

## Single-Group Analysis with Missing Data

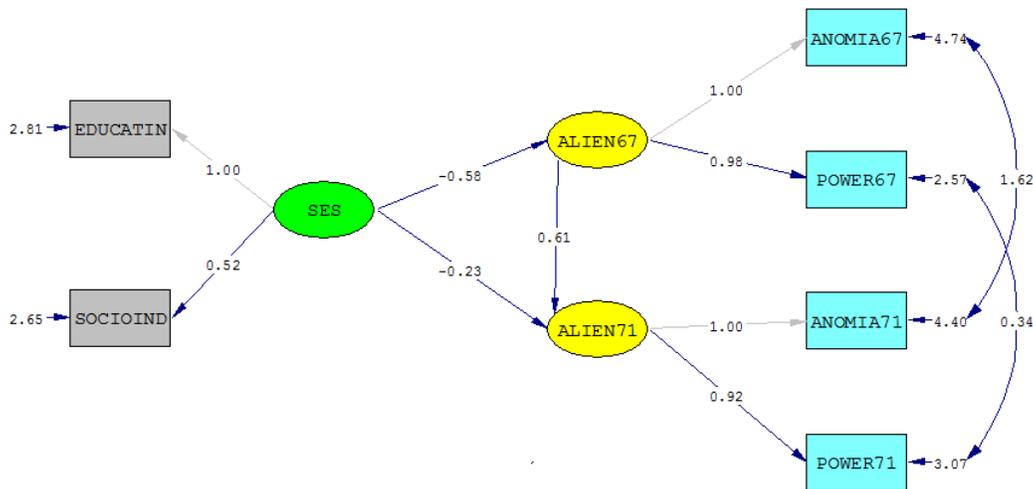
Data on attitude scales were collected from 932 persons in two rural regions in Illinois at three points in time: 1966, 1967 and 1971. The variables used for the present example are the Anomia subscale and the Powerlessness subscale, taken to be indicators of Alienation. This example uses data from 1967 and 1971 only.

The background variables are the respondent's education (years of schooling completed) and Duncan's Socioeconomic Index (SEI). These are taken to be indicators of the respondent's socioeconomic status (SES).

**Observed Variables:** Anomia 67, Powerlessness 67, Anomia 71, Powerlessness 71, Education, SEI

**Latent Variables:** SES, Alienation 67, Alienation 71

The model shown in the path diagram below was fitted by running **ex64d.lis** (in the **LISREL examples** folder).



Chi-Square=4.72, df=4, P-value=0.31731, RMSEA=0.014

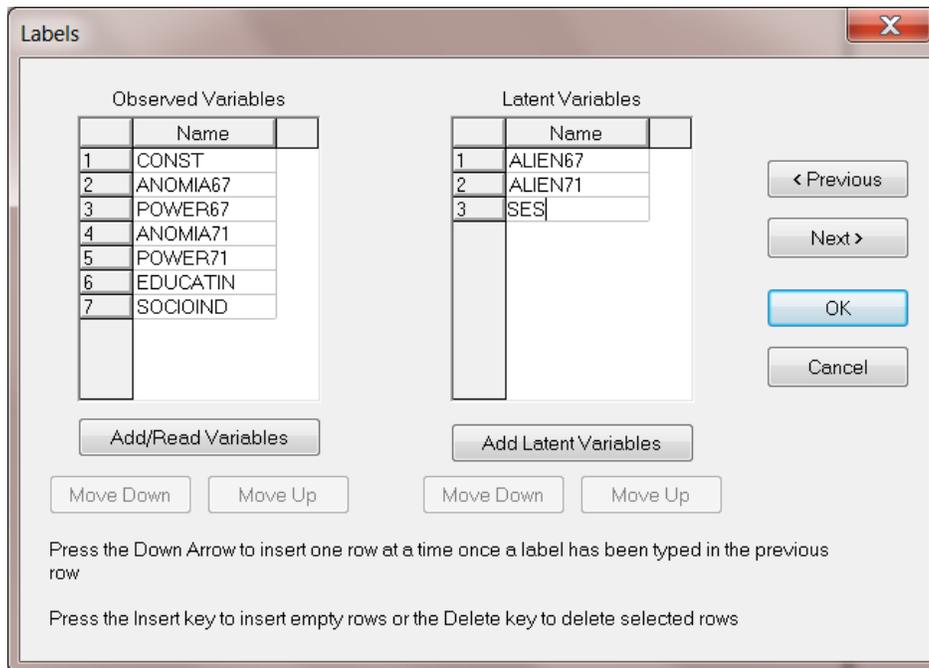
By adding **SI=filename** to the **OU** line of the syntax file, the fitted covariance matrix may be saved to an external file.

Subsequently, a data set of size 1500, with 15% of the values missing at random, was simulated by regarding the fitted covariance matrix as the true population covariance matrix. This data set is stored as the text file **wmas.dat**. A corresponding **\*.Isf** file, containing the variable names, missing value code, number of records and the data is stored as **wmas.Isf**. Select **File, New, Path Diagram** and save the path. In the dialog box below, we used the name **sgroup.pth**.

Click **Save** when done and select the **Title and Options** option from the **Setup** menu. Enter a title and optional comments. Click **Next** to proceed to the **Group Names** dialog box and again click **Next** to proceed to the **Labels** dialog box.

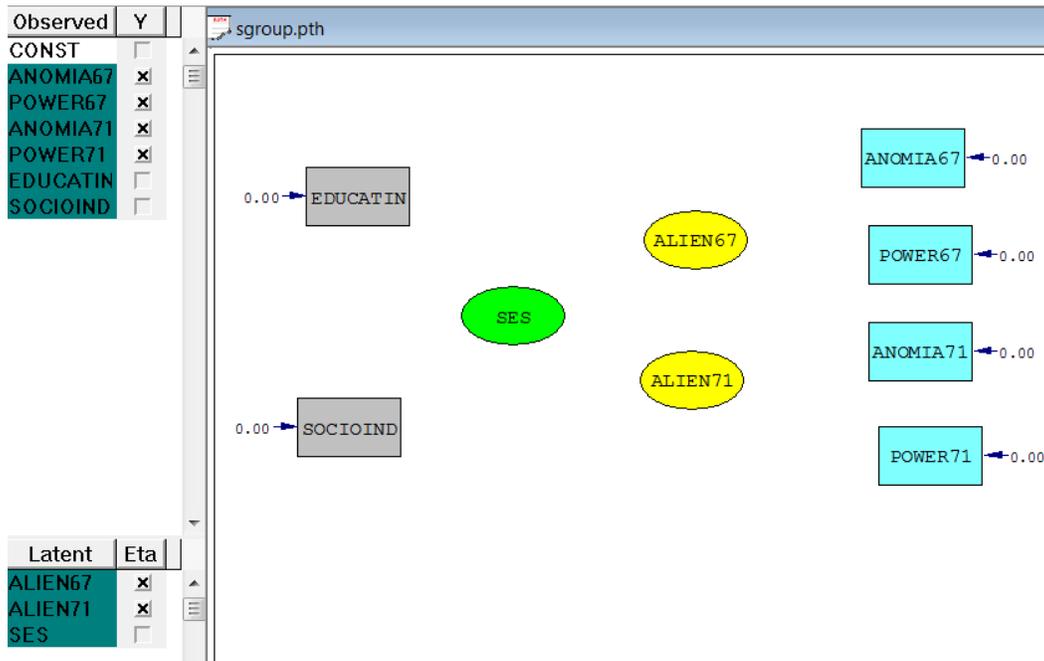
Click the **Add/Read Variables** button and on the **Add/Read Variables** dialog box select LISREL System data file from the **Read from file** drop-down list. Use the **Browse** button to locate **wmas.lsf** in the **Missing data examples** subfolder of either the **LISREL** or **SIMPLIS Examples** folders.

Click **OK** when done and add the latent variable names as shown below. By default, LISREL uses the file selected for reading in variable names as the data file. It is therefore not necessary to proceed to the **Data** menu. Click **OK** to return to the path diagram window.



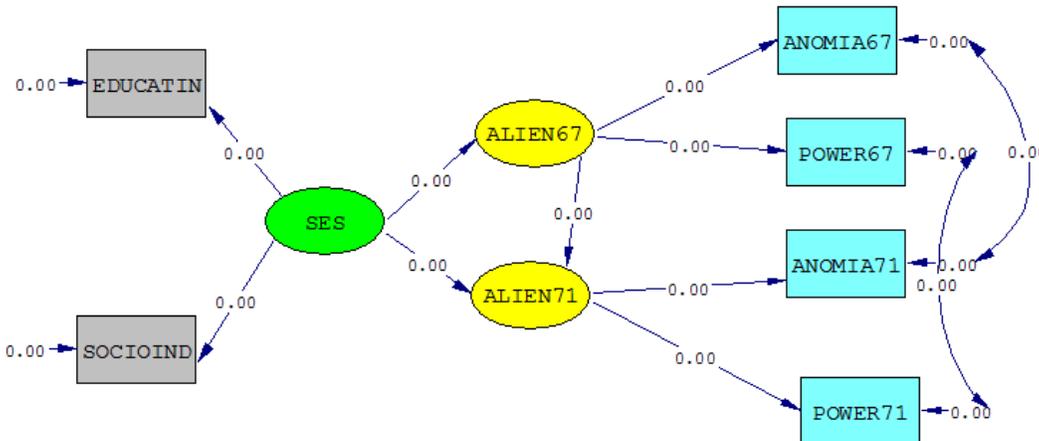
Mark the first four variables as Y-variables and the first two latent variables as Eta-variables. (Left) click on each variable name, and with the mouse button down, drag the variable to the path diagram (PTH) window.

Start with the Y-variables first, then continue with the Eta-variables, then the Ksi-variables and finally the X-variables. In other words, start with ANOMIA67 and end with SOCIOIND.



Click on the draw tool (single-headed arrow) and add all the paths as shown below. Start by moving the mouse cursor to the center of ALIEN67, and, with the mouse button down, drag the arrow to the center of ANOMIA67 and release the button.

Once all the single paths have been drawn, click on the double-headed arrow. Move the cursor to the center of the error variance arrow of ANOMIA67, then, with the left mouse button held down, drag to the center of the error variance arrow of ANOMIA71. Repeat this procedure to allow for a covariance between POWER67 and POWER71.



Select **Build LISREL syntax** from the **Setup** menu to produce the **sgroup.lpj** file. The syntax files **missex4a.lis** and **missex4b.spl** in the **missing data examples** subfolders of **LISREL examples** and **SIMPLIS examples** contain the corresponding LISREL and SIMPLIS syntax for fitting the model. Missing values for this analysis are indicated by a value of -9. A FIML analysis is carried out if the DA line in the LISREL syntax contains the keyword **MI=<value>**. This is required if the data file is not a LSF file:

DA NI=6 NO=1500 MI=-9  
LA

```

ANOMIA67 POWER67 ANOMIA71 POWER71 EDUCATIN SOCIOIND
RA FI=WMAS.DAT
MO NY=4 NX=2 NE=2 NK=1 BE=SD PS=DI TE=SY
LE
ALIEN67 ALIEN71
LK
SES
FR LY(2,1) LY(4,2) LX(2,1) TE(3,1) TE(4,2)
VA 1 LY(1,1) LY(3,2) LX(1,1)
PD
OU SE TV MI ND=3 PT

```

Click the **Run LISREL** icon button to obtain a path diagram and output file. Once the data are read, estimates are obtained of the means and covariances and a  $-2\ln L$  value is printed. This value is the  $-2\ln L$  value for the unrestricted model.

Portions of the output file are shown below:

**(i)  $-2*\text{Log}(\text{likelihood})$  and percentage cases missing**

The EM-algorithm is used to obtain estimates of the population means and covariances. LISREL uses these values to obtain starting values for the maximum likelihood procedure. Convergence is attained in 8 iterations, and at convergence  $-2\ln L$  equals 35822.65. This value is also referred to as the  $-2\ln L$  value for the saturated model.

The screenshot shows a window titled 'sgroup.OUT' with the following text:

```

-----
EM Algorithm for missing Data:
-----

Number of different missing-value patterns=      47
Effective sample size:      1500

Convergence of EM-algorithm in      6 iterations
-2 Ln(L) =      35822.64699
Percentage missing values=  15.32

Note:
The Covariances and/or Means to be analyzed are estimated
by the EM procedure and are only used to obtain starting
values for the FIML procedure

Covariance Matrix

      ANOMIA67   POWER67   ANOMIA71   POWER71   EDUCATIN   SOCIOIND
-----
ANOMIA67      11.84
POWER67         6.75         9.51
ANOMIA71         6.57         4.94         11.99
POWER71         4.37         5.07         7.29         10.05
EDUCATIN        -3.79        -3.74        -3.40        -3.47         8.96
SOCIOIND        -2.02        -1.83        -1.59        -1.66         3.21         4.20

```

LISREL Estimates (Maximum Likelihood)

LAMBDA-Y		ALIEN67	ALIEN71
ANOMIA67	2.57	- -	- -
POWER67	2.62	- -	- -
	(0.16)		
	16.53		
ANOMIA71	- -		2.76
POWER71	- -		2.66
			(0.17)
			15.72
LAMBDA-X			
SES			
EDUCATIN	2.55		
	(0.11)		
	22.76		
SOCIOIND	1.26		
	(0.07)		
	18.57		
BETA		ALIEN67	ALIEN71
ALIEN67	- -	- -	- -
ALIEN71	0.57	- -	- -
	(0.04)		
	12.80		

**(iv) Global Goodness of Fit Statistics, Missing Data Case**

-2ln(L) for the saturated model = 35822.647

-2ln(L) for the fitted model = 35828.671

Degrees of Freedom = 4

Full Information ML Chi-Square = 6.02 (P = 0.20)

Root Mean Square Error of Approximation (RMSEA) = 0.018