Panel model for political efficacy data

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1. Introduction

Aish & Jöreskog (1990) analyze data on political attitudes. Their data consist of 16 ordinal variables measured on the same people at two occasions. Six of the 16 variables were considered to be indicators of Political Efficacy and System Responsiveness. The attitude questions corresponding to these six variables are:

- People like me have no say in what the government does (NOSAY)
- Voting is the only way that people like me can have any say about how the government runs things (VOTING)
- Sometimes politics and government seem so complicated that a person like me cannot really understand what is going on (COMPLEX)
- I don't think that public officials care much about what people like me think (NOCARE)
- Generally speaking, those we elect to Parliament lose touch with the people pretty quickly (TOUCH)
- Parties are only interested in people's votes but not in their opinions (INTEREST)

Permitted responses to these questions were agree strongly, agree, disagree, disagree strongly, don't know and no answer.

This survey was conducted at multiple time points. We intend using the USA data to investigate whether the level of efficacy increased or decreased over time. Also, whether the variance of efficacy increased or decreased over time.

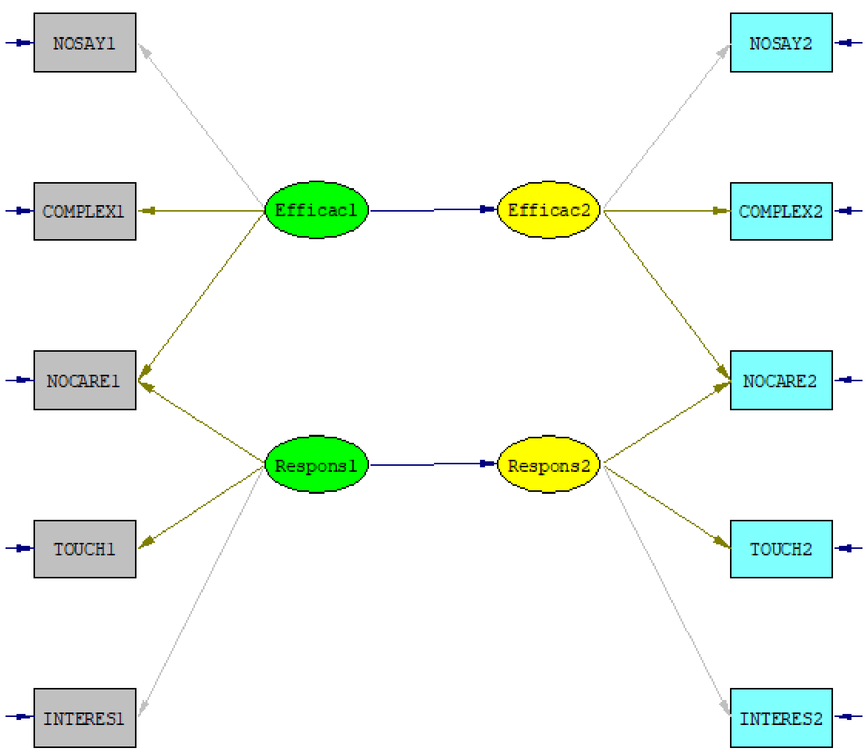
These data are available in the file **panelusa.lsf**. The first few lines of this file are shown below.

panelusa.LSF

	NOSAY1	VOTING1	COMPLEX1	NOCARE1	TOUCH1	INTERES1	NOSAY2	VOTING2	COMPLEX2	NOCARE2	TOUCH2	INTERES2
1	2.00	2.00	1.00	1.00	1.00	1.00	########	2.00	2.00	-999999.00	2.00	2.00
2	2.00	3.00	3.00	3.00	2.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00
3	3.00	2.00	2.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00
4	2.00	2.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00	1.00	2.00
5	3.00	2.00	2.00	3.00	3.00	3.00	3.00	2.00	2.00	3.00	2.00	2.00
6	2.00	2.00	2.00	2.00	1.00	2.00	3.00	2.00	1.00	3.00	2.00	2.00
7	3.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	2.00	2.00
8	2.00	1.00	2.00	2.00	1.00	1.00	3.00	3.00	1.00	2.00	########	3.00
9	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	1.00	3.00	2.00	2.00
10	2.00	2.00	3.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	1.00	2.00
11	3.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	2.00
12	1.00	1.00	1.00	1.00	1.00	1.00	3.00	3.00	2.00	3.00	2.00	2.00
13	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	1.00	2.00	2.00	2.00
14	3.00	3.00	2.00	3.00	2.00	2.00	3.00	2.00	2.00	3.00	3.00	3.00
15	3.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	2.00	2.00
16	3.00	3.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	2.00

2. Estimation

To answer the questions posed in the previous section, we propose to fit the model shown in the conceptual path diagram below.



In this model there is a structural model in the middle of the path diagram, in which Efficacy at time 2 is predicted by Efficacy at time 1 without the use of Respons at time 1. Similarly, Respons at time 2 is predicted by Respons at time 1 without the use of Efficacy at Efficacy 1.

Additional features, not visible in the path diagram, include:

1. The measurement error in each variable at time 1 correlates with the measurement error in the corresponding variable at time 2 due to a specific factor in each item. Consider the variable COMPLEX as an example. Let x be COMPLEX1 and y be COMPLEX2. The measurement equations for these two variables can be expressed as

$$Time\,1: x = \lambda_1 \xi + \delta = \lambda_1 \xi + s + d$$
$$Time\,2: y = \lambda_2 \eta + \varepsilon = \lambda_2 \eta + s + e,$$

where ξ represents Efficac1 and η Efficac2. The measurement errors, δ and ε, are so-called measurement errors in LISREL and each represents the sum of two components: one specific to the item COMPLEX (*d*) and one pure random error component (*e*), where these are uncorrelated. It follows that δ and ε are correlated and that

$$Cov(\delta, \varepsilon) = Var(s).$$

As a result, the specific error variance can be estimated as the covariance between the measurement errors for the same variables.

2. The loading of NOSAY1 on Efficac1 and of NOSAY2 on Efficac2are fixed to 1 to fix the unit of measurement for these two latent variables. Since NOSAY1 and NOSAY2 have the same unit of measurement, the two latent variables will also have the same unit of measurement.
3. The other four loadings on the latent variables are constrained to be the same across time.
4. There is also an intercept term in each measurement equation. These intercept terms are also constrained to be the same over time.
5. Equality of the intercepts and factor loadings over time is required to allow comparison of the latent variables over time on the same scale.

Given the complexity and number of constraints imposed over time, the LISREL syntax file is easier to follow than the comparable SIMPLIS syntax file. Both are, however, shown below.

panelusa2b.lis

```
Estimating the Panel Model by FIML
da ni=12
ra=panelusa.lsf
se
7 9 10 11 12 1 3 4 5 6 /
mo ny=5 nx=5 ne=2 nk=2 ga=di ps=sy,fr th=fi ty=fr tx=fr al=fr
le
Efficac2 Respons2
lk
Efficac1 Respons1
fr lx(2,1) lx(3,1) lx(3,2) lx(4,2)
va 1 lx(1,1) lx(5,2)
fr ly(2,1) ly(3,1) ly(3,2) ly(4,2)
va 1 ly(1,1) ly(5,2)
fr th(1,1) th(2,2) th(3,3) th(4,4) th (5,5)
eq lx(2,1) ly(2,1)
eq lx(3,1) ly(3,1)
eq lx(3,2) ly(3,2)
eq lx(4,2) ly(4,2)
eq tx(1) ty(1)
eq tx(2) ty(2)
eq tx(3) ty(3)
eq tx(4) ty(4)
eq tx(5) ty(5)
pd
ou
```

Partial output is given below. FIML estimation is used as there are missing values in the data. Doing so allows the use of all information without imputing any values.

```
Estimating the Panel Model by FIML
 Raw Data from file panelusa.lsf

               --------------------------------
                EM Algorithm for missing Data:
               --------------------------------

           Number of different missing-value patterns=       36
           Effective sample size:      933

           Convergence of EM-algorithm in     4 iterations
           -2 Ln(L) =    16045.44727
           Percentage missing values=   2.20

     Note:
       The Covariances and/or Means to be analyzed are estimated
       by the EM procedure and are only used to obtain starting
       values for the FIML procedure
```

This is followed by a polychoric covariance matrix, estimated by fixing the mean and the variance of the underlying ordinal variables to 0 and 1.

```
        Covariance Matrix

               NOSAY2   COMPLEX2    NOCARE2     TOUCH2   INTERES2     NOSAY1
             --------   --------   --------   --------   --------   --------
   NOSAY2       0.436
 COMPLEX2       0.126      0.435
  NOCARE2       0.204      0.130      0.418
   TOUCH2       0.127      0.065      0.201      0.380
 INTERES2       0.159      0.100      0.248      0.223      0.413
   NOSAY1       0.176      0.101      0.165      0.105      0.141      0.565
 COMPLEX1       0.086      0.175      0.099      0.067      0.094      0.174
  NOCARE1       0.140      0.083      0.184      0.109      0.150      0.282
   TOUCH1       0.087      0.055      0.133      0.120      0.126      0.204
 INTERES1       0.121      0.082      0.168      0.141      0.178      0.228

         Covariance Matrix

             COMPLEX1    NOCARE1     TOUCH1   INTERES1
             --------   --------   --------   --------
 COMPLEX1       0.521
  NOCARE1       0.190      0.538
   TOUCH1       0.139      0.271      0.488
 INTERES1       0.159      0.308      0.300      0.516
```

The parameter specifications follow next. Care should be taken to verify that these are correctly specified for the model to be fitted.

The maximum likelihood estimates for all LISREL matrices are given subsequently.

LAMBDA-Y

	NOSAY1	VOTING1
NOSAY2	1.000	- -
COMPLEX2	0.651 (0.047) 13.882	- -
NOCARE2	0.609 (0.092) 6.642	0.521 (0.066) 7.909
TOUCH2	- -	0.838 (0.033) 25.643
INTERES2	- -	1.000

LAMBDA-X

	Efficac2	Respons2
NOSAY1	1.000	- -
COMPLEX1	0.651 (0.047) 13.882	- -
NOCARE1	0.609 (0.092) 6.642	0.521 (0.066) 7.909
TOUCH1	- -	0.838 (0.033) 25.643
INTERES1	- -	1.000

GAMMA

	Efficac2	Respons2
NOSAY1	0.515 (0.041) 12.466	- -
VOTING1	- -	0.483 (0.035) 13.710

Covariance Matrix of ETA and KSI

	NOSAY1	VOTING1	Efficac2	Respons2
NOSAY1	0.196			
VOTING1	0.155	0.275		
Efficac2	0.137	0.112	0.266	
Respons2	0.120	0.166	0.233	0.345

PHI

	Efficac2	Respons2
Efficac2	0.266	
	(0.027)	
	9.750	
Respons2	0.233	0.345
	(0.017)	(0.024)
	13.350	14.119

PSI

	NOSAY1	VOTING1
NOSAY1	0.125	
	(0.017)	
	7.483	
VOTING1	0.097	0.195
	(0.010)	(0.016)
	9.398	11.995

Squared Multiple Correlations for Structural Equations

NOSAY1	VOTING1
0.360	0.292

THETA-EPS

NOSAY2	COMPLEX2	NOCARE2	TOUCH2	INTERES2
0.239	0.355	0.159	0.196	0.138
(0.020)	(0.018)	(0.011)	(0.012)	(0.013)
12.083	19.537	13.868	16.150	10.771

Squared Multiple Correlations for Y - Variables

NOSAY2	COMPLEX2	NOCARE2	TOUCH2	INTERES2
0.451	0.190	0.607	0.497	0.666

THETA-DELTA-EPS

	NOSAY2	COMPLEX2	NOCARE2	TOUCH2	INTERES2
NOSAY1	0.030 (0.007) 4.358	- -	- -	- -	- -
COMPLEX1	- -	0.116 (0.007) 16.359	- -	- -	- -
NOCARE1	- -	- -	0.016 (0.005) 3.635	- -	- -
TOUCH1	- -	- -	- -	0.013 (0.005) 2.859	- -
INTERES1	- -	- -	- -	- -	0.007 (0.005) 1.532

THETA-DELTA

NOSAY1	COMPLEX1	NOCARE1	TOUCH1	INTERES1
0.295	0.404	0.212	0.235	0.171
(0.023)	(0.021)	(0.015)	(0.014)	(0.015)
12.749	19.498	14.183	16.450	11.524

Squared Multiple Correlations for X - Variables

NOSAY1	COMPLEX1	NOCARE1	TOUCH1	INTERES1
0.474	0.218	0.615	0.507	0.668

TAU-Y

NOSAY2	COMPLEX2	NOCARE2	TOUCH2	INTERES2
2.602	2.105	2.380	2.172	2.296
(0.023)	(0.021)	(0.023)	(0.021)	(0.023)
112.199	102.137	104.178	104.932	100.498

TAU-X

NOSAY1	COMPLEX1	NOCARE1	TOUCH1	INTERES1
2.602	2.105	2.380	2.172	2.296
(0.023)	(0.021)	(0.023)	(0.021)	(0.023)
112.199	102.137	104.178	104.932	100.498

```
ALPHA

     NOSAY1    VOTING1
   --------   --------
      0.036      0.003
    (0.022)    (0.023)
      1.624      0.154
```

Of particular interest is the estimated mean differences reported in ALPHA. These differences are not significant and so we conclude that there is no significant increase or decrease in Efficacy or Respons between the two occasions.

In general, based on these results we conclude that the measurement model is the same at both time points. Almost all estimated parameters are statistically significant. All the estimates of error covariances are positive which is in line with the interpretation of them as variances of the specific factors. Only the error variance of INTERES is non-significant. It should be noted that this does not mean that it does not exist, but simply that the sample is not large enough to make it significant.

```
Global Goodness of Fit Statistics, FIML case


                -2ln(L) for the saturated model =       16045.447
                -2ln(L) for the fitted model    =       16077.746

 Degrees of Freedom = 31
 Full Information ML Chi-Square                         32.299 (P = 0.4024)
 Root Mean Square Error of Approximation (RMSEA)        0.00670
 90 Percent Confidence Interval for RMSEA               (0.0 ; 0.0257)
 P-Value for Test of Close Fit (RMSEA < 0.05)           1.00
```

The goodness of fit statistics indicates a good fit for this model, regardless of all the constraints imposed.