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, 2015, 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      Undefined
            for MLM

*   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.
    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

SRMR (Standardized Root Mean Square Residual)

          Value                             0.000

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    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:
                                              Standard      Scaled
  Test Statistic                                 0.000       0.000
  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

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.[1] 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, β = .630, SE = .093, β^* = .607, p < 001, and β=.532, SE = .076, β^* = .644, p < .001, respectively. Although the two measures were significantly negatively correlated at baseline, ψ^* = -.463, p <.001, and the disturbances were significantly correlated at follow-up, ψ^* = -.366, p < .001, neither cross-lagged effect was significant. Positive exchanges at baseline did not significantly predict negative exchanges at follow-up, β = -.075, SE = .054, β^* = -.102, ns, and negative social exchanges at baseline did not significantly predictive positive social exchanges at follow-up, β = -.139, SE = .103, β^* = -.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. (2015). Chapter 13, Missing Data and Attrition in *Longitudinal Structural Equation Modeling: A Comprehensive Introduction*. New York: Routledge.

[1] 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.