Two-Factor CFA Example in Mplus

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Mplus VERSION 8.9
MUTHEN & MUTHEN
INPUT INSTRUCTIONS


  title:  Self-esteem CFA Example--Two Factor Model;

    data:  file=se1.dat;  format=free;
    !note that this data set contains no missing values;

    variable:  names = rnotworr rnumqal ramfailr ramable rnotprdr rfelpos;

  analysis:  type=general; estimator=ml;
  !I am using regular maximum likelihood estimation at this point in the course,
  !but I usually recommend the Mplus default--robust estmation (MLM without missing data
  !and MLR with missing data). More on missing data and nonnormality later in the course;

  model: selfneg by rnotworr ramfailr rnotprdr;
         selfpos by rnumqal ramable rfelpos;

  output:  stdyx ;




INPUT READING TERMINATED NORMALLY



Self-esteem CFA Example--Two Factor Model;

SUMMARY OF ANALYSIS

Number of groups                                                 1
Number of observations                                         118

Number of dependent variables                                    6
Number of independent variables                                  0
Number of continuous latent variables                            2

Observed dependent variables

  Continuous
   RNOTWORR    RNUMQAL     RAMFAILR    RAMABLE     RNOTPRDR    RFELPOS

Continuous latent variables
   SELFNEG     SELFPOS


Estimator                                                       ML
Information matrix                                        OBSERVED
Maximum number of iterations                                  1000
Convergence criterion                                    0.500D-04
Maximum number of steepest descent iterations                   20


THE MODEL ESTIMATION TERMINATED NORMALLY


MODEL FIT INFORMATION

Number of Free Parameters                       19

Loglikelihood

          H0 Value                       -757.171
          H1 Value                       -747.474

Information Criteria

          Akaike (AIC)                   1552.341
          Bayesian (BIC)                 1604.984
          Sample-Size Adjusted BIC       1544.921
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(n* = (n + 2) / 24)

Chi-Square Test of Model Fit

Value	19.393
Degrees of Freedom	8
P-Value	0.0129

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.110	
90 Percent C.I.	0.048	0.173
Probability RMSEA <= .05	0.056	

CFI/TLI

CFI	0.902
TLI	0.816

Chi-Square Test of Model Fit for the Baseline Model

Value	131.265
Degrees of Freedom	15
P-Value	0.0000

SRMR (Standardized Root Mean Square Residual)

Value	0.054

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
SELFNEG BY				
RNOTWORR	1.000	0.000	999.000	999.000
RAMFAILR	0.967	0.213	4.536	0.000
RNOTPRDR	1.266	0.320	3.957	0.000
SELFPOS BY				
RNUMQAL	1.000	0.000	999.000	999.000
RAMABLE	0.417	0.315	1.324	0.186
RFELPOS	0.740	0.270	2.736	0.006
SELFPOS WITH				
SELFNEG	0.146	0.041	3.591	0.000
Intercepts				
RNOTWORR	3.653	0.093	39.222	0.000
RNUMQAL	4.093	0.052	78.379	0.000
RAMFAILR	4.008	0.066	60.566	0.000
RAMABLE	3.475	0.086	40.316	0.000
RNOTPRDR	3.992	0.064	62.391	0.000
RFELPOS	3.678	0.068	54.351	0.000
Variances				
SELFNEG	0.230	0.099	2.326	0.020
SELFPOS	0.103	0.052	1.966	0.049
Residual Variances				
RNOTWORR	0.793	0.116	6.856	0.000
RNUMQAL	0.219	0.051	4.274	0.000
RAMFAILR	0.301	0.059	5.105	0.000
RAMABLE	0.859	0.113	7.614	0.000
RNOTPRDR	0.114	0.063	1.807	0.071
RFELPOS	0.484	0.067	7.229	0.000

QUALITY OF NUMERICAL RESULTS

Condition Number for the Information Matrix (ratio of smallest to largest eigenvalue)	0.127E-02

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STANDARDIZED MODEL RESULTS


STDYX Standardization

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

 SELFNEG  BY
    RNOTWORR           0.474      0.089      5.315      0.000
    RAMFAILR           0.646      0.085      7.585      0.000
    RNOTPRDR           0.875      0.075     11.590      0.000

 SELFPOS  BY
    RNUMQAL            0.566      0.132      4.277      0.000
    RAMABLE            0.143      0.108      1.327      0.185
    RFELPOS            0.323      0.105      3.083      0.002

 SELFPOS  WITH
    SELFNEG            0.950      0.193      4.934      0.000

 Intercepts
    RNOTWORR           3.611      0.252     14.305      0.000
    RNUMQAL            7.215      0.479     15.075      0.000
    RAMFAILR           5.576      0.374     14.891      0.000
    RAMABLE            3.711      0.259     14.355      0.000
    RNOTPRDR           5.744      0.385     14.917      0.000
    RFELPOS            5.003      0.338     14.783      0.000

 Variances
    SELFNEG            1.000      0.000    999.000    999.000
    SELFPOS            1.000      0.000    999.000    999.000

 Residual Variances
    RNOTWORR           0.775      0.085      9.147      0.000
    RNUMQAL            0.679      0.150      4.533      0.000
    RAMFAILR           0.583      0.110      5.304      0.000
    RAMABLE            0.980      0.031     31.725      0.000
    RNOTPRDR           0.235      0.132      1.781      0.075
    RFELPOS            0.895      0.068     13.208      0.000


R-SQUARE

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    RNOTWORR           0.225      0.085      2.657      0.008
    RNUMQAL            0.321      0.150      2.139      0.032
    RAMFAILR           0.417      0.110      3.792      0.000
    RAMABLE            0.020      0.031      0.663      0.507
    RNOTPRDR           0.765      0.132      5.795      0.000
    RFELPOS            0.105      0.068      1.542      0.123
```

Two-Factor CFA Example in lavaan

```
## Two-factor CFA example, Newsom's SEM Class, self-esteem
>
> #there is an error in the variable names list and there should be more:
> #rnotworr ' ' rnumqal ' ' ramfailr ' ' ramable ' 'rnotprdr ' '
> #rfelpos ' ' rfelsat ' 'rwishmrr ' ' ruselesr ' ' rspnogdr .
> d <- read.table(file=paste('c:/jason/mplus/semclass/se1.dat',sep="/"))
> names(d) = c("rnotworr","rnumqal","ramfailr","ramable","rnotprdr","rfelpos")
> #Note, there are no missing values, otherwise might need to identify, e.g.,
> ##d[d == -99] <- NA
>
> library(lavaan)
This is lavaan 0.6-15
lavaan is FREE software! Please report any bugs.
> model = '
+         selfneg =~ rnotworr + ramfailr + rnotprdr
+         selfpos =~ rnumqal + ramable  + rfelpos
+ '
> # For now, I use the following analysis commands to estimate using ML, non-robust,
> #   with no missing data estimation
> fit = sem(model, data = d)
```

```
> 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                        13

  Number of observations                           118

Model Test User Model:

  Test statistic                                19.393
  Degrees of freedom                                 8
  P-value (Chi-square)                           0.013

Model Test Baseline Model:

  Test statistic                               131.265
  Degrees of freedom                                15
  P-value                                        0.000

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                    0.902
  Tucker-Lewis Index (TLI)                       0.816

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)                -757.171
  Loglikelihood unrestricted model (H1)        -747.474

  Akaike (AIC)                                 1540.341
  Bayesian (BIC)                               1576.360
  Sample-size adjusted Bayesian (SABIC)        1535.264

Root Mean Square Error of Approximation:

  RMSEA                                          0.110
  90 Percent confidence interval - lower         0.048
  90 Percent confidence interval - upper         0.173
  P-value H_0: RMSEA <= 0.050                    0.056
  P-value H_0: RMSEA >= 0.080                    0.814

Standardized Root Mean Square Residual:

  SRMR                                           0.061

Parameter Estimates:

  Standard errors                             Standard
  Information                                 Expected
  Information saturated (h1) model          Structured

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  selfneg =~
    rnotworr          1.000                               0.480    0.474
    ramfailr          0.967    0.220    4.403    0.000    0.464    0.646
    rnotprdr          1.266    0.282    4.495    0.000    0.608    0.875
  selfpos =~
    rnumqal           1.000                               0.321    0.566
    ramable           0.417    0.311    1.341    0.180    0.134    0.143
    rfelpos           0.740    0.260    2.849    0.004    0.238    0.323

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  selfneg ~~
    selfpos           0.146    0.042    3.450    0.001    0.950    0.950

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .rnotworr          0.793    0.111    7.134    0.000    0.793    0.775
   .ramfailr          0.301    0.050    6.025    0.000    0.301    0.583
   .rnotprdr          0.114    0.053    2.162    0.031    0.114    0.235
   .rnumqal           0.219    0.050    4.390    0.000    0.219    0.679
   .ramable           0.859    0.113    7.626    0.000    0.859    0.980
   .rfelpos           0.484    0.067    7.207    0.000    0.484    0.895
    selfneg           0.230    0.094    2.457    0.014    1.000    1.000
    selfpos           0.103    0.051    2.017    0.044    1.000    1.000

R-Square:
                   Estimate
    rnotworr          0.225
    ramfailr          0.417
    rnotprdr          0.765
```

```
    rnumqal            0.321
    ramable            0.020
    rfelpos            0.105
```

A two-factor confirmatory factor model of a six-item version of the Rosenberg self-esteem scale (Rosenberg, 1965) was tested using Mplus version 8.9 (Muthén, & Muthén, 1998-2017). The chi-square value was significant, χ^2 (8) = 19.393, p = .0129, suggesting poor fit to the data. Because chi-square is sensitive to sample size and several other conditions, however, alternative fit indices were examined to determine whether the fit was adequate. Taken together, the alternative fit indices suggested unacceptable or marginally unacceptable fit, CFI = .902, SRMR = .061, because the Comparative Fit Index did not reach standards suggested by Hu and Bentler (1999) for a good fitting model. In addition, the results suggested that two items, assessing perceived ability to do things well and feeling positive about oneself, had unacceptable standardized loadings on the second factor (λ_{52} = .143, ns, and λ_{62} = .323, p < .01, respectively). A nested comparison of the one-factor model and the two-factor model indicated that the two-factor model did not fit significantly better than the one-factor model, $\Delta\chi^2$ (1) = 0.061, ns).