Modification Index Examples

Mplus

(output excerpts)

```
INPUT INSTRUCTIONS


  title:  Self-esteem CFA Example--One Factor;

  ! I recommend using free format with tab-delimited data, however;
  data:  file=c:\jason\spsswin\arc\se1.dat;  format=free;
   ! there are no missing values in this data set

  variable:  names = rnotworr rnumqal ramfailr ramable rnotprdr rfelpos;

  !  For now, use the following analysis commands to estimate using ML, non-robust,
  !   with no missing data estimation and no meanstructure (the default in most packages);

  analysis:  type=general; estimator=ml;
     model=nomeanstructure; information=expected;

  model: se by rnotworr-rfelpos;

  output:  stdyx modindices(all 3.84);
  ! The keyword all means modification indices for associations
  !  with covariates are included and the 3.84 requests any modification
  ! indices over the chi-square critical value for 1 df.



INPUT READING TERMINATED NORMALLY



Self-esteem CFA Example--One Factor;

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                            1


Estimator                                                       ML

MODEL FIT INFORMATION

Number of Free Parameters                       12

Loglikelihood

          H0 Value                       -757.201
          H1 Value                       -747.474

Information Criteria

          Akaike (AIC)                   1538.402
          Bayesian (BIC)                 1571.650
          Sample-Size Adjusted BIC       1533.715
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             19.454
          Degrees of Freedom                     9
          P-Value                           0.0216
```

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.099	
90 Percent C.I.	0.036	0.160
Probability RMSEA <= .05	0.086	

CFI/TLI

CFI	0.910
TLI	0.850

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	0.061

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
SE BY				
RNOTWORR	1.000	0.000	999.000	999.000
RNUMQAL	0.637	0.159	4.012	0.000
RAMFAILR	0.969	0.220	4.405	0.000
RAMABLE	0.265	0.202	1.309	0.190
RNOTPRDR	1.262	0.279	4.521	0.000
RFELPOS	0.478	0.174	2.751	0.006
Variances				
SE	0.231	0.094	2.460	0.014
Residual Variances				
RNOTWORR	0.793	0.111	7.134	0.000
RNUMQAL	0.228	0.033	6.866	0.000
RAMFAILR	0.300	0.050	6.029	0.000
RAMABLE	0.860	0.112	7.650	0.000
RNOTPRDR	0.116	0.051	2.269	0.023
RFELPOS	0.488	0.065	7.496	0.000

STANDARDIZED MODEL RESULTS

STDYX Standardization

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
SE BY				
RNOTWORR	0.475	0.083	5.724	0.000
RNUMQAL	0.539	0.078	6.898	0.000
RAMFAILR	0.648	0.071	9.174	0.000
RAMABLE	0.136	0.100	1.361	0.173
RNOTPRDR	0.872	0.062	14.068	0.000
RFELPOS	0.312	0.093	3.349	0.001
Variances				
SE	1.000	0.000	999.000	999.000
Residual Variances				
RNOTWORR	0.775	0.079	9.833	0.000
RNUMQAL	0.709	0.084	8.415	0.000
RAMFAILR	0.581	0.091	6.353	0.000
RAMABLE	0.982	0.027	36.213	0.000
RNOTPRDR	0.240	0.108	2.219	0.026

RFELPOS	0.903	0.058	15.525	0.000

R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
RNOTWORR	0.225	0.079	2.862	0.004
RNUMQAL	0.291	0.084	3.449	0.001
RAMFAILR	0.419	0.091	4.587	0.000
RAMABLE	0.018	0.027	0.681	0.496
RNOTPRDR	0.760	0.108	7.034	0.000
RFELPOS	0.097	0.058	1.675	0.094

QUALITY OF NUMERICAL RESULTS

Condition Number for the Information Matrix 0.608E-02
(ratio of smallest to largest eigenvalue)

MODEL MODIFICATION INDICES

Minimum M.I. value for printing the modification index 3.840

	M.I.	E.P.C.	Std E.P.C.	StdYX E.P.C.
ON Statements				
RNOTWORR ON RNUMQAL	9.518	-0.603	-0.603	-0.338
RNOTWORR ON RAMFAILR	11.227	0.637	0.637	0.453
RNUMQAL ON RNOTWORR	9.518	-0.174	-0.174	-0.310
RNUMQAL ON RNOTPRDR	12.921	1.327	1.327	1.625
RAMFAILR ON RNOTWORR	11.225	0.241	0.241	0.340
RAMFAILR ON RNOTPRDR	6.653	-1.563	-1.563	-1.511
RNOTPRDR ON RNUMQAL	12.918	0.673	0.673	0.549
RNOTPRDR ON RAMFAILR	6.645	-0.603	-0.603	-0.624
WITH Statements				
RNUMQAL WITH RNOTWORR	9.518	-0.138	-0.138	-0.324
RAMFAILR WITH RNOTWORR	11.226	0.191	0.191	0.392
RNOTPRDR WITH RNUMQAL	12.917	0.154	0.154	0.945
RNOTPRDR WITH RAMFAILR	6.645	-0.181	-0.181	-0.970

Lavaan

```
## On-factor CFA example, Newsom's SEM Class, self-esteem

mydata <- read.table(file=paste('c:/jason/r/semclass/se1.dat',sep="/"))
names(mydata) = c("rnotworr","rnumqal","ramfailr","ramable","rnotprdr","rfelpos")
#Note, there are no missing values, otherwise might need to identify, e.g.,
##mydata[mydata == -99] <- NA

library(lavaan)

model = '
       se =~ rnotworr + rnumqal + ramfailr + ramable + rnotprdr + rfelpos
'

# For now, I use the following analysis commands to estimate using ML, non-robust,
#   with no missing data estimation and no meanstructure
fit = sem(model, data = se1)
summary(fit,fit.measures=TRUE, rsquare=TRUE, standardized=TRUE)
modificationIndices(fit)
```

(excerpt)

```
                   Estimate  Std.err  Z-value  P(>|z|)   Std.lv  Std.all
Latent variables:
  se =~
    rnotworr          1.000                               0.480    0.475
    rnumqal           0.637    0.159    4.012    0.000    0.306    0.539
    ramfailr          0.969    0.220    4.405    0.000    0.466    0.647
    ramable           0.265    0.202    1.309    0.190    0.127    0.136
    rnotprdr          1.262    0.279    4.521    0.000    0.606    0.872
    rfelpos           0.478    0.174    2.751    0.006    0.229    0.312
```

```
> modificationIndices(fit)
        lhs op      rhs     mi    epc sepc.lv sepc.all sepc.nox
1        se =~ rnotworr     NA     NA      NA       NA       NA
2        se =~  rnumqal  0.000  0.000   0.000    0.000    0.000
3        se =~ ramfailr  0.000  0.000   0.000    0.000    0.000
4        se =~  ramable  0.000  0.000   0.000    0.000    0.000
5        se =~ rnotprdr  0.000  0.000   0.000    0.000    0.000
6        se =~  rfelpos  0.000  0.000   0.000    0.000    0.000
7  rnotworr ~~ rnotworr  0.000  0.000   0.000    0.000    0.000
8  rnotworr ~~  rnumqal  9.519 -0.138  -0.138   -0.240   -0.240
9  rnotworr ~~ ramfailr 11.226  0.191   0.191    0.263    0.263
10 rnotworr ~~  ramable  0.301 -0.043  -0.043   -0.046   -0.046
11 rnotworr ~~ rnotprdr  0.261 -0.035  -0.035   -0.049   -0.049
12 rnotworr ~~  rfelpos  0.035 -0.011  -0.011   -0.015   -0.015
13  rnumqal ~~  rnumqal  0.000  0.000   0.000    0.000    0.000
14  rnumqal ~~ ramfailr  2.016 -0.048  -0.048   -0.117   -0.117
15  rnumqal ~~  ramable  0.229  0.021   0.021    0.039    0.039
16  rnumqal ~~ rnotprdr 12.914  0.154   0.154    0.390    0.390
17  rnumqal ~~  rfelpos  0.006  0.003   0.003    0.006    0.006
18 ramfailr ~~ ramfailr  0.000  0.000   0.000    0.000    0.000
19 ramfailr ~~  ramable  1.209  0.056   0.056    0.084    0.084
20 ramfailr ~~ rnotprdr  6.644 -0.181  -0.181   -0.362   -0.362
21 ramfailr ~~  rfelpos  0.560  0.030   0.030    0.057    0.057
22  ramable ~~  ramable  0.000  0.000   0.000    0.000    0.000
23  ramable ~~ rnotprdr  0.703 -0.043  -0.043   -0.067   -0.067
24  ramable ~~  rfelpos  0.003 -0.004  -0.004   -0.005   -0.005
25 rnotprdr ~~ rnotprdr  0.000  0.000   0.000    0.000    0.000
26 rnotprdr ~~  rfelpos  0.299 -0.023  -0.023   -0.046   -0.046
27  rfelpos ~~  rfelpos  0.000  0.000   0.000    0.000    0.000
28       se ~~       se  0.000  0.000   0.000    0.000    0.000
```