Brief Guide to Use of LISREL 8.50
for Confirmatory Factor Analysis

LISREL is a versatile and powerful program for fitting structural equation models and multilevel models to observed data. Since confirmatory factor analysis (CFA) is a special case of structural equation modeling, LISREL can be used easily for such analyses.

When using LISREL it is almost always the case that there are a great many ways to carry out a given analysis. The following introduction describes one simple method for doing CFA in LISREL. If you wish to make more extensive use of LISREL you are strongly urged to obtain and study the LISREL Users Guide.

Constructing a Data File

The data file should be a text file. If you are typing the file it is simplest to use Notepad. If the input data is a correlation or covariance matrix it is necessary to enter only the lower triangular portion of the matrix, including the diagonal.

For example, the data file for the Holzinger example would have the following form:

```
1.00
.75 1.00
.78 .72 1.00
.44 .52 .47 1.00
.45 .53 .48 .82 1.00
.51 .58 .54 .82 .74 1.00
.21 .23 .28 .33 .37 .35 1.00
.30 .32 .37 .33 .36 .38 .45 1.00
.31 .30 .37 .31 .36 .38 .52 .67 1.00
```

This file should then be named and saved by usual methods.

Constructing a LISREL Syntax File

Open LISREL and click FILE and NEW.

Within the window that appears you can type a LISREL syntax file. This file will provide all instructions to LISREL regarding the input data, the model, and the desired output.

LISREL syntax uses 2-letter keywords to specify options and information for the program.

An input file for a CFA model can be constructed as follows:

1) Title statement: Any desired title to identify the analysis being run.

2) DATA statement: This statement specifies the number of measured variables, number of observations, and type of matrix to be analyzed. (Note that the type of matrix to be analyzed is not necessarily the same as the type of matrix to be input. For example, one may input raw data and analyze a correlation matrix.)

The DATA statement has the following form:

DA NI=*number of input measured variables* NO= *number of observations* MA= *type of matrix to be analyzed*

For MA=, the usual options are KM for correlation matrix or CM for covariance matrix.

3) LABELS for measured variables: This statement (optional) allows you to insert names for your measured variables. The statement has the following form:

LA

Beginning on the following line type labels for the MVs in order. Each label should be no more than 8 characters in length. Continue this list until the proper number of labels has been provided.

4) Identify the type of matrix to be input along with file name and path. The most typical form of this statement will be:

KM FI= *filename*

which indicates that a correlation matrix (KM) will be input.

5) The next series of statements specifies the model. This process begins with a MODEL statement (MO). The MO statement includes the following keywords and specifications:

NX= *number of measured variables in the model (number of x variables)*

NK= *number of common factors (number of ksi (ξ) variables)*

Next on the MO statement the user supplies an overall specification of the form of each of the three parameter matrices. The three matrices are designated LX for the factor loading matrix (Λ_x), PH for the matrix of intercorrelations among the factors (Φ), and TD for the (usually diagonal) matrix of unique factor variances and covariances (Θ_δ).

A typical specification of these three matrices for CFA would look as follows:

LX=FU,FI PH=SY,FR TD=DI,FR

This statement tells LISREL that LX is defined initially as a full matrix (FU) with all elements fixed (FI). PH is defined as a symmetric matrix (SY) with all elements free (FR). TD is defined as a diagonal matrix (DI) with those diagonal elements free (FR).

To summarize, the MO statement could have the following form for CFA:

MO NX=___ NK=___ LX=FU,FI PH=SY,FR TD=DI,FR

Following the MO statement it is almost always necessary to alter the overall initial definition of each matrix by changing the fixed v. free specification of elements within matrices.

To specify particular elements within each matrix as free or fixed we use FREE and FIX statements.

To illustrate, note that LX in the MO statement above is specified such that all elements are fixed (at zero). To revise this specification so that some elements of LX are free parameters we use a FREE statement. For example, if we wish for elements in LX in rows 1, 2, and 3 of column 1 to be free parameters we would use the FREE statement as follows:

FR LX 1 1 LX 2 1 LX 3 1

We often also need to specify certain elements of a matrix as fixed. For example, if we wished to specify that the factors were orthogonal we would need to fix the off-diagonal elements of PH to zero, whereas in the MO statement PH was specified to have free parameters in the off-diagonal positions. To accomplish this change we would use a FIX statement as follows:

FI PH 2 1 PH 3 1 PH 3 2

We also often wish to specify some parameters as being fixed at some value other than zero. Such a specification requires use of a VALUE statement applied to fixed parameters. For example to set the diagonal elements of PH to 1.0 we would first need to designate those elements as fixed, then use the VALUE statement to set them to 1.0. The form of the VALUE statement is VA followed by a numerical value, followed by a list of parameters to be set to that value:

FI PH 1 1 PH 2 2 PH 3 3
VA 1.0 PH 1 1 PH 2 2 PH 3 3

In some models we may wish to constrain certain parameters to be equal to each other. For example, we may wish to constrain selected factor loadings to be equal. We can do this using an EQ statement followed by a list of free parameters to be constrained equal. For example:

EQ LX 1 1 LX 2 1 LX 3 1

By using FR, FI, VA and EQ statements in conjunction with the matrix specifications on the MO statement we are able to specify the status of all elements of our parameter matrices.

6) After model specification is completed we may provide labels for the latent variables using the LK statement:

LK
List of names for factors

7) Path Diagram: Specify PD to obtain path diagram output from LISREL.

8) OUTPUT statement: The final line of the syntax file is the OU statement followed by a series of keywords specifying the desired output. For conventional CFA applications the following are often of interest:

ME= *discrepancy function to be used for parameter estimation. Common choices are* ML *for maximum likelihood (default) and* UL *for unweighted (ordinary) least squares. At least 5 other options are available.*

SE: standard errors for parameter estimates
TV: t-values for testing significance of parameter estimates
RS: residuals
ND=3: specifies that results should be printed using 3 decimal places

A typical OU statement for CFA using ML estimation would then have the form:

OU SE TV RS ND=3

We will also study the use of modification indices which are obtained using the MI keyword on the OU statement.

Example of LISREL Syntax File

Following is an example of a LISREL syntax file for the Holzinger data, fitting a 3 factor model as specified in the course notes.

```
HOLZINGER THREE FACTOR MODEL

DA NI=9 NO=696 MA=KM

LA

WORDMN SENTCMP ODDWORDS MXDARIT REMNDRS

MISSNUM GLOVES BOOTS HATCHETS

KM FI='C:\LISREL850\PSYC236\HOLZCORR.TXT'

MO NX=9 NK=3 LX=FU,FI PH=SY,FR TD=DI,FR

FR LX 1 1 LX 2 1 LX 3 1

FR LX 4 2 LX 5 2 LX 6 2

FR LX 7 3 LX 8 3 LX 9 3

FI PH 1 1 PH 2 2 PH 3 3

VA 1.0 PH 1 1 PH 2 2 PH 3 3

LK

WORDFLN NUMFACIL SPATREL

PD

OU SE TV RS ND=3
```

After the syntax file is prepared it should be saved for future use. An extension .LS8 is applied automatically by the program.

Running LISREL

After the data file and syntax file are prepared the user can execute the LISREL analysis by clicking on the "run LISREL" button near the top of the LISREL window.

Results are provided in two windows, a path diagram and an output file.