED_Q;
DLOV_HIQ = cdash1 + cdash4*LOW_V + cdash5*HIGH_Q;
DMEV_HIQ = cdash1 + cdash4*MED_W + cdash5*HIGH_Q;
DHIIV_HIQ = cdash1 + cdash4*HIGH_V + cdash5*HIGH_Q;

! Calc conditional total effects for each combination of moderator values

TLLLL = ILLLL + DLOV_LOQ;
TMLLL = IMLLL + DLOV_LOQ;
THLLL = IHLLL + DLOV_LOQ;

TLMLL = ILMLL + DLOV_LOQ;
TMMLL = IMMLL + DLOV_LOQ;
THMLL = IHMLL + DLOV_LOQ;

TMLML = ILMLL + DLOV_LOQ;
TMMML = IMMML + DLOV_LOQ;
THHML = IHHML + DLOV_LOQ;

TMLML = ILMLL + DMEV_LOQ;
TMLML = IMLML + DMEV_LOQ;
THHML = IHHML + DMEV_LOQ;

TLHML = ILHML + DMEV_LOQ;
TMHML = IMHML + DMEV_LOQ;
THAMM = IHAML + DMEV_LOQ;

TLHML = ILHML + DMEV_LOQ;
TMHML = IMHML + DMEV_LOQ;
THMML = IHMML + DMEV_LOQ;

TLLHL = ILLHL + DHIV_LOQ;
TMLHL = IMLHL + DHIV_LOQ;
THLHL = IHLHL + DHIV_LOQ;

TLMHL = ILMHL + DHIV_LOQ;
TMMHL = IMMHL + DHIV_LOQ;
THHHL = IHHHL + DHIV_LOQ;

TMLHL = ILMLL + DHIV_LOQ;
TMMHL = IMMHL + DHIV_LOQ;
THHHL = IHHHL + DHIV_LOQ;

TMLML = IMLML + DLOV_MEQ;
TMMML = IMMML + DLOV_MEQ;
THMML = IHMML + DLOV_MEQ;

TMLML = IMLML + DLOV_MEQ;
TMMML = IMMML + DLOV_MEQ;
THMML = IHMML + DLOV_MEQ;

TMLML = IMLML + DLOV_MEQ;
TMMML = IMMML + DLOV_MEQ;
THMML = IHMML + DLOV_MEQ;

TMLML = IMLML + DLOV_MEQ;
TLHLM = ILHLM + DLOV_MEQ;
TMHLM = IMHLM + DLOV_MEQ;
THHLM = IHHLM + DLOV_MEQ;
TLLMM = ILLMM + DMEV_MEQ;
TMLMM = IMLMM + DMEV_MEQ;
THLMM = IHLMM + DMEV_MEQ;
TLMMM = ILMHM + DMEV_MEQ;
TMMHM = IMMHM + DMEV_MEQ;
THHMM = IHMMH + DMEV_MEQ;
TLLHM = ILLLH + DHIV_MEQ;
TMLHM = IMLLM + DHIV_MEQ;
THLHM = IHLHM + DHIV_MEQ;
TLMHM = ILHMH + DHIV_MEQ;
TMMHM = IMMHH + DHIV_MEQ;
THHMM = IHMMM + DHIV_MEQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLLL = IMLLL + DLOV_HIQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLHL = IMLHL + DLOV_HIQ;
THLHL = IHLHL + DLOV_HIQ;
TLHHL = ILHHL + DLOV_HIQ;
TMLMH = IMLMH + DMEV_HIQ;
THLMH = ILMHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHM + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLHM = ILMHM + DMEV_HIQ;
TMLHM = IMLHM + DMEV_HIQ;
THLHM = IHLHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHH + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLLL = IMLLL + DLOV_HIQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLHL = IMLHL + DLOV_HIQ;
THLHL = IHLHL + DLOV_HIQ;
TLHHL = ILHHL + DLOV_HIQ;
TMLMH = IMLMH + DMEV_HIQ;
THLMH = ILMHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHH + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLHM = ILMHM + DMEV_HIQ;
TMLHM = IMLHM + DMEV_HIQ;
THLHM = IHLHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHH + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLLL = IMLLL + DLOV_HIQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLHL = IMLHL + DLOV_HIQ;
THLHL = IHLHL + DLOV_HIQ;
TLHHL = ILHHL + DLOV_HIQ;
TMLMH = IMLMH + DMEV_HIQ;
THLMH = ILMHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHH + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLLH = ILMHM + DMEV_HIQ;
TMLHM = IMLHM + DMEV_HIQ;
THLHM = IHLHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHH + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLLH = ILMHM + DMEV_HIQ;
TMLHM = IMLHM + DMEV_HIQ;
THLHM = IHLHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHH + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLLH = ILMHM + DMEV_HIQ;
TMLHM = IMLHM + DMEV_HIQ;
THLHM = IHLHM + DMEV_HIQ;
TLMHM = ILHMM + DMEV_HIQ;
TMMHM = IMMHH + DMEV_HIQ;
THHMM = IHMMM + DMEV_HIQ;
TLLHH = ILLHH + DHIV_HIQ;
TMLHH = IMLHH + DHIV_HIQ;
THLHH = IHLHH + DHIV_HIQ;
TLMHH = ILMHH + DHIV_HIQ;
TMMHH = IMMHH + DHIV_HIQ;
THMHH = IHMHH + DHIV_HIQ;
TLHHH = ILHHH + DHIV_HIQ;
TMHHH = IMHHH + DHIV_HIQ;
THHHH = IHHHH + DHIV_HIQ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLLPLL PMLLLL PHLLL PLLLL PLPLL PMLLL PHLLL PHHLL
PLLML PMLML PHML PLMLM PMLML PMLML PLMLM PHHLM PLHLL PMHLL PHHLM
PLLMM PMLMML PHMMM PMLMMM PMLMMM PMLMMM PMHMM PHHMM
PLLMM PMLMML PHMMM PMLMMM PMLMMM PMLMMM PMHMM PHHMM
PLLMM PMLMML PHMMM PMLMMM PMLMMM PMLMMM PMHMM PHHMM
PLLHH PLLLL PHLLL PLLLL PLLLL PMLLL PHLLL PHHLL
PLLML PMLML PHML PLMLM PMLML PMLML PLMLM PHHLM PLHLL PMHLL PHHLM
PLLMM PMLMML PHMMM PMLMMM PMLMMM PMLMMM PMHMM PHHMM
PLLMM PMLMML PHMMM PMLMMM PMLMMM PMLMMM PMHMM PHHMM
PLLHH PLLHH PHPHH PLLHH PLLHH PHPHH PLLHH PHPHH
PLLLL = ILLLL*XVAL;
PMLLL = IMLLL*XVAL;
PHLLL = IHLLL*XVAL;

PLMLL = IMLLL*XVAL;
PMMLL = IMMLL*XVAL;
PHMLL = IHMLL*XVAL;

PLHLL = ILHLL*XVAL;
PMHLL = IMHLL*XVAL;
PHHLL = IHHLL*XVAL;

PLLML = ILLML*XVAL;
PMLML = IMLML*XVAL;
PHLML = IHLML*XVAL;
PLMML = ILMLL*XVAL;
PMMML = IMMML*XVAL;
PHMML = IHMML*XVAL;
PLHML = ILHML*XVAL;
PMHML = IMHML*XVAL;
PHHML = IHHML*XVAL;
PLLHL = ILLHL*XVAL;
PMLHL = IMLHL*XVAL;
PHLHL = IHLHL*XVAL;
PLMHL = ILMHL*XVAL;
PHMHL = IHMHL*XVAL;
PLHHL = ILHHL*XVAL;
PMHHL = IMHHL*XVAL;
PHHHL = IHHHL*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;
PLMHM = ILMHM*XVAL;
PHMHM = IHMHM*XVAL;
PLHHM = ILHHM*XVAL;
PMHHM = IMHHM*XVAL;
PHHHM = IHHHM*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PHLMM = IHLMM*XVAL;
PLMMM = ILMMM*XVAL;
PMMMM = IMM MM*XVAL;
PHMMM = IHMMM*XVAL;
PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;
PLMHM = ILMHM*XVAL;
PMHM = IIMHM*XVAL;
PHHM = IHHM*XVAL;
PLHHM = IMLHM*XVAL;
PMHHM = IMHMM*XVAL;
PHHHM = IHHMM*XVAL;
PLLH = ILLLH*XVAL;
PMLH = IMLLH*XVAL;
PHLLH = IHLLH*XVAL;
PLMLH = IMLMLH*XVAL;
PMMLH = IMMLH*XVAL;
PHMLH = IHMLH*XVAL;
PLHLH = ILHLH*XVAL;
PMHLH = IMHLH*XVAL;
PHHLH = IHHLH*XVAL;
PLLMH = ILLMH*XVAL;
PMLMH = IMLMH*XVAL;
PHLMH = IHLMH*XVAL;
PLMMH = ILMMH*XVAL;
PMMMH = IMMMH*XVAL;
PHMMH = IHMMH*XVAL;
PLHMH = ILHMH*XVAL;
PMHMH = IMHMH*XVAL;
PHHMH = IHHMH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PHLHH = IHLHH*XVAL;
PLMHH = ILMHH*XVAL;
PMMHH = IMMHH*XVAL;
PHMHH = IHMHH*XVAL;
PLHHH = ILHHH*XVAL;
PMHHH = IHHHH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
   TYPE = plot2;

OUTPUT:
   STAND CINT(bcbootstrap);
Model 53: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 M V + b_5 M Q + b_6 V Q + b_7 M V Q + c_1' X + c_2' W + c_3' Z + c_4' X W + c_5' X Z \]

\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 V + b_3 Q + b_4 M V + b_5 M Q + b_6 V Q + b_7 M V Q + c_1' X + c_2' W + c_3' Z + c_4' X W + c_5' X Z \]

\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z) + b_2 V + b_3 Q + b_4(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z) + b_5(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z) + b_6 V Q + b_7(a_0 + a_1 X + a_2 W + a_3 Z + a_4 X W + a_5 X Z) + c_1' X + c_2' W + c_3' Z + c_4' X W + c_5' X Z \]
Hence... multiplying out brackets

\[ Y = b_0 + a_{11}X + a_{21}W + a_{31}Z + a_{41}XW + a_{51}ZW + b_{2}V + b_{3}Q + a_{01}b_{4}V + a_{21}b_{4}WV + a_{31}b_{4}VZ + a_{51}b_{4}XW + a_{01}b_{5}Q + a_{21}b_{5}WQ + a_{31}b_{5}WZ + a_{51}b_{5}XWQ + a_{01}b_{6}VQ + a_{21}b_{6}XVQ + a_{31}b_{6}WXQ + a_{51}b_{6}XZVQ + a_{01}b_{7}VQ + a_{21}b_{7}XVQ + a_{31}b_{7}WXQ + a_{51}b_{7}XZVQ + c_{1}'X + c_{2}'W + c_{3}'Z + c_{4}'XW + c_{5}'XZ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{11}X + a_{21}W + a_{31}Z + b_{2}V + b_{3}Q + a_{01}b_{4}V + a_{21}b_{4}WV + a_{31}b_{4}VZ + a_{01}b_{5}Q + a_{21}b_{5}WQ + a_{31}b_{5}WZ + b_{6}VQ + a_{11}b_{7}VQ + a_{21}b_{7}XVQ + a_{31}b_{7}WXQ + c_{2}'W + c_{3}'Z) + (a_{11}b_{1} + a_{41}b_{1}W + a_{51}b_{1}Z + a_{11}b_{4}V + a_{41}b_{4}WV + a_{51}b_{4}VZ + a_{11}b_{5}Q + a_{41}b_{5}WQ + a_{51}b_{5}ZQ + a_{11}b_{7}VQ + a_{41}b_{7}XVQ + a_{51}b_{7}WXQ + c_{1}' + c_{4}'W + c_{5}'Z)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V, Q \):

\[ a_{11}b_{1} + a_{41}b_{1}W + a_{51}b_{1}Z + a_{11}b_{4}V + a_{41}b_{4}WV + a_{51}b_{4}VZ + a_{11}b_{5}Q + a_{41}b_{5}WQ + a_{51}b_{5}ZQ + a_{11}b_{7}VQ + a_{41}b_{7}XVQ + a_{51}b_{7}WXQ = (a_{11} + a_{41}W + a_{51}Z)(b_{1} + b_{4}V + b_{5}Q + b_{7}VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):

\[ c_{1}' + c_{4}'W + c_{5}'Z \]

Mplus code for the model:

```mplus
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y
USEVARIABLES = X M W Z V Q Y XW XZ VQ MV MQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MQ = M*Q;
  MV = M*V;
  XW = X*W;
  XZ = X*Z;
  VQ = V*Q;
  MVQ = M*V*Q;
```
ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
   [Y] (b0);
   Y ON M (b1);
   Y ON V (b2);
   Y ON Q (b3);
   Y ON MV (b4);
   Y ON MQ (b5);
   Y ON VQ (b6);
   Y ON MVQ (b7);
   Y ON X (cdash1);
   Y ON W (cdash2);
   Y ON Z (cdash3);
   Y ON XW (cdash4);
   Y ON XZ (cdash5);

   [M] (a0);
   M ON X (a1);
   M ON W (a2);
   M ON Z (a3);
   M ON XW (a4);
   M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)
   ILLLL IMLLL IHLLL ILMLL IMMLL IHLLL IHLLL IMHLL IHHLL
   ILLML IMLML IHLML ILMML IMMML IHLML IMHML IHHML
   ILLHL IMLHL IHLHL ILMHL IMHHL IHHHL
   ILLLM IMLLM IHLLM ILMLM IMMLM IHLLM IMHLM IHHLM
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ILLMM IMLMM IHLMM ILMMM IMMMM IHMMM ILHMM IMHMM IHHMM
ILLHM IMLHM IHLHM ILMHM IMMHM IHMMH ILHMM IMHMM IHHMM
ILLLL HILLL ILLLH LLLHL LHLHL HHLHL LLHHL FLHLH LHHLH HLHHL LLHLL LHLLH HLLLL
ILLMH IMLMH IHLMH ILMMH IMMMH IHMMH ILHMM IMHMM IHHMM
ILLHH IMLHH IHLHH ILMHH IMMHH IHMMH ILHMM IMHMM IHHMM
DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
DLOW_HIZ DMEW_HIZ DHIW_HIZ
TLLLL TMLLL TLLLH LLHLL LLLHL LHHHL LLHLL LHLLH LHHLH LHHLH
TLLLM TMLLM TLMLH MLHLH TMLLM TMLLM TMLLM TLMLLM TLMLLM TLMLLM
TLLMM TMLMM TLMML TLMLM TMLML TMLML TMLML TMLML TMLML TMLML
TLHLL THHLH HLHHL LHHLH LHHLH LHHLH LHHLH LHHLH LHHLH LHHLH
TLLMH TMLMH TMMLH MLMLH TMLMH TMLMH TMLMH TMLMH TMLMH TMLMH
TLLHH TMLHH TMMLH MLMLH TMLHH TMLHH TMLHH TMLHH TMLHH TMLHH
TLLMH TMLMH TLMLH MLMLH TMLMH TMLMH TMLMH TMLMH TMLMH TMLMH
TLLHH TMLHH TLMLH MLMLH TMLHH TMLHH TMLHH TMLHH TMLHH TMLHH;
LOW_W = #LOWW; ! replace #LOWW in the code with your
calcul low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your
calcul medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
calcul high value of W
LOW_Z = #LOWZ; ! replace #LOWZ in the code with your
calcul low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your
calcul medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
calcul high value of Z
LOW_V = #LOWV; ! replace #LOWV in the code with your
calcul low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your
calcul medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your
calcul high value of V
LOW_Q = #LOWQ; ! replace #LOWQ in the code with your
calcul low value of Q
MED_Q = #MEDQ; ! replace #MEDQ in the code with your
calcul medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your
calcul high value of Q
! Calc conditional indirect effects for each combination of
! moderator values

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V +
a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*LOW_Q +
\[ a_4 \cdot b_5 \cdot \text{LOW}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{LOW}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{LOW}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{IMLLL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{LOW}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + \\
a_4 \cdot b_4 \cdot \text{MED}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{LOW}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + \\
a_4 \cdot b_5 \cdot \text{MED}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{LOW}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{MED}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{LOW}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{IMMLL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{MED}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + \\
a_4 \cdot b_4 \cdot \text{MED}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{MED}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + \\
a_4 \cdot b_5 \cdot \text{MED}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{MED}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{MED}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{MED}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{IMHLL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + \\
a_4 \cdot b_4 \cdot \text{MED}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + \\
a_4 \cdot b_5 \cdot \text{MED}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{HIGH}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{MED}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{HIGH}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{IMHLL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + \\
a_4 \cdot b_4 \cdot \text{MED}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + \\
a_4 \cdot b_5 \cdot \text{MED}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{HIGH}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{MED}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{HIGH}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{IHHLL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + \\
a_4 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + \\
a_4 \cdot b_5 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{HIGH}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{HIGH}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{HIGH}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{IHHLL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + \\
a_4 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + \\
a_4 \cdot b_5 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{HIGH}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{HIGH}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{HIGH}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{IHHLL} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_1 \cdot b_4 \cdot \text{LOW}_V + \\
a_4 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{LOW}_V + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{LOW}_V + a_1 \cdot b_5 \cdot \text{LOW}_Q + \\
a_4 \cdot b_5 \cdot \text{HIGH}_W \cdot \text{LOW}_Q + a_5 \cdot b_5 \cdot \text{HIGH}_Z \cdot \text{LOW}_Q + a_1 \cdot b_7 \cdot \text{LOW}_V \cdot \text{LOW}_Q + \\
a_4 \cdot b_7 \cdot \text{HIGH}_W \cdot \text{LOW}_V \cdot \text{LOW}_Q + a_5 \cdot b_7 \cdot \text{HIGH}_Z \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]
\(a_1*b_7*LOW_V*LOW_Q + \)
\(a_4*b_7*HIGH_W*LOW_V*LOW_Q + a_5*b_7*HIGH_Z*LOW_V*LOW_Q;\)

\(ILLML = a_1*b_1 + a_4*b_1*LOW_W + a_5*b_1*LOW_Z + a_1*b_4*MED_V + \)
\(a_4*b_4*LOW_W*MED_V + a_5*b_4*LOW_Z*MED_V + a_1*b_5*LOW_Q + \)
\(a_4*b_5*LOW_W*LOW_Q + a_5*b_5*LOW_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*LOW_W*MED_V*LOW_Q + a_5*b_7*LOW_Z*MED_V*LOW_Q;\)

\(IMLML = a_1*b_1 + a_4*b_1*LOW_W + a_5*b_1*LOW_Z + a_1*b_4*LOW_W*MED_V + \)
\(a_4*b_4*MED_W*MED_V + a_5*b_4*MED_Z*MED_V + a_1*b_5*MED_Q + \)
\(a_4*b_5*MED_W*LOW_Q + a_5*b_5*MED_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*MED_W*MED_V*LOW_Q + a_5*b_7*MED_Z*MED_V*LOW_Q;\)

\(IHLML = a_1*b_1 + a_4*b_1*MED_W + a_5*b_1*LOW_Z + a_1*b_4*HIGH_W + \)
\(a_4*b_4*LOW_W*MED_V + a_5*b_4*LOW_Z*MED_V + a_1*b_5*LOW_Q + \)
\(a_4*b_5*LOW_W*LOW_Q + a_5*b_5*LOW_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*MED_W*MED_V*LOW_Q + a_5*b_7*LOW_Z*MED_V*LOW_Q;\)

\(ILMML = a_1*b_1 + a_4*b_1*LOW_W + a_5*b_1*MED_Z + a_1*b_4*MED_V + \)
\(a_4*b_4*LOW_W*MED_V + a_5*b_4*MED_Z*MED_V + a_1*b_5*LOW_Q + \)
\(a_4*b_5*MED_W*LOW_Q + a_5*b_5*MED_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*MED_W*MED_V*LOW_Q + a_5*b_7*MED_Z*MED_V*LOW_Q;\)

\(IMMML = a_1*b_1 + a_4*b_1*MED_W + a_5*b_1*MED_Z + a_1*b_4*MED_V + \)
\(a_4*b_4*MED_W*MED_V + a_5*b_4*MED_Z*MED_V + a_1*b_5*LOW_Q + \)
\(a_4*b_5*MED_W*LOW_Q + a_5*b_5*MED_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*MED_W*MED_V*LOW_Q + a_5*b_7*MED_Z*MED_V*LOW_Q;\)

\(IHMML = a_1*b_1 + a_4*b_1*HIGH_W + a_5*b_1*MED_Z + a_1*b_4*MED_V + \)
\(a_4*b_4*HIGH_W*MED_V + a_5*b_4*MED_Z*MED_V + a_1*b_5*LOW_Q + \)
\(a_4*b_5*MED_W*LOW_Q + a_5*b_5*MED_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*MED_W*MED_V*LOW_Q + a_5*b_7*LOW_Z*MED_V*LOW_Q;\)

\(ILHML = a_1*b_1 + a_4*b_1*LOW_W + a_5*b_1*HIGH_Z + a_1*b_4*MED_V + \)
\(a_4*b_4*LOW_W*MED_V + a_5*b_4*LOW_Z*MED_V + a_1*b_5*LOW_Q + \)
\(a_4*b_5*MED_W*LOW_Q + a_5*b_5*MED_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*MED_W*MED_V*LOW_Q + a_5*b_7*LOW_Z*MED_V*LOW_Q;\)

\(IMHML = a_1*b_1 + a_4*b_1*MED_W + a_5*b_1*HIGH_Z + a_1*b_4*MED_V + \)
\(a_4*b_4*MED_W*MED_V + a_5*b_4*MED_Z*MED_V + a_1*b_5*LOW_Q + \)
\(a_4*b_5*MED_W*LOW_Q + a_5*b_5*MED_Z*LOW_Q + a_1*b_7*MED_V*LOW_Q + \)
\(a_4*b_7*MED_W*MED_V*LOW_Q + a_5*b_7*HIGH_Z*MED_V*LOW_Q;\)
\[ IHHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*MED_V +
\]
\[ a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V + a1*b5*LOW_Q +
\]
\[ a4*b5*HIGH_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q +
\]
\[ a1*b7*MED_V*LOW_Q +
\]
\[ a4*b7*HIGH_W*MED_V*LOW_Q + a5*b7*HIGH_Z*MED_V*LOW_Q;
\]
\[ ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*HIGH_V +
\]
\[ a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*LOW_Q +
\]
\[ a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q +
\]
\[ a1*b7*HIGH_V*LOW_Q +
\]
\[ a4*b7*LOW_W*HIGH_V*LOW_Q + a5*b7*LOW_Z*HIGH_V*LOW_Q;
\]
\[ IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*HIGH_V +
\]
\[ a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*LOW_Q +
\]
\[ a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q +
\]
\[ a1*b7*HIGH_V*LOW_Q +
\]
\[ a4*b7*MED_W*HIGH_V*LOW_Q + a5*b7*LOW_Z*HIGH_V*LOW_Q;
\]
\[ IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*HIGH_V +
\]
\[ a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + a1*b5*LOW_Q +
\]
\[ a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q +
\]
\[ a1*b7*LOW_V*LOW_Q +
\]
\[ a4*b7*HIGH_W*HIGH_V*LOW_Q + a5*b7*LOW_Z*HIGH_V*LOW_Q;
\]
\[ ILMHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*HIGH_V +
\]
\[ a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q +
\]
\[ a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q +
\]
\[ a1*b7*HIGH_V*LOW_Q +
\]
\[ a4*b7*LOW_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q;
\]
\[ IMMHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*HIGH_V +
\]
\[ a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q +
\]
\[ a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q +
\]
\[ a1*b7*HIGH_V*LOW_Q +
\]
\[ a4*b7*MED_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q;
\]
\[ IHMHL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*HIGH_V +
\]
\[ a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*LOW_Q +
\]
\[ a4*b5*HIGH_W*LOW_Q + a5*b5*MED_Z*LOW_Q +
\]
\[ a1*b7*HIGH_V*LOW_Q +
\]
\[ a4*b7*HIGH_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q;
\]
\[ ILHHL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*HIGH_V +
\]
\[ a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a1*b5*LOW_Q +
\]
\[ a4*b5*LOW_W*LOW_Q + a5*b5*HIGH_Z*LOW_Q +
\]
\[ a1*b7*HIGH_V*LOW_Q +
\]
\[ a4*b7*HIGH_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q;
\]
\[ 512 \]
ILLLM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + 
a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*MED_Q + 
a4*b5*LOW_W*MED_Q + a5*b5*LOW_Z*MED_Q + a1*b7*LOW_V*MED_Q + 
a4*b7*LOW_W*LOW_V*MED_Q + a5*b7*LOW_Z*LOW_V*MED_Q;
IMLLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V + 
a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*MED_Q + 
a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a1*b7*MED_V*MED_Q + 
a4*b7*MED_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q;
IHLLM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b4*LOW_V + 
a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a1*b5*MED_Q + 
a4*b5*HIGH_W*MED_Q + a5*b5*HIGH_Z*MED_Q + a1*b7*LOW_V*MED_Q + 
a4*b7*HIGH_W*LOW_V*MED_Q + a5*b7*HIGH_Z*LOW_V*MED_Q;
\[ a_1b_7\text{LOW}_V\text{MED}_Q + a_4b_7\text{HIGH}_W\text{LOW}_V\text{MED}_Q + a_5b_7\text{MED}_Z\text{LOW}_V\text{MED}_Q; \]
\[ \text{ILHLM} = a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{HIGH}_Z + a_1b_4\text{LOW}_V + a_4b_4\text{LOW}_W\text{LOW}_V + a_5b_4\text{HIGH}_Z\text{LOW}_V + a_1b_5\text{MED}_Q + a_4b_5\text{MED}_W\text{MED}_Q + a_5b_5\text{HIGH}_Z\text{MED}_Q + a_1b_7\text{LOW}_V\text{MED}_Q + a_4b_7\text{LOW}_W\text{LOW}_V\text{MED}_Q + a_5b_7\text{HIGH}_Z\text{LOW}_V\text{MED}_Q; \]
\[ \text{IMHLM} = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{HIGH}_Z + a_1b_4\text{LOW}_V + a_4b_4\text{MED}_W\text{MED}_V + a_5b_4\text{HIGH}_Z\text{MED}_V + a_1b_5\text{MED}_Q + a_4b_5\text{MED}_W\text{MED}_Q + a_5b_5\text{HIGH}_Z\text{MED}_Q + a_1b_7\text{LOW}_V\text{MED}_Q + a_4b_7\text{HIGH}_W\text{LOW}_V\text{MED}_Q + a_5b_7\text{HIGH}_Z\text{LOW}_V\text{MED}_Q; \]
\[ \text{IHHLM} = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{HIGH}_Z + a_1b_4\text{LOW}_V + a_4b_4\text{HIGH}_W\text{LOW}_V + a_5b_4\text{HIGH}_Z\text{LOW}_V + a_1b_5\text{MED}_Q + a_4b_5\text{HIGH}_W\text{MED}_Q + a_5b_5\text{HIGH}_Z\text{MED}_Q + a_1b_7\text{LOW}_V\text{MED}_Q + a_4b_7\text{HIGH}_W\text{MED}_Q + a_5b_7\text{HIGH}_Z\text{MED}_Q; \]
\[ \text{ILLMM} = a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{LOW}_Z + a_1b_4\text{MED}_V + a_4b_4\text{LOW}_W\text{MED}_V + a_5b_4\text{LOW}_Z\text{MED}_V + a_1b_5\text{MED}_Q + a_4b_5\text{LOW}_W\text{MED}_Q + a_5b_5\text{LOW}_Z\text{MED}_Q + a_1b_7\text{MED}_V\text{MED}_Q + a_4b_7\text{LOW}_W\text{MED}_V\text{MED}_Q + a_5b_7\text{LOW}_Z\text{MED}_V\text{MED}_Q; \]
\[ \text{IMLMM} = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{LOW}_Z + a_1b_4\text{MED}_V + a_4b_4\text{MED}_W\text{MED}_V + a_5b_4\text{LOW}_Z\text{MED}_V + a_1b_5\text{MED}_Q + a_4b_5\text{MED}_W\text{MED}_Q + a_5b_5\text{LOW}_Z\text{MED}_Q + a_1b_7\text{MED}_V\text{MED}_Q + a_4b_7\text{MED}_W\text{MED}_V\text{MED}_Q + a_5b_7\text{LOW}_Z\text{MED}_V\text{MED}_Q; \]
\[ \text{IHLMM} = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{LOW}_Z + a_1b_4\text{MED}_V + a_4b_4\text{HIGH}_W\text{MED}_V + a_5b_4\text{LOW}_Z\text{MED}_V + a_1b_5\text{MED}_Q + a_4b_5\text{HIGH}_W\text{MED}_Q + a_5b_5\text{LOW}_Z\text{MED}_Q + a_1b_7\text{MED}_V\text{MED}_Q + a_4b_7\text{HIGH}_W\text{MED}_V\text{MED}_Q + a_5b_7\text{LOW}_Z\text{MED}_V\text{MED}_Q; \]
\[ \text{ILMMM} = a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{MED}_Z + a_1b_4\text{MED}_V + a_4b_4\text{LOW}_W\text{MED}_V + a_5b_4\text{MED}_Z\text{MED}_V + a_1b_5\text{MED}_Q + a_4b_5\text{LOW}_W\text{MED}_Q + a_5b_5\text{MED}_Z\text{MED}_Q + a_1b_7\text{MED}_V\text{MED}_Q + a_4b_7\text{LOW}_W\text{MED}_V\text{MED}_Q + a_5b_7\text{MED}_Z\text{MED}_V\text{MED}_Q; \]
\[ \text{IMMMM} = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{MED}_Z + a_1b_4\text{MED}_V + a_4b_4\text{MED}_W\text{MED}_V + a_5b_4\text{MED}_Z\text{MED}_V + a_1b_5\text{MED}_Q + a_4b_5\text{MED}_W\text{MED}_Q + a_5b_5\text{MED}_Z\text{MED}_Q + a_1b_7\text{MED}_V\text{MED}_Q + a_4b_7\text{MED}_W\text{MED}_V\text{MED}_Q + a_5b_7\text{MED}_Z\text{MED}_V\text{MED}_Q; \]

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IHMMM = a₁*b₁ + a₄*b₁*HIGH_W + a₅*b₁*MED_Z + a₁*b₄*MED_V + a₄*b₄*HIGH_W*MED_V + a₅*b₄*MED_Z*MED_V + a₁*b₅*MED_Q + a₄*b₅*HIGH_W*MED_Q + a₁*b₇*MED_V*MED_Q + a₄*b₇*HIGH_W*MED_V*MED_Q + a₅*b₇*MED_Z*MED_V*MED_Q;

ILHMM = a₁*b₁ + a₄*b₁*LOW_W + a₅*b₁*HIGH_Z + a₁*b₄*MED_V + a₄*b₄*LOW_W*MED_V + a₅*b₄*HIGH_Z*MED_V + a₁*b₅*MED_Q + a₄*b₅*LOW_W*MED_Q + a₅*b₅*HIGH_Z*MED_Q + a₁*b₇*MED_V*MED_Q + a₄*b₇*LOW_W*MED_V*MED_Q + a₅*b₇*HIGH_Z*MED_V*MED_Q;

IMHMM = a₁*b₁ + a₄*b₁*MED_W + a₅*b₁*HIGH_Z + a₁*b₄*MED_V + a₄*b₄*MED_W*MED_V + a₅*b₄*HIGH_Z*MED_V + a₁*b₅*MED_Q + a₄*b₅*MED_W*MED_Q + a₅*b₅*HIGH_Z*MED_Q + a₁*b₇*MED_V*MED_Q + a₄*b₇*MED_W*MED_V*MED_Q + a₅*b₇*HIGH_Z*MED_V*MED_Q;

IHHMM = a₁*b₁ + a₄*b₁*HIGH_W + a₅*b₁*HIGH_Z + a₁*b₄*MED_V + a₄*b₄*HIGH_W*MED_V + a₅*b₄*HIGH_Z*MED_V + a₁*b₅*MED_Q + a₄*b₅*HIGH_W*MED_Q + a₅*b₅*HIGH_Z*MED_Q + a₁*b₇*MED_V*MED_Q + a₄*b₇*HIGH_W*MED_V*MED_Q + a₅*b₇*HIGH_Z*MED_V*MED_Q;

ILLHM = a₁*b₁ + a₄*b₁*LOW_W + a₅*b₁*LOW_Z + a₁*b₄*HIGH_V + a₄*b₄*LOW_W*HIGH_V + a₅*b₄*LOW_Z*HIGH_V + a₁*b₅*MED_Q + a₄*b₅*LOW_W*MED_Q + a₅*b₅*LOW_Z*MED_Q + a₁*b₇*HIGH_V*MED_Q + a₄*b₇*LOW_W*HIGH_V*MED_Q + a₅*b₇*LOW_Z*HIGH_V*MED_Q;

IMLHM = a₁*b₁ + a₄*b₁*MED_W + a₅*b₁*LOW_Z + a₁*b₄*HIGH_V + a₄*b₄*MED_W*HIGH_V + a₅*b₄*LOW_Z*HIGH_V + a₁*b₅*MED_Q + a₄*b₅*MED_W*MED_Q + a₅*b₅*LOW_Z*MED_Q + a₁*b₇*HIGH_V*MED_Q + a₄*b₇*MED_W*HIGH_V*MED_Q + a₅*b₇*LOW_Z*HIGH_V*MED_Q;

IHLHM = a₁*b₁ + a₄*b₁*HIGH_W + a₅*b₁*LOW_Z + a₁*b₄*HIGH_V + a₄*b₄*HIGH_W*HIGH_V + a₅*b₄*LOW_Z*HIGH_V + a₁*b₅*MED_Q + a₄*b₅*HIGH_W*MED_Q + a₅*b₅*LOW_Z*MED_Q + a₁*b₇*HIGH_V*MED_Q + a₄*b₇*HIGH_W*HIGH_V*MED_Q + a₅*b₇*LOW_Z*HIGH_V*MED_Q;

ILMHM = a₁*b₁ + a₄*b₁*LOW_W + a₅*b₁*MED_Z + a₁*b₄*HIGH_V + a₄*b₄*LOW_W*HIGH_V + a₅*b₄*MED_Z*HIGH_V + a₁*b₅*MED_Q + a₄*b₅*LOW_W*MED_Q + a₅*b₅*MED_Z*MED_Q;
a1*b7*HIGH_V*MED_Q + a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*MED_Z*HIGH_V*MED_Q; IMMHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*MED_W*HIGH_V*MED_Q + a5*b7*MED_Z*HIGH_V*MED_Q; IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*HIGH_W*HIGH_V*MED_Q + a5*b7*MED_Z*HIGH_V*MED_Q; IMHHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*MED_W*HIGH_V*MED_Q + a5*b7*MED_Z*HIGH_V*MED_Q; IHHHM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + a1*b5*MED_Q + a4*b5*HIGH_W*MED_Q + a5*b5*MED_Z*MED_Q + a1*b7*HIGH_V*MED_Q + a4*b7*MED_W*HIGH_V*MED_Q + a5*b7*MED_Z*HIGH_V*MED_Q; IMLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*LOW_W*HIGH_Q + a5*b5*LOW_Z*MED_Q + a1*b7*LOW_V*MED_Q + a4*b7*LOW_W*LOW_V*MED_Q + a5*b7*MED_Z*LOW_V*MED_Q; IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a1*b7*LOW_V*MED_Q + a4*b7*MED_W*MED_Q + a5*b7*MED_Z*MED_Q; IMLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a1*b7*LOW_V*MED_Q + a4*b7*MED_W*MED_Q + a5*b7*MED_Z*MED_Q; IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*MED_Q + a5*b5*MED_Z*MED_Q + a1*b7*LOW_V*MED_Q + a4*b7*MED_W*MED_Q + a5*b7*MED_Z*MED_Q; IMLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a1*b5*HIGH_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a1*b7*LOW_V*MED_Q + a4*b7*MED_W*MED_Q + a5*b7*MED_Z*MED_Q;
a4*b5*HIGH_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q +
   a1*b7*LOW_V*HIGH_Q +
   a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*LOW_Z*LOW_V*HIGH_Q;
ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*LOW_V +
   a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q +
   a4*b5*LOW_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
   a1*b7*LOW_V*HIGH_Q +
   a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
IMMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V +
   a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q +
   a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
   a1*b7*LOW_V*HIGH_Q +
   a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
IHMLH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*LOW_V +
   a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q +
   a4*b5*HIGH_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
   a1*b7*LOW_V*HIGH_Q +
   a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b4*LOW_V +
   a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
   a4*b5*LOW_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q +
   a1*b7*LOW_V*HIGH_Q +
   a4*b7*LOW_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*LOW_V +
   a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q +
   a4*b5*MED_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
   a1*b7*LOW_V*HIGH_Q +
   a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
IHHLH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b4*LOW_V +
   a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V + a1*b5*HIGH_Q +
   a4*b5*HIGH_W*HIGH_Q + a5*b5*MED_Z*HIGH_Q +
   a1*b7*LOW_V*HIGH_Q +
   a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q;
ILLMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*MED_V +
   a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*HIGH_Q +
   a4*b5*LOW_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q +
   a1*b7*MED_V*HIGH_Q +
   a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q;
IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*MED_V +
   a4*b4*MED_W*MED_V + a5*b4*LOW_Z*MED_V + a1*b5*HIGH_Q +
   a4*b5*MED_W*HIGH_Q + a5*b5*LOW_Z*HIGH_Q +
   a1*b7*MED_V*HIGH_Q +
\[
\begin{align*}
\text{IHLMH} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{MED}_V + a_4 b_4 \text{HIGH}_W \text{MED}_V + a_5 b_4 \text{LOW}_Z \text{MED}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{HIGH}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q + a_1 b_7 \text{MED}_V \text{HIGH}_Q + a_4 b_7 \text{HIGH}_W \text{MED}_V \text{HIGH}_Q + a_5 b_7 \text{LOW}_Z \text{MED}_V \text{HIGH}_Q; \\
\text{ILMMH} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{MED}_V + a_4 b_4 \text{LOW}_W \text{MED}_V + a_5 b_4 \text{MED}_Z \text{MED}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{MED}_V \text{HIGH}_Q + a_4 b_7 \text{LOW}_W \text{MED}_V \text{HIGH}_Q + a_5 b_7 \text{MED}_Z \text{MED}_V \text{HIGH}_Q; \\
\text{IMMMH} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{MED}_V + a_4 b_4 \text{MED}_W \text{MED}_V + a_5 b_4 \text{MED}_Z \text{MED}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{MED}_V \text{HIGH}_Q + a_4 b_7 \text{MED}_W \text{MED}_V \text{HIGH}_Q + a_5 b_7 \text{MED}_Z \text{MED}_V \text{HIGH}_Q; \\
\text{IHMMH} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{MED}_V + a_4 b_4 \text{HIGH}_W \text{MED}_V + a_5 b_4 \text{MED}_Z \text{MED}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{HIGH}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{MED}_V \text{HIGH}_Q + a_4 b_7 \text{HIGH}_W \text{MED}_V \text{HIGH}_Q + a_5 b_7 \text{MED}_Z \text{MED}_V \text{HIGH}_Q; \\
\text{ILHMH} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{HIGH}_V + a_4 b_4 \text{LOW}_W \text{HIGH}_V + a_5 b_4 \text{LOW}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + a_4 b_7 \text{LOW}_W \text{HIGH}_V + a_5 b_7 \text{LOW}_Z \text{HIGH}_V + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q;
\end{align*}
\]
\[ a_4 b_7 \text{LOW}_W \text{HIGH}_V \text{HIGH}_Q + a_5 b_7 \text{LOW}_Z \text{HIGH}_V \text{HIGH}_Q; \]
\[ \text{IMLHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{LOW}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{IHLHH} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{HIGH}_W \text{HIGH}_V + a_5 b_4 \text{LOW}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{ILMHH} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{LOW}_W \text{HIGH}_V + a_5 b_4 \text{MED}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{IMMHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{MED}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{IHMHH} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{HIGH}_W \text{HIGH}_V + a_5 b_4 \text{MED}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{ILHHH} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{LOW}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{HIGH}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{IMHHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{HIGH}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{HIGH}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{IHLHH} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{LOW}_W \text{HIGH}_V + a_5 b_4 \text{LOW}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{LOW}_W \text{HIGH}_Q + a_5 b_5 \text{LOW}_Z \text{HIGH}_Q + a_1 b_7 \text{LOW}_V \text{HIGH}_Q + \]
\[ \text{ILMHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{LOW}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \LOW}_Z \text{HIGH}_Q + a_1 b_7 \text{LOW}_V \text{HIGH}_Q + \]
\[ \text{IMMHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{MED}_W \text{HIGH}_V + a_5 b_4 \text{MED}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{MED}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
\[ \text{IHMHH} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_4 \text{HIGH}_V + \]
\[ a_4 b_4 \text{HIGH}_W \text{HIGH}_V + a_5 b_4 \text{MED}_Z \text{HIGH}_V + a_1 b_5 \text{HIGH}_Q + \]
\[ a_4 b_5 \text{HIGH}_W \text{HIGH}_Q + a_5 b_5 \text{MED}_Z \text{HIGH}_Q + a_1 b_7 \text{HIGH}_V \text{HIGH}_Q + \]
a4*b7*MED_W*HIGH_V*HIGH_Q + a5*b7*HIGH_Z*HIGH_V*HIGH_Q;
IHHHH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b4*HIGH_V
+ a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + a1*b5*HIGH_Q
+ a4*b5*HIGH_W*HIGH_Q + a5*b5*HIGH_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q + a4*b7*HIGH_W*HIGH_V*HIGH_Q + a5*b7*HIGH_Z*HIGH_V*HIGH_Q;

! Calc conditional direct effects for each combination of
moderator values

DLOW_LOZ = cdash1 + cdash4*LOW_W + cdash5*LOW_Z;
DMEW_LOZ = cdash1 + cdash4*MED_W + cdash5*LOW_Z;
DHIW_LOZ = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z;

DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z;
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z;
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z;

DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z;
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z;
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z;

! Calc conditional total effects for each combination of
moderator values

TLLLL = ILLLL + DLOW_LOZ;
TMLLL = IMLLL + DMEW_LOZ;
THLLL = IHLLL + DHIW_LOZ;

TLMLL = ILMML + DLOW_MEZ;
TMMLL = IMMLL + DMEW_MEZ;
THMLL = IHMLL + DHIW_MEZ;

TLHLL = ILHLL + DLOW_HIZ;
TMHLL = IMHLL + DMEW_HIZ;
THHLL = IHHLL + DHIW_HIZ;

TLLML = ILLML + DLOW_LOZ;
TMLML = IMLML + DMEW_LOZ;
THLML = IHLML + DHIW_LOZ;

TLMML = ILMML + DLOW_MEZ;
TMMML = IMMLL + DMEW_MEZ;
THMML = IHMML + DHIW_MEZ;

TLHML = ILHML + DLOW_HIZ;
TMHML = IMHML + DMEW_HIZ;
THHML = IHHML + DHIW_HIZ;
TLLHL = ILLHL + DLOW_LOZ;
TMLHL = IMLHL + DM EW_LOZ;
THLHL = IHLHL + DHIW_LOZ;
TLMHL = ILMHL + DLOW_MEZ;
TMMMHL = IMMHL + DM EW_MEZ;
THMHL = IHMHL + DHIW_MEZ;
TLHHL = ILHHL + DLOW_HIZ;
TMHHL = IMHHL + DM EW_HIZ;
THHHL = IHHHL + DHIW_HIZ;
TLLLM = ILLLM + DLOW_LOZ;
TMLLM = IMLLM + DM EW_LOZ;
THLLM = IMLLM + DHIW_LOZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMLM + DM EW_MEZ;
THMLM = IHMLM + DHIW_MEZ;
TLLLM = ILLLM + DLOW_MEZ;
TMLLM = IMLLM + DM EW_MEZ;
THLLM = ILMLM + DHIW_MEZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMLM + DM EW_MEZ;
THMLM = IHMLM + DHIW_MEZ;
TLLLM = ILLLM + DLOW_MEZ;
TMLLM = IMLLM + DM EW_MEZ;
THLLM = ILMLM + DHIW_MEZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMLM + DM EW_MEZ;
THMLM = IHMLM + DHIW_MEZ;
TLLLM = ILLLM + DLOW_MEZ;
TMLLM = IMLLM + DM EW_MEZ;
THLLM = ILMLM + DHIW_MEZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMLM + DM EW_MEZ;
THMLM = IHMLM + DHIW_MEZ;
TLLLM = ILLLM + DLOW_MEZ;
TMLLM = IMLLM + DM EW_MEZ;
THLLM = ILMLM + DHIW_MEZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMLM + DM EW_MEZ;
THMLM = IHMLM + DHIW_MEZ;
TLLHM = ILLHM + DLOW_LOZ;
TMLHM = IMLHM + DM EW_LOZ;
THLHM = IHLHM + DHIW_LOZ;
TLMHM = ILMHM + DLOW_MEZ;
TMMHM = IMMHM + DM EW_MEZ;
THMHM = IHMHM + DHIW_MEZ;
TLHLM = ILHLM + DLOW_HIZ;
TMHM = IMHLM + DM EW_HIZ;
THHLM = IHHLM + DHIW_HIZ;
TLLHHM = ILLHHM + DLOW_LOZ;
TMLHHM = IMLHHM + DM EW_LOZ;
THLHHM = IHLHHM + DHIW_LOZ;
TLMHHM = ILMHHM + DLOW_MEZ;
TMMHHM = IMMHHM + DM EW_MEZ;
THMHHM = IHMHHM + DHIW_MEZ;
TLHH = ILLHH + DLOW_LOZ;
TMLH = IMLH + DM EW_LOZ;
THL = IHLH + DHIW_LOZ;
TLMH = ILMH + DLOW_MEZ;
TMMH = IMMH + DM EW_MEZ;
THM = IHMH + DHIW_MEZ;
TLH = ILH + DLOW_HIZ;
TMH = IMH + DM EW_HIZ;
TH = IHH + DHIW_HIZ;
TLLM = ILLM + DLOW_LOZ;
TMLM = IMLM + DM EW_LOZ;
THLM = IMLM + DHIW_LOZ;
TLMM = ILMM + DLOW_MEZ;
TMMM = IMM + DM EW_MEZ;
THMM = IHM + DHIW_MEZ;
TLHM = ILM + DLOW_HIZ;
TMHM = IMS + DM EW_HIZ;
THHM = IHH + DHIW_HIZ;
TLLH = ILLH + DLOW_LOZ;
TMLH = IMLH + DM EW_LOZ;
THL = IHLH + DHIW_LOZ;
TLMH = ILMH + DLOW_MEZ;
TMMH = IMMH + DM EW_MEZ;
THM = IHMH + DHIW_MEZ;
TLH = ILH + DLOW_HIZ;
TMH = IMS + DM EW_HIZ;
TH = IHH + DHIW_HIZ;
TLMLH = ILMLH + DLOW_MEZ;
TMMLH = IMMLH + DMEW_MEZ;
THMLH = IHMLH + DHIW_MEZ;
TMLHLH = ILMLH + DLOW_HIZ;
TMHLH = IMHLH + DMEW_HIZ;
THHLH = IHHLH + DHIW_HIZ;
TLLMH = ILLMH + DLOW_LOZ;
TMLMH = IMLMH + DMEW_LOZ;
THLMH = IHLMH + DHIW_LOZ;
TLMMH = ILMMH + DLOW_MEZ;
TMMMH = IMMMH + DMEW_MEZ;
THMMH = IHMMH + DHIW_MEZ;
TLHMH = ILHMH + DLOW_HIZ;
TMHMH = IMHMH + DMEW_HIZ;
THHMH = IHHMH + DHIW_HIZ;
TLLHH = ILLHH + DLOW_LOZ;
TMLHH = IMLHH + DMEW_LOZ;
THLHH = IHLHH + DHIW_LOZ;
TLMHH = ILMHH + DLOW_MEZ;
TMMHH = IMMHH + DMEW_MEZ;
THMHH = IHMHH + DHIW_MEZ;
TLHHH = ILHHH + DLOW_HIZ;
TMHHH = IMHHH + DMEW_HIZ;
THHHH = IHHHH + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y
! for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
! total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! by logical min and max limits of predictor X used in analysis

PLOT(PLLLL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL
PLLML PMLML PHML PLML MLML PHML MLML PLML PMML PHML PLHML PMHML PHHML
PLLHL PMLHL PHHL PLHL HLHL PHHL HLHL PLHL PMHL PHHL PLHHL PMHHL PHHHL
PLLHM PMLHM PHLM PLHM HMHM PHLM HMHM PLHM PMHM PHHM PLHMH PMHMH PHHHM
PLLHH PMLHH PHLH PLHH HHHH PHLH HHHH PLHH PMHH PHHH PHHHH)

LOOP(XVAL,1,5,0.1);
PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;

PLL = ILLL*XVAL;
PML = IMLL*XVAL;
PHL = IHLLL*XVAL;

PLM = ILMLL*XVAL;
PMM = IMMLL*XVAL;
PHM = IHMLL*XVAL;
PLMMM = ILMMM*XVAL;
PMMMM = IMMMM*XVAL;
PHHMM = IHMMM*XVAL;
PLHMM = ILHMM*XVAL;
PMHMM = IMHMM*XVAL;
PHHMM = IHHMM*XVAL;
PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLH = IHLH*XVAL;
PLMM = ILMM*XVAL;
PMM = IMMM*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
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PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
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PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL:
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PML = IML*XVAL;
PLM = ILM*XVAL;
PMM = IMMM*XVAL;
PMH = IMH*XVAL;
PHH = IHH*XVAL;
PLL = ILL*XVAL;
PML = IML*XVAL;
PLHHH = ILHHH*XVAL;
PMHHH = IMHHH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 54: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[
Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ
\]

\[
M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ
\]

Algebra to calculate indirect and/or conditional effects by writing model as \(Y = a + bX\):

\[
Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ
\]

\[
M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ
\]

Hence... substituting in equation for M

\[
Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)V + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)Q + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)VQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ
\]
Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_0b_2V + a_1b_2V + a_2b_2WV + a_3b_2ZV + a_4b_2XWV + a_5b_2XZV + a_0b_3Q + a_1b_3Q + a_2b_3WQ + a_3b_3ZQ + a_4b_3XWQ + a_5b_3XZQ + a_0b_4VQ + a_1b_4YQ + a_2b_4WVQ + a_3b_4ZVQ + a_4b_4XWVQ + a_5b_4XZVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + a_0b_2V + a_2b_2WV + a_3b_2ZV + a_0b_3Q + a_2b_3WQ + a_3b_3ZQ + a_0b_4VQ + a_2b_4WVQ + a_3b_4ZVQ + c_2'V + c_3'Q + c_6'VQ) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_1b_2V + a_4b_2WV + a_5b_2ZV + a_1b_3Q + a_4b_3WQ + a_5b_3ZQ + a_1b_4VQ + a_4b_4WVQ + a_5b_4ZVQ + c_1' + c_4'V + c_5'Q + c_7'VQ)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V, Q \):

\[ a_1b_1 + a_4b_1W + a_5b_1Z + a_1b_2V + a_4b_2WV + a_5b_2ZV + a_1b_3Q + a_4b_3WQ + a_5b_3ZQ + a_1b_4VQ + a_4b_4WVQ + a_5b_4ZVQ = (a_1 + a_4W + a_5Z)(b_1 + b_2V + b_3Q + b_4VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( V, Q \):

\[ c_1' + c_4'V + c_5'Q + c_7'VQ \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y
USEVARIABLES = X M W Z V Q Y XW XZ XV XQ VQ MV MQ XVQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
MQ = M*Q;
MV = M*V;
XW = X*W;
XZ = X*Z;
XQ = X*Q;
 XV = X*V;
VQ = V*Q;
```

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MVQ = M*V*Q;
XVQ = X*V*Q;

**ANALYSIS:**

TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

**MODEL:**

[Y] (b0);
Y ON M (b1);
Y ON MV (b2);
Y ON MQ (b3);
Y ON MVQ (b4);
Y ON X (cdash1);
Y ON V (cdash2);
Y ON Q (cdash3);
Y ON XV (cdash4);
Y ON XQ (cdash5);
Y ON VQ (cdash6);
Y ON XVQ (cdash7);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean

! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

**MODEL CONSTRAINT:**

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
ILLLL IMLLL IHLLL ILMLL IMLML IHLLL ILHLL IMHLL IHHLL IlLLL IMLML IHLML ILMMML IMMMML IHMLML IHHML IHHML IMLHL IHLHL ILMHL IMMMHL IMHML IHHML IHHHL IHHHL
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z

LOW_V = #LOWV;  ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;  ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values
\[ \begin{align*}
\text{ILLLL} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{LOW}_W \text{LOW}_V + a_5 b_2 \text{LOW}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{LOW}_W \text{LOW}_Q + a_5 b_3 \text{LOW}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{LOW}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{LOW}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{IMLLL} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{MED}_W \text{LOW}_V + a_5 b_2 \text{LOW}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{MED}_W \text{LOW}_Q + a_5 b_3 \text{LOW}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{MED}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{MED}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{IHLLL} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{HIGH}_W \text{LOW}_V + a_5 b_2 \text{LOW}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{HIGH}_W \text{LOW}_Q + a_5 b_3 \text{LOW}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{HIGH}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{HIGH}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{ILMLL} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{LOW}_W \text{LOW}_V + a_5 b_2 \text{MED}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{LOW}_W \text{LOW}_Q + a_5 b_3 \text{MED}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{LOW}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{MED}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{IMMLL} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{MED}_W \text{LOW}_V + a_5 b_2 \text{MED}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{MED}_W \text{LOW}_Q + a_5 b_3 \text{MED}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{MED}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{MED}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{IHMLL} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{HIGH}_W \text{LOW}_V + a_5 b_2 \text{MED}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{HIGH}_W \text{LOW}_Q + a_5 b_3 \text{MED}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{HIGH}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{MED}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{ILHLL} &= a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{LOW}_W \text{LOW}_V + a_5 b_2 \text{HIGH}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{LOW}_W \text{LOW}_Q + a_5 b_3 \text{HIGH}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{LOW}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{HIGH}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{IMHLL} &= a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{MED}_W \text{LOW}_V + a_5 b_2 \text{HIGH}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{MED}_W \text{LOW}_Q + a_5 b_3 \text{HIGH}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{MED}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{HIGH}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

\[ \begin{align*}
\text{IHHLL} &= a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_2 \text{LOW}_V + \\
&\quad a_4 b_2 \text{HIGH}_W \text{LOW}_V + a_5 b_2 \text{HIGH}_Z \text{LOW}_V + a_1 b_3 \text{LOW}_Q + \\
&\quad a_4 b_3 \text{HIGH}_W \text{LOW}_Q + a_5 b_3 \text{HIGH}_Z \text{LOW}_Q + a_1 b_4 \text{LOW}_V \text{LOW}_Q + \\
&\quad a_4 b_4 \text{HIGH}_W \text{LOW}_V \text{LOW}_Q + a_5 b_4 \text{HIGH}_Z \text{LOW}_V \text{LOW}_Q;
\end{align*} \]

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\[ a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q + \\
a1*b4*LOW_V*LOW_Q + a4*b4*HIGH_W*LOW_V*LOW_Q + a5*b4*HIGH_Z*LOW_V*LOW_Q; \]

\[ ILLML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q; \]

\[ IMLML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q; \]

\[ IHLML = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*HIGH_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q; \]

\[ ILMML = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q; \]

\[ IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q; \]

\[ IHHML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*HIGH_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q; \]

\[ ILHML = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*HIGH_Z*MED_V*LOW_Q; \]

\[ IMHML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q; \]
a1*b4*MED_V*LOW_Q + a4*b4*MED_W*MED_V*LOW_Q + a5*b4*HIGH_Z*MED_V*LOW_Q;
IHHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_W*MED_V*LOW_Q + a5*b4*HIGH_Z*MED_V*LOW_Q;
ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q;
IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*MED_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q;
IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*HIGH_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q;
ILMHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*MED_Z*HIGH_V*LOW_Q;
IMMHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*MED_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q;
IHMHL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*HIGH_W*HIGH_V*LOW_Q + a5*b4*MED_Z*HIGH_V*LOW_Q;
ILHHL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*MED_Z*HIGH_V*LOW_Q;
a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*LOW_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*HIGH_Z*HIGH_V*LOW_Q;
IMHHL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*HIGH_V +
a4*b2*MED_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*HIGH_Z*HIGH_V*LOW_Q;
IHHHL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*HIGH_V +
a4*b2*HIGH_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*HIGH_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*HIGH_W*HIGH_V*LOW_Q + a5*b4*HIGH_Z*HIGH_V*LOW_Q;
IMLLM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*MED_Q +
a4*b3*LOW_W*MED_Q + a5*b3*LOW_Z*MED_Q + a1*b4*LOW_V*MED_Q +
a4*b4*LOW_W*LOW_V*MED_Q + a5*b4*LOW_Z*LOW_V*MED_Q;
IMMLM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q + a5*b3*LOW_Z*MED_Q + a1*b4*LOW_V*MED_Q +
a4*b4*MED_W*LOW_V*MED_Q + a5*b4*LOW_Z*LOW_V*MED_Q;
ILMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q +
a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*MED_Q + a1*b4*LOW_V*MED_Q +
a4*b4*LOW_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q;
ILMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a1*b4*LOW_V*MED_Q +
a4*b4*MED_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q;
IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q + a1*b4*LOW_V*MED_Q +
a4*b4*HIGH_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q;
IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*LOW_V +
a4*b2*HIGH_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q + a1*b4*LOW_V*MED_Q +
a4*b4*HIGH_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q;
\[ a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q + \\
   a1*b4*LOW_V*MED_Q + \\
   a4*b4*HIGH_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q; \\
\]
\[ ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_V + \\
   a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*MED_Q + \\
   a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q + \\
   a1*b4*LOW_V*MED_Q + \\
   a4*b4*LOW_W*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q; \\
\]
\[ IMHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_V + \\
   a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*MED_Q + \\
   a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q + \\
   a1*b4*LOW_V*MED_Q + \\
   a4*b4*LOW_W*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q; \\
\]
\[ IHHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_V + \\
   a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*MED_Q + \\
   a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q + \\
   a1*b4*LOW_V*MED_Q + \\
   a4*b4*LOW_W*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q; \\
\]
\[ ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*MED_V + \\
   a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*MED_Q + \\
   a4*b3*LOW_W*MED_Q + a5*b3*LOW_Z*MED_Q + a1*b4*MED_V*MED_Q + \\
   a4*b4*LOW_W*MED_V*MED_Q + a5*b4*LOW_Z*MED_V*MED_Q; \\
\]
\[ IMLMM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_V + \\
   a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_Q + \\
   a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a1*b4*MED_V*MED_Q + \\
   a4*b4*MED_W*MED_V*MED_Q + a5*b4*LOW_Z*MED_V*MED_Q; \\
\]
\[ IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*MED_V + \\
   a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a1*b3*MED_Q + \\
   a4*b3*HIGH_W*MED_Q + a5*b3*LOW_Z*MED_Q + a1*b4*MED_V*MED_Q + \\
   a4*b4*HIGH_W*MED_V*MED_Q + a5*b4*LOW_Z*MED_V*MED_Q; \\
\]
\[ ILMMM = a1*b1 + a4*b1*MED_Z + a5*b1*MED_Z + a1*b2*MED_V + \\
   a4*b2*MED_Z*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_Q + \\
   a4*b3*MED_Z*MED_Q + a5*b3*MED_Z*MED_Q + a1*b4*MED_V*MED_Q + \\
   a4*b4*MED_Z*MED_V*MED_Q + a5*b4*MED_Z*MED_V*MED_Q; \\
\]
\[ IMMNM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_V + \\
   a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*MED_Q + \\
   a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a1*b4*MED_V*MED_Q + \\
   a4*b4*MED_W*MED_V*MED_Q + a5*b4*MED_Z*MED_V*MED_Q; \\
\]
\[ 535 \]
\[ a_4 b_4 \text{MED}_W \text{MED}_V \text{MED}_Q + a_5 b_4 \text{MED}_Z \text{MED}_V \text{MED}_Q; \]
\[ \text{IHM MMM} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{MED}_Z + a_1 b_2 \text{MED}_V + \]
\[ a_4 b_2 \text{HIGH}_W \text{MED}_V + a_5 b_2 \text{MED}_Z \text{MED}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{HIGH}_W \text{MED}_Q + a_5 b_3 \text{MED}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{MED}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{HIGH}_W \text{MED}_V \text{MED}_Q + a_5 b_4 \text{MED}_Z \text{MED}_V \text{MED}_Q; \]
\[ \text{ILHMM} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_2 \text{MED}_V + \]
\[ a_4 b_2 \text{LOW}_W \text{MED}_V + a_5 b_2 \text{HIGH}_Z \text{MED}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{LOW}_W \text{MED}_Q + a_5 b_3 \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{MED}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{LOW}_W \text{MED}_V \text{MED}_Q + a_5 b_4 \text{HIGH}_Z \text{MED}_V \text{MED}_Q; \]
\[ \text{IMHMM} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_2 \text{MED}_V + \]
\[ a_4 b_2 \text{MED}_W \text{MED}_V + a_5 b_2 \text{HIGH}_Z \text{MED}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{MED}_W \text{MED}_Q + a_5 b_3 \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{MED}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{MED}_W \text{MED}_V \text{MED}_Q + a_5 b_4 \text{HIGH}_Z \text{MED}_V \text{MED}_Q; \]
\[ \text{IHHMM} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{HIGH}_Z + a_1 b_2 \text{MED}_V + \]
\[ a_4 b_2 \text{HIGH}_W \text{MED}_V + a_5 b_2 \text{HIGH}_Z \text{MED}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{HIGH}_W \text{MED}_Q + a_5 b_3 \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{MED}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{HIGH}_W \text{MED}_V \text{MED}_Q + a_5 b_4 \text{HIGH}_Z \text{MED}_V \text{MED}_Q; \]
\[ \text{ILLHM} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + \]
\[ a_4 b_2 \text{LOW}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{LOW}_W \text{MED}_Q + a_5 b_3 \text{LOW}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{LOW}_W \text{HIGH}_V \text{MED}_Q + a_5 b_4 \text{LOW}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IMLHM} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + \]
\[ a_4 b_2 \text{MED}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{MED}_W \text{MED}_Q + a_5 b_3 \text{LOW}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{MED}_W \text{HIGH}_V \text{MED}_Q + a_5 b_4 \text{LOW}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IHLHM} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + \]
\[ a_4 b_2 \text{HIGH}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{HIGH}_W \text{MED}_Q + a_5 b_3 \text{LOW}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{HIGH}_W \text{HIGH}_V \text{MED}_Q + a_5 b_4 \text{LOW}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{ILMHM} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_1 b_2 \text{HIGH}_V + \]
\[ a_4 b_2 \text{LOW}_W \text{HIGH}_V + a_5 b_2 \text{MED}_Z \text{HIGH}_V + a_1 b_3 \text{MED}_Q + \]
\[ a_4 b_3 \text{LOW}_W \text{MED}_Q + a_5 b_3 \text{MED}_Z \text{MED}_Q + \]
\[ a_1 b_4 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4 b_4 \text{HIGH}_W \text{HIGH}_V \text{MED}_Q + a_5 b_4 \text{LOW}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{536} \]
a4*b3*LOW_W*MED_Q + a5*b3*MED_Z*MED_Q + 
a1*b4*HIGH_V*MED_Q +
  a4*b4*LOW_W*HIGH_V*MED_Q + a5*b4*MED_Z*HIGH_V*MED_Q;
IMMHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*HIGH_V +
  a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*HIGH_W*HIGH_V*MED_Q + a5*b4*MED_Z*HIGH_V*MED_Q;
IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_V +
  a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*HIGH_W*HIGH_V*MED_Q + a5*b4*MED_Z*HIGH_V*MED_Q;
IMHMH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*HIGH_V +
  a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*LOW_W*HIGH_V*MED_Q + a5*b4*HIGH_Z*HIGH_V*MED_Q;
IMLLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V +
  a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q;
IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
  a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q;
IHLLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*LOW_V +
  a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*HIGH_W*MED_Q + a5*b3*HIGH_Z*MED_Q +
a1*b4*LOW_V*HIGH_Q +
  a4*b4*MED_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q;
IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
  a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q +
IHMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*HIGH_V +
  a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a1*b3*MED_Q +
  a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q +
  a1*b4*HIGH_V*MED_Q +
  a4*b4*LOW_W*HIGH_V*MED_Q + a5*b4*LOW_Z*HIGH_V*MED_Q;
IMHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_V +
    a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*MED_Q +
    a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q +
    a1*b4*HIGH_V*MED_Q +
    a4*b4*HIGH_W*HIGH_V*MED_Q + a5*b4*MED_Z*HIGH_V*MED_Q;
IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_V +
    a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a1*b3*MED_Q +
    a4*b3*HIGH_W*MED_Q + a5*b3*MED_Z*MED_Q +
    a1*b4*HIGH_V*MED_Q +
    a4*b4*HIGH_W*HIGH_V*MED_Q + a5*b4*MED_Z*HIGH_V*MED_Q;
IHMMH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*HIGH_V +
    a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a1*b3*MED_Q +
    a4*b3*LOW_W*MED_Q + a5*b3*HIGH_Z*MED_Q +
    a1*b4*HIGH_V*MED_Q +
    a4*b4*LOW_W*HIGH_V*MED_Q + a5*b4*HIGH_Z*HIGH_V*MED_Q;
IHLLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V +
    a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*HIGH_Q +
    a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q +
    a1*b4*LOW_V*HIGH_Q +
    a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q;
IHMHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_V +
    a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*HIGH_Q +
    a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q +
    a1*b4*LOW_V*HIGH_Q +
    a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q;
IHLLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*LOW_V +
    a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
    a4*b3*HIGH_W*MED_Q + a5*b3*HIGH_Z*MED_Q +
    a1*b4*LOW_V*HIGH_Q +
    a4*b4*MED_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q;
IHMHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*LOW_V +
    a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*MED_Q +
    a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q +
    a1*b4*LOW_V*MED_Q +
    a4*b4*MED_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q;
a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*HIGH_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q + a1*b4*LOW_V*HIGH_Q + a4*b4*HIGH_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q;

ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a1*b4*LOW_V*HIGH_Q + a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q;

IMMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*HIGH_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a1*b4*LOW_V*HIGH_Q + a4*b4*MED_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q;

IHMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*LOW_V + a4*b3*LOW_W*MED_V + a5*b3*MED_Z*LOW_V + a1*b4*MED_V*LOW_V*HIGH_Q + a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q;

ILLMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a1*b3*LOW_V + a4*b3*MED_W*MED_V + a5*b3*MED_Z*LOW_V + a1*b4*MED_V*MED_V*HIGH_Q + a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q;

ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a1*b4*LOW_V*HIGH_Q + a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q;

ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a1*b4*LOW_V*HIGH_Q + a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q;

ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a1*b4*LOW_V*HIGH_Q + a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q;
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{MED}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{LOW}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{IHLMH} = a_1b_1 + a_4b_1*\text{HIGH}_W + a_5b_1*\text{LOW}_Z + a_1b_2*\text{MED}_V + \]
\[ a_4b_2*\text{HIGH}_W*\text{MED}_V + a_5b_2*\text{LOW}_Z*\text{MED}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{HIGH}_W*\text{HIGH}_Q + a_5b_3*\text{LOW}_Z*\text{HIGH}_Q + \]
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{HIGH}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{LOW}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{ILMMH} = a_1b_1 + a_4b_1*\text{LOW}_W + a_5b_1*\text{MED}_Z + a_1b_2*\text{MED}_V + \]
\[ a_4b_2*\text{LOW}_W*\text{MED}_V + a_5b_2*\text{MED}_Z*\text{MED}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{LOW}_W*\text{HIGH}_Q + a_5b_3*\text{MED}_Z*\text{HIGH}_Q + \]
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{LOW}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{MED}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{IMMMH} = a_1b_1 + a_4b_1*\text{MED}_W + a_5b_1*\text{MED}_Z + a_1b_2*\text{MED}_V + \]
\[ a_4b_2*\text{MED}_W*\text{MED}_V + a_5b_2*\text{MED}_Z*\text{MED}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{MED}_W*\text{HIGH}_Q + a_5b_3*\text{MED}_Z*\text{HIGH}_Q + \]
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{MED}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{MED}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{IHMHH} = a_1b_1 + a_4b_1*\text{HIGH}_W + a_5b_1*\text{MED}_Z + a_1b_2*\text{MED}_V + \]
\[ a_4b_2*\text{HIGH}_W*\text{MED}_V + a_5b_2*\text{MED}_Z*\text{MED}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{HIGH}_W*\text{HIGH}_Q + a_5b_3*\text{MED}_Z*\text{HIGH}_Q + \]
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{MED}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{MED}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{ILHHH} = a_1b_1 + a_4b_1*\text{LOW}_W + a_5b_1*\text{HIGH}_Z + a_1b_2*\text{MED}_V + \]
\[ a_4b_2*\text{LOW}_W*\text{MED}_V + a_5b_2*\text{HIGH}_Z*\text{MED}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{LOW}_W*\text{HIGH}_Q + a_5b_3*\text{HIGH}_Z*\text{HIGH}_Q + \]
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{MED}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{HIGH}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{IMHHH} = a_1b_1 + a_4b_1*\text{MED}_W + a_5b_1*\text{HIGH}_Z + a_1b_2*\text{MED}_V + \]
\[ a_4b_2*\text{MED}_W*\text{MED}_V + a_5b_2*\text{HIGH}_Z*\text{MED}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{MED}_W*\text{HIGH}_Q + a_5b_3*\text{HIGH}_Z*\text{HIGH}_Q + \]
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{MED}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{HIGH}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{IHHHH} = a_1b_1 + a_4b_1*\text{HIGH}_W + a_5b_1*\text{HIGH}_Z + a_1b_2*\text{MED}_V + \]
\[ a_4b_2*\text{HIGH}_W*\text{MED}_V + a_5b_2*\text{HIGH}_Z*\text{MED}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{HIGH}_W*\text{HIGH}_Q + a_5b_3*\text{HIGH}_Z*\text{HIGH}_Q + \]
\[ a_1b_4*\text{MED}_V*\text{HIGH}_Q + \]
\[ a_4b_4*\text{MED}_W*\text{MED}_V*\text{HIGH}_Q + a_5b_4*\text{HIGH}_Z*\text{MED}_V*\text{HIGH}_Q; \]
\[ \text{ILLHH} = a_1b_1 + a_4b_1*\text{LOW}_W + a_5b_1*\text{LOW}_Z + a_1b_2*\text{HIGH}_V + \]
\[ a_4b_2*\text{LOW}_W*\text{HIGH}_V + a_5b_2*\text{LOW}_Z*\text{HIGH}_V + a_1b_3*\text{HIGH}_Q + \]
\[ a_4b_3*\text{LOW}_W*\text{HIGH}_Q + a_5b_3*\text{LOW}_Z*\text{HIGH}_Q + \]
\[ a_1 b_4 \text{HIGH}_V \text{HIGH}_Q + a_4 b_4 \text{LOW}_W \text{HIGH}_V \text{HIGH}_Q + a_5 b_4 \text{LOW}_Z \text{HIGH}_V \text{HIGH}_Q; \]
\[ \text{IMLHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{MED}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{MED}_W \text{HIGH}_Q + a_5 b_3 \text{LOW}_Z \text{HIGH}_Q + a_1 b_4 \text{HIGH}_V \text{HIGH}_Q; \]
\[ a_4 b_2 \text{MED}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{MED}_W \text{HIGH}_Q + a_5 b_3 \text{LOW}_Z \text{HIGH}_Q; \]
\[ \text{IHLHH} = a_1 b_1 + a_4 b_1 \text{HIGH}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{HIGH}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{HIGH}_W \text{HIGH}_Q + a_5 b_3 \text{LOW}_Z \text{HIGH}_Q + a_1 b_4 \text{HIGH}_V \text{HIGH}_Q; \]
\[ a_4 b_2 \text{HIGH}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q; \]
\[ \text{IMLHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{LOW}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{MED}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{MED}_W \text{HIGH}_Q + a_5 b_3 \text{LOW}_Z \text{HIGH}_Q + a_1 b_4 \text{HIGH}_V \text{HIGH}_Q; \]
\[ a_4 b_2 \text{LOW}_W \text{HIGH}_V + a_5 b_2 \text{LOW}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q; \]
\[ \text{IHMHH} = a_1 b_1 + a_4 b_1 \text{MED}_W + a_5 b_1 \text{MED}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{MED}_W \text{HIGH}_V + a_5 b_2 \text{MED}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{MED}_W \text{HIGH}_Q + a_5 b_3 \text{MED}_Z \text{HIGH}_Q + a_1 b_4 \text{HIGH}_V \text{HIGH}_Q; \]
\[ a_4 b_2 \text{HIGH}_W \text{HIGH}_V + a_5 b_2 \text{MED}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q; \]
\[ \text{ILHHH} = a_1 b_1 + a_4 b_1 \text{LOW}_W + a_5 b_1 \text{MED}_Z + a_1 b_2 \text{HIGH}_V + a_4 b_2 \text{LOW}_W \text{HIGH}_V + a_5 b_2 \text{MED}_Z \text{HIGH}_V + a_1 b_3 \text{HIGH}_Q + a_4 b_3 \text{LOW}_W \text{HIGH}_Q + a_5 b_3 \text{MED}_Z \text{HIGH}_Q + a_1 b_4 \text{HIGH}_V \text{HIGH}_Q; \]
\[ a_1b_4*HIGH_V*HIGH_Q + a_4b_4*MED_W*HIGH_V*HIGH_Q + a_5b_4*HIGH_Z*HIGH_V*HIGH_Q; \]
\[ IHHHH = a_1b_1 + a_4b_1*HIGH_W + a_5b_1*HIGH_Z + a_1b_2*HIGH_V + a_4b_2*HIGH_W*HIGH_V + a_5b_2*HIGH_Z*HIGH_V + a_1b_3*HIGH_Q + a_4b_3*HIGH_W*HIGH_Q + a_5b_3*HIGH_Z*HIGH_Q + a_1b_4*HIGH_V*HIGH_Q + a_4b_4*HIGH_W*HIGH_V*HIGH_Q + a_5b_4*HIGH_Z*HIGH_V*HIGH_Q; \]

! Calc conditional direct effects for each combination of moderator values

\[ DLOV_LOQ = cdash_1 + cdash_4*LOW_V + cdash_5*LOW_Q + cdash_7*LOW_V*LOW_Q; \]
\[ DMEV_LOQ = cdash_1 + cdash_4*MED_W + cdash_5*LOW_Q + cdash_7*MED_W*LOW_Q; \]
\[ DHIV_LOQ = cdash_1 + cdash_4*HIGH_V + cdash_5*LOW_Q + cdash_7*HIGH_V*LOW_Q; \]
\[ DLOV_MEQ = cdash_1 + cdash_4*LOW_V + cdash_5*MED_Q + cdash_7*LOW_V*MED_Q; \]
\[ DMEV_MEQ = cdash_1 + cdash_4*MED_W + cdash_5*MED_Q + cdash_7*MED_W*MED_Q; \]
\[ DHIV_MEQ = cdash_1 + cdash_4*HIGH_V + cdash_5*MED_Q + cdash_7*HIGH_V*MED_Q; \]
\[ DLOV_HIQ = cdash_1 + cdash_4*LOW_V + cdash_5*HIGH_Q + cdash_7*LOW_V*HIGH_Q; \]
\[ DMEV_HIQ = cdash_1 + cdash_4*MED_W + cdash_5*HIGH_Q + cdash_7*MED_W*HIGH_Q; \]
\[ DHIV_HIQ = cdash_1 + cdash_4*HIGH_V + cdash_5*HIGH_Q + cdash_7*HIGH_V*HIGH_Q; \]

! Calc conditional total effects for each combination of moderator values

\[ TLLLL = ILLLL + DLOV_LOQ; \]
\[ TMLLL = IMLLL + DLOV_LOQ; \]
\[ THLLL = IHLLL + DLOV_LOQ; \]
\[ TLMLL = ILMLL + DLOV_LOQ; \]
\[ TMMLL = IMMLL + DLOV_LOQ; \]
\[ THMLL = IHMLL + DLOV_LOQ; \]
\[ TLHLL = ILHLL + DLOV_LOQ; \]
\[ TMHLL = IMHLL + DLOV_LOQ; \]
\[ THHLL = IHHLL + DLOV_LOQ; \]
\[ \text{TLLML} = \text{ILLML} + \text{DMEV\_LOQ}; \]
\[ \text{TMLML} = \text{IMLML} + \text{DMEV\_LOQ}; \]
\[ \text{THLML} = \text{IHLML} + \text{DMEV\_LOQ}; \]
\[ \text{TLMMML} = \text{ILMML} + \text{DMEV\_LOQ}; \]
\[ \text{TMMML} = \text{IMMML} + \text{DMEV\_LOQ}; \]
\[ \text{THHML} = \text{IHHML} + \text{DMEV\_LOQ}; \]
\[ \text{TLLHL} = \text{ILLHL} + \text{DHIV\_LOQ}; \]
\[ \text{TMLHL} = \text{IMLHL} + \text{DHIV\_LOQ}; \]
\[ \text{THLHL} = \text{IHLHL} + \text{DHIV\_LOQ}; \]
\[ \text{TLHHL} = \text{ILHHL} + \text{DHIV\_LOQ}; \]
\[ \text{TMHHL} = \text{IMHHL} + \text{DHIV\_LOQ}; \]
\[ \text{THHHL} = \text{IHHHL} + \text{DHIV\_LOQ}; \]
\[ \text{TLLLM} = \text{ILLLM} + \text{DLOV\_MEQ}; \]
\[ \text{TMLLM} = \text{IMLLM} + \text{DLOV\_MEQ}; \]
\[ \text{THLLM} = \text{IHLLM} + \text{DLOV\_MEQ}; \]
\[ \text{TLMLM} = \text{ILMLM} + \text{DLOV\_MEQ}; \]
\[ \text{TMLLM} = \text{IMMLM} + \text{DLOV\_MEQ}; \]
\[ \text{THMLM} = \text{IHMLM} + \text{DLOV\_MEQ}; \]
\[ \text{TLHLM} = \text{ILHLM} + \text{DM\_EV\_MEQ}; \]
\[ \text{TMHLM} = \text{IMHLM} + \text{DM\_EV\_MEQ}; \]
\[ \text{THHLM} = \text{IHHLM} + \text{DM\_EV\_MEQ}; \]
\[ \text{TLLHM} = \text{ILLHM} + \text{DHIV\_MEQ}; \]
\[ \text{TMLHM} = \text{IMLHM} + \text{DHIV\_MEQ}; \]
\[ \text{THLHM} = \text{IHLHM} + \text{DHIV\_MEQ}; \]
TLMHM = ILMHM + DHIV_MEQ;
TMMHM = IMMHM + DHIV_MEQ;
THMMH = IHMMH + DHIV_MEQ;
TLHMM = ILHMM + DHIV_MEQ;
TMHMM = IMHMM + DHIV_MEQ;
THHMM = IHHMM + DHIV_MEQ;
TLLLH = ILLLH + DLOV_HIQ;
TMLLH = IMLLH + DLOV_HIQ;
THLLH = IHLLH + DLOV_HIQ;
TLMLH = ILMLH + DLOV_HIQ;
TMMLH = IMMLH + DLOV_HIQ;
THMLH = IHMLH + DLOV_HIQ;
TLHLH = ILHLH + DLOV_HIQ;
TMHLH = IMHLH + DLOV_HIQ;
THHLH = IHHLH + DLOV_HIQ;
TLLLH = ILLLH + DMEV_HIQ;
TMLLH = IMLLH + DMEV_HIQ;
THLLH = IHLLH + DMEV_HIQ;
TLMLH = ILMLH + DMEV_HIQ;
TMMLH = IMMLH + DMEV_HIQ;
THMLH = IHMLH + DMEV_HIQ;
TLHLH = ILHLH + DMEV_HIQ;
TMHLH = IMHLH + DMEV_HIQ;
THHLH = IHHLH + DMEV_HIQ;
TLLMH = ILLMH + DHIV_HIQ;
TMLMH = IMLMH + DHIV_HIQ;
THLMH = IHLMH + DHIV_HIQ;
TLMHH = ILMHH + DHIV_HIQ;
TMMHH = IMMHH + DHIV_HIQ;
THMHH = IHMHH + DHIV_HIQ;
TLLHH = ILLHH + DLOV_HIQ;
TMLHH = IMLHH + DLOV_HIQ;
THLHH = IHLHH + DLOV_HIQ;
TLMHH = ILMHH + DLOV_HIQ;
TMMHH = IMMHH + DLOV_HIQ;
THMHH = IHMHH + DLOV_HIQ;
TLLLH = ILLLH + DMEV_HIQ;
TMLMH = IMLMH + DMEV_HIQ;
THLMH = IHLMH + DMEV_HIQ;
TLMHH = ILMHH + DMEV_HIQ;
TMMHH = IMMHH + DMEV_HIQ;
THMHH = IHMHH + DMEV_HIQ;
TLLHH = ILLHH + DHIV_HIQ;
TMLHH = IMLHH + DHIV_HIQ;
THLHH = IHLHH + DHIV_HIQ;
TLMHH = ILMHH + DHIV_HIQ;
TMMHH = IMMHH + DHIV_HIQ;
THMHH = IHMHH + DHIV_HIQ;
TLHHH = ILLHH + DHIV_HIQ;
TMHHH = IMMHH + DHIV_HIQ;
THHHH = IHHHH + DHIV_HIQ;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by
! logical min and max limits of predictor X used in analysis
PLOT(PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL, PLL,
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PHHLM = IHHLM*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
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PLMMM = ILMMM*XVAL;
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PLLHM = ILLHM*XVAL;
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PHLMH = IMLMH*XVAL;
PLHMH = ILHMH*XVAL;
PMHMH = IMHMH*XVAL;
PHHMH = IHHMH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PHLHH = IHLHH*XVAL;
PLMHH = ILMHH*XVAL;
PMMHH = IMMHH*XVAL;
PHMHH = IHMHH*XVAL;
PLHHH = ILHHH*XVAL;
PMHHH = IMHHH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 55: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating the Mediator-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3Q + b_4MV + b_5MQ + b_6VQ + b_7MVQ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2V + b_3Q + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + b_5(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)Q + b_6VQ + b_7(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)Q + b_8(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)Q + \cdots \]
\[ a3Z + a4XW + a5XZ + a6WZ + a7XWZ) VQ + c1'X + c2'W + c3'Z + c4'XW + c5'XZ + c6'WZ + c7'XWZ \]

Hence... multiplying out brackets

\[ Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + a6b1WZ + a7b1XWZ + b2V + b3Q + a0b4V + a1b4XV + a2b4WV + a3b4XWV + a4b4XZWV + a5b4XZWV + a6b4XZWV + a7b4XZWV + b0VQ + b1QV + b2VQ + b3QV + a0b5VQ + a1b5XVQ + a2b5WXVQ + a3b5WXVQ + a4b5WXVQ + a5b5WXVQ + a6b5WXVQ + a7b5WXVQ + a0b6VQ + a1b6XVQ + a2b6WXVQ + a3b6WXVQ + a4b6WXVQ + a5b6WXVQ + a6b6WXVQ + a7b6WXVQ + b0VQ + b1QV + b2VQ + b3QV \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b0 + a0b1 + a2b1W + a3b1Z + a6b1WZ + b2V + b3Q + a0b4V + a2b4WV + a3b4ZV + a6b4WZV + a0b5Q + a2b5QV + a3b5QV + b0VQ + b2VQ + b3QV + a0b6VQ + a2b6VQ + a3b6VQ + a6b6VQ + b0VQ + b2VQ + b3QV + a0b7VQ + a2b7VQ + a3b7VQ + a6b7VQ + a0b5Q + a2b5QV + a3b5QV + b0VQ + b2VQ + b3QV + a0b7VQ + a2b7VQ + a3b7VQ + a6b7VQ + c1' + c2'W + c3'Z + c4'XW + c5'XZ + c6'WZ + c7'XWZ \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z, V, Q \):

\[ a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b4V + a4b4WV + a5b4ZV + a7b4WZV + a1b5Q + a4b5WQ + a5b5QZ + a7b5WZQ + a1b7VQ + a4b7WVQ + a5b7WZVQ + a7b7WZVQ = (a1 + a4W + a5Z + a7WZ)(b1 + b4V + b5Q + b7VQ) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):

\[ c1' + c4'W + c5'Z + c7'WZ \]

Mplus code for the model:

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y
USEVARIABLES = X M W Z V Q Y XW XZ WZ VQ MV MQ XWZ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MQ = M*Q;
    MV = M*V;
```

549
\[\text{XW} = \text{X*W};\]
\[\text{XZ} = \text{X*Z};\]
\[\text{WZ} = \text{W*Z};\]
\[\text{VQ} = \text{V*Q};\]
\[\text{MVQ} = \text{M*V*Q};\]
\[\text{XWZ} = \text{X*W*Z};\]

**ANALYSIS:**
- **TYPE** = GENERAL;
- **ESTIMATOR** = ML;
- **BOOTSTRAP** = 10000;

! In model statement name each path and intercept using parentheses

**MODEL:**

\[\text{[Y]} (b0);\]
\[\text{Y ON M} (b1);\]
\[\text{Y ON V} (b2);\]
\[\text{Y ON Q} (b3);\]
\[\text{Y ON MV} (b4);\]
\[\text{Y ON MQ} (b5);\]
\[\text{Y ON VQ} (b6);\]
\[\text{Y ON MVQ} (b7);\]
\[\text{Y ON X} (\text{cdash1});\]
\[\text{Y ON W} (\text{cdash2});\]
\[\text{Y ON Z} (\text{cdash3});\]
\[\text{Y ON XW} (\text{cdash4});\]
\[\text{Y ON XZ} (\text{cdash5});\]
\[\text{Y ON WZ} (\text{cdash6});\]
\[\text{Y ON XWZ} (\text{cdash7});\]

\[\text{[M]} (a0);\]
\[\text{M ON X} (a1);\]
\[\text{M ON W} (a2);\]
\[\text{M ON Z} (a3);\]
\[\text{M ON XW} (a4);\]
\[\text{M ON XZ} (a5);\]
\[\text{M ON WZ} (a6);\]
\[\text{M ON XWZ} (a7);\]

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, of 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and
total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:

NEW (LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z
LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V
LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q
MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q
HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*LOW_W*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q + a1*b7*LOW_V*LOW_Q + a4*b7*LOW_W*LOW_V*LOW_Q + a5*b7*LOW_Z*LOW_V*LOW_Q + a7*b7*LOW_W*LOW_Z*LOW_V*LOW_Q;

IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*LOW_Z*LOW_V + a7*b4*MED_W*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*MED_W*LOW_Z*LOW_Q + a1*b7*MED_W*LOW_Q + a4*b7*MED_W*LOW_V*LOW_Q + a5*b7*MED_W*LOW_Z*LOW_Q + a7*b7*MED_W*LOW_Z*LOW_Q;

IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V + a7*b4*HIGH_W*LOW_Z*LOW_V + a1*b5*LOW_Q + a4*b5*HIGH_W*LOW_Q + a5*b5*LOW_Z*LOW_Q + a7*b5*HIGH_W*LOW_Z*LOW_Q + a1*b7*HIGH_W*LOW_Q + a4*b7*HIGH_W*LOW_V*LOW_Q + a5*b7*HIGH_W*LOW_Z*LOW_Q + a7*b7*HIGH_W*LOW_Z*LOW_Q;

ILMLL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*LOW_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*LOW_W*MED_Z*LOW_Q + a1*b7*LOW_V*LOW_Q + a4*b7*LOW_W*LOW_V*LOW_Q + a5*b7*MED_Z*LOW_V*LOW_Q + a7*b7*LOW_W*MED_Z*LOW_V*LOW_Q;

IMMLL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V + a7*b4*MED_W*MED_Z*LOW_V + a1*b5*LOW_Q + a4*b5*MED_W*LOW_Q + a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q + a1*b7*MED_W*LOW_Q + a4*b7*MED_W*LOW_V*LOW_Q + a5*b7*MED_W*MED_Z*LOW_Q + a7*b7*MED_W*MED_Z*LOW_Q;
\[
\begin{align*}
    a1\cdot b4\cdot \text{LOW}_V + a4\cdot b4\cdot \text{MED}_W\cdot \text{LOW}_V + a5\cdot b4\cdot \text{MED}_Z\cdot \text{LOW}_V + a7\cdot b4\cdot \text{MED}_W\cdot \text{MED}_Z\cdot \text{LOW}_V + a1\cdot b5\cdot \text{LOW}_Q + a4\cdot b5\cdot \text{MED}_W\cdot \text{LOW}_Q + \\
    a5\cdot b5\cdot \text{MED}_Z\cdot \text{LOW}_Q + a7\cdot b5\cdot \text{MED}_W\cdot \text{MED}_Z\cdot \text{LOW}_Q + \\
    a1\cdot b7\cdot \text{LOW}_V\cdot \text{LOW}_Q + a4\cdot b7\cdot \text{MED}_W\cdot \text{LOW}_V\cdot \text{LOW}_Q + a5\cdot b7\cdot \text{MED}_Z\cdot \text{LOW}_V\cdot \text{LOW}_Q + \\
    a7\cdot b7\cdot \text{MED}_W\cdot \text{MED}_Z\cdot \text{LOW}_V\cdot \text{LOW}_Q; \\
    \text{IHMLL} = a1\cdot b1 + a4\cdot b1\cdot \text{HIGH}_W + a5\cdot b1\cdot \text{MED}_Z + \\
    a7\cdot b1\cdot \text{HIGH}_W\cdot \text{MED}_Z + \\
    a1\cdot b4\cdot \text{LOW}_V + a4\cdot b4\cdot \text{HIGH}_W\cdot \text{LOW}_V + a5\cdot b4\cdot \text{MED}_Z\cdot \text{LOW}_V + a7\cdot b4\cdot \text{MED}_W\cdot \text{MED}_Z\cdot \text{LOW}_V + a1\cdot b5\cdot \text{LOW}_Q + \\
    a4\cdot b5\cdot \text{HIGH}_W\cdot \text{LOW}_Q + a5\cdot b5\cdot \text{MED}_Z\cdot \text{LOW}_Q + a7\cdot b5\cdot \text{MED}_W\cdot \text{MED}_Z\cdot \text{LOW}_Q + \\
    a1\cdot b7\cdot \text{LOW}_V\cdot \text{LOW}_Q + a4\cdot b7\cdot \text{HIGH}_W\cdot \text{LOW}_V\cdot \text{LOW}_Q + a5\cdot b7\cdot \text{MED}_Z\cdot \text{LOW}_V\cdot \text{LOW}_Q + a7\cdot b7\cdot \text{MED}_W\cdot \text{MED}_Z\cdot \text{LOW}_V\cdot \text{LOW}_Q; \\
    \text{ILHLL} = a1\cdot b1 + a4\cdot b1\cdot \text{LOW}_W + a5\cdot b1\cdot \text{HIGH}_Z + \\
    a7\cdot b1\cdot \text{LOW}_W\cdot \text{HIGH}_Z + \\
    a1\cdot b4\cdot \text{LOW}_V + a4\cdot b4\cdot \text{LOW}_W\cdot \text{LOW}_V + a5\cdot b4\cdot \text{HIGH}_Z\cdot \text{LOW}_V + a7\cdot b4\cdot \text{LOW}_W\cdot \text{HIGH}_Z\cdot \text{LOW}_V + a1\cdot b5\cdot \text{LOW}_Q + \\
    a4\cdot b5\cdot \text{LOW}_W\cdot \text{LOW}_Q + a5\cdot b5\cdot \text{HIGH}_Z\cdot \text{LOW}_Q + a7\cdot b5\cdot \text{LOW}_W\cdot \text{HIGH}_Z\cdot \text{LOW}_Q + \\
    a1\cdot b7\cdot \text{LOW}_V\cdot \text{LOW}_Q + a4\cdot b7\cdot \text{LOW}_W\cdot \text{LOW}_V\cdot \text{LOW}_Q + a5\cdot b7\cdot \text{HIGH}_Z\cdot \text{LOW}_V\cdot \text{LOW}_Q + a7\cdot b7\cdot \text{LOW}_W\cdot \text{HIGH}_Z\cdot \text{LOW}_V\cdot \text{LOW}_Q; \\
    \text{IMHLL} = a1\cdot b1 + a4\cdot b1\cdot \text{MED}_W + a5\cdot b1\cdot \text{HIGH}_Z + \\
    a7\cdot b1\cdot \text{MED}_W\cdot \text{HIGH}_Z + \\
    a1\cdot b4\cdot \text{LOW}_V + a4\cdot b4\cdot \text{MED}_W\cdot \text{LOW}_V + a5\cdot b4\cdot \text{HIGH}_Z\cdot \text{LOW}_V + a7\cdot b4\cdot \text{MED}_W\cdot \text{MED}_Z\cdot \LOW_V + a1\cdot b5\cdot \text{LOW}_Q + \\
    a4\cdot b5\cdot \text{MED}_W\cdot \LOW_Q + a5\cdot b5\cdot \text{HIGH}_Z\cdot \LOW_Q + a7\cdot b5\cdot \LOW_W\cdot \HIGH_Z\cdot \LOW_Q + \\
    a1\cdot b7\cdot \LOW_V\cdot \LOW_Q + a4\cdot b7\cdot \LOW_W\cdot \LOW_V\cdot \LOW_Q + a5\cdot b7\cdot \HIGH_Z\cdot \LOW_V\cdot \LOW_Q + a7\cdot b7\cdot \LOW_W\cdot \HIGH_Z\cdot \LOW_V\cdot \LOW_Q; \\
    \text{IHHLL} = a1\cdot b1 + a4\cdot b1\cdot \HIGH_W + a5\cdot b1\cdot \HIGH_Z + \\
    a7\cdot b1\cdot \HIGH_W\cdot \HIGH_Z + \\
    a1\cdot b4\cdot \LOW_V + a4\cdot b4\cdot \HIGH_W\cdot \LOW_V + a5\cdot b4\cdot \HIGH_Z\cdot \LOW_V + a7\cdot b4\cdot \HIGH_W\cdot \HIGH_Z\cdot \LOW_V + a1\cdot b5\cdot \LOW_Q + \\
    a4\cdot b5\cdot \HIGH_W\cdot \LOW_Q + a5\cdot b5\cdot \HIGH_Z\cdot \LOW_Q + a7\cdot b5\cdot \HIGH_W\cdot \HIGH_Z\cdot \LOW_Q + \\
    a1\cdot b7\cdot \LOW_V\cdot \LOW_Q + a4\cdot b7\cdot \HIGH_W\cdot \LOW_V\cdot \LOW_Q + a5\cdot b7\cdot \HIGH_Z\cdot \LOW_V\cdot \LOW_Q + a7\cdot b7\cdot \HIGH_W\cdot \HIGH_Z\cdot \LOW_V\cdot \LOW_Q; \\
    \text{ILLML} = a1\cdot b1 + a4\cdot b1\cdot \LOW_W + a5\cdot b1\cdot \LOW_Z + \\
    a7\cdot b1\cdot \LOW_W\cdot \LOW_Z + \\
    a1\cdot b4\cdot \MED_V + a4\cdot b4\cdot \LOW_W\cdot \MED_V + a5\cdot b4\cdot \LOW_Z\cdot \MED_V + \\
 \end{align*}
\]
\[ a_7b_4\text{LOW}_W\text{LOW}_Z\text{MED}_V + a_1b_5\text{LOW}_Q + a_4b_5\text{LOW}_W\text{LOW}_Q + \\
\]
\[ a_5b_5\text{LOW}_Z\text{LOW}_Q + a_7b_5\text{LOW}_W\text{LOW}_Z\text{LOW}_Q + \\
a_1b_7\text{MED}_V\text{LOW}_Q + \\
a_4b_7\text{LOW}_W\text{MED}_V\text{LOW}_Q + a_5b_7\text{LOW}_Z\text{MED}_V\text{LOW}_Q + \\
a_7b_7\text{LOW}_W\text{LOW}_Z\text{MED}_V\text{LOW}_Q; \\
\]
\[ \text{IMLML} = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{LOW}_Z + \\
a_7b_1\text{MED}_W\text{LOW}_Z + \\
a_1b_4\text{MED}_V + a_4b_4\text{MED}_W\text{MED}_V + a_5b_4\text{LOW}_Z\text{MED}_V + \\
a_7b_4\text{MED}_W\text{LOW}_Z\text{MED}_V + a_1b_5\text{LOW}_Q + a_4b_5\text{MED}_W\text{LOW}_Q + \\
\]
\[ a_5b_5\text{LOW}_Z\text{LOW}_Q + a_7b_5\text{MED}_W\text{LOW}_Z\text{LOW}_Q + \\
a_1b_7\text{MED}_V\text{LOW}_Q + \\
a_4b_7\text{MED}_W\text{MED}_V\text{LOW}_Q + a_5b_7\text{LOW}_Z\text{MED}_V\text{LOW}_Q + \\
a_7b_7\text{MED}_W\text{LOW}_Z\text{MED}_V\text{LOW}_Q; \\
\]
\[ \text{IHLML} = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{LOW}_Z + \\
a_7b_1\text{HIGH}_W\text{LOW}_Z + \\
a_1b_4\text{MED}_V + a_4b_4\text{HIGH}_W\text{MED}_V + a_5b_4\text{LOW}_Z\text{MED}_V + \\
a_7b_4\text{HIGH}_W\text{LOW}_Z\text{MED}_V + a_1b_5\text{LOW}_Q + \\
a_4b_5\text{HIGH}_W\text{LOW}_Q + \\
a_5b_5\text{LOW}_Z\text{LOW}_Q + a_7b_5\text{HIGH}_W\text{LOW}_Z\text{LOW}_Q + \\
a_1b_7\text{MED}_V\text{LOW}_Q + \\
a_4b_7\text{HIGH}_W\text{MED}_V\text{LOW}_Q + a_5b_7\text{LOW}_Z\text{MED}_V\text{LOW}_Q + \\
a_7b_7\text{HIGH}_W\text{LOW}_Z\text{MED}_V\text{LOW}_Q; \\
\]
\[ \text{ILMML} = a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{MED}_Z + \\
a_7b_1\text{LOW}_W\text{MED}_Z + \\
a_1b_4\text{MED}_V + a_4b_4\text{LOW}_W\text{MED}_V + a_5b_4\text{MED}_Z\text{MED}_V + \\
a_7b_4\text{LOW}_W\text{MED}_Z\text{MED}_V + a_1b_5\text{LOW}_Q + a_4b_5\text{LOW}_W\text{LOW}_Q + \\
\]
\[ a_5b_5\text{MED}_Z\text{LOW}_Q + a_7b_5\text{LOW}_W\text{MED}_Z\text{LOW}_Q + \\
a_1b_7\text{MED}_V\text{LOW}_Q + \\
a_4b_7\text{LOW}_W\text{MED}_V\text{LOW}_Q + a_5b_7\text{MED}_Z\text{MED}_V\text{LOW}_Q + \\
a_7b_7\text{LOW}_W\text{MED}_Z\text{MED}_V\text{LOW}_Q; \\
\]
\[ \text{IMMML} = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{MED}_Z + \\
a_7b_1\text{MED}_W\text{MED}_Z + \\
a_1b_4\text{MED}_V + a_4b_4\text{LOW}_W\text{MED}_V + a_5b_4\text{MED}_Z\text{MED}_V + \\
a_7b_4\text{MED}_W\text{MED}_Z\text{MED}_V + a_1b_5\text{LOW}_Q + a_4b_5\text{MED}_W\text{LOW}_Q + \\
\]
\[ a_5b_5\text{MED}_Z\text{LOW}_Q + a_7b_5\text{MED}_W\text{MED}_Z\text{LOW}_Q + \\
a_1b_7\text{MED}_V\text{LOW}_Q + \\
a_4b_7\text{MED}_W\text{MED}_V\text{LOW}_Q + a_5b_7\text{MED}_Z\text{MED}_V\text{LOW}_Q + \\
a_7b_7\text{MED}_W\text{MED}_Z\text{MED}_V\text{LOW}_Q; \\
\]
\[ \text{IHMML} = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{MED}_Z + \\
a_7b_1\text{HIGH}_W\text{MED}_Z + \\
a_1b_4\text{MED}_V + a_4b_4\text{HIGH}_W\text{MED}_V + a_5b_4\text{HIGH}_W\text{MED}_V + \\
a_7b_4\text{HIGH}_W\text{LOW}_Z\text{MED}_V + a_1b_5\text{LOW}_Q + a_4b_5\text{HIGH}_W\text{LOW}_Q + \\
\]
a5*b5*MED_Z*LOW_Q + a7*b5*HIGH_W*MED_Z*LOW_Q +
    a1*b7*MED_V*LOW_Q +
        a4*b7*HIGH_W*MED_V*LOW_Q + a5*b7*MED_Z*MED_V*LOW_Q +
    a7*b7*HIGH_W*MED_Z*MED_V*LOW_Q;

ILHML = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
    a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V +
    a7*b4*LOW_W*HIGH_Z*MED_V + a1*b5*LOW_Q +
a4*b5*LOW_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*LOW_W*HIGH_Z*LOW_Q +
a1*b7*MED_V*LOW_Q +
    a4*b7*LOW_W*MED_V*LOW_Q + a5*b7*HIGH_Z*MED_V*LOW_Q +
    a7*b7*LOW_W*HIGH_Z*MED_V*LOW_Q;

IMHML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
    a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V +
    a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*MED_W*HIGH_Z*LOW_Q +
a1*b7*MED_V*LOW_Q +
    a4*b7*MED_W*MED_V*LOW_Q + a5*b7*HIGH_Z*MED_V*LOW_Q +
    a7*b7*MED_W*HIGH_Z*MED_V*LOW_Q;

IMHML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
    a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V +
    a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*LOW_Q +
a4*b5*MED_W*LOW_Q +
a5*b5*HIGH_Z*LOW_Q + a7*b5*MED_W*HIGH_Z*LOW_Q +
a1*b7*MED_V*LOW_Q +
    a4*b7*HIGH_W*MED_V*LOW_Q + a5*b7*HIGH_Z*MED_V*LOW_Q +
    a7*b7*HIGH_W*HIGH_Z*MED_V*LOW_Q;

IMLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
    a7*b1*LOW_W*LOW_Z +
        a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
    a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*LOW_Q +
    a4*b5*LOW_W*LOW_Q +
        a5*b5*LOW_Z*LOW_Q + a7*b5*LOW_W*LOW_Z*LOW_Q +
    a1*b7*HIGH_V*LOW_Q +
        a4*b7*LOW_W*HIGH_V*LOW_Q + a5*b7*LOW_Z*HIGH_V*LOW_Q +
    a7*b7*LOW_W*LOW_Z*HIGH_V*LOW_Q;

IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
    a7*b1*MED_W*LOW_Z +
        a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
    a7*b4*MED_W*LOW_Z*HIGH_V + a1*b5*LOW_Q +
    a4*b5*MED_W*LOW_Q +
        a5*b5*LOW_Z*LOW_Q + a7*b5*MED_W*LOW_Z*LOW_Q +

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a1*b7*HIGH_V*LOW_Q + 
a4*b7*MED_W*HIGH_V*LOW_Q + a5*b7*LOW_Z*HIGH_V*LOW_Q + 
a7*b7*MED_W*LOW_Z*HIGH_V*LOW_Q;

IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + 
a7*b1*HIGH_W*LOW_Z + 
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + 

a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*HIGH_W*LOW_Q + 
a5*b5*LOW_Z*LOW_Q + a7*b5*HIGH_W*LOW_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*HIGH_W*HIGH_V*LOW_Q + a5*b7*LOW_Z*HIGH_V*LOW_Q + 
a7*b7*HIGH_W*LOW_Z*HIGH_V*LOW_Q;

ILMHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
a7*b1*LOW_W*MED_Z + 
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + 
a7*b4*LOW_W*MED_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*LOW_W*LOW_Q + 
a5*b5*MED_Z*LOW_Q + a7*b5*LOW_W*MED_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*LOW_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q + 
a7*b7*LOW_W*MED_Z*HIGH_V*LOW_Q;

IMMHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
a7*b1*MED_W*MED_Z + 
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + 
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*MED_W*LOW_Q + 
a5*b5*MED_Z*LOW_Q + a7*b5*MED_W*MED_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*MED_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q + 
a7*b7*MED_W*MED_Z*HIGH_V*LOW_Q;

IHMHL = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + 
a7*b1*HIGH_W*MED_Z + 
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V + 
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*LOW_Q + 
a4*b5*HIGH_W*LOW_Q + 
a5*b5*MED_Z*LOW_Q + a7*b5*HIGH_W*MED_Z*LOW_Q + 
a1*b7*HIGH_V*LOW_Q + 
a4*b7*HIGH_W*HIGH_V*LOW_Q + a5*b7*MED_Z*HIGH_V*LOW_Q + 
a7*b7*HIGH_W*MED_Z*HIGH_V*LOW_Q;

ILHHL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + 
a7*b1*LOW_W*HIGH_Z + 
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V + 

a7*b4*LOW_W*HIGH_Z*HIGH_V + a1*b5*LOW_Q +
\[a_4b_5*\text{LOW\_W}*\text{LOW\_Q} + \]
\[a_5b_5*\text{HIGH\_Z}*\text{LOW\_Q} + a_7b_5*\text{LOW\_W}*\text{HIGH\_Z}*\text{LOW\_Q} + \]
\[a_1b_7*\text{HIGH\_V}*\text{LOW\_Q} + \]
\[a_4b_7*\text{LOW\_W}*\text{HIGH\_V}*\text{LOW\_Q} + a_5b_7*\text{HIGH\_Z}*\text{HIGH\_V}*\text{LOW\_Q} + \]
\[a_7b_7*\text{LOW\_W}*\text{HIGH\_Z}*\text{HIGH\_V}*\text{LOW\_Q}; \]
\[\text{IMHHL} = a_1b_1 + a_4b_1*\text{MED\_W} + a_5b_1*\text{HIGH\_Z} + \]
\[a_7b_1*\text{MED\_W}*\text{HIGH\_Z} + \]
\[a_1b_4*\text{HIGH\_V} + a_4b_4*\text{MED\_W}*\text{HIGH\_V} + a_5b_4*\text{HIGH\_Z}*\text{HIGH\_V} + \]
\[a_7b_4*\text{MED\_W}*\text{HIGH\_Z}*\text{HIGH\_V} + a_1b_5*\text{LOW\_Q} + \]
\[a_4b_5*\text{MED\_W}*\text{LOW\_Q} + \]
\[a_5b_5*\text{HIGH\_Z}*\text{LOW\_Q} + a_7b_5*\text{MED\_W}*\text{HIGH\_Z}*\text{LOW\_Q} + \]
\[a_1b_7*\text{HIGH\_V}*\text{LOW\_Q} + \]
\[a_4b_7*\text{MED\_W}*\text{HIGH\_V}*\text{LOW\_Q} + a_5b_7*\text{HIGH\_Z}*\text{HIGH\_V}*\text{LOW\_Q} + \]
\[a_7b_7*\text{MED\_W}*\text{HIGH\_Z}*\text{HIGH\_V}*\text{LOW\_Q}; \]
\[\text{IHHHL} = a_1b_1 + a_4b_1*\text{HIGH\_W} + a_5b_1*\text{HIGH\_Z} + \]
\[a_7b_1*\text{HIGH\_W}*\text{HIGH\_Z} + \]
\[a_1b_4*\text{HIGH\_V} + a_4b_4*\text{HIGH\_W}*\text{HIGH\_V} + a_5b_4*\text{HIGH\_Z}*\text{HIGH\_V} + \]
\[a_7b_4*\text{HIGH\_W}*\text{HIGH\_Z}*\text{HIGH\_V} + a_1b_5*\text{LOW\_Q} + \]
\[a_4b_5*\text{HIGH\_W}*\text{LOW\_Q} + \]
\[a_5b_5*\text{LOW\_Z}*\text{LOW\_Q} + a_7b_5*\text{MED\_W}*\text{LOW\_Z}*\text{LOW\_Q} + \]
\[a_1b_7*\text{LOW\_W} + a_4b_7*\text{LOW\_V}*\text{LOW\_W} + a_5b_7*\text{LOW\_W} + \]
\[a_4b_7*\text{LOW\_W} + a_5b_7*\text{LOW\_W} + a_7b_7*\text{LOW\_W} + \]
\[a_1b_7*\text{LOW\_W} + a_4b_7*\text{LOW\_V} + a_5b_7*\text{LOW\_W}; \]
\[\text{ILLLM} = a_1b_1 + a_4b_1*\text{LOW\_W} + a_5b_1*\text{LOW\_Z} + \]
\[a_7b_1*\text{LOW\_W}*\text{LOW\_Z} + \]
\[a_1b_4*\text{LOW\_V} + a_4b_4*\text{LOW\_W} + a_5b_4*\text{LOW\_Z} + \]
\[a_7b_4*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
\[a_7b_5*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
\[a_7b_5*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
\[a_7b_5*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
\[a_7b_5*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
\[a_7b_5*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
\[a_7b_5*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
\[a_7b_5*\text{LOW\_W} + a_1b_5*\text{MED\_Q} + a_4b_5*\text{LOW\_W} + \]
a4*b5*HIGH_W*MED_Q +
a5*b5*LOW_Z*MED_Q + a7*b5*HIGH_W*LOW_Z*MED_Q +
al*b7*LOW_V*MED_Q +
a4*b7*HIGH_W*LOW_V*MED_Q + a5*b7*LOW_Z*LOW_V*MED_Q +
a7*b7*HIGH_W*LOW_Z*LOW_V*MED_Q;

ILMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*LOW_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q +
al*b7*LOW_V*MED_Q +
a4*b7*LOW_W*LOW_V*MED_Q + a5*b7*MED_Z*LOW_V*MED_Q +
a7*b7*LOW_W*MED_Z*LOW_V*MED_Q;

IMMLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*MED_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q +
al*b7*LOW_V*MED_Q +
a4*b7*MED_W*LOW_V*MED_Q + a5*b7*MED_Z*LOW_V*MED_Q +
a7*b7*MED_W*MED_Z*LOW_V*MED_Q;

IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*MED_Z*LOW_V +
a7*b4*HIGH_W*MED_Z*LOW_V + a1*b5*MED_Q + a4*b5*HIGH_W*MED_Q +
a5*b5*MED_Z*MED_Q + a7*b5*HIGH_W*MED_Z*MED_Q +
al*b7*LOW_V*MED_Q +
a4*b7*HIGH_W*LOW_V*MED_Q + a5*b7*HIGH_Z*LOW_V*MED_Q +
a7*b7*HIGH_W*MED_Z*LOW_V*MED_Q;

ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*LOW_W*HIGH_Z*LOW_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
a5*b5*HIGH_Z*MED_Q + a7*b5*LOW_W*HIGH_Z*MED_Q +
al*b7*LOW_V*MED_Q +
a4*b7*LOW_W*LOW_V*MED_Q + a5*b7*HIGH_Z*LOW_V*MED_Q +
a7*b7*LOW_W*HIGH_Z*LOW_V*MED_Q;

IMHLM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*MED_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*MED_W*HIGH_Z*LOW_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
a5*b5*MED_Z*MED_Q;
a5*b5*HIGH_Z*MED_Q + a7*b5*MED_W*HIGH_Z*MED_Q +
+ a1*b7*LOW_V*MED_Q +
+ a4*b7*MED_W*LOW_V*MED_Q + a5*b7*HIGH_Z*LOW_V*MED_Q +
+ a7*b7*MED_W*HIGH_Z*LOW_V*MED_Q;
IHHLM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
+ a7*b1*HIGH_W*HIGH_Z +
+ a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
+ a7*b4*HIGH_W*HIGH_Z*LOW_V + a1*b5*MED_Q +
+ a4*b5*HIGH_W*MED_Q +
+ a5*b5*HIGH_Z*MED_Q + a7*b5*HIGH_W*HIGH_Z*MED_Q +
+ a1*b7*LOW_V*MED_Q +
+ a4*b7*MED_W*LOW_V*MED_Q + a5*b7*HIGH_Z*LOW_V*MED_Q +
+ a7*b7*MED_W*HIGH_Z*LOW_V*MED_Q;
ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
+ a7*b1*LOW_W*LOW_Z +
+ a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V +
+ a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
+ a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q +
+ a1*b7*MED_V*MED_Q +
+ a4*b7*LOW_W*MED_V*MED_Q + a5*b7*LOW_Z*MED_V*MED_Q +
+ a7*b7*LOW_W*LOW_Z*MED_V*MED_Q;
ILMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
+ a7*b1*LOW_W*LOW_Z +
+ a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V +
+ a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
+ a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q +
+ a1*b7*MED_V*MED_Q +
+ a4*b7*LOW_W*MED_V*MED_Q + a5*b7*LOW_Z*MED_V*MED_Q +
+ a7*b7*LOW_W*LOW_Z*MED_V*MED_Q;
MLMM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
+ a7*b1*MED_W*LOW_Z +
+ a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V +
+ a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*MED_Q + a4*b5*LOW_W*MED_Q +
+ a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q +
+ a1*b7*MED_V*MED_Q +
+ a4*b7*LOW_W*MED_V*MED_Q + a5*b7*LOW_Z*MED_V*MED_Q +
+ a7*b7*LOW_W*LOW_Z*MED_V*MED_Q;
a1*b7*MED_V*MED_Q +
  a4*b7*LOW_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q +
  a7*b7*LOW_W*MED_Z*MED_V*MED_Q;
IMMMM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
  a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V +
  a7*b4*MED_W*MED_Z*MED_V + a1*b5*MED_Q + a4*b5*MED_W*MED_Q +
  a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q +
a1*b7*MED_V*MED_Q +
  a4*b7*MED_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q +
  a7*b7*MED_W*MED_Z*MED_V*MED_Q;
IHMMM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
  a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*MED_Z*MED_V +
  a7*b4*HIGH_W*MED_Z*MED_V + a1*b5*MED_Q +
  a4*b5*HIGH_W*MED_Q +
  a5*b5*MED_Z*MED_Q + a7*b5*HIGH_W*MED_Z*MED_Q +
a1*b7*MED_V*MED_Q +
  a4*b7*HIGH_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q +
  a7*b7*HIGH_W*MED_Z*MED_V*MED_Q;
ILHMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
  a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V +
  a7*b4*LOW_W*HIGH_Z*MED_V + a1*b5*MED_Q +
  a4*b5*LOW_W*MED_Q +
  a5*b5*HIGH_Z*MED_Q + a7*b5*LOW_W*HIGH_Z*MED_Q +
a1*b7*MED_V*MED_Q +
  a4*b7*LOW_W*MED_V*MED_Q + a5*b7*HIGH_Z*MED_V*MED_Q +
  a7*b7*LOW_W*HIGH_Z*MED_V*MED_Q;
IMHMM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
  a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V +
  a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*MED_Q +
  a4*b5*MED_W*MED_Q +
  a5*b5*HIGH_Z*MED_Q + a7*b5*MED_W*HIGH_Z*MED_Q +
a1*b7*MED_V*MED_Q +
  a4*b7*MED_W*MED_V*MED_Q + a5*b7*HIGH_Z*MED_V*MED_Q +
  a7*b7*MED_W*HIGH_Z*MED_V*MED_Q;
IHHMM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
  a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V +
  a7*b4*HIGH_W*HIGH_Z*MED_V + a1*b5*MED_Q +
  a4*b5*HIGH_W*MED_Q +
  a5*b5*HIGH_Z*MED_Q + a7*b5*HIGH_W*HIGH_Z*MED_Q +
a1*b7*MED_V*MED_Q +
\[ a4*b7*HIGH_W*MED_V*MED_Q + a5*b7*HIGH_Z*MED_V*MED_Q + \\
a7*b7*HIGH_W*HIGH_Z*MED_V*MED_Q; \]

\[ ILLHM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + \\
a7*b1*LOW_W*LOW_Z + \\
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + \\
a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*MED_Q + \\
a4*b5*LOW_W*MED_Q + \\
a5*b5*LOW_Z*MED_Q + a7*b5*LOW_W*LOW_Z*MED_Q + \\
a1*b7*HIGH_V*MED_Q + \\
a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*LOW_Z*HIGH_V*MED_Q + \\
a7*b7*LOW_W*LOW_Z*HIGH_V*MED_Q; \]

\[ IMLHM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + \\
a7*b1*MED_W*LOW_Z + \\
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + \\
a7*b4*MED_W*LOW_Z*HIGH_V + a1*b5*MED_Q + \\
a4*b5*MED_W*MED_Q + \\
a5*b5*LOW_Z*MED_Q + a7*b5*MED_W*LOW_Z*MED_Q + \\
a1*b7*HIGH_V*MED_Q + \\
a4*b7*MED_W*HIGH_V*MED_Q + a5*b7*LOW_Z*HIGH_V*MED_Q + \\
a7*b7*MED_W*LOW_Z*HIGH_V*MED_Q; \]

\[ IHLHM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + \\
a7*b1*HIGH_W*LOW_Z + \\
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*LOW_Z*HIGH_V + \\
a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b5*MED_Q + \\
a4*b5*HIGH_W*MED_Q + \\
a5*b5*HIGH_Z*MED_Q + a7*b5*HIGH_W*LOW_Z*MED_Q + \\
a1*b7*HIGH_V*MED_Q + \\
a4*b7*HIGH_W*HIGH_V*MED_Q + a5*b7*LOW_Z*HIGH_V*MED_Q + \\
a7*b7*HIGH_W*LOW_Z*HIGH_V*MED_Q; \]

\[ ILMHM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + \\
a7*b1*LOW_W*MED_Z + \\
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V + \\
a7*b4*LOW_W*MED_Z*HIGH_V + a1*b5*MED_Q + \\
a4*b5*LOW_W*MED_Q + \\
a5*b5*MED_Z*MED_Q + a7*b5*LOW_W*MED_Z*MED_Q + \\
a1*b7*HIGH_V*MED_Q + \\
a4*b7*LOW_W*HIGH_V*MED_Q + a5*b7*MED_Z*HIGH_V*MED_Q + \\
a7*b7*LOW_W*MED_Z*HIGH_V*MED_Q; \]

\[ IMMHM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + \\
a7*b1*MED_W*MED_Z + \\
a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V + \\
a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*MED_Q + \\
a4*b5*MED_W*MED_Q + \\
a5*b5*MED_Z*MED_Q + a7*b5*MED_W*MED_Z*MED_Q + \\
a1*b7*HIGH_V*MED_Q + \\
\]
\[ a_4b_7 \text{MED}_W \text{HIGH}_V \text{MED}_Q + a_5b_7 \text{MED}_Z \text{HIGH}_V \text{MED}_Q + a_7b_7 \text{MED}_W \text{MED}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IHMM} = a_1b_1 + a_4b_1 \text{HIGH}_W + a_5b_1 \text{MED}_Z + \]
\[ a_7b_1 \text{HIGH}_W \text{MED}_Z + \]
\[ a_1b_4 \text{HIGH}_V + a_4b_4 \text{HIGH}_W \text{HIGH}_V + a_5b_4 \text{MED}_Z \text{HIGH}_V + \]
\[ a_7b_4 \text{HIGH}_W \text{MED}_Z \text{HIGH}_V + a_1b_5 \text{MED}_Q + \]
\[ a_4b_5 \text{HIGH}_W \text{MED}_Q + \]
\[ a_5b_5 \text{MED}_Z \text{MED}_Q + a_7b_5 \text{HIGH}_W \text{MED}_Z \text{MED}_Q + \]
\[ a_1b_7 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4b_7 \text{HIGH}_W \text{HIGH}_V \text{MED}_Q + a_5b_7 \text{MED}_Z \text{HIGH}_V \text{MED}_Q + \]
\[ a_7b_7 \text{HIGH}_W \text{MED}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IHMHM} = a_1b_1 + a_4b_1 \text{LOW}_W + a_5b_1 \text{HIGH}_Z + \]
\[ a_7b_1 \text{LOW}_W \text{HIGH}_Z + \]
\[ a_1b_4 \text{HIGH}_V + a_4b_4 \text{LOW}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + \]
\[ a_7b_4 \text{LOW}_W \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{MED}_Q + \]
\[ a_4b_5 \text{LOW}_W \text{MED}_Q + \]
\[ a_5b_5 \text{HIGH}_Z \text{MED}_Q + a_7b_5 \text{LOW}_W \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1b_7 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4b_7 \text{LOW}_W \text{HIGH}_V \text{MED}_Q + a_5b_7 \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q + \]
\[ a_7b_7 \text{LOW}_W \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IMHH} = a_1b_1 + a_4b_1 \text{MED}_W + a_5b_1 \text{HIGH}_Z + \]
\[ a_7b_1 \text{MED}_W \text{HIGH}_Z + \]
\[ a_1b_4 \text{HIGH}_V + a_4b_4 \text{MED}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + \]
\[ a_7b_4 \text{MED}_W \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{MED}_Q + \]
\[ a_4b_5 \text{MED}_W \text{MED}_Q + \]
\[ a_5b_5 \text{HIGH}_Z \text{MED}_Q + a_7b_5 \text{MED}_W \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1b_7 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4b_7 \text{MED}_W \text{HIGH}_V \text{MED}_Q + a_5b_7 \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q + \]
\[ a_7b_7 \text{MED}_W \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IHMM} = a_1b_1 + a_4b_1 \text{LOW}_W + a_5b_1 \text{HIGH}_Z + \]
\[ a_7b_1 \text{LOW}_W \text{HIGH}_Z + \]
\[ a_1b_4 \text{HIGH}_V + a_4b_4 \text{LOW}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + \]
\[ a_7b_4 \text{LOW}_W \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{MED}_Q + \]
\[ a_4b_5 \text{LOW}_W \text{MED}_Q + \]
\[ a_5b_5 \text{HIGH}_Z \text{MED}_Q + a_7b_5 \text{LOW}_W \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1b_7 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4b_7 \text{LOW}_W \text{HIGH}_V \text{MED}_Q + a_5b_7 \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q + \]
\[ a_7b_7 \text{LOW}_W \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IMHHM} = a_1b_1 + a_4b_1 \text{HIGH}_W + a_5b_1 \text{HIGH}_Z + \]
\[ a_7b_1 \text{HIGH}_W \text{HIGH}_Z + \]
\[ a_1b_4 \text{HIGH}_V + a_4b_4 \text{HIGH}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + \]
\[ a_7b_4 \text{HIGH}_W \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{MED}_Q + \]
\[ a_4b_5 \text{HIGH}_W \text{MED}_Q + \]
\[ a_5b_5 \text{HIGH}_Z \text{MED}_Q + a_7b_5 \text{HIGH}_W \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1b_7 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4b_7 \text{HIGH}_W \text{HIGH}_V \text{MED}_Q + a_5b_7 \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q + \]
\[ a_7b_7 \text{HIGH}_W \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{IHHHM} = a_1b_1 + a_4b_1 \text{HIGH}_W + a_5b_1 \text{HIGH}_Z + \]
\[ a_7b_1 \text{HIGH}_W \text{HIGH}_Z + \]
\[ a_1b_4 \text{HIGH}_V + a_4b_4 \text{HIGH}_W \text{HIGH}_V + a_5b_4 \text{HIGH}_Z \text{HIGH}_V + \]
\[ a_7b_4 \text{HIGH}_W \text{HIGH}_Z \text{HIGH}_V + a_1b_5 \text{MED}_Q + \]
\[ a_4b_5 \text{HIGH}_W \text{MED}_Q + \]
\[ a_5b_5 \text{HIGH}_Z \text{MED}_Q + a_7b_5 \text{HIGH}_W \text{HIGH}_Z \text{MED}_Q + \]
\[ a_1b_7 \text{HIGH}_V \text{MED}_Q + \]
\[ a_4b_7 \text{HIGH}_W \text{HIGH}_V \text{MED}_Q + a_5b_7 \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q + \]
\[ a_7b_7 \text{HIGH}_W \text{HIGH}_Z \text{HIGH}_V \text{MED}_Q; \]
\[ \text{ILLHH} = a_1b_1 + a_4b_1 \text{LOW}_W + a_5b_1 \text{LOW}_Z + \]
\[ a_7b_1 \text{LOW}_W \text{LOW}_Z + \]
\[ a_1b_4 \text{LOW}_V + a_4b_4 \text{LOW}_W \text{LOW}_V + a_5b_4 \text{LOW}_Z \text{LOW}_V + \]
\[ a_7b_4 \text{LOW}_W \text{LOW}_Z \text{LOW}_V + a_1b_5 \text{HIGH}_Q + \]
a4\*b5*LOW_W*HIGH_Q + a5\*b5*LOW_Z*HIGH_Q + a7\*b5*LOW_W*LOW_Z*HIGH_Q +
a1\*b7*LOW_V*HIGH_Q + a4\*b7*LOW_W*LOW_V*HIGH_Q + a5\*b7*LOW_Z*LOW_V*HIGH_Q + a7\*b7*LOW_W*LOW_Z*LOW_V*HIGH_Q;
IMLLH = a1\*b1 + a4\*b1*MED_W + a5\*b1*LOW_Z +
a7\*b1*MED_W*LOW_Z +
a1\*b4*LOW_V + a4\*b4*MED_W*LOW_V + a5\*b4*LOW_Z*LOW_V + a7\*b4*MED_W*LOW_Z*LOW_V + a1\*b5*HIGH_Q +
a4\*b5*MED_W*HIGH_Q + a5\*b5*LOW_Z*HIGH_Q + a7\*b5*MED_W*LOW_Z*HIGH_Q +
a1\*b7*LOW_V*HIGH_Q + a4\*b7*MED_W*LOW_V*HIGH_Q + a5\*b7*LOW_Z*LOW_V*HIGH_Q + a7\*b7*MED_W*LOW_Z*LOW_V*HIGH_Q;
IHLLH = a1\*b1 + a4\*b1*HIGH_W + a5\*b1*LOW_Z +
a7\*b1*HIGH_W*LOW_Z +
a1\*b4*LOW_V + a4\*b4*HIGH_W*LOW_V + a5\*b4*LOW_Z*LOW_V + a7\*b4*HIGH_W*LOW_Z*LOW_V + a1\*b5*HIGH_Q +
a4\*b5*HIGH_W*HIGH_Q + a5\*b5*LOW_Z*HIGH_Q + a7\*b5*HIGH_W*LOW_Z*HIGH_Q +
a1\*b7*LOW_V*HIGH_Q + a4\*b7*HIGH_W*LOW_V*HIGH_Q + a5\*b7*LOW_Z*LOW_V*HIGH_Q + a7\*b7*HIGH_W*LOW_Z*LOW_V*HIGH_Q;
ILMLH = a1\*b1 + a4\*b1*LOW_W + a5\*b1*MED_Z + a7\*b1*LOW_W*MED_Z +
a1\*b4*LOW_V + a4\*b4*LOW_W*LOW_V + a5\*b4*MED_Z*LOW_V + a7\*b4*LOW_W*MED_Z*LOW_V + a1\*b5*HIGH_Q +
a4\*b5*LOW_W*HIGH_Q + a5\*b5*MED_Z*HIGH_Q + a7\*b5*LOW_W*MED_Z*HIGH_Q +
a1\*b7*LOW_V*HIGH_Q + a4\*b7*LOW_W*LOW_V*HIGH_Q + a5\*b7*MED_Z*LOW_V*HIGH_Q + a7\*b7*LOW_W*MED_Z*LOW_V*HIGH_Q;
IMMLH = a1\*b1 + a4\*b1*MED_W + a5\*b1*MED_Z +
a7\*b1*MED_W*MED_Z +
a1\*b4*LOW_V + a4\*b4*MED_W*LOW_V + a5\*b4*MED_Z*LOW_V + a7\*b4*MED_W*MED_Z*LOW_V + a1\*b5*HIGH_Q +
a4\*b5*MED_W*MED_Z +
a5\*b5*MED_Z*HIGH_Q + a7\*b5*MED_W*MED_Z*HIGH_Q +
a1\*b7*LOW_V*HIGH_Q + a4\*b7*MED_W*LOW_V*HIGH_Q + a5\*b7*MED_Z*LOW_V*HIGH_Q + a7\*b7*MED_W*MED_Z*LOW_V*HIGH_Q;
IHMLH = a1\*b1 + a4\*b1*HIGH_W + a5\*b1*MED_Z +
a7\*b1*HIGH_W*MED_Z +
a1\*b4*LOW_V + a4\*b4*HIGH_W*LOW_V + a5\*b4*MED_Z*LOW_V + a7\*b4*HIGH_W*MED_Z*LOW_V + a1\*b5*HIGH_Q +
a4\*b5*HIGH_W*HIGH_Q + a5\*b5*MED_Z*HIGH_Q + a7\*b5*HIGH_W*MED_Z*HIGH_Q +
a1*b7*LOW_V*HIGH_Q +
a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*MED_Z*LOW_V*HIGH_Q +
a7*b7*HIGH_W*MED_Z*LOW_V*HIGH_Q;

ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*LOW_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*LOW_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q +
a1*b7*LOW_V*HIGH_Q +
a4*b7*LOW_W*LOW_V*HIGH_Q + a5*b7*HIGH_Z*LOW_V*HIGH_Q +
a7*b7*LOW_W*HIGH_Z*LOW_V*HIGH_Q;

IMHLH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*MED_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*MED_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*MED_W*HIGH_Z*HIGH_Q +
a1*b7*LOW_V*HIGH_Q +
a4*b7*MED_W*LOW_V*HIGH_Q + a5*b7*HIGH_Z*LOW_V*HIGH_Q +
a7*b7*MED_W*HIGH_Z*LOW_V*HIGH_Q;

IHHLH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*LOW_V + a4*b4*HIGH_W*LOW_V + a5*b4*HIGH_Z*LOW_V +
a7*b4*HIGH_W*HIGH_Z*LOW_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q +
a1*b7*LOW_V*HIGH_Q +
a4*b7*HIGH_W*LOW_V*HIGH_Q + a5*b7*HIGH_Z*LOW_V*HIGH_Q +
a7*b7*HIGH_W*HIGH_Z*LOW_V*HIGH_Q;

ILLMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*LOW_Z*MED_V +
a7*b4*LOW_W*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*LOW_W*LOW_Z*HIGH_Q +
a1*b7*MED_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q +
a7*b7*LOW_W*LOW_Z*MED_V*HIGH_Q;

IMLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V +
a7*b4*MED_W*LOW_Z*MED_V + a1*b5*HIGH_Q +

a4*b5*MED_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*HIGH_Q +
a1*b7*MED_V*HIGH_Q +
a4*b7*MED_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q + 
a7*b7*MED_W*LOW_Z*MED_V*HIGH_Q;
IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + 
a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*HIGH_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q + 
a7*b7*HIGH_W*LOW_Z*MED_V*HIGH_Q;
IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*MED_V + 
a7*b4*HIGH_W*LOW_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*MED_Z*MED_V*HIGH_Q + 
a7*b7*LOW_W*MED_Z*MED_V*HIGH_Q;
ILMMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + 
a7*b4*LOW_W*MED_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*MED_Z*MED_V*HIGH_Q + 
a7*b7*LOW_W*MED_Z*MED_V*HIGH_Q;
IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V + 
a7*b4*MED_W*MED_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*MED_W*MED_V*HIGH_Q + a5*b7*MED_Z*MED_V*HIGH_Q + 
a7*b7*MED_W*MED_Z*MED_V*HIGH_Q;
ILHMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*MED_Z*MED_V + 
a7*b4*LOW_W*MED_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*MED_W*MED_V*HIGH_Q + a5*b7*MED_Z*MED_V*HIGH_Q + 
a7*b7*MED_W*MED_Z*MED_V*HIGH_Q;
IILMH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b4*MED_V + a4*b4*LOW_W*MED_V + a5*b4*HIGH_Z*MED_V + 
a7*b4*LOW_W*HIGH_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*HIGH_Z*MED_V*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*HIGH_Z*MED_V*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*HIGH_Z*MED_V*HIGH_Q +

a1*b7*MED_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*HIGH_Z*MED_V*HIGH_Q +
a7*b7*LOW_W*HIGH_Z*MED_V*HIGH_Q;
IMHMH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*MED_W*MED_V + a5*b4*HIGH_Z*MED_V +
a7*b4*MED_W*HIGH_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*MED_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*MED_W*HIGH_Z*HIGH_Q +
a1*b7*MED_V*HIGH_Q +
a4*b7*MED_W*MED_V*HIGH_Q + a5*b7*HIGH_Z*MED_V*HIGH_Q +
a7*b7*MED_W*HIGH_Z*MED_V*HIGH_Q;
IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*HIGH_Z*MED_V +
a7*b4*HIGH_W*HIGH_Z*MED_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q +
a1*b7*MED_V*HIGH_Q +
a4*b7*HIGH_W*MED_V*HIGH_Q + a5*b7*HIGH_Z*MED_V*HIGH_Q +
a7*b7*HIGH_W*HIGH_Z*MED_V*HIGH_Q;
ILLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*LOW_Z*HIGH_V +
a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*LOW_W*HIGH_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*LOW_W*LOW_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +
a4*b7*LOW_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q +
a7*b7*LOW_W*LOW_Z*MED_V*HIGH_Q;
IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b4*MED_V + a4*b4*MED_W*MED_V + a5*b4*MED_Z*MED_V +
a7*b4*MED_W*LOW_Z*MED_V + a1*b5*MED_Q +
a4*b5*MED_W*MED_Q +
a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*LOW_Z*HIGH_Q +
a1*b7*MED_V*MED_Q +
a4*b7*MED_W*MED_V*MED_Q + a5*b7*MED_Z*MED_V*MED_Q +
a7*b7*MED_W*LOW_Z*MED_V*MED_Q;
IHLHH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b4*MED_V + a4*b4*HIGH_W*MED_V + a5*b4*LOW_Z*HIGH_V +
+ a7*b4*LOW_W*LOW_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*MED_Q +
a5*b5*LOW_Z*HIGH_Q + a7*b5*HIGH_W*LOW_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +
a4*b7*HIGH_W*MED_V*HIGH_Q + a5*b7*LOW_Z*MED_V*HIGH_Q +
a7*b7*LOW_Z*MED_V*MED_Q;
ILMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
       a7*b1*LOW_W*MED_Z +
       a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
       a7*b4*LOW_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
       a4*b5*LOW_W*HIGH_Q +
       a5*b5*MED_Z*HIGH_Q + a7*b5*LOW_W*MED_Z*HIGH_Q +
       a1*b7*HIGH_V*HIGH_Q +
       a4*b7*LOW_W*HIGH_V*HIGH_Q + a5*b7*MED_Z*HIGH_V*HIGH_Q +
       a7*b7*LOW_W*MED_Z*HIGH_V*HIGH_Q;
IMMHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
       a7*b1*MED_W*MED_Z +
       a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
       a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
       a4*b5*MED_W*HIGH_Q +
       a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q +
       a1*b7*HIGH_V*HIGH_Q +
       a4*b7*MED_W*HIGH_V*HIGH_Q + a5*b7*MED_Z*HIGH_V*HIGH_Q +
       a7*b7*MED_W*MED_Z*HIGH_V*HIGH_Q;
IHMHH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
       a7*b1*HIGH_W*MED_Z +
       a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
       a7*b4*HIGH_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
       a4*b5*HIGH_W*HIGH_Q +
       a5*b5*MED_Z*HIGH_Q + a7*b5*HIGH_W*MED_Z*HIGH_Q +
       a1*b7*HIGH_V*HIGH_Q +
       a4*b7*HIGH_W*HIGH_V*HIGH_Q + a5*b7*MED_Z*HIGH_V*HIGH_Q +
       a7*b7*HIGH_W*MED_Z*HIGH_V*HIGH_Q;
ILHHH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
       a7*b1*LOW_W*HIGH_Z +
       a1*b4*HIGH_V + a4*b4*LOW_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
       a7*b4*LOW_W*HIGH_Z*HIGH_V + a1*b5*HIGH_Q +
       a4*b5*LOW_W*HIGH_Q +
       a5*b5*HIGH_Z*HIGH_Q + a7*b5*LOW_W*HIGH_Z*HIGH_Q +
       a1*b7*HIGH_V*HIGH_Q +
       a4*b7*LOW_W*HIGH_V*HIGH_Q + a5*b7*HIGH_Z*HIGH_V*HIGH_Q +
       a7*b7*LOW_W*HIGH_Z*HIGH_V*HIGH_Q;
IMHHH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
       a7*b1*MED_W*MED_Z +
       a1*b4*HIGH_V + a4*b4*MED_W*HIGH_V + a5*b4*MED_Z*HIGH_V +
       a7*b4*MED_W*MED_Z*HIGH_V + a1*b5*HIGH_Q +
       a4*b5*MED_W*HIGH_Q +
       a5*b5*MED_Z*HIGH_Q + a7*b5*MED_W*MED_Z*HIGH_Q +
       a1*b7*MED_W*HIGH_Q +
       a4*b7*MED_W*HIGH_V*HIGH_Q + a5*b7*MED_Z*HIGH_V*HIGH_Q +
       a7*b7*MED_W*MED_Z*HIGH_V*HIGH_Q;
a7*b7*MED_W*HIGH_Z*HIGH_V*HIGH_Q;
IHHHH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b4*HIGH_V + a4*b4*HIGH_W*HIGH_V + a5*b4*HIGH_Z*HIGH_V +
a7*b4*HIGH_W*HIGH_Z*HIGH_V + a1*b5*HIGH_Q +
a4*b5*HIGH_W*HIGH_Q +
a5*b5*HIGH_Z*HIGH_Q + a7*b5*HIGH_W*HIGH_Z*HIGH_Q +
a1*b7*HIGH_V*HIGH_Q +
a4*b7*HIGH_W*HIGH_V*HIGH_Q + a5*b7*HIGH_Z*HIGH_V*HIGH_Q +
a7*b7*HIGH_W*HIGH_Z*HIGH_V*HIGH_Q;

! Calc conditional direct effects for each combination of
moderator values

DLOW_LOZ = cdash1 + cdash4*LOW_W + cdash5*LOW_Z + cdash7*LOW_W*LOW_Z;
DMEW_LOZ = cdash1 + cdash4*MED_W + cdash5*LOW_Z + cdash7*MED_W*LOW_Z;
DHIW_LOZ = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z + cdash7*HIGH_W*LOW_Z;

DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z + cdash7*LOW_W*MED_Z;
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z + cdash7*MED_W*MED_Z;
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z + cdash7*HIGH_W*MED_Z;

DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z + cdash7*LOW_W*HIGH_Z;
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z + cdash7*MED_W*HIGH_Z;
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z + cdash7*HIGH_W*HIGH_Z;

! Calc conditional total effects for each combination of
moderator values

TLLLL = ILLLL + DLOW_LOZ;
TMLLL = IMLLL + DMEW_LOZ;
THLLL = IHLLL + DHIW_LOZ;

TLMLL = ILMLL + DLOW_MEZ;
TMMLL = IMMLL + DM EW_MEZ;
THMLL = IHMLL + DHIW_MEZ;

TLHLL = ILHLL + DLOW_HIZ;
TMHLL = IMHLL + DM EW_HIZ;
THHLL = IHHLL + DHIW_HIZ;
TLLML = ILLML + DLOW_LOZ;
TMLML = IMLML + DM EW_LOZ;
THLML = IHLML + DHIW_LOZ;
TLMML = ILMML + DLOW_MEZ;
TMMML = IMMML + DM EW_MEZ;
THHML = IHHML + DHIW_MEZ;
TLHML = ILHML + DLOW_HIZ;
TMHML = IMHML + DM EW_HIZ;
THHML = IHHML + DHIW_HIZ;
TLLHL = ILLHL + DLOW_LOZ;
TMLHL = IMLHL + DM EW_LOZ;
THLHL = IHLHL + DHIW_LOZ;
TLMHL = ILMHL + DLOW_MEZ;
TMMHL = IMMHL + DM EW_MEZ;
THHHL = IHHHL + DHIW_MEZ;
TLHHL = ILHHL + DLOW_HIZ;
TMHHL = IMHHL + DM EW_HIZ;
THHHL = IHHHL + DHIW_HIZ;
TLLLM = ILLLM + DLOW_LOZ;
TMLLM = IMLLM + DM EW_LOZ;
THLLM = IHLLM + DHIW_LOZ;
TLMLM = ILMLM + DLOW_MEZ;
TMMLM = IMMLM + DM EW_MEZ;
THHLM = IHHLM + DHIW_MEZ;
TLHLM = ILHLM + DLOW_HIZ;
TMHLM = IMHLM + DM EW_HIZ;
THHLM = IHHLM + DHIW_HIZ;
TLLMM = ILLMM + DLOW_LOZ;
TMLMM = IMLMM + DM EW_LOZ;
THLMM = IHLMM + DHIW_LOZ;
TLMMM = ILMMM + DLOW_MEZ;
TMMMM = IMM MM + DM EW_MEZ;
THMMM = IHHMM + DHIW_MEZ;
TLHMM = ILHMM + DLOW_HIZ;
TMHMM = IMHMM + DM EW_HIZ;
THHMM = IHHMM + DHIW_HIZ;
TLLHM = ILLHM + DLOW_LOZ;
TMLHM = IMLHM + DM EW_LOZ;
THLHM = IHLHM + DHIW_LOZ;
TLMHM = ILMHM + DLOW_MEZ;
TMMHM = IMMHM + DM EW_MEZ;
THMMH = IHMMH + DHIW_MEZ;
TLHHM = ILHHM + DLOW_HIZ;
TMHHH = IMHHH + DMEW_HIZ;
THHMH = IHHMH + DHIW_HIZ;
TLLLH = ILLLH + DLOW_LOZ;
TMLLH = IMLLH + DM EW_LOZ;
THLLH = IHLLH + DHIW_LOZ;
TLMLH = ILMLH + DLOW_MEZ;
TMMLH = IMMLH + DM EW_MEZ;
THMLH = IHMLH + DHIW_MEZ;
TLHLH = ILHLH + DLOW_HIZ;
TMHLH = IMHLH + DMEW_HIZ;
THHLH = IHHHL + DHIW_HIZ;
TLLMH = ILLMH + DLOW_LOZ;
TMLMH = IMLMH + DM EW_LOZ;
THLMH = IHLMH + DHIW_LOZ;
TLMHM = ILMHM + DLOW_MEZ;
TMMHM = IMMHM + DM EW_MEZ;
THMMH = IHMMH + DHIW_MEZ;
TLHHH = ILHHH + DLOW_HIZ;
TMHHH = IMHHH + DMEW_HIZ;
THHMH = IHHMH + DHIW_HIZ;
TLLHH = ILLHH + DLOW_LOZ;
TMLHH = IMLHH + DMEW_LOZ;
THLHH = IHLHH + DHIW_LOZ;
TLMHH = ILMHH + DLOW_MEZ;
TMMHH = IMMHH + DM EW_MEZ;
THMHH = IHMHH + DHIW_MEZ;
TLHHH = ILHHH + DLOW_HIZ;
TMHHH = IMHHH + DMEW_HIZ;
THHHH = IHHHH + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(PLL LL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL)
PLLML PMLML PHLML PLML PLMML PHMML PLHML PMHML PHHML
PLLMM PMLMM PHHML PLMLM PMLMM PHMML PLHML PMHML PHHML
PLLHM PMLHM PHHML PLHML PMLHM PHMML PLHML PMHML PHHML
PLLHH PMLHH PHHHL PLMLH PMLHH PHHMM PLHHL PMHHL PHHMM
PLLHH PMLHH PHHHL PLMLH PMLHH PHHMM PLHHL PMHHL PHHMM
LOOP(XVAL,1,5,0.1);
PLL LLL = ILLL L*XVAL;
PML LL = IML LL*XVAL;
PHLLL = IHLLL*XVAL;
PLMLL = IMLLL*XVAL;
PMMLL = IMMLL*XVAL;
PHMLL = IHMLL*XVAL;
PLHLL = IILLL*XVAL;
PMHLL = IMHLL*XVAL;
PHHLL = IHHLL*XVAL;
PLLML = ILLML*XVAL;
PMLML = IMLML*XVAL;
PHHLM = IHHLM*XVAL;
PLML = IMLL*XVAL;
PMMML = IMML*XVAL;
PHHML = IHML*XVAL;
PLHML = IILML*XVAL;
PMHML = IMHML*XVAL;
PHHML = IHHML*XVAL;
PLLHL = ILLHL*XVAL;
PMLHL = IMLHL*XVAL;
PHHL = IHLHL*XVAL;
PLMHL = IILMHL*XVAL;
PMMHL = IMMHL*XVAL;
PHHHL = IHHHL*XVAL;
PLLHL = IILHL*XVAL;
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PMMLM = IMMLM*XVAL;
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PLLMM = ILLMM*XVAL;
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PMMHH = IMMHH*XVAL;
PHMHH = IHMHH*XVAL;
PLHHH = ILHHH*XVAL;
PMHHH = IMHHH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 56: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate the IV-Mediator path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MV + b_3MQ + b_4MVQ + c_1'X + c_2'V + c_3'Q + c_4'XV + c_5'XQ + c_6'VQ + c_7'XVQ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)V + b_3(a_0 + a_1X + a_2W + a_3Z \]
\[\begin{align*}
+ a4XW + a5XZ + a6WZ + a7XWZ)Q &+ b4(a0 + a1X + a2W + a3Z + a4XW + a5XZ + a6WZ + a7XWZ)VQ + c1'X + c2'V + c3'Q + c4'XV + c5'XQ + c6'VQ + c7'XVQ
\end{align*}\]

Hence... multiplying out brackets

\[Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + a6b1WZ + a7b1XWZ + a0b2V + a1b2XV + a2b2WV + a3b2ZV + a4b2XWV + a5b2XZV + a6b2WZV + a7b2XWZV + a0b3Q + a1b3XQ + a2b3WQ + a3b3ZQ + a4b3XWQ + a5b3XZQ + a6b3WZQ + a7b3XWZQ + a0b4VQ + a1b4XVQ + a2b4WVQ + a3b4ZVQ + a4b4XWVQ + a5b4XZVQ + a6b4WZVQ + a7b4XWZVQ + c1'X + c2'V + c3'Q + c4'XV + c5'XQ + c6'VQ + c7'XVQ\]

Hence... grouping terms into form \(Y = a + bX\)

\[Y = (b0 + a0b1 + a2b1W + a3b1Z + a6b1WZ + a0b2V + a2b2WV + a3b2ZV + a6b2WZV + a0b3Q + a2b3WQ + a3b3ZQ + a6b3WZQ + a0b4VQ + a2b4WVQ + a3b4ZVQ + a6b4WZVQ + c2'V + c3'Q + c6'VQ) + (a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b2V + a4b2WV + a5b2ZV + a7b2WZV + a1b3Q + a4b3WQ + a5b3ZQ + a7b3WZQ + a1b4VQ + a4b4WVQ + a5b4ZVQ + a7b4WZVQ + c1' + c4'V + c5'Q + c7'VQ)X\]

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V, Q:

\[a1b1 + a4b1W + a5b1Z + a7b1WZ + a1b2V + a4b2WV + a5b2ZV + a7b2WZV + a1b3Q + a4b3WQ + a5b3ZQ + a7b3WZQ + a1b4VQ + a4b4WVQ + a5b4ZVQ + a7b4WZVQ = (a1 + a4W + a5Z + a7WZ)(b1 + b2V + b3Q + b4VQ)\]

One direct effect of X on Y, conditional on V, Q:

\[c1' + c4'V + c5'Q + c7'VQ\]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y

USEVARIABLES = X M W Z V Q Y XW XZ WZ XV XQ VQ MV MQ XWZ XVQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MQ = M*Q;
```
MV = M*V;
XW = X*W;
XZ = X*Z;
XQ = X*Q;
XV = X*V;
WZ = W*Z;
VQ = V*Q;
MVQ = M*V*Q;
XWZ = X*W*Z;
XVQ = X*V*Q;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON MV (b2);
  Y ON MQ (b3);
  Y ON MVQ (b4);
  Y ON X (cdash1);
  Y ON V (cdash2);
  Y ON Q (cdash3);
  Y ON XV (cdash4);
  Y ON XQ (cdash5);
  Y ON VQ (cdash6);
  Y ON XVQ (cdash7);

  [M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON Z (a3);
  M ON XW (a4);
  M ON XZ (a5);
  M ON WZ (a6);
  M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! For example, of 1 SD below mean, mean, 1 SD above mean
4 moderators, 3 values for each, gives 81 combinations
arbitrary naming convention for conditional indirect and
total effects used below:

<table>
<thead>
<tr>
<th>HHML = high value of W, high value of Z, medium value of V and low value of Q.</th>
</tr>
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</table>

MODEL CONSTRAINT:

```plaintext
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q)
```

```plaintext
ILLLL IMLLL IHLLL ILMLL IHMLL ILHLL IHMHL ILHHL IMLHL IMHLH IHHLH
ILLLL IMLLM IHLLM ILMLM IHMML ILHML IHMHL ILHHL IMLHL IMHLH IHHLH
ILLMM IMLMM IHLMM ILMMM IHMMM ILMHM IHMHH IHMHL IMHLM IHHLM
ILLMM IMLMM IHLMM ILMMM IHMMM ILMHM IHMHH IHMHL IMHLM IHHLM
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ILLH IMLH IHLHM ILMHM IHHMH ILMHL IHMHL IMLHL IMHLH IHHHL
```

<table>
<thead>
<tr>
<th>DLOV_LQ DMEV_LQ DHI_V_LQ DLOV_MEQ DMEV_MEQ DHI_V_MEQ</th>
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</table>

```plaintext
DLOV_HIQ DMEV_HIQ DHI_V_HIQ
```

```plaintext
TLLLL TMLLL THLLL TLLML TMLML THMLL TLHLL TMHLL THHLL
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```

```plaintext
LOW_W = #LOWW; ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W
LOW_Z = #LOWZ; ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
chosen high value of Z
LOW_V = #LOWV; ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your
chosen medium value of V
```
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

LOW_Q = #LOWQ;  ! replace #LOWQ in the code with your chosen low value of Q

MED_Q = #MEDQ;  ! replace #MEDQ in the code with your chosen medium value of Q

HIGH_Q = #HIGHQ;  ! replace #HIGHQ in the code with your chosen high value of Q

! Calc conditional indirect effects for each combination of moderator values

ILLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q + a1*b4*LOW_V*LOW_Q + a4*b4*LOW_W*LOW_V*LOW_Q + a5*b4*LOW_Z*LOW_V*LOW_Q + a7*b4*LOW_W*LOW_Z*LOW_V*LOW_Q;

IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q + a1*b4*MED_W*LOW_Q + a4*b4*MED_W*LOW_V*LOW_Q + a5*b4*LOW_Z*LOW_V*LOW_Q + a7*b4*LOW_W*LOW_Z*LOW_V*LOW_Q;

IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*HIGH_W*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q + a1*b4*HIGH_W*LOW_Q + a4*b4*HIGH_W*LOW_V*LOW_Q + a5*b4*LOW_Z*LOW_V*LOW_Q + a7*b4*HIGH_W*LOW_Z*LOW_V*LOW_Q;

ILMLL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*LOW_W*MED_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*LOW_W*MED_Z*LOW_Q + a1*b4*LOW_V*LOW_Q + a4*b4*LOW_W*LOW_V*LOW_Q + a5*b4*MED_Z*LOW_V*LOW_Q + a7*b4*LOW_W*MED_Z*LOW_V*LOW_Q;
\[ a_7b_4\text{LOW}_W\text{MED}_Z\text{LOW}_V\text{LOW}_Q; \]
\[
\text{IMM}L = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{MED}_Z + \\
a_7b_1\text{MED}_W\text{MED}_Z + \\
a_1b_2\text{LOW}_V + a_4b_2\text{MED}_W\text{LOW}_V + a_5b_2\text{MED}_Z\text{LOW}_V + \\
a_7b_2\text{MED}_W\text{MED}_Z\text{LOW}_V + a_1b_3\text{LOW}_Q + a_4b_3\text{MED}_W\text{LOW}_Q + \\
a_5b_3\text{MED}_Z\text{LOW}_Q + a_7b_3\text{MED}_W\text{MED}_Z\text{LOW}_Q + \\
a_1b_4\text{LOW}_V\text{LOW}_Q + \\
a_4b_4\text{MED}_W\text{LOW}_V\text{LOW}_Q + a_5b_4\text{MED}_Z\text{LOW}_V\text{LOW}_Q + \\
a_7b_4\text{MED}_W\text{MED}_Z\text{LOW}_V\text{LOW}_Q; \\
\text{IH}MLL = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{MED}_Z + \\
a_7b_1\text{HIGH}_W\text{MED}_Z + \\
a_1b_2\text{LOW}_V + a_4b_2\text{HIGH}_W\text{LOW}_V + a_5b_2\text{MED}_Z\text{LOW}_V + \\
a_7b_2\text{HIGH}_W\text{MED}_Z\text{LOW}_V + a_1b_3\text{LOW}_Q + \\
a_4b_3\text{HIGH}_W\text{LOW}_Q + \\
a_5b_3\text{MED}_Z\text{LOW}_Q + a_7b_3\text{HIGH}_W\text{MED}_Z\text{LOW}_Q + \\
a_1b_4\text{LOW}_V\text{LOW}_Q + \\
a_4b_4\text{HIGH}_W\text{LOW}_V\text{LOW}_Q + a_5b_4\text{MED}_Z\text{LOW}_V\text{LOW}_Q + \\
a_7b_4\text{HIGH}_W\text{MED}_Z\text{LOW}_V\text{LOW}_Q; \\
\text{IL}HLL = a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{HIGH}_Z + \\
a_7b_1\text{LOW}_W\text{HIGH}_Z + \\
a_1b_2\text{LOW}_V + a_4b_2\text{LOW}_W\text{LOW}_V + a_5b_2\text{HIGH}_Z\text{LOW}_V + \\
a_7b_2\text{LOW}_W\text{HIGH}_Z\text{LOW}_V + a_1b_3\text{LOW}_Q + \\
a_4b_3\text{LOW}_W\text{LOW}_Q + \\
a_5b_3\text{HIGH}_Z\text{LOW}_Q + a_7b_3\text{LOW}_W\text{HIGH}_Z\text{LOW}_Q + \\
a_1b_4\text{LOW}_V\text{LOW}_Q + \\
a_4b_4\text{LOW}_W\text{LOW}_V\text{LOW}_Q + a_5b_4\text{HIGH}_Z\text{LOW}_V\text{LOW}_Q + \\
a_7b_4\text{LOW}_W\text{HIGH}_Z\text{LOW}_V\text{LOW}_Q; \\
\text{IM}HLL = a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{HIGH}_Z + \\
a_7b_1\text{MED}_W\text{HIGH}_Z + \\
a_1b_2\text{LOW}_V + a_4b_2\text{MED}_W\text{LOW}_V + a_5b_2\text{HIGH}_Z\text{LOW}_V + \\
a_7b_2\text{MED}_W\text{HIGH}_Z\text{LOW}_V + a_1b_3\text{LOW}_Q + \\
a_4b_3\text{MED}_W\text{LOW}_Q + \\
a_5b_3\text{HIGH}_Z\text{LOW}_Q + a_7b_3\text{MED}_W\text{HIGH}_Z\text{LOW}_Q + \\
a_1b_4\text{LOW}_V\text{LOW}_Q + \\
a_4b_4\text{MED}_W\text{LOW}_V\text{LOW}_Q + a_5b_4\text{HIGH}_Z\text{LOW}_V\text{LOW}_Q + \\
a_7b_4\text{MED}_W\text{HIGH}_Z\text{LOW}_V\text{LOW}_Q; \\
\text{IH}HLL = a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{HIGH}_Z + \\
a_7b_1\text{HIGH}_W\text{HIGH}_Z + \\
a_1b_2\text{LOW}_V + a_4b_2\text{HIGH}_W\text{LOW}_V + a_5b_2\text{HIGH}_Z\text{LOW}_V + \\
a_7b_2\text{HIGH}_W\text{HIGH}_Z\text{LOW}_V + a_1b_3\text{LOW}_Q + \\
a_4b_3\text{HIGH}_W\text{LOW}_Q + \\
a_5b_3\text{HIGH}_Z\text{LOW}_Q + a_7b_3\text{HIGH}_W\text{HIGH}_Z\text{LOW}_Q + \\
a_1b_4\text{HIGH}_V\text{LOW}_Q + \\
a_4b_4\text{HIGH}_W\text{LOW}_V\text{LOW}_Q + a_5b_4\text{HIGH}_Z\text{LOW}_V\text{LOW}_Q + \\
a_7b_4\text{HIGH}_W\text{HIGH}_Z\text{LOW}_V\text{LOW}_Q;
ILLML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q +
+ a5*b3*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q +
a1*b4*MED_V*LOW_Q +
a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q +
a7*b4*LOW_W*LOW_Z*MED_V*LOW_Q;

IMLML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q +
+ a5*b3*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q +
a1*b4*MED_V*LOW_Q +
a4*b4*MED_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q +
a7*b4*LOW_W*LOW_Z*MED_V*LOW_Q;

IHLM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q +
+ a5*b3*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q +
a1*b4*MED_V*LOW_Q +
a4*b4*HIGH_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q +
a7*b4*HIGH_W*LOW_Z*MED_V*LOW_Q;

ILMML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*LOW_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q +
+ a5*b3*LOW_Q + a7*b3*LOW_W*MED_Z*LOW_Q +
a1*b4*MED_V*LOW_Q +
a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q +
a7*b4*LOW_W*MED_Z*MED_V*LOW_Q;

IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*MED_Q +
+ a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q +
a1*b4*MED_V*MED_Q +
a4*b4*MED_W*MED_V*MED_Q + a5*b4*MED_Z*MED_V*MED_Q +
a7*b4*MED_W*MED_Z*MED_V*MED_Q;

IHMMML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*HIGH_W*MED_Z*LOW_Q + a1*b4*LOW_W*MED_Q + a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q + a7*b4*LOW_W*MED_V*MED_V*LOW_Q;

ILHML = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*LOW_W*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q + a7*b4*MED_V*MED_V*LOW_Q;

IMHML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*MED_W*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q + a7*b4*MED_V*MED_V*LOW_Q;

IHHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*HIGH_W*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q + a7*b4*MED_V*MED_V*LOW_Q;

ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q + a7*b4*LOW_W*LOW_Z*HIGH_V*LOW_Q;

IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*MED_W*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q + a7*b4*MED_V*MED_V*LOW_Q;

IHHML = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*HIGH_W*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q + a7*b4*MED_V*MED_V*LOW_Q;

IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*MED_W*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q + a1*b4*MED_V*LOW_Q + a4*b4*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q + a7*b4*MED_V*MED_V*LOW_Q;

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a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q +
a7*b4*MED_W*LOW_Z*HIGH_V*LOW_Q;
IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*HIGH_W*LOW_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*HIGH_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*HIGH_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q +
a7*b4*HIGH_W*LOW_Z*HIGH_V*LOW_Q;
IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*HIGH_W*LOW_Q +
a5*b3*LOW_Z*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*HIGH_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q +
a7*b4*HIGH_W*LOW_Z*HIGH_V*LOW_Q;
ILMHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*LOW_W*LOW_Q +
a5*b3*MED_Z*LOW_Q + a7*b3*LOW_W*MED_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*MED_Z*HIGH_V*LOW_Q +
a7*b4*LOW_W*MED_Z*HIGH_V*LOW_Q;
IMMHHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q +
a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*MED_Z*HIGH_V*LOW_Q +
a7*b4*MED_W*MED_Z*HIGH_V*LOW_Q;
IMMHHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*LOW_Q +
a4*b3*MED_W*LOW_Q +
a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q +
a1*b4*HIGH_V*LOW_Q +
a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*MED_Z*HIGH_V*LOW_Q +
a7*b4*MED_W*MED_Z*HIGH_V*LOW_Q;
ILHHL = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a7*b2*LOW_W*HIGH_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q + a7*b3*LOW_W*HIGH_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*HIGH_Z*HIGH_V*LOW_Q + a7*b4*LOW_W*HIGH_Z*HIGH_V*LOW_Q;

IMHHHL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z;

IHHHL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V + a7*b2*MED_W*HIGH_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*HIGH_Z*LOW_Q + a7*b3*MED_W*HIGH_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*MED_W*HIGH_Z*LOW_Q + a7*b4*MED_W*HIGH_Z*LOW_Q;

IMLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q;

IMLLM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q;

IHHLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*MED_W*LOW_Z*LOW_Q + a7*b4*MED_W*LOW_Z*LOW_Q;

IMHHL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q + a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q + a1*b4*HIGH_V*LOW_Q + a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*MED_W*LOW_Z*LOW_Q + a7*b4*MED_W*LOW_Z*LOW_Q;
a7*b1*HIGH_W*LOW_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*HIGH_W*LOW_Z*LOW_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*HIGH_W*LOW_Z*MED_Q +
a1*b4*LOW_V*MED_Q +
a4*b4*HIGH_W*LOW_V*MED_Q + a5*b4*LOW_Z*LOW_V*MED_Q +
a7*b4*HIGH_W*LOW_Z*LOW_V*MED_Q;

ILMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*LOW_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q +
a1*b4*LOW_V*MED_Q +
a4*b4*LOW_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q +
a7*b4*LOW_W*MED_Z*LOW_V*MED_Q;

IMMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*LOW_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q +
a1*b4*LOW_V*MED_Q +
a4*b4*LOW_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q +
a7*b4*LOW_W*MED_Z*LOW_V*MED_Q;

IHMLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V +
a7*b2*LOW_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q +
a1*b4*LOW_V*MED_Q +
a4*b4*LOW_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q +
a7*b4*LOW_W*MED_Z*LOW_V*MED_Q;

ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*LOW_W*HIGH_Z*LOW_V + a1*b3*MED_Q +
a4*b3*LOW_W*MED_Q +
a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q +
a1*b4*LOW_V*MED_Q +
a4*b4*LOW_W*LOW_V*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q +
a7*b4*LOW_W*HIGH_Z*LOW_V*MED_Q;

IMHLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*HIGH_Z*MED_Q + a7*b3*MED_W*HIGH_Z*MED_Q +
a1*b4*LOW_V*MED_Q +
a4*b4*MED_W*LOW_V*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q +
a7*b4*MED_W*HIGH_Z*LOW_V*MED_Q;
IHHLM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*HIGH_W*HIGH_Z*LOW_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q +
a5*b3*HIGH_Z*MED_Q + a7*b3*HIGH_W*HIGH_Z*MED_Q +
a1*b4*LOW_V*MED_Q +
a4*b4*HIGH_W*LOW_V*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q +
a7*b4*HIGH_W*HIGH_Z*LOW_V*MED_Q;
ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*LOW_W*LOW_Z*MED_Q +
a1*b4*MED_V*MED_Q +
a4*b4*LOW_W*MED_V*MED_Q + a5*b4*LOW_Z*MED_V*MED_Q +
a7*b4*LOW_W*LOW_Z*MED_V*MED_Q;
IMLMM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*MED_W*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q +
a1*b4*MED_V*MED_Q +
a4*b4*MED_W*MED_V*MED_Q + a5*b4*LOW_Z*MED_V*MED_Q +
a7*b4*MED_W*LOW_Z*MED_V*MED_Q;
IHLMM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*HIGH_W*LOW_Z*MED_Q +
a1*b4*HIGH_W*MED_Q +
a4*b4*HIGH_W*MED_V*MED_Q + a5*b4*LOW_Z*MED_V*MED_Q +
a7*b4*HIGH_W*LOW_Z*MED_V*MED_Q;
ILMMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*LOW_W*MED_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q +
a1*b4*MED_V*MED_Q +
a4*b4*LOW_W*MED_V*MED_Q + a5*b4*MED_Z*MED_V*MED_Q +
a7*b4*LOW_W*MED_Z*MED_V*MED_Q;
IMMMM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q +
a1*b4*MED_V*MED_Q +
a4*b4*MED_W*MED_V*MED_Q + a5*b4*MED_Z*MED_V*MED_Q +
a7*b4*MED_W*MED_Z*MED_V*MED_Q;
IHMMM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*HIGH_W*MED_Z*MED_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*HIGH_W*MED_Z*MED_Q +
a1*b4*MED_V*MED_Q +
a4*b4*HIGH_W*MED_V*MED_Q + a5*b4*MED_Z*MED_V*MED_Q +
a7*b4*HIGH_W*MED_Z*MED_V*MED_Q;
ILHMM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*MED_Q +
a4*b3*LOW_W*MED_Q +
a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q +
a1*b4*MED_V*MED_Q +
a4*b4*LOW_W*MED_V*MED_Q + a5*b4*HIGH_Z*MED_V*MED_Q +
a7*b4*LOW_W*HIGH_Z*MED_V*MED_Q;
IMHMM = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*MED_W*HIGH_Z*MED_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*HIGH_Z*MED_Q + a7*b3*MED_W*HIGH_Z*MED_Q +
a1*b4*MED_V*MED_Q +
a4*b4*MED_W*MED_V*MED_Q + a5*b4*HIGH_Z*MED_V*MED_Q +
a7*b4*MED_W*HIGH_Z*MED_V*MED_Q;
IHHMM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V +
a7*b2*HIGH_W*HIGH_Z*MED_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q +
a5*b3*HIGH_Z*MED_Q + a7*b3*HIGH_W*HIGH_Z*MED_Q;
a5*b3*HIGH_Z*MED_Q + a7*b3*HIGH_W*HIGH_Z*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*HIGH_W*MED_V*MED_Q + a5*b4*HIGH_Z*MED_V*MED_Q +
a7*b4*HIGH_W*HIGH_Z*MED_V*MED_Q;

ILLHM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*LOW_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*LOW_W*LOW_Z*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*LOW_W*HIGH_V*MED_Q + a5*b4*LOW_Z*HIGH_V*MED_Q +
a7*b4*LOW_W*LOW_Z*HIGH_V*MED_Q;

IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
a5*b3*LOW_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*MED_W*HIGH_V*MED_Q + a5*b4*LOW_Z*HIGH_V*MED_Q +
a7*b4*MED_W*LOW_Z*HIGH_V*MED_Q;

IHLHM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V +
a7*b2*HIGH_W*LOW_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*HIGH_W*MED_Q +
a5*b3*LOW_W*MED_Q + a7*b3*HIGH_W*LOW_W*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*HIGH_W*HIGH_V*MED_Q + a5*b4*LOW_Z*HIGH_V*MED_Q +
a7*b4*HIGH_W*LOW_Z*HIGH_V*MED_Q;

ILMIIH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*LOW_W*MED_Q +
a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q +
a1*b4*HIGH_V*MED_Q +
a4*b4*LOW_W*HIGH_V*MED_Q + a5*b4*MED_Z*HIGH_V*MED_Q +
a7*b4*LOW_W*MED_Z*HIGH_V*MED_Q;

IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*MED_Q +
\[ a5*b3*MED_Z*\text{MED}_Q + a7*b3*MED_W*\text{MED}_Z*\text{MED}_Q + \\
\quad a1*b4*\text{HIGH}_V*\text{MED}_Q + \\
\quad a4*b4*\text{MED}_W*\text{HIGH}_V*\text{MED}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + \\
\quad a1*b4*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q; \\
\text{IHMHM} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{MED}_Z + \\
\quad a7*b1*\text{HIGH}_W*\text{MED}_Z + \\
\quad a1*b2*\text{HIGH}_V + a4*b2*\text{HIGH}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + \\
\quad a7*b2*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q + a1*b3*\text{MED}_Q + \\
\quad a4*b3*\text{HIGH}_W*\text{MED}_Q + a5*b3*\text{MED}_Z*\text{MED}_Q + a7*b3*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q + \\
\quad a1*b4*\text{HIGH}_V*\text{MED}_Q + \\
\quad a4*b4*\text{MED}_W*\text{HIGH}_V*\text{MED}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_V*\text{MED}_Q + \\
\quad a1*b4*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q; \\
\text{ILHHM} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{HIGH}_Z + \\
\quad a7*b1*\text{LOW}_W*\text{HIGH}_Z + \\
\quad a1*b2*\text{HIGH}_V + a4*b2*\text{LOW}_W*\text{HIGH}_V + a5*b2*\text{HIGH}_Z*\text{HIGH}_V + \\
\quad a7*b2*\text{LOW}_W*\text{HIGH}_Z*\text{HIGH}_V + a1*b3*\text{MED}_Q + \\
\quad a4*b3*\text{MED}_Z*\text{MED}_Q + a5*b3*\text{LOW}_W*\text{HIGH}_Z*\text{MED}_Q + \\
\quad a1*b4*\text{LOW}_W*\text{MED}_Q + \\
\quad a4*b4*\text{LOW}_W*\text{MED}_Q + a5*b4*\text{HIGH}_Z*\text{HIGH}_V*\text{MED}_Q + \\
\quad a7*b4*\text{MED}_W*\text{MED}_Z*\text{MED}_Q; \\
\text{IMHHM} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{HIGH}_Z + \\
\quad a7*b1*\text{MED}_W*\text{HIGH}_Z + \\
\quad a1*b2*\text{HIGH}_V + a4*b2*\text{MED}_W*\text{HIGH}_V + a5*b2*\text{HIGH}_Z*\text{HIGH}_V + \\
\quad a7*b2*\text{MED}_W*\text{HIGH}_Z*\text{HIGH}_V + a1*b3*\text{MED}_Q + \\
\quad a4*b3*\text{HIGH}_W*\text{MED}_Q + a5*b3*\text{HIGH}_Z*\text{MED}_Q + a7*b3*\text{MED}_W*\text{MED}_Q + \\
\quad a1*b4*\text{HIGH}_V*\text{MED}_Q + \\
\quad a4*b4*\text{HIGH}_W*\text{MED}_Q + a5*b4*\text{HIGH}_Z*\text{MED}_Q + \\
\quad a7*b4*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q; \\
\text{IHHHM} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{HIGH}_Z + \\
\quad a7*b1*\text{HIGH}_W*\text{HIGH}_Z + \\
\quad a1*b2*\text{HIGH}_V + a4*b2*\text{HIGH}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + \\
\quad a7*b2*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q + a1*b3*\text{MED}_Q + \\
\quad a4*b3*\text{MED}_W*\text{MED}_Q + a5*b3*\text{HIGH}_Z*\text{MED}_Q + a7*b3*\text{MED}_W*\text{MED}_Z*\text{MED}_Q + \\
\quad a1*b4*\text{HIGH}_V*\text{MED}_Q + \\
\quad a4*b4*\text{HIGH}_W*\text{MED}_Q + a5*b4*\text{HIGH}_Z*\text{MED}_Q + \\
\quad a7*b4*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q; \\
\text{ILLLL} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{LOW}_Z + \\
\quad a7*b1*\text{LOW}_W*\text{LOW}_Z + \\
\quad a4*b4*\text{LOW}_W*\text{MED}_Q + a5*b4*\text{LOW}_Z*\text{MED}_Q + \\
\quad a7*b4*\text{LOW}_W*\text{MED}_Z*\text{MED}_Q; \\
\text{IHHHM} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{HIGH}_Z + \\
\quad a7*b1*\text{HIGH}_W*\text{HIGH}_Z + \\
\quad a1*b2*\text{HIGH}_V + a4*b2*\text{HIGH}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + \\
\quad a7*b2*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q + a1*b3*\text{MED}_Q + \\
\quad a4*b3*\text{HIGH}_W*\text{MED}_Q + a5*b3*\text{HIGH}_Z*\text{MED}_Q + a7*b3*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q + \\
\quad a1*b4*\text{HIGH}_V*\text{MED}_Q + \\
\quad a4*b4*\text{HIGH}_W*\text{MED}_Q + a5*b4*\text{HIGH}_Z*\text{MED}_Q + \\
\quad a7*b4*\text{HIGH}_W*\text{MED}_Z*\text{MED}_Q; \\
\text{ILLLH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{LOW}_Z + \\
\quad a7*b1*\text{LOW}_W*\text{LOW}_Z + \\
\quad a4*b4*\text{LOW}_W*\text{MED}_Q + a5*b4*\text{LOW}_Z*\text{MED}_Q + \\
\quad a7*b4*\text{LOW}_W*\text{MED}_Z*\text{MED}_Q; \]
\[a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
\]
\[a4*b3*LOW_W*HIGH_Q +
\]
\[a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q +
\]
\[a1*b4*LOW_V*HIGH_Q +
\]
\[a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q + a7*b4*LOW_W*LOW_Z*LOW_V*HIGH_Q;
\]
\[IMLLH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
\]
\[a7*b1*MED_W*LOW_Z +
\]
\[a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*MED_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
\]
\[a4*b3*MED_W*HIGH_Q +
\]
\[a5*b3*LOW_Z*HIGH_Q + a7*b3*MED_W*LOW_Z*HIGH_Q +
\]
\[a1*b4*LOW_V*HIGH_Q +
\]
\[a4*b4*MED_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q + a7*b4*MED_W*LOW_Z*LOW_V*HIGH_Q;
\]
\[IMLLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
\]
\[a7*b1*HIGH_W*LOW_Z +
\]
\[a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*HIGH_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
\]
\[a4*b3*HIGH_W*HIGH_Q +
\]
\[a5*b3*LOW_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q +
\]
\[a1*b4*LOW_V*HIGH_Q +
\]
\[a4*b4*HIGH_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q + a7*b4*HIGH_W*LOW_Z*LOW_V*HIGH_Q;
\]
\[ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
\]
\[a7*b1*LOW_W*MED_Z +
\]
\[a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*LOW_W*MED_Z*LOW_V + a1*b3*HIGH_Q +
\]
\[a4*b3*LOW_W*HIGH_Q +
\]
\[a5*b3*MED_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q +
\]
\[a1*b4*LOW_V*HIGH_Q +
\]
\[a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q + a7*b4*LOW_W*MED_Z*LOW_V*HIGH_Q;
\]
\[IMMLH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
\]
\[a7*b1*MED_W*MED_Z +
\]
\[a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*MED_W*MED_Z*LOW_V + a1*b3*HIGH_Q +
\]
\[a4*b3*MED_Z*HIGH_Q +
\]
\[a5*b3*MED_Z*HIGH_Q + a7*b3*MED_W*MED_Z*HIGH_Q +
\]
\[a1*b4*LOW_V*HIGH_Q +
\]
\[a4*b4*MED_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q + a7*b4*MED_W*MED_Z*LOW_V*HIGH_Q;
\]
\[IHMLH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
\]
a4*b3*HIGH_W*HIGH_Q +
a5*b3*MED_Z*HIGH_Q + a7*b3*HIGH_W*MED_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*HIGH_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q +
a7*b4*HIGH_W*MED_Z*LOW_V*HIGH_Q;

ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*LOW_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*LOW_W*HIGH_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*HIGH_Z*LOW_V*HIGH_Q +
IHLHL = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*MED_W*LOW_V*HIGH_Q + a5*b4*HIGH_Z*LOW_V*HIGH_Q +
IMHHL = a1*b1 + a4*b1*LOW_V + a5*b1*LOW_Z +
a7*b1*LOW_V*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +

IHHLH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*HIGH_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*HIGH_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*HIGH_W*HIGH_Z*HIGH_Q +
IHLLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*LOW_W*HIGH_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*LOW_W*HIGH_Z*HIGH_Q +
IMHHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q +

ILLMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
IHMHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V +
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q +
IHMML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
a7*b2*MED_W*MED_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*MED_W*LOW_Z*HIGH_Q +
a1*b4*MED_V*HIGH_Q +
a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*LOW_Z*MED_V*HIGH_Q + a7*b4*MED_W*LOW_Z*MED_V*HIGH_Q;
IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*HIGH_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q +
a1*b4*MED_V*HIGH_Q +
a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*LOW_Z*MED_V*HIGH_Q + a7*b4*HIGH_W*LOW_Z*MED_V*HIGH_Q;
IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +

a7*b1*HIGH_W*LOW_Z +
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*HIGH_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q +
a1*b4*MED_V*HIGH_Q +
a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*LOW_Z*MED_V*HIGH_Q + a7*b4*HIGH_W*LOW_Z*MED_V*HIGH_Q;
ILMMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*LOW_W*MED_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*MED_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q +
a1*b4*MED_V*HIGH_Q +
a4*b4*LOW_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q + a7*b4*LOW_W*MED_Z*MED_V*HIGH_Q;
IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*MED_W*MED_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*MED_W*HIGH_Q +
a5*b3*MED_Z*HIGH_Q + a7*b3*MED_W*MED_Z*HIGH_Q +
a1*b4*HIGH_W*MED_V*HIGH_Q +
a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q + a7*b4*HIGH_W*MED_Z*MED_V*HIGH_Q;
IHMHM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
IIHHM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
IIHMH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*LOW_W*HIGH_Z*HIGH_Q +

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a1*b4*MED_V*HIGH_Q + 
a4*b4*LOW_W*MED_V*HIGH_Q + a5*b4*HIGH_Z*MED_V*HIGH_Q + 
a7*b4*LOW_W*HIGH_Z*MED_V*HIGH_Q;
IMHMH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + 
a7*b1*MED_W*HIGH_Z + 
a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V + 
a7*b2*MED_W*HIGH_Z*MED_V + a1*b3*HIGH_Q + 
a4*b3*MED_W*HIGH_Q + 
a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q + 
a1*b4*MED_V*HIGH_Q + 
a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*HIGH_Z*MED_V*HIGH_Q + 
a7*b4*MED_W*HIGH_Z*MED_V*HIGH_Q;
IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + 
a7*b1*HIGH_W*HIGH_Z + 
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V + 
a7*b2*HIGH_W*HIGH_Z*MED_V + a1*b3*HIGH_Q + 
a4*b3*HIGH_W*HIGH_Q + 
a5*b3*HIGH_Z*HIGH_Q + a7*b3*HIGH_W*HIGH_Z*HIGH_Q + 
a1*b4*HIGH_W*HIGH_Q + 
a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*HIGH_Z*MED_V*HIGH_Q + 
a7*b4*HIGH_W*HIGH_Z*MED_V*HIGH_Q;
ILLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*LOW_W*LOW_Z + 
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b3*HIGH_Q + 
a4*b3*LOW_W*HIGH_Q + 
a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q + 
a1*b4*HIGH_V*HIGH_Q + 
a4*b4*LOW_W*HIGH_V*HIGH_Q + a5*b4*LOW_Z*HIGH_V*HIGH_Q + 
a7*b4*LOW_W*LOW_Z*HIGH_V*HIGH_Q;
IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + 
a7*b1*MED_W*LOW_Z + 
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*HIGH_Q + 
a4*b3*MED_W*HIGH_Q + 
a5*b3*LOW_Z*HIGH_Q + a7*b3*MED_W*LOW_Z*HIGH_Q + 
a1*b4*HIGH_V*HIGH_Q + 
a4*b4*MED_W*HIGH_V*HIGH_Q + a5*b4*LOW_Z*HIGH_V*HIGH_Q + 
a7*b4*MED_W*LOW_Z*HIGH_V*HIGH_Q;
IHLHH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + 
a7*b1*HIGH_W*LOW_Z + 
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*HIGH_W*LOW_Z*HIGH_V + a1*b3*HIGH_Q + 
a4*b3*HIGH_W*HIGH_Q + 
a5*b3*LOW_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q + 
a1*b4*HIGH_V*HIGH_Q + 
a4*b4*HIGH_W*LOW_Z*HIGH_V + a5*b4*LOW_Z*HIGH_V + 
a7*b4*HIGH_W*LOW_Z*HIGH_V + a1*b3*HIGH_Q + 
a4*b3*HIGH_W*HIGH_Q + 
a5*b3*LOW_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q + 
a1*b4*HIGH_V*HIGH_Q +
a4*b4*HIGH_W*HIGH_V*HIGH_Q + a5*b4*LOW_Z*HIGH_V*HIGH_Q +
a7*b4*HIGH_W*LOW_Z*HIGH_V*HIGH_Q;

ILMHH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*MED_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q +
a1*b4*HIGH_V*HIGH_Q +
a4*b4*LOW_W*HIGH_V*HIGH_Q + a5*b4*MED_Z*HIGH_V*HIGH_Q +
a7*b4*LOW_W*MED_Z*HIGH_V*HIGH_Q;

IMMHH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
a7*b1*MED_W*MED_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*HIGH_Q +
a5*b3*MED_Z*HIGH_Q + a7*b3*MED_W*MED_Z*HIGH_Q +
a1*b4*HIGH_Q +
a4*b4*MED_W*HIGH_V*HIGH_Q + a5*b4*MED_Z*HIGH_V*HIGH_Q +
a7*b4*MED_W*MED_Z*HIGH_V*HIGH_Q;

IHMHH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a7*b1*HIGH_W*MED_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*HIGH_W*MED_Z*HIGH_V + a1*b3*HIGH_Q +
a4*b3*HIGH_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*HIGH_W*MED_Z*HIGH_Q +
a1*b4*HIGH_Q +
a4*b4*HIGH_W*HIGH_V*HIGH_Q + a5*b4*HIGH_Z*HIGH_V*HIGH_Q +
a7*b4*HIGH_W*MED_Z*HIGH_V*HIGH_Q;

ILHHH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a7*b1*LOW_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*LOW_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q +
a1*b4*LOW_W*HIGH_Q +
a4*b4*LOW_W*HIGH_V*HIGH_Q + a5*b4*HIGH_Z*HIGH_V*HIGH_Q +
a7*b4*LOW_W*MED_Z*HIGH_V*HIGH_Q;

IMHHH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a7*b1*MED_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V +
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*MED_Q +
a4*b3*MED_W*HIGH_Q +

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a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*HIGH_Z*HIGH_Q +
a1*b4*HIGH_V*HIGH_Q +
a4*b4*MED_W*HIGH_V*HIGH_Q + a5*b4*HIGH_Z*HIGH_V*HIGH_Q +
a7*b4*MED_W*HIGH_Z*HIGH_V*HIGH_Q;
IHHHH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a7*b1*HIGH_W*HIGH_Z +
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*HIGH_Z*HIGH_V +
a7*b2*HIGH_W*HIGH_Z*HIGH_V + a1*b3*HIGH_Q +
a4*b3*HIGH_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*HIGH_W*HIGH_Z*HIGH_Q +
a1*b4*HIGH_V*HIGH_Q +
a4*b4*HIGH_W*HIGH_V*HIGH_Q + a5*b4*HIGH_Z*HIGH_V*HIGH_Q +
a7*b4*HIGH_W*HIGH_Z*HIGH_V*HIGH_Q;

! Calc conditional direct effects for each combination of moderator values

DLOV_LOQ = cdash1 + cdash4*LOW_V + cdash5*LOW_Q +
          cdash7*LOW_V*LOW_Q;
DMEV_LOQ = cdash1 + cdash4*MED_W + cdash5*LOW_Q +
          cdash7*MED_W*LOW_Q;
DHIV_LOQ = cdash1 + cdash4*HIGH_V + cdash5*LOW_Q +
          cdash7*HIGH_V*LOW_Q;

DLOV_MEQ = cdash1 + cdash4*LOW_V + cdash5*MED_Q +
          cdash7*LOW_V*MED_Q;
DMEV_MEQ = cdash1 + cdash4*MED_W + cdash5*MED_Q +
          cdash7*MED_W*MED_Q;
DHIV_MEQ = cdash1 + cdash4*HIGH_V + cdash5*MED_Q +
          cdash7*HIGH_V*MED_Q;

DLOV_HIQ = cdash1 + cdash4*LOW_V + cdash5*HIGH_Q +
          cdash7*LOW_V*HIGH_Q;
DMEV_HIQ = cdash1 + cdash4*MED_W + cdash5*HIGH_Q +
          cdash7*MED_W*HIGH_Q;
DHIV_HIQ = cdash1 + cdash4*HIGH_V + cdash5*HIGH_Q +
          cdash7*HIGH_V*HIGH_Q;

! Calc conditional total effects for each combination of moderator values

TLLLL = ILLLL + DLOV_LOQ;
TMLLL = IMLLL + DLOV_LOQ;
THLLL = IHLLL + DLOV_LOQ;
TLMLL = ILMLL + DLOV_LOQ;
TMMLL = IMMLL + DLOV_LOQ;
THMLL = IHMLL + DLOV_LOQ;
TLHLL = ILHLL + DLOV_LOQ;
TMHLL = IMHLL + DLOV_LOQ;
THHLL = IHHLL + DLOV_LOQ;
TLLML = ILLML + DMEV_LOQ;
TMLML = IMLML + DMEV_LOQ;
THLML = IHLML + DMEV_LOQ;
TLMML = ILMML + DMEV_LOQ;
TMMML = IMMML + DMEV_LOQ;
THMML = IHMML + DMEV_LOQ;
TLHML = ILHML + DMEV_LOQ;
TMHML = IMHML + DMEV_LOQ;
THHML = IHHML + DMEV_LOQ;
TLLHL = ILLHL + DHIV_LOQ;
TMLHL = IMLHL + DHIV_LOQ;
THLHL = IHLHL + DHIV_LOQ;
TLMHL = ILMHL + DHIV_LOQ;
TMMHL = IMMHL + DHIV_LOQ;
THMHL = IHMHL + DHIV_LOQ;
TLHHL = ILHHL + DHIV_LOQ;
TMHHL = IMHHL + DHIV_LOQ;
THHHL = IHHHL + DHIV_LOQ;
TLLLM = ILLLM + DLOV_MEQ;
TMLLM = IMLLM + DLOV_MEQ;
THLLM = IHLLM + DLOV_MEQ;
TLLLM = ILMLM + DLOV_MEQ;
TMLLM = IMMML + DLOV_MEQ;
THMLM = IHMLM + DLOV_MEQ;
TLHLM = ILHLM + DLOV_MEQ;
TMHLM = IMHLM + DLOV_MEQ;
THHLM = IHHLM + DLOV_MEQ;
TLLMM = ILLMM + DMEV_MEQ;
TMLMM = IMLMM + DMEV_MEQ;
THLMM = IHLMM + DMEV_MEQ;
TLMMM = ILMMM + DMEV_MEQ;
TMMMM = IMM MM + DMEV_MEQ;
THMMM = IHMMM + DMEV_MEQ;
TLHMM = ILHMM + DMEV_MEQ;
TMHMM = IMHMM + DMEV_MEQ;
THHMM = IHHMM + DMEV_MEQ;
TLLHM = ILLHM + DHI\textunderscore MEQ;
TMLHM = IMLHM + DHI\textunderscore MEQ;
THLHM = IHLHM + DHI\textunderscore MEQ;
TLMHM = ILMHM + DHI\textunderscore MEQ;
TMMHM = IMMHM + DHI\textunderscore MEQ;
THMHM = IHMHM + DHI\textunderscore MEQ;
TLHHM = ILHHM + DLOV\textunderscore HIQ;
TMLHH = IMLHH + DLOV\textunderscore HIQ;
THLHH = IHLHH + DLOV\textunderscore HIQ;
TLMHH = ILMHH + DLOV\textunderscore HIQ;
TMMHH = IMMHH + DLOV\textunderscore HIQ;
THMHH = IHMHH + DLOV\textunderscore HIQ;
TLLMH = ILLMH + DMEV\textunderscore HIQ;
TMLMH = IMLMH + DMEV\textunderscore HIQ;
THLMH = IHLMH + DMEV\textunderscore HIQ;
TLMMH = ILMMH + DMEV\textunderscore HIQ;
TMMMH = IMMMH + DMEV\textunderscore HIQ;
THMMH = IHMMH + DMEV\textunderscore HIQ;
TLLHH = ILLHH + DHI\textunderscore HIQ;
TMLHH = IMLHH + DHI\textunderscore HIQ;
THLHH = IHLHH + DHI\textunderscore HIQ;
TLMHH = ILMHH + DHI\textunderscore HIQ;
TMMHH = IMMHH + DHI\textunderscore HIQ;
THMHH = IHMHH + DHI\textunderscore HIQ;
TLHHH = ILHHH + DLOV\textunderscore HIQ;
TMLHH = IMLHH + DLOV\textunderscore HIQ;
THLHH = IHLHH + DLOV\textunderscore HIQ;
TLMHH = ILMHH + DLOV\textunderscore HIQ;
TMMHH = IMMHH + DLOV\textunderscore HIQ;
THMHH = IHMHH + DLOV\textunderscore HIQ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by

! logical min and max limits of predictor X used in analysis

PLOT(PLLLL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL
 PHHLL
 PLLML PMLML PHLML PLMML PMMML PHMML PMLML PLHML PMHML PHHML
 PLLHL PMLHL PHLHL PLMHL PMMHL PHMHL PLMLH PMMLH PHMML PHHML
 PLLLM PMLLM PHLLM PLMLM PMLLM PHMLM PLHLM PMHLM PHHLM
 PLLMM PMLMM PHLMM PMLMM PMMML PHMML PLHMM PMHMM PHHMM
 PLLHM PMLHM PHLHM PLMHM PMMHM PHMHM PLHMM PMHMM PHHMM
 PLLLH PMLLH PHLH PMLH PMLH PHMH PMLH PMMH PHHMM
 PLLMH PMLMH PHLMH PLMHM PMMHM PHMHH PLMHH PMMHH PHHMM
 PLLHL PMLHL PHLHL PLMHL PMMLH PHMLH PLHHL PMHHL PHHHL
 PLLHL PMLHL PHLHL PLMHL PMMLH PHMLH PLHHL PMHHL PHHHL
 PLLHL PMLHL PHLHL PLMHL PMMLH PHMLH PLHHL PMHHL PHHHL
 PLLHL PMLHL PHLHL PLMHL PMMLH PHMLH PLHHL PMHHL PHHHL

LOOP(XVAL,1,5,0.1);

PLLLL = ILLL*XVAL;
PMLLL = IMLL*XVAL;
PHLLL = IHLLL*XVAL;

PLMLL = ILML*XVAL;
PMMLL = IMM*XVAL;
PHMLL = IHM*XVAL;

PLHLL = ILHL*XVAL;
PMHLL = IMHL*XVAL;
PHHLL = IHHL*XVAL;

PLLML = IML*XVAL;
PMLML = IMM*XVAL;
PHLML = IHM*XVAL;

PLMML = ILM*XVAL;
PMMML = IMM*XVAL;
PHMML = IHM*XVAL;

PLLHL = IML*XVAL;
PMLHL = IMM*XVAL;
PHLHL = IHM*XVAL;

PLMH = IML*XVAL;
PMMH = IMM*XVAL;
PHMH = IHM*XVAL;

PLLHL = IML*XVAL;
PMLHL = IMM*XVAL;
PHLHL = IHM*XVAL;

PLHHL = ILH*XVAL;
PMHHL = IMH*XVAL;
PHHHL = IHH*XVAL;
PLLMM = ILLLM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLM = IHLLM*XVAL;

PLMLM = ILMLM*XVAL;
PMMLM = IMMLM*XVAL;
PHMLM = IHMLM*XVAL;

PLHLM = ILHLM*XVAL;
PMLHM = IMLHM*XVAL;
PHHLM = IHHLM*XVAL;

PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PHLMM = IHLMM*XVAL;

PLMMM = ILMMM*XVAL;
PMMMM = IMMMM*XVAL;
PHMMM = IHMMM*XVAL;

PLHMM = ILHMM*XVAL;
PMLHM = IMLHM*XVAL;
PHHMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLLM = IMLLM*XVAL;
PHLLM = IHLLM*XVAL;

PLMLH = ILMLH*XVAL;
PMMLH = IMMLH*XVAL;
PHMLH = IHMLH*XVAL;

PLHLM = ILHLM*XVAL;
PMLHM = IMLHM*XVAL;
PHHLM = IHHLM*XVAL;

PLLH = ILLLH*XVAL;
PMLH = IMLLH*XVAL;
PHLH = IHLLH*XVAL;

PLML = ILML*XVAL;
PMML = IMML*XVAL;
PHML = IHML*XVAL;

PLH = ILH*XVAL;
PMLH = IMLH*XVAL;
PHLH = IHLH*XVAL;

PLL = ILL*XVAL;
PML = IML*XVAL;
PHL = IHL*XVAL;

P = I*XVAL;
PLMMH = ILMMH*XVAL;
PMMMH = IMMMH*XVAL;
PHMMH = IHMMH*XVAL;
PLHMH = ILHMH*XVAL;
PMHMH = IMHMH*XVAL;
PHHMH = IHHMH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PMLHH = IMLHH*XVAL;
PLMHH = ILMHH*XVAL;
PMMHH = IMMHH*XVAL;
PHMHH = IHMHH*XVAL;
PLHHH = ILHHH*XVAL;
PMHHH = IMHHH*XVAL;
PHHHH = IHHHH*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 57: 1 or more mediators, in parallel if multiple (example uses 1), 4 moderators, 2 of which moderate both the IV-Mediator path and the direct IV-DV path with all 2-way and 3-way interactions, with the other 2 moderating both the Mediator-DV path and the direct IV-DV path with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 4 moderators W, Z, V, Q, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 MV + b_3 MQ + b_4 MVQ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ + c_8'V + c_9'Q + c_{10}'XV + c_{11}'XQ + c_{12}'VQ + c_{13}'XVQ \]

\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 MV + b_3 MQ + b_4 MVQ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ + c_8'V + c_9'Q + c_{10}'XV + c_{11}'XQ + c_{12}'VQ + c_{13}'XVQ \]

\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ \]

Hence... substituting in equation for M

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ) + b_2(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)V + b_3(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)Q + \cdots \]
Hence... multiplying out brackets

\[ Y = b_0 + a_1 b_1 + a_2 b_1 W + a_3 b_1 Z + a_4 b_1 WZ + a_5 b_1 XV + a_6 b_1 Q + a_7 b_1 VX + a_8 b_1 XW + a_9 b_1 WZ + a_{10} b_1 Q + a_{11} b_1 QX + a_{12} b_1 VX + a_{13} b_1 XQ + a_{14} b_1 QX + a_{15} b_2 W + a_{16} b_2 Z + a_{17} b_2 WZ + a_{18} b_2 XV + a_{19} b_2 Q + a_{20} b_2 XQ + a_{21} b_2 QX + a_{22} b_2 VX + a_{23} b_2 QX + a_{24} b_3 Q + a_{25} b_3 WX + a_{26} b_3 WZ + a_{27} b_3 VQ + a_{28} b_3 VXQ + a_{29} b_3 QX + a_{30} b_3 VXQ + c_1 X + c_2 W + c_3 Z + c_4 XW + c_5 XZ + c_6 WZ + c_7 XWZ + c_8 V + c_9 Q + c_{10} XV + c_{11} XQ + c_{12} VX + c_{13} VQ + c_{14} VXQ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0 b_1 + a_2 b_1 W + a_3 b_1 Z + a_6 b_1 WX + a_0 b_2 V + a_2 b_2 WV + a_3 b_2 XW + a_5 b_2 WZ + a_0 b_3 Q + a_1 b_3 XQ + a_6 b_3 WZ + a_0 b_4 VQ + a_2 b_4 WVQ + a_3 b_4 VX + a_5 b_4 WZ + a_6 b_4 QX + a_{10} b_1 XV + a_{11} b_1 QX + a_{12} b_1 VX + a_{13} b_1 QX + a_{14} b_2 W + a_{15} b_2 Z + a_{16} b_2 WZ + a_{17} b_2 XV + a_{18} b_2 Q + a_{19} b_2 XQ + a_{20} b_2 QX + a_{21} b_2 VX + a_{22} b_2 QX + a_{23} b_3 Q + a_{24} b_3 WX + a_{25} b_3 WZ + a_{26} b_3 VQ + a_{27} b_3 VXQ + a_{28} b_3 QX + a_{29} b_3 VXQ + c_1 + c_2 W + c_3 Z + c_4 XW + c_5 XZ + c_6 WZ + c_7 XWZ + c_8 V + c_9 Q + c_{10} XV + c_{11} XQ + c_{12} VX + c_{13} VQ + c_{14} VXQ)X \]

Hence...

One indirect effect(s) of X on Y, conditional on W, Z, V, Q:

\[ a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 WX + a_1 b_2 V + a_4 b_2 WV + a_5 b_2 ZV + a_7 b_2 WZV + a_1 b_3 Q + a_4 b_3 WQ + a_5 b_3 ZQ + a_7 b_3 WZQ + a_1 b_4 VQ + a_4 b_4 WVQ + a_5 b_4 ZVQ + a_7 b_4 WZVQ = (a_1 + a_4 W + a_5 Z + a_7 WZ)(b_1 + b_2 V + b_3 Q + b_4 VQ) \]

One direct effect of X on Y, conditional on W, Z, V, Q:

\[ c_1 + c_4 W + c_5 Z + c_7 WZ + c_{10} V + c_{11} Q + c_{13} VQ \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z, V, Q
! Outcome variable - Y

USEVARIABLES = X M W Z V Q Y XV XZ WZ XV XQ VQ MV MQ XWZ XVQ MVQ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
```
DEFINE:
MQ = M*Q;
MV = M*V;
XW = X*W;
XZ = X*Z;
XQ = X*Q;
XV = X*V;
WZ = W*Z;
VQ = V*Q;
MVQ = M*V*Q;
XWZ = X*W*Z;
XVQ = X*V*Q;

ANALYSIS:
TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
[Y] (b0);
  Y ON M (b1);
  Y ON MV (b2);
  Y ON MQ (b3);
  Y ON MVQ (b4);

  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON Z (cdash3);
  Y ON XW (cdash4);
  Y ON XZ (cdash5);
  Y ON WZ (cdash6);
  Y ON XWZ (cdash7);
  Y ON V (cdash8);
  Y ON Q (cdash9);
  Y ON XV (cdash10);
  Y ON XQ (cdash11);
  Y ON VQ (cdash12);
  Y ON XVQ (cdash13);

[M] (a0);
  M ON X (a1);
  M ON W (a2);
  M ON Z (a3);
  M ON XW (a4);
  M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z, V, Q
! for example, 0f 1 SD below mean, mean, 1 SD above mean
! 4 moderators, 3 values for each, gives 81 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! HHML = high value of W, high value of Z, medium value of V and low value of Q.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z LOW_V MED_V HIGH_V LOW_Q MED_Q HIGH_Q
    ILLL LIMLL IHLLL IMLLL IHMLL ILHLL IMHLL IHHLL
    ILLL IMLML IHLML ILMML IHMLM ILHLM IMHLM IHHLM
    ILLHL IMLHL IHLHL ILMHL IHHLH ILMHL IHHHL
    ILLLM IMLLM IHLLM ILMLM IHLLM ILMLM IHHLM
    ILLMM IMLMM IHLMM ILMMM IHMML ILMMM IHHMM
    ILLMH IMLMH IHLMH ILMMH IHHMH ILMMH IHHHM
    ILLH IMLH IHLH ILMH IHHH ILMH IHHHH
    DLLL DMLLL DHLLL DLMLL DMMLL DHMLL DMHLL DHHLL
    DLLL DMLLL DHLLL DLMLL DMMLL DHMLL DMHLL DHHLL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL
    DLLM DMLLM DHLLM DLMML DMMML DMLML DMHML DHHML
    DLLH DMLHL DLHLH DLHHL DHHLH DMHHL DHHHL

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
chosen high value of Z

LOW_V = #LOWV; ! replace #LOWV in the code with your
chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your
chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your
chosen high value of V

LOW_Q = #LOWQ; ! replace #LOWQ in the code with your
chosen low value of Q
MED_Q = #MEDQ; ! replace #MEDQ in the code with your
chosen medium value of Q
HIGH_Q = #HIGHQ; ! replace #HIGHQ in the code with your
chosen high value of Q

! Calc conditional indirect effects for each combination of
moderator values

ILLLLL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
          a7*b1*LOW_W*LOW_Z +
          a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V +
          a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q +
          a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q +
          a1*b4*LOW_V*LOW_Q +
          a4*b4*LOW_W*LOW_V*LOW_Q + a5*b4*LOW_Z*LOW_V*LOW_Q +
          a7*b4*LOW_W*LOW_Z*LOW_V*LOW_Q;
IMLLL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
          a7*b1*MED_W*LOW_Z +
          a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V +
          a7*b2*MED_W*LOW_Z*LOW_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q +
          a5*b3*LOW_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q +
          a1*b4*LOW_V*LOW_Q +
          a4*b4*MED_W*LOW_V*LOW_Q + a5*b4*LOW_Z*LOW_V*LOW_Q +
          a7*b4*MED_W*LOW_Z*LOW_V*LOW_Q;
IHLLL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
          a7*b1*HIGH_W*LOW_Z +
          a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V +
          a7*b2*HIGH_W*LOW_Z*LOW_V +
          a1*b3*LOW_Q + a4*b3*HIGH_W*LOW_Q + a5*b3*LOW_Z*LOW_Q +
          a7*b3*HIGH_W*LOW_Z*LOW_Q +
          a1*b4*LOW_V*LOW_Q +
          a4*b4*HIGH_W*LOW_V*LOW_Q + a5*b4*LOW_Z*LOW_V*LOW_Q +
          a7*b4*HIGH_W*LOW_Z*LOW_V*LOW_Q;
\[
\text{ILMLL} = a_1b_1 + a_4b_1\cdot\text{LOW}_W + a_5b_1\cdot\text{MED}_Z + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_Q + \\
a_1b_1\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_4b_4\cdot\text{LOW}_W\cdot\text{LOW}_V\cdot\text{LOW}_Q + a_5b_4\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_7b_4\cdot\text{HIGH}_W\cdot\text{LOW}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q;
\]

\[
\text{IMMLL} = a_1b_1 + a_4b_1\cdot\text{MED}_W + a_5b_1\cdot\text{MED}_Z + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_Q + \\
a_1b_1\cdot\text{LOW}_V + a_4b_1\cdot\text{LOW}_W\cdot\text{LOW}_V + a_5b_1\cdot\text{MED}_Z\cdot\text{LOW}_V + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_V + a_1b_3\cdot\text{LOW}_Q + a_4b_3\cdot\text{LOW}_W\cdot\text{LOW}_Q + \\
a_5b_3\cdot\text{MED}_Z\cdot\text{LOW}_Q + a_7b_3\cdot\text{LOW}_W\cdot\text{MED}_Z\cdot\text{LOW}_Q + \\
a_1b_4\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_4b_4\cdot\text{MED}_W\cdot\text{LOW}_V\cdot\text{LOW}_Q + a_5b_4\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_7b_4\cdot\text{HIGH}_W\cdot\text{LOW}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q;
\]

\[
\text{IHMLL} = a_1b_1 + a_4b_1\cdot\text{HIGH}_W + a_5b_1\cdot\text{MED}_Z + \\
a_7b_1\cdot\text{HIGH}_W\cdot\text{MED}_Z + \\
a_1b_1\cdot\text{LOW}_V + a_4b_1\cdot\text{LOW}_W\cdot\text{LOW}_V + a_5b_1\cdot\text{MED}_Z\cdot\text{LOW}_V + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_V + a_1b_3\cdot\text{LOW}_Q + a_4b_3\cdot\text{MED}_W\cdot\text{LOW}_Q + \\
a_5b_3\cdot\text{MED}_Z\cdot\text{LOW}_Q + a_7b_3\cdot\text{HIGH}_W\cdot\text{MED}_Z\cdot\text{LOW}_Q + \\
a_1b_4\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_4b_4\cdot\text{HIGH}_W\cdot\text{LOW}_V\cdot\text{LOW}_Q + a_5b_4\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_7b_4\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q;
\]

\[
\text{ILHLL} = a_1b_1 + a_4b_1\cdot\text{LOW}_W + a_5b_1\cdot\text{HIGH}_Z + \\
a_7b_1\cdot\text{LOW}_W\cdot\text{HIGH}_Z + \\
a_1b_1\cdot\text{LOW}_V + a_4b_1\cdot\text{LOW}_W\cdot\text{LOW}_V + a_5b_1\cdot\text{HIGH}_Z\cdot\text{LOW}_V + \\
a_7b_1\cdot\text{LOW}_W\cdot\text{HIGH}_Z\cdot\text{LOW}_V + a_1b_3\cdot\text{LOW}_Q + \\
a_4b_3\cdot\text{LOW}_W\cdot\text{LOW}_Q + \\
a_5b_3\cdot\text{HIGH}_Z\cdot\text{LOW}_Q + a_7b_3\cdot\text{LOW}_W\cdot\text{HIGH}_Z\cdot\text{LOW}_Q + \\
a_1b_4\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_4b_4\cdot\text{HIGH}_W\cdot\text{LOW}_V\cdot\text{LOW}_Q + a_5b_4\cdot\text{HIGH}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_7b_4\cdot\text{LOW}_W\cdot\text{HIGH}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q;
\]

\[
\text{IMHLL} = a_1b_1 + a_4b_1\cdot\text{MED}_W + a_5b_1\cdot\text{HIGH}_Z + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z + \\
a_1b_1\cdot\text{LOW}_V + a_4b_1\cdot\text{MED}_W\cdot\text{LOW}_V + a_5b_1\cdot\text{MED}_Z\cdot\text{LOW}_V + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_V + a_1b_3\cdot\text{LOW}_Q + a_4b_3\cdot\text{MED}_W\cdot\text{LOW}_Q + \\
a_5b_3\cdot\text{MED}_Z\cdot\text{LOW}_Q + a_7b_3\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_Q + \\
a_1b_4\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_4b_4\cdot\text{MED}_W\cdot\text{LOW}_V\cdot\text{LOW}_Q + a_5b_4\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_7b_4\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q;
\]

\[
\text{ILHLL} = a_1b_1 + a_4b_1\cdot\text{LOW}_W + a_5b_1\cdot\text{HIGH}_Z + \\
a_7b_1\cdot\text{LOW}_W\cdot\text{HIGH}_Z + \\
a_1b_1\cdot\text{LOW}_V + a_4b_1\cdot\text{LOW}_W\cdot\text{LOW}_V + a_5b_1\cdot\text{HIGH}_Z\cdot\text{LOW}_V + \\
a_7b_1\cdot\text{LOW}_W\cdot\text{HIGH}_Z\cdot\text{LOW}_V + a_1b_3\cdot\text{LOW}_Q + \\
a_4b_3\cdot\text{LOW}_W\cdot\text{LOW}_Q + \\
a_5b_3\cdot\text{HIGH}_Z\cdot\text{LOW}_Q + a_7b_3\cdot\text{LOW}_W\cdot\text{HIGH}_Z\cdot\text{LOW}_Q + \\
a_1b_4\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_4b_4\cdot\text{HIGH}_W\cdot\text{LOW}_V\cdot\text{LOW}_Q + a_5b_4\cdot\text{HIGH}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_7b_4\cdot\text{LOW}_W\cdot\text{HIGH}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q;
\]

\[
\text{IMHLL} = a_1b_1 + a_4b_1\cdot\text{MED}_W + a_5b_1\cdot\text{HIGH}_Z + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z + \\
a_1b_1\cdot\text{LOW}_V + a_4b_1\cdot\text{MED}_W\cdot\text{LOW}_V + a_5b_1\cdot\text{MED}_Z\cdot\text{LOW}_V + \\
a_7b_1\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_V + a_1b_3\cdot\text{LOW}_Q + a_4b_3\cdot\text{MED}_W\cdot\text{LOW}_Q + \\
a_5b_3\cdot\text{MED}_Z\cdot\text{LOW}_Q + a_7b_3\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_Q + \\
a_1b_4\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_4b_4\cdot\text{MED}_W\cdot\text{LOW}_V\cdot\text{LOW}_Q + a_5b_4\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q + \\
a_7b_4\cdot\text{MED}_W\cdot\text{MED}_Z\cdot\text{LOW}_V\cdot\text{LOW}_Q;
\]
a4*b3*MED_W*LOW_Q + 
  a5*b3*HIGH_Z*LOW_Q + a7*b3*MED_W*HIGH_Z*LOW_Q + 
a1*b4*LOW_V*LOW_Q + 
  a4*b4*MED_W*LOW_V*LOW_Q + a5*b4*HIGH_Z*LOW_V*LOW_Q + 
a7*b4*MED_W*HIGH_Z*LOW_V*LOW_Q;
IHHLL = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + 
a7*b1*HIGH_W*HIGH_Z + 
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + 
a7*b2*HIGH_W*HIGH_Z*LOW_V + a1*b3*LOW_Q + 
a4*b3*HIGH_W*LOW_Q + 
a5*b3*HIGH_Z*LOW_Q + a7*b3*HIGH_W*HIGH_Z*LOW_Q + 
a1*b4*LOW_V*LOW_Q + 
a4*b4*HIGH_W*LOW_V*LOW_Q + a5*b4*HIGH_Z*LOW_V*LOW_Q + 
a7*b4*HIGH_W*HIGH_Z*LOW_V*LOW_Q;
ILLML = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*LOW_W*LOW_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + 
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + 
  a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q + 
+a1*b4*LOW_V*LOW_Q + 
a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q + 
a7*b4*LOW_W*LOW_Z*MED_V*LOW_Q;
IMLML = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + 
a7*b1*LOW_W*LOW_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + 
a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + 
  a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q + 
+a1*b4*MED_V*LOW_Q + 
a4*b4*MED_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q + 
a7*b4*LOW_W*LOW_Z*MED_V*LOW_Q;
IHLML = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + 
a7*b1*HIGH_W*LOW_Z + 
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + 
a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*LOW_Q + 
a4*b3*HIGH_W*LOW_Q + 
a5*b3*HIGH_Z*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q + 
a1*b4*MED_V*LOW_Q + 
a4*b4*HIGH_W*MED_V*LOW_Q + a5*b4*LOW_Z*MED_V*LOW_Q + 
a7*b4*HIGH_W*LOW_Z*MED_V*LOW_Q;
ILMML = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
a7*b1*LOW_W*MED_Z + 
a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + 
a7*b2*LOW_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*LOW_W*LOW_Q + 
++
a5*b3*MED_Z*LOW_Q + a7*b3*LOW_W*MED_Z*LOW_Q +
 a1*b4*MED_V*LOW_Q +
 a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q +
 a7*b4*LOW_W*MED_Z*MED_V*LOW_Q;
 IMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
 a7*b1*MED_W*MED_Z +
 a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
 a7*b2*MED_W*MED_Z*MED_V + a1*b3*LOW_Q + a4*b3*MED_W*LOW_Q +
 a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q +
 a1*b4*MED_V*LOW_Q +
 a4*b4*MED_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q +
 a7*b4*MED_W*MED_Z*MED_V*LOW_Q;
 IHMMML = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
 a7*b1*HIGH_W*MED_Z +
 a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V +
 a7*b2*HIGH_W*MED_Z*MED_V + a1*b3*LOW_Q +
 a4*b3*HIGH_W*LOW_Q +
 a5*b3*MED_Z*LOW_Q + a7*b3*HIGH_W*MED_Z*LOW_Q +
 a1*b4*MED_V*LOW_Q +
 a4*b4*HIGH_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q +
 a7*b4*HIGH_W*MED_Z*MED_V*LOW_Q;
 ILMML = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
 a7*b1*LOW_W*HIGH_Z +
 a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V +
 a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*LOW_Q +
 a4*b3*LOW_W*LOW_Q +
 a5*b3*HIGH_Z*LOW_Q + a7*b3*LOW_W*HIGH_Z*LOW_Q +
 a1*b4*MED_V*LOW_Q +
 a4*b4*LOW_W*MED_V*LOW_Q + a5*b4*HIGH_Z*MED_V*LOW_Q +
 a7*b4*LOW_W*HIGH_Z*MED_V*LOW_Q;
 IMMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
 a7*b1*MED_W*MED_Z +
 a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
 a7*b2*MED_W*MED_Z*MED_V + a1*b3*LOW_Q +
 a4*b3*MED_W*LOW_Q +
 a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q +
 a1*b4*MED_V*LOW_Q +
 a4*b4*MED_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q +
 a7*b4*MED_W*MED_Z*MED_V*LOW_Q;
 IHHMMML = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
 a7*b1*MED_W*MED_Z +
 a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V +
 a7*b2*MED_W*MED_Z*MED_V + a1*b3*LOW_Q +
 a4*b3*MED_W*LOW_Q +
 a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q +
 a1*b4*MED_V*LOW_Q +
 a4*b4*MED_W*MED_V*LOW_Q + a5*b4*MED_Z*MED_V*LOW_Q +
 a7*b4*MED_W*MED_Z*MED_V*LOW_Q;
a4*b4*HIGH_W*HIGH_V*LOW_Q + a5*b4*HIGH_Z*HIGH_V*LOW_Q + 
a7*b4*HIGH_W*HIGH_Z*HIGH_V*LOW_Q;

ILLHL = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + 
a7*b1*LOW_W*LOW_Z + 
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b3*LOW_Q + 
a4*b3*LOW_W*LOW_Q + 
a5*b3*LOW_Z*LOW_Q + a7*b3*LOW_W*LOW_Z*LOW_Q + 
a1*b4*HIGH_V*LOW_Q + 
a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q + 
a7*b4*LOW_W*LOW_Z*HIGH_V*LOW_Q;

IMLHL = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + 
a7*b1*MED_W*LOW_Z + 
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*LOW_Q + 
a4*b3*MED_W*LOW_Q + 
a5*b3*LOW_Z*LOW_Q + a7*b3*MED_W*LOW_Z*LOW_Q + 
a1*b4*HIGH_V*LOW_Q + 
a4*b4*MED_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q + 
a7*b4*MED_W*LOW_Z*HIGH_V*LOW_Q;

IHLHL = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + 
a7*b1*HIGH_W*LOW_Z + 
a1*b2*HIGH_V + a4*b2*HIGH_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + 
a7*b2*HIGH_W*LOW_Z*HIGH_V + a1*b3*LOW_Q + 
a4*b3*HIGH_W*LOW_Q + 
a5*b3*LOW_Z*LOW_Q + a7*b3*HIGH_W*LOW_Z*LOW_Q + 
a1*b4*HIGH_V*LOW_Q + 
a4*b4*HIGH_W*HIGH_V*LOW_Q + a5*b4*LOW_Z*HIGH_V*LOW_Q + 
a7*b4*HIGH_W*LOW_Z*HIGH_V*LOW_Q;

ILMHL = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + 
a7*b1*LOW_W*MED_Z + 
a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*MED_Z*HIGH_V + 
a7*b2*LOW_W*MED_Z*HIGH_V + a1*b3*LOW_Q + 
a4*b3*LOW_W*LOW_Q + 
a5*b3*MED_Z*LOW_Q + a7*b3*LOW_W*MED_Z*LOW_Q + 
a1*b4*HIGH_V*LOW_Q + 
a4*b4*LOW_W*HIGH_V*LOW_Q + a5*b4*MED_Z*HIGH_V*LOW_Q + 
a7*b4*LOW_W*MED_Z*HIGH_V*LOW_Q;

IMMHL = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + 
a7*b1*MED_W*MED_Z + 
a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*MED_Z*HIGH_V + 
a7*b2*MED_W*MED_Z*HIGH_V + a1*b3*LOW_Q + 
a4*b3*MED_W*LOW_Q + 
a5*b3*MED_Z*LOW_Q + a7*b3*MED_W*MED_Z*LOW_Q + 
a1*b4*HIGH_V*LOW_Q +
\[ a4*b4*\text{MED}_W*\text{HIGH}_V*\text{LOW}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_V*\text{LOW}_Q + a7*b4*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V*\text{LOW}_Q; \]
\[ \text{IHMMHL} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{MED}_Z + a7*b1*\text{HIGH}_W*\text{MED}_Z + a1*b2*\text{HIGH}_V + a4*b2*\text{HIGH}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + a7*b2*\text{HIGH}_W*\text{MED}_Z*\text{HIGH}_V + a1*b3*\text{LOW}_Q + a4*b3*\text{HIGH}_W*\text{LOW}_Q + a5*b3*\text{MED}_Z*\text{LOW}_Q + a7*b3*\text{HIGH}_W*\text{MED}_Z*\text{LOW}_Q + a1*b4*\text{HIGH}_V*\text{LOW}_Q + a4*b4*\text{HIGH}_W*\text{HIGH}_V*\text{LOW}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_V*\text{LOW}_Q + a7*b4*\text{HIGH}_W*\text{MED}_Z*\text{HIGH}_V*\text{LOW}_Q; \]
\[ \text{ILHHL} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{HIGH}_Z + a7*b1*\text{LOW}_W*\text{HIGH}_Z + a1*b2*\text{HIGH}_V + a4*b2*\text{LOW}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + a7*b2*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V + a1*b3*\text{LOW}_Q + a4*b3*\text{LOW}_W*\text{LOW}_Q + a5*b3*\text{HIGH}_Z*\text{LOW}_Q + a7*b3*\text{LOW}_W*\text{HIGH}_Z*\text{LOW}_Q + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V*\text{LOW}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_Z*\text{LOW}_Q + a7*b4*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_Z*\text{LOW}_Q; \]
\[ \text{IMHHL} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{HIGH}_Z + a7*b1*\text{MED}_W*\text{MED}_Z + a1*b2*\text{HIGH}_V + a4*b2*\text{MED}_W*\text{HIGH}_V + a5*b2*\text{HIGH}_Z*\text{HIGH}_V + a7*b2*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b3*\text{LOW}_Q + a4*b3*\text{MED}_W*\text{LOW}_Q + a5*b3*\text{MED}_Z*\text{LOW}_Q + a7*b3*\text{MED}_W*\text{MED}_Z*\text{LOW}_Q + a1*b4*\text{HIGH}_V + a4*b4*\text{MED}_W*\text{HIGH}_V + a5*b4*\text{MED}_Z*\text{HIGH}_V + a7*b4*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b5*\text{LOW}_Q + a4*b5*\text{LOW}_W*\text{LOW}_Q + a5*b5*\text{LOW}_Z*\text{LOW}_Q + a7*b5*\text{LOW}_W*\text{LOW}_Z*\text{LOW}_Q; \]
\[ \text{IHHHL} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{HIGH}_Z + a7*b1*\text{HIGH}_W*\text{HIGH}_Z + a1*b2*\text{HIGH}_V + a4*b2*\text{HIGH}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + a7*b2*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b3*\text{LOW}_Q + a4*b3*\text{LOW}_W*\text{LOW}_Q + a5*b3*\text{MED}_Z*\text{LOW}_Q + a7*b3*\text{LOW}_W*\text{MED}_Z*\text{LOW}_Q + a1*b4*\text{HIGH}_V + a4*b4*\text{LOW}_W*\text{HIGH}_V*\text{LOW}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_Z*\text{LOW}_Q + a7*b4*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_Z*\text{LOW}_Q; \]
\[ \text{ILLLM} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{LOW}_Z + a7*b1*\text{LOW}_W*\text{LOW}_Z + a1*b2*\text{LOW}_V + a4*b2*\text{LOW}_W*\text{LOW}_V + a5*b2*\text{LOW}_Z*\text{LOW}_V + a7*b2*\text{LOW}_W*\text{LOW}_Z*\text{LOW}_V + a1*b3*\text{MED}_Q + a4*b3*\text{LOW}_W*\text{MED}_Q + a5*b3*\text{LOW}_Z*\text{LOW}_Q + a7*b3*\text{LOW}_W*\text{LOW}_Z*\text{LOW}_Q; \]
+ a5*b3*LOW_Z*MED_Q + a7*b3*LOW_W*LOW_Z*MED_Q + a1*b4*LOW_V*MED_Q + a4*b4*LOW_W*LOW_V*MED_Q + a7*b4*LOW_Z*LOW_V*MED_Q;
IMLLM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*LOW_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q + a1*b4*LOW_V*MED_Q + a4*b4*MED_W*LOW_V*MED_Q + a5*b4*LOW_Z*LOW_V*MED_Q + a7*b4*MED_W*LOW_Z*LOW_V*MED_Q;
IMLLM = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*LOW_Z*LOW_V + a7*b2*HIGH_W*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*LOW_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q + a1*b4*LOW_V*MED_Q + a4*b4*MED_W*LOW_V*MED_Q + a5*b4*LOW_Z*LOW_V*MED_Q + a7*b4*MED_W*LOW_Z*LOW_V*MED_Q;
IHLLM = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*MED_W*LOW_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*MED_Q + a1*b4*LOW_V*MED_Q + a4*b4*MED_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q + a7*b4*MED_Z*LOW_V*MED_Q;
ILMLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q + a1*b4*LOW_V*MED_Q + a4*b4*MED_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q + a7*b4*MED_Z*LOW_V*MED_Q;
IMMLM = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a7*b3*MED_W*MED_Z*MED_Q + a1*b4*LOW_V*MED_Q + a4*b4*MED_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q + a7*b4*MED_Z*LOW_V*MED_Q;
IHMLM = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*MED_Z*LOW_V + a7*b2*MED_W*MED_Z*LOW_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + a5*b3*MED_Z*MED_Q + a7*b3*HIGH_W*MED_Z*MED_Q +
\[a1*b4*LOW_V*MED_Q + \]
\[a4*b4*HIGH_W*LOW_V*MED_Q + a5*b4*MED_Z*LOW_V*MED_Q + \]
\[a7*b4*HIGH_W*MED_Z*LOW_V*MED_Q;\]

\[ILHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + \]
\[a7*b1*LOW_W*HIGH_Z + \]
\[a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*HIGH_Z*LOW_V + \]
\[a7*b2*LOW_W*HIGH_Z*LOW_V + a1*b3*MED_Q + \]
\[a4*b3*LOW_W*MED_Q + \]
\[a5*b3*HIGH_Z*MED_Q + a7*b3*LOW_W*HIGH_Z*MED_Q + \]
\[a1*b4*LOW_V*MED_Q + \]
\[a4*b4*LOW_W*LOW_V*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q + \]
\[a7*b4*LOW_W*MED_Z*LOW_V*MED_Q;\]

\[IMHLM = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + \]
\[a7*b1*MED_W*HIGH_Z + \]
\[a1*b2*LOW_V + a4*b2*MED_W*LOW_V + a5*b2*HIGH_Z*LOW_V + \]
\[a7*b2*MED_W*HIGH_Z*LOW_V + a1*b3*MED_Q + \]
\[a4*b3*MED_W*MED_Q + \]
\[a5*b3*HIGH_Z*MED_Q + a7*b3*MED_W*HIGH_Z*MED_Q + \]
\[a1*b4*LOW_V*MED_Q + \]
\[a4*b4*MED_W*LOW_V*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q + \]
\[a7*b4*MED_W*MED_Z*LOW_V*MED_Q;\]

\[IHHLML = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + \]
\[a7*b1*HIGH_W*HIGH_Z + \]
\[a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V + \]
\[a7*b2*HIGH_W*HIGH_Z*LOW_V + a1*b3*MED_Q + \]
\[a4*b3*HIGH_W*MED_Q + \]
\[a5*b3*HIGH_Z*MED_Q + a7*b3*HIGH_W*HIGH_Z*MED_Q + \]
\[a1*b4*LOW_V*MED_Q + \]
\[a4*b4*HIGH_W*LOW_V*MED_Q + a5*b4*HIGH_Z*LOW_V*MED_Q + \]
\[a7*b4*HIGH_W*MED_Z*LOW_V*MED_Q;\]

\[ILLMM = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + \]
\[a7*b1*LOW_W*LOW_Z + \]
\[a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + \]
\[a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*LOW_W*MED_Q + \]
\[a5*b3*LOW_Z*MED_Q + a7*b3*LOW_W*LOW_Z*MED_Q + \]
\[a1*b4*MED_V*MED_Q + \]
\[a4*b4*LOW_W*MED_V*MED_Q + a5*b4*LOW_Z*MED_V*MED_Q + \]
\[a7*b4*LOW_W*MED_Z*MED_V*MED_Q;\]

\[IMLMM = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + \]
\[a7*b1*LOW_W*LOW_Z + \]
\[a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + \]
\[a7*b2*MED_W*LOW_Z*MED_V + a1*b3*MED_Q + a4*b3*MED_W*MED_Q + \]
\[a5*b3*LOW_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q + \]
\[a1*b4*MED_V*MED_Q + \]
\[ a4*b4*\text{MED} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b4*\text{LOW} \_Z*\text{MED} \_V*\text{MED} \_Q + a7*b4*\text{MED} \_W*\text{LOW} \_Z*\text{MED} \_V*\text{MED} \_Q; \]
\[ \text{IHLMM} = a1*b1 + a4*b1*\text{HIGH} \_W + a5*b1*\text{LOW} \_Z + a7*b1*\text{HIGH} \_W*\text{LOW} \_Z + a1*b2*\text{MED} \_V + a4*b2*\text{HIGH} \_W*\text{MED} \_V + a5*b2*\text{LOW} \_Z*\text{MED} \_V + a7*b2*\text{HIGH} \_W*\text{LOW} \_Z*\text{MED} \_V + a1*b3*\text{MED} \_Q + a4*b3*\text{HIGH} \_W*\text{LOW} \_Z*\text{MED} \_Q + a5*b3*\text{LOW} \_Z*\text{MED} \_Q + a7*b3*\text{HIGH} \_W*\text{LOW} \_Z*\text{MED} \_Q + a1*b4*\text{MED} \_V*\text{MED} \_Q + a4*b4*\text{HIGH} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b4*\text{LOW} \_Z*\text{MED} \_V*\text{MED} \_Q + a7*b4*\text{HIGH} \_W*\text{LOW} \_Z*\text{MED} \_V*\text{MED} \_Q; \]
\[ \text{ILMMM} = a1*b1 + a4*b1*\text{LOW} \_W + a5*b1*\text{MED} \_Z + a7*b1*\text{LOW} \_W*\text{MED} \_Z + a1*b2*\text{MED} \_V + a4*b2*\text{LOW} \_W*\text{MED} \_V + a5*b2*\text{MED} \_Z*\text{MED} \_V + a7*b2*\text{LOW} \_W*\text{MED} \_Z*\text{MED} \_V + a1*b3*\text{MED} \_Q + a4*b3*\text{LOW} \_W*\text{MED} \_Q + a5*b3*\text{MED} \_Z*\text{MED} \_Q + a7*b3*\text{LOW} \_W*\text{MED} \_Z*\text{MED} \_Q + a1*b4*\text{MED} \_V*\text{MED} \_Q + a4*b4*\text{LOW} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b4*\text{MED} \_Z*\text{MED} \_V*\text{MED} \_Q + a7*b4*\text{LOW} \_W*\text{MED} \_Z*\text{MED} \_V*\text{MED} \_Q; \]
\[ \text{IMMM} = a1*b1 + a4*b1*\text{MED} \_W + a5*b1*\text{MED} \_Z + a7*b1*\text{MED} \_W*\text{MED} \_Z + a1*b2*\text{MED} \_V + a4*b2*\text{MED} \_W*\text{MED} \_V + a5*b2*\text{MED} \_Z*\text{MED} \_V + a7*b2*\text{MED} \_W*\text{MED} \_Z*\text{MED} \_V + a1*b3*\text{MED} \_Q + a4*b3*\text{MED} \_W*\text{MED} \_Q + a5*b3*\text{MED} \_Z*\text{MED} \_Q + a7*b3*\text{MED} \_W*\text{MED} \_Z*\text{MED} \_Q + a1*b4*\text{MED} \_V*\text{MED} \_Q + a4*b4*\text{MED} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b4*\text{MED} \_Z*\text{MED} \_V*\text{MED} \_Q + a7*b4*\text{MED} \_W*\text{MED} \_Z*\text{MED} \_V*\text{MED} \_Q; \]
\[ \text{IHMMM} = a1*b1 + a4*b1*\text{HIGH} \_W + a5*b1*\text{MED} \_Z + a7*b1*\text{HIGH} \_W*\text{MED} \_Z + a1*b2*\text{MED} \_V + a4*b2*\text{HIGH} \_W*\text{MED} \_V + a5*b2*\text{MED} \_Z*\text{MED} \_V + a7*b2*\text{HIGH} \_W*\text{MED} \_Z*\text{MED} \_V + a1*b3*\text{MED} \_Q + a4*b3*\text{HIGH} \_W*\text{MED} \_Z*\text{MED} \_Q + a5*b3*\text{MED} \_Z*\text{MED} \_Q + a7*b3*\text{HIGH} \_W*\text{MED} \_Z*\text{MED} \_Q + a1*b4*\text{MED} \_V*\text{MED} \_Q + a4*b4*\text{HIGH} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b4*\text{MED} \_Z*\text{MED} \_V*\text{MED} \_Q + a7*b4*\text{HIGH} \_W*\text{MED} \_Z*\text{MED} \_V*\text{MED} \_Q; \]
\[ \text{ILHMM} = a1*b1 + a4*b1*\text{LOW} \_W + a5*b1*\text{HIGH} \_Z + a7*b1*\text{LOW} \_W*\text{HIGH} \_Z + a1*b2*\text{MED} \_V + a4*b2*\text{LOW} \_W*\text{MED} \_V + a5*b2*\text{HIGH} \_Z*\text{MED} \_V + a7*b2*\text{LOW} \_W*\text{HIGH} \_Z*\text{MED} \_V + a1*b3*\text{MED} \_Q + a4*b3*\text{LOW} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b3*\text{HIGH} \_Z*\text{MED} \_Q + a7*b3*\text{LOW} \_W*\text{HIGH} \_Z*\text{MED} \_Q + a1*b4*\text{MED} \_V*\text{MED} \_Q + a4*b4*\text{LOW} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b4*\text{HIGH} \_Z*\text{MED} \_V*\text{MED} \_Q + a7*b4*\text{LOW} \_W*\text{HIGH} \_Z*\text{MED} \_Q + a1*b5*\text{MED} \_V*\text{MED} \_Q + a4*b5*\text{LOW} \_W*\text{MED} \_V*\text{MED} \_Q + a5*b5*\text{HIGH} \_Z*\text{MED} \_Q + a7*b5*\text{LOW} \_W*\text{HIGH} \_Z*\text{MED} \_Q + a1*b6*\text{MED} \_V*\text{MED} \_Q + a4*b6*\text{LOW} \_W*\text{MED} \_V*\text{MED} \_Q = \text{a6*b6*MED} \_W*\text{MED} \_V*\text{MED} \_Q; \]
\[ a7*b4*LOW_W*HIGH_Z*MED_V*MED_Q; \]
\[ \text{IMHMM} = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + \]
\[ a7*b1*MED_W*HIGH_Z + \]
\[ a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V + \]
\[ a7*b2*MED_W*HIGH_Z*MED_V + a1*b3*MED_Q + \]
\[ a4*b3*MED_W*MED_Q + \]
\[ a5*b3*HIGH_Z*MED_Q + a7*b3*MED_W*HIGH_Z*MED_Q + \]
\[ a1*b4*MED_V*MED_Q + \]
\[ a4*b4*MED_W*MED_V*MED_Q + a5*b4*HIGH_Z*MED_V*MED_Q + \]
\[ a7*b4*MED_W*HIGH_Z*MED_V*MED_Q; \]
\[ \text{IHHMM} = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + \]
\[ a7*b1*HIGH_W*HIGH_Z + \]
\[ a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V + \]
\[ a7*b2*MED_W*HIGH_Z*MED_V + a1*b3*MED_Q + \]
\[ a4*b3*HIGH_W*MED_Q + \]
\[ a5*b3*HIGH_Z*MED_Q + a7*b3*HIGH_W*HIGH_Z*MED_Q + \]
\[ a1*b4*MED_V*MED_Q + \]
\[ a4*b4*HIGH_W*MED_V*MED_Q + a5*b4*HIGH_Z*MED_V*MED_Q + \]
\[ a7*b4*HIGH_W*HIGH_Z*MED_V*MED_Q; \]
\[ \text{ILLHM} = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + \]
\[ a7*b1*LOW_W*LOW_Z + \]
\[ a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + \]
\[ a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b3*MED_Q + \]
\[ a4*b3*LOW_W*MED_Q + \]
\[ a5*b3*LOW_Z*MED_Q + a7*b3*LOW_W*LOW_Z*MED_Q + \]
\[ a1*b4*HIGH_V*MED_Q + \]
\[ a4*b4*LOW_W*HIGH_V*MED_Q + a5*b4*LOW_Z*HIGH_V*MED_Q + \]
\[ a7*b4*LOW_W*LOW_Z*MED_Q; \]
\[ \text{IMLHM} = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + \]
\[ a7*b1*MED_W*LOW_Z + \]
\[ a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + \]
\[ a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*MED_Q + \]
\[ a4*b3*MED_W*MED_Q + \]
\[ a5*b3*MED_W*LOW_Z*MED_Q + a7*b3*MED_W*LOW_Z*MED_Q + \]
\[ a1*b4*HIGH_V*MED_Q + \]
\[ a4*b4*MED_W*HIGH_V*MED_Q + a5*b4*LOW_Z*HIGH_V*MED_Q + \]
\[ a7*b4*MED_W*LOW_Z*HIGH_V*MED_Q; \]
\[ \text{IHLHM} = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + \]
\[ a7*b1*HIGH_W*LOW_Z + \]
\[ a1*b2*HIGH_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*HIGH_V + \]
\[ a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*MED_Q + \]
\[ a4*b3*MED_W*MED_Q + \]
\[ a5*b3*HIGH_Z*MED_Q + a7*b3*HIGH_W*LOW_Z*MED_Q + \]
\[ a1*b4*HIGH_V*MED_Q + \]
\[ a4*b4*HIGH_W*MED_V*MED_Q + a5*b4*LOW_Z*HIGH_V*MED_Q + \]
\[ a7*b4*HIGH_W*LOW_Z*MED_Q; \]
\[
\begin{align*}
\text{ILMHM} &= a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{MED}_Z + \\
    &+ a_7b_1\text{LOW}_W\text{MED}_Z + \\
    &+ a_1b_2\text{HIGH}_V + a_4b_2\text{LOW}_W\text{HIGH}_V + a_5b_2\text{MED}_Z\text{HIGH}_V + \\
    &+ a_7b_2\text{LOW}_W\text{MED}_Z\text{HIGH}_V + a_1b_3\text{MED}_Q + \\
\text{a}_4b_3\text{LOW}_W\text{MED}_Q + \\
    &+ a_1b_4\text{HIGH}_V\text{MED}_Q + \\
    &+ a_4b_4\text{LOW}_W\text{HIGH}_V\text{MED}_Q + a_5b_4\text{MED}_Z\text{HIGH}_V\text{MED}_Q + \\
    &+ a_7b_4\text{LOW}_W\text{MED}_Z\text{HIGH}_V\text{MED}_Q; \\
\text{IMMHM} &= a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{MED}_Z + \\
    &+ a_7b_1\text{MED}_W\text{MED}_Z + \\
    &+ a_1b_2\text{HIGH}_V + a_4b_2\text{MED}_W\text{HIGH}_V + a_5b_2\text{MED}_Z\text{HIGH}_V + \\
    &+ a_7b_2\text{MED}_W\text{MED}_Z\text{HIGH}_V + a_1b_3\text{MED}_Q + \\
\text{a}_4b_3\text{MED}_W\text{MED}_Q + \\
    &+ a_5b_3\text{MED}_Z\text{MED}_Q + a_7b_3\text{MED}_W\text{MED}_Z\text{MED}_Q + \\
\text{a}_1b_4\text{HIGH}_V\text{MED}_Q + \\
    &+ a_4b_4\text{MED}_W\text{HIGH}_V\text{MED}_Q + a_5b_4\text{MED}_Z\text{HIGH}_V\text{MED}_Q + \\
    &+ a_7b_4\text{MED}_W\text{MED}_Z\text{HIGH}_V\text{MED}_Q; \\
\text{IHMHM} &= a_1b_1 + a_4b_1\text{HIGH}_W + a_5b_1\text{MED}_Z + \\
    &+ a_7b_1\text{HIGH}_W\text{MED}_Z + \\
    &+ a_1b_2\text{HIGH}_V + a_4b_2\text{HIGH}_W\text{HIGH}_V + a_5b_2\text{HIGH}_Z\text{HIGH}_V + \\
    &+ a_7b_2\text{HIGH}_W\text{MED}_Z\text{HIGH}_V + a_1b_3\text{MED}_Q + \\
\text{a}_4b_3\text{HIGH}_W\text{MED}_Q + \\
    &+ a_5b_3\text{MED}_Z\text{MED}_Q + a_7b_3\text{HIGH}_W\text{MED}_Z\text{MED}_Q + \\
\text{a}_1b_4\text{HIGH}_V\text{MED}_Q + \\
    &+ a_4b_4\text{HIGH}_W\text{HIGH}_V\text{MED}_Q + a_5b_4\text{MED}_Z\text{HIGH}_V\text{MED}_Q + \\
    &+ a_7b_4\text{HIGH}_W\text{MED}_Z\text{HIGH}_V\text{MED}_Q; \\
\text{ILHHM} &= a_1b_1 + a_4b_1\text{LOW}_W + a_5b_1\text{HIGH}_Z + \\
    &+ a_7b_1\text{LOW}_W\text{HIGH}_Z + \\
    &+ a_1b_2\text{HIGH}_V + a_4b_2\text{LOW}_W\text{HIGH}_V + a_5b_2\text{HIGH}_Z\text{HIGH}_V + \\
    &+ a_7b_2\text{LOW}_W\text{HIGH}_Z\text{HIGH}_V + a_1b_3\text{MED}_Q + \\
\text{a}_4b_3\text{LOW}_W\text{MED}_Q + \\
    &+ a_5b_3\text{HIGH}_Z\text{MED}_Q + a_7b_3\text{LOW}_W\text{HIGH}_Z\text{MED}_Q + \\
\text{a}_1b_4\text{HIGH}_V\text{MED}_Q + \\
    &+ a_4b_4\text{LOW}_W\text{HIGH}_V\text{MED}_Q + a_5b_4\text{HIGH}_Z\text{HIGH}_V\text{MED}_Q + \\
    &+ a_7b_4\text{LOW}_W\text{MED}_Z\text{HIGH}_V\text{MED}_Q; \\
\text{IMHHM} &= a_1b_1 + a_4b_1\text{MED}_W + a_5b_1\text{HIGH}_Z + \\
    &+ a_7b_1\text{LOW}_W\text{HIGH}_Z + \\
    &+ a_1b_2\text{HIGH}_V + a_4b_2\text{LOW}_W\text{HIGH}_V + a_5b_2\text{HIGH}_Z\text{HIGH}_V + \\
    &+ a_7b_2\text{LOW}_W\text{HIGH}_Z\text{HIGH}_V + a_1b_3\text{MED}_Q + \\
\text{a}_4b_3\text{MED}_W\text{MED}_Q + \\
    &+ a_5b_3\text{HIGH}_Z\text{MED}_Q + a_7b_3\text{MED}_W\text{HIGH}_Z\text{MED}_Q + \\
\text{a}_1b_4\text{HIGH}_V\text{MED}_Q + \\
    &+ a_4b_4\text{MED}_W\text{HIGH}_V\text{MED}_Q + a_5b_4\text{HIGH}_Z\text{HIGH}_V\text{MED}_Q + \\
    &+ a_7b_4\text{MED}_W\text{MED}_Z\text{HIGH}_V\text{MED}_Q.
\end{align*}
\]
\[ a7*b4*MED_W*HIGH_Z*HIGH_V*MED_Q; \]
\[ IHHHM = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + \]
\[ a7*b2*HIGH_W*HIGH_Z*HIGH_V + a1*b3*MED_Q + \]
\[ a4*b3*HIGH_W*MED_Q + \]
\[ a5*b3*HIGH_Z*MED_Q + a7*b3*HIGH_W*HIGH_Z*MED_Q + \]
\[ a1*b4*HIGH_V*MED_Q + \]
\[ a4*b4*HIGH_W*HIGH_V*MED_Q + a5*b4*HIGH_W*HIGH_V*MED_Q + \]
\[ a7*b4*HIGH_W*HIGH_Z*HIGH_V*MED_Q; \]
\[ ILLLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + \]
\[ a7*b2*LOW_W*LOW_Z + \]
\[ a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*HIGH_Q + \]
\[ a4*b3*LOW_W*HIGH_Q + \]
\[ a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q + \]
\[ a1*b4*LOW_V*HIGH_Q + \]
\[ a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q + \]
\[ a7*b4*LOW_W*LOW_V*LOW_V*HIGH_Q; \]
\[ IMLLH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + \]
\[ a7*b2*MED_W*LOW_Z + \]
\[ a7*b2*MED_W*LOW_Z*LOW_V + a1*b3*MED_Q + \]
\[ a4*b3*MED_W*MED_Q + \]
\[ a5*b3*MED_Z*MED_Q + a7*b3*MED_W*LOW_Z*HIGH_Q + \]
\[ a1*b4*HIGH_Q + \]
\[ a4*b4*HIGH_W*HIGH_Q + a5*b4*HIGH_Z*HIGH_Q + \]
\[ a7*b4*HIGH_W*HIGH_Z*HIGH_Q; \]
\[ IHLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + \]
\[ a7*b2*HIGH_W*LOW_Z + \]
\[ a7*b2*HIGH_W*LOW_Z*LOW_V + a1*b3*HIGH_Q + \]
\[ a4*b3*HIGH_W*HIGH_Q + \]
\[ a5*b3*HIGH_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q + \]
\[ a1*b4*LOW_V*HIGH_Q + \]
\[ a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V*HIGH_Q + \]
\[ a7*b4*LOW_W*LOW_V*LOW_V*HIGH_Q; \]
\[ ILMLH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + \]
\[ a7*b2*LOW_W*LOW_Z + \]
\[ a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*MED_Q + \]
\[ a4*b3*MED_Z*MED_Q + \]
\[ a5*b3*MED_Z*MED_Q + a7*b3*LOW_W*MED_Z*HIGH_Q + \]
\[ a1*b4*LOW_V*HIGH_Q + \]
\[ a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*MED_Z*LOW_V*HIGH_Q + \]
a7*b4*LOW_W*MED_Z*LOW_V*HIGH_Q;
IMMLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*MED_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z*LOW_V*HIGH_Q;
IHMLH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a1*b2*LOW_V + a4*b2*HIGH_W*LOW_V + a5*b2*HIGH_Z*LOW_V +
a7*b2*HIGH_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*HIGH_W*HIGH_Q +
a5*b3*HIGH_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q +
a1*b4*HIGH_V*HIGH_Q +
a4*b4*HIGH_W*HIGH_V*HIGH_Q + a5*b4*HIGH_Z*LOW_V +
a7*b4*HIGH_W*LOW_Z*LOW_V*HIGH_Q;
ILHLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z*LOW_V*HIGH_Q;
IMHLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z*LOW_V*HIGH_Q;
IHHLH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b2*LOW_V + a4*b2*LOW_W*LOW_V + a5*b2*LOW_Z*LOW_V +
a7*b2*LOW_W*LOW_Z*LOW_V + a1*b3*HIGH_Q +
a4*b3*LOW_W*HIGH_Q +
a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q +
a1*b4*LOW_V*HIGH_Q +
a4*b4*LOW_W*LOW_V*HIGH_Q + a5*b4*LOW_Z*LOW_V +
a7*b4*LOW_W*LOW_Z*LOW_V*HIGH_Q;
ILLMH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z +
    a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*LOW_W*LOW_Z*MED_V + a1*b3*HIGH_Q +
    a4*b3*LOW_W*HIGH_Q +
    a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q +
    a1*b4*MED_V*HIGH_Q +
    a4*b4*LOW_W*MED_V*HIGH_Q + a5*b4*LOW_Z*MED_V*HIGH_Q + a7*b4*LOW_W*LOW_Z*MED_V*HIGH_Q;

IMLMH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z +
    a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*MED_W*LOW_Z*MED_V + a1*b3*HIGH_Q +
    a4*b3*MED_W*HIGH_Q +
    a5*b3*LOW_Z*HIGH_Q + a7*b3*MED_W*LOW_Z*HIGH_Q +
    a1*b4*MED_V*HIGH_Q +
    a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*LOW_Z*MED_V*HIGH_Q + a7*b4*MED_W*LOW_Z*MED_V*HIGH_Q;

IHLMH = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z +
    a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*LOW_Z*MED_V + a7*b2*HIGH_W*LOW_Z*MED_V + a1*b3*HIGH_Q +
    a4*b3*HIGH_W*HIGH_Q +
    a5*b3*LOW_Z*HIGH_Q + a7*b3*HIGH_W*LOW_Z*HIGH_Q +
    a1*b4*MED_V*HIGH_Q +
    a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*LOW_Z*MED_V*HIGH_Q + a7*b4*HIGH_W*LOW_Z*MED_V*HIGH_Q;

ILMMH = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z +
    a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*LOW_W*MED_Z*MED_V + a1*b3*HIGH_Q +
    a4*b3*LOW_W*HIGH_Q +
    a5*b3*MED_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q +
    a1*b4*MED_V*HIGH_Q +
    a4*b4*LOW_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q + a7*b4*LOW_W*MED_Z*MED_V*HIGH_Q;

IMMMH = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z +
    a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*MED_W*MED_Z*MED_V + a1*b3*HIGH_Q +
    a4*b3*MED_W*HIGH_Q +
    a5*b3*MED_Z*HIGH_Q + a7*b3*MED_W*MED_Z*HIGH_Q +
    a1*b4*MED_V*HIGH_Q +
    a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q + a7*b4*MED_W*MED_Z*MED_V*HIGH_Q;

IHMMH = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z +
    a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V + a1*b3*HIGH_Q +
    a4*b3*HIGH_W*HIGH_Q +
    a5*b3*MED_Z*HIGH_Q + a7*b3*HIGH_W*MED_Z*HIGH_Q +
    a1*b4*MED_V*HIGH_Q +
    a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q + a7*b4*HIGH_W*MED_Z*MED_V*HIGH_Q;
a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*MED_Z*MED_V + a7*b2*HIGH_W*MED_Z*MED_V + a1*b3*HIGH_Q + a4*b3*HIGH_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a7*b3*HIGH_W*MED_Z*HIGH_Q + a1*b4*MED_V*HIGH_Q + a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q + a7*b4*HIGH_W*MED_Z*MED_V*HIGH_Q;

ILHMH = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b2*MED_V + a4*b2*LOW_W*MED_V + a5*b2*HIGH_Z*MED_V + a7*b2*LOW_W*HIGH_Z*MED_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a7*b3*LOW_W*MED_Z*HIGH_Q + a1*b4*MED_V*HIGH_Q + a4*b4*LOW_W*MED_V*HIGH_Q + a5*b4*MED_Z*MED_V*HIGH_Q + a7*b4*LOW_W*MED_Z*MED_V*HIGH_Q;

IMHMH = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*HIGH_Z + a1*b2*MED_V + a4*b2*MED_W*MED_V + a5*b2*HIGH_Z*MED_V + a7*b2*MED_W*HIGH_Z*MED_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*HIGH_Z*HIGH_Q + a7*b3*MED_W*MED_Z*HIGH_Q + a1*b4*MED_V*HIGH_Q + a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*HIGH_Z*MED_V*HIGH_Q + a7*b4*MED_W*MED_Z*MED_V*HIGH_Q;

IHHMH = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*HIGH_Z + a1*b2*MED_V + a4*b2*HIGH_W*MED_V + a5*b2*HIGH_Z*MED_V + a7*b2*HIGH_W*HIGH_Z*MED_V + a1*b3*HIGH_Q + a4*b3*HIGH_W*HIGH_Q + a5*b3*MED_Z*HIGH_Q + a7*b3*MED_W*MED_Z*HIGH_Q + a1*b4*MED_V*HIGH_Q + a4*b4*HIGH_W*MED_V*HIGH_Q + a5*b4*HIGH_Z*MED_V*HIGH_Q + a7*b4*HIGH_W*MED_Z*MED_V*HIGH_Q;

ILLHH = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*HIGH_V + a4*b2*LOW_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*LOW_W*LOW_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*LOW_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q + a7*b3*LOW_W*LOW_Z*HIGH_Q + a1*b4*HIGH_V*HIGH_Q + a4*b4*LOW_W*HIGH_V*HIGH_Q + a5*b4*LOW_Z*HIGH_V*HIGH_Q + a7*b4*LOW_W*LOW_Z*HIGH_V*HIGH_Q;

IMLHH = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*HIGH_V + a4*b2*MED_W*HIGH_V + a5*b2*LOW_Z*HIGH_V + a7*b2*MED_W*LOW_Z*HIGH_V + a1*b3*HIGH_Q + a4*b3*MED_W*HIGH_Q + a5*b3*LOW_Z*HIGH_Q + a7*b3*MED_W*LOW_Z*HIGH_Q + a1*b4*MED_V*HIGH_Q + a4*b4*MED_W*MED_V*HIGH_Q + a5*b4*LOW_Z*MED_V*HIGH_Q + a7*b4*MED_W*LOW_Z*MED_V*HIGH_Q.

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\[ a7*b2*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b3*\text{HIGH}_Q + \]
\[ a4*b3*\text{MED}_W*\text{HIGH}_Q + \]
\[ a5*b3*\text{LOW}_Z*\text{HIGH}_Q + a7*b3*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_Q + \]
\[ a1*b4*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a4*b4*\text{MED}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b4*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a7*b4*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]
\[ \text{IHLHH} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{LOW}_Z + \]
\[ a7*b1*\text{HIGH}_W*\text{LOW}_Z + a1*b2*\text{HIGH}_V + a4*b2*\text{LOW}_W*\text{HIGH}_V + a5*b2*\text{LOW}_Z*\text{HIGH}_V + \]
\[ a7*b2*\text{HIGH}_W*\text{LOW}_Z*\text{HIGH}_V + a1*b3*\text{HIGH}_Q + \]
\[ a4*b3*\text{HIGH}_W*\text{HIGH}_Q + \]
\[ a5*b3*\text{LOW}_Z*\text{HIGH}_Q + a7*b3*\text{HIGH}_W*\text{LOW}_Z*\text{HIGH}_Q + \]
\[ a1*b4*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a4*b4*\text{MED}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b4*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a7*b4*\text{MED}_W*\text{LOW}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]
\[ \text{ILMHH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{MED}_Z + a1*b2*\text{HIGH}_V + a4*b2*\text{LOW}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + \]
\[ a7*b2*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V + a1*b3*\text{HIGH}_Q + \]
\[ a4*b3*\text{LOW}_W*\text{HIGH}_Q + \]
\[ a5*b3*\text{MED}_Z*\text{HIGH}_Q + a7*b3*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_Q + \]
\[ a1*b4*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a4*b4*\text{LOW}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a7*b4*\text{LOW}_W*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]
\[ \text{IMMHH} = a1*b1 + a4*b1*\text{MED}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{MED}_W*\text{MED}_Z + a1*b2*\text{HIGH}_V + a4*b2*\text{MED}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + \]
\[ a7*b2*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b3*\text{HIGH}_Q + \]
\[ a4*b3*\text{MED}_W*\text{HIGH}_Q + \]
\[ a5*b3*\text{MED}_Z*\text{HIGH}_Q + a7*b3*\text{MED}_W*\text{MED}_Z*\text{HIGH}_Q + \]
\[ a1*b4*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a4*b4*\text{MED}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a7*b4*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]
\[ \text{IHMHH} = a1*b1 + a4*b1*\text{HIGH}_W + a5*b1*\text{MED}_Z + \]
\[ a7*b1*\text{HIGH}_W*\text{MED}_Z + \]
\[ a1*b2*\text{HIGH}_V + a4*b2*\text{MED}_W*\text{HIGH}_V + a5*b2*\text{MED}_Z*\text{HIGH}_V + \]
\[ a7*b2*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V + a1*b3*\text{HIGH}_Q + \]
\[ a4*b3*\text{MED}_W*\text{HIGH}_Q + \]
\[ a5*b3*\text{MED}_Z*\text{HIGH}_Q + a7*b3*\text{MED}_W*\text{MED}_Z*\text{HIGH}_Q + \]
\[ a1*b4*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a4*b4*\text{MED}_W*\text{HIGH}_V*\text{HIGH}_Q + a5*b4*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q + \]
\[ a7*b4*\text{MED}_W*\text{MED}_Z*\text{HIGH}_V*\text{HIGH}_Q; \]
\[ \text{ILHHH} = a1*b1 + a4*b1*\text{LOW}_W + a5*b1*\text{HIGH}_Z + \]
\[ a7*b1*\text{LOW}_W*\text{HIGH}_Z + \]
\[ a_1 \cdot b_2 \cdot \text{HIGH}_V + a_4 \cdot b_2 \cdot \text{LOW}_W \cdot \text{HIGH}_V + a_5 \cdot b_2 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_7 \cdot b_2 \cdot \text{LOW}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_1 \cdot b_3 \cdot \text{HIGH}_Q + a_4 \cdot b_3 \cdot \text{LOW}_W \cdot \text{HIGH}_Q + a_5 \cdot b_3 \cdot \text{HIGH}_Z \cdot \text{HIGH}_Q + a_7 \cdot b_3 \cdot \text{LOW}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_Q + a_1 \cdot b_4 \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_4 \cdot b_4 \cdot \text{LOW}_W \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_7 \cdot b_4 \cdot \text{LOW}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{HIGH}_Q; \]

\[ \text{IMHHH} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{MED}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_7 \cdot b_1 \cdot \text{MED}_W \cdot \text{HIGH}_Z + a_1 \cdot b_2 \cdot \text{HIGH}_V + a_4 \cdot b_2 \cdot \text{MED}_W \cdot \text{HIGH}_V + a_5 \cdot b_2 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_7 \cdot b_2 \cdot \text{MED}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_1 \cdot b_3 \cdot \text{HIGH}_Q + a_4 \cdot b_3 \cdot \text{MED}_W \cdot \text{HIGH}_Q + a_5 \cdot b_3 \cdot \text{HIGH}_Z \cdot \text{HIGH}_Q + a_7 \cdot b_3 \cdot \text{MED}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_Q + a_1 \cdot b_4 \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_4 \cdot b_4 \cdot \text{MED}_W \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_7 \cdot b_4 \cdot \text{MED}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{HIGH}_Q; \]

\[ \text{IHHHH} = a_1 \cdot b_1 + a_4 \cdot b_1 \cdot \text{HIGH}_W + a_5 \cdot b_1 \cdot \text{HIGH}_Z + a_7 \cdot b_1 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z + a_1 \cdot b_2 \cdot \text{HIGH}_V + a_4 \cdot b_2 \cdot \text{HIGH}_W \cdot \text{HIGH}_V + a_5 \cdot b_2 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_7 \cdot b_2 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V + a_1 \cdot b_3 \cdot \text{HIGH}_Q + a_4 \cdot b_3 \cdot \text{HIGH}_W \cdot \text{HIGH}_Q + a_5 \cdot b_3 \cdot \text{HIGH}_Z \cdot \text{HIGH}_Q + a_7 \cdot b_3 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_Q + a_1 \cdot b_4 \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_4 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_5 \cdot b_4 \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{HIGH}_Q + a_7 \cdot b_4 \cdot \text{HIGH}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_V \cdot \text{HIGH}_Q; \]

! Calc conditional direct effects for each combination of moderator values

\[ \text{DLLLL} = c_{\text{dash}1} + c_{\text{dash}4} \cdot \text{LOW}_W + c_{\text{dash}5} \cdot \text{LOW}_Z + c_{\text{dash}7} \cdot \text{LOW}_W \cdot \text{LOW}_Z + c_{\text{dash}10} \cdot \text{LOW}_V + c_{\text{dash}11} \cdot \text{LOW}_Q + c_{\text{dash}13} \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{DMLLL} = c_{\text{dash}1} + c_{\text{dash}4} \cdot \text{MED}_W + c_{\text{dash}5} \cdot \text{LOW}_Z + c_{\text{dash}7} \cdot \text{MED}_W \cdot \text{LOW}_Z + c_{\text{dash}10} \cdot \text{LOW}_V + c_{\text{dash}11} \cdot \text{LOW}_Q + c_{\text{dash}13} \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{DHLLL} = c_{\text{dash}1} + c_{\text{dash}4} \cdot \text{HIGH}_W + c_{\text{dash}5} \cdot \text{LOW}_Z + c_{\text{dash}7} \cdot \text{HIGH}_W \cdot \text{LOW}_Z + c_{\text{dash}10} \cdot \text{LOW}_V + c_{\text{dash}11} \cdot \text{LOW}_Q + c_{\text{dash}13} \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{DLMLL} = c_{\text{dash}1} + c_{\text{dash}4} \cdot \text{LOW}_W + c_{\text{dash}5} \cdot \text{MED}_Z + c_{\text{dash}7} \cdot \text{LOW}_W \cdot \text{MED}_Z + c_{\text{dash}10} \cdot \text{LOW}_V + c_{\text{dash}11} \cdot \text{LOW}_Q + c_{\text{dash}13} \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]

\[ \text{DMMLL} = c_{\text{dash}1} + c_{\text{dash}4} \cdot \text{MED}_W + c_{\text{dash}5} \cdot \text{MED}_Z + c_{\text{dash}7} \cdot \text{MED}_W \cdot \text{MED}_Z + c_{\text{dash}10} \cdot \text{LOW}_V + c_{\text{dash}11} \cdot \text{LOW}_Q + c_{\text{dash}13} \cdot \text{LOW}_V \cdot \text{LOW}_Q; \]
DHMLL = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
    cdash7*HIGH_W*MED_Z +
    cdash10*LOW_V + cdash11*LOW_Q + cdash13*LOW_V*LOW_Q;
DLHLL = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z +
    cdash7*LOW_W*HIGH_Z +
    cdash10*LOW_V + cdash11*LOW_Q + cdash13*LOW_V*LOW_Q;
DMHLL = cdash1 + cdash4*MED_W + cdash5*HIGH_Z +
    cdash7*MED_W*HIGH_Z +
    cdash10*LOW_V + cdash11*LOW_Q + cdash13*LOW_V*LOW_Q;
DHLLL = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
    cdash7*HIGH_W*HIGH_Z +
    cdash10*LOW_V + cdash11*LOW_Q + cdash13*LOW_V*LOW_Q;
DLHLL = cdash1 + cdash4*LOW_W + cdash5*LOW_Z +
    cdash7*LOW_W*LOW_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DMLML = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
    cdash7*MED_W*LOW_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DHLML = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
    cdash7*HIGH_W*LOW_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DLMML = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
    cdash7*LOW_W*MED_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DMMML = cdash1 + cdash4*MED_W + cdash5*MED_Z +
    cdash7*MED_W*MED_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DHMML = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
    cdash7*HIGH_W*MED_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DLHML = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
    cdash7*LOW_W*HIGH_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DMLHL = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
    cdash7*MED_W*LOW_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DHML = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
    cdash7*HIGH_W*LOW_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DLLHL = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
    cdash7*LOW_W*MED_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DMLH = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
    cdash7*MED_W*LOW_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DHML = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
    cdash7*HIGH_W*MED_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DLLHL = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
    cdash7*LOW_W*MED_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DMLHL = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
    cdash7*MED_W*LOW_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;
DHML = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
    cdash7*HIGH_W*MED_Z +
    cdash10*MED_V + cdash11*LOW_Q + cdash13*MED_V*LOW_Q;

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cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DHLHL = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
   cdash7*HIGH_W*LOW_Z +
   cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DLMHL = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
   cdash7*LOW_W*MED_Z +
   cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DMMLH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
   cdash7*MED_W*MED_Z +
   cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DHMHL = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
   cdash7*HIGH_W*MED_Z +
   cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DLMHL = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
   cdash7*LOW_W*MED_Z +
   cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DMLHL = cdash1 + cdash4*MED_W + cdash5*MED_Z +
   cdash7*MED_W*MED_Z +
   cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DHMML = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
   cdash7*HIGH_W*MED_Z +
   cdash10*HIGH_V + cdash11*LOW_Q + cdash13*HIGH_V*LOW_Q;
DHHHL = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
   cdash7*HIGH_W*HIGH_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DLLLM = cdash1 + cdash4*LOW_W + cdash5*LOW_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DMLLM = cdash1 + cdash4*MED_W + cdash5*MED_Z +
   cdash7*MED_W*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DHLLM = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
   cdash7*HIGH_W*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DLMLM = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DMLML = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DMMLH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
   cdash7*MED_W*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DHMLM = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
   cdash7*HIGH_W*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DHHLM = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
   cdash7*HIGH_W*HIGH_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DLHLM = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DMHLM = cdash1 + cdash4*MED_W + cdash5*MED_Z +
   cdash7*MED_W*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DHMLHM = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
   cdash7*HIGH_W*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DLMHLM = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DMLHM = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DMHLM = cdash1 + cdash4*MED_W + cdash5*MED_Z +
   cdash7*MED_W*MED_Z +
   cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
cdash7*MED_W*HIGH_Z +
  cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;
DHLM = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
  cdash7*HIGH_W*HIGH_Z +
  cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;

DLLMM = cdash1 + cdash4*LOW_W + cdash5*LOW_Z +
  cdash7*LOW_W*LOW_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;
DMLMM = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
  cdash7*MED_W*LOW_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;
DHLMM = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
  cdash7*HIGH_W*LOW_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DHLHM = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
  cdash7*HIGH_W*HIGH_Z +
  cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;

DHHLM = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
  cdash7*HIGH_W*HIGH_Z +
  cdash10*LOW_V + cdash11*MED_Q + cdash13*LOW_V*MED_Q;

DLMHM = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
  cdash7*MED_W*MED_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;
DMHM = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
  cdash7*HIGH_W*LOW_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DHHMM = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
  cdash7*HIGH_W*HIGH_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DLLHM = cdash1 + cdash4*LOW_W + cdash5*LOW_Z +
  cdash7*LOW_W*LOW_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DMLHM = cdash1 + cdash4*MED_W + cdash5*HIGH_Z +
  cdash7*MED_W*HIGH_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DHLHM = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
  cdash7*HIGH_W*LOW_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DLMHM = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
  cdash7*MED_W*MED_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DLMHM = cdash1 + cdash4*MED_W + cdash5*MED_Z +
  cdash7*MED_W*MED_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DHLHM = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
  cdash7*MED_W*MED_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;

DHLHM = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
  cdash7*HIGH_W*LOW_Z +
  cdash10*MED_V + cdash11*MED_Q + cdash13*MED_V*MED_Q;
DMMHM = cdash1 + cdash4*MED_W + cdash5*MED_Z +
      cdash7*MED_W*MED_Z +
      cdash10*HIGH_V + cdash11*MED_Q + cdash13*HIGH_V*MED_Q;
DHMM = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
      cdash7*HIGH_W*MED_Z +
      cdash10*HIGH_V + cdash11*MED_Q + cdash13*HIGH_V*MED_Q;
DLHHM = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z +
      cdash7*LOW_W*HIGH_Z +
      cdash10*HIGH_V + cdash11*MED_Q + cdash13*HIGH_V*MED_Q;
DMHHM = cdash1 + cdash4*MED_W + cdash5*HIGH_Z +
      cdash7*MED_W*HIGH_Z +
      cdash10*HIGH_V + cdash11*MED_Q + cdash13*HIGH_V*MED_Q;
DHHHM = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z +
      cdash7*HIGH_W*HIGH_Z +
      cdash10*HIGH_V + cdash11*MED_Q + cdash13*HIGH_V*MED_Q;
DLLLH = cdash1 + cdash4*LOW_W + cdash5*LOW_Z +
      cdash7*LOW_W*LOW_Z +
      cdash10*LOW_V + cdash11*HIGH_Q + cdash13*LOW_V*HIGH_Q;
DMLLH = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
      cdash7*MED_W*LOW_Z +
      cdash10*LOW_V + cdash11*HIGH_Q + cdash13*LOW_V*HIGH_Q;
DHLLH = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
      cdash7*HIGH_W*LOW_Z +
      cdash10*HIGH_V + cdash11*MED_Q + cdash13*HIGH_V*MED_Q;
DLMLH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
      cdash7*LOW_W*MED_Z +
      cdash10*LOW_V + cdash11*HIGH_Q + cdash13*LOW_V*HIGH_Q;
DMMLH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
      cdash7*MED_W*MED_Z +
      cdash10*LOW_V + cdash11*HIGH_Q + cdash13*LOW_V*HIGH_Q;
DHMLH = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
      cdash7*HIGH_W*MED_Z +
      cdash10*LOW_V + cdash11*HIGH_Q + cdash13*LOW_V*HIGH_Q;
DHLMH = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z +
      cdash7*LOW_W*HIGH_Z +
      cdash10*LOW_V + cdash11*HIGH_Q + cdash13*LOW_V*HIGH_Q;
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMH = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
cdash7*MED_W*LOW_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DHLMH = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z +
cdash7*HIGH_W*LOW_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DHLMH = cdash1 + cdash4*MED_W + cdash5*LOW_Z +
cdash7*MED_W*LOW_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMMMH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DHMMH = cdash1 + cdash4*HIGH_W + cdash5*MED_Z +
cdash7*HIGH_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DLMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DLMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DLMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DLMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMMH = cdash1 + cdash4*LOW_W + cdash5*MED_Z +
cdash7*LOW_W*MED_Z +

cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
DMLMHH = cdash1 + cdash4*MED_W + cdash5*MED_Z +
cdash7*MED_W*MED_Z +
cdash10*MED_V + cdash11*HIGH_Q + cdash13*MED_V*HIGH_Q;
\[ DLHHH = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z + cdash7*LOW_W*HIGH_Z + cdash10*HIGH_V + cdash11*HIGH_Q + cdash13*HIGH_V*HIGH_Q; \]
\[ DMHHH = cdash1 + cdash4*MED_W + cdash5*HIGH_Z + cdash7*MED_W*HIGH_Z + cdash10*HIGH_V + cdash11*HIGH_Q + cdash13*HIGH_V*HIGH_Q; \]
\[ DHHHH = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z + cdash7*HIGH_W*HIGH_Z + cdash10*HIGH_V + cdash11*HIGH_Q + cdash13*HIGH_V*HIGH_Q; \]

! Calc conditional total effects for each combination of moderator values

\[ TLLLL = ILLLL + DLLLL; \]
\[ TMLLL = IMLLL + DMLLL; \]
\[ THLLL = IHLLL + DHLLL; \]
\[ TLMLL = ILMLL + DLMLL; \]
\[ TMMLL = IMMLL + DMMLL; \]
\[ THMLL = IHMLL + DHMLL; \]
\[ TLHLL = ILHLL + DLHLL; \]
\[ TMHLL = IMHLL + DMHLL; \]
\[ THHLL = IHHLL + DHHLL; \]
\[ TLLML = ILLML + DLLML; \]
\[ TMLML = IMLML + DMLML; \]
\[ THLML = IHLML + DHLML; \]
\[ TLMML = ILMML + DLMML; \]
\[ TMMML = IMMML + DMMML; \]
\[ THMML = IHMML + DHMML; \]
\[ TLHML = ILHML + DLHML; \]
\[ TMHML = IMHML + DMHML; \]
\[ THHML = IHHML + DHHML; \]
\[ TLLHL = ILLHL + DLLHL; \]
\[ TMLHL = IMLHL + DMLHL; \]
\[ THLHL = IHLHL + DHLHL; \]
\[ TLMHL = ILMHL + DLMHL; \]
\[ TMMHL = IMMHL + DMMHL; \]
\[ THMHL = IHMHL + DHMHL; \]
\[ TLHHL = ILHHL + DLHHL; \]
\[ TMHHL = IMHHL + DMHHL; \]
\[ THHHL = IHHHL + DHHHL; \]
\[ TLLLH = ILLLH + DLLLM; \]
\[ TMLLM = IMLLM + DMLLM; \]
\[ THLLM = IHLLM + DHLLM; \]
\[ TLHHL = ILHHL + DLHHL; \]
\[ TMHHL = IMHHL + DMHHL; \]
\[ THHHL = IHHHL + DHHHL; \]
\[ TLLLH = ILLLH + DLLLM; \]
\[ TMLLM = IMLLM + DMLLM; \]
\[ THLLM = IHLLM + DHLLM; \]

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TLMLM = ILMLM + DLMLM;
TMMLM = IMMLM + DMMLM;
THMLM = IHMLM + DHMLM;
TLHLM = ILHLM + DLHLM;
TMHLM = IMHLM + DMHLM;
THHLM = IHHLM + DHHLM;
TLLLM = ILLLM + DLLLM;
TMLLM = IMLLM + DMLLM;
THLLM = IHLLM + DHLLM;
TLMMM = ILMMM + DLLMM;
TMLMM = IMLMM + DMLMM;
THMMM = IHMM + DHMM;
TLLMM = ILLMM + DLLMM;
TMLMM = IMLMM + DMLMM;
THHMM = IHHMM + DHMM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THMTHM = IHMTHM + DHMTHM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THHMM = IHHMM + DHMM;
TLLLM = ILLLM + DLLLM;
TMLLM = IMLLM + DMLLM;
THLLM = IHLLM + DHLLM;
TLHLM = ILHLM + DLHLM;
TMHLM = IMHLM + DMHLM;
THHLM = IHHLM + DHHLM;
TLLMM = ILLMM + DLLMM;
TMLMM = IMLMM + DMLMM;
THMMM = IHMM + DHMM;
TLLMM = ILLMM + DLLMM;
TMLMM = IMLMM + DMLMM;
THHMM = IHHMM + DHMM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THMTHM = IHMTHM + DHMTHM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THHHMM = IHHHMM + DHHHMM;
TLLLH = ILLLH + DLLLH;
TMLLH = IMLLH + DMLLH;
THLLH = IHLH + DHLH;
TLMLH = ILMLH + DLMH;
TMMLH = IMMLH + DMLLH;
THMLH = IHMLH + DHLH;
TLHLM = ILHLM + DLHLM;
TMHLM = IMHLM + DMHLM;
THHLM = IHHLM + DHHLM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THMTHM = IHMTHM + DHMTHM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THHHMM = IHHHMM + DHHHMM;
TLLLH = ILLLH + DLLLH;
TMLLH = IMLLH + DMLLH;
THLLH = IHLH + DHLH;
TLMLH = ILMLH + DLMH;
TMMLH = IMMLH + DMLLH;
THMLH = IHMLH + DHLH;
TLHLM = ILHLM + DLHLM;
TMHLM = IMHLM + DMHLM;
THHLM = IHHLM + DHHLM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THMTHM = IHMTHM + DHMTHM;
TLLHM = ILLHM + DLLHM;
TMLHM = IMLHM + DMLHM;
THLHM = IHLHM + DHLHM;
TLMHM = ILMHM + DLMHM;
TMHMM = IMHMM + DMHMM;
THHHMM = IHHHMM + DHHHMM;
TLLLH = ILLLH + DLLLH;
TMLLH = IMLLH + DMLLH;
THLLH = IHLH + DHLH;
TLMLH = ILMLH + DLMH;
TMMLH = IMMLH + DMLLH;
THMLH = IHMLH + DHLH;
TLHMH = ILHMH + DLHMH;
TMHMH = IMHMH + DMHMH;
THHMH = IHHMH + DHHMH;

TLLHH = ILLHH + DLLHH;
TMLHH = IMLHH + DMLHH;
THLHH = IHLHH + DHLHH;
TLMHH = ILMHH + DLMHH;

TMMHH = IMMHH + DMMHH;
THHMH = IHMHH + DHMHH;

TLHHH = ILHHH + DLHHH;
TMHHH = IMHHH + DMHHH;

THHHH = IHHHH + DHHHH;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLLLL PMLLL PHLLL PLMLL PMMLL PHMLL PLHLL PMHLL PHHLL
     PLLML PMLML PHLML PLMLM PMMLM PHMLM PLHML PMHML PHHML
     PLLLM PMLLM PHLLM PLMLM PMMLM PHMLM PLHLM PMHLM PHHLM
     PLLMM PMLMM PHLMM PLMMM PMMMM PHMMM PLHMM PMHMM PHHMM
     PLLHM PMLHM PHLHM PLHMH PMHMH PHHMH PLHMH PMHMH PHHMH
     PLLLLH PMLLLH PHLLLH PLMLLL PMMLLL PHMLLL PLHLLL PMHLLL PHHLLL
     PLLMMH PMLMMH PHLMMH PLMMMH PMMMMH PHMMMH PLHMHH PMHHHH PHHHHH;

LOOP(XVAL,1,5,0.1);

PLLLL = ILLL*XVAL;
PMLLL = IMLL*XVAL;
PHLLL = IHLLL*XVAL;

PLMLL = ILML*XVAL;
PMMLL = IMML*XVAL;
PHMLL = IHML*XVAL;

PLHLL = ILHLL*XVAL;
PMHLL = IMHLL*XVAL;
PHHLL = IHHLL*XVAL;

PLLML = ILLML*XVAL;
PMLML = IMLML*XVAL;
PMLML = IMLML*XVAL;
PHLML = IHLML*XVAL;
PLMML = ILMML*XVAL;
PMMML = IMMML*XVAL;
PHMML = IHMML*XVAL;

PLHML = ILHML*XVAL;
PMHML = IMHML*XVAL;
PHHML = IHHML*XVAL;

PLLHL = ILLHL*XVAL;
PMLHL = IMLHL*XVAL;
PHLHL = IHLHL*XVAL;

PLMHL = ILMHL*XVAL;
PMMHL = IMMHL*XVAL;
PHMHL = IHMHL*XVAL;

PLHHL = ILHHL*XVAL;
PMHHL = IMHHL*XVAL;
PHHHL = IHHHL*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMMHM*XVAL;
PHMHM = IHMHM*XVAL;

PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PMLMM = IHLMX*XVAL;

PLMMM = ILMMM*XVAL;
PMMM = IMMXX*XVAL;
PHMMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHH = ILMHH*XVAL;
PMMHH = IMMHH*XVAL;
PHMHH = IHHMH*XVAL;

PLMML = ILMML*XVAL;
PMMML = IMMML*XVAL;
PHMML = IHMML*XVAL;

PLHML = ILHML*XVAL;
PMHML = IMHML*XVAL;
PHHML = IHHML*XVAL;

PLLHL = ILLHL*XVAL;
PMLHL = IMLHL*XVAL;
PHLHL = IHLHL*XVAL;

PLMHL = ILMHL*XVAL;
PMMHL = IMMHL*XVAL;
PHMHL = IHMHL*XVAL;

PLHHL = ILHHL*XVAL;
PMHHL = IMHHL*XVAL;
PHHHL = IHHHL*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHM = ILMHM*XVAL;
PMMHM = IMMHM*XVAL;
PHMHM = IHMHM*XVAL;

PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PMLMM = IHLMX*XVAL;

PLMMM = ILMMM*XVAL;
PMMM = IMMXX*XVAL;
PHMMM = IHHMM*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHH = ILMHH*XVAL;
PMMHH = IMMHH*XVAL;
PHMHH = IHHMH*XVAL;

PLLHM = ILLHM*XVAL;
PMLHM = IMLHM*XVAL;
PHLHM = IHLHM*XVAL;

PLMHH = ILMHH*XVAL;
PMMHH = IMMHH*XVAL;
PHMHH = IHHMH*XVAL;
PLHMM = ILHMM*XVAL;
PMHMM = IHMMH*XVAL;
PHHMM = IHHMM*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PHLMM = IHLMH*XVAL;
PLHLL = ILLLH*XVAL;
PMLLL = IMLLH*XVAL;
PHLLL = IHLLL*XVAL;
PMHLH = IHMLH*XVAL;
PHLHL = IHHHL*XVAL;
PLLML = ILLML*XVAL;
PMLML = IMLML*XVAL;
PHMLL = IHMLL*XVAL;
PLMHL = ILMHL*XVAL;
PMLMH = IMLMH*XVAL;
PHMHL = IHMHL*XVAL;
PLLMM = ILLMM*XVAL;
PMLMM = IMLMM*XVAL;
PHLMM = IHLMH*XVAL;
PLHMH = ILHMH*XVAL;
PMLH = IMLH*XVAL;
PHLH = IHLH*XVAL;
PLMHH = ILMHH*XVAL;
PMLHH = IMLHH*XVAL;
PHMHH = IHMHH*XVAL;
PLLHH = ILLHH*XVAL;
PMLHH = IMLHH*XVAL;
PHLHH = IHLHH*XVAL;
PMH = IMHH*XVAL;
PHM = IHMH*XVAL;
PLHHH = ILHHH*XVAL;
PMLHH = IMLHH*XVAL;
PHLHH = IHLHH*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 58: 1 or more mediators, in parallel if multiple (example uses 1), 1 moderators, which moderates both the IV- Mediator path and the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2W + b_3MW + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2W + b_3MW + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2W + b_3(a_0 + a_1X + a_2W + a_3XW)W + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + b_2W + a_0b_3W + a_1b_3XW + a_2b_3WW + a_3b_3XWW + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + b_2W + a_0b_3W + a_2b_3WW) + (a_1b_1 + a_3b_1W + a_1b_3W + a_3b_3WW + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$:

$a_1b_1 + a_3b_1W + a_1b_3W + a_3b_3WW = (a_1 + a_3W)(b_1 + b_3W)$

One direct effect of $X$ on $Y$:

$c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M W Y XW MW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MW = M*W;
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON W (b2);
    Y ON MW (b3);
    Y ON X (cdash);
    [M] (a0);
    M ON X (a1);
```
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W
! for example, of 1 SD below mean, mean, 1 SD above mean
! 1 moderator, 3 values for it
! arbitrary naming convention for conditional indirect and total effects used below:
! MED_Q = medium value of Q, etc.
MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W
       IND_LOWW IND_MEDW IND_HIW
       TOT_LOWW TOT_MEDW TOT_HIW);

  LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
  MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
  HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

! Calc conditional indirect effects for each combination of moderator values
  IND_LOWW = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_W + a3*b3*LOW_W*LOW_W;
  IND_MEDW = a1*b1 + a3*b1*MED_W + a1*b3*MED_W + a3*b3*MED_W*MED_W;
  IND_HIW = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_W + a3*b3*HIGH_W*HIGH_W;

! Calc conditional total effects for each combination of moderator values
  TOT_LOWW = IND_LOWW + cdash;
  TOT_MEDW = IND_MEDW + cdash;
  TOT_HIW = IND_HIW + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
  PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = IND_LOWW*XVAL;
MEDMOD = IND_MEDW*XVAL;
HIMOD = IND_HIW*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 59: 1 or more mediators, in parallel if multiple (example uses 1), 1 moderators, which moderates all of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MW + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \): 

\[ Y = b_0 + b_1M + b_2MW + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)W + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets 

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + a_0b_2W + a_1b_2XW + a_2b_2WW + a_3b_2XWW + c_1'X + c_2'W + c_3'XW \]
Hence... grouping terms into form \( Y = a + bX \)
\[
Y = (b_0 + a_0b_1 + a_2b_2W + a_0b_2W + a_2b_2WW + c_2'W) + (a_1b_1 + a_3b_1W + a_1b_2W + a_3b_2WW + c_1' + c_3'W)X
\]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W \):
\[
a_1b_1 + a_3b_1W + a_1b_2W + a_3b_2WW = (a_1 + a_3W)(b_1 + b_2W)
\]

One direct effect of \( X \) on \( Y \), conditional on \( W \):
\[
c_1' + c_3'W
\]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M W Y XW MW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MW = M*W;
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON MW (b2);
    Y ON X (c1);
    Y ON W (c2);
    Y ON XW (c3);
    [M] (a0);
    M ON X (a1);
```
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W
! for example, of 1 SD below mean, mean, 1 SD above mean
! 1 moderator, 3 values for it
! arbitrary naming convention for conditional indirect and total effects used below:
! MED_Q = medium value of Q, etc.

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W
  IND_LOWW IND_MEDW IND_HIW
  DIR_LOWW DIR_MEDW DIR_HIW
  TOT_LOWW TOT_MEDW TOT_HIW);

  LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
  MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
  HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

! Calc conditional indirect effects for each combination of moderator values
  IND_LOWW = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_W + a3*b2*LOW_W*LOW_W;
  IND_MEDW = a1*b1 + a3*b1*MED_W + a1*b2*MED_W + a3*b2*MED_W*MED_W;
  IND_HIW = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_W + a3*b2*HIGH_W*HIGH_W;

! Calc conditional direct effects for each combination of moderator values
  DIR_LOWW = cdash1 + cdash3*LOW_W;
  DIR_MEDW = cdash1 + cdash3*MED_W;
  DIR_HIW = cdash1 + cdash3*HIGH_W;

! Calc conditional total effects for each combination of moderator values
  TOT_LOWW = IND_LOWW + DIR_LOWW;
  TOT_MEDW = IND_MEDW + DIR_MEDW;
  TOT_HIW = IND_HIW + DIR_HIW;
! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
  total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);

LOMOD = IND_LOWW*XVAL;
MEDMOD = IND_MEDW*XVAL;
HIMOD = IND_HIW*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 60: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):
\[ Y = b_0 + b_1M + b_2W + b_3MW + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1M + b_2W + b_3MW + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Hence... substituting in equation for \( M \)
\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2W + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)W + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + b_2W + a_0b_3W + a_1b_3XW + a_2b_3WW + a_3b_3ZW + a_4b_3XWW + a_5b_3XZW + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + b_2W + a_0b_3W + a_2b_3WW + a_3b_3ZW) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_1b_3W + a_4b_3WW + a_5b_3ZW + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $Z$:

$a_1b_1 + a_4b_1W + a_5b_1Z + a_1b_3W + a_4b_3WW + a_5b_3ZW = (a_1 + a_4W + a_5Z)(b_1 + b_3W)$

One direct effect of $X$ on $Y$:

$c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ MW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:

   MW = M*W;
   XW = X*W;
   XZ = X*Z;

ANALYSIS:

   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:

   [Y] (b0);
   Y ON M (b1);
   Y ON W (b2);
   Y ON MW (b3);
   Y ON X (cdash);
```
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
ILOW_HIZ IMEW_HIZ IHIW_HIZ
ILOW_LOZ TM EW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THI W_MEZ
TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW;  ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW;   ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ;   ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ;   ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
chosen high value of Z

! Calc conditional indirect effects for each combination of
moderator values

ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b3*LOW_W
+ a4*b3*LOW_W*LOW_W + a5*b3*LOW_Z*LOW_W;
IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b3*MED_W
+ a4*b3*MED_W*MED_W + a5*b3*LOW_Z*MED_W;
IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a1*b3*HIGH_W +
a4*b3*HIGH_W*HIGH_W + a5*b3*LOW_Z*HIGH_W;

ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b3*LOW_W +
a4*b3*LOW_W*LOW_W + a5*b3*MED_Z*LOW_W;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b3*MED_W +
a4*b3*MED_W*MED_W + a5*b3*MED_Z*MED_W;
IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a4*b3*HIGH_W*HIGH_W + a5*b3*MED_Z*HIGH_W;

ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
1*b3*LOW_W +
a4*b3*LOW_W*LOW_W + a5*b3*HIGH_Z*LOW_W;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
1*b3*MED_W +
a4*b3*MED_W*MED_W + a5*b3*HIGH_Z*MED_W;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
1*b3*HIGH_W +
a4*b3*HIGH_W*HIGH_W + a5*b3*HIGH_Z*HIGH_W;

! Calc conditional total effects for each combination of moderator values
TLOW_LOZ = ILOW_LOZ + cdash;
TMEW_LOZ = IMEW_LOZ + cdash;
THIW_LOZ = IHIW_LOZ + cdash;
TLOW_MEZ = ILOW_MEZ + cdash;
TMEW_MEZ = IMEW_MEZ + cdash;
THIW_MEZ = IHIW_MEZ + cdash;
TLOW_HIZ = ILOW_HIZ + cdash;
TMEW_HIZ = IMEW_HIZ + cdash;
THIW_HIZ = IHIW_HIZ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis
PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ
PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);
LOOP(XVAL,1,5,0.1);
PLOW_LOZ  =  ILOW_LOZ*XVAL;
PMEW_LOZ  =  IMEW_LOZ*XVAL;
PHIW_LOZ  =  IHIW_LOZ*XVAL;

PLOW_MEZ  =  ILOW_MEZ*XVAL;
PMEW_MEZ  =  IMEW_MEZ*XVAL;
PHIW_MEZ  =  IHIW_MEZ*XVAL;

PLOW_HIZ  =  ILOW_HIZ*XVAL;
PMEW_HIZ  =  IMEW_HIZ*XVAL;
PHIW_HIZ  =  IHIW_HIZ*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 61: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path, 1 of which also moderates both the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MW + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MW + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)W + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_0b_2W + a_1b_2XW + a_2b_2WW + a_3b_2ZW + a_4b_2XWW + a_5b_2XZW + c_1'X + c_2'W + c_3'XW \]
Hence... grouping terms into form $Y = a + bX$

$$Y = (b0 + a0b1 + a2b1W + a3b1Z + a0b2W + a2b2WW + a3b2ZW + c2'W) + (a1b1 + a4b1W + a5b1Z + a1b2W + a4b2WW + a5b2ZW + c1' + c3'W)X$$

Hence...

One indirect effect(s) of X on Y, conditional on W, Z:

$$a1b1 + a4b1W + a5b1Z + a1b2W + a4b2WW + a5b2ZW = (a1 + a4W + a5Z)(b1 + b2W)$$

One direct effect of X on Y, conditional on W:

$$c1' + c3'W$$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ MW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MW = M*W;
  XW = X*W;
  XZ = X*Z;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON MW (b2);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON XW (cdash3);
```
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
ILOW_HIZ IMEW_HIZ IHIW_HIZ
DIR_LOWW DIR_MEDW DIR_HIW
TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z

! Calc conditional indirect effects for each combination of moderator values
ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_W +
a4*b2*LOW_W*LOW_W + a5*b2*LOW_Z*LOW_W;
IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_W +
a4*b2*MED_W*MED_W + a5*b2*LOW_Z*MED_W;
IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +

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a1*b2*HIGH_W +
a4*b2*HIGH_W*HIGH_W + a5*b2*LOW_Z*HIGH_W;
ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_W +
a4*b2*LOW_W*LOW_W + a5*b2*MED_Z*LOW_W;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_W +
a4*b2*MED_W*MED_W + a5*b2*MED_Z*MED_W;
IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
a1*b2*HIGH_W +
a4*b2*HIGH_W*HIGH_W + a5*b2*MED_Z*HIGH_W;
ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
a1*b2*LOW_W +
a4*b2*LOW_W*LOW_W + a5*b2*HIGH_Z*LOW_W;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
a1*b2*MED_W +
a4*b2*MED_W*MED_W + a5*b2*HIGH_Z*MED_W;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
a1*b2*HIGH_W +
a4*b2*HIGH_W*HIGH_W + a5*b2*HIGH_Z*HIGH_W;

! Calc conditional direct effects for each combination of moderator values

DIR_LOWW = cdash1 + cdash3*LOW_W;
DIR_MEDW = cdash1 + cdash3*MED_W;
DIR_HIW = cdash1 + cdash3*HIGH_W;

! Calc conditional total effects for each combination of moderator values

TLOW_LOZ = ILOW_LOZ + DIR_LOWW;
TMIEW_LOZ = IMEW_LOZ + DIR_MEDW;
THIW_LOZ = IHIW_LOZ + DIR_HIW;
TLOW_MEZ = ILOW_MEZ + DIR_LOWW;
TMIEW_MEZ = IMEW_MEZ + DIR_MEDW;
THIW_MEZ = IHIW_MEZ + DIR_HIW;
TLOW_HIZ = ILOW_HIZ + DIR_LOWW;
TMIEW_HIZ = IMEW_HIZ + DIR_MEDW;
THIW_HIZ = IHIW_HIZ + DIR_HIW;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by

! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 62: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV- Mediator path, 1 of which also moderates the Mediator-DV path, the with the other moderating the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):
Y = b0 + b1M + b2W + b3MW + c1′X + c2′Z + c3′XZ
M = a0 + a1X + a2W + a3Z + a4XW + a5XZ

Algebra to calculate indirect and/or conditional effects by writing model as Y = a + bX:
Y = b0 + b1M + b2W + b3MW + c1′X + c2′Z + c3′XZ
M = a0 + a1X + a2W + a3Z + a4XW + a5XZ

Hence... substituting in equation for M
Y = b0 + b1(a0 + a1X + a2W + a3Z + a4XW + a5XZ) + b2W + b3(a0 + a1X + a2W + a3Z + a4XW + a5XZ)W + c1′X + c2′Z + c3′XZ

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + b2W + a0b3W + a1b3XW + a2b3WW + a3b3ZW + a4b3XWW + a5b3XZW + c1′X + c2′Z + c3′XZ
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_{0b1} + a_{2b1}W + a_{3b1}Z + b_2W + a_{0b3}W + a_{2b3}WW + a_{3b3}ZW + c_{2}'Z) + (a_{1b1} + a_{4b1}W + a_{5b1}Z + a_{1b3}W + a_{4b3}WW + a_{5b3}ZW + c_{1}' + c_{3}'Z)X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W, Z$:

$a_{1b1} + a_{4b1}W + a_{5b1}Z + a_{1b3}W + a_{4b3}WW + a_{5b3}ZW = (a_1 + a_4W + a_5Z)(b_1 + b_3W)$

One direct effect of $X$ on $Y$, conditional on $Z$:

$c_{1}' + c_{3}'Z$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ MW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MW = M*W;
    XW = X*W;
    XZ = X*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON W (b2);
    Y ON MW (b3);
```
Y ON X (cdash1);
Y ON Z (cdash2);
Y ON XZ (cdash3);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
ILOW_HIZ IMEW_HIZ IHIW_HIZ
DIR_LOWZ DIR_MEDZ DIR_HIZ
TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW; ! replace #LOWW in the code with your
calculated low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your
calculated medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
calculated high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your
calculated low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your
calculated medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
calculated high value of Z

! Calc conditional indirect effects for each combination of moderator values

ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b3*LOW_W +
a4*b3*LOW_W*LOW_W + a5*b3*LOW_Z*LOW_W;
IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b3*MED_W +
a4*b3*MED_W*LOW_W + a5*b3*MED_Z*LOW_W;
+ a4*b3*MED_W*MED_W + a5*b3*LOW_Z*MED_W;
IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
al*b3*HIGH_W +
a4*b3*HIGH_W*HIGH_W + a5*b3*LOW_Z*HIGH_W;
ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b3*LOW_W +
a4*b3*LOW_W*LOW_W + a5*b3*MED_Z*LOW_W;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b3*MED_W +
a4*b3*MED_W*MED_W + a5*b3*MED_Z*MED_W;
IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
al*b3*HIGH_W +
a4*b3*HIGH_W*HIGH_W + a5*b3*MED_Z*HIGH_W;
ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
al*b3*LOW_W +
a4*b3*LOW_W*LOW_W + a5*b3*HIGH_Z*LOW_W;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z +
al*b3*MED_W +
a4*b3*MED_W*MED_W + a5*b3*HIGH_Z*MED_W;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
al*b3*HIGH_W +
a4*b3*HIGH_W*HIGH_W + a5*b3*HIGH_Z*HIGH_W;

! Calc conditional direct effects for each combination of
moderator values

DIR_LOWZ = cdash1 + cdash3*LOW_Z;
DIR_MEDZ = cdash1 + cdash3*MED_Z;
DIR_HIZ = cdash1 + cdash3*HIGH_Z;

! Calc conditional total effects for each combination of
moderator values

TLOW_LOZ = ILOW_LOZ + DIR_LOWZ;
TMLOW_LOZ = IMEW_LOZ + DIR_LOWZ;
THIW_LOZ = IHIW_LOZ + DIR_LOWZ;
TLOW_MEZ = ILOW_MEZ + DIR_MEDZ;
TMLOW_MEZ = IMEW_MEZ + DIR_MEDZ;
THIW_MEZ = IHIW_MEZ + DIR_MEDZ;
TLOW_HIZ = ILOW_HIZ + DIR_HIZ;
TMLOW_HIZ = IMEW_HIZ + DIR_HIZ;
THIW_HIZ = IHIW_HIZ + DIR_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ
PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;

PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;

PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 63: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path and the direct IV-DV path, 1 of which also moderates the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MW + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)W + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1Z + a4b1XW + a5b1XZ + a0b2W + a1b2XW + a2b2WW + a3b2ZW + a4b2XWW + a5b2XZW + c1'X + c2'W + c3'Z + c4'XW + c5'XZ

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a3b1Z + a0b2W + a2b2WW + a3b2ZW + c1'W + c3'Z) + (a1b1 + a4b1W + a5b1Z + a1b2W + a4b2WW + a5b2Z + c1' + c4'W + c5'Z)X

Hence...

One indirect effect(s) of X on Y, conditional on W, Z:

a1b1 + a4b1W + a5b1Z + a1b2W + a4b2WW + a5b2Z = (a1 + a4W + a5Z)(b1 + b2W)

One direct effect of X on Y, conditional on W, Z:

c1' + c4'W + c5'Z

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ MW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MW = M*W;
    XW = X*W;
    XZ = X*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
    [Y] (b0);
    Y ON M (b1);
    Y ON MW (b2);
```
Y ON X (cdash1);
Y ON W (cdash2);
Y ON Z (cdash3);
Y ON XW (cdash4);
Y ON XZ (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
  ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
  ILOW_HIZ IMEW_HIZ IHIW_HIZ
  DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
  DLOW_HIZ DMEW_HIZ DHIW_HIZ
  TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
  TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z

! Calc conditional indirect effects for each combination of moderator values
ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*LOW_Z*LOW_W;
IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*LOW_Z*MED_W;
IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*LOW_Z*HIGH_W;

ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*MED_Z*LOW_W;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*MED_Z*MED_W;
IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*MED_Z*HIGH_W;

ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*HIGH_Z*LOW_W;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*HIGH_Z*MED_W;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*HIGH_Z*HIGH_W;

! Calc conditional direct effects for each combination of moderator values
DLOW_LOZ = cdash1 + cdash4*LOW_W + cdash5*LOW_Z;
DMEW_LOZ = cdash1 + cdash4*MED_W + cdash5*LOW_Z;
DHIW_LOZ = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z;

DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z;
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z;
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z;

DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z;
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z;
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z;

! Calc conditional total effects for each combination of moderator values
TLOW_LOZ = ILOW_LOZ + DLOW_LOZ;
TMEW_LOZ = IMEW_LOZ + DM EW LOZ;
THIW_LOZ = IHIW_LOZ + DHIW_LOZ;
TLOW_MEZ = ILOW_MEZ + DLOW_MEZ;
TMEW_MEZ = IMEW_MEZ + DMEW_MEZ;
THIW_MEZ = IHIW_MEZ + DHIW_MEZ;
TLOW_HIZ = ILOW_HIZ + DLOW_HIZ;
TMEW_HIZ = IMEW_HIZ + DMEW_HIZ;
THIW_HIZ = IHIW_HIZ + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
  total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
  by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ
PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 64: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates the IV-Mediator path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Model Equation(s):

\[ Y = b_0 + b_1M + b_2W + b_3V + b_4MW + b_5MV + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2W + b_3V + b_4MW + b_5MV + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2W + b_3V + b_4(a_0 + a_1X + a_2W + a_3XW)W + b_5(a_0 + a_1X + a_2W + a_3XW)V + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + b_2W + b_3V + a_0b_4W + a_1b_4XW + a_2b_4WW + a_3b_4XWW + a_0b_5V + a_1b_5XV + a_2b_5WW + a_3b_5XWV + c'X \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + b_2W + b_3V + a_0b_4W + a_2b_4WW + a_0b_5V + a_2b_5WV) + (a_1b_1 + a_3b_1W + a_1b_4W + a_3b_4WW + a_1b_5V + a_3b_5WV + c')X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$:

$a_1b_1 + a_3b_1W + a_1b_4W + a_3b_4WW + a_1b_5V + a_3b_5WV = (a_1 + a_3W)(b_1 + b_4W + b_5V)$

One direct effect of $X$ on $Y$:

$c'$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y

USEVARIABLES = X M W V Y XW MW MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
   MW = M*W;
   MV = M*V;
   XW = X*W;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
   [Y] (b0);
   Y ON M (b1);
   Y ON W (b2);
   Y ON V (b3);
   Y ON MW (b4);
   Y ON MV (b5);
```

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Y ON X (cdash);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
ILOW_HIV IMEW_HIV IHIW_HIV
TLOW_LOV TMEW_LOV THIW_LOV TLOW_MEV TMEW_MEV THIW_MEV
TLOW_HIV TMEW_HIV THIW_HIV);

LOW_W = #LOWW;   ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;    ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV;    ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV;    ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values
ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_W + a3*b4*LOW_W*LOW_W + a1*b5*LOW_V + a3*b5*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b4*MED_W + a3*b4*MED_W*MED_W + a1*b5*MED_V + a3*b5*MED_W*MED_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_W + a3*b4*HIGH_W*HIGH_W + a1*b5*HIGH_V + a3*b5*HIGH_W*HIGH_V;
ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_W +
a3*b4*LOW_W*LOW_W +
   a1*b5*MED_V + a3*b5*LOW_W*MED_V;
IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b4*MED_W +
a3*b4*MED_W*MED_W +
   a1*b5*MED_V + a3*b5*MED_W*MED_V;
IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_W +
a3*b4*HIGH_W*HIGH_W +
   a1*b5*MED_V + a3*b5*HIGH_W*MED_V;
ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_W +
a3*b4*LOW_W*LOW_W +
   a1*b5*HIGH_V + a3*b5*LOW_W*HIGH_V;
IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b4*MED_W +
a3*b4*MED_W*MED_W +
   a1*b5*HIGH_V + a3*b5*MED_W*HIGH_V;
IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_W +
a3*b4*HIGH_W*HIGH_W +
   a1*b5*HIGH_V + a3*b5*HIGH_W*HIGH_V;

! Calc conditional total effects for each combination of
moderator values
TLOW_LOV = ILOW_LOV + cdash;
TMEW_LOV = IMEW_LOV + cdash;
THIW_LOV = IHIW_LOV + cdash;
TLOW_MEV = ILOW_MEV + cdash;
TMEW_MEV = IMEW_MEV + cdash;
THIW_MEV = IHIW_MEV + cdash;
TLOW_HIV = ILOW_HIV + cdash;
TMEW_HIV = IMEW_HIV + cdash;
THIW_HIV = IHIW_HIV + cdash;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
! logical min and max limits of predictor X used in analysis
PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV
PHIW_MEV
   PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL,1,5,0.1);
PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;

PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;

PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 65: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates both the IV-Mediator path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2V + b_3MW + b_4MV + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2V + b_3MW + b_4MV + c_1'X + c_2'W + c_3'XW \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2V + b_3(a_0 + a_1X + a_2W + a_3XW)W + b_4(a_0 + a_1X + a_2W + a_3XW)V + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + b_2V + a_0b_3W + a_1b_3XW + a_2b_3WW + a_3b_3XWW + a_0b_4V + a_1b_4XV + a_2b_4WV + a_3b_4XWV + c_1'X + c_2'W + c_3'XW \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + b_2V + a_0b_3W + a_2b_3WW + a_0b_4V + a_2b_4W + c_2'W) + (a_1b_1 + a_3b_1W + a_1b_3W + a_3b_3WW + a_1b_4V + a_3b_4W + c_1' + c_3'W)X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$:

$a_1b_1 + a_3b_1W + a_1b_3W + a_3b_3WW + a_1b_4V + a_3b_4WV = (a_1 + a_3W)(b_1 + b_3W + b_4V)$

One direct effect of $X$ on $Y$, conditional on $W$:

$c_1' + c_3'W$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y

USEVARIABLES = X M W V Y XW MW MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MW = M*W;
  MV = M*V;
  XW = X*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON V (b2);
  Y ON MW (b3);
  Y ON MV (b4);
```
Y ON X (cdash1);
Y ON W (cdash2);
Y ON XW (cdash3);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
ILOW_HIV IMEW_HIV IHIW_HIV
DIR_LOWW DIR_MEDW DIR_HIW
TLOW_LOV TMEW_LOV THIW_LOV TLOW_MEV TMEW_MEV THIW_MEV
TLOW_HIV TMEW_HIV THIW_HIV);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values
ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_W + a3*b3*LOW_W*LOW_W +
a1*b4*LOW_V + a3*b4*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b3*MED_W +
a3*b3*MED_W*MED_W +
a1*b4*LOW_V + a3*b4*MED_W*LOW_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_W*HIGH_W + 
a1*b4*LOW_V + a3*b4*HIGH_W*LOW_V;

ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_W + 
a3*b3*LOW_W*LOW_W + 
a1*b4*MED_V + a3*b4*LOW_W*MED_V;

IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b3*MED_W + 
a3*b3*MED_W*MED_W + 
a1*b4*MED_V + a3*b4*MED_W*MED_V;

IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_W + 
a3*b3*HIGH_W*HIGH_W + 
a1*b4*MED_V + a3*b4*HIGH_W*MED_V;

ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_W + 
a3*b3*LOW_W*LOW_W + 
a1*b4*HIGH_V + a3*b4*LOW_W*HIGH_V;

IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b3*MED_W + 
a3*b3*MED_W*MED_W + 
a1*b4*MED_V + a3*b4*MED_W*MED_V;

IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_W + 
a3*b3*HIGH_W*HIGH_W + 
a1*b4*HIGH_V + a3*b4*HIGH_W*HIGH_V;

! Calc conditional direct effects for each combination of
moderator values

DIR_LOWW = cdash1 + cdash3*LOW_W;

DIR_MEDW = cdash1 + cdash3*MED_W;

DIR_HIW = cdash1 + cdash3*HIGH_W;

! Calc conditional total effects for each combination of
moderator values

TLOW_LOV = ILOW_LOV + DIR_LOWW;

TMEW_LOV = IMEW_LOV + DIR_MEDW;

THIW_LOV = IHIW_LOV + DIR_HIW;

TLOW_MEV = ILOW_MEV + DIR_LOWW;

TMEW_MEV = IMEW_MEV + DIR_MEDW;

THIW_MEV = IHIW_MEV + DIR_HIW;

TLOW_HIV = ILOW_HIV + DIR_LOWW;

TMEW_HIV = IMEW_HIV + DIR_MEDW;

THIW_HIV = IHIW_HIV + DIR_HIW;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by

! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV PHIW_MEV
PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL,1,5,0.1);

PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;
PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
TYPE = plot2;

OUTPUT:
STAND CINT(bcbootstrap);
Model 66: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path, 1 of which also moderates the IV-Mediator path, the with the other moderating the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 W + b_3 MW + b_4 MV + c_1'X + c_2'V + c_3'XV \]

\[ M = a_0 + a_1 X + a_2 W + a_3 XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 XW) + b_2W + b_3(a_0 + a_1 X + a_2 W + a_3 XW)W + b_4(a_0 + a_1 X + a_2 W + a_3 XW)V + c_1'X + c_2'V + c_3'XV \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + a_0b_1 + a_1b_1 X + a_2b_1 W + a_3b_1 XW + b_2W + a_0b_3 + a_1b_3 X + a_2b_3 W + a_3b_3 XWW + a_0b_4V + a_1b_4 XV + a_2b_4 WV + a_3b_4XWV + c_1'X + c_2'V + c_3'XV \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1 X + a_2b_1 W + a_3b_1 XW + b_2W + a_0b_3 + a_1b_3 X + a_2b_3 W + a_3b_3 XWW + a_0b_4V + a_1b_4 XV + a_2b_4 WV + a_3b_4XWV + c_1'X + c_2'V + c_3'XV \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_0b_1 + a_2b_1W + b_2W + a_0b_3W + a_2b_3WW + a_0b_4V + a_2b_4WV + c_2'V) + (a_1b_1 + a_3b_1W + a_1b_3W + a_3b_3WW + a_1b_4V + a_3b_4WV + c_1' + c_3'V)X$

Hence...

One indirect effect(s) of $X$ on $Y$, conditional on $W$, $V$:

$a_1b_1 + a_3b_1W + a_1b_3W + a_3b_3WW + a_1b_4V + a_3b_4WV = (a_1 + a_3W)(b_1 + b_3W + b_4V)$

One direct effect of $X$ on $Y$, conditional on $V$:

$c_1' + c_3'V$

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y
USEVARIABLES = X M W V Y XW XV MW MV;
! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MW = M*W;
  MV = M*V;
  XW = X*W;
  XV = X*V;
ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
  [Y] (b0);
  Y ON M (b1);
  Y ON W (b2);
  Y ON MW (b3);
  Y ON MV (b4);
```
Y ON X (cdash1);
Y ON V (cdash2);
Y ON XV (cdash3);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
  ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
  ILOW_HIV IMEW_HIV IHIW_HIV
  DIR_LOWV DIR_MEDV DIR_HIV
  TLOW_LOV TM EW_LOV THIW_LOV TLOW_MEV TM EW_MEV THIW_MEV
  TLOW_HIV TM EW_HIV THIW_HIV);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_W + a3*b3*LOW_W*LOW_W + 
a1*b4*LOW_V + a3*b4*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b3*MED_W + a3*b3*MED_W*MED_W + 
a1*b4*LOW_V + a3*b4*MED_W*LOW_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_W + 
               a3*b3*HIGH_W*HIGH_W + 
               a1*b4*LOW_V + a3*b4*HIGH_W*LOW_V;
ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_W + 
              a3*b3*LOW_W*LOW_W + 
              a1*b4*MED_V + a3*b4*LOW_W*MED_V;
IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b3*MED_W + 
           a3*b3*MED_W*MED_W + 
           a1*b4*MED_V + a3*b4*MED_W*MED_V;
IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_W + 
            a3*b3*HIGH_W*HIGH_W + 
            a1*b4*MED_V + a3*b4*HIGH_W*MED_V;
ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b3*LOW_W + 
          a3*b3*LOW_W*LOW_W + 
          a1*b4*HIGH_V + a3*b4*LOW_W*HIGH_V;
IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b3*MED_W + 
        a3*b3*MED_W*MED_W + 
        a1*b4*HIGH_V + a3*b4*MED_W*HIGH_V;
IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b3*HIGH_W + 
          a3*b3*HIGH_W*HIGH_W + 
          a1*b4*HIGH_V + a3*b4*HIGH_W*HIGH_V;

! Calc conditional direct effects for each combination of 
! moderator values
DIR_LOWV = cdash1 + cdash3*LOW_V;
DIR_MEDV = cdash1 + cdash3*MED_V;
DIR_HIV = cdash1 + cdash3*HIGH_V;

! Calc conditional total effects for each combination of 
! moderator values
TLOW_LOV = ILOW_LOV + DIR_LOWV;
TMEW_LOV = IMEW_LOV + DIR_LOWV;
THIW_LOV = IHIW_LOV + DIR_LOWV;
TLOW_MEV = ILOW_MEV + DIR_MEDV;
TMEW_MEV = IMEW_MEV + DIR_MEDV;
THIW_MEV = IHIW_MEV + DIR_MEDV;
TLOW_HIV = ILOW_HIV + DIR_HIV;
TMEW_HIV = IMEW_HIV + DIR_HIV;
THIW_HIV = IHIW_HIV + DIR_HIV;

! Use loop plot to plot conditional indirect effect of X on Y 
! for each combination of low, med, high moderator values 
! Could be edited to show conditional direct or conditional 
! total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by

! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV
PHIW_MEV
PLOW_HIV PMEW_HIV PHIW_HIV);

LOOP(XVAL,1,5,0.1);

PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;
PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 67: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the Mediator-DV path and the direct IV-DV path, 1 of which also moderates the IV-Mediator path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.

- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).

- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.

- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M + b_2MW + b_3MV + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MW + b_3MV + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'XV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)W + b_3(a_0 + a_1X + a_2W + a_3XW)V + c_1'X + c_2'W + c_3'XW + c_4'V + c_5'XV \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1XW + a0b2W + a1b2XW + a2b2WW + a3b2XWW + a0b3V + a1b3XV + a2b3WV + a3b3XWV + c1’X + c2’W + c3’XW + c4’V + c5’XV

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + a0b2W + a2b2WW + a0b3V + a2b3WV + c1’X + c2’W + c4’V) + (a1b1 + a3b1W + a1b2W + a3b2WW + a1b3V + a3b3WV + c1’ + c3’W + c5’V)X

Hence...

One indirect effect(s) of X on Y, conditional on W, V:
a1b1 + a3b1W + a1b2W + a3b2WW + a1b3V + a3b3WV = (a1 + a3W)(b1 + b2W + b3V)

One direct effect of X on Y, conditional on W, V:
c1’ + c3’W + c5’V

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y

USEVARIABLES = X M W V Y XW XV MW MV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES
! subcommand above

DEFINE:
   MW = M*W;
   MV = M*V;
   XW = X*W;
   XV = X*V;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
   [Y] (b0);
   Y ON M (b1);
```

687
Y ON MW (b2);
Y ON MV (b3);
Y ON X (cdash1);
Y ON W (cdash2);
Y ON XW (cdash3);
Y ON V (cdash4);
Y ON XV (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
  ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
  ILOW_HIV IMEW_HIV IHIW_HIV
  DLOW_LOV DMEW_LOV DHIW_LOV DLOW_MEV DMEW_MEV DHIW_MEV
  DLOW_HIV DMEW_HIV DHIW_HIV
  TLOW_LOV TMHW_LOV THIW_LOV TLOW_MEV TMHW_MEV THIW_MEV
  TLOW_HIV TMHW_HIV THIW_HIV);

  LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
  MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
  HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

  LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
  MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
  HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values
ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_W + a3*b2*LOW_W*LOW_W + a1*b3*LOW_V + a3*b3*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b2*MED_W + a3*b2*MED_W*MED_W + a1*b3*LOW_V + a3*b3*MED_W*LOW_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_W + a3*b2*HIGH_W*HIGH_W + a1*b3*LOW_V + a3*b3*HIGH_W*LOW_V;
ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_W + a3*b2*LOW_W*LOW_W + a1*b3*MED_V + a3*b3*LOW_W*MED_V;
IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b2*MED_W + a3*b2*MED_W*MED_W + a1*b3*MED_V + a3*b3*MED_W*MED_V;
IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_W + a3*b2*HIGH_W*HIGH_W + a1*b3*MED_V + a3*b3*HIGH_W*MED_V;
ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_W + a3*b2*LOW_W*LOW_W + a1*b3*HIGH_V + a3*b3*LOW_W*HIGH_V;
IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b2*MED_W + a3*b2*MED_W*MED_W + a1*b3*HIGH_V + a3*b3*MED_W*HIGH_V;
IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_W + a3*b2*HIGH_W*HIGH_W + a1*b3*HIGH_V + a3*b3*HIGH_W*HIGH_V;

! Calc conditional direct effects for each combination of moderator values
DLOW_LOV = cdash1 + cdash3*LOW_W + cdash5*LOW_V;
DMEW_LOV = cdash1 + cdash3*MED_W + cdash5*LOW_V;
DHIW_LOV = cdash1 + cdash3*HIGH_W + cdash5*LOW_V;
DLOW_MEV = cdash1 + cdash3*LOW_W + cdash5*MED_V;
DMEW_MEV = cdash1 + cdash3*MED_W + cdash5*MED_V;
DHIW_MEV = cdash1 + cdash3*HIGH_W + cdash5*MED_V;
DLOW_HIV = cdash1 + cdash3*LOW_W + cdash5*HIGH_V;
DMEW_HIV = cdash1 + cdash3*MED_W + cdash5*HIGH_V;
DHIW_HIV = cdash1 + cdash3*HIGH_W + cdash5*HIGH_V;

! Calc conditional total effects for each combination of moderator values
TLOW_LOV = ILOW_LOV + DLOW_LOV;
TMEW_LOV = IMEW_LOV + DMEW_LOV;
THIW_LOV = IHIW_LOV + DHIW_LOV;
TLOW_MEV = ILOW_MEV + DLOW_MEV;
TMEW_MEV = IMEW_MEV + DM EW_MEV;
THIW_MEV = IHIW_MEV + DHIW_MEV;
TLOW_HIV = ILOW_HIV + DLOW_HIV;
TM EW_HIV = IM EW_HIV + DME W_HIV;
THIW_HIV = IHIW_HIV + DHIW_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV
PHIW_MEV
PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL,1,5,0.1);
PLOW_LOV = ILOW_LOV*XVAL;
PM EW_LOV = IM EW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;
PLOW_MEV = ILOW_MEV*XVAL;
PM EW_MEV = IM EW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PM EW_HIV = IM EW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 68: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the IV-Mediator path with all 2-way and 3-way interactions, 1 of which also moderates the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[
Y = b_0 + b_1 M + b_2 W + b_3 MW + c'X \\
M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ
\]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[
Y = b_0 + b_1 M + b_2 W + b_3 MW + c'X \\
M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ
\]

Hence... substituting in equation for \( M \)

\[
Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ) + b_2 W + b_3(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)W + c'X
\]

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}X + a_{21}W + a_{31}Z + a_{41}XW + a_{51}XZ + a_{61}WZ + a_{71}XWZ + b_{21}W + a_{03}W + a_{13}XW + a_{23}WW + a_{33}ZW + a_{43}XWW + a_{53}XZW + a_{63}WWZ + a_{73}XWWZ + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01} + a_{21}W + a_{31}Z + a_{61}WZ + b_{21}W + a_{03}W + a_{13}XW + a_{23}WW + a_{33}ZW + a_{63}WWZ) + (a_{11} + a_{41}W + a_{51}Z + a_{71}WZ + a_{13}W + a_{43}WW + a_{53}ZW + a_{73}WWZ + c')X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z \):

\[ a_{11} + a_{41}W + a_{51}Z + a_{71}WZ + a_{13}W + a_{43}WW + a_{53}ZW + a_{73}WWZ = (a_1 + a_4W + a_5Z + a_7WZ)(b_1 + b_3W) \]

One direct effect of \( X \) on \( Y \):

\[ c' \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y
USEVARIABLES = X M W Z Y XW XZ WZ MW XWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES
subcommand above
DEFINE:
   MW = M*W;
   XW = X*W;
   XZ = X*Z;
   WZ = W*Z;
   XWZ = X*W*Z;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using
parentheses
```
MODEL:
[Y] (b0);
Y ON M (b1);
Y ON W (b2);
Y ON MW (b3);
Y ON X(cdash);
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
  ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
  ILOW_HIZ IMEW_HIZ IHIW_HIZ
  TLOW_LOZ TM EW_LOZ THI W_LOZ TLOW_MEZ TM EW_MEZ THI W_MEZ
  TLOW_HIZ TM EW_HIZ THI W_HIZ);

LOW_W = #LOWW; ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
chosen high value of Z

! Calc conditional indirect effects for each combination of moderator values
\[
\begin{align*}
I_{LOW\_LOZ} &= a_1 b_1 + a_4 b_1 \cdot LOW\_W + a_5 b_1 \cdot LOW\_Z + \\
a_7 b_1 \cdot LOW\_W \cdot LOW\_Z + \\
a_1 b_3 \cdot LOW\_W + a_4 b_3 \cdot LOW\_W \cdot LOW\_W + a_5 b_3 \cdot LOW\_Z \cdot LOW\_W + \\
a_7 b_3 \cdot LOW\_W \cdot LOW\_W \cdot LOW\_Z; \\
IMEW\_LOZ &= a_1 b_1 + a_4 b_1 \cdot MED\_W + a_5 b_1 \cdot LOW\_Z + \\
a_7 b_1 \cdot MED\_W \cdot LOW\_Z + \\
a_1 b_3 \cdot MED\_W + a_4 b_3 \cdot MED\_W \cdot MED\_W + a_7 b_3 \cdot MED\_W \cdot MED\_W \cdot MED\_Z; \\
I_{HIW\_LOZ} &= a_1 b_1 + a_4 b_1 \cdot HIGH\_W + a_5 b_1 \cdot LOW\_Z + \\
a_7 b_1 \cdot HIGH\_W \cdot LOW\_Z + \\
a_1 b_3 \cdot HIGH\_W + a_4 b_3 \cdot HIGH\_W \cdot HIGH\_W + a_5 b_3 \cdot LOW\_Z \cdot HIGH\_W \;
\end{align*}
\]

\[
\begin{align*}
I_{LOW\_MEZ} &= a_1 b_1 + a_4 b_1 \cdot LOW\_W + a_5 b_1 \cdot MED\_Z + \\
a_7 b_1 \cdot LOW\_W \cdot MED\_Z + \\
a_1 b_3 \cdot LOW\_W + a_4 b_3 \cdot LOW\_W \cdot LOW\_W + a_5 b_3 \cdot MED\_Z \cdot LOW\_W + \\
a_7 b_3 \cdot LOW\_W \cdot LOW\_W \cdot MED\_Z; \\
IMEW\_MEZ &= a_1 b_1 + a_4 b_1 \cdot MED\_W + a_5 b_1 \cdot MED\_Z + \\
a_7 b_1 \cdot MED\_W \cdot MED\_Z + \\
a_1 b_3 \cdot MED\_W + a_4 b_3 \cdot MED\_W \cdot MED\_W + a_5 b_3 \cdot MED\_Z \cdot MED\_W + \\
a_7 b_3 \cdot MED\_W \cdot MED\_W \cdot MED\_Z; \\
I_{HIW\_MEZ} &= a_1 b_1 + a_4 b_1 \cdot HIGH\_W + a_5 b_1 \cdot MED\_Z + \\
a_7 b_1 \cdot HIGH\_W \cdot MED\_Z + \\
a_1 b_3 \cdot HIGH\_W + a_4 b_3 \cdot HIGH\_W \cdot HIGH\_W + a_5 b_3 \cdot MED\_Z \cdot HIGH\_W \;
\end{align*}
\]

\[
\begin{align*}
I_{LOW\_HIZ} &= a_1 b_1 + a_4 b_1 \cdot LOW\_W + a_5 b_1 \cdot HIGH\_Z + \\
a_7 b_1 \cdot LOW\_W \cdot HIGH\_Z + \\
a_1 b_3 \cdot LOW\_W + a_4 b_3 \cdot LOW\_W \cdot LOW\_W + a_5 b_3 \cdot HIGH\_Z \cdot LOW\_W + \\
a_7 b_3 \cdot LOW\_W \cdot LOW\_W \cdot HIGH\_Z; \\
IMEW\_HIZ &= a_1 b_1 + a_4 b_1 \cdot MED\_W + a_5 b_1 \cdot HIGH\_Z + \\
a_7 b_1 \cdot MED\_W \cdot HIGH\_Z + \\
a_1 b_3 \cdot MED\_W + a_4 b_3 \cdot MED\_W \cdot MED\_W + a_5 b_3 \cdot MED\_Z \cdot MED\_W + \\
a_7 b_3 \cdot MED\_W \cdot MED\_W \cdot MED\_Z; \\
I_{HIW\_HIZ} &= a_1 b_1 + a_4 b_1 \cdot HIGH\_W + a_5 b_1 \cdot HIGH\_Z + \\
a_7 b_1 \cdot HIGH\_W \cdot HIGH\_Z + \\
a_1 b_3 \cdot HIGH\_W + a_4 b_3 \cdot HIGH\_W \cdot HIGH\_W + a_5 b_3 \cdot HIGH\_Z \cdot HIGH\_W \;
\end{align*}
\]

! Calc conditional total effects for each combination of 
moderator values

\[
\begin{align*}
T_{LOW\_LOZ} &= I_{LOW\_LOZ} + cdash; \\
T_{MEW\_LOZ} &= IMEW\_LOZ + cdash; \\
T_{HIW\_LOZ} &= IHIW\_LOZ + cdash;
\end{align*}
\]
TLOW_MEZ = ILOW_MEZ + cdash;
TMEW_MEZ = IMEW_MEZ + cdash;
THIW_MEZ = IHIW_MEZ + cdash;

TLOW_HIZ = ILOW_HIZ + cdash;
TMEW_HIZ = IMEW_HIZ + cdash;
THIW_HIZ = IHIW_HIZ + cdash;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ
PHIW_MEZ
PLow_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 69: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both of the IV-Mediator path and the direct IV-DV path, with all 2-way and 3-way interactions, 1 of which also moderates the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MW + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_5(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_6(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_7(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_8(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_9(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_{10}(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_5(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_6(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_7(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_8(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_9(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_{10}(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_6b_1WZ + a_7b_1XWZ + a_0b_2W + a_1b_2XW + a_2b_2WW + a_3b_2ZW + a_4b_2XWW + a_5b_2XZW + a_6b_2WWZ + a_7b_2XWWZ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + a_6b_1WZ + a_0b_2W + a_2b_2WW + a_3b_2ZW + a_6b_2WWZ + c_2'W + c_3'Z + c_6'WZ) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + a_1b_2W + a_4b_2WW + a_5b_2ZW + a_7b_2WWZ + c_1' + c_4'W + c_5'Z + c_7'WZ)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z \):

\[ a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + a_1b_2W + a_4b_2WW + a_5b_2ZW + a_7b_2WWZ = (a_1 + a_4W + a_5Z + a_7WZ)(b_1 + b_2W) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):

\[ c_1' + c_4'W + c_5'Z + c_7'WZ \]

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ WZ XWZ MW;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MW = M*W;
    XW = X*W;
    XZ = X*Z;
    WZ = W*Z;
    XWZ = X*W*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
```
MODEL:

[Y] (b0);
Y ON M (b1);
Y ON MW (b2);

Y ON X(cdash1);
Y ON W (cdash2);
Y ON Z (cdash3);
Y ON XW (cdash4);
Y ON XZ (cdash5);
Y ON WZ (cdash6);
Y ON XWZ (cdash7);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);
M ON WZ (a6);
M ON XWZ (a7);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean

! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:

NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
  ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
  ILOW_HIZ IMEW_HIZ IHIW_HIZ
  DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
  DLOW_HIZ DMEW_HIZ DHIW_HIZ
  TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
  TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your chosen high value of Z

! Calc conditional indirect effects for each combination of moderator values

ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*LOW_Z*LOW_W + a7*b2*LOW_W*LOW_W*LOW_Z;
IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*LOW_Z*MED_W + a7*b2*MED_W*MED_W*LOW_Z;
IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*LOW_Z*HIGH_W + a7*b2*HIGH_W*HIGH_W*LOW_Z;
ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a7*b1*LOW_W*MED_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*MED_Z*LOW_W + a7*b2*LOW_W*MED_W*LOW_W;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*MED_Z*MED_W + a7*b2*MED_W*MED_W*MED_Z;
IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a7*b1*HIGH_W*MED_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*MED_Z*HIGH_W + a7*b2*HIGH_W*HIGH_W*MED_Z;
ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*HIGH_Z*LOW_W + a7*b2*LOW_W*LOW_W*HIGH_Z;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a7*b1*MED_W*MED_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*HIGH_Z*MED_W + a7*b2*MED_W*MED_W*MED_Z;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + a7*b1*HIGH_W*MED_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*MED_Z*HIGH_W + a7*b2*MED_Z*MED_Z*HIGH_W


! Calc conditional direct effects for each combination of moderator values

\[
D_{LOZ} = c_{dash1} + c_{dash4} \cdot LOW_W + c_{dash5} \cdot LOW_Z + c_{dash7} \cdot LOW_W \cdot LOW_Z;
\]
\[
D_{MEW} = c_{dash1} + c_{dash4} \cdot MED_W + c_{dash5} \cdot LOW_Z + c_{dash7} \cdot MED_W \cdot LOW_Z;
\]
\[
D_{HIW} = c_{dash1} + c_{dash4} \cdot HIGH_W + c_{dash5} \cdot LOW_Z + c_{dash7} \cdot HIGH_W \cdot LOW_Z;
\]
\[
D_{LOW} = c_{dash1} + c_{dash4} \cdot LOW_W + c_{dash5} \cdot MED_Z + c_{dash7} \cdot LOW_W \cdot MED_Z;
\]
\[
D_{MEW} = c_{dash1} + c_{dash4} \cdot MED_W + c_{dash5} \cdot MED_Z + c_{dash7} \cdot MED_W \cdot MED_Z;
\]
\[
D_{HIW} = c_{dash1} + c_{dash4} \cdot HIGH_W + c_{dash5} \cdot MED_Z + c_{dash7} \cdot HIGH_W \cdot MED_Z;
\]
\[
D_{LOW} = c_{dash1} + c_{dash4} \cdot LOW_W + c_{dash5} \cdot HIGH_Z + c_{dash7} \cdot LOW_W \cdot HIGH_Z;
\]
\[
D_{MEW} = c_{dash1} + c_{dash4} \cdot MED_W + c_{dash5} \cdot HIGH_Z + c_{dash7} \cdot MED_W \cdot HIGH_Z;
\]
\[
D_{HIW} = c_{dash1} + c_{dash4} \cdot HIGH_W + c_{dash5} \cdot HIGH_Z + c_{dash7} \cdot HIGH_W \cdot HIGH_Z;
\]

! Calc conditional total effects for each combination of moderator values

\[
T_{LOZ} = L_{LOZ} + D_{LOZ};
\]
\[
T_{MEW} = L_{MEW} + D_{MEW};
\]
\[
T_{HIW} = L_{HIW} + D_{HIW};
\]
\[
T_{LOW} = L_{LOW} + D_{LOW};
\]
\[
T_{MEW} = L_{MEW} + D_{MEW};
\]
\[
T_{HIW} = L_{HIW} + D_{HIW};
\]
\[
T_{LOW} = L_{LOW} + D_{LOW};
\]
\[
T_{MEW} = L_{MEW} + D_{MEW};
\]
\[
T_{HIW} = L_{HIW} + D_{HIW};
\]

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ PLOW_HIZ PMEW_HIZ PHIW_HIZ);
LOOP(XVAL,1,5,0.1);
PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 70: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating the Mediator- DV path with all 2-way and 3-way interactions, 1 of which also moderates the IV-Mediator path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2W + b_3V + b_4MW + b_5MV + b_6WV + b_7MWV + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2W + b_3V + b_4(a_0 + a_1X + a_2W + a_3XW)W + b_5(a_0 + a_1X + a_2W + a_3XW)V + b_6WV + b_7(a_0 + a_1X + a_2W + a_3XW)WV + c'X \]

Hence... multiplying out brackets
Y = b0 + a0b1 + a1b1X + a2b1W + a3b1XW + b2W + b3V + a0b4W + a1b4XW + a2b4WW + a3b4XWW + a0b5V + a1b5XV + a2b5WW + a3b5XWW + b6W + a0b7W + a1b7XWV + a2b7WWV + a3b7XWWV + c'X

Hence... grouping terms into form Y = a + bX

Y = (b0 + a0b1 + a2b1W + b2W + b3V + a0b4W + a2b4WW + a0b5V + a2b5WW + b6W + a0b7W + a1b7WV + a3b7WWV) + (a1b1 + a3b1W + a1b4W + a3b4WW + a1b5V + a3b5WV + a1b7WV + a3b7WWV + c')X

Hence...

One indirect effect(s) of X on Y, conditional on W, V:

a1b1 + a3b1W + a1b4W + a3b4WW + a1b5V + a3b5WV = (a1 + a3W)(b1 + b4W + b5V + b7WV)

One direct effect of X on Y:

c'

Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y

USEVARIABLES = X M W V Y XW WV MW MV MWV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
    MW = M*W;
    MV = M*V;
    XW = X*W;
    WV = W*V;
    MWV = M*W*V;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
[Y] (b0);
Y ON M (b1);
Y ON W (b2);
Y ON V (b3);
Y ON MW (b4);
Y ON MV (b5);
Y ON WV (b6);
Y ON MWV (b7);
Y ON X(cdash);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
ILOW_HIV IMEW_HIV IHIW_HIV
TLOW_LOV TM EW_LOV THIW_LOV TLOW_MEV TM EW_MEV THIW_MEV
TLOW_HIV TM EW_HIV THIW_HIV);

LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values
ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b4*LOW_W +
a3*b4*LOW_W*LOW_W +
a1*b5*LOW_V + a3*b5*LOW_W*LOW_V + a1*b7*LOW_W*LOW_V +
a3*b7*LOW_W*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b4*MED_W +
a3*b4*MED_W*MED_W +
a1*b5*MED_V + a3*b5*MED_W*MED_V + a1*b7*MED_W*MED_V +
a3*b7*MED_W*MED_W*MED_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b4*HIGH_W +
a3*b4*HIGH_W*HIGH_W +
a1*b5*HIGH_V + a3*b5*HIGH_W*HIGH_V + a1*b7*HIGH_W*HIGH_V +
a3*b7*HIGH_W*HIGH_W*HIGH_V;

! Calc conditional total effects for each combination of

! moderator values

TLOW_LOV = ILOW_LOV + cdash;
TMEW_LOV = IMEW_LOV + cdash;
THIW_LOV = IHIW_LOV + cdash;
TLOW_MEV = ILOW_MEV + cdash;
TMEW_MEV = IMEW_MEV + cdash;
THIW_MEV = IHIW_MEV + cdash;
TLOW_HIV = ILOW_HIV + cdash;
TMEW_HIV = IMEW_HIV + cdash;
THIW_HIV = IHIW_HIV + cdash;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV
PHIW_MEV
PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL,1,5,0.1);

PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;

PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;

PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 71: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both of the Mediator-DV path and the direct IV-DV path, with all 2-way and 3-way interactions, 1 of which also moderates the IV-Mediator path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, V, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MW + b_3MV + b_4MWV + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV + c_6'WV + c_7'XWV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2MW + b_3MV + b_4MWV + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV + c_6'WV + c_7'XWV \]
\[ M = a_0 + a_1X + a_2W + a_3XW \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3XW) + b_2(a_0 + a_1X + a_2W + a_3XW)W + b_3(a_0 + a_1X + a_2W + a_3XW)V + b_4(a_0 + a_1X + a_2W + a_3XW)WV + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV + c_6'WV + c_7'XWV \]
Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1XW + a_0b_2W + a_1b_2XW + a_2b_2WW + a_3b_2XWW + a_0b_3V + a_1b_3XV + a_2b_3WW + a_3b_3XWW + a_0b_4WV + a_1b_4XWV + a_2b_4WWV + a_3b_4XWWV + c_1'X + c_2'W + c_3'V + c_4'XW + c_5'XV + c_6'WV + c_7'XWW \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + a_0b_1 + a_2b_1W + a_0b_2W + a_2b_2WW + a_3b_2XWW + a_0b_3V + a_2b_3WW + a_3b_3XWW + a_0b_4WV + a_2b_4WWV + a_3b_4XWWV + c_2'W + c_3'V + c_6'WV) + (a_1b_1 + a_3b_1W + a_1b_2W + a_3b_2WW + a_3b_3XWW + a_1b_4WV + a_3b_4WWV + c_1' + c_4'W + c_5'V + c_7'WV)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, V \):
\[ a_1b_1 + a_3b_1W + a_1b_2W + a_3b_2WW + a_1b_3V + a_3b_3WV + a_1b_4WV + a_3b_4WWV = (a_1 + a_3W)(b_1 + b_2W + b_3V + b_4WV) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, V \):
\[ c_1' + c_4'W + c_5'V + c_7'WV \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, V
! Outcome variable - Y
USEVARIABLES = X M W V Y XW XV WV MW MV XWV MWV;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MW = M*W;
    MV = M*V;
    XW = X*W;
    XV = X*V;
    WV = W*V;
    MWV = M*W*V;
    XWV = X*W*V;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;
```

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MODEL:
[Y] (b0);
Y ON M (b1);
Y ON MW (b2);
Y ON MV (b3);
Y ON MWV (b4);
Y ON X(cdash1);
Y ON W (cdash2);
Y ON V (cdash3);
Y ON XW (cdash4);
Y ON XV (cdash5);
Y ON WV (cdash6);
Y ON XWV (cdash7);
[M] (a0);
M ON X (a1);
M ON W (a2);
M ON XW (a3);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, V
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.
MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
ILOW_LOV IMEW_LOV IHIW_LOV ILOW_MEV IMEW_MEV IHIW_MEV
ILOW_HIW IMEW_HIW IHIW_HIW
DLOW_LOV DM EW_LOV DHIW_LOV DLOW_MEV DMEW_MEV DHIW_MEV
DLOW_HIW DMEW_HIW DHIW_HIW
TLOW_LOV TEMW_LOV THIW_LOV TLOW_MEV TEMW_MEV THIW_MEV
TLOW_HIW TEMW_HIW THIW_HIW);

LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W
LOW_V = #LOWV; ! replace #LOWV in the code with your chosen low value of V
MED_V = #MEDV; ! replace #MEDV in the code with your chosen medium value of V
HIGH_V = #HIGHV; ! replace #HIGHV in the code with your chosen high value of V

! Calc conditional indirect effects for each combination of moderator values

ILOW_LOV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_W +
a3*b2*LOW_W*LOW_W +
a1*b3*LOW_V + a3*b3*LOW_W*LOW_V + a1*b4*LOW_W*LOW_V +
a3*b4*LOW_W*LOW_W*LOW_V;
IMEW_LOV = a1*b1 + a3*b1*MED_W + a1*b2*MED_W +
a3*b2*MED_W*MED_W +
a1*b3*LOW_V + a3*b3*MED_W*LOW_V + a1*b4*MED_W*LOW_V +
a3*b4*MED_W*MED_W*LOW_V;
IHIW_LOV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_W +
a3*b2*HIGH_W*HIGH_W +
a1*b3*LOW_V + a3*b3*HIGH_W*LOW_V + a1*b4*HIGH_W*LOW_V +
a3*b4*HIGH_W*HIGH_W*LOW_V;

ILOW_MEV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_W +
a3*b2*LOW_W*LOW_W +
a1*b3*MED_V + a3*b3*LOW_W*MED_V + a1*b4*LOW_W*MED_V +
a3*b4*LOW_W*LOW_W*MED_V;
IMEW_MEV = a1*b1 + a3*b1*MED_W + a1*b2*MED_W +
a3*b2*MED_W*MED_W +
a1*b3*MED_V + a3*b3*MED_W*MED_V + a1*b4*MED_W*MED_V +
a3*b4*MED_W*MED_W*MED_V;
IHIW_MEV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_W +
a3*b2*HIGH_W*HIGH_W +
a1*b3*MED_V + a3*b3*HIGH_W*MED_V + a1*b4*HIGH_W*MED_V +
a3*b4*HIGH_W*HIGH_W*MED_V;

ILOW_HIV = a1*b1 + a3*b1*LOW_W + a1*b2*LOW_W +
a3*b2*LOW_W*LOW_W +
a1*b3*HIGH_V + a3*b3*LOW_W*HIGH_V + a1*b4*LOW_W*HIGH_V +
a3*b4*LOW_W*LOW_W*HIGH_V;
IMEW_HIV = a1*b1 + a3*b1*MED_W + a1*b2*MED_W +

a3*b2*MED_W*MED_W +
a1*b3*HIGH_V + a3*b3*MED_W*HIGH_V + a1*b4*MED_W*HIGH_V +
a3*b4*MED_W*MED_W*HIGH_V;
IHIW_HIV = a1*b1 + a3*b1*HIGH_W + a1*b2*HIGH_W +
a3*b2*HIGH_W*HIGH_W +
a1*b3*HIGH_V + a3*b3*HIGH_W*HIGH_V + a1*b4*HIGH_W*HIGH_V +
a3*b4*HIGH_W*HIGH_W*HIGH_V;
! Calc conditional direct effects for each combination of moderator values

DLOW_LOV = cdash1 + cdash4*LOW_W + cdash5*LOW_V + cdash7*LOW_W*LOW_V;
DMEW_LOV = cdash1 + cdash4*MED_W + cdash5*LOW_V + cdash7*MED_W*LOW_V;
DHIW_LOV = cdash1 + cdash4*HIGH_W + cdash5*LOW_V + cdash7*HIGH_W*LOW_V;
DLOW_MEV = cdash1 + cdash4*LOW_W + cdash5*MED_V + cdash7*LOW_W*MED_V;
DMEW_MEV = cdash1 + cdash4*MED_W + cdash5*MED_V + cdash7*MED_W*MED_V;
DHIW_MEV = cdash1 + cdash4*HIGH_W + cdash5*MED_V + cdash7*HIGH_W*MED_V;
DLOW_HIV = cdash1 + cdash4*LOW_W + cdash5*HIGH_V + cdash7*LOW_W*HIGH_V;
DMEW_HIV = cdash1 + cdash4*MED_W + cdash5*HIGH_V + cdash7*MED_W*HIGH_V;
DHIW_HIV = cdash1 + cdash4*HIGH_W + cdash5*HIGH_V + cdash7*HIGH_W*HIGH_V;

! Calc conditional total effects for each combination of moderator values

TLOW_LOV = ILOW_LOV + DLOW_LOV;
TMEW_LOV = IMEW_LOV + DMEW_LOV;
THIW_LOV = IHIW_LOV + DHIW_LOV;
TLOW_MEV = ILOW_MEV + DLOW_MEV;
TMEW_MEV = IMEW_MEV + DMEW_MEV;
THIW_MEV = IHIW_MEV + DHIW_MEV;
TLOW_HIV = ILOW_HIV + DLOW_HIV;
TMEW_HIV = IMEW_HIV + DMEW_HIV;
THIW_HIV = IHIW_HIV + DHIW_HIV;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOV PMEW_LOV PHIW_LOV PLOW_MEV PMEW_MEV PHIW_MEV
     PLOW_HIV PMEW_HIV PHIW_HIV);
LOOP(XVAL,1,5,0.1);
PLOW_LOV = ILOW_LOV*XVAL;
PMEW_LOV = IMEW_LOV*XVAL;
PHIW_LOV = IHIW_LOV*XVAL;
PLOW_MEV = ILOW_MEV*XVAL;
PMEW_MEV = IMEW_MEV*XVAL;
PHIW_MEV = IHIW_MEV*XVAL;
PLOW_HIV = ILOW_HIV*XVAL;
PMEW_HIV = IMEW_HIV*XVAL;
PHIW_HIV = IHIW_HIV*XVAL;

PLOT:
 TYPE = plot2;

OUTPUT:
 STAND CINT(bcbootstrap);
Model 72: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV- Mediator path and the Mediator-DV path, with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:
The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 W + b_3 Z + b_4 MW + b_5 MZ + b_6 WZ + b_7 MWZ + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M + b_2 W + b_3 Z + b_4 MW + b_5 MZ + b_6 WZ + b_7 MWZ + c'X \]
\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ) + b_2 W + b_3 Z + b_4 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)W + b_5 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)Z + b_6 WZ + b_7 (a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ + a_6 WZ + a_7 XWZ)WZ + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + a_6b_1WZ + a_7b_1XWZ + b_2W + b_3Z + a_0b_4W + a_1b_4XW + a_2b_4WW + a_3b_4ZW + a_4b_4XWW + a_5b_4XZW + a_6b_4WWZ + a_7b_4XWWZ + a_0b_5Z + a_1b_5XZ + a_2b_5WZ + a_3b_5ZZ + a_4b_5XWZ + a_5b_5XXZ + a_6b_5WZZ + a_7b_5XWZZ + b_6WZ + a_0b_7WZ + a_1b_7XWZ + a_2b_7WWZ + a_3b_7WZZ + a_4b_7XWWZ + a_5b_7XWZZ + a_6b_7WWZZ + a_7XWWZZ + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + a_6b_1WZ + b_2W + b_3Z + a_0b_4W + a_2b_4WW + a_3b_4ZW + a_6b_4WWZ + a_0b_5Z + a_2b_5WZ + a_3b_5ZZ + a_6b_5WZZ + b_6WZ + a_0b_7WZ + a_2b_7WWZ + a_3b_7WZZ + a_6b_7WWZZ) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + a_1b_4W + a_4b_4WW + a_5b_4ZW + a_7b_4XWW + a_1b_5Z + a_4b_5WZ + a_5b_5ZZ + a_7b_5WWZ + a_1b_7WZ + a_4b_7WWZ + a_5b_7WZZ + a_7b_7WWZZ + a_0b_7WZ + a_2b_7WWZ + a_3b_7WZZ + a_6b_7WWZZ + c')X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z \):

\[ a_1b_1 + a_4b_1W + a_5b_1Z + a_7b_1WZ + a_1b_4W + a_4b_4WW + a_5b_4ZW + a_7b_4XWW + a_1b_5Z + a_4b_5WZ + a_5b_5ZZ + a_7b_5WWZ + a_1b_7WZ + a_4b_7WWZ + a_5b_7WZZ + a_7b_7WWZZ = (a_1 + a_4W + a_5Z + a_7WZ)(b_1 + b_4W + b_5Z + b_7WZ) \]

One direct effect of \( X \) on \( Y \):

\[ c' \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ WZ MW MZ XWZ MWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
  MW = M*W;
  MZ = M*Z;
  XW = X*W;
  XZ = X*Z;
  WZ = W*Z;
  MWZ = M*W*Z;
  XWZ = X*W*Z;
```

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ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

   ! In model statement name each path and intercept using parentheses

MODEL:
   [Y] (b0);
   Y ON M (b1);
   Y ON W (b2);
   Y ON Z (b3);
   Y ON MW (b4);
   Y ON MZ (b5);
   Y ON WZ (b6);
   Y ON MWZ (b7);
   Y ON X (cdash);
   [M] (a0);
   M ON X (a1);
   M ON W (a2);
   M ON Z (a3);
   M ON XW (a4);
   M ON XZ (a5);
   M ON WZ (a6);
   M ON XWZ (a7);

   ! Use model constraint subcommand to test conditional indirect effects
   ! You need to pick low, medium and high moderator values for W, Z
   ! for example, of 1 SD below mean, mean, 1 SD above mean
   ! 2 moderators, 3 values for each, gives 9 combinations
   ! arbitrary naming convention for conditional indirect and total effects used below:
   ! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
      ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
      ILOW_HIZ IMEW_HIZ IHIW_HIZ
      TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
      TLOW_HIZ TMEW_HIZ THIW_HIZ);
   LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your
chosen low value of Z

MED_Z = #MEDZ;  ! replace #MEDZ in the code with your
chosen medium value of Z

HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your
chosen high value of Z

! Calc conditional indirect effects for each combination of
moderator values

ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z +
a7*b1*LOW_W*LOW_Z +
a1*b4*LOW_W + a4*b4*LOW_W*LOW_W + a5*b4*LOW_Z*LOW_W +
a7*b4*LOW_W*LOW_W*LOW_Z + a1*b5*LOW_Z + a4*b5*LOW_W*LOW_Z +
a5*b5*LOW_Z*LOW_Z + a7*b5*LOW_W*LOW_Z*LOW_Z +

IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z +
a7*b1*MED_W*LOW_Z +
a4*b4*MED_W*MED_W + a5*b4*LOW_Z*MED_W +
a7*b4*MED_W*MED_W*LOW_Z + a1*b5*LOW_Z + a4*b5*MED_W*LOW_Z +
a5*b5*LOW_Z*LOW_Z + a7*b5*MED_W*LOW_Z*LOW_Z +

IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
a7*b1*HIGH_W*LOW_Z +
a4*b4*HIGH_W*HIGH_W + a5*b4*LOW_Z*HIGH_W +
a7*b4*HIGH_W*HIGH_W*LOW_Z + a1*b5*LOW_Z + a4*b5*HIGH_W*LOW_Z +
a5*b5*LOW_Z*LOW_Z + a7*b5*HIGH_W*LOW_Z*LOW_Z +

ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z +
a7*b1*LOW_W*MED_Z +
a1*b4*LOW_W + a4*b4*LOW_W*LOW_W + a5*b4*MED_Z*LOW_W +
a7*b4*LOW_W*LOW_W*MED_Z + a1*b5*MED_Z + a4*b5*LOW_W*MED_Z +
a5*b5*MED_Z*MED_Z + a7*b5*LOW_W*MED_Z*MED_Z +

a1*b7*LOW_W*MED_Z +

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a4*b7*LOW_W*LOW_W*MED_Z + a5*b7*LOW_W*MED_Z*MED_Z + a7*b7*LOW_W*LOW_W*MED_Z*MED_Z;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*MED_W + a4*b4*MED_W*MED_W + a5*b4*MED_Z*MED_W + a7*b4*MED_W*MED_W*MED_Z + a1*b5*MED_Z + a4*b5*MED_W*MED_Z + a5*b5*MED_Z*MED_Z + a7*b5*MED_W*MED_Z*MED_Z + a4*b7*MED_W*MED_Z + a5*b7*MED_W*MED_Z*MED_Z + a7*b7*MED_W*MED_W*MED_Z;
ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_W + a4*b4*LOW_W*LOW_W + a5*b4*HIGH_Z*LOW_W + a7*b4*LOW_W*LOW_W*HIGH_Z + a1*b5*HIGH_Z + a4*b5*LOW_W*HIGH_Z + a5*b5*HIGH_Z*HIGH_Z + a7*b5*LOW_W*HIGH_Z*HIGH_Z + a1*b7*LOW_W*HIGH_Z + a4*b7*LOW_W*LOW_W*HIGH_Z + a5*b7*LOW_W*HIGH_Z*HIGH_Z + a7*b7*LOW_W*LOW_W*HIGH_Z*MED_Z;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a7*b1*MED_W*MED_Z + a1*b4*MED_W + a4*b4*MED_W*MED_W + a5*b4*MED_Z*MED_W + a7*b4*MED_W*MED_W*MED_Z + a1*b5*MED_Z + a4*b5*MED_W*MED_Z + a5*b5*MED_Z*MED_Z + a7*b5*MED_W*MED_Z*MED_Z + a4*b7*MED_W*MED_Z + a5*b7*MED_W*MED_Z*MED_Z + a7*b7*MED_W*MED_W*MED_Z;
IHLOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_W + a4*b4*LOW_W*LOW_W + a5*b4*HIGH_Z*LOW_W + a7*b4*LOW_W*LOW_W*HIGH_Z + a1*b5*HIGH_Z + a4*b5*LOW_W*HIGH_Z + a5*b5*HIGH_Z*HIGH_Z + a7*b5*LOW_W*HIGH_Z*HIGH_Z + a1*b7*LOW_W*HIGH_Z + a4*b7*LOW_W*LOW_W*HIGH_Z + a5*b7*LOW_W*HIGH_Z*HIGH_Z + a7*b7*LOW_W*LOW_W*HIGH_Z*MED_Z;
IHLOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_W + a4*b4*LOW_W*LOW_W + a5*b4*HIGH_Z*LOW_W + a7*b4*LOW_W*LOW_W*HIGH_Z + a1*b5*HIGH_Z + a4*b5*LOW_W*HIGH_Z + a5*b5*HIGH_Z*HIGH_Z + a7*b5*LOW_W*HIGH_Z*HIGH_Z + a1*b7*LOW_W*HIGH_Z + a4*b7*LOW_W*LOW_W*HIGH_Z + a5*b7*LOW_W*HIGH_Z*HIGH_Z + a7*b7*LOW_W*LOW_W*HIGH_Z*MED_Z;
IHLOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a7*b1*LOW_W*HIGH_Z + a1*b4*LOW_W + a4*b4*LOW_W*LOW_W + a5*b4*HIGH_Z*LOW_W + a7*b4*LOW_W*LOW_W*HIGH_Z + a1*b5*HIGH_Z + a4*b5*LOW_W*HIGH_Z + a5*b5*HIGH_Z*HIGH_Z + a7*b5*LOW_W*HIGH_Z*HIGH_Z + a1*b7*LOW_W*HIGH_Z + a4*b7*LOW_W*LOW_W*HIGH_Z + a5*b7*LOW_W*HIGH_Z*HIGH_Z + a7*b7*LOW_W*LOW_W*HIGH_Z*MED_Z;
\[ a4*b7*HIGH_W*HIGH_W*HIGH_Z + a5*b7*HIGH_W*HIGH_Z*HIGH_Z + a7*b7*HIGH_W*HIGH_W*HIGH_Z*HIGH_Z; \]

! Calc conditional total effects for each combination of moderator values

\[
\begin{align*}
TLOW\_LOZ &= ILOW\_LOZ + cdash; \\
TM EW\_LOZ &= IMEW\_LOZ + cdash; \\
THIW\_LOZ &= IHIW\_LOZ + cdash; \\
TLOW\_MEZ &= ILOW\_MEZ + cdash; \\
TM EW\_MEZ &= IMEW\_MEZ + cdash; \\
THIW\_MEZ &= IHIW\_MEZ + cdash; \\
TLOW\_HIZ &= ILOW\_HIZ + cdash; \\
TM EW\_HIZ &= IMEW\_HIZ + cdash; \\
THIW\_HIZ &= IHIW\_HIZ + cdash; \\
\end{align*}
\]

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values

! Could be edited to show conditional direct or conditional total effects instead

! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

\[
\begin{align*}
\text{PLOT(PLOW\_LOZ PMEW\_LOZ PHIW\_LOZ PLOW\_MEZ PMEW\_MEZ PHIW\_MEZ PLOW\_HIZ PMEW\_HIZ PHIW\_HIZ);} \\
\text{LOOP(XVAL,1,5,0.1);} \\
\text{PLOW\_LOZ = ILOW\_LOZ*XVAL;} \\
\text{PM EW\_LOZ = IMEW\_LOZ*XVAL;} \\
\text{PHIW\_LOZ = IHIW\_LOZ*XVAL;} \\
\text{PLOW\_MEZ = ILOW\_MEZ*XVAL;} \\
\text{PM EW\_MEZ = IMEW\_MEZ*XVAL;} \\
\text{PHIW\_MEZ = IHIW\_MEZ*XVAL;} \\
\text{PLOW\_HIZ = ILOW\_HIZ*XVAL;} \\
\text{PM EW\_HIZ = IMEW\_HIZ*XVAL;} \\
\text{PHIW\_HIZ = IHIW\_HIZ*XVAL;} \\
\end{align*}
\]

\begin{verbatim}
PLOT: TYPE = plot2; OUTPUT: STAND CINT(bcbootstrap); 
\end{verbatim}
Model 73: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating each of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path, with all 2-way and 3-way interactions

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that
- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2MW + b_3MZ + b_4MWZ + c_1'X + c_2W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)W + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)Z + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)WZ + c_1'X + c_2W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ) + b_2(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)W + b_3(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)Z + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ + a_6WZ + a_7XWZ)WZ + c_1'X + c_2W + c_3'Z + c_4'XW + c_5'XZ + c_6'WZ + c_7'XWZ \]
Hence... multiplying out brackets

\[ Y = b_0 + a_0 b_1 + a_2 b_1 W + a_3 b_1 Z + a_4 b_1 WZ + a_5 b_1 X + a_6 b_1 WZ + a_7 b_1 XWZ + a_0 b_2 W + a_1 b_2 XW + a_2 b_2 WW + a_3 b_2 ZZ + a_4 b_2 WZZ + a_5 b_2 XWW + a_6 b_2 XZZ + a_7 b_2 XWWZ + a_0 b_3 Z + a_1 b_3 XZ + a_2 b_3 WZ + a_3 b_3 ZZ + a_4 b_3 WZZ + a_5 b_3 XWW + a_6 b_3 XZZ + a_7 b_3 XWWZ + a_0 b_4 W + a_1 b_4 WX + a_2 b_4 WW + a_3 b_4 XWZ + a_4 b_4 WZZ + a_5 b_4 WXZ + a_6 b_4 WZZ + a_7 b_4 WXZW + c_1 X + c_2 W + c_3 Z + c_4 WX + c_5 XZ + c_6 WZ + c_7 XZW \]

Hence... grouping terms into form \( Y = a + b X \)

\[ Y = (b_0 + a_0 b_1 + a_2 b_1 W + a_3 b_1 Z + a_6 b_1 WZ + a_0 b_2 W + a_2 b_2 WW + a_3 b_2 ZZ + a_0 b_3 Z + a_2 b_3 WZ + a_3 b_3 ZZ + a_0 b_4 W + a_2 b_4 WW + a_3 b_4 WZZ + a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 WZ + a_1 b_2 W + a_4 b_2 WW + a_5 b_2 Z + a_7 b_2 WWZ + a_1 b_3 Z + a_4 b_3 WZ + a_5 b_3 ZZ + a_7 b_3 WZZ + a_1 b_4 W + a_4 b_4 WW + a_5 b_4 ZZ + a_7 b_4 WZZ + c_1 + c_4 W + c_5 Z + c_7 WZ)X \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z \):

\[ a_1 b_1 + a_4 b_1 W + a_5 b_1 Z + a_7 b_1 WZ + a_1 b_2 W + a_4 b_2 WW + a_5 b_2 Z + a_7 b_2 WWZ + a_1 b_3 Z + a_4 b_3 WZ + a_5 b_3 ZZ + a_7 b_3 WZZ + a_1 b_4 W + a_4 b_4 WW + a_5 b_4 ZZ + a_7 b_4 WZZ = (a_1 + a_4 W + a_5 Z + a_7 WZ)(b_1 + b_2 W + b_3 Z + b_4 WZ) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):

\[ c_1' + c_4' W + c_5' Z + c_7' WZ \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y
USEVARIABLES = X M W Z Y XW XZ WZ MW MZ XWZ MWZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
  MW = M*W;
  MZ = M*Z;
  XW = X*W;
  XZ = X*Z;
```

726
WZ = W*Z;
MWZ = M*W*Z;
XWZ = X*W*Z;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
   [Y] (b0);
   Y ON M (b1);
   Y ON MW (b2);
   Y ON MZ (b3);
   Y ON MWZ (b4);
   Y ON X (cdash1);
   Y ON W (cdash2);
   Y ON Z (cdash3);
   Y ON XW (cdash4);
   Y ON XZ (cdash5);
   Y ON WZ (cdash6);
   Y ON XWZ (cdash7);

   [M] (a0);
   M ON X (a1);
   M ON W (a2);
   M ON Z (a3);
   M ON XW (a4);
   M ON XZ (a5);
   M ON WZ (a6);
   M ON XWZ (a7);

   ! Use model constraint subcommand to test conditional indirect effects
   ! You need to pick low, medium and high moderator values for W, Z
   ! for example, of 1 SD below mean, mean, 1 SD above mean
   ! 2 moderators, 3 values for each, gives 9 combinations
   ! arbitrary naming convention for conditional indirect and total effects used below:
   ! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
   ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
   ILOW_HIZ IMEW_HIZ IHIW_HIZ
LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

LOW_Z = #LOWZ; ! replace #LOWZ in the code with your chosen low value of Z
MED_Z = #MEDZ; ! replace #MEDZ in the code with your chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your chosen high value of Z

! Calc conditional indirect effects for each combination of moderator values

ILOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a7*b1*LOW_W*LOW_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*LOW_Z*LOW_W + a7*b2*LOW_W*LOW_W*LOW_Z + a1*b3*LOW_Z + a4*b3*LOW_W*LOW_Z + a5*b3*LOW_Z*LOW_Z + a7*b3*LOW_W*LOW_Z*LOW_Z + a1*b4*LOW_W*LOW_Z + a4*b4*LOW_W*LOW_W*LOW_Z + a5*b4*LOW_W*LOW_W*LOW_Z + a7*b4*LOW_W*LOW_W*LOW_Z*LOW_Z;

IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a7*b1*MED_W*LOW_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*LOW_Z*MED_W + a7*b2*MED_W*MED_W*LOW_Z + a1*b3*LOW_Z + a4*b3*MED_W*LOW_Z + a5*b3*LOW_Z*LOW_Z + a7*b3*MED_W*LOW_Z*LOW_Z + a1*b4*MED_W*MED_W*LOW_Z + a4*b4*MED_W*MED_W*LOW_Z + a5*b4*MED_W*MED_W*LOW_Z + a7*b4*MED_W*MED_W*LOW_Z*LOW_Z;

IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a7*b1*HIGH_W*LOW_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*LOW_Z*HIGH_W + a7*b2*HIGH_W*HIGH_W*LOW_Z + a1*b3*LOW_Z + a4*b3*HIGH_W*LOW_Z + a5*b3*LOW_Z*LOW_Z + a7*b3*HIGH_W*LOW_Z*LOW_Z + a1*b4*HIGH_W*LOW_Z +
\[a4 \cdot b4 \cdot \text{HIGH}_W \cdot \text{HIGH}_W \cdot \text{LOW}_Z + a5 \cdot b4 \cdot \text{HIGH}_W \cdot \text{LOW}_Z \cdot \text{LOW}_Z + a7 \cdot b4 \cdot \text{HIGH}_W \cdot \text{LOW}_Z \cdot \text{LOW}_Z;\]

\[\text{ILOW}_\text{MEZ} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{LOW}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{MED}_Z +\]
\[a1 \cdot b2 \cdot \text{LOW}_W + a4 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_W + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{LOW}_W + a7 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{MED}_Z + a1 \cdot b3 \cdot \text{MED}_Z + a4 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Z +\]
\[a5 \cdot b3 \cdot \text{MED}_Z \cdot \text{MED}_Z + a7 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_Z + a1 \cdot b4 \cdot \text{LOW}_W \cdot \text{MED}_Z + a4 \cdot b4 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{MED}_Z + a5 \cdot b4 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_Z + a7 \cdot b4 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_Z;\]

\[\text{IMEW}_\text{MEZ} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{MED}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{MED}_Z + a1 \cdot b2 \cdot \text{MED}_W + a4 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_W + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{MED}_W + a7 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_W \cdot \text{MED}_Z + a1 \cdot b3 \cdot \text{MED}_Z + a4 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Z + a5 \cdot b3 \cdot \text{MED}_Z \cdot \text{MED}_Z + a7 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_Z + a1 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_Z + a4 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_W \cdot \text{MED}_Z + a5 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{MED}_Z + a7 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{MED}_Z;\]

\[\text{IHIG}_\text{MEZ} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{HIGH}_W + a5 \cdot b1 \cdot \text{MED}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{MED}_Z + a1 \cdot b2 \cdot \text{HIGH}_W + a4 \cdot b2 \cdot \text{HIGH}_W \cdot \text{HIGH}_W + a5 \cdot b2 \cdot \text{MED}_Z \cdot \text{HIGH}_W + a7 \cdot b2 \cdot \text{HIGH}_W \cdot \text{HIGH}_W \cdot \text{MED}_Z + a1 \cdot b3 \cdot \text{MED}_Z + a4 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Z + a5 \cdot b3 \cdot \text{MED}_Z \cdot \text{MED}_Z + a7 \cdot b3 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_Z + a1 \cdot b4 \cdot \text{LOW}_W \cdot \text{MED}_Z + a4 \cdot b4 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{MED}_Z + a5 \cdot b4 \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_Z + a7 \cdot b4 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{MED}_Z \cdot \text{MED}_Z;\]

\[\text{ILLO}_\text{HIZ} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{LOW}_W + a5 \cdot b1 \cdot \text{HIGH}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{HIGH}_Z + a1 \cdot b2 \cdot \text{LOW}_W + a4 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_W + a5 \cdot b2 \cdot \text{HIGH}_Z \cdot \text{LOW}_W + a7 \cdot b2 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{HIGH}_Z + a1 \cdot b3 \cdot \text{HIGH}_Z + a4 \cdot b3 \cdot \text{LOW}_W \cdot \text{HIGH}_Z + a5 \cdot b3 \cdot \text{HIGH}_Z \cdot \text{HIGH}_Z + a7 \cdot b3 \cdot \text{LOW}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_Z + a1 \cdot b4 \cdot \text{LOW}_W \cdot \text{HIGH}_Z + a4 \cdot b4 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{HIGH}_Z + a5 \cdot b4 \cdot \text{LOW}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_Z + a7 \cdot b4 \cdot \text{LOW}_W \cdot \text{LOW}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_Z;\]

\[\text{IMEW}_\text{HIZ} = a1 \cdot b1 + a4 \cdot b1 \cdot \text{MED}_W + a5 \cdot b1 \cdot \text{HIGH}_Z + a7 \cdot b1 \cdot \text{LOW}_W \cdot \text{HIGH}_Z + a1 \cdot b2 \cdot \text{MED}_W + a4 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_W + a5 \cdot b2 \cdot \text{HIGH}_Z \cdot \text{MED}_W + a7 \cdot b2 \cdot \text{MED}_W \cdot \text{MED}_W \cdot \text{HIGH}_Z + a1 \cdot b3 \cdot \text{HIGH}_Z + a4 \cdot b3 \cdot \text{MED}_W \cdot \text{HIGH}_Z + a5 \cdot b3 \cdot \text{MED}_Z \cdot \text{HIGH}_Z + a7 \cdot b3 \cdot \text{MED}_W \cdot \text{HIGH}_Z \cdot \text{HIGH}_Z + a1 \cdot b4 \cdot \text{MED}_W \cdot \text{HIGH}_Z + a4 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_W \cdot \text{HIGH}_Z + a5 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{HIGH}_Z + a7 \cdot b4 \cdot \text{MED}_W \cdot \text{MED}_W \cdot \text{MED}_Z \cdot \text{HIGH}_Z;\]
a4*b4*MED_W*MED_W*HIGH_Z + a5*b4*MED_W*HIGH_Z*HIGH_Z + 
a7*b4*MED_W*MED_W*HIGH_Z*HIGH_Z;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z + 
a7*b1*HIGH_W*HIGH_Z + 
a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*HIGH_Z*HIGH_W + 
a7*b2*HIGH_W*HIGH_W*HIGH_Z + a1*b3*HIGH_Z + 
a4*b3*HIGH_W*HIGH_Z + a5*b3*HIGH_Z*HIGH_Z + a7*b3*HIGH_W*HIGH_Z*HIGH_Z + 
a1*b4*HIGH_W*HIGH_Z + a4*b4*HIGH_W*HIGH_W*HIGH_Z + a5*b4*HIGH_W*HIGH_Z*HIGH_Z + 
a7*b4*HIGH_W*HIGH_W*HIGH_Z*HIGH_Z;

! Calc conditional direct effects for each combination of 
moderator values
DLOW_LOZ = cdash1 + cdash4*LOW_W + cdash5*LOW_Z + 
cdash7*LOW_W*LOW_Z;
DMEW_LOZ = cdash1 + cdash4*MED_W + cdash5*LOW_Z + 
cdash7*MED_W*LOW_Z;
DHIW_LOZ = cdash1 + cdash4*HIGH_W + cdash5*LOW_Z + 
cdash7*HIGH_W*LOW_Z;

DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z + 
cdash7*LOW_W*MED_Z;
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z + 
cdash7*MED_W*MED_Z;
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z + 
cdash7*HIGH_W*MED_Z;

DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z + 
cdash7*LOW_W*HIGH_Z;
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z + 
cdash7*MED_W*HIGH_Z;
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z + 
cdash7*HIGH_W*HIGH_Z;

! Calc conditional total effects for each combination of 
moderator values
TLOW_LOZ = ILOW_LOZ + DLOW_LOZ;
TMEW_LOZ = IMEW_LOZ + DMEW_LOZ;
THIW_LOZ = IHIW_LOZ + DHIW_LOZ;

TLOW_MEZ = ILOW_MEZ + DLOW_MEZ;
TMEW_MEZ = IMEW_MEZ + DMEW_MEZ;
THIW_MEZ = IHIW_MEZ + DHIW_MEZ;
TLOW_HIZ = ILOW_HIZ + DLOW_HIZ;
TMEW_HIZ = IMEW_HIZ + DMEW_HIZ;
THIW_HIZ = IHIW_HIZ + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y
for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional
  total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced
  by
  ! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ
  PHIW_MEZ
  PLOW_HIZ PMEW_HIZ PHIW_HIZ);
LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PMEW_LOZ = IMEW_LOZ*XVAL;
PHIW_LOZ = IHIW_LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PMEW_MEZ = IMEW_MEZ*XVAL;
PHIW_MEZ = IHIW_MEZ*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PMEW_HIZ = IMEW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 74: 1 or more mediators, in parallel if multiple (example uses 1), IV also moderates the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- The mediator (variable M) is continuous. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):
\[ Y = b_0 + b_1 M + c_1'X + c_2'MX \]
\[ M = a_0 + a_1X \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1 M + c_1'X + c_2'MX \]
\[ M = a_0 + a_1X \]

Hence... substituting in equations for \( M \)
\[ Y = b_0 + b_1(a_0 + a_1X) + c_1'X + c_2'(a_0 + a_1X)X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X + c_1'X + a_0c_2'X + a_1c_2'XX \]
Hence... grouping terms into form $Y = a + bX$

$Y = (b_0 + a_1b_1) + (a_1b_1 + c_1' + a_0c_2' + a_1c_2')X$

Hence...

Conditional Indirect effect of $X$ on $Y$:

$a_1b_1 + a_1c_2'X = a_1(b_1 + c_2'X)$

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - (X)
! Outcome variable - Y

USEVARIABLES = X M Y XM;

DEFINE:
   XM = X*M;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
   Y ON M (b1);
   Y ON X (cdash1); ! direct effect of X on Y
   Y ON XM (cdash2);
   [M] (a0);
   M ON X (a1);

! Use model constraint to calculate indirect effect

MODEL CONSTRAINT:
   NEW(LOW_X MED_X HIGH_X IND_LOWX IND_MEDX IND_HIX);
   LOW_X = #LOWX; ! replace #LOWX in the code with your chosen low value of X
   MED_X = #MEDX; ! replace #MEDX in the code with your chosen medium value of X
   HIGH_X = #HIGHX; ! replace #HIGHX in the code with your chosen high value of X
```
! Calc conditional indirect effects of X on Y via M for low, medium, high values of X

    IND_LOWX = a1*b1 + a1*cdash2*LOW_X;
    IND_MEDX = a1*b1 + a1*cdash2*MED_X;
    IND_HIX = a1*b1 + a1*cdash2*HIGH_X;

! Use loop plot to plot conditional indirect effect of X on Y
! NOTE - values of 1, 5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

   PLOT(INDX);
   LOOP(XVAL,1,5,0.1);
   INDX = (a1*b1 + a1*cdash2*XVAL)*XVAL;

PLOT:
   TYPE = plot2;

OUTPUT:
   STAND CINT(bcbootstrap);
Model 75: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating both the IV-Mediator path and the Mediator-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + b_2W + b_3Z + b_4MW + b_5MZ + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + b_2W + b_3Z + b_4MW + b_5MZ + c'X \]
\[ M = a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ) + b_2W + b_3Z + b_4(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)W + b_5(a_0 + a_1X + a_2W + a_3Z + a_4XW + a_5XZ)Z + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_0b_1 + a_1b_1X + a_2b_1W + a_3b_1Z + a_4b_1XW + a_5b_1XZ + b_2W + b_3Z + a_0b_4W + a_1b_4XW + a_2b_4WW + a_3b_4ZW + a_4b_4XWW + a_5b_4XZW + a_0b_5Z + a_1b_5XZ + a_2b_5WZ + a_3b_5ZZ + a_4b_5XWZ + a_5b_5ZZZ + c'X \]
Hence... grouping terms into form \( Y = a + bX \)
\[
Y = (b_0 + a_0b_1 + a_2b_1W + a_3b_1Z + b_2W + b_3Z + a_0b_4W + a_2b_4WW + a_3b_4ZW + a_0b_5Z + a_2b_5WZ + a_3b_5ZZ) + (a_1b_1 + a_4b_1W + a_5b_1Z + a_1b_4W + a_4b_4WW + a_5b_4ZW + a_1b_5Z + a_4b_5WZ + a_5b_5ZZ + c')X
\]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z \):

\[
a_1b_1 + a_4b_1W + a_5b_1Z + a_1b_4W + a_4b_4WW + a_5b_4ZW + a_1b_5Z + a_4b_5WZ + a_5b_5ZZ = (a_1 + a_4W + a_5Z)(b_1 + b_4W + b_5Z)
\]

One direct effect of \( X \) on \( Y \):

\[
c'
\]

Mplus code for the model:

```
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y

USEVARIABLES = X M W Z Y XW XZ MW MZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above

DEFINE:
        MW = M*W;
        MZ = M*Z;
        XW = X*W;
        XZ = X*Z;

ANALYSIS:
        TYPE = GENERAL;
        ESTIMATOR = ML;
        BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses

MODEL:
        [Y] (b0);
        Y ON M (b1);
        Y ON W (b2);
        Y ON Z (b3);
```
Y ON MW (b4);  
Y ON MZ (b5);  
Y ON X (cdash);  
[M] (a0);  
M ON X (a1);  
M ON W (a2);  
M ON Z (a3);  
M ON XW (a4);  
M ON XZ (a5);  

! Use model constraint subcommand to test conditional indirect effects  
! You need to pick low, medium and high moderator values for  
! W, Z  
! for example, of 1 SD below mean, mean, 1 SD above mean  
! 2 moderators, 3 values for each, gives 9 combinations  
! arbitrary naming convention for conditional indirect and  
! total effects used below:  
! MEV_LOQ = medium value of V and low value of Q, etc.  
MODEL CONSTRAINT:  
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z  
  ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ  
  ILOW_HIZ IMEW_HIZ IHIW_HIZ  
  TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ  
  TLOW_HIZ TMEW_HIZ THIW_HIZ);  

LOW_W = #LOWW;  ! replace #LOWW in the code with your  
chosen low value of W  
MED_W = #MEDW;  ! replace #MEDW in the code with your  
chosen medium value of W  
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your  
chosen high value of W  

LOW_Z = #LOWZ;  ! replace #LOWZ in the code with your  
chosen low value of Z  
MED_Z = #MEDZ;  ! replace #MEDZ in the code with your  
chosen medium value of Z  
HIGH_Z = #HIGHZ;  ! replace #HIGHZ in the code with your  
chosen high value of Z  

! Calc conditional indirect effects for each combination of  
! moderator values  
ILLOW_LOZ = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b4*LOW_W  
+ a4*b4*LOW_W*LOW_W + a5*b4*LOW_Z*LOW_W + a1*b5*LOW_Z +  
a4*b5*LOW_W*LOW_Z + a5*b5*LOW_Z*LOW_Z;  

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IMEW_LOZ = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b4*MED_W +
           a4*b4*MED_W*MED_W + a5*b4*LOW_Z*MED_W + a1*b5*LOW_Z +
           a4*b5*MED_W*LOW_Z + a5*b5*LOW_Z*LOW_Z;
IHIW_LOZ = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z +
           a1*b4*HIGH_W +
           a4*b4*HIGH_W*HIGH_W + a5*b4*LOW_Z*HIGH_W + a1*b5*LOW_Z +
           a4*b5*HIGH_W*LOW_Z + a5*b5*LOW_Z*LOW_Z;
ILOW_MEZ = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b4*MED_W +
           a4*b4*LOW_W*LOW_W + a5*b4*MED_Z*LOW_W + a1*b5*MED_Z +
           a4*b5*MED_W*MED_Z + a5*b5*MED_Z*MED_Z;
IMEW_MEZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b4*MED_W +
           a4*b4*MED_W*MED_W + a5*b4*MED_Z*MED_W + a1*b5*MED_Z +
           a4*b5*MED_W*MED_Z + a5*b5*MED_Z*MED_Z;
IHIW_MEZ = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z +
           a1*b4*HIGH_W +
           a4*b4*HIGH_W*HIGH_W + a5*b4*MED_Z*HIGH_W + a1*b5*MED_Z +
           a4*b5*HIGH_W*HIGH_Z + a5*b5*MED_Z*MED_Z;
ILOW_HIZ = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z +
           a1*b4*LOW_W +
           a4*b4*LOW_W*LOW_W + a5*b4*HIGH_Z*LOW_W + a1*b5*HIGH_Z +
           a4*b5*LOW_W*HIGH_Z + a5*b5*LOW_Z*HIGH_Z;
IMEW_HIZ = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z +
           a1*b4*MED_W +
           a4*b4*MED_W*MED_W + a5*b4*MED_Z*MED_W + a1*b5*MED_Z +
           a4*b5*MED_W*MED_Z + a5*b5*MED_Z*MED_Z;
IHIW_HIZ = a1*b1 + a4*b1*HIGH_W + a5*b1*HIGH_Z +
           a1*b4*HIGH_W +
           a4*b4*HIGH_W*HIGH_W + a5*b4*HIGH_Z*HIGH_W + a1*b5*HIGH_Z +
           a4*b5*HIGH_W*HIGH_Z + a5*b5*HIGH_Z*HIGH_Z;

! Calc conditional total effects for each combination of
moderator values

TLOW_LOZ = ILOW_LOZ + cdash;
TM EW_LOZ = IM EW_LOZ + cdash;
THIW_LOZ = IHIW_LOZ + cdash;
TLOW_MEZ = ILOW_MEZ + cdash;
TM EW_MEZ = IM EW_MEZ + cdash;
THIW_MEZ = IHIW_MEZ + cdash;
TLOW_HIZ = ILOW_HIZ + cdash;
TM EW_HIZ = IM EW_HIZ + cdash;
THIW_HIZ = IHIW_HIZ + cdash;
! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

    PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ
    PLOW_HIZ PMEW_HIZ PHIW_HIZ);
    LOOP(XVAL,1,5,0.1);
    PLOW_LOZ = ILOW_LOZ*XVAL;
    PMEW_LOZ = IMEW_LOZ*XVAL;
    PHIW_LOZ = IHIW_LOZ*XVAL;
    PLOW_MEZ = ILOW_MEZ*XVAL;
    PMEW_MEZ = IMEW_MEZ*XVAL;
    PHIW_MEZ = IHIW_MEZ*XVAL;
    PLOW_HIZ = ILOW_HIZ*XVAL;
    PMEW_HIZ = IMEW_HIZ*XVAL;
    PHIW_HIZ = IHIW_HIZ*XVAL;

    PLOT:
        TYPE = plot2;

    OUTPUT:
        STAND CINT(bcbootstrap);
Model 76: 1 or more mediators, in parallel if multiple (example uses 1), 2 moderators, both moderating each of the IV-Mediator path, the Mediator-DV path and the direct IV-DV path

Example Variables: 1 predictor X, 1 mediator M, 2 moderators W, Z, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous.
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation).
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous.
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M + b_2 MW + b_3 MZ + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

\[ M = a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ \]

Algebra to calculate indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ) + b_2(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ)W + b_3(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ)Z + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

Hence... substituting in equation for \( M \)

\[ Y = b_0 + b_1(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ) + b_2(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ)W + b_3(a_0 + a_1 X + a_2 W + a_3 Z + a_4 XW + a_5 XZ)Z + c_1'X + c_2'W + c_3'Z + c_4'XW + c_5'XZ \]

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}X + a_{11}W + a_{31}Z + a_{41}XW + a_{51}XZ + a_{02}W + a_{12}WX + a_{22}WW + a_{32}ZW + a_{42}XWW + a_{52}XZW + a_{03}Z + a_{13}XZ + a_{23}WZ + a_{33}ZZ + a_{43}XWZ + a_{53}XZZ + c_{11}'X + c_{21}'W + c_{31}'Z + c_{41}'XW + c_{51}'XZ \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01} + a_{11} + a_{31} + a_{02} + a_{22} + a_{32} + a_{03} + a_{23} + c_{21}' + c_{41}')W + (a_{11} + a_{41} + a_{51} + a_{12} + a_{42} + a_{52} + a_{13} + a_{43} + a_{53} + c_{31}')Z \]

Hence...

One indirect effect(s) of \( X \) on \( Y \), conditional on \( W, Z \):
\[ a_{11} + a_{41} + a_{51} + a_{12} + a_{42} + a_{52} + a_{13} + a_{43} + a_{53} = (a_1 + a_4 + a_5)(b_1 + b_2 + b_3) \]

One direct effect of \( X \) on \( Y \), conditional on \( W, Z \):
\[ c_{11}' + c_{41}' + c_{51}' \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M
! Moderator variable(s) - W, Z
! Outcome variable - Y
USEVARIABLES = X M W Z Y XW XZ MW MZ;

! Create interaction terms
! Note that they have to be placed at end of USEVARIABLES subcommand above
DEFINE:
    MW = M*W;
    MZ = M*Z;
    XW = X*W;
    XZ = X*Z;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path and intercept using parentheses
MODEL:
    [Y] (b0);
    Y ON M (b1);
```
Y ON MW (b2);
Y ON MZ (b3);

Y ON X(cdash1);
Y ON W (cdash2);
Y ON Z (cdash3);
Y ON XW (cdash4);
Y ON XZ (cdash5);

[M] (a0);
M ON X (a1);
M ON W (a2);
M ON Z (a3);
M ON XW (a4);
M ON XZ (a5);

! Use model constraint subcommand to test conditional indirect effects
! You need to pick low, medium and high moderator values for W, Z
! for example, of 1 SD below mean, mean, 1 SD above mean
! 2 moderators, 3 values for each, gives 9 combinations
! arbitrary naming convention for conditional indirect and total effects used below:
! MEV_LOQ = medium value of V and low value of Q, etc.

MODEL CONSTRAINT:
NEW(LOW_W MED_W HIGH_W LOW_Z MED_Z HIGH_Z
 ILOW_LOZ IMEW_LOZ IHIW_LOZ ILOW_MEZ IMEW_MEZ IHIW_MEZ
 ILOW_HIZ IMEW_HIZ IHIW_HIZ
 DLOW_LOZ DMEW_LOZ DHIW_LOZ DLOW_MEZ DMEW_MEZ DHIW_MEZ
 DLOW_HIZ DMEW_HIZ DHIW_HIZ
 TLOW_LOZ TMEW_LOZ THIW_LOZ TLOW_MEZ TMEW_MEZ THIW_MEZ
 TLOW_HIZ TMEW_HIZ THIW_HIZ);

LOW_W = #LOWW;   ! replace #LOWW in the code with your
chosen low value of W
MED_W = #MEDW;   ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
chosen high value of W

LOW_Z = #LOWZ;   ! replace #LOWZ in the code with your
chosen low value of Z
MED_Z = #MEDZ;   ! replace #MEDZ in the code with your
chosen medium value of Z
HIGH_Z = #HIGHZ; ! replace #HIGHZ in the code with your
chosen high value of Z
! Calc conditional indirect effects for each combination of moderator values

\[ \text{ILOW}_\text{LOZ} = a1*b1 + a4*b1*LOW_W + a5*b1*LOW_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*LOW_Z*LOW_W + a1*b3*LOW_Z + a4*b3*LOW_W*LOW_Z + a5*b3*LOW_Z*LOW_Z; \]

\[ \text{IMEW}_\text{LOZ} = a1*b1 + a4*b1*MED_W + a5*b1*LOW_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*LOW_Z*MED_W + a1*b3*MED_Z + a4*b3*MED_W*MED_Z + a5*b3*MED_Z*MED_Z; \]

\[ \text{IHIW}_\text{LOZ} = a1*b1 + a4*b1*HIGH_W + a5*b1*LOW_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*LOW_Z*HIGH_W + a1*b3*HIGH_Z + a4*b3*HIGH_W*HIGH_Z + a5*b3*HIGH_Z*HIGH_Z; \]

\[ \text{ILOW}_\text{MEZ} = a1*b1 + a4*b1*LOW_W + a5*b1*MED_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*MED_Z*LOW_W + a1*b3*MED_Z + a4*b3*MED_W*MED_Z + a5*b3*MED_Z*MED_Z; \]

\[ \text{IMEW}_\text{MEZ} = a1*b1 + a4*b1*MED_W + a5*b1*MED_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*MED_Z*MED_W + a1*b3*MED_Z + a4*b3*MED_W*MED_Z + a5*b3*MED_Z*MED_Z; \]

\[ \text{IHIW}_\text{MEZ} = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*MED_Z*HIGH_W + a1*b3*MED_Z + a4*b3*HIGH_W*HIGH_Z + a5*b3*MED_Z*MED_Z; \]

\[ \text{ILOW}_\text{HIZ} = a1*b1 + a4*b1*LOW_W + a5*b1*HIGH_Z + a1*b2*LOW_W + a4*b2*LOW_W*LOW_W + a5*b2*HIGH_Z*LOW_W + a1*b3*HIGH_Z + a4*b3*LOW_W*HIGH_Z + a5*b3*HIGH_Z*HIGH_Z; \]

\[ \text{IMEW}_\text{HIZ} = a1*b1 + a4*b1*MED_W + a5*b1*HIGH_Z + a1*b2*MED_W + a4*b2*MED_W*MED_W + a5*b2*HIGH_Z*MED_W + a1*b3*MED_Z + a4*b3*MED_W*MED_Z + a5*b3*MED_Z*MED_Z; \]

\[ \text{IHIW}_\text{HIZ} = a1*b1 + a4*b1*HIGH_W + a5*b1*MED_Z + a1*b2*HIGH_W + a4*b2*HIGH_W*HIGH_W + a5*b2*MED_Z*HIGH_W + a1*b3*MED_Z + a4*b3*HIGH_W*HIGH_Z + a5*b3*MED_Z*MED_Z; \]

! Calc conditional direct effects for each combination of moderator values

\[ \text{DLOW}_\text{LOZ} = \text{cdash1} + \text{cdash4}*LOW_W + \text{cdash5}*LOW_Z; \]

\[ \text{DMEW}_\text{LOZ} = \text{cdash1} + \text{cdash4}*MED_W + \text{cdash5}*LOW_Z; \]

\[ \text{DHIW}_\text{LOZ} = \text{cdash1} + \text{cdash4}*HIGH_W + \text{cdash5}*LOW_Z; \]
DLOW_MEZ = cdash1 + cdash4*LOW_W + cdash5*MED_Z;
DMEW_MEZ = cdash1 + cdash4*MED_W + cdash5*MED_Z;
DHIW_MEZ = cdash1 + cdash4*HIGH_W + cdash5*MED_Z;

DLOW_HIZ = cdash1 + cdash4*LOW_W + cdash5*HIGH_Z;
DMEW_HIZ = cdash1 + cdash4*MED_W + cdash5*HIGH_Z;
DHIW_HIZ = cdash1 + cdash4*HIGH_W + cdash5*HIGH_Z;

! Calc conditional total effects for each combination of moderator values
TLOW_LOZ = ILOW_LOZ + DLOW_LOZ;
TMEW_LOZ = IMEW_LOZ + DM EW_LOZ;
THIW_LOZ = IHIW_LOZ + DHIW_LOZ;
TLOW_MEZ = ILOW_MEZ + DLOW_MEZ;
TMEW_MEZ = IMEW_MEZ + DMEW_MEZ;
THIW_MEZ = IHIW MEZ + DHIW MEZ;
TLOW_HIZ = ILOW_HIZ + DLOW_HIZ;
TM EW_HIZ = IM EW_HIZ + DME W_HIZ;
THIW_HIZ = IHIW_HIZ + DHIW_HIZ;

! Use loop plot to plot conditional indirect effect of X on Y for each combination of low, med, high moderator values
! Could be edited to show conditional direct or conditional total effects instead
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(PLOW_LOZ PMEW_LOZ PHIW_LOZ PLOW_MEZ PMEW_MEZ PHIW_MEZ
PLOW_HIZ PMEW_HIZ PHIW_HIZ);

LOOP(XVAL,1,5,0.1);

PLOW_LOZ = ILOW_LOZ*XVAL;
PM EW_LOZ = IM EW_LOZ*XVAL;
PHIW_LOZ = IHIW LOZ*XVAL;
PLOW_MEZ = ILOW_MEZ*XVAL;
PM EW_MEZ = IM EW_MEZ*XVAL;
PHIW_MEZ = IHIW_ME Z*XVAL;
PLOW_HIZ = ILOW_HIZ*XVAL;
PM EW_HIZ = IM EW_HIZ*XVAL;
PHIW_HIZ = IHIW_HIZ*XVAL;

PLOT:
TYPE = plot2;
OUTPUT:
   STAND CINT(bcbootstrap);
Model 80: 3 or more mediators, both in parallel and in series

Example Variables: 1 predictor X, 3 mediators M1, M2, and M3, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1 M_1 + b_2 M_2 + b_3 M_3 + c'X \]

\[ M_1 = a_{01} + a_1 X \]
\[ M_2 = a_{02} + a_2 X \]
\[ M_3 = a_{03} + a_3 X + d_1 M_1 + d_2 M_2 \]

**Albegra to calculate total, indirect and/or conditional effects by writing model as** \( Y = a + bX \):

\[ Y = b_0 + b_1 (a_{01} + a_1 X) + b_2 (a_{02} + a_2 X) + b_3 M_3 + c'X \]
\[ M_3 = a_{03} + a_3 X + d_1 (a_{01} + a_1 X) + d_2 (a_{02} + a_2 X) \]

Hence... substituting in equations for M1 and M2 into Y and M3

\[ Y = b_0 + b_1 (a_{01} + a_1 X) + b_2 (a_{02} + a_2 X) + b_3 M_3 + c'X \]
\[ M_3 = a_{03} + a_3 X + d_1 (a_{01} + a_1 X) + d_2 (a_{02} + a_2 X) \]

Hence... substituting in equations for M3 into Y
\[ Y = b_0 + b_1(a_{01} + a_{1}X) + b_2(a_{02} + a_{2}X) + b_3(a_{03} + a_{3}X + d_1(a_{01} + a_{1}X) + d_2(a_{02} + a_{2}X)) + c'X \]

Hence... multiplying out brackets
\[
Y = b_0 + a_{01}b_1 + a_{1}b_1X + a_{02}b_2 + a_{2}b_2X + a_{03}b_3X + a_{01}b_3d_1 + a_{1}b_3d_1X + a_{02}b_3d_2 + a_{2}b_3d_2X + c'X
\]

Hence... grouping terms into form \( Y = a + bX \)
\[
Y = (b_0 + a_{01}b_1 + a_{02}b_2 + a_{03}b_3 + a_{01}b_3d_1 + a_{02}b_3d_2) + (a_{1}b_1 + a_{2}b_2 + a_{3}b_3 + a_{1}b_3d_1 + a_{2}b_3d_2 + c')X
\]

Hence...

Five indirect effects of \( X \) on \( Y \):
- \( a_{1}b_1, a_{2}b_2, a_{3}b_3, a_{1}b_3d_1, a_{2}b_3d_2 \)

One direct effect of \( X \) on \( Y \):
\( c' \)

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M1, M2, M3
! Moderator variable(s) - none
! Outcome variable - Y
USEVARIABLES = X M1 M2 Y;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path using parentheses
MODEL:
    Y ON M1 (b1);
    Y ON M2 (b2);
    Y ON M3 (b3);
    Y ON X (c'\text{\textdagger}); ! direct effect of X on Y
    M1 ON X (a1);
    M2 ON X (a2);
    M3 ON X (a3);
```

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M3 ON M1 (d1);
M3 ON M2 (d2);

! Use model constraint to calculate specific indirect paths and total indirect effect

MODEL CONSTRAINT:
NEW(a1b1 a2b2 a3b3 a1d1b3 a2d2b3 TOTALIND TOTAL);

a1b1 = a1*b1; ! Specific indirect effect of X on Y via M1 only
a2b2 = a2*b2; ! Specific indirect effect of X on Y via M2 only
a3b3 = a3*b3; ! Specific indirect effect of X on Y via M3 only
a1d1b3 = a1*d1*b3; ! Specific indirect effect of X on Y via M1 and M3
a2d2b3 = a2*d2*b3; ! Specific indirect effect of X on Y via M2 and M3

TOTALIND = a1b1 + a2b2 + a3b3 + a1d1b3 + a2d2b3; ! Total indirect effect of X on Y via M1, M2, M3
TOTAL = a1b1 + a2b2 + a3b3 + a1d1b3 + a2d2b3 + cdash; ! Total effect of X on Y

OUTPUT:
STAND CINT(bcbootstrap);
Model 81: Model 80: 3 or more mediators, both in parallel and in series

Example Variables: 1 predictor X, 3 mediators M1, M2, and M3, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given in model 1b. Handling categorical moderators with > 2 categories is demonstrated in model 1d.
- Any mediators (variable M, or M1, M2, etc.) are continuous and satisfy the assumptions of standard multiple regression. An example of how to handle a dichotomous mediator is given in model 4c.
- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

Model Diagram:
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3M_3 + c'X \]
\[ M_1 = a_{01} + a_{1}X \]
\[ M_2 = a_{02} + a_{2}X \]
\[ M_3 = a_{03} + a_{3}X + d_1M_1 + d_2M_2 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_{01} + a_{1}X) + b_2(a_{02} + a_{2}X) + b_3M_3 + c'X \]
\[ M_3 = a_{03} + a_{3}X + d_1(a_{01} + a_{1}X) + d_2(a_{02} + a_{2}X) \]

Hence... substituting in equations for M1 and M2 into Y and M3

\[ Y = b_0 + b_1(a_{01} + a_{1}X) + b_2(a_{02} + a_{2}X) + b_3(a_{03} + a_{3}X + d_1(a_{01} + a_{1}X) + d_2(a_{02} + a_{2}X) + c'X \]

Hence... substituting in equations for M3 into Y
\[ Y = b_0 + b_1(a_01 + a_1X) + b_2(a_02 + a_2X) + b_3(a_03 + a_3X + d_1(a_01 + a_1X) + d_2(a_02 + a_2X)) + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}b_1 + a_{11}X + a_{02}b_2 + a_{22}X + a_{03}b_3 + a_{33}X + a_{01}d_1b_3 + a_{11}d_1b_3X + a_{02}d_2b_3 + a_{22}d_2b_3X + c'X \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + a_{01}b_1 + a_{02}b_2 + a_{03}b_3 + a_{01}d_1b_3 + a_{02}d_2b_3) + (a_{11}b_1 + a_{22}b_2 + a_{33} + a_{11}d_1b_3 + a_{22}d_2b_3 + c')X \]

Hence...

Five indirect effects of \( X \) on \( Y \):
\( a_{11}b_1, a_{22}b_2, a_{33}, a_{11}d_1b_3, a_{22}d_2b_3 \)

One direct effect of \( X \) on \( Y \):
\( c' \)

**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M1, M2, M3
! Moderator variable(s) - none
! Outcome variable - Y

USEVARIABLES = X M1 M2 M3 Y;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
  Y ON M1 (b1);
  Y ON M2 (b2);
  Y ON M3 (b3);
  Y ON X (cdash);  ! direct effect of X on Y
  M1 ON X (a1);
  M2 ON X (a2);
  M3 ON X (a3);
```
M3 ON M1 (d1);
M3 ON M2 (d2);

! Use model constraint to calculate specific indirect paths and total indirect effect

MODEL CONSTRAINT:
    NEW(a1b1 a2b2 a3b3 a1d1b3 a2d2b3 TOTALIND TOTAL);
    a1b1 = a1*b1;   ! Specific indirect effect of X on Y via M1 only
    a2b2 = a2*b2;   ! Specific indirect effect of X on Y via M2 only
    a3b3 = a3*b3;   ! Specific indirect effect of X on Y via M3 only
    a1d1b3 = a1*d1*b3;   ! Specific indirect effect of X on Y via M1 and M3
    a2d2b3 = a2*d2*b3;   ! Specific indirect effect of X on Y via M2 and M3
    TOTALIND = a1b1 + a2b2 + a3b3 + a1d1b3 + a2d2b3;   ! Total indirect effect of X on Y via M1, M2, M3
    TOTAL = a1b1 + a2b2 + a3b3 + a1d1b3 + a2d2b3 + cdash;   ! Total effect of X on Y

OUTPUT:
    STAND CINT(bcbootstrap);

Editing required for testing indirect effect using alternative MODEL INDIRECT: subcommand

MODEL INDIRECT: offers an alternative to MODEL CONSTRAINT: for models containing indirect effects, where these are not moderated. To instead use MODEL INDIRECT: to test this model, you would edit the code above as follows:

First, you can remove the naming of parameters using parentheses in the MODEL: command, i.e. you just need:

MODEL:
    Y ON X M1 M2 M3;
    M1 M2 ON X;
    M3 ON M1 M2 X;

Second, replace the MODEL CONSTRAINT: subcommand with the following MODEL INDIRECT: subcommand:

    MODEL INDIRECT:
    Y IND X;

Leave the OUTPUT: command unchanged.
Model 82: Model 80: 4 or more mediators, both in parallel and in series (parallel serial paths)

Example Variables: 1 predictor X, 4 mediators M1, M2, M3, M4, and 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3M_3 + b_4M_4 + c'X \]

\[ M_1 = a_{01} + a_{11}X \]
\[ M_2 = a_{02} + a_{2}X \]
\[ M_3 = a_{03} + a_{3}X + d_1M_1 \]
\[ M_4 = a_{04} + a_{4}X + d_2M_2 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_{01} + a_{11}X) + b_2(a_{02} + a_{2}X) + b_3(a_{03} + a_{3}X + d_1(a_{01} + a_{11}X)) + b_4(a_{04} + a_{4}X + d_2(a_{02} + a_{2}X)) + c'X \]

Hence... substituting in equations for M1 and M2 into Y, M3 and M4

\[ Y = b_0 + b_1(a_{01} + a_{11}X) + b_2(a_{02} + a_{2}X) + b_3(a_{03} + a_{3}X + d_1(a_{01} + a_{11}X)) + b_4(a_{04} + a_{4}X + d_2(a_{02} + a_{2}X)) + c'X \]

Hence... substituting in equations for M3 and M4 into Y

\[ Y = b_0 + b_1(a_{01} + a_{11}X) + b_2(a_{02} + a_{2}X) + b_3(a_{03} + a_{3}X + d_1(a_{01} + a_{11}X)) + b_4(a_{04} + a_{4}X + d_2(a_{02} + a_{2}X)) + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_{01}b_{11} + a_{11}b_{11}X + a_{02}b_{2} + a_{2}b_{2}X + a_{03}b_{3} + a_{3}b_{3}X + a_{01}b_{11}d_{1} + a_{11}b_{11}d_{1}X + a_{04}b_{4} + a_{4}b_{4}X + a_{02}d_{2}b_{4} + a_{2}d_{2}b_{4}X + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01}b_{11} + a_{02}b_{2} + a_{03}b_{3} + a_{04}b_{4} + a_{01}d_{1}b_{11} + a_{02}d_{2}b_{4}) + (a_{11}b_{11} + a_{2}b_{2} + a_{3}b_{3} + a_{4}b_{4} + a_{11}d_{1}b_{11} + a_{2}d_{2}b_{4} + c')X \]

Hence...

Six indirect effects of X on Y:

\[ a_{11}b_{11}, a_{2}b_{2}, a_{3}b_{3}, a_{4}b_{4}, a_{11}d_{1}b_{11}, a_{2}d_{2}b_{4} \]

One direct effect of X on Y: \( c' \)
Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M1, M2, M3, M4
! Moderator variable(s) - none
! Outcome variable - Y

USEVARIABLES = X M1 M2 M3 M4 Y;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
  Y ON M1 (b1);
  Y ON M2 (b2);
  Y ON M3 (b3);
  Y ON M4 (b4);
  Y ON X (cdash);   ! direct effect of X on Y
  M1 ON X (a1);
  M2 ON X (a2);
  M3 ON X (a3);
  M4 ON X (a4);
  M3 ON M1 (d1);
  M4 ON M2 (d2);

! Use model constraint to calculate specific indirect paths
! and total indirect effect

MODEL CONSTRAINT:
  NEW(a1b1 a2b2 a3b3 a4b4 a1d1b3 a2d2b4 TOTALIND TOTAL);
  a1b1 = a1*b1;   ! Specific indirect effect of X on Y via M1 only
  a2b2 = a2*b2;   ! Specific indirect effect of X on Y via M2 only
  a3b3 = a3*b3;   ! Specific indirect effect of X on Y via M3 only
  a4b4 = a4*b4;   ! Specific indirect effect of X on Y via M4 only
  a1d1b3 = a1*d1*b3;   ! Specific indirect effect of X on Y via M1
                       ! and M3
  a2d2b4 = a2*d2*b4;   ! Specific indirect effect of X on Y via M2
                       ! and M4
  TOTALIND = a1b1 + a2b2 + a3b3 + a4b4 + a1d1b3 + a2d2b4;   !
Total indirect effect of X on Y via M1, M2, M3, M4
    TOTAL = a1b1 + a2b2 + a3b3 + a4b4 + a1d1b3 + a2d2b4 + cdash;  ! Total effect of X on Y

OUTPUT:
    STAND CINT(bcbootstrap);

Editing required for testing indirect effect using alternative MODEL INDIRECT: subcommand

MODEL INDIRECT: offers an alternative to MODEL CONSTRAINT: for models containing indirect effects, where these are not moderated. To instead use MODEL INDIRECT: to test this model, you would edit the code above as follows:

First, you can remove the naming of parameters using parentheses in the MODEL: command, i.e. you just need:

MODEL:
    Y ON X M1 M2 M3 M4;
    M1 ON X;
    M2 ON X;
    M3 ON M1 X;
    M4 ON M2 X;

Second, replace the MODEL CONSTRAINT: subcommand with the following MODEL INDIRECT: subcommand:

    MODEL INDIRECT:
    Y IND X;

Leave the OUTPUT: command unchanged.
Model 83: 2 or more mediators in series, 1 moderator, moderating the IV-first mediator path

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + c'X \]
\[ M_1 = a_{01} + a_{11}X + a_{3W} + a_{4XW} \]
\[ M_2 = a_{02} + a_{2X} + d_1M_1 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1(a_{01} + a_{11}X + a_{3W} + a_{4XW}) + b_2(a_{02} + a_{2X} + d_1(a_{01} + a_{11}X + a_{3W} + a_{4XW})) + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_{01}b_1 + a_{11}b_1X + a_{3W}b_1 + a_{4XW}b_1 + a_{02}b_2 + a_{2X}b_2 + a_{01}d_1b_2 + a_{11}d_1b_2X + a_{3W}d_1b_2 + a_{4XW}d_1b_2 + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01}b_1 + a_{02}b_2 + a_{01}d_1b_2 + a_{3W}b_1 + a_{4XW}b_1) + (a_{11}b_1 + a_{2X}b_2 + a_{11}d_1b_2 + a_{3W}d_1b_2 + a_{4XW}d_1b_2 + c')X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):

\( (a_{11} + a_{4W})b_1, a_{4W}b_2, (a_{11} + a_{4W})d_1b_2 \)

One direct effect of \( X \) on \( Y \):

\( c' \)
Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y XW;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
   XW = X*W;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
   Y ON M1 (b1);
   Y ON M2 (b2);
   Y ON X (cdash); ! direct effect of X on Y
   M1 ON X (a1);
   M1 ON W (a3);
   M1 ON XW (a4);
   M2 ON X (a2);
   M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W a2b2 LWa1b1 MWa1b1 HWa1b1 LWa1d1b2 MWa1d1b2 HWa1d1b2 TOT_LOW W TOT_MED W TOT_HI W);
   LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
   HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
! Now calc indirect and total effects for each value of W

! Conditional indirect effects of X on Y via M1 only given values of W

LWa1b1 = a1*b1 + a4*b1*LOW_W;
MWa1b1 = a1*b1 + a4*b1*MED_W;
HWa1b1 = a1*b1 + a4*b1*HIGH_W;

a2b2 = a2*b2;       ! Specific indirect effect of X on Y via M2 only

! Conditional indirect effects of X on Y via M1 and M2 given values of W

LWa1d1b2 = a1*d1*b2 + a4*d1*b2*LOW_W;
MWa1d1b2 = a1*d1*b2 + a4*d1*b2*MED_W;
HWa1d1b2 = a1*d1*b2 + a4*d1*b2*HIGH_W;

! Conditional total effects of X on Y given values of W

TOT_LOWW = LWa1d1b2 + LWa1b1 + a2b2 + cdash;
TOT_MEDW = MWa1d1b2 + MWa1b1 + a2b2 + cdash;
TOT_HIW = HWa1d1b2 + HWa1b1 + a2b2 + cdash;

! Use loop plot to plot total effect of X on Y for low, med, high values of W

! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);

LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;

PLOT:
   TYPE = plot2;

OUTPUT:
   STAND CINT(bcbootstrap);
Model 84: 2 or more mediators in series, 1 moderator, moderating both IV-first mediator path and IV-second mediator path

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):
\[ Y = b_0 + b_1M_1 + b_2M_2 + c'X \]
\[ M_1 = a_{01} + a_{11}X + a_{31}W + a_{41}XW \]
\[ M_2 = a_{02} + a_{21}X + a_{51}W + a_{61}XW + d_{11}M_1 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1M_1 + b_2M_2 + c'X \]
\[ M_1 = a_{01} + a_{11}X + a_{31}W + a_{41}XW \]
\[ M_2 = a_{02} + a_{21}X + a_{51}W + a_{61}XW + d_{11}M_1 \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \)
\[ Y = b_0 + b_1(a_{01} + a_{11}X + a_{31}W + a_{41}XW) + b_2(a_{02} + a_{21}X + a_{51}W + a_{61}XW + d_{11}(a_{01} + a_{11}X + a_{31}W + a_{41}XW)) + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}b_1 + a_{11}b_1X + a_{31}b_1W + a_{41}b_1XW + a_{02}b_2 + a_{21}b_2X + a_{51}b_2W + a_{61}b_2XW + a_{01}d_{11}b_2 + a_{11}d_{11}b_2X + a_{31}d_{11}b_2W + a_{41}d_{11}b_2XW + c'X \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + a_{01}b_1 + a_{31}b_1W + a_{41}b_1XW + a_{02}b_2 + a_{21}b_2X + a_{51}b_2W + a_{61}b_2XW + a_{01}d_{11}b_2 + a_{31}d_{11}b_2W + a_{41}d_{11}b_2XW) + (a_{11}b_1 + a_{41}b_1W + a_{21}b_2 + a_{61}b_2W + a_{11}d_{11}b_2 + a_{41}d_{11}b_2W + c')X \]

Hence...
Three indirect effects of \( X \) on \( Y \), conditional on \( W \):
\[ (a_1 + a_{4W})b_1, (a_2 + a_{6W})b_2, (a_1 + a_{4W})d_{11}b_2 \]
One direct effect of \( X \) on \( Y \):
\[ c' \]
Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y XW;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
   XW = X*W;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
   Y ON M1 (b1);
   Y ON M2 (b2);
   Y ON X (cdash);  ! direct effect of X on Y
   M1 ON X (a1);
   M1 ON W (a3);
   M1 ON XW (a4);
   M2 ON X (a2);
   M2 ON W (a5);
   M2 ON XW (a6);
   M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LWa1b1 MWa1b1 HWa1b1 LWa2b2 MWa2b2 HWa2b2
      LWa1d1b2 MWa1d1b2 HWa1d1b2 TOT_LOWW TOT_MEDW TOT_HIW);
   LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

! Now calc indirect and total effects for each value of W

! Conditional indirect effects of X on Y via M1 only given values of W

LWa1b1 = a1*b1 + a4*b1*LOW_W;
MWa1b1 = a1*b1 + a4*b1*MED_W;
HWa1b1 = a1*b1 + a4*b1*HIGH_W;

! Conditional indirect effects of X on Y via M2 only given values of W

LWa2b2 = a2*b2 + a6*b2*LOW_W;
MWa2b2 = a2*b2 + a6*b2*MED_W;
HWa2b2 = a2*b2 + a6*b2*HIGH_W;

! Conditional indirect effects of X on Y via M1 and M2 given values of W

LWa1d1b2 = a1*d1*b2 + a4*d1*b2*LOW_W;
MWa1d1b2 = a1*d1*b2 + a4*d1*b2*MED_W;
HWa1d1b2 = a1*d1*b2 + a4*d1*b2*HIGH_W;

! Conditional total effects of X on Y given values of W

TOT_LOWW = LWa1d1b2 + LWa1b1 + LWa2b2 + cdash;
TOT_MEDW = MWa1d1b2 + MWa1b1 + MWa2b2 + cdash;
TOT_HIW = HWa1d1b2 + HWa1b1 + HWa2b2 + cdash;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;

PLOT:
    TYPE = plot2;
OUTPUT:
    STAND CINT(bcbootstrap);
Model 85: 2 or more mediators in series, 1 moderator, moderating the IV-first mediator path, IV-second mediator path, and the direct IV-DV path

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + c_1'X \]
\[ M_1 = a_{01} + a_1X + a_3W + a_4XW \]
\[ M_2 = a_{02} + a_2X + a_5W + a_6XW + d_1M_1 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M_1 + b_2M_2 + c_1'X + c_2'W + c_3'XW \]
\[ M_1 = a_{01} + a_1X + a_3W + a_4XW \]
\[ M_2 = a_{02} + a_2X + a_5W + a_6XW + d_1M_1 \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \)

\[ Y = b_0 + b_1(a_{01} + a_1X + a_3W + a_4XW) + b_2(a_{02} + a_2X + a_5W + a_6XW + d_1(a_{01} + a_1X + a_3W + a_4XW)) + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_{01}b_1 + a_1b_1X + a_3b_1W + a_4b_1XW + a_{02}b_2 + a_2b_2X + a_5b_2W + a_6b_2XW + a_{01}d_1b_2 + a_1d_1b_2X + a_3d_1b_2W + a_4d_1b_2XW + c_1'X + c_2'W + c_3'XW \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01}b_1 + a_3b_1W + a_{02}b_2 + a_5b_2W + a_{01}d_1b_2 + a_3d_1b_2W + a_4d_1b_2XW + c_2'W) + (a_1b_1 + a_4b_1W + a_2b_2 + a_6b_2W + a_1d_1b_2 + a_4d_1b_2W + c_1' + c_3'W)X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):

\( (a_1 + a_4W)b_1, (a_2 + a_6W)b_2, (a_1 + a_4W)d_1b_2 \)

One direct effect of \( X \) on \( Y \), conditional on \( W \):

\( c_1' + c_3'W \)
**Mplus code for the model:**

```
! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y XW;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
    XW = X*W;

ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
    Y ON M1 (b1);
    Y ON M2 (b2);
    Y ON X (c1);
    Y ON W (c2);
    Y ON XW (c3);
    M1 ON X (a1);
    M1 ON W (a3);
    M1 ON XW (a4);
    M2 ON X (a2);
    M2 ON W (a5);
    M2 ON XW (a6);
    M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W LWa1b1 MWa1b1 HWa1b1 LWa2b2 MWa2b2 HWa2b2
      LWa1d1b2 MWa1d1b2 HWa1d1b2 DIR_LW DIR_MW DIR_HW TOT_LOWW
      TOT_MEDW TOT_HIW);
    LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
```
MED_W = #MEDW;     ! replace #MEDW in the code with your
chosen medium value of W
HIGH_W = #HIGHW;     ! replace #HIGHW in the code with your
chosen high value of W

! Now calc indirect, direct and total effects for each value
of W

! Conditional indirect effects of X on Y via M1 only given
values of W
LWa1b1 = a1*b1 + a4*b1*LOW_W;
MWa1b1 = a1*b1 + a4*b1*MED_W;
HWa1b1 = a1*b1 + a4*b1*HIGH_W;

! Conditional indirect effects of X on Y via M2 only given
values of W
LWa2b2 = a2*b2 + a6*b2*LOW_W;
MWa2b2 = a2*b2 + a6*b2*MED_W;
HWa2b2 = a2*b2 + a6*b2*HIGH_W;

! Conditional indirect effects of X on Y via M1 and M2 given
values of W
LWa1d1b2 = a1*d1*b2 + a4*d1*b2*LOW_W;
MWa1d1b2 = a1*d1*b2 + a4*d1*b2*MED_W;
HWa1d1b2 = a1*d1*b2 + a4*d1*b2*HIGH_W;

! Conditional direct effects of X on Y given values of W
DIR_LW = cdash1 + cdash3*LOW_W;
DIR_MW = cdash1 + cdash3*MED_W;
DIR_HW = cdash1 + cdash3*HIGH_W;

! Conditional total effects of X on Y given values of W
TOT_LOWW = LWa1d1b2 + LWa1b1 + LWa2b2 + DIR_LW;
TOT_MEDW = MWa1d1b2 + MWa1b1 + MWa2b2 + DIR_MW;
TOT_HIW = HWa1d1b2 + HWa1b1 + HWa2b2 + DIR_HW;

! Use loop plot to plot total effect of X on Y for low, med,
high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced
by
! logical min and max limits of predictor X used in analysis
PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;
PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 86: 2 or more mediators in series, 1 moderator, moderating the IV-first mediator path and the direct IV-DV path

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
**Model Equation(s):**

\[ Y = b_0 + b_1 M_1 + b_2 M_2 + c_1' X \]

\[ M_1 = a_{01} + a_{11} X + a_{31} W + a_{41} X W \]

\[ M_2 = a_{02} + a_{21} X + d_{11} M_1 \]

**Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):**

\[ Y = b_0 + b_1 (a_{01} + a_{11} X + a_{31} W + a_{41} X W) + b_2 (a_{02} + a_{21} X + d_{11} (a_{01} + a_{11} X + a_{31} W + a_{41} X W)) + c_1' X + c_2' W + c_3' X W \]

Hence... multiplying out brackets

\[ Y = b_0 + a_{01} b_1 + a_{11} b_1 X + a_{31} b_1 W + a_{41} b_1 X W + a_{02} b_2 + a_{21} b_2 X + a_{01} d_{11} b_2 + a_{11} d_{11} b_2 X + a_{31} d_{11} b_2 W + a_{41} d_{11} b_2 X W + c_1' X + c_2' W + c_3' X W \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01} b_1 + a_{31} b_1 W + a_{02} b_2 + a_{11} b_2 + a_{31} b_2 W + a_{41} b_2 X W + c_2' W) + (a_{11} b_1 + a_{41} b_1 W + a_{21} b_2 + a_{11} d_{11} b_2 + a_{41} d_{11} b_2 W + c_1' + c_3' W) X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):

\( (a_1 + a_{4W}) b_1, a_{21} b_2, (a_1 + a_{4W}) d_{11} b_2 \)

One direct effect of \( X \) on \( Y \), conditional on \( W \):

\( c_1' + c_3' W \)
**Mplus code for the model:**

```mplus
! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y XW;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
   XW = X*W;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
   Y ON M1 (b1);
   Y ON M2 (b2);

   Y ON X (cdash1);
   Y ON W (cdash2);
   Y ON XW (cdash3);

   M1 ON X (a1);
   M1 ON W (a3);
   M1 ON XW (a4);

   M2 ON X (a2);
   M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LWa1b1 MWa1b1 HWa1b1 a2b2
   LWa1d1b2 MWa1d1b2 HWa1d1b2 DIR_LW DIR_MW DIR_HW TOT_LOW_W
   TOT_MED_W TOT_HI_W);

   LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW;  ! replace #MEDW in the code with your chosen medium value of W
```
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

! Now calc indirect, direct and total effects for each value of W

! Conditional indirect effects of X on Y via M1 only given values of W

LWa1b1 = a1*b1 + a4*b1*LOW_W;
MWa1b1 = a1*b1 + a4*b1*MED_W;
HWa1b1 = a1*b1 + a4*b1*HIGH_W;

a2b2 = a2*b2 ;  ! indirect effects of X on Y via M2 only

! Conditional indirect effects of X on Y via M1 and M2 given values of W

LWa1d1b2 = a1*d1*b2 + a4*d1*b2*LOW_W;
MWa1d1b2 = a1*d1*b2 + a4*d1*b2*MED_W;
HWa1d1b2 = a1*d1*b2 + a4*d1*b2*HIGH_W;

! Conditional direct effects of X on Y given values of W

DIR_LW = cdash1 + cdash3*LOW_W;
DIR_MW = cdash1 + cdash3*MED_W;
DIR_HW = cdash1 + cdash3*HIGH_W;

! Conditional total effects of X on Y given values of W

TOT_LOWW = LWa1d1b2 + LWa1b1 + a2b2 + DIR_LW;
TOT_MEDW = MWa1d1b2 + MWa1b1 + a2b2 + DIR_MW;
TOT_HIW = HWa1d1b2 + HWa1b1 + a2b2 + DIR_HW;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;

PLOT:
   TYPE = plot2;
OUTPUT:
   STAND CINT(bcbootstrap);
Model 87: 2 or more mediators in series, 1 moderator, moderating the second mediator-DV path

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):
\[ Y = b_0 + b_1 M_1 + b_2 M_2 + b_3 W + b_4 M_2 W + c'X \]
\[ M_1 = a_{01} + a_{11}X \]
\[ M_2 = a_{02} + a_{21}X + d_{11}M_1 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1 M_1 + b_2 M_2 + b_3 W + b_4 M_2 W + c'X \]
\[ M_1 = a_{01} + a_{11}X \]
\[ M_2 = a_{02} + a_{21}X + d_{11}M_1 \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \)
\[ Y = Y = b_0 + b_1(a_{01} + a_{11}X) + b_2(a_{02} + a_{21}X + d_{11}(a_{01} + a_{11}X)) + b_3 W + b_4(a_{02} + a_{21}X + d_{11}(a_{01} + a_{11}X))W + c'X \]

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}b_1 + a_{11}b_1X + a_{02}b_2 + a_{21}b_2X + a_{01}d_{11}b_2 + a_{11}d_{11}b_2X + b_3 W + a_{02}b_4 + a_{21}b_4X + a_{01}d_{11}b_4W + a_{11}d_{11}b_4WX + c'X \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + a_{01}b_1 + a_{02}b_2 + a_{01}d_{11}b_2 + a_{11}d_{11}b_2X + b_3 W + a_{02}b_4 + a_{21}b_4WX + a_{01}d_{11}b_4W + a_{11}d_{11}b_4WX + c')X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):
\[ a_{11}b_1, a_{11}d_{11}(b_2 + b_4W), a_{21}(b_2 + b_4W) \]

One direct effect of \( X \) on \( Y \):
\[ c' \]
Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y M2W;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
   M2W = M2*W;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
   Y ON M1 (b1);
   Y ON M2 (b2);
   Y ON W (b3);
   Y ON M2W (b4);
   Y ON X (cdash); ! direct effect of X on Y
   M1 ON X (a1);
   M2 ON X (a2);
   M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W a1b1 LWa2b2 MWa2b2 HWa2b2 LWald1b2
      MWald1b2 HWald1b2
      TOT_LOWW TOT_MEDW TOT_HIW);
   LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
   HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W
! Now calc indirect and total effects for each value of W
  albl = a1*b1;  ! Specific indirect effect of X on Y via M1 only

! Conditional indirect effects of X on Y via M2 only given values of W
  LWa2b2 = a2*b2 + a2*b4*LOW_W;
  MWa2b2 = a2*b2 + a2*b4*MED_W;
  HWa2b2 = a2*b2 + a2*b4*HIGH_W;

! Conditional indirect effects of X on Y via M1 and M2 given values of W
  LWal1b2 = a1*d1*b2 + a1*b1 + cdash;
  MWal1b2 = a1*d1*b2 + a1*b1 + cdash;
  HWal1b2 = a1*d1*b2 + a1*b1 + cdash;

! Conditional total effects of X on Y given values of W
  TOT_LOW = LWal1b2 + LWa2b2 + albl + cdash;
  TOT_MED = MWal1b2 + MWa2b2 + albl + cdash;
  TOT_HI = HWal1b2 + HWa2b2 + albl + cdash;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOW*XVAL;
MEDMOD = TOT_MED*XVAL;
HIMOD = TOT_HI*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 88: 2 or more mediators in series, 1 moderator, moderating both the first mediator-DV and the second mediator-DV paths

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3W + b_4M_1W + b_5M_2W + c'X \]

\[ M_1 = a_{01} + a_{1}X \]

\[ M_2 = a_{02} + a_{2}X + d_{1}M_1 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3W + b_4M_1W + b_5M_2W + c'X \]

\[ M_1 = a_{01} + a_{1}X \]

\[ M_2 = a_{02} + a_{2}X + d_{1}M_1 \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \)

\[ Y = Y = b_0 + b_1(a_{01} + a_{1}X) + b_2(a_{02} + a_{2}X + d_1(a_{01} + a_{1}X)) + b_3W + b_4(a_{01} + a_{1}X)W + b_5(a_{02} + a_{2}X + d_1(a_{01} + a_{1}X))W + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_{01}b_1 + a_{1}b_1X + a_{02}b_2 + a_{2}b_2X + a_{01}d_1b_2 + a_{1}d_1b_2X + b_3W + a_{01}b_4W + a_{1}b_4WX + a_{02}b_5 + a_{2}b_5X + a_{01}d_1b_5W + a_{1}d_1b_5WX + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01}b_1 + a_{02}b_2 + a_{01}d_1b_2 + b_3W + a_{01}b_4W + a_{02}b_5 + a_{01}d_1b_5W) + (a_{1}b_1 + a_{2}b_2 + a_{2}b_5W + a_{1}d_1b_2 + a_{1}b_4W + a_{1}d_1b_5W + c')X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):

\[ a_{1}(b_1 + b_4W), a_{2}(b_2 + b_5W), a_{1}d_1(b_2 + b_5W) \]

One direct effect of \( X \) on \( Y \):

\[ c' \]
Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y M1W M2W;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
  M1W = M1*W;
  M2W = M2*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
  Y ON M1 (b1);
  Y ON M2 (b2);
  Y ON W (b3);
  Y ON M1W (b4);
  Y ON M2W (b5);
  Y ON X (cdash); ! direct effect of X on Y
  M1 ON X (a1);
  M2 ON X (a2);
  M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W LWa1b1 MWa1b1 HWa1b1 LWa2b2 MWa2b2 HWa2b2
  LWa1d1b2 MWa1d1b2 HWa1d1b2 TOT_LOWW TOT_MEDW TOT_HIW);

  LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
  MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

! Now calc indirect and total effects for each value of W

! Conditional indirect effects of X on Y via M1 only given values of W

LWa1b1 = a1*b1 + a1*b4*LOW_W;
MWa1b1 = a1*b1 + a1*b4*MED_W;
HWa1b1 = a1*b1 + a1*b4*HIGH_W;

! Conditional indirect effects of X on Y via M2 only given values of W

LWa2b2 = a2*b2 + a2*b5*LOW_W;
MWa2b2 = a2*b2 + a2*b5*MED_W;
HWa2b2 = a2*b2 + a2*b5*HIGH_W;

! Conditional indirect effects of X on Y via M1 and M2 given values of W

LWa1d1b2 = a1*d1*b2 + a1*d1*b5*LOW_W;
MWa1d1b2 = a1*d1*b2 + a1*d1*b5*MED_W;
HWa1d1b2 = a1*d1*b2 + a1*d1*b5*HIGH_W;

! Conditional total effects of X on Y given values of W

TOT_LOWW = LWa1d1b2 + LWa2b2 + LWa1b1 + cdash;
TOT_MEDW = MWa1d1b2 + MWa2b2 + MWa1b1 + cdash;
TOT_HIW = HWa1d1b2 + HWa2b2 + HWa1b1 + cdash;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis

PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;

PLOT:
  TYPE = plot2;

OUTPUT:
  STAND CINT(bcbootstrap);
Model 89: 2 or more mediators in series, 1 moderator, moderating the direct IV-DV path, the first mediator-DV path, and the second mediator-DV path

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3W + b_4M_1W + b_5M_2W + c_1'X + c_2'W + c_3'XW \]

\[ M_1 = a_{01} + a_1X \]

\[ M_2 = a_{02} + a_2X + d_1M_1 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3W + b_4M_1W + b_5M_2W + c_1'X + c_2'W + c_3'XW \]

\[ M_1 = a_{01} + a_1X \]

\[ M_2 = a_{02} + a_2X + d_1M_1 \]

Hence...

substituting in equations for \( M_1 \) and \( M_2 \)

\[ Y = b_0 + b_1(a_{01} + a_1X) + b_2(a_{02} + a_2X + d_1(a_{01} + a_1X)) + b_3W + b_4(a_{01} + a_1X)W + b_5(a_{02} + a_2X + d_1(a_{01} + a_1X))W + c_1'X + c_2'W + c_3'XW \]

Hence...

multiplying out brackets

\[ Y = b_0 + a_{01}b_1 + a_1b_1X + a_{02}b_2 + a_2b_2X + a_{01}d_1b_2 + a_1d_1b_2X + b_3W + a_{01}b_4W + a_1b_4XW + a_{02}b_5 + a_2b_5X + a_{01}d_1b_5W + a_1d_1b_5XW + c_1'X + c_2'W + c_3'XW \]

Hence...

grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01}b_1 + a_2b_2 + a_{01}d_1b_2 + b_3W + a_{01}b_4W + a_1d_1b_5W + c_2'W) + (a_{01}b_1 + a_2b_2 + a_1d_1b_2 + a_{01}b_4W + a_{01}d_1b_5W + c_1' + c_3'W)X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):

\( a_{1}(b_1 + b_4W), a_{2}(b_2 + b_5W), a_{1d_1}(b_2 + b_5W) \)

One direct effect of \( X \) on \( Y \):

\( c_1' + c_3'W \)

Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) – M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y XW M1W M2W;
! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
   XW = X*W;
   M1W = M1*W;
   M2W = M2*W;

ANALYSIS:
   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
   Y ON M1 (b1);
   Y ON M2 (b2);
   Y ON W (b3);
   Y ON M1W (b4);
   Y ON M2W (b5);
   Y ON X (cdash1);
   Y ON W (cdash2);
   Y ON XW (cdash3);
   M1 ON X (a1);
   M2 ON X (a2);
   M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LWa1b1 MWa1b1 HWa1b1 LWa2b2 MWa2b2 HWa2b2
   LWa1d1b2 MWa1d1b2 HWa1d1b2 DIR_LW DIR_MW DIR_HW TOT_LOWW
   TOT_MEDW TOT_HIW);
   LOW_W = #LOWW;    ! replace #LOWW in the code with your chosen low value of W
   MED_W = #MEDW;    ! replace #MEDW in the code with your chosen medium value of W
   HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your chosen high value of W

! Now calc indirect and total effects for each value of W
! Conditional indirect effects of X on Y via M1 only given values of W
LWa1b1 = a1*b1 + a1*b4*LOW_W;
MWa1b1 = a1*b1 + a1*b4*MED_W;
HWa1b1 = a1*b1 + a1*b4*HIGH_W;

! Conditional indirect effects of X on Y via M2 only given values of W
LWa2b2 = a2*b2 + a2*b5*LOW_W;
MWa2b2 = a2*b2 + a2*b5*MED_W;
HWa2b2 = a2*b2 + a2*b5*HIGH_W;

! Conditional indirect effects of X on Y via M1 and M2 given values of W
LWa1d1b2 = a1*d1*b2 + a1*d1*b5*LOW_W;
MWa1d1b2 = a1*d1*b2 + a1*d1*b5*MED_W;
HWa1d1b2 = a1*d1*b2 + a1*d1*b5*HIGH_W;

! Conditional direct effects of X on Y given values of W
DIR_LW = cdash1 + cdash3*LOW_W;
DIR_MW = cdash + cdash3*MED_W;
DIR_HW = cdash + cdash3*HIGH_W;

! Conditional total effects of X on Y given values of W
TOT_LOWW = LWa1d1b2 + LWa2b2 + LWa1b1 + DIR_LW;
TOT_MEDW = MWa1d1b2 + MWa2b2 + MWa1b1 + DIR_MW;
TOT_HIW = HWa1d1b2 + HWa2b2 + HWa1b1 + DIR_HW;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;
PLOT:
  TYPE = plot2;
OUTPUT:
  STAND CI(bcbootstrap);
Model 90: 2 or more mediators in series, 1 moderator, moderating both the direct IV-DV path and the second mediator-DV path

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3W + b_4M_2W + c_1'X + c_2'W + c_3'XW \]
\[ M_1 = a_01 + a_1X \]
\[ M_2 = a_02 + a_2X + d_1M_1 \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3W + b_4M_2W + c_1'X + c_2'W + c_3'XW \]
\[ M_1 = a_01 + a_1X \]
\[ M_2 = a_02 + a_2X + d_1M_1 \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \)

\[ Y = Y = b_0 + b_1(a_01 + a_1X) + b_2(a_02 + a_2X + d_1(a_01 + a_1X)) + b_3W + b_4(a_02 + a_2X + d_1(a_01 + a_1X))W + c_1'X + c_2'W + c_3'XW \]

Hence... multiplying out brackets

\[ Y = b_0 + a_01b_1 + a_1b_1X + a_02b_2 + a_2b_2X + a_01d_1b_2 + a_1d_1b_2X + b_3W + a_02b_4 + a_2b_4X + a_01d_1b_4W + a_1d_1b_4WX + c_1'X + c_2'W + c_3'XW \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_01b_1 + a_02b_2 + a_01d_1b_2 + b_3 + a_2b_4 + a_01d_1b_4W + c_1'X + c_2'W) + (a_1b_1 + a_2b_2 + a_1d_1b_2 + a_1d_1b_4WX + c_1' + c_3'W)X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):

\[ a_1b_1, a_2(b_2 + b_4W), a_1d_1(b_2 + b_4W) \]

One direct effect of \( X \) on \( Y \):

\[ c_1' + c_3'W \]

Mplus code for the model:

```plaintext
! Predictor variable - X
! Mediator variable(s) – M1, M2
! Moderator variable(s) - W
! Outcome variable - Y
USEVARIABLES = X M1 M2 W Y XW M2W;
```
! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:
  XW = X*W;
  M2W = M2*W;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
  Y ON M1 (b1);
  Y ON M2 (b2);
  Y ON W (b3);
  Y ON M2W (b4);
  Y ON X (cdash1);
  Y ON W (cdash2);
  Y ON XW (cdash3);
  M1 ON X (a1);
  M2 ON X (a2);
  M2 ON M1 (d1);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
  NEW(LOW_W MED_W HIGH_W a1b1 LWa2b2 MWa2b2 HWa2b2
  LWa1d1b2 MWa1d1b2 HWa1d1b2 DIR_LW DIR_MW DIR_HW TOT_LOWW
  TOT_MEDW TOT_HIW);

  LOW_W = #LOWW; ! replace #LOWW in the code with your chosen low value of W
  MED_W = #MEDW; ! replace #MEDW in the code with your chosen medium value of W
  HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

! Now calc indirect and total effects for each value of W
  a1b1 = a1*b1;! indirect effect of X on Y via M1 only

! Conditional indirect effects of X on Y via M2 only given values of W
LWa2b2 = a2*b2 + a2*b4*LOW_W;
MWa2b2 = a2*b2 + a2*b4*MED_W;
HWa2b2 = a2*b2 + a2*b4*HIGH_W;

! Conditional indirect effects of X on Y via M1 and M2 given values of W
LWa1d1b2 = a1*d1*b2 + a1*d1*b4*LOW_W;
MWa1d1b2 = a1*d1*b2 + a1*d1*b4*MED_W;
HWa1d1b2 = a1*d1*b2 + a1*d1*b4*HIGH_W;

! Conditional direct effects of X on Y given values of W
DIR_LW = cdash1 + cdash3*LOW_W;
DIR_MW = cdash + cdash3*MED_W;
DIR_HW = cdash + cdash3*HIGH_W;

! Conditional total effects of X on Y given values of W
TOT_LOWW = LWa1d1b2 + LWa2b2 + a1b1 + DIR_LW;
TOT_MEDW = MWa1d1b2 + MWa2b2 + a1b1 + DIR_MW;
TOT_HIW = HWa1d1b2 + HWa2b2 + a1b1 + DIR_HW;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis
PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;

PLOT:
TYPE = plot2;
OUTPUT:
STAND CINT(bcbootstrap);
Model 91: 2 or more mediators, in series, 1 moderator moderating path between mediators

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Preliminary notes:

The code below assumes that:

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W,V,Q,Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):  
\[ Y = b_0 + b_1M_1 + b_2M_2 + c'X \]  
\[ M_1 = a_{01} + a_{1}X \]  
\[ M_2 = a_{02} + a_{2}X + d_{1}M_1 + d_{2}W + d_{3}M_1W \]  

*Albegra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):*  
\[ Y = b_0 + b_1(a_{01} + a_{1}X) + b_2(a_{02} + a_{2}X + d_{1}(a_{01} + a_{1}X) + d_{2}W + d_{3}(a_{01} + a_{1}X)W) + c'X \]  

Hence... multiplying out brackets
\[ Y = b_0 + a_{01}b_1 + a_{1b1}X + a_{02}b_2 + a_{2b2}X + a_{01}b_{d1} + a_{1b_{d1}}X + d_{2b2}W + a_{01}b_{d3}W + a_{1b_{d3}}XW + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01}b_1 + a_{02}b_2 + a_{01}b_{d1} + d_{2b2}W + a_{01}b_{d3}W) + (a_{1b1} + a_{1b_{d1}} + a_{2b2} + a_{1b_{d3}}W + c')X \]

Hence... 

Three indirect effects of \( X \) on \( Y \):

\( a_{1b1}, a_{2b2}, a_{1b_{d1}} + d_{3W} \)

One direct effect of \( X \) on \( Y \):

\( c' \)

**Mplus code for the model:**

```plaintext
USEVARIABLES = X M1 M2 W Y M1W;
DEFINE:
    M1W = M1*W;
ANALYSIS:
    TYPE = GENERAL;
    ESTIMATOR = ML;
    BOOTSTRAP = 10000;
MODEL:
    Y ON M1 (b1);
    Y ON M2 (b2);
    Y ON X (cdash);  ! direct effect of X on Y
    M1 ON X (a1);
    M2 ON X (a2);
    M2 ON M1 (d1);
```

```
M2 ON W (d2);
M2 ON M1W (d3);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:
    NEW(LOW_W MED_W HIGH_W a1b1 a2b2 LWald1b2 MWald1b2
    HWald1b2
    TOT_LOWW TOT_MEDW TOT_HIW);

    LOW_W = #LOWW;  ! replace #LOWW in the code with your
    ! chosen low value of W
    MED_W = #MEDW;  ! replace #MEDW in the code with your
    ! chosen medium value of W
    HIGH_W = #HIGHW; ! replace #HIGHW in the code with your
    ! chosen high value of W

    ! Now calc indirect and total effects for each value of W
    a1b1 = a1*b1;   ! Specific indirect effect of X on Y via M1
                   ! only
    a2b2 = a2*b2;   ! Specific indirect effect of X on Y via M2
                   ! only

    ! Conditional indirect effects of X on Y via M1 and M2 given
    ! values of W
    LWald1b2 = a1*d1*b2 + a1*d3*b2*LOW_W;
    MWald1b2 = a1*d1*b2 + a1*d3*b2*MED_W;
    HWald1b2 = a1*d1*b2 + a1*d3*b2*HIGH_W;

    ! Conditional total effects of X on Y given values of W
    TOT_LOWW = LWald1b2 + a1b1 + a2b2 + cdash;
    TOT_MEDW = MWald1b2 + a1b1 + a2b2 + cdash;
    TOT_HIW = HWald1b2 + a1b1 + a2b2 + cdash;

    ! Use loop plot to plot total effect of X on Y for low, med,
    ! high values of W
    ! NOTE - values of 1,5 in LOOP() statement need to be replaced
    ! by
    ! logical min and max limits of predictor X used in analysis

    PLOT(LOMOD MEDMOD HIMOD);
    LOOP(XVAL,1,5,0.1);
    LOMOD = TOT_LOWW*XVAL;
    MEDMOD = TOT_MEDW*XVAL;
    HIMOD = TOT_HIW*XVAL;
PLOT:
    TYPE = plot2;

OUTPUT:
    STAND CINT(bcbootstrap);
Model 92: 2 or more mediators in series, 1 moderator, moderating all of the direct IV-DV path, IV-first mediator path, IV-second mediator path, first mediator-DV path, second mediator-DV path, and the path between mediators

Example Variables: 1 predictor X, 2 mediators M1 and M2, 1 moderator W, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3M_1W + b_4M_2W + c_1'X + c_2'W + c_3'XW \]
\[ M_1 = a_01 + a_1X + a_3W + a_4XW \]
\[ M_2 = a_02 + a_2X + a_5W + a_6XW + d_1M_1 + d_2M_1W \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M_1 + b_2M_2 + b_3M_1W + b_4M_2W + c_1'X + c_2'W + c_3'XW \]
\[ M_1 = a_01 + a_1X + a_3W + a_4XW \]
\[ M_2 = a_02 + a_2X + a_5W + a_6XW + d_1M_1 + d_2M_1W \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \)

\[ Y = b_0 + (a_01 + a_1X + a_3W + a_4XW)b_1 + (a_02 + a_2X + a_5W + a_6XW + d_1(a_01 + a_1X + a_3W + a_4XW))b_2 + (a_01d_1b_2 + a_3d_1b_2W + a_4d_1b_2WX + a_01d_2b_2W + a_3d_2b_2WW + a_4d_2b_2XWW + a_01b_3W + a_1b_3WX + a_3b_3WW + a_4b_3XWW + a_02b_4W + a_2b_4XW + a_5b_4WW + a_6b_4XWW + a_01d_1b_4W + a_1d_1b_4WX + a_3d_1b_4WW + a_4d_1b_4XWW + a_01d_2b_4WW + a_1d_2b_4WX + a_3d_2b_4WW + a_4d_2b_4XWW + c_1'X + c_2'W + c_3'XW \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = b_0 + a_01b_1 + a_1b_1X + a_3b_1W + a_02b_2 + a_2b_2X + a_5b_2W + a_6b_2XW + a_01d_1b_2 + a_1d_1b_2X + a_3d_1b_2W + a_4d_1b_2WX + a_01d_2b_2W + a_3d_2b_2WW + a_4d_2b_2XWW + a_01b_3W + a_1b_3WX + a_3b_3WW + a_4b_3XWW + a_02b_4W + a_2b_4XW + a_5b_4WW + a_6b_4XWW + a_01d_1b_4W + a_1d_1b_4WX + a_3d_1b_4WW + a_4d_1b_4XWW + a_01d_2b_4WW + a_1d_2b_4WX + a_3d_2b_4WW + a_4d_2b_4XWW + c_1' + c_3'X \]

Hence...

Three indirect effects of \( X \) on \( Y \), conditional on \( W \):

\((a_1 + a_4W)(b_1 + b_3W), (a_2 + a_6W)(b_2 + b_4W), (a_1 + a_4W)(d_1 + d_2W)(b_2 + b_4W)\)

One direct effect of \( X \) on \( Y \):

\(c_1' + c_3'W\)
Mplus code for the model:

! Predictor variable - X
! Mediator variable(s) - M1, M2
! Moderator variable(s) - W
! Outcome variable - Y

USEVARIABLES = X M1 M2 W Y XW M1W M2W;

! Create interaction term
! Note that it has to be placed at end of USEVARIABLES subcommand above

DEFINE:

   XW = X*W;
   M1W = M1*W;
   M2W = M2*W;

ANALYSIS:

   TYPE = GENERAL;
   ESTIMATOR = ML;
   BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:

   Y ON M1 (b1);
   Y ON M2 (b2);
   Y ON M1W (b3);
   Y ON M2W (b4);
   Y ON X (cdash1);
   Y ON W (cdash2);
   Y ON XW (cdash3);
   M1 ON X (a1);
   M2 ON X (a2);
   M1 ON W (a3);
   M1 ON XW (a4);
   M2 ON W (a5);
   M2 ON XW (a6);
   M2 ON M1 (d1);
   M2 ON M1W (d2);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator

MODEL CONSTRAINT:

   NEW (LOW_W MED_W HIGH_W LWa1b1 MWa1b1 HWa1b1 LWa2b2 MWa2b2 HWa2b2 LWa1d1b2 MWa1d1b2 HWa1d1b2 DIR_LW DIR_MW DIR_HW TOT_LOWW TOT_MEDW TOT_HIW);
LOW_W = #LOWW;  ! replace #LOWW in the code with your chosen low value of W
MED_W = #MEDW;   ! replace #MEDW in the code with your chosen medium value of W
HIGH_W = #HIGHW; ! replace #HIGHW in the code with your chosen high value of W

! Now calc indirect and total effects for each value of W

! Conditional indirect effects of X on Y via M1 only given values of W
LWa1b1 = (a1 + a4*LOW_W)*(b1 + b3*LOW_W);
MWa1b1 = (a1 + a4*MED_W)*(b1 + b3*MED_W);
HWa1b1 = (a1 + a4*HIGH_W)*(b1 + b3*HIGH_W);

! Conditional indirect effects of X on Y via M2 only given values of W
LWa2b2 = (a2 + a6*LOW_W)*(b2 + b4*LOW_W);
MWa2b2 = (a2 + a6*MED_W)*(b2 + b4*MED_W);
HWa2b2 = (a2 + a6*HIGH_W)*(b2 + b4*HIGH_W);

! Conditional indirect effects of X on Y via M1 and M2 given values of W
LWa1d1b2 = (a1 + a4*LOW_W)*(d1 + d2*LOW_W)*(b2 + b4*LOW_W);
MWa1d1b2 = (a1 + a4*MED_W)*(d1 + d2*MED_W)*(b2 + b4*MED_W);
HWa1d1b2 = (a1 + a4*HIGH_W)*(d1 + d2*HIGH_W)*(b2 + b4*HIGH_W);

! Conditional direct effects of X on Y given values of W
DIR_LW = cdash1 + cdash3*LOW_W;
DIR_MW = cdash + cdash3*MED_W;
DIR_HW = cdash + cdash3*HIGH_W;

! Conditional total effects of X on Y given values of W
TOT_LOWW = LWa1d1b2 + LWa2b2 + LWa1b1 + DIR_LW;
TOT_MEDW = MWa1d1b2 + MWa2b2 + MWa1b1 + DIR_MW;
TOT_HIW = HWa1d1b2 + HWa2b2 + HWa1b1 + DIR_HW;

! Use loop plot to plot total effect of X on Y for low, med, high values of W
! NOTE - values of 1,5 in LOOP() statement need to be replaced by logical min and max limits of predictor X used in analysis
PLOT(LOMOD MEDMOD HIMOD);
LOOP(XVAL,1,5,0.1);
LOMOD = TOT_LOWW*XVAL;
MEDMOD = TOT_MEDW*XVAL;
HIMOD = TOT_HIW*XVAL;

PLOT:
TYPE = plot2;
OUTPUT:
   STAND CINT(bcbootstrap);
Model 501: 1 mediator, multiple focal predictors

Example Variables: 2 predictors X1, X2, 1 mediator M, 1 outcome Y

Model Diagram:

Statistical Diagram:
Model Equation(s):
\[ Y = b_0 + b_1M + c_1'X_1 + c_2'X_2; \]
\[ M = a_0 + a_1X_1 + a_2X_2; \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):
\[ Y = b_0 + b_1M + c_1'X_1 + c_2'X_2; \]
\[ M = a_0 + a_1X_1 + a_2X_2; \]

Hence... substituting in equations for \( M \)
\[ Y = b_0 + b_1(a_0 + a_1X_1 + a_2X_2) + c_1'X_1 + c_2'X_2 \]

Hence... multiplying out brackets
\[ Y = b_0 + a_0b_1 + a_1b_1X_1 + a_2b_1X_2 + c_1'X_1 + c_2'X_2 \]

Hence... grouping terms into form \( Y = a + bX \)
\[ Y = (b_0 + a_0b_1) + (a_1b_1 + c_1')X_1 + (a_2b_1 + c_2')X_2 \]

Hence...
Indirect effect of \( X_1 \) on \( Y \):
\[ a_1b_1 \]
Indirect effect of \( X_2 \) on \( Y \):
\[ a_2b_1 \]
Direct effect of \( X_1 \) on \( Y \):
\[ c_1' \]
Direct effect of \( X_2 \) on \( Y \):
\[ c_2' \]

Mplus code for the model:
```plaintext
! Predictor variables - X1, X2
! Mediator variable(s) - M
! Moderator variable(s) - none
! Outcome variable - Y
USEVARIABLES = X1 X2 M Y;
```
ANALYSIS:
TYPE = GENERAL;
ESTIMATOR = ML;
BOOTSTRAP = 10000;

! In model statement name each path using parentheses
MODEL:
Y ON M (b1);
Y ON X1 (cdash1);  ! direct effect of X1 on Y
Y ON X2 (cdash2);  ! direct effect of X2 on Y
M ON X1 (a1);
M ON X2 (a2);

! Use model constraint to calculate indirect and total effects
MODEL CONSTRAINT:
NEW(a1b1 a2b1 TOTALX1 TOTALX2);
  a1b1 = a1*b1;  ! Indirect effect of X1 on Y via M
  a2b1 = a2*b1;  ! Indirect effect of X2 on Y via M
  TOTALX1 = a1*b1 + cdash1;  ! Total effect of X1 on Y
  TOTALX2 = a2*b1 + cdash2;  ! Total effect of X2 on Y

OUTPUT:
STAND CINT(bcbootstrap);
Model 502: 1 mediator, multiple focal outcomes

Example Variables: 1 predictor X, 1 mediator M, 2 outcomes Y1, Y2

Model Diagram:

Statistical Diagram:
Model Equation(s):

\[ Y_1 = b_0 + b_1 M + c_1' X; \]
\[ Y_2 = b_0 + b_2 M + c_2' X; \]
\[ M = a_0 + a_1 X; \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + b X \):

\[ Y_1 = b_0 + b_1 M + c_1' X; \]
\[ Y_2 = b_0 + b_2 M + c_2' X; \]
\[ M = a_0 + a_1 X; \]

Hence... substituting in equations for \( M \)

\[ Y_1 = b_0 + b_1 (a_0 + a_1 X) + c_1' X; \]
\[ Y_2 = b_0 + b_2 (a_0 + a_1 X) + c_2' X; \]

Hence... multiplying out brackets

\[ Y_1 = b_0 + a_0 b_1 + a_1 b_1 X_1 + c_1' X_1 \]
\[ Y_2 = b_0 + a_0 b_2 + a_1 b_2 X_1 + c_2' X_1 \]

Hence... grouping terms into form \( Y = a + b X \)

\[ Y_1 = (b_0 + a_0 b_1) + (a_1 b_1 + c_1') X_1 \]
\[ Y_1 = (b_0 + a_0 b_2) + (a_1 b_2 + c_2') X_1 \]

Hence...

Indirect effect of \( X \) on \( Y_1 \):
\[ a_1 b_1 \]
Indirect effect of \( X \) on \( Y_2 \):
\[ a_1 b_2 \]
Direct effect of \( X \) on \( Y_1 \):
\[ c_1' \]
Direct effect of \( X \) on \( Y_2 \):
\[ c_2' \]
Mplus code for the model:

! Predictor variables - X
! Mediator variable(s) - M
! Moderator variable(s) - none
! Outcome variable - Y1, Y2

USEVARIABLES = X1 M Y1 Y2;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses

MODEL:
  Y1 ON M (b1);
  Y2 ON M (b2);
  Y1 ON X (cdash1); ! direct effect of X1 on Y
  Y2 ON X (cdash2); ! direct effect of X2 on Y
  M ON X (a1);

! Use model constraint to calculate indirect and total effects

MODEL CONSTRAINT:
  NEW(a1b1 a1b2 TOTALY1 TOTALY2);
  a1b1 = a1*b1;    ! Indirect effect of X on Y1 via M
  a1b2 = a1*b2;    ! Indirect effect of X on Y2 via M
  TOTALY1 = a1*b1 + cdash1; ! Total effect of X on Y1
  TOTALY2 = a1*b2 + cdash2; ! Total effect of X on Y2

OUTPUT:
  STAND CINT(bcbootstrap);
Model 503: 1 mediator, predictor has non-linear effect on mediator and outcome

Example Variables: 1 predictor X, 1 mediator M, 1 outcome Y

Preliminary notes:

The code below assumes that

- The primary IV (variable X) is continuous or dichotomous

- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given in model 1b. Handling categorical moderators with > 2 categories is demonstrated in model 1d.

- Any mediators (variable M, or M1, M2, etc.) are continuous and satisfy the assumptions of standard multiple regression. An example of how to handle a dichotomous mediator is given in model 4c.

- The DV (variable Y) is continuous and satisfies the assumptions of standard multiple regression. An example of how to handle a dichotomous DV is given in model 1e (i.e. a moderated logistic regression) and in model 4d (i.e. an indirect effect in a logistic regression).

Model Diagram:
Model Equation(s):

\[ Y = b_0 + b_1M + c_1'X + c_2'XX \]
\[ M = a_0 + a_1X + a_2XX \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1M + c_1'X + c_2'XX \]
\[ M = a_0 + a_1X + a_2XX \]

Hence... differentiating each equation to calculate the rates of change in the DV wrto the IV(s)

\[ \frac{dY}{dX} = c_1' + 2c_2'X \]
\[ \frac{dY}{dM} = b_1 \]
\[ \frac{dM}{dX} = a_1 + 2a_2X \]

Hence... multiplying the relationships between \( X \) and \( M \), and \( M \) and \( Y \) to get the indirect effect:

Instantaneous Indirect Effect (IIE) of \( X \) on \( Y \):

\((a_1 + 2a_2X)b_1\)
And we also have the... Instantaneous Direct Effect (IDE) of X on Y:
\[ c'1 + 2c'2X \]

**Mplus code for the model:**

```plaintext
! Predictor variable(s) - X, XX
! Mediator variable(s) - M
! Moderator variable(s) - none
! Outcome variable - Y
USEVARIABLES = X XX M Y;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses
MODEL:
  Y ON M (b1);
  Y ON X (cdash1); ! direct effect of X on Y
  Y ON XX (cdash2); ! direct effect of X on Y
  M ON X (a1);
  M ON XX (a2);

! Use model constraint to calculate instantaneous indirect and
direct effects
! at different values of X
MODEL CONSTRAINT:
  NEW(LOW_X MED_X HIGH_X
  IIE_LOWX IIE_MEDX IIE_HIX
  IDE_LOWX IDE_MEDX IDE_HIX);
  LOW_X = #LOWX; ! replace #LOWX in the code with your
  chosen low value of X
  MED_X = #MEDX; ! replace #MEDX in the code with your
  chosen medium value of X
  HIGH_X = #HIGHX; ! replace #HIGHX in the code with your
  chosen high value of X

! Calc instantaneous indirect effects for low, medium, high
values of X
  IIE_LOWX = (a1 + 2*a2*LOW_X)*b1;
  IIE_MEDX = (a1 + 2*a2*MED_X)*b1;
  IIE_HIX = (a1 + 2*a2*HIGH_X)*b1;
```
! Calc instantaneous direct effects for low, medium, high values of X

    IDE_LOWX = cdash1 + 2*cdash2*LOW_X;
    IDE_MEDX = cdash1 + 2*cdash2*MED_X;
    IDE_HIX = cdash1 + 2*cdash2*HIGH_X;

! Use loop plot to plot instantaneous indirect effect of X on Y
! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

    PLOT(IIEX);
    LOOP(XVAL,1,5,0.1);
    IIEX = (a1*b1 + 2*a2*b1*XVAL)*XVAL;

PLOT:
   TYPE = plot2;

OUTPUT:
   STAND CINT(bcbootstrap);
Model 504: 3 or more mediators, both in parallel and in series, 2 moderators, 1 moderating paths between predictor and mediator, the second moderating paths between mediators, and between mediator and DV

Example Variables: 1 predictor X, 3 mediators M1, M2, and M3, 2 moderators W, V, 1 outcome Y

Preliminary notes:
The code below assumes that

- The primary IV (variable X) is continuous or dichotomous
- Any moderators (variables W, V, Q, Z) are continuous, though the only adaptation required to handle dichotomous moderators is in the MODEL CONSTRAINT: and loop plot code - an example of how to do this is given for model 1 (simple moderation)
- Any mediators (variable M, or M1, M2, etc.) are assumed to be continuous
- The DV (variable Y) is assumed to be continuous and to satisfy the assumptions of standard multiple regression - an example of how to handle a dichotomous DV is given for model 1 (i.e. a moderated logistic regression) and for model 4 (i.e. an indirect effect in a logistic regression).
Statistical Diagram:

Model Equation(s):

\[ Y = b_0 + b_1 M_1 + b_2 M_2 + b_3 M_3 + b_4 V + b_5 M_1 V + c'X \]
\[ M_1 = a_{01} + a_1 X + a_4 W + a_5 X W \]
\[ M_2 = a_{02} + a_2 X \]
\[ M_3 = a_{03} + a_3 X + d_1 M_1 + d_2 M_2 + d_3 V + d_4 M_1 V \]

Algebra to calculate total, indirect and/or conditional effects by writing model as \( Y = a + bX \):

\[ Y = b_0 + b_1 M_1 + b_2 M_2 + b_3 M_3 + b_4 V + b_5 M_1 V + c'X \]
\[ M_1 = a_{01} + a_1 X + a_4 W + a_5 X W \]
\[ M_2 = a_{02} + a_2 X \]
\[ M_3 = a_{03} + a_3 X + d_1 M_1 + d_2 M_2 + d_3 V + d_4 M_1 V \]

Hence... substituting in equations for \( M_1 \) and \( M_2 \) into \( Y \) and \( M_3 \):

\[ Y = Y = b_0 + b_1(a_{01} + a_1 X + a_4 W + a_5 X W) + b_2(a_{02} + a_2 X) + b_3 M_3 + b_4 V + b_5(a_{01} + a_1 X + a_4 W + a_5 X W)V + c'X \]
\[ M_3 = a_{03} + a_3 X + d_1(a_{01} + a_1 X + a_4 W + a_5 X W) + d_2(a_{02} + a_2 X) + d_3 V + d_4(a_{01} + a_1 X + a_4 W + a_5 X W)V \]
Hence... substituting in equations for M3 into Y

\[ Y = b_0 + b_1(a_{01} + a_{1X} + a_{4W} + a_{5XW}) + b_2(a_{02} + a_{2X}) + b_3(a_{03} + a_{3X} + d_1(a_{01} + a_{1X} + a_{4W} + a_{5XW}) + d_2(a_{02} + a_{2X}) + d_3V + d_4(a_{01} + a_{1X} + a_{4W} + a_{5XW})V) + b_4V + b_5(a_{01} + a_{1X} + a_{4W} + a_{5XW})V + c'X \]

Hence... multiplying out brackets

\[ Y = b_0 + a_{01b1} + a_{1b1X} + a_{4b1W} + a_{5b1XW} + a_{02b2} + a_{2b2X} + a_{03b3} + a_{3b3X} + a_{01d1b3} + a_{1d1b3X} + a_{4d1b3W} + a_{5d1b3XW} + a_{02d2b3} + a_{2d2b3X} + b_3d_3V + a_{01d4b3V} + a_{1d4b3XV} + a_{4d4b3WV} + a_{5d4b3XWV} + b_4V + a_{01b5V} + a_{1b5XV} + a_{4b5WV} + a_{5b5XWV} + c'X \]

Hence... grouping terms into form \( Y = a + bX \)

\[ Y = (b_0 + a_{01b1} + a_{4b1W} + a_{02b2} + a_{03b3} + a_{01d1b3} + a_{4d1b3W} + a_{02d2b3} + b_3d_3V + a_{01d4b3V} + a_{4d4b3WV} + b_4V + a_{01b5V} + a_{4b5WV}) + (a_{1b1} + a_{5b1W} + a_{2b2} + a_{3b3} + a_{1d1b3} + a_{5d1b3W} + a_{2d2b3} + a_{1d4b3V} + a_{5d4b3WV} + a_{1b5V} + a_{5b5WV} + c')X \]

Hence...

Five indirect effects of X on Y:

\[ a_{1b1} + a_{5b1W} + a_{1b5V} + a_{5b5WV}, a_{2b2}, a_{3b3}, a_{2d2b3}, a_{1b3d1} + a_{5d1b3W} + a_{1d4b3V} + a_{5d4b3WV} \]

One direct effect of X on Y:

\[ c' \]

**Mplus code for the model:**

```plaintext
! Predictor variable - X
! Mediator variable(s) - M1, M2, M3
! Moderator variable(s) - W, V
! Outcome variable - Y

USEVARIABLES = X M1 M2 M3 W V Y XW M1V;

ANALYSIS:
  TYPE = GENERAL;
  ESTIMATOR = ML;
  BOOTSTRAP = 10000;

! In model statement name each path using parentheses
```

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MODEL:
   Y ON M1 (b1);
   Y ON M2 (b2);
   Y ON M3 (b3);
   Y ON V (b4);
   Y ON M1V (b5);
   Y ON X (cdash);  ! direct effect of X on Y
   M1 ON X (a1);
   M1 ON W (a4);
   M1 ON XW (a5);
   M2 ON X (a2);
   M3 ON X (a3);
   M3 ON M1 (d1);
   M3 ON M2 (d2);
   M3 ON V (d3);
   M3 ON M1V (d4);

! Use model constraint subcommand to test simple slopes
! You need to pick low, medium and high moderator values,
! for example, of 1 SD below mean, mean, 1 SD above mean
! Also calc total effects at lo, med, hi values of moderator
MODEL CONSTRAINT:
   NEW(LOW_W MED_W HIGH_W LOW_V MED_V HIGH_V
      a1b1LWLV a1b1MWLV a1b1HWLV a1b1LWMV a1b1HWMV
      a1b1LWHV a1b1MWHV a1b1HWHV
      a2b2 a3b3 a2d2b3
      adbLWLV adbMWLV adbHWLV adbLWMV adbMWMV adbHWMV
      adbLWHV adbMWHV adbHWHV
      TI_LWLV TI_MWLV TI_HWLV TI_LWMV TI_MWMV TI_HWMV
      TI_LWHV TI_MWHV TI_HWHV
      TOT_LWLV TOT_MWLV TOT_HWLV TOT_LWMV TOT_MWMV TOT_HWMV
      TOT_LWHV TOT_MWHV TOT_HWHV);
   LOW_W = #LOWW;  ! replace #LOWW in the code with your
                   chosen low value of W
   MED_W = #MEDW;  ! replace #MEDW in the code with your
                   chosen medium value of W
   HIGH_W = #HIGHW;  ! replace #HIGHW in the code with your
                    chosen high value of W
   LOW_V = #LOWV;  ! replace #LOWV in the code with your
                   chosen low value of V
   MED_V = #MEDV;  ! replace #MEDV in the code with your
                   chosen medium value of V
   HIGH_V = #HIGHV;  ! replace #HIGHV in the code with your
                    chosen high value of V
! Now calc specific indirect effects for each value of W and V

\[ a_{1b1LWLV} = a_1b_1 + a_5b_1*LOW_W + a_1b_5*LOW_V + a_5b_5*LOW_W*LOW_V; \]
\[ a_{1b1MWLV} = a_1b_1 + a_5b_1*MED_W + a_1b_5*LOW_V + a_5b_5*MED_W*LOW_V; \]
\[ a_{1b1HWLV} = a_1b_1 + a_5b_1*HIGH_W + a_1b_5*LOW_V + a_5b_5*HIGH_W*LOW_V; \]
\[ a_{1b1LWMV} = a_1b_1 + a_5b_1*LOW_W + a_1b_5*MED_V + a_5b_5*LOW_W*MED_V; \]
\[ a_{1b1MWMV} = a_1b_1 + a_5b_1*MED_W + a_1b_5*MED_V + a_5b_5*MED_W*MED_V; \]
\[ a_{1b1HWMV} = a_1b_1 + a_5b_1*HIGH_W + a_1b_5*MED_V + a_5b_5*HIGH_W*MED_V; \]
\[ a_{1b1LWHV} = a_1b_1 + a_5b_1*LOW_W + a_1b_5*HIGH_V + a_5b_5*LOW_W*HIGH_V; \]
\[ a_{1b1MWHV} = a_1b_1 + a_5b_1*MED_W + a_1b_5*HIGH_V + a_5b_5*MED_W*HIGH_V; \]
\[ a_{1b1HWHV} = a_1b_1 + a_5b_1*HIGH_W + a_1b_5*HIGH_V + a_5b_5*HIGH_W*HIGH_V; \]
\[ a_{2b2} = a_2*b_2; \]
\[ a_{3b3} = a_3*b_3; \]
\[ a_{2d2b3} = a_2*d_2*b_3; \]
\[ a_{dbLWLV} = a_1b_3*d_1 + a_5d_1*b_3*LOW_W + a_1d_4*b_3*LOW_V + a_5d_4*b_3*LOW_W*LOW_V; \]
\[ a_{dbMWLV} = a_1b_3*d_1 + a_5d_1*b_3*MED_W + a_1d_4*b_3*LOW_V + a_5d_4*b_3*MED_W*LOW_V; \]
\[ a_{dbHWLV} = a_1b_3*d_1 + a_5d_1*b_3*HIGH_W + a_1d_4*b_3*LOW_V + a_5d_4*b_3*HIGH_W*LOW_V; \]
\[ a_{dbLWMV} = a_1b_3*d_1 + a_5d_1*b_3*LOW_W + a_1d_4*b_3*MED_V + a_5d_4*b_3*LOW_W*MED_V; \]
\[ a_{dbMWMV} = a_1b_3*d_1 + a_5d_1*b_3*MED_W + a_1d_4*b_3*MED_V + a_5d_4*b_3*MED_W*MED_V; \]
\[ a_{dbHWLV} = a_1b_3*d_1 + a_5d_1*b_3*HIGH_W + a_1d_4*b_3*MED_V + a_5d_4*b_3*HIGH_W*MED_V; \]
\[ a_{dbLWHV} = a_1b_3*d_1 + a_5d_1*b_3*LOW_W + a_1d_4*b_3*HIGH_V + a_5d_4*b_3*LOW_W*HIGH_V; \]
\[ a_{dbMWHV} = a_1b_3*d_1 + a_5d_1*b_3*MED_W + a_1d_4*b_3*HIGH_V + a_5d_4*b_3*MED_W*HIGH_V; \]
\[ a_{dbHWLV} = a_1b_3*d_1 + a_5d_1*b_3*HIGH_W + a_1d_4*b_3*HIGH_V + a_5d_4*b_3*HIGH_W*HIGH_V; \]

! Now calc total indirect effects for each value of W and V
\[ TI_{LWLV} = a_{1b1LWLV} + a_{2b2} + a_{3b3} + a_{2d2b3} + a_{dbLWLV}; \]
\[ TI_{MWLV} = a_{1b1MWLV} + a_{2b2} + a_{3b3} + a_{2d2b3} + a_{dbMWLV}; \]
\[ TI_{HWLV} = a_1 b_1 H_{WLH} + a_2 b_2 + a_3 b_3 + a_2 d_2 b_3 + a d b H_{WLH}; \]
\[ TI_{LMWV} = a_1 b_1 L_{MWH} + a_2 b_2 + a_3 b_3 + a_2 d_2 b_3 + a d b L_{MWH}; \]
\[ TI_{MMW} = a_1 b_1 M_{MWH} + a_2 b_2 + a_3 b_3 + a_2 d_2 b_3 + a d b M_{MWH}; \]
\[ TI_{HWM} = a_1 b_1 H_{MWH} + a_2 b_2 + a_3 b_3 + a_2 d_2 b_3 + a d b H_{MWH}; \]
\[ TI_{LWH} = a_1 b_1 L_{WHH} + a_2 b_2 + a_3 b_3 + a_2 d_2 b_3 + a d b L_{WHH}; \]
\[ TI_{MMWH} = a_1 b_1 M_{WHH} + a_2 b_2 + a_3 b_3 + a_2 d_2 b_3 + a d b M_{WHH}; \]
\[ TI_{HWH} = a_1 b_1 H_{WHH} + a_2 b_2 + a_3 b_3 + a_2 d_2 b_3 + a d b H_{WHH}; \]

! Now calc total effects for each value of W and V

\[ TOT_{LWLV} = TI_{LWLV} + c; \]
\[ TOT_{MWLV} = TI_{MWLV} + c; \]
\[ TOT_{HWLV} = TI_{HWLV} + c; \]
\[ TOT_{LMV} = TI_{LMV} + c; \]
\[ TOT_{MMV} = TI_{MMV} + c; \]
\[ TOT_{HWM} = TI_{HWM} + c; \]
\[ TOT_{LWH} = TI_{LWH} + c; \]
\[ TOT_{MMWH} = TI_{MMWH} + c; \]
\[ TOT_{HWH} = TI_{HWH} + c; \]

! Use loop plot to plot total indirect effect of X on Y for low, med, high values of W

! NOTE - values of 1,5 in LOOP() statement need to be replaced by
! logical min and max limits of predictor X used in analysis

\[ PLOT(PTI_{LWLV} PTI_{MWLV} PTI_{HWLV} PTI_{LMV} PTI_{MMV} PTI_{HWM} \]
\[ PTI_{LWH} PTI_{MMWH} PTI_{HWH}); \]
\[ LOOP(XVAL,1,5,0.1); \]
\[ PTI_{LWLV} = TI_{LWLV} * XVAL; \]
\[ PTI_{MWLV} = TI_{MWLV} * XVAL; \]
\[ PTI_{HWLV} = TI_{HWLV} * XVAL; \]
\[ PTI_{LMV} = TI_{LMV} * XVAL; \]
\[ PTI_{MMV} = TI_{MMV} * XVAL; \]
\[ PTI_{HWM} = TI_{HWM} * XVAL; \]
\[ PTI_{LWH} = TI_{LWH} * XVAL; \]
\[ PTI_{MMWH} = TI_{MMWH} * XVAL; \]
\[ PTI_{HWH} = TI_{HWH} * XVAL; \]

\[ PLOT: \]
\[ TYPE = plot2; \]
\[ OUTPUT: \]
\[ STAND CINT(bcbootstrap); \]