Multilevel confirmatory factor analysis

Contents

1 Introduction

This example illustrates

- o importing of external data such as SPSS *.**sav** files
- o drawing a multiple-group path diagram
- o building SIMPLIS/LISREL syntax from a path diagram
- o fitting a multilevel structural equations model to the data

The data set used in this example forms part of the data library of the Multilevel Project at the University of London, and comes from the Junior School Project (Mortimore et al, 1988). Mathematics and language tests were administered in three consecutive years to more than 1000 students from 50 primary schools, which were randomly selected from primary schools maintained by the Inner London Education Authority. The data set is stored as an SPSS for Windows file named **jsp2.sav**.

It is convenient to work with LISREL system data files (***.lsf**) since LISREL can read the variable names, the number of variables, the number of records and other relevant information directly from these files. It is therefore advantageous to convert files from other software packages to the ***.lsf** format.

2 Import of External Data

Use the **Import External Data in Other Formats** option from the **File** menu to obtain the **Input Database** dialog box. Select SPSS for Windows (***.sav**) from the **Files of type** drop-down menu list and select **jsp2.sav**. Click **Open** to obtain the **Save As** dialog box.

Enter the name **jsp2.lsf** in the **File name** string field. By clicking the **Save** button a LISREL system data file is created and displayed in the form of a data spreadsheet.

Although no missing value codes were assigned in **jsp2.sav**, data values of -9 indicate missing values and can be defined as such by selecting the **Define Variables** option from the **Data** menu.

Click on MATH1 (or any other variable) to select it. Click **Missing Values** to obtain the **Missing Values** dialog box. Enter the value -9.0 in the **Global Missing Value** edit box and change the method of deletion from listwise to pairwise. The pairwise option ensures that recoding and computing of variables do not change the number of cases.
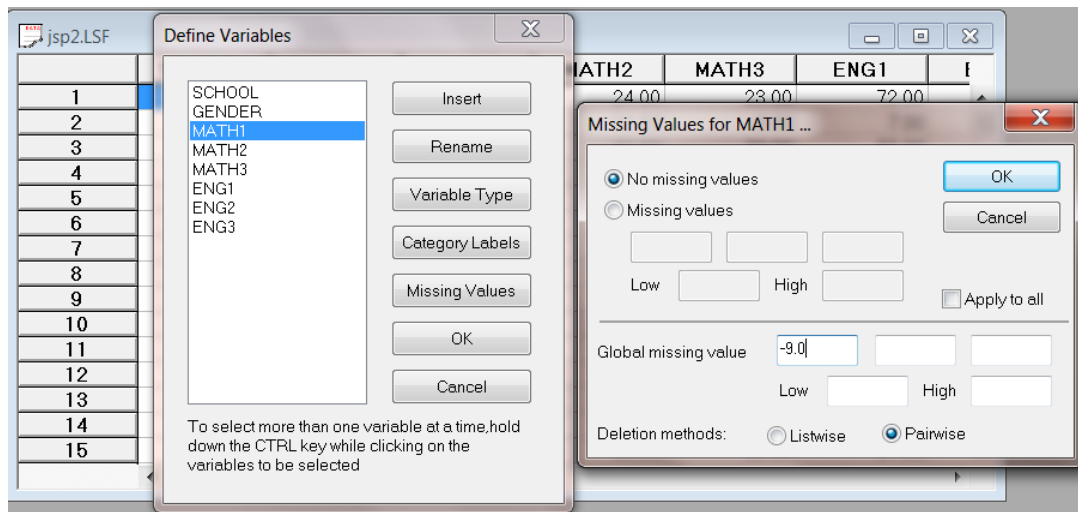

3 Draw the Path Diagram

Click the **OK** buttons of the **Missing Values** and **Define Variables** dialog boxes to return to the main window. Use the **Save** option from the **File** menu to save the changes to **jsp2.lsf**. Use the **New** option from the **File** menu to open the **New** dialog box and select the **Path Diagram** option from the **New** dialog box and assign a file name, for example, **msemex.pth**. By clicking the **Save** button, the path diagram window appears.

Select the **Title and Comments** option from the **Setup** menu to open the **Title and Comments** dialog box. Enter the title Multilevel CFA model for Numeric and Verbal Ability in the **Title** string field to produce the following **Title and Comments** dialog box.
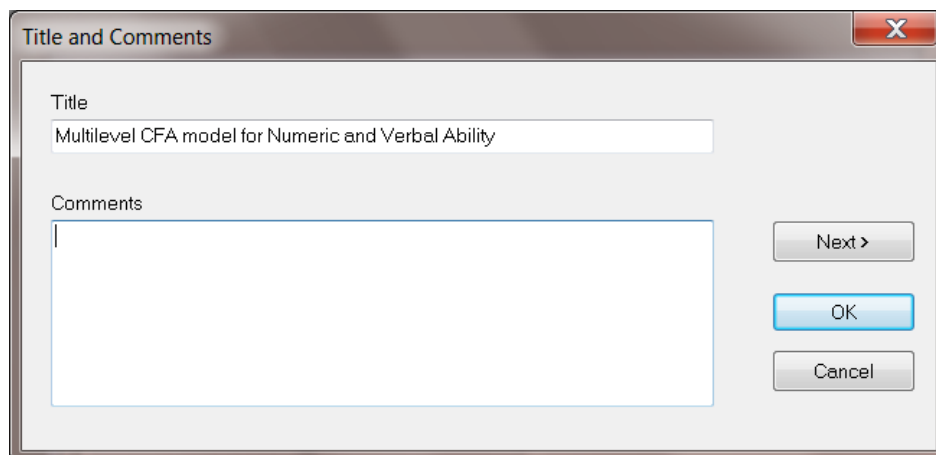
Click **Next** to open the **Groups** dialog box. Enter the label Group1: Between Schools in the first string field. Use the down arrow key to create a string field for the second group. Enter the label Group2: Within Schools in the second string field to produce the following **Groups** dialog box.
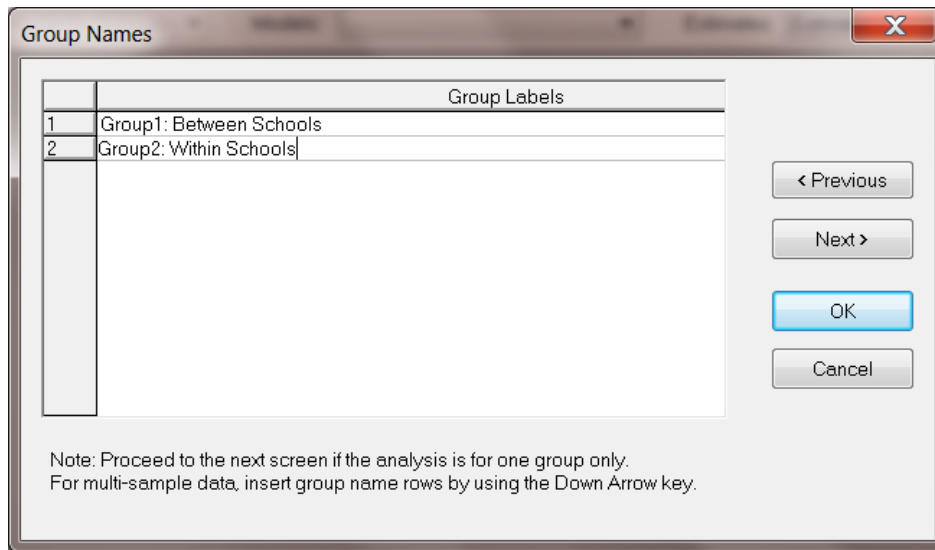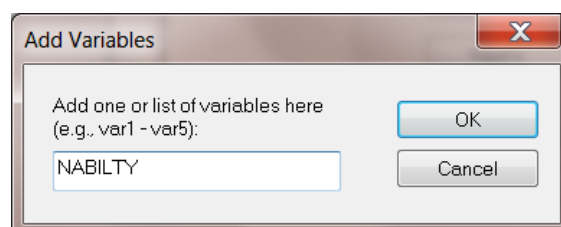

Click **Next** to proceed to the **Labels** dialog box. Since the observed variables are stored in the file **jsp2.lsf**, it is convenient to read the variable names from this file. Click **Add/Read Variables** to open the **Add/Read Variables** dialog box. Select the **LISREL System File** option from the **Read from file** drop-down list box.

Use the **Browse** button to select the file **jsp2.lsf** to produce the following **Add/Read Variables** dialog box. Click **OK** to return to the **Labels** dialog box.
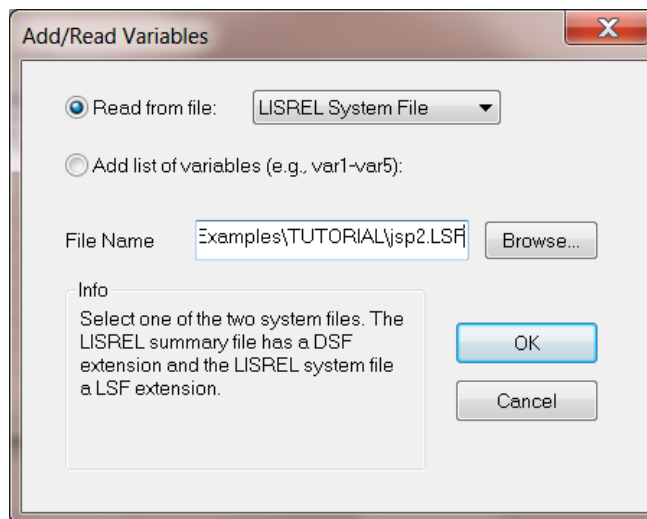
Click **Add Latent Variables** to open the **Latent Variables** dialog box. Enter the label NABILITY for Numeric Ability to produce the following dialog box.

Click **OK**. Repeat the process to enter the label VABILITY for Verbal Ability. Click **OK** to produce the following **Labels** dialog box.
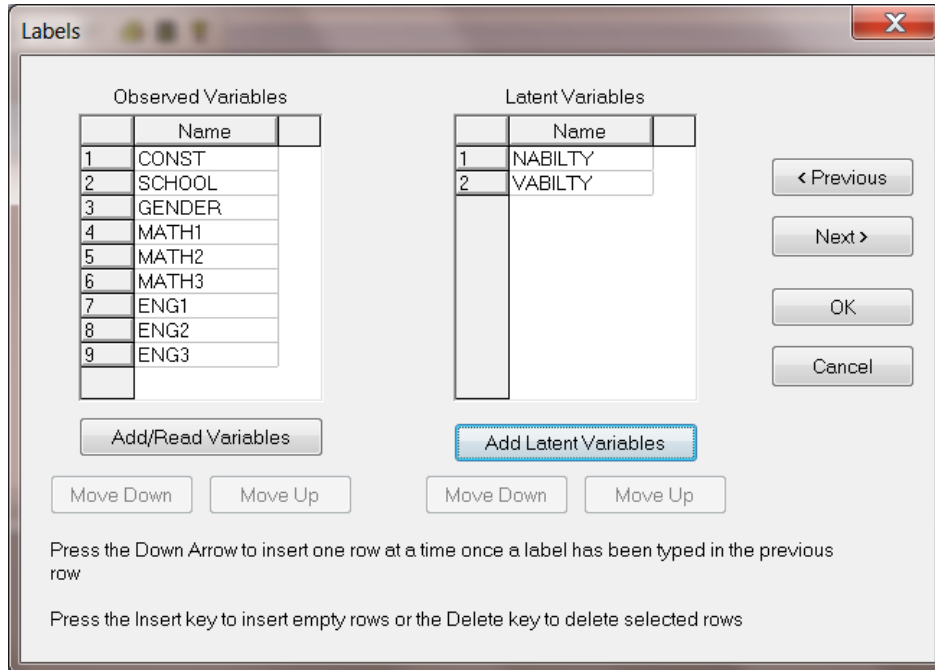

Click **OK** to return to the path diagram window. Click and drag the observed variables MATH1, MATH2, MATH3, ENG1, ENG2 and ENG3 one by one into the path diagram window. Also click and drag the latent variables NABILITY and VABILITY one by one into the path diagram window to produce the following display.

Use the one-directional arrow on the **Draw** toolbar to insert paths from NABILITY to MATH1, MATH2 and MATH3 and also to insert paths from VABILITY to ENG1, ENG2 and ENG3 as shown below.
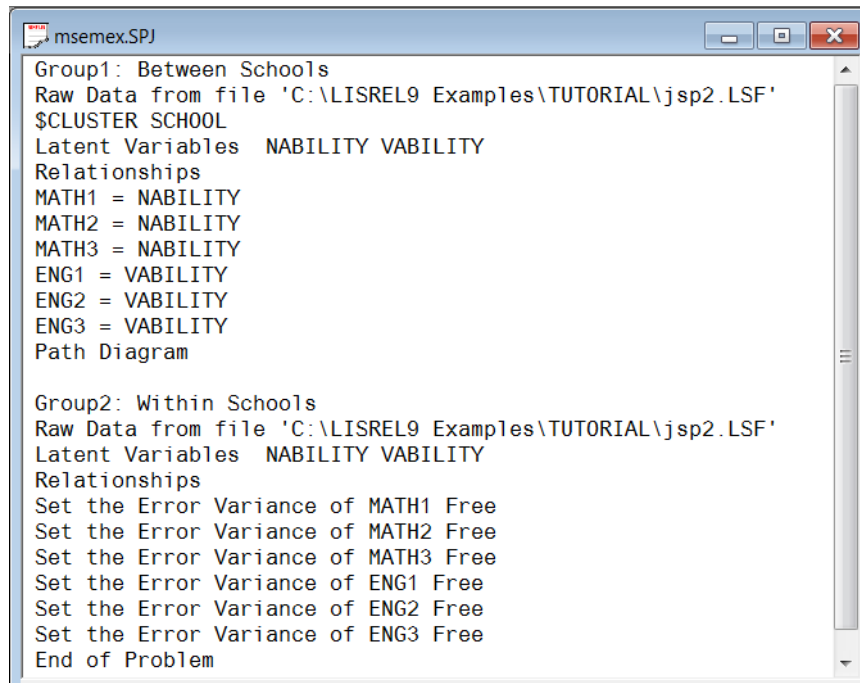
Note:

Once this arrow is selected, move the mouse to within an ellipse representing a latent variable. With the left mouse button down, drag the arrow to an observed variable. Release the mouse button when the arrow is in the rectangle representing the observed variable.
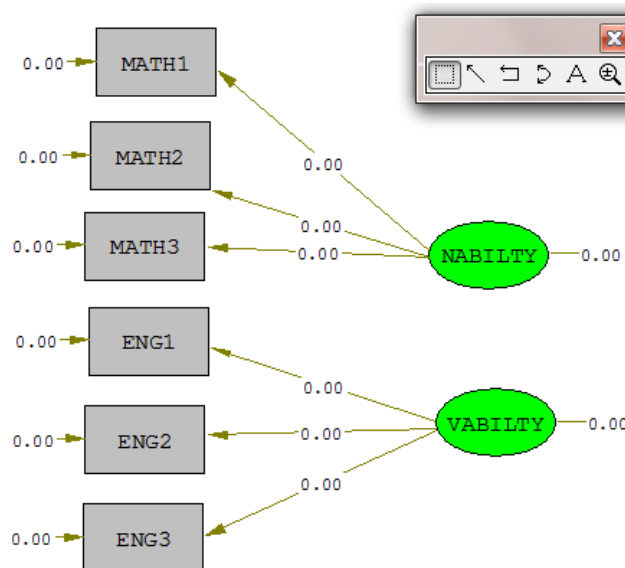
4 Build SIMPLIS/LISREL Syntax

Select the **Build SIMPLIS Syntax** option from the **Setup** menu to produce the text editor window shown overleaf. Insert the command line $CLUSTER SCHOOL after the Raw Data from File command:
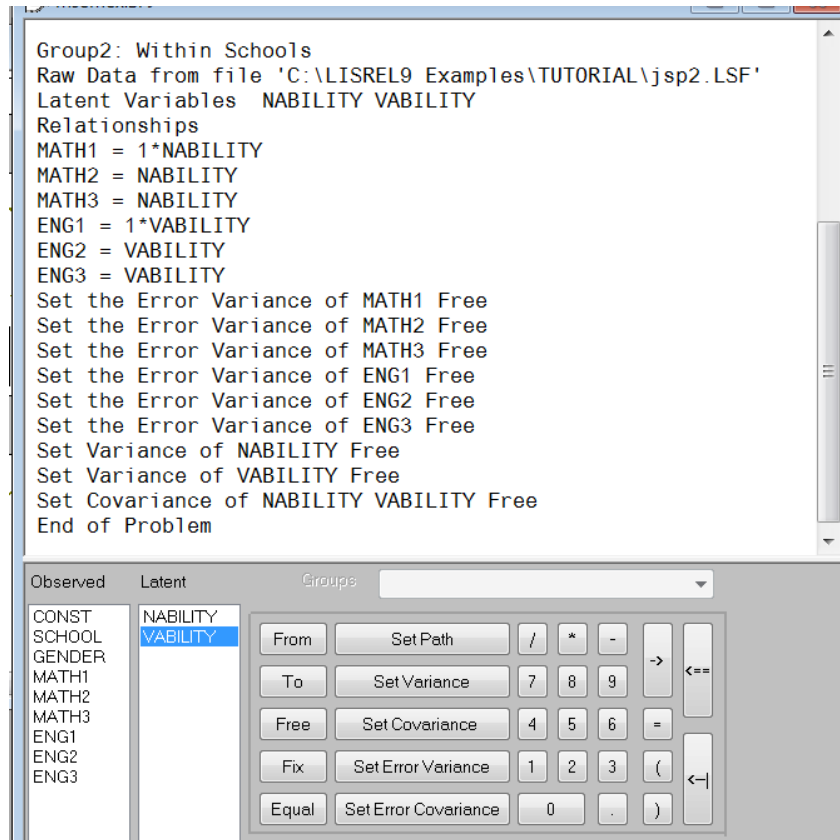
```
msemex.SPJ

Group1: Between Schools
Raw Data from file 'C:\LISREL9 Examples\TUTORIAL\jsp2.LSF'
$CLUSTER SCHOOL
Latent Variables  NABILITY VABILITY
Relationships
MATH1 = NABILITY
MATH2 = NABILITY
MATH3 = NABILITY
ENG1 = VABILITY
ENG2 = VABILITY
ENG3 = VABILITY
Path Diagram

Group2: Within Schools
Raw Data from file 'C:\LISREL9 Examples\TUTORIAL\jsp2.LSF'
Latent Variables  NABILITY VABILITY
Relationships
Set the Error Variance of MATH1 Free
Set the Error Variance of MATH2 Free
Set the Error Variance of MATH3 Free
Set the Error Variance of ENG1 Free
Set the Error Variance of ENG2 Free
Set the Error Variance of ENG3 Free
End of Problem
```

Change the command line MATH1=NABILITY to MATH1=1*NABILITY to set the scale of NABILITY. Change the command line ENG1=VABILITY to ENG1=1*VABILITY to set the scale of VABILITY. Copy and paste the relationships of the Between Schools group to the Relationships paragraph of the Within Schools group.

In the Relationships paragraph of the Within Schools group, insert the following SIMPLIS commands

Set Variance of NABILITY Free
Set Variance of VABILITY Free
Set Covariance NABILITY VABILITY Free

```
Group2: Within Schools
Raw Data from file 'C:\LISREL9 Examples\TUTORIAL\jsp2.LSF'
Latent Variables  NABILITY VABILITY
Relationships
MATH1 = 1*NABILITY
MATH2 = NABILITY
MATH3 = NABILITY
ENG1 = 1*VABILITY
ENG2 = VABILITY
ENG3 = VABILITY
Set the Error Variance of MATH1 Free
Set the Error Variance of MATH2 Free
Set the Error Variance of MATH3 Free
Set the Error Variance of ENG1 Free
Set the Error Variance of ENG2 Free
Set the Error Variance of ENG3 Free
Set Variance of NABILITY Free
Set Variance of VABILITY Free
Set Covariance of NABILITY VABILITY Free
End of Problem
```

5 Fit the Model to the Data

Click the **Run LISREL** icon button on the main toolbar to produce the path diagram for the between schools group
shown below:
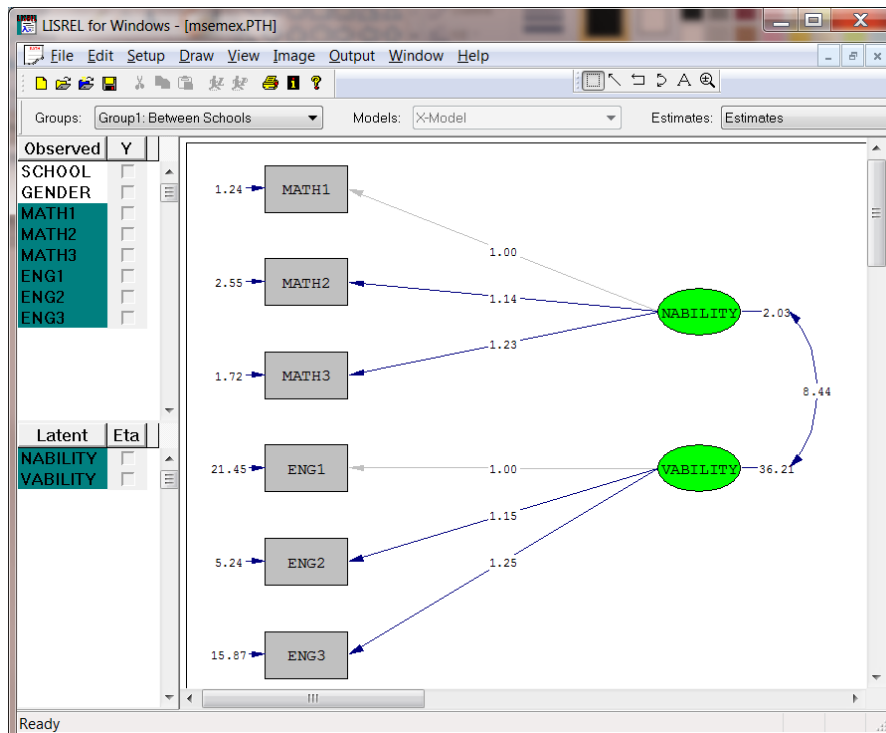
LISREL produces an output file, **msemex.out** which contains the results of the analysis. See the **Additional Topics Guide** for more information on multilevel structural equation models.