This module will demonstrate how to use two packages for fitting structural equation models: lavaan and OpenMx. The model syntax used in lavaan is simpler than OpenMx and handles some aspects of model fitting automatically. OpenMx model syntax is more verbose than lavaan, but also more flexible. OpenMx also has great capabilities for working with ordinal outcome data. OpenMx supports model specification by path specification or matrix algebra; this demonstration will use path specification. **Line 28** installs the packages that are used in this demonstration.

**Lines 37 to 54** provide a reminder about how to set your working directory and read in data. Variable and value labels for the items that are used in the demonstration follow on **lines 58 to 110**. We generate a dataframe that only includes the variables of interest at **lines 120-122**. Data cleaning procedures follow on **lines 124 to 153**.

**Lines 157 to 233** demonstrate how to use lavaan to fit a model that tests if educational attainment, a proxy for socioeconomic status, predicts food insecurity and if food insecurity and educational attainment predict self-reported health. **Lines 174 to 181** include the lavaan model syntax. The measurement model for latent food insecurity is defined at **line 176**. The regression paths in the model are defined at **lines 179 to 180**.

[SCROLL TO 182]

**Lines 184 to 186** fit the specified model. **Line 185** specifies that the model should be fit by full information maximum likelihood. A summary of the model is generated at **line 188** and standardized results are extracted at **line 189.** Fit statistics for the model are calculated at **line 193.** The results are exported at **lines 197 to 207** using stargazer.

[SCROLL TO 209]

A path diagram is generated using the semPlot package at **lines 213 to 219.** The plot is displayed in the Plots window in the lower right. We can see that our measurement model for food insecurity performs reasonably well, with standardized loadings greater than 0.8. Educational attainment is associated with less food insecurity and greater self-reported health. Food insecurity is associated with lower self-reported health.

**Lines 237 to 442** demonstrate how to use OpenMx to fit this same model. **Lines 246 to 253** define 2 objects that group the names of the variables that are included in the model. These will save some space later on in the script.

[SCROLL TO 255]

Models in OpenMx can be built by specifying a series of single and double-headed arrows using the MxPath() function. Single-headed arrows indicate a directional relationship. Double-headed arrows indicate a non-directional relationship.

This format for model specification has its roots in a system of path tracing rules that can be used to infer variances and covariances based on path coefficients. More information about these rules can be found at the link on **line 266**.

As an example, the mxPath at **lines 271 to 276** builds a single-headed arrow from food insecurity to self-reported health.

[SCROLL TO 278]

As an example, the mxPath at **lines 279 to 283** builds a series of double-headed arrow from each observed variable to itself, specifying the variances of these variables.

[SCROLL TO 286]

The full model syntax for this analysis can be found at **lines 287 to 345**. **Lines 293 to 298** specifythe means of the observed variables as free parameters**. Lines 300-305** fix the latent mean of food insecurity to 0, mirroring the identifying constraints used by lavaan.

[SCROLL TO 307]

**Lines 308 to 318** specify observed and latent variances as free parameters. The measurement model for food insecurity is defined at **lines 321 to 326**. Note that the first factor loading is fixed to 1 at **lines 324 to 325**, mirroring the identifying constraints used by lavaan.

[SCROLL TO 328]

**Lines 329 to 341** specify the directional regression paths in the model. **Line 344** identifies the source of data and **Line 345** indicates that the input object is raw data rather than a covariance matrix.

[SCROLL TO 347]

**Line 349** fits the specified model. A summary of the model is generated at **line 351** and standardized results are extracted at **line 352.** Fit statistics for the model are calculated at **lines 357 to 358.** The step of calculating a saturated reference model is implicit when calculating fit statistics in lavaan.

[SCROLL TO 360]

The results are exported at **lines 362 to 379** using stargazer.

[SCROLL TO 381]

A path diagram is generated using the semPlot package at **lines 382 to 389.**

[SCROLL TO 399]

**Lines 400 to 409** generate likelihood-based confidence intervals for the standardized estimates for the model. This code is included in the package documentation for OpenMx and can be adapted by changing the model name (OpenMxModel) at **lines 400, 401, 405, 407, and 409.**

[SCROLL TO 420]

**Line 421** extracts the likelihood-based confidence intervals. By default, these estimates are labeled by the position in the Az and Sz matrices. **Lines 426 to 433** apply more descriptive names to the table. **Line 435** removes rows from the table where likelihood-based confidence intervals were not estimated. **Lines 438 to 442** export the table using stargazer.