

MULTISTEP APPROACHES WITH MIXTURE MODELING

The AUXILIARY option is used in conjunction with TYPE=MIXTURE to provide automatic estimation of the 3-step and BCH approaches to multistep mixture modeling. The automatic approach can be used in conjunction with TYPE=IMPUTATION. It is not allowed for models with more than one categorical latent variable or for models for which numerical integration is required. These models must use the manual approach (Asparouhov & Muthén, 2014, 2021, Web Talk 8).

The AUXILIARY option has six settings. One is for covariates used in the multinomial logistic regression for the categorical latent variable. The other five are for testing the differences between the means or probabilities of distal outcomes across classes.

The setting for covariates is R3STEP (Vermunt, 2010; Asparouhov & Muthén, 2014). It is used to identify a set of variables not used in the first step of the analysis that is used in the last step as covariates in a multinomial logistic regression for a categorical latent variable. The multinomial logistic regression uses all covariates jointly. Confidence intervals are given for the odds ratio of each covariate.

Of the five settings for distal outcomes, three use the 3-step method and two use the BCH method. A set of variables, often distal outcomes, not used in the first step of the analysis are identified. For continuous variables, the equality of means across classes is tested. For categorical variables, the equality of probabilities across classes is tested. These tests are done one variable at a time. Odds ratios are also provided for categorical variables. More than one of these five settings can be used in a single analysis.

The 3-step settings are D3STEP, DU3STEP, and D3STEP. D3STEP (Asparouhov & Muthén, 2014) tests the equality of means for continuous variables across classes with the variances equal across classes. DU3STEP (Asparouhov & Muthén, 2014) tests the equality of means for continuous variables across classes with the variances unequal across classes. D3STEP tests the equality of probabilities for categorical variables across classes. Odds ratios are also provided.

The BCH settings are BCH and BCHC. BCH (Vermunt, 2010; Bakk & Vermunt, 2016) tests the equality of means for continuous variables across classes with the variances equal across classes. BCHC tests the equality of probabilities for categorical variables across classes. Odds ratios are also provided.

All of the settings are specified in the same way. The setting in parentheses is placed behind each variable or list of variables on the AUXILIARY statement. Alternatively, the

setting in parentheses can come first followed by variables and lists of variables. All of the variables on the AUXILIARY statement will be saved if the SAVEDATA command is used and will be available for plots if the PLOT command is used.

Following is an example of how to specify the R3STEP setting:

```
AUXILIARY = race (R3STEP) ses (R3STEP) x1-x5 (R3STEP);
```

where race, ses, x1, x2, x3, x4, and x5 will be used as covariates in a multinomial logistic regression.

An alternative specification is:

```
AUXILIARY = (R3STEP) race ses x1-x5;
```

where all variables and lists of variables after (R3STEP) will be used as covariates in a multinomial logistic regression. This is convenient when there are several variables that cannot be specified using the list function.

Following is an example of how to specify the settings for testing the equality of means and probabilities across classes. It is possible to use more than one of these settings in the same AUXILIARY statement:

```
AUXILIARY = abuse (BCH) dropout (BCHC) y1-y5 (D3STEP);
```

where the equality of the means of abuse, the probabilities of dropout, and the means of y1, y2, y3, y4, and y5 will be tested across classes.