

Mediation_BMASEM_WithCovariate_Geweke

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Load packages and functions

```
library(matrixcalc)
library(MASS)
library(coda)
library(Matrix)
library(R2OpenBUGS)
library(xlsx)
#source('https://github.com/zijunke/HeterogeneityMASEM/blob/master/RFuncs.R')
source('D:/Research/WorkStation/HeteroRD2/RFuncs.R')
```

Set working directory

```
wd = 'D:/Research/WorkStation/HeteroRD2/MED/WithCovariate_Geweke/'
setwd(wd)
```

Read in data

```
#dat = read.xlsx('https://github.com/zijunke/HeterogeneityMASEM/blob/master/Mediation%20Example/data3.xlsx')
dat = read.xlsx('D:/Research/WorkStation/HeteroRD2/Github/Mediation Example/data3.xlsx',1)
head(dat)
```

##	AuthorYear	doi	study	N	rXM	rMY	
## 1	Wong2018	10.1038/s41598-018-24945-4	1	139	NA	NA	
## 2	Vollestad2011	10.1016/j.brat.2011.01.007	2	65	0.4500000	-0.26	
## 3	VanSon2013	10.2337/dc12-1477	3	139	NA	NA	
## 4	VanSon2013	10.2337/dc12-1477	3	139	NA	NA	
## 5	Sevinc2018	10.1097/psy.0000000000000590	4	37	-0.1578195	NA	
## 6	Song2015	10.1016/j.nedt.2014.06.010	5	44	0.3202971	NA	
##	rXY	AgeM	AgeSD	T1DeprR	T1DeprM	T1DeprSD	DeprMeasure
## 1	-0.1823328	52.000	3.09000	2.505803	0.4516041	0.1802233	GCS-D
## 2	-0.5000000	42.500	11.30000	1.965117	0.2682540	0.1365079	BDI-II
## 3	-0.2829384	56.500	13.00000	2.188851	0.3998287	0.1826660	HADS-D
## 4	-0.3345372	56.500	13.00000	4.301732	0.8107914	0.1884802	POMS-D8
## 5	NA	38.292	10.21452	NA	NA	NA	<NA>
## 6	-0.4470000	19.600	1.85000	1.165779	0.2013528	0.1727195	DASS-D
##	FemaleProp	Mreliability	YReliability	AssessTime.day	Quality	Noutcome	
## 1	1.00	0.93	NA	224	12	3	
## 2	0.67	0.90	0.88	56	8	5	

## 3	0.50	NA	0.81	56	6	5
## 4	0.50	NA	0.85	56	6	5
## 5	0.64	NA	NA	70	9	1
## 6	0.81	0.93	0.81	70	8	3

Data cleaning

```
# remove multiple correlations from the same study
sid = dat[, 'study']
sel.id = (duplicated(sid) == 0)
dat = dat[sel.id,]
# remove studies that did not report baseline depression severity
na.id = which(is.na(dat[, "T1DeprR"]) == 1)
dat = dat[-na.id,]

summary(dat)
```

```
##           AuthorYear              doi          study
## Armstrong2016 : 1  10.1001/jama.2015.8361 : 1  Min.   : 1.0
## Batink2013     : 1  10.1002/cpp.2076       : 1  1st Qu.:10.0
## Branstrom2010  : 1  10.1002/jclp.22370     : 1  Median :22.0
## CladderMicus2018: 1  10.1002/pon.4430       : 1  Mean    :20.3
## Duarte2016     : 1  10.1007/s00406-016-0746-x: 1  3rd Qu.:30.0
## Eisendrath2015 : 1  10.1007/s00520-016-3220-4: 1  Max.    :38.0
## (Other)        :27  (Other)                :27
##           N              rXM              rMY              rXY
## Min.   : 13.00  Min.   :0.02616  Min.   : -0.4600  Min.   : -0.72511
## 1st Qu.: 45.00  1st Qu.:0.29621  1st Qu.: -0.4350  1st Qu.: -0.40055
## Median : 67.00  Median :0.35000  Median : -0.3360  Median : -0.26814
## Mean    : 73.33  Mean    :0.33346  Mean    : -0.3487  Mean    : -0.27946
## 3rd Qu.:115.00  3rd Qu.:0.43000  3rd Qu.: -0.2640  3rd Qu.: -0.13751
## Max.    :139.00  Max.    :0.48673  Max.    : -0.2472  Max.    : 0.05637
##           NA's :12  NA's :26  NA's :3
##           AgeM          AgeSD          T1DeprR          T1DeprM
## Min.   :19.60  Min.   : 1.850  Min.   : 0.8797  Min.   :0.04538
## 1st Qu.:42.60  1st Qu.: 8.228  1st Qu.: 1.4976  1st Qu.:0.19710
## Median :47.35  Median : 9.581  Median : 1.9651  Median :0.31449
## Mean    :48.03  Mean    : 9.000  Mean    : 2.4195  Mean    :0.32043
## 3rd Qu.:55.51  3rd Qu.:11.325  3rd Qu.: 2.8193  3rd Qu.:0.40600
## Max.    :78.00  Max.    :13.707  Max.    :10.1796  Max.    :0.59346
## NA's :1  NA's :1
##           T1DeprSD          DeprMeasure          FemaleProp          Mreliability
## Min.   :0.04278  BDI-II :8  Min.   :0.0000  Min.   :0.5300
## 1st Qu.:0.11464  DASS-D :5  1st Qu.:0.5600  1st Qu.:0.8200
## Median :0.15680  HAM-D17:5  Median :0.7403  Median :0.8800
## Mean    :0.15539  HADS-D :4  Mean    :0.6687  Mean    :0.8408
## 3rd Qu.:0.18838  PHQ9 :3  3rd Qu.:0.8100  3rd Qu.:0.9300
## Max.    :0.35606  BSI-D6 :1  Max.    :1.0000  Max.    :0.9700
##           (Other):7  NA's :21
##           YReliability          AssessTime.day          Quality          Noutcome
## Min.   :0.7800  Min.   : 42.0  Min.   : 2.000  Min.   :1.000
## 1st Qu.:0.8100  1st Qu.: 56.0  1st Qu.: 5.000  1st Qu.:1.000
## Median :0.8800  Median : 56.0  Median : 7.000  Median :2.000
```

```
## Mean :0.8539 Mean : 73.3 Mean : 6.788 Mean :2.394
## 3rd Qu.:0.8850 3rd Qu.: 70.0 3rd Qu.: 8.000 3rd Qu.:3.000
## Max. :0.9300 Max. :224.0 Max. :12.000 Max. :5.000
## NA's :18
```

Data preparation for BMASEM

```
vR = as.matrix(dat[,c('rXM','rXY','rMY')]) # bivariate correlations
N = dat[, 'N'] # individual study sample sizes
Nstudy = nrow(dat) # number of studies
mu.N = mean(N) # mean sample size per study

M = dat[, "T1DeprR"] # moderator: baseline depression severity
M = (M-mean(M))/sd(M) # standardization
predM = c(min(M),median(M),max(M)) # Low, moderate, and high levels of baseline depression

# Coordinations (matrix <-> vector)
p = 3 # number of observed variables
pp = p*(p-1)/2 # number of bivariate correlations
index.list = jkvil(p)
j = index.list$j
k = index.list$k
vil = index.list$vil

# Sampling covariance (precision) matrix of the observed correlation vectors
vR.bar = apply(vR,2,mean,na.rm = TRUE)
vR.impute = Mimpute(vR,N,'MCAR')
Stau.vR <- Vj(vR.bar,N,pp,Nstudy,index.list)
tau.vR <- Stau.vR$tau.vR;

# Hyperparameters for priors (additional error term)
mu.vR.psi = rep(0,pp)
df.prelim = 2*pp
alpha.prior.vE = (df.prelim-pp+1)/2
beta.prior.vE = alpha.prior.vE*(0.3*(1-max(vR,na.rm=T)^2)^2/mu.N)

# Name list of the data for BMASEM
data<-list("Nstudy","N","mu.N","pp","vR","tau.vR",'M','predM',
"mu.vR.psi",'alpha.prior.vE','beta.prior.vE')
```

Initials values

```
vR.inits = vR.impute; vR.inits[which(is.na(vR)==0,arr.ind = TRUE)] = NA
inits1 <- list(list(b0.a=0,b0.b=0,b0.cp=0,b1.a=0,b1.cp=0,
sd.ua=0.1,sd.ucp=0.1,tau.R=mu.N*2,
vR.psi = matrix(0,Nstudy,pp),vR=vR.inits))
```

Parameters to save

```
pru = c(paste0('b0.',c('a','b','cp')),paste0('b1.',c('a','cp')),
        paste0('sd.u',c('a','cp')), 'cphat')
```

Filename of the likelihood model and prior

```
#model.fn = 'https://github.com/zijunke/HeterogeneityMASEM/blob/master/Mediation%20Example/Mediation_Ra
model.fn = 'D:/Research/WorkStation/HeteroRD2/Github/Mediation Example/Mediation_Covariate.txt'
```

Model fitting using BMASEM

```
fit = wbugs(data, initsl, prn, model.fn, 'cphat',
            nchains=1, niter=60000, nburnin=30000, nthin=1, wd, diagm='Geweke')
```

```
## [1] "Iteration: 60000"
## [1] "Iteration: 90000"
## [1] "Iteration: 120000"
##          b0.a          b0.b          b0.cp          b1.a          b1.cp
## -0.0008932705 -0.7924305993  0.7951673877  0.3125929324 -0.2163251265
##          cphat[1]          cphat[2]          cphat[3]          deviance          sd.ua
##  0.8403454727  1.0372525882 -0.0610814930 -0.9421485812  0.6760284305
##          sd.ucp
##  1.2103479235
##
## Iterations = 90003:120002
## Thinning interval = 1
## Number of chains = 1
## Sample size per chain = 30000
##
## 1. Empirical mean and standard deviation for each variable,
##    plus standard error of the mean:
##
##              Mean          SD Naive SE Time-series SE
## b0.a           0.2959  0.0444 0.000256      0.00196
## b0.b          -0.2614  0.0507 0.000293      0.00265
## b0.cp         -0.1941  0.0348 0.000201      0.00110
## b1.a          -0.0877  0.0860 0.000497      0.00465
## b1.cp         -0.0817  0.0388 0.000224      0.00137
## cphat[1]      -0.1215  0.0491 0.000284      0.00161
## cphat[2]      -0.1727  0.0363 0.000210      0.00115
## cphat[3]      -0.5599  0.1770 0.001022      0.00613
## deviance    -179.5605 35.3333 0.203997      0.96218
## sd.ua         0.0931  0.0371 0.000214      0.00157
## sd.ucp        0.1080  0.0389 0.000225      0.00153
##
## 2. Quantiles for each variable:
##
##              2.5%          25%          50%          75%          97.5%
## b0.a           0.2091  0.2667  0.2960  0.3246  3.85e-01
## b0.b          -0.3619 -0.2956 -0.2615 -0.2265 -1.65e-01
## b0.cp         -0.2627 -0.2172 -0.1937 -0.1710 -1.25e-01
## b1.a          -0.2538 -0.1464 -0.0890 -0.0295  8.10e-02
```

```
## b1.cp      -0.1599   -0.1069   -0.0815   -0.0560 -5.96e-03
## cphat[1]   -0.2176   -0.1544   -0.1220   -0.0886 -2.33e-02
## cphat[2]   -0.2446   -0.1969   -0.1723   -0.1485 -1.01e-01
## cphat[3]   -0.9157   -0.6745   -0.5594   -0.4436 -2.14e-01
## deviance -246.1000 -204.5000 -180.5000 -155.1000 -1.10e+02
## sd.ua      0.0276    0.0675    0.0900    0.1152  1.74e-01
## sd.ucp     0.0354    0.0812    0.1073    0.1334  1.87e-01
```

```
fit[-7]
```

```
## $est
##      b0.a      b0.b      b0.cp      b1.a      b1.cp      sd.ua      sd.ucp cphat[1]
##      0.296     -0.262    -0.194     -0.089     -0.081     0.090     0.107    -0.122
## cphat[2] cphat[3]
##     -0.172    -0.559
##
## $psd
##      b0.a      b0.b      b0.cp      b1.a      b1.cp      sd.ua      sd.ucp cphat[1]
##      0.044     0.051     0.035     0.086     0.039     0.037     0.039     0.049
## cphat[2] cphat[3]
##      0.036     0.177
##
## $CI1
##      b0.a      b0.b      b0.cp      b1.a      b1.cp      sd.ua      sd.ucp cphat[1]
##      0.209     -0.362    -0.261     -0.258     -0.162     0.018     0.032    -0.219
## cphat[2] cphat[3]
##     -0.245    -0.919
##
## $CIu
##      b0.a      b0.b      b0.cp      b1.a      b1.cp      sd.ua      sd.ucp cphat[1]
##      0.385     -0.165    -0.124     0.075     -0.008     0.161     0.183    -0.026
## cphat[2] cphat[3]
##     -0.101    -0.218
##
## $conv
##           b0.a      b0.b      b0.cp      b1.a      b1.cp cphat[1] cphat[2]
##      4.000     -0.001    -0.792     0.795     0.313    -0.216     0.840     1.037
## cphat[3] deviance      sd.ua      sd.ucp
##     -0.061    -0.942     0.676     1.210
##
## $DIC
## [1] -121.4
```