Example of a MASEM-analysis using the OC approach

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Contents

Installing the metaSEM package

- R can be downloaded at http://www.r-project.org/.
- We only need to install the metaSEM-package once.

```
install.packages("metaSEM")
```

Loading metaSEM and the Stage1.OC() function

```
library(metaSEM)
```

```
## Warning: package 'metaSEM' was built under R version 3.3.3
```

```
## Warning: package 'OpenMx' was built under R version 3.3.3
```

```
# read the Stage1.OC() function from an URL
source("http://www.suzannejak.nl/Stage1.OC.R")
```

Loading the data

- The datafile should be saved in the working directory, it can be downloaded from http://www.suzannejak.nl/exampledata.R

```
load("exampledata.R")

data <- exampledat$data
n <- exampledat$n

## show part of the data
## NA's represent missing correlations
head(data)
```

```
## $`1`
##           v1        v2        v3        v4 v5
## v1 1.0000000        NA 0.1337607 0.3790011 NA
## v2        NA 1.0000000 0.3176261 0.5343438 NA
## v3 0.1337607 0.3176261 1.0000000 0.2490913 NA
```

```
## v4 0.3790011 0.5343438 0.2490913 1.0000000 NA
## v5        NA        NA        NA        NA NA
##
## $`2`
##           v1        v2        v3        v4 v5
## v1 1.0000000 0.4277664 0.2104662 0.4189287 NA
## v2 0.4277664 1.0000000 0.2254605 0.5791790 NA
## v3 0.2104662 0.2254605 1.0000000 0.2434884 NA
## v4 0.4189287 0.5791790 0.2434884 1.0000000 NA
## v5        NA        NA        NA        NA NA
##
## $`3`
##           v1        v2         v3        v4         v5
## v1 1.0000000        NA 0.12120473 0.3869396 0.16440272
## v2        NA 1.0000000 0.28942770 0.5320153 0.22664944
## v3 0.1212047 0.2894277 1.00000000 0.2968476 0.09832017
## v4 0.3869396 0.5320153 0.29684761 1.0000000         NA
## v5 0.1644027 0.2266494 0.09832017        NA 1.00000000
##
## $`4`
##           v1        v2        v3        v4        v5
## v1 1.0000000        NA 0.1762705 0.3357207 0.1899715
## v2        NA 1.0000000 0.3682914 0.5684330 0.2579966
## v3 0.1762705 0.3682914 1.0000000 0.3413604 0.2251231
## v4 0.3357207 0.5684330 0.3413604 1.0000000 0.4965113
## v5 0.1899715 0.2579966 0.2251231 0.4965113 1.0000000
##
## $`5`
##           v1        v2        v3        v4 v5
## v1 1.0000000 0.4237114 0.1475889 0.3858164 NA
## v2 0.4237114 1.0000000 0.1648990 0.5951703 NA
## v3 0.1475889 0.1648990 1.0000000 0.2303143 NA
## v4 0.3858164 0.5951703 0.2303143 1.0000000 NA
## v5        NA        NA        NA        NA NA
##
## $`6`
##           v1        v2        v3        v4 v5
## v1 1.0000000        NA 0.1931003 0.3732731 NA
## v2        NA 1.0000000 0.1878165 0.4958514 NA
## v3 0.1931003 0.1878165 1.0000000 0.3248142 NA
## v4 0.3732731 0.4958514 0.3248142 1.0000000 NA
## v5        NA        NA        NA        NA NA
```

Fit the Stage 1 model

```
stage1.fit <- Stage1.OC(data,n)
```

- The parameters named 'varname_varname' (for example 'v1_v2') without an additional subscript are the estimated pooled correlations

```
stage1.fit$summary
```

```
## Summary of Stage1
##
```

```
## free parameters:
##              name    matrix row col  Estimate  Std.Error A
## 1         v2_v1_1  Study1.R   1   2 0.4082216 0.05677017
## 2           v3_v1  Study1.R   1   3 0.1723269 0.01866181
## 3           v3_v2  Study1.R   2   3 0.2500300 0.01803853
## 4           v4_v1  Study1.R   1   4 0.3844283 0.01677918
## 5           v4_v2  Study1.R   2   4 0.5612909 0.01347725
## 6           v4_v3  Study1.R   3   4 0.2733916 0.01809644
## 7   Study1.D[1,1]  Study1.D   1   1 1.0003962 0.05404203
## 8   Study1.D[2,2]  Study1.D   2   2 1.0033897 0.05150474
## 9   Study1.D[3,3]  Study1.D   3   3 0.9961179 0.05461772
## 10  Study1.D[4,4]  Study1.D   4   4 1.0079903 0.05136543
## 11          v2_v1  Study2.R   1   2 0.3961914 0.02066434
## 12  Study2.D[1,1]  Study2.D   1   1 0.9876256 0.03758887
## 13  Study2.D[2,2]  Study2.D   2   2 0.9889389 0.03593669
## 14  Study2.D[3,3]  Study2.D   3   3 1.0014348 0.03946251
## 15  Study2.D[4,4]  Study2.D   4   4 0.9899748 0.03596041
## 16        v2_v1_3  Study3.R   1   2 0.4085775 0.03422400
## 17          v5_v1  Study3.R   1   5 0.1923540 0.02384504
## 18          v5_v2  Study3.R   2   5 0.2570609 0.02319053
## 19          v5_v3  Study3.R   3   5 0.1610699 0.02400087
## 20        v5_v4_3  Study3.R   4   5 0.4798270 0.03186567
## 21  Study3.D[1,1]  Study3.D   1   1 1.0022034 0.03225473
## 22  Study3.D[2,2]  Study3.D   2   2 1.0075205 0.03105862
## 23  Study3.D[3,3]  Study3.D   3   3 0.9973941 0.03248184
## 24  Study3.D[4,4]  Study3.D   4   4 1.0106213 0.03075806
## 25  Study3.D[5,5]  Study3.D   5   5 1.0061537 0.03306331
## 26        v2_v1_4  Study4.R   1   2 0.4200181 0.05127224
## 27          v5_v4  Study4.R   4   5 0.4614729 0.03055451
## 28  Study4.D[1,1]  Study4.D   1   1 1.0048568 0.04935553
## 29  Study4.D[2,2]  Study4.D   2   2 0.9900994 0.04598144
## 30  Study4.D[3,3]  Study4.D   3   3 0.9817736 0.04843889
## 31  Study4.D[4,4]  Study4.D   4   4 0.9862023 0.04370591
## 32  Study4.D[5,5]  Study4.D   5   5 0.9858476 0.04769470
## 33  Study5.D[1,1]  Study5.D   1   1 0.9944915 0.03173957
## 34  Study5.D[2,2]  Study5.D   2   2 0.9892372 0.03014256
## 35  Study5.D[3,3]  Study5.D   3   3 1.0090789 0.03332190
## 36  Study5.D[4,4]  Study5.D   4   4 0.9910450 0.03018272
## 37        v2_v1_6  Study6.R   1   2 0.4173744 0.04101664
## 38  Study6.D[1,1]  Study6.D   1   1 1.0042399 0.04006509
## 39  Study6.D[2,2]  Study6.D   2   2 1.0252479 0.03925901
## 40  Study6.D[3,3]  Study6.D   3   3 0.9979039 0.04023611
## 41  Study6.D[4,4]  Study6.D   4   4 1.0176855 0.03851655
## 42        v5_v4_7  Study7.R   4   5 0.4689783 0.05024808
## 43  Study7.D[1,1]  Study7.D   1   1 1.0215404 0.05340393
## 44  Study7.D[2,2]  Study7.D   2   2 1.0056254 0.04957512
## 45  Study7.D[3,3]  Study7.D   3   3 1.0220451 0.05497446
## 46  Study7.D[4,4]  Study7.D   4   4 1.0227939 0.05026655
## 47  Study7.D[5,5]  Study7.D   5   5 1.0040288 0.05367500
## 48  Study8.D[1,1]  Study8.D   1   1 1.0000747 0.03697773
## 49  Study8.D[2,2]  Study8.D   2   2 1.0043971 0.03550675
## 50  Study8.D[3,3]  Study8.D   3   3 0.9959951 0.03762448
## 51  Study8.D[4,4]  Study8.D   4   4 0.9992211 0.03451656
## 52  Study8.D[5,5]  Study8.D   5   5 1.0024216 0.03775416
```

```
## 53        v5_v4_9  Study9.R   4   5 0.4469941 0.04817291
## 54  Study9.D[1,1]  Study9.D   1   1 0.9877207 0.04649311
## 55  Study9.D[2,2]  Study9.D   2   2 0.9808660 0.04375659
## 56  Study9.D[3,3]  Study9.D   3   3 0.9848725 0.04759421
## 57  Study9.D[4,4]  Study9.D   4   4 0.9795266 0.04310023
## 58  Study9.D[5,5]  Study9.D   5   5 0.9896828 0.04807775
## 59       v2_v1_10 Study10.R   1   2 0.3708073 0.06741842
## 60 Study10.D[1,1] Study10.D   1   1 0.9831932 0.05474844
## 61 Study10.D[2,2] Study10.D   2   2 0.9748127 0.05317144
## 62 Study10.D[3,3] Study10.D   3   3 0.9835970 0.05459663
## 63 Study10.D[4,4] Study10.D   4   4 0.9819895 0.05437257
##
## Model Statistics:
##                |  Parameters  |  Degrees of Freedom  |  Fit (-2lnL units)
##        Model:             63                    62             10026.812
##    Saturated:            125                     0              9963.677
## Independence:             NA                    NA                    NA
## Number of observations/statistics: 2718/125
##
## chi-square:  <U+03C7>² ( df=62 ) = 63.13464,  p = 0.4360062
## Information Criteria:
##       |  df Penalty  |  Parameters Penalty  |  Sample-Size Adjusted
## AIC:      -60.86536              189.1346                       NA
## BIC:     -427.13976              561.3167                361.1456
## CFI: NA
## TLI: NA   (also known as NNFI)
## RMSEA:  0.002594831  [95% CI (0, 0.01313995)]
## Prob(RMSEA <= 0.05): 1
## To get additional fit indices, see help(mxRefModels)
## timestamp: 2017-10-10 11:52:50
## Wall clock time (HH:MM:SS.hh): 00:00:00.54
## optimizer:  SLSQP
## OpenMx version number: 2.7.12
## Need help?  See help(mxSummary)
```

Fit the Stage 2 model

- Create a matrix with direct effects (A) and a matrix with variances and covariances (S)
- For instruction regarding model specification see Jak (2015) or Cheung (2014).

```
nvar <- nrow(data[[1]])
varnames <- rownames(data[[1]])

Amatrix <- create.mxMatrix(
  c( 0,0,0,0,0,
     0,0,0,0,0,
     0,0,0,0,0,
     "0.2*b41","0.5*b42","0.1*b43",0,0,
     0,0,0,"0.4*b54",0),
  type = "Full",
  nrow = nvar,
  ncol = nvar,
  byrow = TRUE,
```

```
  name = "A",
  dimnames = list(varnames,varnames))


Smatrix <- create.mxMatrix(
  c("1",
    ".2*p21","1",
    ".2*p31",".2*p32","1",
    0,0,0,"1*p44",
    0,0,0,0,"1*p55"),
  type="Symm",
  byrow = TRUE,
  name="S",
  dimnames = list(varnames,varnames))
```

- Fitting the Stage 2 model on the pooled correlation matrix from the random effects Stage 1 analysis

```
Stage2.fit <- wls(Cov = stage1.fit$pooledR, asyCov = stage1.fit$acovR,
                  n = sum(n), Amatrix = Amatrix, Smatrix = Smatrix)

summary(Stage2.fit)
```

```
##
## Call:
## wls(Cov = stage1.fit$pooledR, asyCov = stage1.fit$acovR, n = sum(n),
##     Amatrix = Amatrix, Smatrix = Smatrix)
##
## 95% confidence intervals: z statistic approximation
## Coefficients:
##     Estimate Std.Error   lbound   ubound z value  Pr(>|z|)
## b41 0.181407  0.018181 0.145773 0.217042  9.9777 < 2.2e-16 ***
## b42 0.457195  0.016009 0.425818 0.488572 28.5584 < 2.2e-16 ***
## b43 0.128694  0.016314 0.096719 0.160669  7.8884 3.109e-15 ***
## b54 0.469241  0.027082 0.416161 0.522321 17.3265 < 2.2e-16 ***
## p21 0.396448  0.020666 0.355943 0.436952 19.1836 < 2.2e-16 ***
## p31 0.172007  0.018668 0.135418 0.208596  9.2139 < 2.2e-16 ***
## p32 0.250629  0.018047 0.215257 0.286001 13.8874 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Goodness-of-fit indices:
##                                                Value
## Sample size                                2718.0000
## Chi-square of target model                    2.8342
## DF of target model                            3.0000
## p value of target model                       0.4179
## Number of constraints imposed on "Smatrix"    0.0000
## DF manually adjusted                          0.0000
## Chi-square of independence model           2135.4534
## DF of independence model                     10.0000
## RMSEA                                         0.0000
## RMSEA lower 95% CI                            0.0000
## RMSEA upper 95% CI                            0.0317
## SRMR                                          0.0113
```

```
## TLI                                                 1.0003
## CFI                                                 1.0000
## AIC                                                -3.1658
## BIC                                               -20.8888
## OpenMx status1: 0 ("0" or "1": The optimization is considered fine.
## Other values indicate problems.)
```

References

- Jak, S. (2015). Meta-analytic structural equation modeling. Cham: Springer International Publishing
- Cheung, M.W.-L. (2014). MetaSEM: an R package for meta-analysis using structural equation modeling. Frontiers in Psychology, 5 (1521)