

Moderator analyses in OSMASEM

Ya (modified by Mike Cheung)

11/25/2020

- <https://openmx.ssri.psu.edu/node/4633>

```
library(metaSEM)
```

```
## Loading required package: OpenMx
```

```
## To take full advantage of multiple cores, use:
```

```
##   mxOption(key='Number of Threads', value=parallel::detectCores()) #now
```

```
##   Sys.setenv(OMP_NUM_THREADS=parallel::detectCores()) #before library(OpenMx)
```

```
## "SLSQP" is set as the default optimizer in OpenMx.
```

```
## mxOption(NULL, "Gradient algorithm") is set at "central".
```

```
## mxOption(NULL, "Optimality tolerance") is set at "6.3e-14".
```

```
## mxOption(NULL, "Gradient iterations") is set at "2".
```

```
library(readxl)
```

```
dat=read.csv('1.csv',header=T)
```

```
dat_matrix=split(dat[,c('r_x_med','r_x_y','r_med_y')],dat$studyid)
```

```
dat_matrix=lapply(dat_matrix,function(x){m=vec2symMat(as.numeric(x),diag=F)
```

```
dimnames(m)=list(c('x','med','y'),c('x','med','y')); m})
```

```
dat_matrix
```

```
## $`1`
```

```
##      x med      y
```

```
## x    1.00 NA -0.25
```

```
## med  NA  1  NA
```

```
## y   -0.25 NA  1.00
```

```
##
```

```
## $`2`
```

```
##      x med      y
```

```
## x    1.00 NA -0.42
```

```
## med  NA  1  NA
```

```
## y   -0.42 NA  1.00
```

```
##
```

```
## $`3`
```

```
##      x med      y
```

```
## x    1.00 NA -0.36
```

```
## med  NA  1  NA
```

```
## y   -0.36 NA  1.00
```

```
##
```

```
## $`4`
```

```
##      x med      y
```

```
## x    1.00 NA -0.37
```

```

## med    NA    1    NA
## y   -0.37  NA    1.00
##
## $`5`
##      x med    y
## x    1.00  NA  -0.06
## med   NA    1    NA
## y   -0.06  NA    1.00
##
## $`6`
##      x med    y
## x    1.00  NA  -0.26
## med   NA    1    NA
## y   -0.26  NA    1.00
##
## $`7`
##      x med    y
## x    1.00  NA  -0.34
## med   NA    1    NA
## y   -0.34  NA    1.00
##
## $`8`
##      x med    y
## x     1   NA    0
## med  NA    1   NA
## y     0   NA    1
##
## $`9`
##      x med    y
## x    1.00  NA  -0.13
## med   NA    1    NA
## y   -0.13  NA    1.00
##
## $`10`
##      x med    y
## x    1.00  NA  -0.36
## med   NA    1    NA
## y   -0.36  NA    1.00
##
## $`11`
##      x med    y
## x    1.00  NA  -0.09
## med   NA    1    NA
## y   -0.09  NA    1.00
##
## $`12`
##      x med    y
## x    1.00  NA   0.12
## med   NA    1    NA
## y    0.12  NA    1.00
##
## $`13`
##      x med    y
## x     1   NA    0

```

```

## med NA 1 NA
## y 0 NA 1
##
## $`14`
##      x med y
## x 1.00 -0.45 NA
## med -0.45 1.00 0.89
## y NA 0.89 1.00
##
## $`15`
##      x med y
## x 1.0 -0.20 NA
## med -0.2 1.00 0.42
## y NA 0.42 1.00
##
## $`16`
##      x med y
## x 1.0 0.10 NA
## med 0.1 1.00 0.85
## y NA 0.85 1.00
##
## $`17`
##      x med y
## x 1.00 0.06 NA
## med 0.06 1.00 0.57
## y NA 0.57 1.00
##
## $`18`
##      x med y
## x 1 0.00 NA
## med 0 1.00 0.64
## y NA 0.64 1.00
##
## $`19`
##      x med y
## x 1.00 -0.12 NA
## med -0.12 1.00 0.55
## y NA 0.55 1.00
##
## $`20`
##      x med y
## x 1.00 -0.26 NA
## med -0.26 1.00 0.2
## y NA 0.20 1.0
##
## $`21`
##      x med y
## x 1.00 -0.08 NA
## med -0.08 1.00 0.76
## y NA 0.76 1.00
##
## $`22`
##      x med y
## x 1.00 0.25 0.73

```

```

## med 0.25 1.00 0.36
## y 0.73 0.36 1.00
##
## $`23`
##      x med y
## x 1.00 0.02 0.91
## med 0.02 1.00 0.29
## y 0.91 0.29 1.00
##
## $`24`
##      x med y
## x 1.00 -0.01 0.41
## med -0.01 1.00 NA
## y 0.41 NA 1.00
##
## $`25`
##      x med y
## x 1.00 -0.04 0.08
## med -0.04 1.00 NA
## y 0.08 NA 1.00
##
## $`26`
##      x med y
## x 1.00 0.3 0.73
## med 0.30 1.0 NA
## y 0.73 NA 1.00
##
## $`27`
##      x med y
## x 1.00 -0.16 0.07
## med -0.16 1.00 NA
## y 0.07 NA 1.00
##
## $`28`
##      x med y
## x 1.00 -0.38 0.32
## med -0.38 1.00 NA
## y 0.32 NA 1.00
##
## $`29`
##      x med y
## x 1.00 0.05 0.57
## med 0.05 1.00 NA
## y 0.57 NA 1.00
##
## $`30`
##      x med y
## x 1.00 -0.07 0.73
## med -0.07 1.00 NA
## y 0.73 NA 1.00
##
## $`31`
##      x med y
## x 1.00 -0.06 0.61

```

```

## med -0.06 1.00 NA
## y 0.61 NA 1.00
##
## $`32`
##      x med y
## x 1.00 NA 0.77
## med NA 1.0 0.30
## y 0.77 0.3 1.00
##
## $`33`
##      x med y
## x 1.00 NA 0.82
## med NA 1.00 0.31
## y 0.82 0.31 1.00
##
## $`34`
##      x med y
## x 1 NA NA
## med NA 1.00 -0.16
## y NA -0.16 1.00
##
## $`35`
##      x med y
## x 1 NA NA
## med NA 1.00 -0.09
## y NA -0.09 1.00
##
## $`36`
##      x med y
## x 1 NA NA
## med NA 1.00 -0.38
## y NA -0.38 1.00
##
## $`37`
##      x med y
## x 1 NA NA
## med NA 1.00 0.05
## y NA 0.05 1.00
##
## $`38`
##      x med y
## x 1 NA NA
## med NA 1.00 -0.07
## y NA -0.07 1.00
##
## $`39`
##      x med y
## x 1 NA NA
## med NA 1.00 -0.12
## y NA -0.12 1.00
##
## $`40`
##      x med y
## x 1 NA NA

```

```

## med NA 1.00 -0.06
## y NA -0.06 1.00
##
## $`41`
##      x med y
## x 1.00 NA 0.26
## med NA 1.0 0.10
## y 0.26 0.1 1.00
##
## $`42`
##      x med y
## x 1.00 NA 0.71
## med NA 1.00 -0.23
## y 0.71 -0.23 1.00
##
## $`43`
##      x med y
## x 1.00 NA 0.39
## med NA 1.00 -0.04
## y 0.39 -0.04 1.00
##
## $`44`
##      x med y
## x 1.00 NA 0.94
## med NA 1.00 -0.06
## y 0.94 -0.06 1.00
##
## $`45`
##      x med y
## x 1.00 NA 0.36
## med NA 1.00 -0.08
## y 0.36 -0.08 1.00

```

```
pattern.na(dat_matrix)
```

```

##      x med y
## x 0 27 15
## med 27 0 21
## y 15 21 0

```

```
is.pd(dat_matrix)
```

```

##      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
## NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA
## 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
## NA NA NA NA NA TRUE TRUE NA NA NA NA NA NA NA NA NA
## 33 34 35 36 37 38 39 40 41 42 43 44 45
## NA NA NA NA NA NA NA NA NA NA NA NA NA

```

```

dat2 <- Cor2DataFrame(dat_matrix, dat$sample_size, acov = "weighted")
dat2$data=data.frame(dat2$data, mod=scale(dat$moderator1), check.names=F) # check.names has to be False
dat2$data$mod[sample(length(dat2$data$mod),length(dat2$data$mod)*0.4)]=NA

mod="med ~ x; y ~ med + x; x ~~ 1*x"
ram=lavaan2RAM(mod, obs.variables=c("x","med","y"))
ram

```

```

## $A
##      x      med      y
## x   "0"      "0"      "0"
## med "0*medONx" "0"      "0"
## y   "0*yONx"   "0*yONmed" "0"
##
## $S
##      x med      y
## x   "1" "0"      "0"
## med "0" "0*medWITHmed" "0"
## y   "0" "0"      "0*yWITHy"
##
## $F
##      x med y
## x   1  0  0
## med 0  1  0
## y   0  0  1
##
## $M
##      x med y
## 1  0  0  0

```

one stage MASEM no moderator

```

osmasem1=osmasem(model.name='no moderator',RAM=ram,data=dat2)
summary(osmasem1)

```

```

## Summary of no moderator
##
## free parameters:
##      name matrix row col Estimate Std.Error A z value Pr(>|z|)
## 1 medONx      A0 med x -0.04354496 0.02967147 -1.467570 1.422211e-01
## 2 yONx        A0 y x 0.22384152 0.07968942 2.808924 4.970737e-03
## 3 yONmed      A0 y med 0.21502272 0.07164941 3.001039 2.690597e-03
## 4 Tau1_1 vecTau1 1 1 -2.35215774 0.30693007 -7.663497 1.798561e-14
## 5 Tau1_2 vecTau1 2 1 -0.85649412 0.13476335 -6.355542 2.076934e-10
## 6 Tau1_3 vecTau1 3 1 -1.10087475 0.15766774 -6.982245 2.905010e-12
##
## Model Statistics:
##      | Parameters | Degrees of Freedom | Fit (-2lnL units)
##      Model:      6 66 35.758
##      Saturated:  9 63 NA
##      Independence: 6 66 NA
## Number of observations/statistics: 395635/72
##
## Information Criteria:
##      | df Penalty | Parameters Penalty | Sample-Size Adjusted
##      AIC: -96.2420 47.7580 47.75821
##      BIC: -814.8663 113.0875 94.01919
## To get additional fit indices, see help(mxRefModels)
## timestamp: 2020-11-25 18:49:50
## Wall clock time: 0.1149876 secs
## optimizer: SLSQP
## OpenMx version number: 2.18.1
## Need help? See help(mxSummary)

```

```

### one stage MASEM one moderator on all paths

moderated_paths=matrix(
c(
0,0,0,
'0*data.mod', 0, 0,
'0*data.mod', '0*data.mod', 0 # make the path 0 if the moderation on that path is not interested
),
3, 3, byrow=T
)
moderated_paths

##      [,1]      [,2]      [,3]
## [1,] "0"      "0"      "0"
## [2,] "0*data.mod" "0"      "0"
## [3,] "0*data.mod" "0*data.mod" "0"

## Error! There are NAs in mod.
osmasem2=osmasem(model.name='moderating all', RAM=ram, Ax=moderated_paths, data=dat2)

## <simpleError in runHelper(model, frontendStart, intervals, silent, suppressWarnings, unsafe, che
## Create an index without NA in the moderator
index <- !is.na(dat2$data$mod)

## You may need the developmental version of metaSEM in Github.
osmasem2=osmasem(model.name='moderating all', RAM=ram, Ax=moderated_paths, data=dat2,
subset.rows = index)
summary(osmasem2)

## Summary of moderating all
##
## free parameters:
##      name matrix row col Estimate Std.Error A z value Pr(>|z|)
## 1 medONx A0 med x -0.05401993 0.05151141 -1.0486983 2.943170e-01
## 2 yONx A0 y x 0.42143950 0.12380936 3.4039391 6.642157e-04
## 3 yONmed A0 y med 0.52203553 0.07123661 7.3281915 2.333689e-13
## 4 medONx_1 A1 med x 0.10413503 0.12820686 0.8122423 4.166526e-01
## 5 yONx_1 A1 y x 0.26408348 0.12631212 2.0907217 3.655302e-02
## 6 yONmed_1 A1 y med -0.53427776 0.13415479 -3.9825469 6.818066e-05
## 7 Tau1_1 vecTau1 1 1 -1.97135694 0.38080115 -5.1768671 2.256428e-07
## 8 Tau1_2 vecTau1 2 1 -1.41675992 0.20745470 -6.8292495 8.536061e-12
## 9 Tau1_3 vecTau1 3 1 -1.77318127 0.24954129 -7.1057631 1.196598e-12
##
## Model Statistics:
##      | Parameters | Degrees of Freedom | Fit (-2lnL units)
##      Model: 9 34 -8.908117
##      Saturated: 9 34 NA
##      Independence: 6 37 NA
## Number of observations/statistics: 334814/43
##
## Information Criteria:
##      | df Penalty | Parameters Penalty | Sample-Size Adjusted
##      AIC: -76.90812 9.091883 9.092421
##      BIC: -441.43335 105.583857 76.981426

```



```

## CFI: NA
## TLI: 1 (also known as NNFI)
## RMSEA: 0 [95% CI (NA, NA)]
## Prob(RMSEA <= 0.05): NA
## To get additional fit indices, see help(mxRefModels)
## timestamp: 2020-11-25 18:49:50
## Wall clock time: 0.1910558 secs
## optimizer: SLSQP
## OpenMx version number: 2.18.1
## Need help? See help(mxSummary)

## If you want to compare the models with and without the moderator,
## make sure that the same data are used.
osmasem1b=osmasem(model.name='no moderator',RAM=ram,data=dat2,
                  subset.rows = index)
anova(osmasem2, osmasem1b)

##          base  comparison ep  minus2LL df      AIC  diffLL diffdf
## 1 moderating all      <NA>  9 -8.908117 34 -76.90812      NA      NA
## 2 moderating all no moderator  6 24.766144 37 -49.23386 33.67426      3
##          p
## 1          NA
## 2 2.321038e-07

sessionInfo()

## R version 4.0.3 (2020-10-10)
## Platform: x86_64-pc-linux-gnu (64-bit)
## Running under: Ubuntu 20.10
##
## Matrix products: default
## BLAS: /usr/lib/x86_64-linux-gnu/blas/libblas.so.3.9.0
## LAPACK: /usr/lib/x86_64-linux-gnu/lapack/liblapack.so.3.9.0
##
## locale:
## [1] LC_CTYPE=en_SG.UTF-8      LC_NUMERIC=C
## [3] LC_TIME=en_SG.UTF-8       LC_COLLATE=en_SG.UTF-8
## [5] LC_MONETARY=en_SG.UTF-8   LC_MESSAGES=en_SG.UTF-8
## [7] LC_PAPER=en_SG.UTF-8     LC_NAME=C
## [9] LC_ADDRESS=C              LC_TELEPHONE=C
## [11] LC_MEASUREMENT=en_SG.UTF-8 LC_IDENTIFICATION=C
##
## attached base packages:
## [1] stats      graphics  grDevices  utils      datasets  methods   base
##
## other attached packages:
## [1] readxl_1.3.1 metaSEM_1.2.4.1 OpenMx_2.18.1
##
## loaded via a namespace (and not attached):
## [1] Rcpp_1.0.5      knitr_1.29      magrittr_1.5    MASS_7.3-53
## [5] mnormt_2.0.1    pbivnorm_0.6.0  ellipse_0.4.2   lattice_0.20-41
## [9] rlang_0.4.7     stringr_1.4.0   tools_4.0.3     parallel_4.0.3
## [13] grid_4.0.3      tmvnsim_1.0-2   xfun_0.16       htmltools_0.4.0
## [17] yaml_2.2.1      digest_0.6.25   lifecycle_0.2.0 lavaan_0.6-7
## [21] Matrix_1.2-18  evaluate_0.14   rmarkdown_2.3   stringi_1.4.6
## [25] cellranger_1.1.0 compiler_4.0.3  stats4_4.0.3    mvtnorm_1.1-1

```