LISREL 9.30 for Windows (free upgrade from 9.10 and 9.20) release notes

NEW FEATURES IN LISREL 9

Introduction

Structural equation modeling (SEM) was introduced initially as a way of analyzing a covariance or correlation matrix. Typically, one would read this matrix into LISREL and estimate the model by maximum likelihood. If raw data was available without missing values, one could also use PRELIS first to estimate an asymptotic covariance matrix to obtain robust estimates of standard errors and chi-squares.

Modern structural equation modeling is based on raw data. With LISREL 9, if raw data is available in a LISREL data system file or in a text file, one can read the data into LISREL and formulate the model using either SIMPLIS syntax or LISREL syntax and, if requested, LISREL 9 will automatically perform robust estimation of standard errors and chi-square goodness of fit measures under non-normality. If the data contain missing values, LISREL 9 will automatically use FIML to estimate the model. Alternatively, users may choose to impute the missing values by EM or MCMC and estimate the model based on the imputed data. Several new sections of the output are also included.

The examples located in **C:\LISREL Examples\LS9EX** illustrate these new features.

The following is a list of additional new features in LISREL 9:

- o Full information maximum likelihood Structural Equation Modeling for a mixture of ordinal and continuous variables for simple random samples and complex survey data. This method is based on adaptive quadrature and there is a choice of any one of four link functions: Logit, Probit, Complementary Log-Log and Log-Log.
  Examples to illustrate this feature are available in the **ORFIMLEX** and **LS9EX** folders.

- o Three-level Multilevel Generalized Linear Models using adaptive quadrature.
  Examples to illustrate these new features are available in the **MGLIMEX** folder.

- o Five-level Multilevel Linear Models for continuous outcome variables.
  Examples are available in the **MLEVELEX** folder.

- All LISREL syntax files have extension **.lis** (previously **.ls8**), while all PRELIS syntax files have extension **.prl** (previously **.pr2**). The LISREL spreadsheet has been renamed LISREL data system file and has extension **.lsf** (previously **.psf**)

- To ensure backwards compatibility, users can still run previously created syntax files using a **.psf** file.

- Any one of the statistical applications can be run in batch mode by using a .bat file with the following script.

  "c:\program files (x86)\LISREL93(x64)\x64\MLISREL64_9" <application name> <syntax file> <output file>
  where <application name> is LISREL, PRELIS, MULTILEV, MAPGLIM or SURVEYGLIM, <syntax file> denotes the name of the syntax file, and <output file> denotes the name of the output file.

Examples of batch files are contained in the **LS9EX** folder

Documentation

The following user guides are available the Help menu of the application.
- New features in LISREL 9
- The LISREL Graphical User's Interface (GUI)
- PRELIS Examples Guide
- LISREL Examples Guide
- Multilevel (Hierarchical Linear) Modeling Guide
- Complex Survey Sampling
- Generalized Linear Modeling Guide
- Multilevel Generalized Linear Modeling Guide
- LISREL Syntax Guide
- SIMPLIS Syntax Guide
- PRELIS Syntax Guide
- Additional Topics Guide

Documentation of the LISREL graphical user's interface is also available in the Help file. The Help file has features that simplify navigation across topics.

Examples

The syntax and data files for the examples are installed in **C:\Lisrel Examples**.

NEW FEATURES IN LISREL 9.30

- o **Fixes to all bugs** reported by users of LISREL 9.10 and 9.20
- o **Exploratory Factor Analysis of ordinal data using PRELIS**
  This module has been extended to work with many variables and factors. A chi-square and an RMSEA measure of fit are also provided.
- o **Structural Equation Modeling:**
  If an LSF file is read in, then moment matrices are based on the definitions of the variables contained in the LSF file. For example, if all variables are declared ordinal, then a matrix of sample polychoric covariance or correlation coefficients will be computed instead of product moment coefficients.
- o **Robust Fit Statistics** are now available for multiple groups and the output file contains additional summary statistics for each variable selected. Below is sections of the output from an example:

```
gendera.OUT                                                          □ ▣ ✖

  RESULTS ARE FOR GROUP:    1

  Total Sample Size (N) =   1250

  Univariate Summary Statistics for Continuous Variables

  Variable     Mean  St. Dev.  Skewness  Kurtosis  Minimum Freq.  Maximum Freq.
  --------     ----  --------  --------  --------  ------- -----  ------- -----
   visperc    0.618     6.429    -0.009     0.438  -22.383     1   22.416     1
     cubes    0.042     4.162     0.176     0.731  -13.808     1   20.084     1
  lozenges   -0.098     7.769    -0.098     0.479  -31.082     1   24.903     1
  paragraf    0.047     2.866     0.111     0.020   -8.247     1    9.692     1
   sentenc   -0.151     3.838    -0.064     0.257  -14.326     1   12.288     1
  wordmean    0.060     7.343    -0.012     0.093  -29.309     1   25.975     1

  Test of Univariate Normality for Continuous Variables

                 Skewness           Kurtosis       Skewness and Kurtosis

  Variable Z-Score P-Value   Z-Score P-Value   Chi-Square P-Value

   visperc -0.134   0.893     3.166   0.002      10.042    0.007
     cubes  2.533   0.011     5.283   0.000      34.327    0.000
  lozenges -1.412   0.158     3.461   0.001      13.973    0.001
  paragraf  1.601   0.109     0.148   0.883       2.585    0.275
   sentenc -0.928   0.353     1.859   0.063       4.317    0.116
  wordmean -0.172   0.863     0.674   0.501       0.483    0.785
```

```
gendera.OUT                                                    [ _ ][ □ ][ ✕ ]

                    Global Goodness-of-Fit Statistics

Degrees of Freedom for (C1)-(C3)                      16
Maximum Likelihood Ratio Chi-Square (C1)              39.801 (P = 0.0008)
Browne's (1984) ADF Chi-Square (C2_NT)               40.197 (P = 0.0007)
Browne's (1984) ADF Chi-Square (C2_NNT)              42.278 (P = 0.0004)
Satorra-Bentler (1988) Scaled Chi-Square (C3)        39.892 (P = 0.0008)
Satorra-Bentler (1988) Adjusted Chi-Square (C4)      38.869 (P = 0.0000)
Degrees of Freedom for C4                             7.795

Estimated Non-centrality Parameter (NCP)             23.801
90 Percent Confidence Interval for NCP               (8.962 ; 46.317)

Minimum Fit Function Value                            0.0159
Population Discrepancy Function Value (F0)            0.00952
90 Percent Confidence Interval for F0                (0.00359 ; 0.0185)
Root Mean Square Error of Approximation (RMSEA)      0.0345
90 Percent Confidence Interval for RMSEA             (0.0212 ; 0.0481)
P-Value for Test of Close Fit (RMSEA < 0.05)         0.970
```

- **Generalized linear modeling:**
  Following the results for the unit-specific model estimates, the population average estimates are now also produced for count and categorical outcome variables. LISREL 9.30 additionally includes Zero inflated Poisson and Negative Binomial models.

MVABOOK examples

These examples are based on a new book: "Multivariate Analysis with LISREL" authored by Karl G Jöreskog, Ulf H. Olsson & Fan Y. Wallentin (2017).

The book is published by Springer-Verlag and is available both as a hardcover book and as an e-book at http://www.springer.com/us/book/9783319331522.

This book can be used by Master and PhD students and researchers in the economic, social, behavioral, and many other sciences that need to have a basic understanding of multivariate statistical theory and methods for their analysis of multivariate data.

It can also be used as a text book for courses on multivariate statistical analysis. All examples are listed in the Table of Contents. All the syntax and data files for these examples are distributed with LISREL 9.30 and are located in
LISREL Examples\MVABOOK\CHAPTER1
LISREL Examples\MVABOOK\CHAPTER2
LISREL Examples\MVABOOK\CHAPTER3
LISREL Examples\MVABOOK\CHAPTER4
LISREL Examples\MVABOOK\CHAPTER5