

## Cross-lagged Panel Model of Positive and Negative Social Exchanges

Note: I use listwise deletion and robust estimation here (Satorra-Bentler corrections) for convenience, specified as MLM in Mplus and lavaan. With attrition, the MAR assumption deserves additional consideration, but may be a reasonable or more reasonable approach with this example (see Newsom, 2024, for a more in-depth discussion of the topic of missing data with longitudinal models).

```

title: Cross-lag panel model of positive and negative exchanges;

data: file=c:\jason\mplus\semclass\long1.dat; format=4f9.6;
      listwise=on;

variable: names = pos posf neg negf;
          missing=blank;

analysis: type=general;
          estimator=mlm;

model: negf on neg pos;
       posf on neg pos;
       neg with pos;
       negf with posf;

output: stdyx;
  
```

**(output excerpts)**

Number of observations 151

TESTS OF MODEL FIT

Chi-Square Test of Model Fit

Value	0.000*
Degrees of Freedom	0
P-Value	0.0000
Scaling Correction Factor for MLM	Undefined

\* The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference tests. MLM, MLR and WLSM chi-square difference testing is described in the Mplus Technical Appendices at [www.statmodel.com](http://www.statmodel.com). See chi-square difference testing in the index of the Mplus User's Guide.

CFI/TLI

CFI	1.000
TLI	1.000

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.000
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SRMR (Standardized Root Mean Square Residual)

Value	0.000
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MODEL RESULTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
NEGF	ON				
	NEG	0.630	0.093	6.740	0.000
	POS	-0.075	0.054	-1.395	0.163
POSF	ON				
	NEG	-0.139	0.103	-1.353	0.176
	POS	0.532	0.076	6.968	0.000

NEG	WITH				
POS		-0.191	0.051	-3.734	0.000
NEGF	WITH				
POSF		-0.069	0.021	-3.233	0.001
Means					
POS		2.778	0.062	44.634	0.000
NEG		0.629	0.044	14.301	0.000
Intercepts					
POSF		1.476	0.265	5.562	0.000
NEGF		0.515	0.185	2.784	0.005
Variances					
POS		0.585	0.079	7.410	0.000
NEG		0.292	0.053	5.517	0.000
Residual Variances					
POSF		0.199	0.027	7.461	0.000
NEGF		0.178	0.026	6.933	0.000

STANDARDIZED MODEL RESULTS

STDYX Standardization

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
NEGF	ON				
NEG		0.607	0.068	8.910	0.000
POS		-0.102	0.073	-1.410	0.159
POSF	ON				
NEG		-0.119	0.085	-1.398	0.162
POS		0.644	0.064	10.119	0.000
NEG	WITH				
POS		-0.463	0.088	-5.256	0.000
NEGF	WITH				
POSF		-0.366	0.092	-3.976	0.000
Means					
POS		3.632	0.295	12.311	0.000
NEG		1.164	0.087	13.426	0.000
Intercepts					
POSF		2.338	0.508	4.606	0.000
NEGF		0.917	0.334	2.750	0.006
Variances					
POS		1.000	0.000	999.000	999.000
NEG		1.000	0.000	999.000	999.000
Residual Variances					
POSF		0.500	0.061	8.252	0.000
NEGF		0.564	0.068	8.311	0.000

R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
POSF	0.500	0.061	8.253	0.000
NEGF	0.436	0.068	6.425	0.000

## lavaan

```
> mydata <- mydata[complete.cases(mydata), ]
> library(psych)
> #describe(mydata)
>
>
> library(lessR)
>
> model = '
+ posf ~ pos + neg
+ negf ~ pos + neg
+
> #note: including the correlations between the exogenous variables
> # and endogenous disturbances causes an error, so omit (still estimated by default)
> fit = sem(model, data = mydata, mimic="Mplus", missing = 'listwise', estimator="MLM")
> summary(fit, fit.measures=TRUE, rsquare=TRUE, standardized=TRUE)
lavaan 0.6.15 ended normally after 32 iterations
```

Estimator	ML	
Optimization method	NLMINB	
Number of model parameters	9	
Number of observations	151	

Model Test User Model:

Test Statistic	Standard	Scaled
Degrees of freedom	0	0

Model Test Baseline Model:

Test statistic	212.861	139.021
Degrees of freedom	5	5
P-value	0.000	0.000
Scaling correction factor		1.531

User Model versus Baseline Model:

Comparative Fit Index (CFI)	1.000	1.000
Tucker-Lewis Index (TLI)	1.000	1.000
Robust Comparative Fit Index (CFI)		NA
Robust Tucker-Lewis Index (TLI)		NA

Loglikelihood and Information Criteria:

Loglikelihood user model (H0)	-165.435	-165.435
Loglikelihood unrestricted model (H1)	-165.435	-165.435
Akaike (AIC)	348.870	348.870
Bayesian (BIC)	376.026	376.026
Sample-size adjusted Bayesian (SABIC)	347.542	347.542

Root Mean Square Error of Approximation:

RMSEA	0.000	NA
90 Percent confidence interval - lower	0.000	NA
90 Percent confidence interval - upper	0.000	NA
P-value H_0: RMSEA <= 0.050	NA	NA
P-value H_0: RMSEA >= 0.080	NA	NA
Robust RMSEA		0.000
90 Percent confidence interval - lower		0.000
90 Percent confidence interval - upper		0.000
P-value H_0: Robust RMSEA <= 0.050		NA
P-value H_0: Robust RMSEA >= 0.080		NA

Standardized Root Mean Square Residual:

SRMR	0.000	0.000
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Parameter Estimates:

Standard errors	Robust.sem
Information	Expected
Information saturated (h1) model	Structured

Regressions:

	Estimate	Std.Err	z-value	P(> z )	Std.lv	Std.all
posf ~						
pos	0.532	0.076	6.968	0.000	0.532	0.644

neg	-0.139	0.103	-1.353	0.176	-0.139	-0.119
negf ~						
pos	-0.075	0.054	-1.395	0.163	-0.075	-0.102
neg	0.630	0.093	6.740	0.000	0.630	0.607
Covariances:						
	Estimate	Std.Err	z-value	P(> z )	Std.lv	Std.all
.posf ~						
.negf	-0.069	0.021	-3.233	0.001	-0.069	-0.366
Intercepts:						
	Estimate	Std.Err	z-value	P(> z )	Std.lv	Std.all
.posf	1.476	0.265	5.561	0.000	1.476	2.338
.negf	0.515	0.185	2.785	0.005	0.515	0.917
Variances:						
	Estimate	Std.Err	z-value	P(> z )	Std.lv	Std.all
.posf	0.199	0.027	7.461	0.000	0.199	0.500
.negf	0.178	0.026	6.933	0.000	0.178	0.564
R-Square:						
	Estimate					
posf	0.500					
negf	0.436					

The output only shows the correlation between endogenous disturbances, but it is still estimating the correlation between exogenous variables. *lavaan* and *Mplus* are sometimes quirky about showing exogenous correlations with measured variables.<sup>1</sup> How do I know they are being estimated? Because the df is equal to 0, so I know that all possible relations are being estimated in this model.

### Write-up

A cross-lagged panel model was tested to investigate the longitudinal effects of positive and negative social exchanges over a thirteen-week interval. The model was just identified, so there was no information about fit. Both negative and positive social exchange measures were highly stable over the thirteen weeks,  $\beta = .630$ ,  $SE = .093$ ,  $\beta^* = .607$ ,  $p < .001$ , and  $\beta = .532$ ,  $SE = .076$ ,  $\beta^* = .644$ ,  $p < .001$ , respectively. Although the two measures were significantly negatively correlated at baseline,  $\psi^* = -.463$ ,  $p < .001$ , and the disturbances were significantly correlated at follow-up,  $\psi^* = -.366$ ,  $p < .001$ , neither cross-lagged effect was significant. Positive exchanges at baseline did not significantly predict negative exchanges at follow-up,  $\beta = -.075$ ,  $SE = .054$ ,  $\beta^* = -.102$ , ns, and negative social exchanges at baseline did not significantly predictive positive social exchanges at follow-up,  $\beta = -.139$ ,  $SE = .103$ ,  $\beta^* = -.119$ , ns. Approximately 50% of the variance in positive social exchanges,  $R^2 = .500$ , and approximately 44% of the variance in negative social exchanges,  $R^2 = .436$ , was accounted for by the predictors. The results do not support the possibility of a causal effect in either direction over the thirteen-week period.

### References

Newsom, J.T. (2024). Chapter 13, Missing Data and Attrition in *Longitudinal Structural Equation Modeling: A Comprehensive Introduction, second edition*. New York: Routledge.

<sup>1</sup> A workaround is to specify single indicator latent variables, each with loading equal to 1 and residual variance equal to 0, and then request the correlation between the latent variables.