

## Multigroup SEM Example<sup>1</sup>

### All Parameters Free Across Groups

```
title: Multigroup structural model example--All parameters free ;

data: file=C:\Jason\mplus\semclass\stack1.dat; format=11f1.0;
      listwise=on;

variable: names = widow panas1 panas2 panas3 panas4 panas5
           panas6 panas7 panas8 panas9 panas10 ;
           grouping is widow (0=notwidow,1=widow);

           missing = blank;

analysis: type=general; iterations = 200;
          model=nomeanstructure; information=expected;

model:
      posaff by panas1-panas5*;
      posaff@1;
      negaff by panas6-panas10* ;
      negaff@1;

! Note: by default in Mplus, measurement errors and factor correlations are not
! constrained to be equal across groups;

Model notwidow:
      posaff by panas1-panas5*;
      posaff@1;
      negaff by panas6-panas10* ;
      negaff@1;

Model widow:
      posaff by panas1-panas5*;
      posaff@1;
      negaff by panas6-panas10* ;
      negaff@1;

! I've freed all factor loadings but set variances to 1, alternatively, some authors
! have suggested using the highest loading item as a reference loading and freeing
! factor variances;

output: stdyx ;
```

Multigroup structural model example--All parameters free ;

#### SUMMARY OF ANALYSIS

Number of groups	2
Number of observations	
Group NOTWIDOW	159
Group WIDOW	40
Number of dependent variables	10
Number of independent variables	0
Number of continuous latent variables	2

Grouping variable      WIDOW

Estimator	ML
Information matrix	EXPECTED
Maximum number of iterations	200
Convergence criterion	0.500D-04
Maximum number of steepest descent iterations	20

Input data file(s)  
C:\Jason\mplus\semclass\stack1.dat

<sup>1</sup> Note: I only illustrate some of the tests that may be needed (e.g., all parameters equal vs. all parameters free, factor variance comparisons, or other specific paths). For brevity sake, I do not illustrate comparison of variances, covariances, or mean and intercept comparisons. See the handout "Multigroup SEM" for an overview.

THE MODEL ESTIMATION TERMINATED NORMALLY

TESTS OF MODEL FIT

Chi-Square Test of Model Fit

Value	112.947
Degrees of Freedom	68
P-Value	0.0005

Chi-Square Contributions From Each Group

NOTWIDOW	72.686
WIDOW	40.260

Chi-Square Test of Model Fit for the Baseline Model

Value	1643.772
Degrees of Freedom	90
P-Value	0.0000

CFI/TLI

CFI	0.971
TLI	0.962

Loglikelihood

H0 Value	-1958.440
H1 Value	-1901.967

Information Criteria

Number of Free Parameters	42
Akaike (AIC)	4000.880
Bayesian (BIC)	4139.198
Sample-Size Adjusted BIC	4006.140
(n* = (n + 2) / 24)	

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.082
90 Percent C.I.	0.054 0.108

SRMR (Standardized Root Mean Square Residual)

Value	0.046
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MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Group NOTWIDOW				
POSAFF BY				
PANAS1	0.745	0.054	13.734	0.000
PANAS2	0.865	0.071	12.145	0.000
PANAS3	0.791	0.055	14.401	0.000
PANAS4	0.855	0.057	14.881	0.000
PANAS5	0.830	0.062	13.367	0.000
NEGAFF BY				
PANAS6	0.798	0.054	14.910	0.000
PANAS7	0.597	0.065	9.234	0.000
PANAS8	0.748	0.058	12.804	0.000
PANAS9	0.380	0.054	7.049	0.000
PANAS10	0.813	0.083	9.777	0.000
NEGAFF WITH				
POSAFF	-0.674	0.050	-13.557	0.000
Variances				
POSAFF	1.000	0.000	999.000	999.000
NEGAFF	1.000	0.000	999.000	999.000

Group WIDOW

POSAFF BY					
PANAS1	1.092	0.127	8.599	0.000	
PANAS2	1.252	0.160	7.841	0.000	
PANAS3	1.037	0.132	7.825	0.000	
PANAS4	1.054	0.135	7.788	0.000	
PANAS5	0.914	0.136	6.719	0.000	
NEGAFF BY					
PANAS6	1.099	0.136	8.075	0.000	
PANAS7	0.952	0.142	6.710	0.000	
PANAS8	0.843	0.139	6.047	0.000	
PANAS9	0.405	0.127	3.188	0.001	
PANAS10	0.676	0.188	3.601	0.000	
NEGAFF WITH					
POSAFF	-0.472	0.129	-3.661	0.000	
Variances					
POSAFF	1.000	0.000	999.000	999.000	
NEGAFF	1.000	0.000	999.000	999.000	

### Loadings Only Constrained Equal Across Groups

```
title: Multigroup structural model example--Loadings Only Equal ;

data: file=C:\Jason\mplus\semclass\stack1.dat; format=11f1.0;
      listwise=on;

variable: names = widow panas1 panas2 panas3 panas4 panas5
           panas6 panas7 panas8 panas9 panas10 ;
           grouping is widow (0=notwidow,1=widow);

           missing = blank;

analysis: type=general; iterations = 200;
           model=nomeanstructure; information=expected;

model: posaff by panas1* panas2-panas5;
       negaff by panas6* panas7-panas10*;

! Note: by default in Mplus, measurement errors and factor correlations are not
! constrained to be equal across groups;

Model notwidow:
  posaff by panas1* (1)
           panas2* (2)
           panas3 (3)
           panas4 (4)
           panas5 (5);
  posaff@1;

  negaff by panas6* (6)
           panas7* (7)
           panas8* (8)
           panas9* (9)
           panas10* (10);
  negaff@1;

Model widow:
  posaff by panas1* (1)
           panas2* (2)
           panas3 (3)
           panas4 (4)
           panas5 (5);
  posaff@1;

  negaff by panas6* (6)
           panas7* (7)
           panas8* (8)
           panas9* (9)
           panas10* (10);
  negaff@1;

output: stdyx ;
```

INPUT READING TERMINATED NORMALLY

Multigroup structural model example--Loadings Only Equal ;

SUMMARY OF ANALYSIS

Number of groups	2
Number of observations	
Group NOTWIDOW	159
Group WIDOW	40
Number of dependent variables	10
Number of independent variables	0
Number of continuous latent variables	2

Variables with special functions

Grouping variable	WIDOW	
Estimator		ML
Information matrix		EXPECTED
Maximum number of iterations		200
Convergence criterion	0.500D-04	
Maximum number of steepest descent iterations		20

THE MODEL ESTIMATION TERMINATED NORMALLY

TESTS OF MODEL FIT

Chi-Square Test of Model Fit		
Value	136.569	
Degrees of Freedom	78	
P-Value	0.0000	

Chi-Square Contributions From Each Group

NOTWIDOW	80.162
WIDOW	56.407

Chi-Square Test of Model Fit for the Baseline Model

Value	1643.772
Degrees of Freedom	90
P-Value	0.0000

CFI/TLI

CFI	0.962
TLI	0.957

Loglikelihood

H0 Value	-1970.251
H1 Value	-1901.967

Information Criteria

Number of Free Parameters	32
Akaike (AIC)	4004.502
Bayesian (BIC)	4109.888
Sample-Size Adjusted BIC	4008.510
(n* = (n + 2) / 24)	

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.087	
90 Percent C.I.	0.062	0.111

SRMR (Standardized Root Mean Square Residual)

Value	0.143
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MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Group NOTWIDOW				
POSAFF BY				
PANAS1	0.858	0.050	17.035	0.000
PANAS2	0.979	0.065	15.071	0.000
PANAS3	0.854	0.051	16.632	0.000
PANAS4	0.906	0.054	16.915	0.000
PANAS5	0.856	0.057	15.016	0.000
NEGAFF BY				
PANAS6	0.867	0.051	17.098	0.000
PANAS7	0.694	0.059	11.671	0.000
PANAS8	0.786	0.054	14.484	0.000
PANAS9	0.396	0.050	7.973	0.000
PANAS10	0.816	0.076	10.688	0.000
NEGAFF WITH				
POSAFF	-0.711	0.043	-16.386	0.000
Variances				
POSAFF	1.000	0.000	999.000	999.000
NEGAFF	1.000	0.000	999.000	999.000
Group WIDOW				
POSAFF BY				
PANAS1	0.858	0.050	17.035	0.000
PANAS2	0.979	0.065	15.071	0.000
PANAS3	0.854	0.051	16.632	0.000
PANAS4	0.906	0.054	16.915	0.000
PANAS5	0.856	0.057	15.016	0.000
NEGAFF BY				
PANAS6	0.867	0.051	17.098	0.000
PANAS7	0.694	0.059	11.671	0.000
PANAS8	0.786	0.054	14.484	0.000
PANAS9	0.396	0.050	7.973	0.000
PANAS10	0.816	0.076	10.688	0.000
NEGAFF WITH				
POSAFF	-0.405	0.139	-2.922	0.003
Variances				
POSAFF	1.000	0.000	999.000	999.000
NEGAFF	1.000	0.000	999.000	999.000

**Chi-square comparisons**

	$\chi^2$	df	Comparison to all-free model	
			$\Delta\chi^2$	$\Delta df$
All parameters free	112.947	68		
Loadings only equal	136.569	78	23.6222 <sup>a</sup>	10

<sup>a</sup> p < .10, \* p < .05, \*\* p < .01, \*\*\* p < .001

**Sample Write-up**

A multigroup structural equation modeling approach was used to compare men and women on the factor loadings of the positive and negative affect scale. To test for partial measurement invariance across groups, the chi-square from a model with all parameters allowed to be unequal across groups was compared to the chi-square from a model with only the loadings constrained to be equal across groups. The model with all parameters freely estimated in the two groups, fit the data well (CFI = .971, SRMR = .042), according to fit criteria suggested by Hu and Bentler (1999), although the overall chi-square was significant,  $\chi^2(68) = 112.947$  p < .001. The partial invariance model with loadings constrained to be equal across groups had fit that was significantly poorer,  $\chi^2(78) = 136.569$ , p < .001,  $\Delta\chi^2(10) = 23.622$ , p < .01. The Comparative Fit Index for this model indicated good fit (CFI = .962), but the Standardized Root Mean Square Residual (SRMR = .143) suggested the fit could be improved. Further analyses are required to determine which loadings may differ across groups. The findings suggest that the measurement of the two-factor positive and negative affect scale differs across groups, and, thus, caution may be warranted in comparing these groups.