



Multiple groups: parental socioeconomic characteristics

An interesting example of multi-sample analyses is given by Mare & Mason (1981) in a study of the reliabilities of son's and parents' reports on father's and mother's education and occupation. They report the covariance matrices given in Table 1 below for six variables and three populations. The sample size is 80 for each group.

The variables are:

SOFED = Son's report of father's education,

SOMED = Son's report of mother's education,

SOFOC = Son's report of father's occupation,

FAFED = Father's report of his own education,

MOMED = Mother's report of her own education, and

FAFOC = Father's report of his own occupation.

The three populations are:

Group 1: Sixth graders

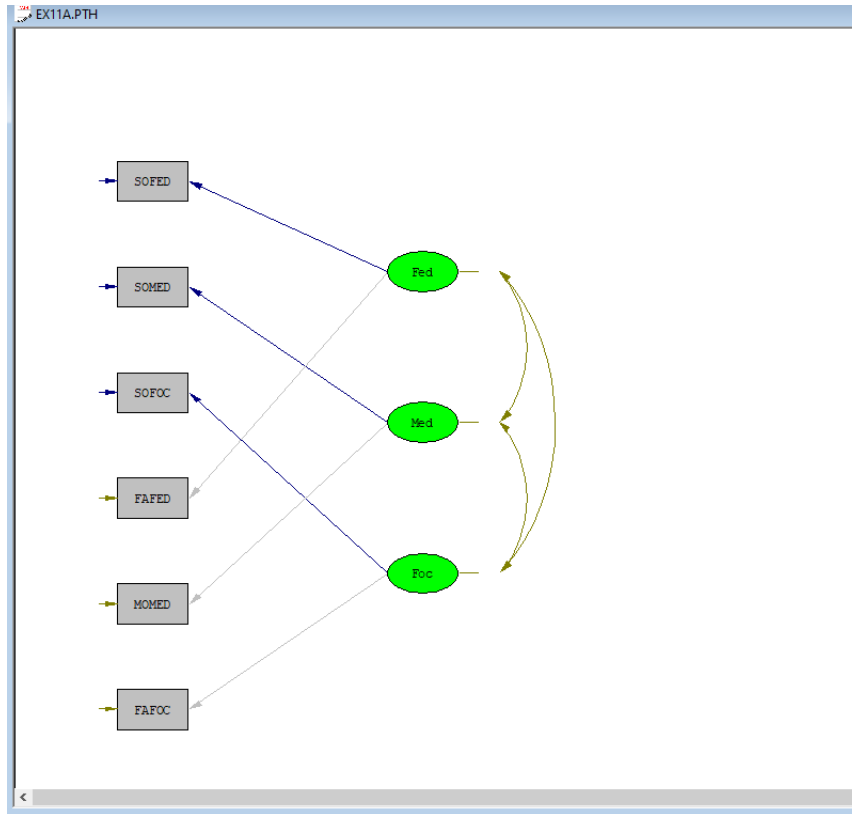
Group 2: Ninth graders

Group 3: twelfth graders

Table 1: Covariance matrices for SAT Verbal and Math sections

Covariance matrix for

Sixth grade						
<i>Tests</i>	SOFED	SOMED	SOFOC	FAFED	MOMED	FAFOC
SOFED	5.86					
SOMED	3.12	3.32				
SOFOC	35.28	23.85	622.09			
FAFED	4.02	2.14	29.42	5.33		
MOMED	2.99	2.55	19.20	3.17	4.64	
FAFOC	35.30	26.91	465.62	31.22	23.38	546.01
Ninth grade						
<i>Tests</i>	SOFED	SOMED	SOFOC	FAFED	MOMED	FAFOC
SOFED	8.20					
SOMED	3.47	4.36				
SOFOC	45.65	22.58	611.63			
FAFED	6.39	3.16	44.62	7.32		
MOMED	3.22	3.77	23.47	3.33	4.02	
FAFOC	45.58	22.01	548.00	40.99	21.43	585.14
Twelfth grade						
<i>Tests</i>	SOFED	SOMED	SOFOC	FAFED	MOMED	FAFOC
SOFED	5.74					
SOMED	1.35	2.49				
SOFOC	39.24	12.73	535.30			
FAFED	4.94	1.65	37.36	5.39		
MOMED	1.67	2.32	15.71	1.85	3.06	
FAFOC	40.11	12.94	496.86	38.09	14.91	538.76



The model is shown in the figure above, where the latent variables Fed, Med, and Foc represent the true father's education, mother's education, and father's occupation, respectively.

It seems reasonable to assume that the covariance matrix of the latent variables Fed, Med, and Foc are the same in all groups and that the error variances of FAFED, MOMED and FAFOC should be the same in all groups but that the error variances of SOFED, SOMED, and SOFOC should vary over groups. Such a model may be specified as follows (**EX11A.SPL** in the **Simplis Examples** folder):

Group 1: Reports of Parental Socioeconomic Characteristics - Grade 6

Observed Variables: SOFED SOMED SOFOC FAFED MOMED FAFOC

Covariance Matrix

```
5.86 3.12 3.32 35.28 23.85 622.09 4.02 2.14 29.42 5.33
2.99 2.55 19.20 3.17 4.64 35.30 26.91 465.62 31.22 23.38 546.01
```

Sample Size: 80

Latent Variables: Fed Med Foc

SOFED = Fed

SOMED = Med

SOFOC = Foc

FAFED = 1*Fed

MOMED = 1*Med

FAFOC = 1*Foc

Group 2: Reports of Parental Socioeconomic Characteristics - Grade 9

Covariance Matrix

8.20 3.47 4.36 45.65 22.58 611.63 6.39 3.16 44.62 7.32

3.22 3.77 23.47 3.33 4.02 45.58 22.01 548.00 40.99 21.43 585.14

SOFED = Fed

SOMED = Med

SOFOC = Foc

Let the Error Variances of SOFED - SOFOC be free

Group 3: Reports of Parental Socioeconomic Characteristics - Grade 12

Covariance Matrix

5.74 1.35 2.49 39.24 12.73 535.30 4.94 1.65 37.36 5.39

1.67 2.32 15.71 1.85 3.06 40.11 12.94 496.86 38.09 14.91 538.76

SOFED = Fed

SOMED = Med

SOFOC = Foc

Let the Error Variances of SOFED - SOFOC be free

Path Diagram

End of Problem

Note the following:

- Since the sample size is the same for all groups, it need only be specified for the first group.
- The units of measurements of the latent variables Fed, Med, and Foc are defined in the first group by using FAFED, MOMED and FAFOC as reference variables. Since this is not repeated in the second and third group, it stays the same. This defines the units of the latent variables to be the same in all groups, which is essential. Otherwise, it would not make sense to postulate equal variances and covariances for the latent variables.
- Since nothing is specified about the variances and covariances of the latent variables, their covariance matrix will be the same in all groups.
- The inclusion of the line

Let the Error Variances of SOFED - SOFOC be free

for the second and third group makes the error variances of SOFED, SOMED, and SOFOC free in all groups.

The chi-square for this model is

Degrees of Freedom for (C1)-(C2)

36

Maximum Likelihood Ratio Chi-Square (C1)

78.368 (P = 0.0001)

Mare & Mason (1981) considered another model in which the error terms of SOMED and SOFED were allowed to correlate in the first two groups but not in the third. To specify this, add the line

Set the Error Covariance between SOMED and SOFED free

in the first two groups, and add the line

Set the Error Covariance between SOMED and SOFED equal to 0

in the third group, see **EX11B.SPL**. The last line is needed, otherwise the error covariance between SOMED and SOFED in the third group would be estimated to be equal to that of the second group. The chi-square for this model is

Degrees of Freedom for (C1)-(C2) 34
Maximum Likelihood Ratio Chi-Square (C1) 52.950 (P = 0.0202)

The output file gives the reliabilities (squared multiple correlations) shown in the table below. This is a somewhat remarkable result because in grade 12, the sons' reports of their fathers' education and occupation are more reliable than the fathers' reports of their own education and occupation. In the earlier ages, however, the sons' reports are less reliable than their parents' reports, as expected.

Table 2: Estimated reliabilities of son's and parents' reports of parental socioeconomic characteristics

	SOFED	SOMED	SOFOC	FAFED	MOMED	FAFOC
Grade 6	0.62	0.38	0.71	0.87	0.93	0.90
Grade 9	0.76	0.86	0.92	0.87	0.93	0.90
Grade 12	0.91	0.81	0.95	0.87	0.93	0.90