Mediation_BMASEM_NoCovariate_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/NoCovariate_Geweke/'
setwd(wd)
```

Read in data

```
#dat =
read.xlsx('https://github.com/zijunke/HeterogeneityMASEM/blob/master/Mediation%20Example/data3.x

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,]
summary(dat)
```

```
##             AuthorYear                          doi         study
##  Armstrong2016   : 1   10.1001/jama.2015.8361   : 1   Min.   : 1.00
##  Batink2013      : 1   10.1002/cpp.2076         : 1   1st Qu.:10.25
##  Branstrom2010   : 1   10.1002/jclp.22370       : 1   Median :19.50
##  CladderMicus2018: 1   10.1002/pon.4430         : 1   Mean   :19.50
##  Duarte2016      : 1   10.1007/s00406-016-0746-x: 1   3rd Qu.:28.75
##  Eisendrath2015  : 1   10.1007/s00520-016-3220-4: 1   Max.   :38.00
##  (Other)         :32   (Other)                  :32
##        N                rXM                rMY                rXY
##  Min.   : 13.00   Min.   :-0.1578   Min.   :-0.4600   Min.   :-0.72511
##  1st Qu.: 44.25   1st Qu.: 0.2683   1st Qu.:-0.4350   1st Qu.:-0.40055
##  Median : 63.50   Median : 0.3451   Median :-0.3360   Median :-0.26814
##  Mean   : 72.61   Mean   : 0.3129   Mean   :-0.3487   Mean   :-0.27946
##  3rd Qu.:105.50   3rd Qu.: 0.4224   3rd Qu.:-0.2640   3rd Qu.:-0.13751
##  Max.   :167.00   Max.   : 0.4867   Max.   :-0.2472   Max.   : 0.05637
##                   NA's   :12        NA's   :31        NA's   :8
##       AgeM            AgeSD            T1DeprR           T1DeprM
##  Min.   :19.60   Min.   : 1.835   Min.   : 0.8797   Min.   :0.04538
##  1st Qu.:40.17   1st Qu.: 8.228   1st Qu.: 1.4976   1st Qu.:0.19710
##  Median :45.84   Median : 9.581   Median : 1.9651   Median :0.31449
##  Mean   :47.34   Mean   : 8.909   Mean   : 2.4195   Mean   :0.32043
##  3rd Qu.:55.18   3rd Qu.:11.325   3rd Qu.: 2.8193   3rd Qu.:0.40600
##  Max.   :83.00   Max.   :13.707   Max.   :10.1796   Max.   :0.59346
##  NA's   :1       NA's   :2        NA's   :5         NA's   :5
##     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.:0.5754   1st Qu.:0.8275
##  Median :0.15680   HAM-D17:5    Median :0.7260   Median :0.8600
##  Mean   :0.15539   HADS-D :4    Mean   :0.6664   Mean   :0.8444
##  3rd Qu.:0.18838   PHQ9   :3    3rd Qu.:0.7843   3rd Qu.:0.9150
##  Max.   :0.35606   (Other):8    Max.   :1.0000   Max.   :0.9700
##  NA's   :5         NA's   :5                     NA's   :22
##   YReliability    AssessTime.day.      Quality         Noutcome
##  Min.   :0.7800   Min.   : 42.00   Min.   : 2.00   Min.   :1.000
##  1st Qu.:0.8100   1st Qu.: 56.00   1st Qu.: 5.25   1st Qu.:1.000
##  Median :0.8800   Median : 56.00   Median : 7.00   Median :2.000
##  Mean   :0.8539   Mean   : 84.66   Mean   : 7.00   Mean   :2.211
```

```
##  3rd Qu.:0.8850   3rd Qu.: 70.00   3rd Qu.: 8.75   3rd Qu.:3.000
##  Max.   :0.9300   Max.   :560.00   Max.   :12.00   Max.   :5.000
##  NA's   :23
```

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

# 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)
I3 = diag(1,3); u0 = rep(0,3);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",'p',"pp","vR","tau.vR","mu.vR.psi",
    'alpha.prior.vE','beta.prior.vE','u0','I3')
```

Initials values

```
vR.inits = vR.impute; vR.inits[which(is.na(vR)==0,arr.ind = TRUE)] = NA
initsl <- list(list(mu.a=0,mu.b=0,mu.cp=0,tau.u=diag(100,3),xi=rep(1,3),tau.R = mu.N*2,
    vR.psi = matrix(0,Nstudy,pp),vR = vR.inits))
```

Parameters to save

```
prm = c('mu.a','mu.b','mu.cp','mu.ab','sd.a','sd.b','sd.cp','sd.ab',
    'rho.ab','rho.acp','rho.bcp')
```

Filename of the likelihood model and prior

```
#model.fn =
'https://github.com/zijunke/HeterogeneityMASEM/blob/master/Mediation%20Example/Mediation_Random.

model.fn = 'D:/Research/WorkStation/HeteroRD2/Github/Mediation Example/Mediation_Random.txt'
```

Model fitting using BMASEM

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

```
## [1] "Iteration: 60000"
## [1] "Iteration: 90000"
## [1] "Iteration: 120000"
## [1] "Iteration: 150000"
## [1] "Iteration: 180000"
## [1] "Iteration: 210000"
##   deviance       mu.a      mu.ab       mu.b      mu.cp     rho.ab    rho.acp
##  1.6043805  1.2216194 -1.1795966 -0.6933926  0.7793192 -1.8289967  0.2388048
##    rho.bcp       sd.a      sd.ab       sd.b      sd.cp
##  1.0305817 -0.7301507 -0.4888552 -0.6996835 -0.7804138
##
## Iterations = 180006:210005
## 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
## deviance -1.94e+02 38.9362 0.224798        1.24516
## mu.a      3.17e-01  0.0327 0.000189        0.00192
## mu.ab    -7.99e-02  0.0358 0.000206        0.00276
## mu.b     -2.54e-01  0.0940 0.000543        0.00634
## mu.cp    -1.90e-01  0.0481 0.000278        0.00290
## rho.ab    1.33e-03  0.3898 0.002250        0.02294
## rho.acp  -1.69e-01  0.3346 0.001932        0.01847
## rho.bcp  -1.71e-01  0.3791 0.002189        0.02168
## sd.a      1.13e-01  0.0354 0.000204        0.00146
## sd.ab     5.75e-02  0.0368 0.000212        0.00257
## sd.b      1.34e-01  0.1006 0.000581        0.00618
## sd.cp     1.20e-01  0.0482 0.000278        0.00237
##
## 2. Quantiles for each variable:
##
##               2.5%       25%       50%       75%     97.5%
## deviance -265.2025 -221.7000 -194.6000 -166.2000 -115.9000
## mu.a        0.2527    0.2939    0.3175    0.3386    0.3813
```

```
## mu.ab      -0.1409   -0.0977   -0.0807   -0.0648   -0.0233
## mu.b       -0.4113   -0.3054   -0.2589   -0.2121   -0.0908
## mu.cp      -0.2866   -0.2161   -0.1881   -0.1603   -0.1054
## rho.ab     -0.7096   -0.2911   -0.0105    0.2912    0.7364
## rho.acp    -0.7644   -0.4170   -0.1812    0.0663    0.5000
## rho.bcp    -0.8086   -0.4670   -0.1910    0.1030    0.5947
## sd.a        0.0473    0.0894    0.1113    0.1349    0.1886
## sd.ab       0.0188    0.0356    0.0490    0.0688    0.1456
## sd.b        0.0199    0.0685    0.1106    0.1708    0.3881
## sd.cp       0.0345    0.0877    0.1174    0.1487    0.2259
```

```
fit[-7]
```

```
## $est
##    mu.a   mu.ab    mu.b   mu.cp    sd.a   sd.ab    sd.b   sd.cp  rho.ab rho.acp
##   0.318  -0.081  -0.259  -0.188   0.111   0.049   0.111   0.117  -0.010  -0.181
## rho.bcp
##  -0.191
##
## $psd
##    mu.a   mu.ab    mu.b   mu.cp    sd.a   sd.ab    sd.b   sd.cp  rho.ab rho.acp
##   0.033   0.036   0.094   0.048   0.035   0.037   0.101   0.048   0.390   0.335
## rho.bcp
##   0.379
##
## $CIl
##    mu.a   mu.ab    mu.b   mu.cp    sd.a   sd.ab    sd.b   sd.cp  rho.ab rho.acp
##   0.252  -0.145  -0.422  -0.274   0.041   0.013   0.004   0.025  -0.696  -0.788
## rho.bcp
##  -0.859
##
## $CIu
##    mu.a   mu.ab    mu.b   mu.cp    sd.a   sd.ab    sd.b   sd.cp  rho.ab rho.acp
##   0.380  -0.029  -0.105  -0.096   0.181   0.118   0.313   0.213   0.749   0.468
## rho.bcp
##   0.520
##
## $conv
##          deviance      mu.a     mu.ab      mu.b     mu.cp   rho.ab  rho.acp
##    7.000    1.604    1.222   -1.180   -0.693    0.779   -1.829    0.239
##  rho.bcp     sd.a    sd.ab     sd.b     sd.cp
##    1.031   -0.730   -0.489   -0.700   -0.780
##
## $DIC
## [1] -124.6
```

80% Credibility intervals

```
mu.n = paste0('mu.',c('a','b','cp','ab'))
sd.n = paste0('sd.',c('a','b','cp','ab'))
fit$est[mu.n]-qnorm(.9)*fit$est[sd.n]
```

```
##       mu.a       mu.b      mu.cp      mu.ab
##  0.1757478 -0.4012522 -0.3379415 -0.1437960
```

```
fit$est[mu.n]+qnorm(.9)*fit$est[sd.n]
```

```
##        mu.a        mu.b       mu.cp       mu.ab
##  0.46025222 -0.11674778 -0.03805847 -0.01820397
```