

STRUCTURAL EQUATION MODELING IN LISREL

Preparing data for LISREL

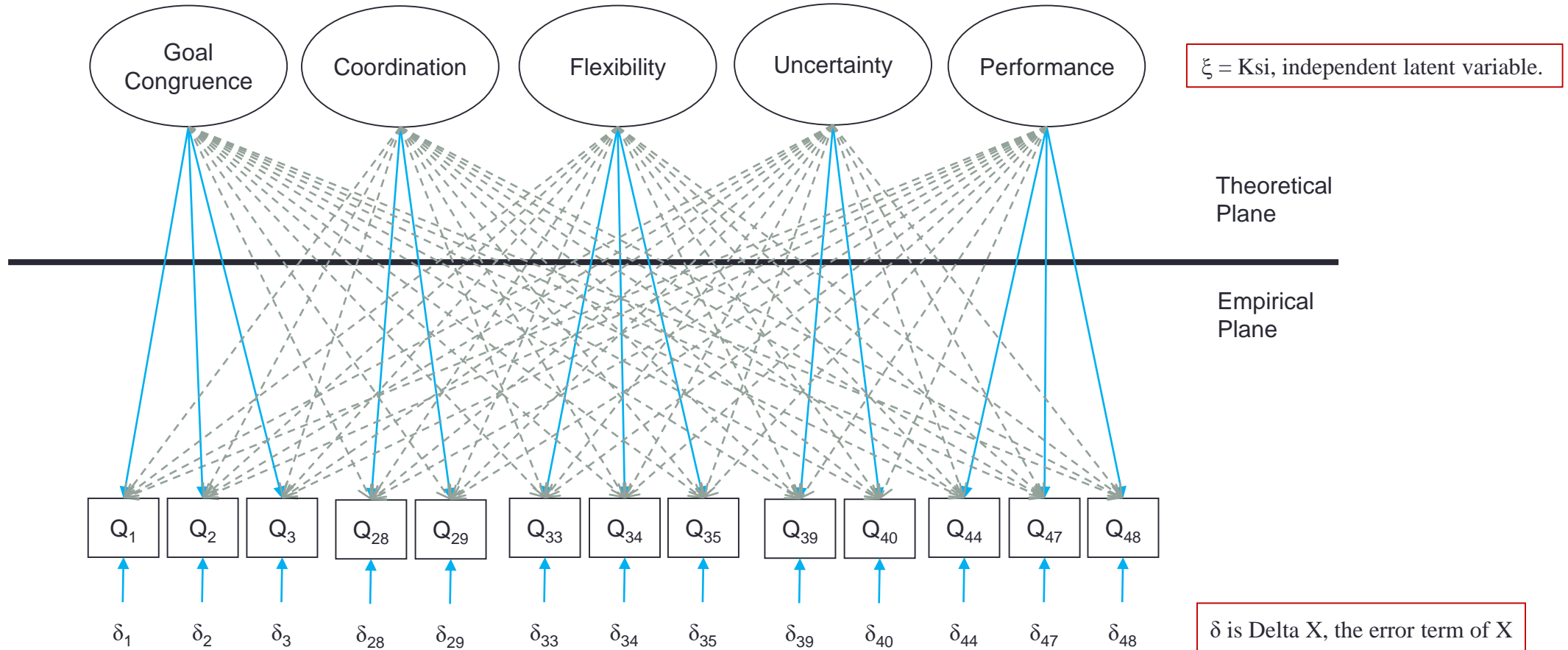
We have a dyadic dataset (buyer and seller). We are using only the seller side.

EFA & CFA

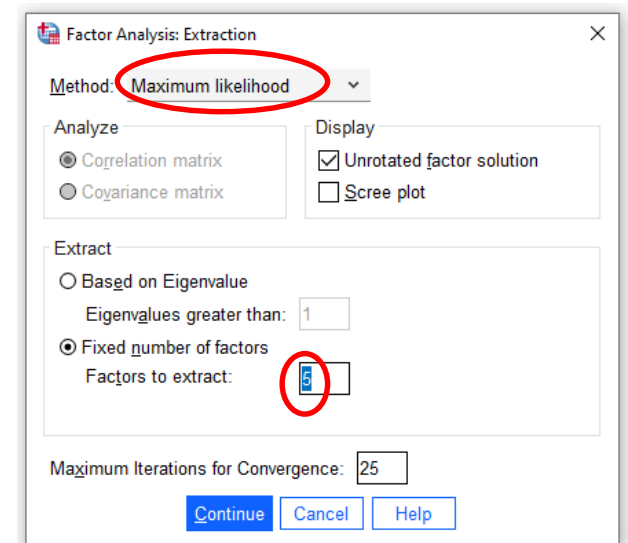
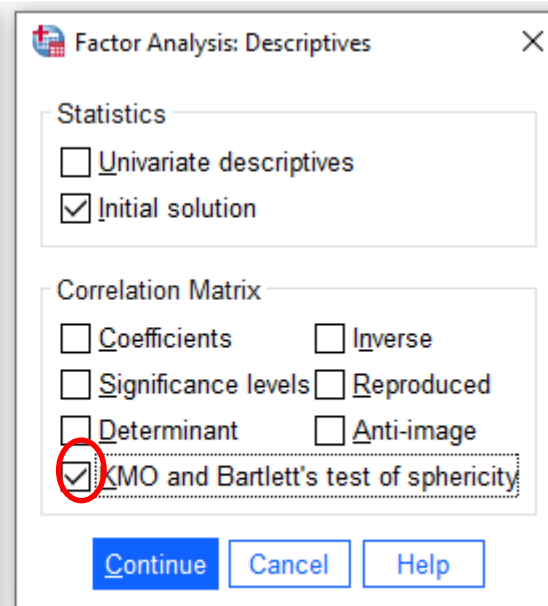
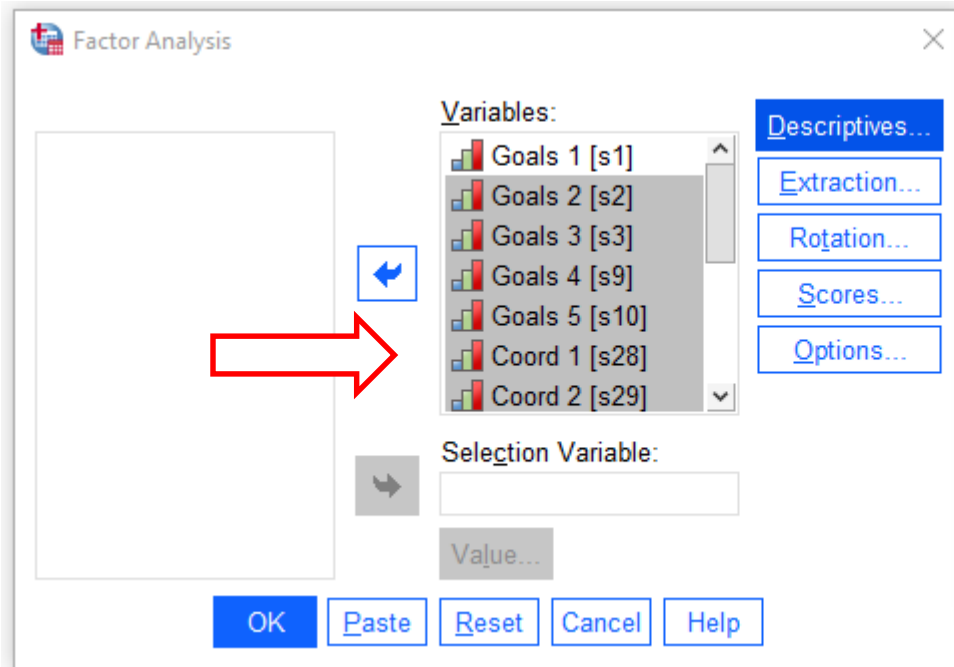
- The fundamental difference between EFA and CFA (in LISREL) is that EFA does not have significance tests for model fit.
- EFA suggests a factor structure.
- In CFA we impose and test a factor structure.

In EFA, all these relationships are estimated.
In CFA, only the solid lines (the relationships we specify) are estimated.

This is called a measurement model.



An EFA Example



Factor Analysis: Rotation

Method

☐ None ☐ Quartimax

☒ Varimax ☐ Equamax

☐ Direct Oblimin ☐ Promax

Delta: Kappa

Display

☒ Rotated solution ☐ Loading plot(s)

Maximum Iterations for Convergence:

Continue Cancel Help

Factor Analysis: Options

Missing Values

☒ Exclude cases listwise

☐ Exclude cases pairwise

☐ Replace with mean

Coefficient Display Format

☐ Sorted by size

☒ Suppress small coefficients

Absolute value below:

Continue Cancel Help

Problems....

Remove Goals 4 & 5

Rotated Factor Matrix^a

	Factor				
	1	2	3	4	5
Goals 1	,715				
Goals 2	,788				
Goals 3	,781				
Goals 4				,812	
Goals 5				,839	
Coord 1					,604
Coord 2					,696
Flex 1		,633			
Flex 2		,617			
Flex 3		,646			
Uncert 1		,456			
Uncert 2		,502			
Perform 1			,406		
Perform 2			,685		
Perform 3			,668		

No suppressed values

Rotated Factor Matrix^a

	Factor				
	1	2	3	4	5
Goals 1	,724	,284	,229	,173	,194
Goals 2	,792	,248	,249	,224	,188
Goals 3	,776	,219	,200	,234	,149
Coord 1	,304	,251	,261	,831	,144
Coord 2	,365	,341	,248	,501	,120
Flex 1	,258	,626	,294	,228	,170
Flex 2	,254	,642	,292	,221	,185
Flex 3	,277	,553	,224	,156	,267
Uncert 1	,243	,316	,320	,149	,376
Uncert 2	,228	,246	,215	,123	,909
Perform 1	,297	,340	,428	,197	,098
Perform 2	,190	,230	,693	,200	,176
Perform 3	,221	,244	,666	,147	,169

a. Extraction Method: Maximum Likelihood.

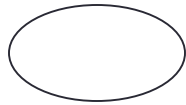
Values suppressed below 3.7

Rotated Factor Matrix^a

	Factor				
	1	2	3	4	5
Goals 1	,724				
Goals 2	,792				
Goals 3	,776				
Coord 1				,831	
Coord 2				,501	
Flex 1		,626			
Flex 2		,642			
Flex 3		,553			
Uncert 1					,376
Uncert 2					,909
Perform 1			,428		
Perform 2			,693		
Perform 3			,666		

In CFA we do not estimate the blank values.

Notation



Ovals are latent unobserved variables



Squares are observed variables



Straight arrows indicate causality



Curved arrows indicate association/correlation

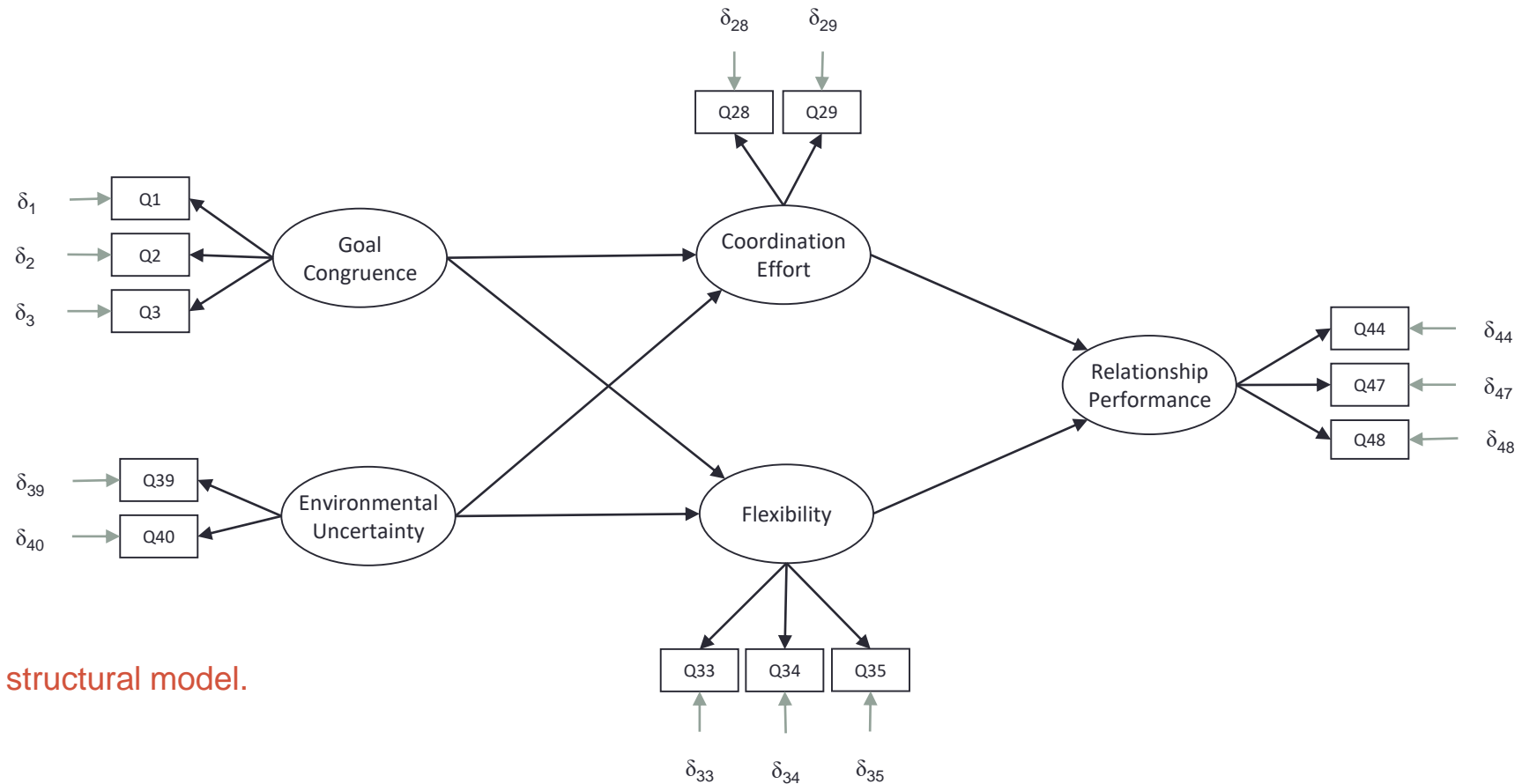
Example of Theoretical Model

Exogenous Variables

No latent variable points at it

Endogenous Variables

At least one latent variable points at it



This is called a structural model.

Pre-CFA (LISREL)

The more you know about your data BEFORE going into CFA – the better!

Typical data screening procedures in, for example SPSS.

- Missing Data.
 - Outliers.
 - Normality.
 - Relationships between variables.
-
- **I Impute missing data** AFTER moving to PRELIS/LISREL
 - How much missing is a problem?
 - 10% cutoff for no problem.

Moving to PRELIS/LISREL

Proverb: There is more than one way to skin a cat!

SPSS > PRELIS > LISREL (old versions)

SPSS > LISREL (new versions)

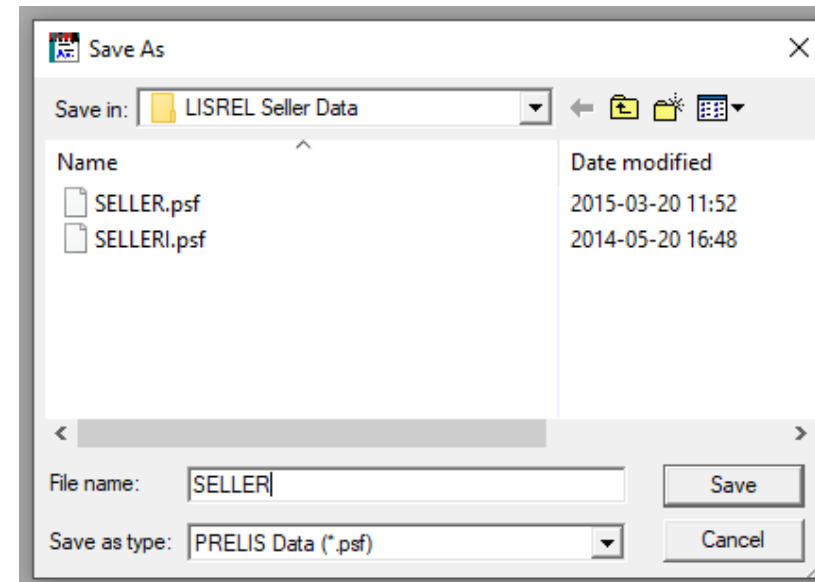
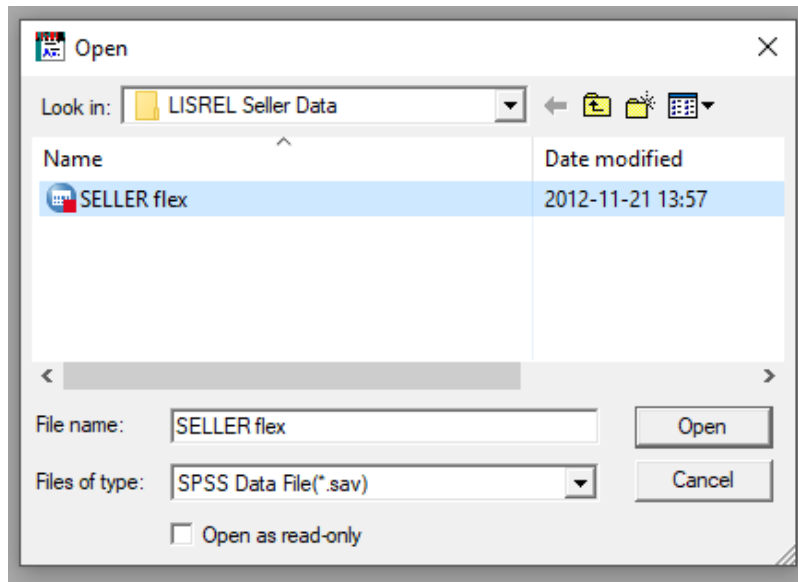


Procedures

Almost identical between versions

- Save your data as, for example, an SPSS data file.
 - Other file formats are fine as well.
- Do not mix version folders (e.g. 8.8 & 10.30)
- Open LISREL (PRELIS)
- Import Data – choose the SPSS.dat file, name the PRELIS (*.pls) or LISREL (*.lsf) file - save.
- Does it look OK?

Import data



This is different in current versions of the software. It now creates a *.lsf LISREL data file.

Define Variables

- Data – Define Variables
- In 'SELLER' data set select all variables
- Check 'Variable Type' – are they all ordinal?
- Define Missing Values as -999999 (or whatever you chose)
- Save

SELLER.psf

	s1	s2	s3	s9	s10	s28	s29	s34	s35
1	4,00	4,00	4,00	3,00	2,00	6,00	2,00	5,00	5,00
2	4,00					3,00	3,00	3,00	6,00
3	3,00					1,00	1,00	6,00	6,00
4	4,00								
5	5,00								
6	4,00								
7	4,00								
8	6,00								
9	5,00								
10	2,00								
11	6,00								
12	5,00								
13	6,00								
14	6,00								
15	2,00								
16	-999999,00								
17	5,00					2,00	2,00	*****	*****
18	4,00					5,00	5,00	6,00	7,00
19	6,00					5,00	6,00	5,00	4,00
20	5,00					2,00	2,00	5,00	5,00
21	6,00	6,00	6,00	7,00	7,00	6,00	6,00	6,00	6,00

Define Variables

Variables: s1, s2, s3, s9, s10, s28, s29, s33, s34, s35, s39, s40, s44, s47, s48

Buttons: Insert, Rename, Variable Type, Category Labels, Missing Values, OK, Cancel

To select more than one variable at a time, hold down the CTRL key while clicking on the variables to be selected

Missing Values for s1 ...

☐ No missing values

☒ Missing values

Low: -999999,00 High:

Global missing value: -999999,00 Low: High:

Apply to all: ☐

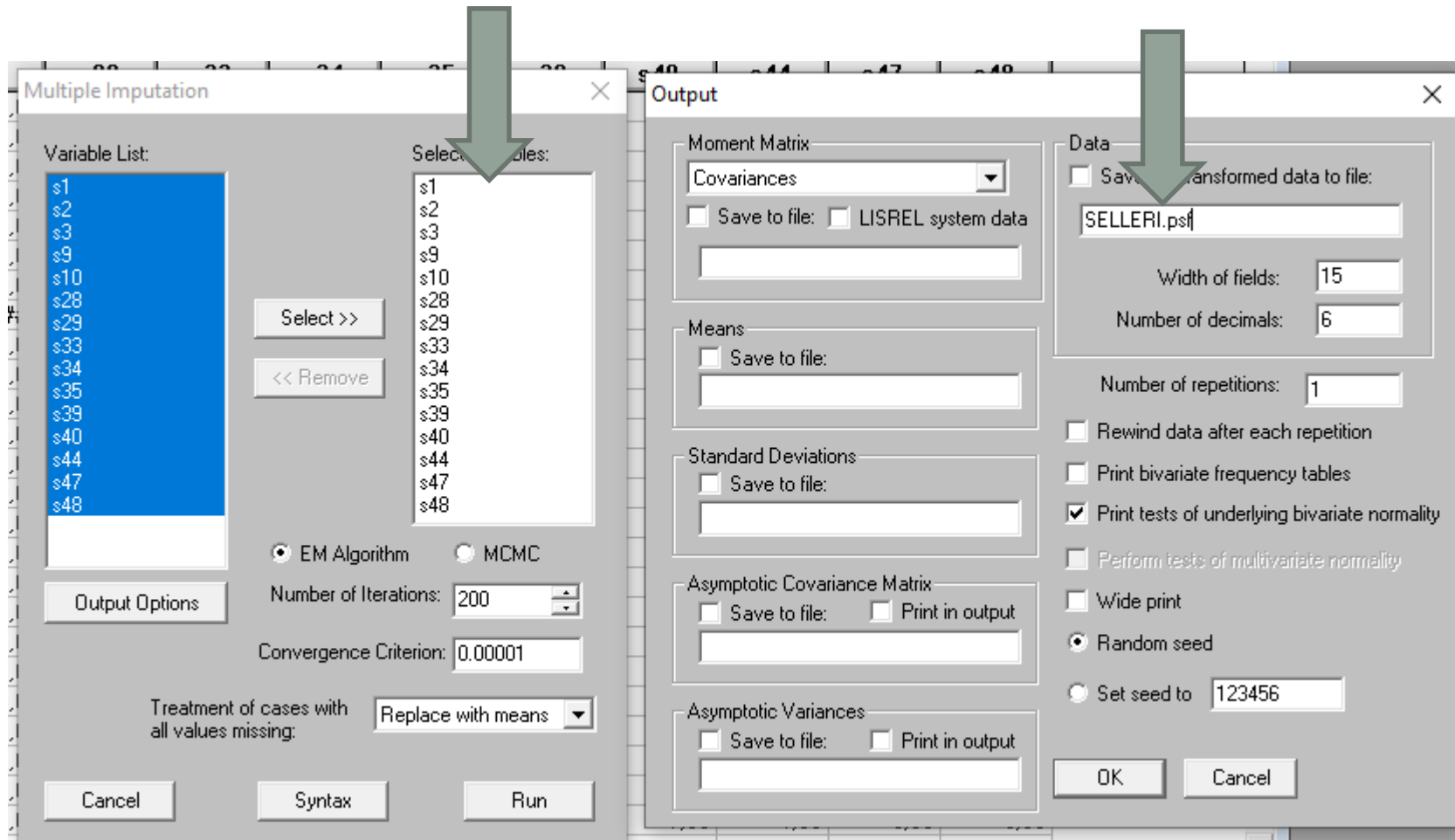
Deletion methods: ☒ Listwise ☐ Pairwise

Buttons: OK, Cancel

Impute Missing Values

- Statistics – Multiple Imputation
- Use 'EM algorithm'
- Output options – Save the transformed data file – NAME (optional)
- Default: imputed-data
- If needed, change data file name in folder.

Multiple Imputation



Create Input Matrices

Several types of out- inputs

- Covariance matrices
- Correlation matrices

Statistics – output options – moment matrix

Ordinal Data

- Polychoric Correlations – save to file “name.pm”
- Asymptotic covariance matrix “name.acp”

Continuous data

- For Covariances: “name.cm”
- For Correlations (pearson) “name.km”

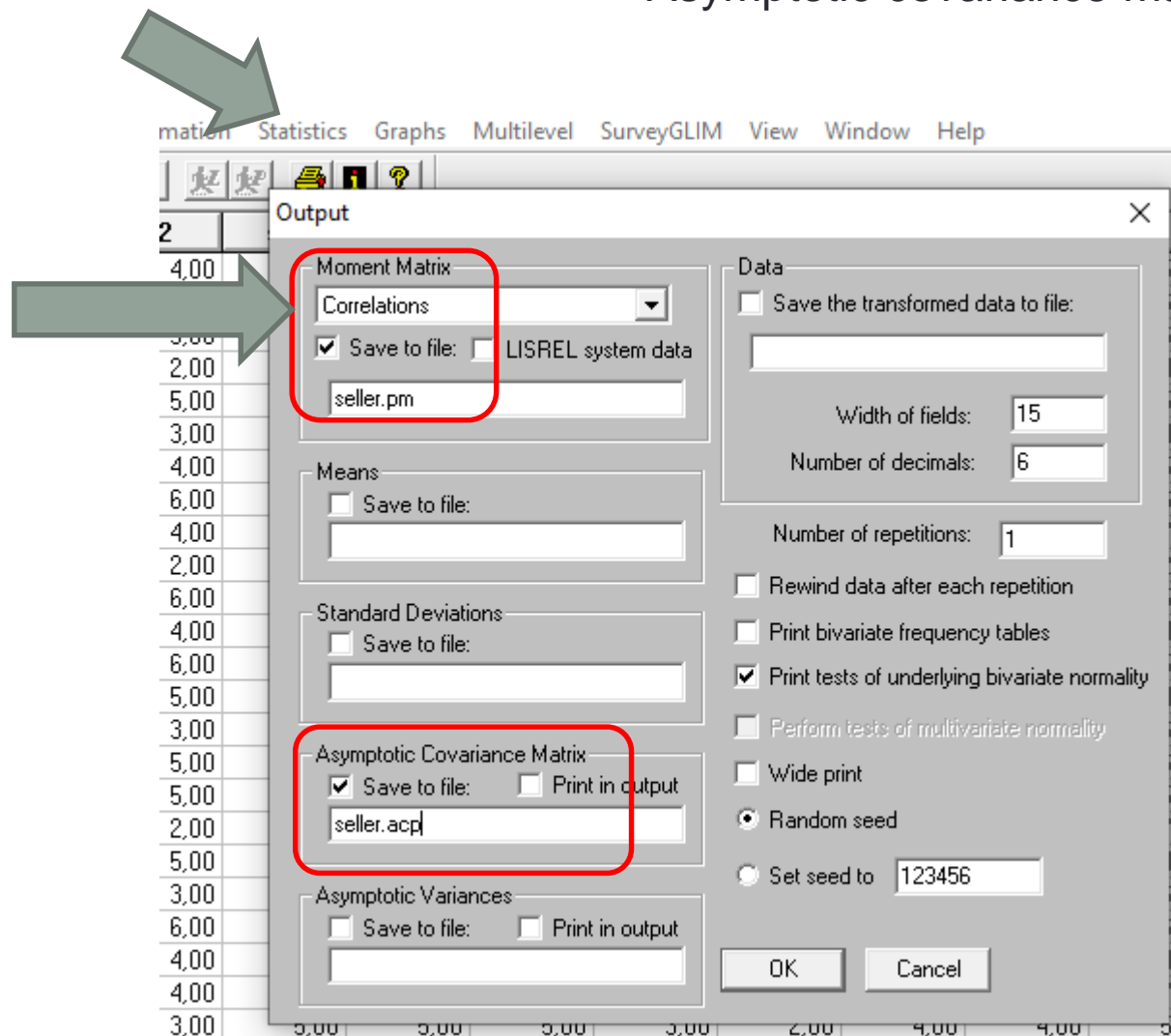
Move to LISREL

Input Matrices

ORDINAL DATA

Polychoric correlation matrix

Asymptotic covariance matrix



Covariance Matrix

The screenshot shows the 'Output' dialog box in LISREL, which is used to configure the output of the analysis. The dialog is divided into several sections:

- Moment Matrix:** A dropdown menu is set to 'Covariances'. The 'Save to file' checkbox is checked, and the file name 'seller.cm' is entered in the text field. The 'LISREL system data' checkbox is unchecked.
- Means:** The 'Save to file' checkbox is unchecked, and the text field is empty.
- Standard Deviations:** The 'Save to file' checkbox is unchecked, and the text field is empty.
- Asymptotic Covariance Matrix:** Both 'Save to file' and 'Print in output' checkboxes are unchecked, and the text field is empty.
- Asymptotic Variances:** Both 'Save to file' and 'Print in output' checkboxes are unchecked, and the text field is empty.
- Data:** The 'Save the transformed data to file' checkbox is unchecked, and the text field is empty. The 'Width of fields' is set to 15, and the 'Number of decimals' is set to 6. The 'Number of repetitions' is set to 1. The 'Rewind data after each repetition' checkbox is unchecked. The 'Print bivariate frequency tables' checkbox is unchecked. The 'Print tests of underlying bivariate normality' checkbox is checked. The 'Perform tests of multivariate normality' checkbox is unchecked. The 'Wide print' checkbox is unchecked. The 'Random seed' radio button is selected, and the 'Set seed to' text field contains the value 123456.

At the bottom of the dialog are 'OK' and 'Cancel' buttons.

Pearson Correlation Matrix

Output

Moment Matrix
Correlations
☒ Save to file: ☐ LISREL system data
seller.km






Means
☐ Save to file:

Standard Deviations
☐ Save to file:

Asymptotic Covariance Matrix
☐ Save to file: ☐ Print in output

Asymptotic Variances
☐ Save to file: ☐ Print in output

Data
☐ Save the transformed data to file:
Width of fields: 15
Number of decimals: 6
Number of repetitions: 1
☐ Rewind data after each repetition
☐ Print bivariate frequency tables
☒ Print tests of underlying bivariate normality
☐ Perform tests of multivariate normality
☐ Wide print
☒ Random seed
☐ Set seed to 123456
OK Cancel

 seller.acp	2014-05-20 16:49	ACP File	44 KB
 seller.cm	2021-03-18 10:07	CM File	2 KB
 seller.km	2021-03-18 10:08	KM File	2 KB
 SELLER.OUT	2021-03-18 09:57	OUT File	18 KB
 seller.pm	2014-05-20 16:49	PM File	2 KB

These are the input files for you LISREL models. It is a good idea to check the folder to see that there is data in them.

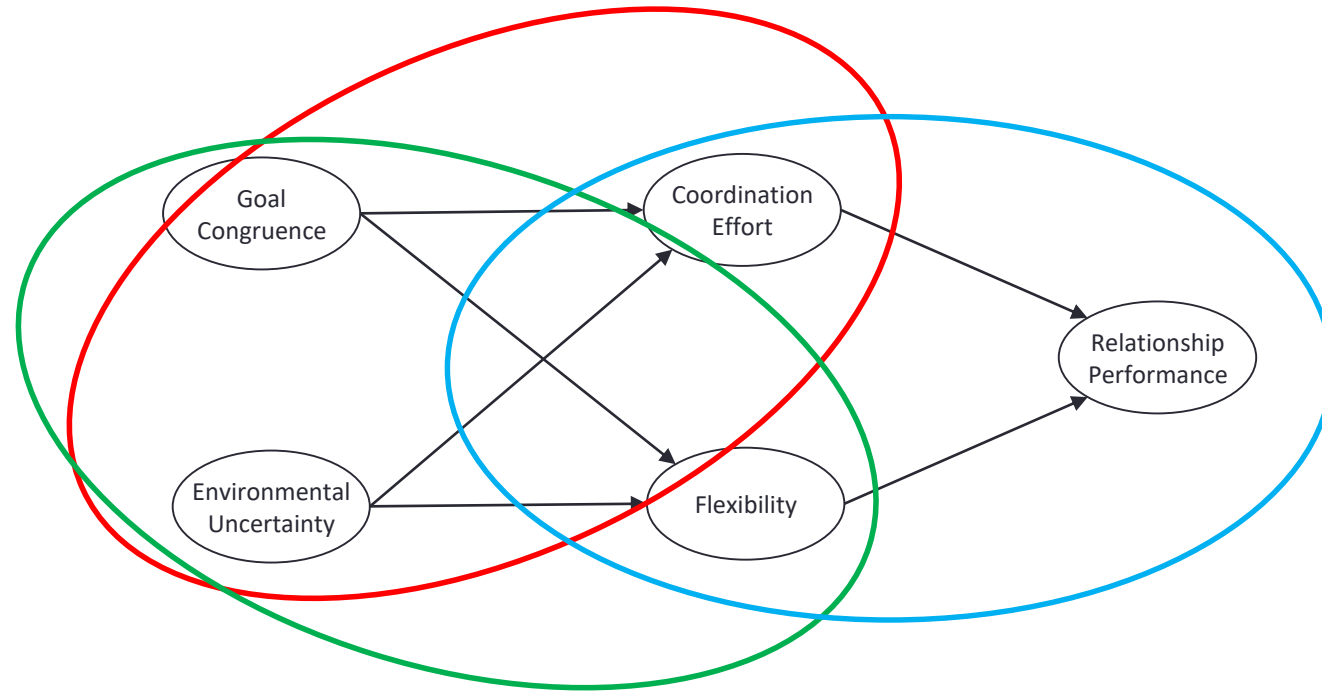
Raw Data Alternative

- LISREL 11 can read the data directly from the raw data file *.LSF.
- This allows you to use a windows interface.
- It automatically estimates the proper input matrices and selects the estimation method (e.g. maximum likelihood), but you have less control over the analysis.

IF YOU ONLY HAD MULTIPLE REGRESSION

We have to aggregate the indicators

Instead of the SEM Model



Or

Independent Variables

Dependent Variable

