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# -----
# Program: Bivariate Cholesky of DEPRESSION AND ILLNESS with IGEMS-CIRS and age
moderation of covariance
# MODELS WITH MALES ONLY
# Variables- IGEMS CAMDEX Dep Crosswalk and IGEMS- CIRS
# CIRS moderating covariacne bivariate cholesky with age moderation
# Author: Drew Petkus
# Initial Date: 09 09 2015
# Final Version: 12 20 2016

## clear working space
rm(list=ls(all=TRUE))

##set working directory

setwd("/Users/Drew/Documents/IGEMS dep x age moderation analyses/depXage")

# load OpenMx and helper functions
##source website below loads the help functions
require(psych)
require(OpenMx)
require(gtools)
require(gdata)
source("http://www.vipbg.vcu.edu/~vipbg/Tc24/GenEpiHelperFunctions.R")
source("GenEpiHelperFunctions.R")

# -----
# PREPARE DATA
#####
# Read Twin Data
data<- read.csv(file="depcirs_24sep15.csv", header=TRUE)
describe(data)

###CENTER AGE ON AGE 75 AND CREATE THE 40-75 AND 75+ SLOPE VARIABLES#####

data$ageC1<-data$age1-75
data$old<-ifelse(data$ageC1>=0,c(1),c(0))
table(data$old)
data$slope2<-ifelse(data$ageC1>=0,c(data$ageC1),c(0))

data$slope1<-data$ageC1
data$slope1<-ifelse(data$ageC1>=0,c(0),(data$ageC1))

table(data$slope2)
describe(data)
data<-subset(data,age1<=90 &age1>=40)

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# Select Variables for twin models Analysis ORDER THAT YOU PUT IN THE VARIABLES
IS important
Vars      <- c("tlncirsC", "tlndepC")
nv        <- length(Vars)                # number of variables
selVars   <- paste(Vars, c(rep(1, nv), rep(2, nv)), sep="")
modVars   <- c("slope1", "tcirsC1", "tcirsC2", "old", "slope2")

####remove cases with missing physical illness and age
data <- data[!is.na(data$ageC1),]
data <- data[!is.na(data$tcirsC1),]
data <- data[!is.na(data$tcirsC2),]

# Select subsets of data (mz and dz) for the analyses
mzData    <- subset(data, zygos1==1)
mzMData   <- subset(mzData, sex1==1 , c(selVars, modVars))

dzData    <- subset(data, zygos1==2)
dzMData   <- subset(dzData, sex1==1 , c(selVars, modVars))

# Store and Print Descriptive Statistics
# -----
summary(mzMData)
summary(dzMData)

describe(mzMData)
describe(dzMData)

(mzMMeans  <- colMeans(mzMData, na.rm=TRUE))
(dzMMeans  <- colMeans(dzMData, na.rm=TRUE))

(mzMCor    <- cor(mzMData, use="complete"))
(dzMCor    <- cor(dzMData, use="complete"))

# Raw data in OpenMx format

dataMZM    <- mxData(observed = mzMData, type = "raw" )
dataDZM    <- mxData(observed = dzMData, type = "raw" )

# -----
# -----Cholesky part!-----
# Set up Cholesky ACE decomposition, with RawData and Matrices Input
# -----

# Moderation free parameters starting values

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apathM<-c(5,0.7,6.04)
cpathM<-c(3,2,1)
epathM<-c(7,1,12)
```

```
AmodSTm<-c(0,0.5,-0.5)
CmodSTm<-c(0,0.5,-0.5)
EmodSTm<-c(0,-0.5,-0.5)
```

```
AmodSTm1<-c(0,1,0.5)
CmodSTm1<-c(0,1,0.5)
EmodSTm1<-c(0,1,0.5)
```

```
AmodSTm2<-c(0,1,1)
CmodSTm2<-c(0,1,1)
EmodSTm2<-c(0,1,1)
```

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##CREATE LABELS FOR MATRICES INTERCEPT
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```
aLabsM <- c("a11M","a21M","a22M")
cLabsM <- c("c11M","c21M","c22M")
eLabsM <- c("e11M","e21M","e22M")
mLabsM <- c("meanM1","meanM2")
```

```
##SET UP AGE MODERATION PATHS
###FIRST SET UP AGE 40-75 AGE MODERATION LABELS
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```
aLabsMmod1 <- c("a11L1m","a21L1m","a22L1m")
cLabsMmod1 <- c("c11L1m","c21L1m","c22L1m")
eLabsMmod1 <- c("e11L1m","e21L1m","e22L1m")
mLabsMmod1 <- c("meanM1mod1","meanM2mod1")
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####SECOND SET UP AGE 75-90 AGE MODERATION PATH LABELS
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```
aLabsMmod2 <- c("a11L2m","a21L2m","a22L2m")
cLabsMmod2 <- c("c11L2m","c21L2m","c22L2m")
eLabsMmod2 <- c("e11L2m","e21L2m","e22L2m")
mLabsMmod2 <- c("meanM1mod1","meanM2mod1")
```

```
##SET UP CIRS MODERATION PATH LABELS
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```
aLabsMmod3 <- c("a11H1m","a21H1m","a22H1m")
cLabsMmod3 <- c("c11H1m","c21H1m","c22H1m")
eLabsMmod3 <- c("e11H1m","e21H1m","e22H1m")
mLabsMmod3 <- c("meanM1mod1","meanM2mod1")
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## Modeling
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# Matrices a, c, and e to store a, c, and e Path Coefficients
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pathAM <- mxMatrix(name = "aM", type = "Lower", nrow = nv, ncol = nv, labels =
aLabsM, free=c(T,T,T), values=apathM)
pathCM <- mxMatrix(name = "cM", type = "Lower", nrow = nv, ncol = nv, labels =
cLabsM, free=c(T,T,T), values=cpathM)
pathEM <- mxMatrix(name = "eM", type = "Lower", nrow = nv, ncol = nv, labels =
eLabsM, free=c(T,T,T), values=epathM)

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#MATRICES FOR THE AGE 40-75 AGE MODERATION PATHS

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pathALM<- mxMatrix(name="aLM", type = "Lower", nrow= nv, ncol= nv, labels=
aLabsMmod1, free=c(T,T,T),
values=AmodSTm)
pathCLM<- mxMatrix(name="cLM", type = "Lower", nrow= nv, ncol= nv, labels=
cLabsMmod1, free=c(T,T,T),
values=CmodSTm)
pathELM<- mxMatrix(name="eLM", type = "Lower", nrow= nv, ncol= nv, labels=
eLabsMmod1, free=c(T,T,T),
values=EmodSTm)

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#MATRICES FOR THE 75-90 AGE MODERATION PATHS

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pathALM2<- mxMatrix(name="aLM1", type = "Lower", nrow= nv, ncol= nv, labels=
aLabsMmod2, free=c(T,T,T),
values=AmodSTm1)
pathCLM2<- mxMatrix(name="cLM1", type = "Lower", nrow= nv, ncol= nv, labels=
cLabsMmod2, free=c(T,T,T),
values=CmodSTm1)
pathELM2<- mxMatrix(name="eLM1", type = "Lower", nrow= nv, ncol= nv, labels=
eLabsMmod2, free=c(T,T,T),
values=EmodSTm1)

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#MATRICES FOR THE I-CIRS MODERATION PATHS

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pathALM3<- mxMatrix(name="aLMH", type = "Lower", nrow= nv, ncol= nv, labels=
aLabsMmod3, free=c(F,T,T),
values=AmodSTm2)
pathCLM3<- mxMatrix(name="cLMH", type = "Lower", nrow= nv, ncol= nv, labels=
cLabsMmod3, free=c(F,T,T),
values=CmodSTm2)
pathELM3<- mxMatrix(name="eLMH", type = "Lower", nrow= nv, ncol= nv, labels=
eLabsMmod3, free=c(F,T,T),
values=EmodSTm2)

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#MATRICES FOR THE MEAN MODERATION PATHS

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depmeanBm      <- mxMatrix( type="Full", nrow=1, ncol=1, free=TRUE, values=
c(0.5), label=c("lDepAgelm"), name="bmDep" )

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cirmsmeanBm    <- mxMatrix( type="Full", nrow=1, ncol=1, free=TRUE, values=
c(0.5), label=c("lCirsAgelm"), name="bmCir" )

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depmeanB2m      <- mxMatrix( type="Full", nrow=1, ncol=1, free=TRUE, values=
c(0.5), label=c("lDepAge2m"), name="bmDep2" )

cirmsmeanB2m    <- mxMatrix( type="Full", nrow=1, ncol=1, free=TRUE, values=
c(0.5), label=c("lCirsAge2m"), name="bmCir2" )

##Matrices to hold definition variable for AGE

defage <- mxMatrix( type="Full", nrow=1, ncol=1, free=FALSE,
labels="data.slope1",
                name="age")

defsold<- mxMatrix(type="Full", nrow=1, ncol=1, free=FALSE, labels="data.old",
name="old")
defsolda<- mxMatrix(type="Full", nrow=1, ncol=1, free=FALSE,
labels="data.slope2", name="olda")

##MATRICES TO HOLD DEFINITION VARIABLE FOR I-CIRS TWIN 1 AND TWIN 2

defcirs1 <- mxMatrix( type="Full", nrow=1, ncol=1, free=FALSE,
labels="data.tcirsC1",
                name="cirs1")

defcirs2 <- mxMatrix( type="Full", nrow=1, ncol=1, free=FALSE,
labels="data.tcirsC2",
                name="cirs2")

# Matrices generated to hold A, C, and E computed Variance Components

###MATRICES FOR GENERATED TO HOLD A,CE, and E compute variance for twin 1

covAMmod1<- mxAlgebra(name = "AM1", expression = (aM+ age%x%aLM+
old%x%olda%x%aLM1+ cirs1%x%aLMH) %*% t(aM+ age%x%aLM+ old%x%olda%x%aLM1+
cirs1%x%aLMH))
covCMmod1<- mxAlgebra(name = "CM1", expression = (cM+ age%x%cLM+
old%x%olda%x%cLM1+ cirs1%x%cLMH) %*% t(cM+ age%x%cLM+ old%x%olda%x%cLM1+
cirs1%x%cLMH))
covEMmod1<- mxAlgebra(name = "EM1", expression = (eM+ age%x%eLM+
old%x%olda%x%eLM1+ cirs1%x%eLMH) %*% t(eM+ age%x%eLM+ old%x%olda%x%eLM1+
cirs1%x%eLMH))

##matrices to hold computed variance for twin 2

covAMmod2<- mxAlgebra(name = "AM2", expression = (aM+ age%x%aLM+
old%x%olda%x%aLM1+ cirs2%x%aLMH) %*% t(aM+ age%x%aLM+ old%x%olda%x%aLM1+
cirs2%x%aLMH))
covCMmod2<- mxAlgebra(name = "CM2", expression = (cM+ age%x%cLM+
old%x%olda%x%cLM1+ cirs2%x%cLMH) %*% t(cM+ age%x%cLM+ old%x%olda%x%cLM1+
cirs2%x%cLMH))

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covEMmod2<- mxAlgebra(name = "EM2", expression = (eM+ age%x%eLM+
old%x%olda%x%eLM1+ cirs2%x%eLMH) %*% t(eM+ age%x%eLM+ old%x%olda%x%eLM1+
cirs2%x%eLMH))

###matrix to hold computed covariance between twin 1 and twin 2
covAM12<-mxAlgebra(name= "AM12", expression = (aM+ age%x%aLM+ old%x%olda%x%aLM1+
cirs1%x%aLMH) %*% t(aM+ age%x%aLM+ old%x%olda%x%aLM1+ cirs2%x%aLMH))
covCM12<-mxAlgebra(name= "CM12", expression = (cM+ age%x%cLM+ old%x%olda%x%cLM1+
cirs1%x%cLMH) %*% t(cM+ age%x%cLM+ old%x%olda%x%cLM1+ cirs2%x%cLMH))
covEM12<-mxAlgebra(name= "EM12", expression = (eM+ age%x%eLM+ old%x%olda%x%eLM1+
cirs1%x%eLMH) %*% t(eM+ age%x%eLM+ old%x%olda%x%eLM1+ cirs2%x%eLMH))

##matrix to hold computed covariance between twin 2 and twin 1

covAM21<-mxAlgebra(name= "AM21", expression = (aM+ age%x%aLM+ old%x%olda%x%aLM1+
cirs2%x%aLMH) %*% t(aM+ age%x%aLM+ old%x%olda%x%aLM1+ cirs1%x%aLMH))
covCM21<-mxAlgebra(name= "CM21", expression = (cM+ age%x%cLM+ old%x%olda%x%cLM1+
cirs2%x%cLMH) %*% t(cM+ age%x%cLM+ old%x%olda%x%cLM1+ cirs1%x%cLMH))
covEM21<-mxAlgebra(name= "EM21", expression = (eM+ age%x%eLM+ old%x%olda%x%eLM1+
cirs2%x%eLMH) %*% t(eM+ age%x%eLM+ old%x%olda%x%eLM1+ cirs1%x%eLMH))

###predicted covarition between twins at age 75 with no health conditions
covAM<- mxAlgebra(name = "AM", expression = aM %*% t(aM))
covCM<- mxAlgebra(name = "CM", expression = cM %*% t(cM))
covEM<- mxAlgebra(name = "EM", expression = eM %*% t(eM))

# Algebra to compute total variances and standard deviations (diagonal only)

# Algebra to compute total variances and standard deviations (diagonal only)

##algebra to compute A,C, E variance estimates ate each respective age for
individuals with mean health conditions

covAMmod40<- mxAlgebra(name = "AM40", expression = (aM+ (-35%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-35%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod40<- mxAlgebra(name = "CM40", expression = (cM+ (-35%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-35%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod40<- mxAlgebra(name = "EM40", expression = (eM+ (-35%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-35%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod41<- mxAlgebra(name = "AM41", expression = (aM+ (-34%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-34%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod41<- mxAlgebra(name = "CM41", expression = (cM+ (-34%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-34%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod41<- mxAlgebra(name = "EM41", expression = (eM+ (-34%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-34%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod42<- mxAlgebra(name = "AM42", expression = (aM+ (-33%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-33%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod42<- mxAlgebra(name = "CM42", expression = (cM+ (-33%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-33%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))

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covEMmod42<- mxAlgebra(name = "EM42", expression = (eM+ (-33%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-33%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod43<- mxAlgebra(name = "AM43", expression = (aM+ (-32%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-32%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod43<- mxAlgebra(name = "CM43", expression = (cM+ (-32%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-32%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod43<- mxAlgebra(name = "EM43", expression = (eM+ (-32%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-32%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod44<- mxAlgebra(name = "AM44", expression = (aM+ (-31%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-31%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod44<- mxAlgebra(name = "CM44", expression = (cM+ (-31%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-31%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod44<- mxAlgebra(name = "EM44", expression = (eM+ (-31%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-31%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod45<- mxAlgebra(name = "AM45", expression = (aM+ (-30%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-30%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod45<- mxAlgebra(name = "CM45", expression = (cM+ (-30%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-30%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod45<- mxAlgebra(name = "EM45", expression = (eM+ (-30%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-30%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod46<- mxAlgebra(name = "AM46", expression = (aM+ (-29%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-29%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod46<- mxAlgebra(name = "CM46", expression = (cM+ (-29%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-29%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod46<- mxAlgebra(name = "EM46", expression = (eM+ (-29%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-29%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod47<- mxAlgebra(name = "AM47", expression = (aM+ (-28%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-28%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod47<- mxAlgebra(name = "CM47", expression = (cM+ (-28%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-28%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod47<- mxAlgebra(name = "EM47", expression = (eM+ (-28%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-28%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod48<- mxAlgebra(name = "AM48", expression = (aM+ (-27%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-27%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod48<- mxAlgebra(name = "CM48", expression = (cM+ (-27%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-27%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod48<- mxAlgebra(name = "EM48", expression = (eM+ (-27%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-27%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod49<- mxAlgebra(name = "AM49", expression = (aM+ (-26%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-26%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod49<- mxAlgebra(name = "CM49", expression = (cM+ (-26%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-26%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod49<- mxAlgebra(name = "EM49", expression = (eM+ (-26%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-26%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

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covCMmod65<- mxAlgebra(name = "CM65", expression = (cM+ (-10%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-10%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod65<- mxAlgebra(name = "EM65", expression = (eM+ (-10%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-10%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod66<- mxAlgebra(name = "AM66", expression = (aM+ (-9%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-9%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod66<- mxAlgebra(name = "CM66", expression = (cM+ (-9%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-9%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod66<- mxAlgebra(name = "EM66", expression = (eM+ (-9%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-9%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod67<- mxAlgebra(name = "AM67", expression = (aM+ (-8%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-8%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod67<- mxAlgebra(name = "CM67", expression = (cM+ (-8%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-8%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod67<- mxAlgebra(name = "EM67", expression = (eM+ (-8%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-8%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod68<- mxAlgebra(name = "AM68", expression = (aM+ (-7%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-7%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod68<- mxAlgebra(name = "CM68", expression = (cM+ (-7%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-7%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod68<- mxAlgebra(name = "EM68", expression = (eM+ (-7%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-7%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod69<- mxAlgebra(name = "AM69", expression = (aM+ (-6%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-6%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod69<- mxAlgebra(name = "CM69", expression = (cM+ (-6%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-6%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod69<- mxAlgebra(name = "EM69", expression = (eM+ (-6%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-6%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod70<- mxAlgebra(name = "AM70", expression = (aM+ (-5%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-5%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod70<- mxAlgebra(name = "CM70", expression = (cM+ (-5%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-5%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod70<- mxAlgebra(name = "EM70", expression = (eM+ (-5%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-5%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod71<- mxAlgebra(name = "AM71", expression = (aM+ (-4%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-4%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod71<- mxAlgebra(name = "CM71", expression = (cM+ (-4%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-4%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod71<- mxAlgebra(name = "EM71", expression = (eM+ (-4%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-4%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod72<- mxAlgebra(name = "AM72", expression = (aM+ (-3%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-3%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod72<- mxAlgebra(name = "CM72", expression = (cM+ (-3%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-3%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod72<- mxAlgebra(name = "EM72", expression = (eM+ (-3%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-3%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

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covAMmod73<- mxAlgebra(name = "AM73", expression = (aM+ (-2%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-2%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod73<- mxAlgebra(name = "CM73", expression = (cM+ (-2%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-2%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod73<- mxAlgebra(name = "EM73", expression = (eM+ (-2%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-2%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod74<- mxAlgebra(name = "AM74", expression = (aM+ (-1%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (-1%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod74<- mxAlgebra(name = "CM74", expression = (cM+ (-1%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (-1%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod74<- mxAlgebra(name = "EM74", expression = (eM+ (-1%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (-1%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod75<- mxAlgebra(name = "AM75", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmod75<- mxAlgebra(name = "CM75", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmod75<- mxAlgebra(name = "EM75", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmod76<- mxAlgebra(name = "AM76", expression = (aM+ (0%x%aLM)+
(1%x%1%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%1%x%aLM1)+ (0%x%aLMH)))
covCMmod76<- mxAlgebra(name = "CM76", expression = (cM+ (0%x%cLM)+
(1%x%1%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%1%x%cLM1)+ (0%x%cLMH)))
covEMmod76<- mxAlgebra(name = "EM76", expression = (eM+ (0%x%eLM)+
(1%x%1%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%1%x%eLM1)+ (0%x%eLMH)))

covAMmod77<- mxAlgebra(name = "AM77", expression = (aM+ (0%x%aLM)+
(1%x%2%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%2%x%aLM1)+ (0%x%aLMH)))
covCMmod77<- mxAlgebra(name = "CM77", expression = (cM+ (0%x%cLM)+
(1%x%2%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%2%x%cLM1)+ (0%x%cLMH)))
covEMmod77<- mxAlgebra(name = "EM77", expression = (eM+ (0%x%eLM)+
(1%x%2%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%2%x%eLM1)+ (0%x%eLMH)))

covAMmod78<- mxAlgebra(name = "AM78", expression = (aM+ (0%x%aLM)+
(1%x%3%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%3%x%aLM1)+ (0%x%aLMH)))
covCMmod78<- mxAlgebra(name = "CM78", expression = (cM+ (0%x%cLM)+
(1%x%3%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%3%x%cLM1)+ (0%x%cLMH)))
covEMmod78<- mxAlgebra(name = "EM78", expression = (eM+ (0%x%eLM)+
(1%x%3%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%3%x%eLM1)+ (0%x%eLMH)))

covAMmod79<- mxAlgebra(name = "AM79", expression = (aM+ (0%x%aLM)+
(1%x%4%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%4%x%aLM1)+ (0%x%aLMH)))
covCMmod79<- mxAlgebra(name = "CM79", expression = (cM+ (0%x%cLM)+
(1%x%4%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%4%x%cLM1)+ (0%x%cLMH)))
covEMmod79<- mxAlgebra(name = "EM79", expression = (eM+ (0%x%eLM)+
(1%x%4%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%4%x%eLM1)+ (0%x%eLMH)))

covAMmod80<- mxAlgebra(name = "AM80", expression = (aM+ (0%x%aLM)+
(1%x%5%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%5%x%aLM1)+ (0%x%aLMH)))
covCMmod80<- mxAlgebra(name = "CM80", expression = (cM+ (0%x%cLM)+
(1%x%5%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%5%x%cLM1)+ (0%x%cLMH)))

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covEMmod80<- mxAlgebra(name = "EM80", expression = (eM+ (0%x%eLM)+
(1%x%5%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%5%x%eLM1)+ (0%x%eLMH)))

covAMmod81<- mxAlgebra(name = "AM81", expression = (aM+ (0%x%aLM)+
(1%x%6%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%6%x%aLM1)+ (0%x%aLMH)))
covCMmod81<- mxAlgebra(name = "CM81", expression = (cM+ (0%x%cLM)+
(1%x%6%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%6%x%cLM1)+ (0%x%cLMH)))
covEMmod81<- mxAlgebra(name = "EM81", expression = (eM+ (0%x%eLM)+
(1%x%6%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%6%x%eLM1)+ (0%x%eLMH)))

covAMmod82<- mxAlgebra(name = "AM82", expression = (aM+ (0%x%aLM)+
(1%x%7%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%7%x%aLM1)+ (0%x%aLMH)))
covCMmod82<- mxAlgebra(name = "CM82", expression = (cM+ (0%x%cLM)+
(1%x%7%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%7%x%cLM1)+ (0%x%cLMH)))
covEMmod82<- mxAlgebra(name = "EM82", expression = (eM+ (0%x%eLM)+
(1%x%7%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%7%x%eLM1)+ (0%x%eLMH)))

covAMmod83<- mxAlgebra(name = "AM83", expression = (aM+ (0%x%aLM)+
(1%x%8%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%8%x%aLM1)+ (0%x%aLMH)))
covCMmod83<- mxAlgebra(name = "CM83", expression = (cM+ (0%x%cLM)+
(1%x%8%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%8%x%cLM1)+ (0%x%cLMH)))
covEMmod83<- mxAlgebra(name = "EM83", expression = (eM+ (0%x%eLM)+
(1%x%8%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%8%x%eLM1)+ (0%x%eLMH)))

covAMmod84<- mxAlgebra(name = "AM84", expression = (aM+ (0%x%aLM)+
(1%x%9%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%9%x%aLM1)+ (0%x%aLMH)))
covCMmod84<- mxAlgebra(name = "CM84", expression = (cM+ (0%x%cLM)+
(1%x%9%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%9%x%cLM1)+ (0%x%cLMH)))
covEMmod84<- mxAlgebra(name = "EM84", expression = (eM+ (0%x%eLM)+
(1%x%9%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%9%x%eLM1)+ (0%x%eLMH)))

covAMmod85<- mxAlgebra(name = "AM85", expression = (aM+ (0%x%aLM)+
(1%x%10%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%10%x%aLM1)+ (0%x%aLMH)))
covCMmod85<- mxAlgebra(name = "CM85", expression = (cM+ (0%x%cLM)+
(1%x%10%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%10%x%cLM1)+ (0%x%cLMH)))
covEMmod85<- mxAlgebra(name = "EM85", expression = (eM+ (0%x%eLM)+
(1%x%10%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%10%x%eLM1)+ (0%x%eLMH)))

covAMmod86<- mxAlgebra(name = "AM86", expression = (aM+ (0%x%aLM)+
(1%x%11%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%11%x%aLM1)+ (0%x%aLMH)))
covCMmod86<- mxAlgebra(name = "CM86", expression = (cM+ (0%x%cLM)+
(1%x%11%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%11%x%cLM1)+ (0%x%cLMH)))
covEMmod86<- mxAlgebra(name = "EM86", expression = (eM+ (0%x%eLM)+
(1%x%11%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%11%x%eLM1)+ (0%x%eLMH)))

covAMmod87<- mxAlgebra(name = "AM87", expression = (aM+ (0%x%aLM)+
(1%x%12%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%12%x%aLM1)+ (0%x%aLMH)))
covCMmod87<- mxAlgebra(name = "CM87", expression = (cM+ (0%x%cLM)+
(1%x%12%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%12%x%cLM1)+ (0%x%cLMH)))
covEMmod87<- mxAlgebra(name = "EM87", expression = (eM+ (0%x%eLM)+
(1%x%12%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%12%x%eLM1)+ (0%x%eLMH)))

covAMmod88<- mxAlgebra(name = "AM88", expression = (aM+ (0%x%aLM)+
(1%x%13%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%13%x%aLM1)+ (0%x%aLMH)))

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covCMmod88<- mxAlgebra(name = "CM88", expression = (cM+ (0%x%cLM)+
(1%x%13%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%13%x%cLM1)+ (0%x%cLMH)))
covEMmod88<- mxAlgebra(name = "EM88", expression = (eM+ (0%x%eLM)+
(1%x%13%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%13%x%eLM1)+ (0%x%eLMH)))

covAMmod89<- mxAlgebra(name = "AM89", expression = (aM+ (0%x%aLM)+
(1%x%14%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%14%x%aLM1)+ (0%x%aLMH)))
covCMmod89<- mxAlgebra(name = "CM89", expression = (cM+ (0%x%cLM)+
(1%x%14%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%14%x%cLM1)+ (0%x%cLMH)))
covEMmod89<- mxAlgebra(name = "EM89", expression = (eM+ (0%x%eLM)+
(1%x%14%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%14%x%eLM1)+ (0%x%eLMH)))

covAMmod90<- mxAlgebra(name = "AM90", expression = (aM+ (0%x%aLM)+
(1%x%15%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (1%x%15%x%aLM1)+ (0%x%aLMH)))
covCMmod90<- mxAlgebra(name = "CM90", expression = (cM+ (0%x%cLM)+
(1%x%15%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (1%x%15%x%cLM1)+ (0%x%cLMH)))
covEMmod90<- mxAlgebra(name = "EM90", expression = (eM+ (0%x%eLM)+
(1%x%15%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (1%x%15%x%eLM1)+ (0%x%eLMH)))

###SET UP ALGEBRAS TO COMPUTE THE ESTIMATED HERITABILITY AT DIFFERENT AGES

dep40A<-mxAlgebra(name="dep40Avar", expression= AM40[2,2]+AM40[2,1])
dep40C<-mxAlgebra(name="dep40Cvar", expression= CM40[2,2]+CM40[2,1])
dep40E<-mxAlgebra(name="dep40Evar", expression= EM40[2,2]+EM40[2,1])
dep40V<-mxAlgebra(name="dep40Vvar",expression=dep40Avar+dep40Cvar+dep40Evar)
dep40H<-mxAlgebra(name="Hdep40",expression=dep40Avar/dep40Vvar)

dep41A<-mxAlgebra(name="dep41Avar", expression= AM41[2,2]+AM41[2,1])
dep41C<-mxAlgebra(name="dep41Cvar", expression= CM41[2,2]+CM41[2,1])
dep41E<-mxAlgebra(name="dep41Evar", expression= EM41[2,2]+EM41[2,1])
dep41V<-mxAlgebra(name="dep41Vvar",expression=dep41Avar+dep41Cvar+dep41Evar)
dep41H<-mxAlgebra(name="Hdep41",expression=dep41Avar/dep41Vvar)

dep42A<-mxAlgebra(name="dep42Avar", expression= AM42[2,2]+AM42[2,1])
dep42C<-mxAlgebra(name="dep42Cvar", expression= CM42[2,2]+CM42[2,1])
dep42E<-mxAlgebra(name="dep42Evar", expression= EM42[2,2]+EM42[2,1])
dep42V<-mxAlgebra(name="dep42Vvar",expression=dep42Avar+dep42Cvar+dep42Evar)
dep42H<-mxAlgebra(name="Hdep42",expression=dep42Avar/dep42Vvar)

dep43A<-mxAlgebra(name="dep43Avar", expression= AM43[2,2]+AM43[2,1])
dep43C<-mxAlgebra(name="dep43Cvar", expression= CM43[2,2]+CM43[2,1])
dep43E<-mxAlgebra(name="dep43Evar", expression= EM43[2,2]+EM43[2,1])
dep43V<-mxAlgebra(name="dep43Vvar",expression=dep43Avar+dep43Cvar+dep43Evar)
dep43H<-mxAlgebra(name="Hdep43",expression=dep43Avar/dep43Vvar)

dep44A<-mxAlgebra(name="dep44Avar", expression= AM44[2,2]+AM44[2,1])
dep44C<-mxAlgebra(name="dep44Cvar", expression= CM44[2,2]+CM44[2,1])
dep44E<-mxAlgebra(name="dep44Evar", expression= EM44[2,2]+EM44[2,1])
dep44V<-mxAlgebra(name="dep44Vvar",expression=dep44Avar+dep44Cvar+dep44Evar)
dep44H<-mxAlgebra(name="Hdep44",expression=dep44Avar/dep44Vvar)

```

```
dep45A<-mxAlgebra(name="dep45Avar", expression= AM45[2,2]+AM45[2,1])
dep45C<-mxAlgebra(name="dep45Cvar", expression= CM45[2,2]+CM45[2,1])
dep45E<-mxAlgebra(name="dep45Evar", expression= EM45[2,2]+EM45[2,1])
dep45V<-mxAlgebra(name="dep45Vvar", expression=dep45Avar+dep45Cvar+dep45Evar)
dep45H<-mxAlgebra(name="Hdep45", expression=dep45Avar/dep45Vvar)
```

```
dep46A<-mxAlgebra(name="dep46Avar", expression= AM46[2,2]+AM46[2,1])
dep46C<-mxAlgebra(name="dep46Cvar", expression= CM46[2,2]+CM46[2,1])
dep46E<-mxAlgebra(name="dep46Evar", expression= EM46[2,2]+EM46[2,1])
dep46V<-mxAlgebra(name="dep46Vvar", expression=dep46Avar+dep46Cvar+dep46Evar)
dep46H<-mxAlgebra(name="Hdep46", expression=dep46Avar/dep46Vvar)
```

```
dep47A<-mxAlgebra(name="dep47Avar", expression= AM47[2,2]+AM47[2,1])
dep47C<-mxAlgebra(name="dep47Cvar", expression= CM47[2,2]+CM47[2,1])
dep47E<-mxAlgebra(name="dep47Evar", expression= EM47[2,2]+EM47[2,1])
dep47V<-mxAlgebra(name="dep47Vvar", expression=dep47Avar+dep47Cvar+dep47Evar)
dep47H<-mxAlgebra(name="Hdep47", expression=dep47Avar/dep47Vvar)
```

```
dep48A<-mxAlgebra(name="dep48Avar", expression= AM48[2,2]+AM48[2,1])
dep48C<-mxAlgebra(name="dep48Cvar", expression= CM48[2,2]+CM48[2,1])
dep48E<-mxAlgebra(name="dep48Evar", expression= EM48[2,2]+EM48[2,1])
dep48V<-mxAlgebra(name="dep48Vvar", expression=dep48Avar+dep48Cvar+dep48Evar)
dep48H<-mxAlgebra(name="Hdep48", expression=dep48Avar/dep48Vvar)
```

```
dep49A<-mxAlgebra(name="dep49Avar", expression= AM49[2,2]+AM49[2,1])
dep49C<-mxAlgebra(name="dep49Cvar", expression= CM49[2,2]+CM49[2,1])
dep49E<-mxAlgebra(name="dep49Evar", expression= EM49[2,2]+EM49[2,1])
dep49V<-mxAlgebra(name="dep49Vvar", expression=dep49Avar+dep49Cvar+dep49Evar)
dep49H<-mxAlgebra(name="Hdep49", expression=dep49Avar/dep49Vvar)
```

```
dep50A<-mxAlgebra(name="dep50Avar", expression= AM50[2,2]+AM50[2,1])
dep50C<-mxAlgebra(name="dep50Cvar", expression= CM50[2,2]+CM50[2,1])
dep50E<-mxAlgebra(name="dep50Evar", expression= EM50[2,2]+EM50[2,1])
dep50V<-mxAlgebra(name="dep50Vvar", expression=dep50Avar+dep50Cvar+dep50Evar)
dep50H<-mxAlgebra(name="Hdep50", expression=dep50Avar/dep50Vvar)
```

```
dep51A<-mxAlgebra(name="dep51Avar", expression= AM51[2,2]+AM51[2,1])
dep51C<-mxAlgebra(name="dep51Cvar", expression= CM51[2,2]+CM51[2,1])
dep51E<-mxAlgebra(name="dep51Evar", expression= EM51[2,2]+EM51[2,1])
dep51V<-mxAlgebra(name="dep51Vvar", expression=dep51Avar+dep51Cvar+dep51Evar)
dep51H<-mxAlgebra(name="Hdep51", expression=dep51Avar/dep51Vvar)
```

```
dep52A<-mxAlgebra(name="dep52Avar", expression= AM52[2,2]+AM52[2,1])
dep52C<-mxAlgebra(name="dep52Cvar", expression= CM52[2,2]+CM52[2,1])
dep52E<-mxAlgebra(name="dep52Evar", expression= EM52[2,2]+EM52[2,1])
dep52V<-mxAlgebra(name="dep52Vvar", expression=dep52Avar+dep52Cvar+dep52Evar)
dep52H<-mxAlgebra(name="Hdep52", expression=dep52Avar/dep52Vvar)
```

```
dep53A<-mxAlgebra(name="dep53Avar", expression= AM53[2,2]+AM53[2,1])
dep53C<-mxAlgebra(name="dep53Cvar", expression= CM53[2,2]+CM53[2,1])
dep53E<-mxAlgebra(name="dep53Evar", expression= EM53[2,2]+EM53[2,1])
dep53V<-mxAlgebra(name="dep53Vvar", expression=dep53Avar+dep53Cvar+dep53Evar)
dep53H<-mxAlgebra(name="Hdep53", expression=dep53Avar/dep53Vvar)
```

```
dep54A<-mxAlgebra(name="dep54Avar", expression= AM54[2,2]+AM54[2,1])
dep54C<-mxAlgebra(name="dep54Cvar", expression= CM54[2,2]+CM54[2,1])
dep54E<-mxAlgebra(name="dep54Evar", expression= EM54[2,2]+EM54[2,1])
dep54V<-mxAlgebra(name="dep54Vvar",expression=dep54Avar+dep54Cvar+dep54Evar)
dep54H<-mxAlgebra(name="Hdep54",expression=dep54Avar/dep54Vvar)
```

```
dep55A<-mxAlgebra(name="dep55Avar", expression= AM55[2,2]+AM55[2,1])
dep55C<-mxAlgebra(name="dep55Cvar", expression= CM55[2,2]+CM55[2,1])
dep55E<-mxAlgebra(name="dep55Evar", expression= EM55[2,2]+EM55[2,1])
dep55V<-mxAlgebra(name="dep55Vvar",expression=dep55Avar+dep55Cvar+dep55Evar)
dep55H<-mxAlgebra(name="Hdep55",expression=dep55Avar/dep55Vvar)
```

```
dep56A<-mxAlgebra(name="dep56Avar", expression= AM56[2,2]+AM56[2,1])
dep56C<-mxAlgebra(name="dep56Cvar", expression= CM56[2,2]+CM56[2,1])
dep56E<-mxAlgebra(name="dep56Evar", expression= EM56[2,2]+EM56[2,1])
dep56V<-mxAlgebra(name="dep56Vvar",expression=dep56Avar+dep56Cvar+dep56Evar)
dep56H<-mxAlgebra(name="Hdep56",expression=dep56Avar/dep56Vvar)
```

```
dep57A<-mxAlgebra(name="dep57Avar", expression= AM57[2,2]+AM57[2,1])
dep57C<-mxAlgebra(name="dep57Cvar", expression= CM57[2,2]+CM57[2,1])
dep57E<-mxAlgebra(name="dep57Evar", expression= EM57[2,2]+EM57[2,1])
dep57V<-mxAlgebra(name="dep57Vvar",expression=dep57Avar+dep57Cvar+dep57Evar)
dep57H<-mxAlgebra(name="Hdep57",expression=dep57Avar/dep57Vvar)
```

```
dep58A<-mxAlgebra(name="dep58Avar", expression= AM58[2,2]+AM58[2,1])
dep58C<-mxAlgebra(name="dep58Cvar", expression= CM58[2,2]+CM58[2,1])
dep58E<-mxAlgebra(name="dep58Evar", expression= EM58[2,2]+EM58[2,1])
dep58V<-mxAlgebra(name="dep58Vvar",expression=dep58Avar+dep58Cvar+dep58Evar)
dep58H<-mxAlgebra(name="Hdep58",expression=dep58Avar/dep58Vvar)
```

```
dep59A<-mxAlgebra(name="dep59Avar", expression= AM59[2,2]+AM59[2,1])
dep59C<-mxAlgebra(name="dep59Cvar", expression= CM59[2,2]+CM59[2,1])
dep59E<-mxAlgebra(name="dep59Evar", expression= EM59[2,2]+EM59[2,1])
dep59V<-mxAlgebra(name="dep59Vvar",expression=dep59Avar+dep59Cvar+dep59Evar)
dep59H<-mxAlgebra(name="Hdep59",expression=dep59Avar/dep59Vvar)
```

```
dep60A<-mxAlgebra(name="dep60Avar", expression= AM60[2,2]+AM60[2,1])
dep60C<-mxAlgebra(name="dep60Cvar", expression= CM60[2,2]+CM60[2,1])
dep60E<-mxAlgebra(name="dep60Evar", expression= EM60[2,2]+EM60[2,1])
dep60V<-mxAlgebra(name="dep60Vvar",expression=dep60Avar+dep60Cvar+dep60Evar)
dep60H<-mxAlgebra(name="Hdep60",expression=dep60Avar/dep60Vvar)
```

```
dep61A<-mxAlgebra(name="dep61Avar", expression= AM61[2,2]+AM61[2,1])
dep61C<-mxAlgebra(name="dep61Cvar", expression= CM61[2,2]+CM61[2,1])
dep61E<-mxAlgebra(name="dep61Evar", expression= EM61[2,2]+EM61[2,1])
dep61V<-mxAlgebra(name="dep61Vvar",expression=dep61Avar+dep61Cvar+dep61Evar)
dep61H<-mxAlgebra(name="Hdep61",expression=dep61Avar/dep61Vvar)
```

```
dep62A<-mxAlgebra(name="dep62Avar", expression= AM62[2,2]+AM62[2,1])
dep62C<-mxAlgebra(name="dep62Cvar", expression= CM62[2,2]+CM62[2,1])
dep62E<-mxAlgebra(name="dep62Evar", expression= EM62[2,2]+EM62[2,1])
dep62V<-mxAlgebra(name="dep62Vvar",expression=dep62Avar+dep62Cvar+dep62Evar)
dep62H<-mxAlgebra(name="Hdep62",expression=dep62Avar/dep62Vvar)
```

```
dep63A<-mxAlgebra(name="dep63Avar", expression= AM63[2,2]+AM63[2,1])
dep63C<-mxAlgebra(name="dep63Cvar", expression= CM63[2,2]+CM63[2,1])
dep63E<-mxAlgebra(name="dep63Evar", expression= EM63[2,2]+EM63[2,1])
dep63V<-mxAlgebra(name="dep63Vvar", expression=dep63Avar+dep63Cvar+dep63Evar)
dep63H<-mxAlgebra(name="Hdep63", expression=dep63Avar/dep63Vvar)
```

```
dep64A<-mxAlgebra(name="dep64Avar", expression= AM64[2,2]+AM64[2,1])
dep64C<-mxAlgebra(name="dep64Cvar", expression= CM64[2,2]+CM64[2,1])
dep64E<-mxAlgebra(name="dep64Evar", expression= EM64[2,2]+EM64[2,1])
dep64V<-mxAlgebra(name="dep64Vvar", expression=dep64Avar+dep64Cvar+dep64Evar)
dep64H<-mxAlgebra(name="Hdep64", expression=dep64Avar/dep64Vvar)
```

```
dep65A<-mxAlgebra(name="dep65Avar", expression= AM65[2,2]+AM65[2,1])
dep65C<-mxAlgebra(name="dep65Cvar", expression= CM65[2,2]+CM65[2,1])
dep65E<-mxAlgebra(name="dep65Evar", expression= EM65[2,2]+EM65[2,1])
dep65V<-mxAlgebra(name="dep65Vvar", expression=dep65Avar+dep65Cvar+dep65Evar)
dep65H<-mxAlgebra(name="Hdep65", expression=dep65Avar/dep65Vvar)
```

```
dep66A<-mxAlgebra(name="dep66Avar", expression= AM66[2,2]+AM66[2,1])
dep66C<-mxAlgebra(name="dep66Cvar", expression= CM66[2,2]+CM66[2,1])
dep66E<-mxAlgebra(name="dep66Evar", expression= EM66[2,2]+EM66[2,1])
dep66V<-mxAlgebra(name="dep66Vvar", expression=dep66Avar+dep66Cvar+dep66Evar)
dep66H<-mxAlgebra(name="Hdep66", expression=dep66Avar/dep66Vvar)
```

```
dep67A<-mxAlgebra(name="dep67Avar", expression= AM67[2,2]+AM67[2,1])
dep67C<-mxAlgebra(name="dep67Cvar", expression= CM67[2,2]+CM67[2,1])
dep67E<-mxAlgebra(name="dep67Evar", expression= EM67[2,2]+EM67[2,1])
dep67V<-mxAlgebra(name="dep67Vvar", expression=dep67Avar+dep67Cvar+dep67Evar)
dep67H<-mxAlgebra(name="Hdep67", expression=dep67Avar/dep67Vvar)
```

```
dep68A<-mxAlgebra(name="dep68Avar", expression= AM68[2,2]+AM68[2,1])
dep68C<-mxAlgebra(name="dep68Cvar", expression= CM68[2,2]+CM68[2,1])
dep68E<-mxAlgebra(name="dep68Evar", expression= EM68[2,2]+EM68[2,1])
dep68V<-mxAlgebra(name="dep68Vvar", expression=dep68Avar+dep68Cvar+dep68Evar)
dep68H<-mxAlgebra(name="Hdep68", expression=dep68Avar/dep68Vvar)
```

```
dep69A<-mxAlgebra(name="dep69Avar", expression= AM69[2,2]+AM69[2,1])
dep69C<-mxAlgebra(name="dep69Cvar", expression= CM69[2,2]+CM69[2,1])
dep69E<-mxAlgebra(name="dep69Evar", expression= EM69[2,2]+EM69[2,1])
dep69V<-mxAlgebra(name="dep69Vvar", expression=dep69Avar+dep69Cvar+dep69Evar)
dep69H<-mxAlgebra(name="Hdep69", expression=dep69Avar/dep69Vvar)
```

```
dep70A<-mxAlgebra(name="dep70Avar", expression= AM70[2,2]+AM70[2,1])
dep70C<-mxAlgebra(name="dep70Cvar", expression= CM70[2,2]+CM70[2,1])
dep70E<-mxAlgebra(name="dep70Evar", expression= EM70[2,2]+EM70[2,1])
dep70V<-mxAlgebra(name="dep70Vvar", expression=dep70Avar+dep70Cvar+dep70Evar)
dep70H<-mxAlgebra(name="Hdep70", expression=dep70Avar/dep70Vvar)
```

```
dep71A<-mxAlgebra(name="dep71Avar", expression= AM71[2,2]+AM71[2,1])
dep71C<-mxAlgebra(name="dep71Cvar", expression= CM71[2,2]+CM71[2,1])
dep71E<-mxAlgebra(name="dep71Evar", expression= EM71[2,2]+EM71[2,1])
dep71V<-mxAlgebra(name="dep71Vvar", expression=dep71Avar+dep71Cvar+dep71Evar)
dep71H<-mxAlgebra(name="Hdep71", expression=dep71Avar/dep71Vvar)
```



```

dep72A<-mxAlgebra(name="dep72Avar", expression= AM72[2,2]+AM72[2,1])
dep72C<-mxAlgebra(name="dep72Cvar", expression= CM72[2,2]+CM72[2,1])
dep72E<-mxAlgebra(name="dep72Evar", expression= EM72[2,2]+EM72[2,1])
dep72V<-mxAlgebra(name="dep72Vvar", expression=dep72Avar+dep72Cvar+dep72Evar)
dep72H<-mxAlgebra(name="Hdep72", expression=dep72Avar/dep72Vvar)

dep73A<-mxAlgebra(name="dep73Avar", expression= AM73[2,2]+AM73[2,1])
dep73C<-mxAlgebra(name="dep73Cvar", expression= CM73[2,2]+CM73[2,1])
dep73E<-mxAlgebra(name="dep73Evar", expression= EM73[2,2]+EM73[2,1])
dep73V<-mxAlgebra(name="dep73Vvar", expression=dep73Avar+dep73Cvar+dep73Evar)
dep73H<-mxAlgebra(name="Hdep73", expression=dep73Avar/dep73Vvar)

dep74A<-mxAlgebra(name="dep74Avar", expression= AM74[2,2]+AM74[2,1])
dep74C<-mxAlgebra(name="dep74Cvar", expression= CM74[2,2]+CM74[2,1])
dep74E<-mxAlgebra(name="dep74Evar", expression= EM74[2,2]+EM74[2,1])
dep74V<-mxAlgebra(name="dep74Vvar", expression=dep74Avar+dep74Cvar+dep74Evar)
dep74H<-mxAlgebra(name="Hdep74", expression=dep74Avar/dep74Vvar)

dep75A<-mxAlgebra(name="dep75Avar", expression= AM75[2,2]+AM75[2,1])
dep75C<-mxAlgebra(name="dep75Cvar", expression= CM75[2,2]+CM75[2,1])
dep75E<-mxAlgebra(name="dep75Evar", expression= EM75[2,2]+EM75[2,1])
dep75V<-mxAlgebra(name="dep75Vvar", expression=dep75Avar+dep75Cvar+dep75Evar)
dep75H<-mxAlgebra(name="Hdep75", expression=dep75Avar/dep75Vvar)

dep75As<-mxAlgebra(name="dep75Asex", expression=AM75[2,1]/(AM75[2,2]+AM75[2,1]))
dep75Es<-mxAlgebra(name="dep75Esex", expression=EM75[2,1]/(EM75[2,2]+EM75[2,1]))

dep76A<-mxAlgebra(name="dep76Avar", expression= AM76[2,2]+AM76[2,1])
dep76C<-mxAlgebra(name="dep76Cvar", expression= CM76[2,2]+CM76[2,1])
dep76E<-mxAlgebra(name="dep76Evar", expression= EM76[2,2]+EM76[2,1])
dep76V<-mxAlgebra(name="dep76Vvar", expression=dep76Avar+dep76Cvar+dep76Evar)
dep76H<-mxAlgebra(name="Hdep76", expression=dep76Avar/dep76Vvar)

dep77A<-mxAlgebra(name="dep77Avar", expression= AM77[2,2]+AM77[2,1])
dep77C<-mxAlgebra(name="dep77Cvar", expression= CM77[2,2]+CM77[2,1])
dep77E<-mxAlgebra(name="dep77Evar", expression= EM77[2,2]+EM77[2,1])
dep77V<-mxAlgebra(name="dep77Vvar", expression=dep77Avar+dep77Cvar+dep77Evar)
dep77H<-mxAlgebra(name="Hdep77", expression=dep77Avar/dep77Vvar)

dep78A<-mxAlgebra(name="dep78Avar", expression= AM78[2,2]+AM78[2,1])
dep78C<-mxAlgebra(name="dep78Cvar", expression= CM78[2,2]+CM78[2,1])
dep78E<-mxAlgebra(name="dep78Evar", expression= EM78[2,2]+EM78[2,1])
dep78V<-mxAlgebra(name="dep78Vvar", expression=dep78Avar+dep78Cvar+dep78Evar)
dep78H<-mxAlgebra(name="Hdep78", expression=dep78Avar/dep78Vvar)

dep79A<-mxAlgebra(name="dep79Avar", expression= AM79[2,2]+AM79[2,1])
dep79C<-mxAlgebra(name="dep79Cvar", expression= CM79[2,2]+CM79[2,1])
dep79E<-mxAlgebra(name="dep79Evar", expression= EM79[2,2]+EM79[2,1])
dep79V<-mxAlgebra(name="dep79Vvar", expression=dep79Avar+dep79Cvar+dep79Evar)
dep79H<-mxAlgebra(name="Hdep79", expression=dep79Avar/dep79Vvar)

dep80A<-mxAlgebra(name="dep80Avar", expression= AM80[2,2]+AM80[2,1])
dep80C<-mxAlgebra(name="dep80Cvar", expression= CM80[2,2]+CM80[2,1])

```

```
dep80E<-mxAlgebra(name="dep80Evar", expression= EM80[2,2]+EM80[2,1])
dep80V<-mxAlgebra(name="dep80Vvar",expression=dep80Avar+dep80Cvar+dep80Evar)
dep80H<-mxAlgebra(name="Hdep80",expression=dep80Avar/dep80Vvar)
```

```
dep81A<-mxAlgebra(name="dep81Avar", expression= AM81[2,2]+AM81[2,1])
dep81C<-mxAlgebra(name="dep81Cvar", expression= CM81[2,2]+CM81[2,1])
dep81E<-mxAlgebra(name="dep81Evar", expression= EM81[2,2]+EM81[2,1])
dep81V<-mxAlgebra(name="dep81Vvar",expression=dep81Avar+dep81Cvar+dep81Evar)
dep81H<-mxAlgebra(name="Hdep81",expression=dep81Avar/dep81Vvar)
```

```
dep82A<-mxAlgebra(name="dep82Avar", expression= AM82[2,2]+AM82[2,1])
dep82C<-mxAlgebra(name="dep82Cvar", expression= CM82[2,2]+CM82[2,1])
dep82E<-mxAlgebra(name="dep82Evar", expression= EM82[2,2]+EM82[2,1])
dep82V<-mxAlgebra(name="dep82Vvar",expression=dep82Avar+dep82Cvar+dep82Evar)
dep82H<-mxAlgebra(name="Hdep82",expression=dep82Avar/dep82Vvar)
```

```
dep83A<-mxAlgebra(name="dep83Avar", expression= AM83[2,2]+AM83[2,1])
dep83C<-mxAlgebra(name="dep83Cvar", expression= CM83[2,2]+CM83[2,1])
dep83E<-mxAlgebra(name="dep83Evar", expression= EM83[2,2]+EM83[2,1])
dep83V<-mxAlgebra(name="dep83Vvar",expression=dep83Avar+dep83Cvar+dep83Evar)
dep83H<-mxAlgebra(name="Hdep83",expression=dep83Avar/dep83Vvar)
```

```
dep84A<-mxAlgebra(name="dep84Avar", expression= AM84[2,2]+AM84[2,1])
dep84C<-mxAlgebra(name="dep84Cvar", expression= CM84[2,2]+CM84[2,1])
dep84E<-mxAlgebra(name="dep84Evar", expression= EM84[2,2]+EM84[2,1])
dep84V<-mxAlgebra(name="dep84Vvar",expression=dep84Avar+dep84Cvar+dep84Evar)
dep84H<-mxAlgebra(name="Hdep84",expression=dep84Avar/dep84Vvar)
```

```
dep85A<-mxAlgebra(name="dep85Avar", expression= AM85[2,2]+AM85[2,1])
dep85C<-mxAlgebra(name="dep85Cvar", expression= CM85[2,2]+CM85[2,1])
dep85E<-mxAlgebra(name="dep85Evar", expression= EM85[2,2]+EM85[2,1])
dep85V<-mxAlgebra(name="dep85Vvar",expression=dep85Avar+dep85Cvar+dep85Evar)
dep85H<-mxAlgebra(name="Hdep85",expression=dep85Avar/dep85Vvar)
```

```
dep86A<-mxAlgebra(name="dep86Avar", expression= AM86[2,2]+AM86[2,1])
dep86C<-mxAlgebra(name="dep86Cvar", expression= CM86[2,2]+CM86[2,1])
dep86E<-mxAlgebra(name="dep86Evar", expression= EM86[2,2]+EM86[2,1])
dep86V<-mxAlgebra(name="dep86Vvar",expression=dep86Avar+dep86Cvar+dep86Evar)
dep86H<-mxAlgebra(name="Hdep86",expression=dep86Avar/dep86Vvar)
```

```
dep87A<-mxAlgebra(name="dep87Avar", expression= AM87[2,2]+AM87[2,1])
dep87C<-mxAlgebra(name="dep87Cvar", expression= CM87[2,2]+CM87[2,1])
dep87E<-mxAlgebra(name="dep87Evar", expression= EM87[2,2]+EM87[2,1])
dep87V<-mxAlgebra(name="dep87Vvar",expression=dep87Avar+dep87Cvar+dep87Evar)
dep87H<-mxAlgebra(name="Hdep87",expression=dep87Avar/dep87Vvar)
```

```
dep88A<-mxAlgebra(name="dep88Avar", expression= AM88[2,2]+AM88[2,1])
dep88C<-mxAlgebra(name="dep88Cvar", expression= CM88[2,2]+CM88[2,1])
dep88E<-mxAlgebra(name="dep88Evar", expression= EM88[2,2]+EM88[2,1])
dep88V<-mxAlgebra(name="dep88Vvar",expression=dep88Avar+dep88Cvar+dep88Evar)
dep88H<-mxAlgebra(name="Hdep88",expression=dep88Avar/dep88Vvar)
```

```
dep89A<-mxAlgebra(name="dep89Avar", expression= AM89[2,2]+AM89[2,1])
dep89C<-mxAlgebra(name="dep89Cvar", expression= CM89[2,2]+CM89[2,1])
```

```

dep89E<-mxAlgebra(name="dep89Evar", expression= EM89[2,2]+EM89[2,1])
dep89V<-mxAlgebra(name="dep89Vvar",expression=dep89Avar+dep89Cvar+dep89Evar)
dep89H<-mxAlgebra(name="Hdep89",expression=dep89Avar/dep89Vvar)

```

```

dep90A<-mxAlgebra(name="dep90Avar", expression= AM90[2,2]+AM90[2,1])
dep90C<-mxAlgebra(name="dep90Cvar", expression= CM90[2,2]+CM90[2,1])
dep90E<-mxAlgebra(name="dep90Evar", expression= EM90[2,2]+EM90[2,1])
dep90V<-mxAlgebra(name="dep90Vvar",expression=dep90Avar+dep90Cvar+dep90Evar)
dep90H<-mxAlgebra(name="Hdep90",expression=dep90Avar/dep90Vvar)

```

```

matIM <- mxMatrix(name= "IM", type="Iden", nrow = nv, ncol = nv)

```

```

###ALGEBRAS TO COMPUTE THE DIFFERENT VARIANCE COMPONENTS AT DIFFERENT LEVELS OF
IGEMS-CIRS

```

```

covAMmodHm10<- mxAlgebra(name = "AMm10", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-10%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-
10%x%aLMH)) )
covCMmodHm10<- mxAlgebra(name = "CMm10", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-10%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-
10%x%cLMH)) )
covEMmodHm10<- mxAlgebra(name = "EMm10", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-10%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-
10%x%eLMH)) )

```

```

covAMmodHm9<- mxAlgebra(name = "AMm9", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-9%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-9%x%aLMH)) )
covCMmodHm9<- mxAlgebra(name = "CMm9", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-9%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-9%x%cLMH)) )
covEMmodHm9<- mxAlgebra(name = "EMm9", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-9%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-9%x%eLMH)) )

```

```

covAMmodHm8<- mxAlgebra(name = "AMm8", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-8%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-8%x%aLMH)) )
covCMmodHm8<- mxAlgebra(name = "CMm8", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-8%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-8%x%cLMH)) )
covEMmodHm8<- mxAlgebra(name = "EMm8", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-8%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-8%x%eLMH)) )

```

```

covAMmodHm7<- mxAlgebra(name = "AMm7", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-7%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-7%x%aLMH)) )
covCMmodHm7<- mxAlgebra(name = "CMm7", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-7%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-7%x%cLMH)) )
covEMmodHm7<- mxAlgebra(name = "EMm7", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-7%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-7%x%eLMH)) )

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covAMmodHm6<- mxAlgebra(name = "AMm6", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-6%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-6%x%aLMH)) )
covCMmodHm6<- mxAlgebra(name = "CMm6", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-6%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-6%x%cLMH)) )
covEMmodHm6<- mxAlgebra(name = "EMm6", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-6%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-6%x%eLMH)) )

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covAMmodHm5<- mxAlgebra(name = "AMm5", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-5%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-5%x%aLMH)))
covCMmodHm5<- mxAlgebra(name = "CMm5", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-5%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-5%x%cLMH)))
covEMmodHm5<- mxAlgebra(name = "EMm5", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-5%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-5%x%eLMH)))

covAMmodHm4<- mxAlgebra(name = "AMm4", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-4%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-4%x%aLMH)))
covCMmodHm4<- mxAlgebra(name = "CMm4", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-4%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-4%x%cLMH)))
covEMmodHm4<- mxAlgebra(name = "EMm4", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-4%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-4%x%eLMH)))

covAMmodHm3<- mxAlgebra(name = "AMm3", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-3%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-3%x%aLMH)))
covCMmodHm3<- mxAlgebra(name = "CMm3", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-3%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-3%x%cLMH)))
covEMmodHm3<- mxAlgebra(name = "EMm3", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-3%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-3%x%eLMH)))

covAMmodHm2<- mxAlgebra(name = "AMm2", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-2%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-2%x%aLMH)))
covCMmodHm2<- mxAlgebra(name = "CMm2", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-2%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-2%x%cLMH)))
covEMmodHm2<- mxAlgebra(name = "EMm2", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-2%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-2%x%eLMH)))

covAMmodHm1<- mxAlgebra(name = "AMm1", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (-1%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (-1%x%aLMH)))
covCMmodHm1<- mxAlgebra(name = "CMm1", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (-1%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (-1%x%cLMH)))
covEMmodHm1<- mxAlgebra(name = "EMm1", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (-1%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (-1%x%eLMH)))

covAMmodHm0<- mxAlgebra(name = "AMm0", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (0%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (0%x%aLMH)))
covCMmodHm0<- mxAlgebra(name = "CMm0", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (0%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (0%x%cLMH)))
covEMmodHm0<- mxAlgebra(name = "EMm0", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (0%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (0%x%eLMH)))

covAMmodHp10<- mxAlgebra(name = "AMp10", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (10%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (10%x%aLMH)))
covCMmodHp10<- mxAlgebra(name = "CMp10", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (10%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (10%x%cLMH)))
covEMmodHp10<- mxAlgebra(name = "EMp10", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (10%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (10%x%eLMH)))

covAMmodHp9<- mxAlgebra(name = "AMp9", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (9%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (9%x%aLMH)))
covCMmodHp9<- mxAlgebra(name = "CMp9", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (9%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (9%x%cLMH)))

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covEMmodHp9<- mxAlgebra(name = "EMp9", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (9%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (9%x%eLMH)))

covAMmodHp8<- mxAlgebra(name = "AMp8", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (8%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (8%x%aLMH)))
covCMmodHp8<- mxAlgebra(name = "CMp8", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (8%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (8%x%cLMH)))
covEMmodHp8<- mxAlgebra(name = "EMp8", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (8%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (8%x%eLMH)))

covAMmodHp7<- mxAlgebra(name = "AMp7", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (7%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (7%x%aLMH)))
covCMmodHp7<- mxAlgebra(name = "CMp7", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (7%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (7%x%cLMH)))
covEMmodHp7<- mxAlgebra(name = "EMp7", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (7%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (7%x%eLMH)))

covAMmodHp6<- mxAlgebra(name = "AMp6", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (6%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (6%x%aLMH)))
covCMmodHp6<- mxAlgebra(name = "CMp6", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (6%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (6%x%cLMH)))
covEMmodHp6<- mxAlgebra(name = "EMp6", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (6%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (6%x%eLMH)))

covAMmodHp5<- mxAlgebra(name = "AMp5", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (5%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (5%x%aLMH)))
covCMmodHp5<- mxAlgebra(name = "CMp5", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (5%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (5%x%cLMH)))
covEMmodHp5<- mxAlgebra(name = "EMp5", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (5%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (5%x%eLMH)))

covAMmodHp4<- mxAlgebra(name = "AMp4", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (4%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (4%x%aLMH)))
covCMmodHp4<- mxAlgebra(name = "CMp4", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (4%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (4%x%cLMH)))
covEMmodHp4<- mxAlgebra(name = "EMp4", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (4%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (4%x%eLMH)))

covAMmodHp3<- mxAlgebra(name = "AMp3", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (3%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (3%x%aLMH)))
covCMmodHp3<- mxAlgebra(name = "CMp3", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (3%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (3%x%cLMH)))
covEMmodHp3<- mxAlgebra(name = "EMp3", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (3%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (3%x%eLMH)))

covAMmodHp2<- mxAlgebra(name = "AMp2", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (2%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (2%x%aLMH)))
covCMmodHp2<- mxAlgebra(name = "CMp2", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (2%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (2%x%cLMH)))
covEMmodHp2<- mxAlgebra(name = "EMp2", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (2%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (2%x%eLMH)))

covAMmodHp1<- mxAlgebra(name = "AMp1", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (1%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (1%x%aLMH)))

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covCMmodHp1<- mxAlgebra(name = "CMp1", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (1%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (1%x%cLMH)))
covEMmodHp1<- mxAlgebra(name = "EMp1", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (1%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (1%x%eLMH)))

covAMmodHp20<- mxAlgebra(name = "AMp20", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (20%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (20%x%aLMH)))
covCMmodHp20<- mxAlgebra(name = "CMp20", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (20%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (20%x%cLMH)))
covEMmodHp20<- mxAlgebra(name = "EMp20", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (20%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (20%x%eLMH)))

covAMmodHp19<- mxAlgebra(name = "AMp19", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (19%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (19%x%aLMH)))
covCMmodHp19<- mxAlgebra(name = "CMp19", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (19%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (19%x%cLMH)))
covEMmodHp19<- mxAlgebra(name = "EMp19", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (19%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (19%x%eLMH)))

covAMmodHp18<- mxAlgebra(name = "AMp18", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (18%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (18%x%aLMH)))
covCMmodHp18<- mxAlgebra(name = "CMp18", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (18%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (18%x%cLMH)))
covEMmodHp18<- mxAlgebra(name = "EMp18", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (18%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (18%x%eLMH)))

covAMmodHp17<- mxAlgebra(name = "AMp17", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (17%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (17%x%aLMH)))
covCMmodHp17<- mxAlgebra(name = "CMp17", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (17%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (17%x%cLMH)))
covEMmodHp17<- mxAlgebra(name = "EMp17", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (17%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (17%x%eLMH)))

covAMmodHp16<- mxAlgebra(name = "AMp16", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (16%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (16%x%aLMH)))
covCMmodHp16<- mxAlgebra(name = "CMp16", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (16%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (16%x%cLMH)))
covEMmodHp16<- mxAlgebra(name = "EMp16", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (16%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (16%x%eLMH)))

covAMmodHp15<- mxAlgebra(name = "AMp15", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (15%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (15%x%aLMH)))
covCMmodHp15<- mxAlgebra(name = "CMp15", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (15%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (15%x%cLMH)))
covEMmodHp15<- mxAlgebra(name = "EMp15", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (15%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (15%x%eLMH)))

covAMmodHp14<- mxAlgebra(name = "AMp14", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (14%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (14%x%aLMH)))
covCMmodHp14<- mxAlgebra(name = "CMp14", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (14%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (14%x%cLMH)))
covEMmodHp14<- mxAlgebra(name = "EMp14", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (14%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (14%x%eLMH)))

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covAMmodHp13<- mxAlgebra(name = "AMp13", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (13%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (13%x%aLMH)))
covCMmodHp13<- mxAlgebra(name = "CMp13", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (13%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (13%x%cLMH)))
covEMmodHp13<- mxAlgebra(name = "EMp13", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (13%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (13%x%eLMH)))

covAMmodHp12<- mxAlgebra(name = "AMp12", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (12%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (12%x%aLMH)))
covCMmodHp12<- mxAlgebra(name = "CMp12", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (12%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (12%x%cLMH)))
covEMmodHp12<- mxAlgebra(name = "EMp12", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (12%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (12%x%eLMH)))

covAMmodHp11<- mxAlgebra(name = "AMp11", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (11%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (11%x%aLMH)))
covCMmodHp11<- mxAlgebra(name = "CMp11", expression = (cM+ (0%x%cLM)+
(0%x%0%x%cLM1)+ (11%x%cLMH)) %*% t(cM+ (0%x%cLM)+ (0%x%0%x%cLM1)+ (11%x%cLMH)))
covEMmodHp11<- mxAlgebra(name = "EMp11", expression = (eM+ (0%x%eLM)+
(0%x%0%x%eLM1)+ (11%x%eLMH)) %*% t(eM+ (0%x%eLM)+ (0%x%0%x%eLM1)+ (11%x%eLMH)))

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###CODE TO COMPUTE GENETIC AND ENVIRONMENTAL CORRELATIONS BETWEEN DEPRESSIVE
SYMPTOMS AND I-CIRS SCORE AT DIFFERENT LEVELS OF PHYSICAL ILLNESS

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covPhMm10 <- mxAlgebra(name = "VMm10", expression = AMm10+CMm10+EMm10)

invSDMm10 <- mxAlgebra(name ="iSDMm10", expression = solve(sqrt(IM*VMm10)))
corPhMm10 <- mxAlgebra(name ="rPhMm10", expression = iSDMm10%*%VMm10%*%iSDMm10)
corAMm10 <- mxAlgebra(name ="rAMm10", expression =
solve(sqrt(IM*AMm10))%*%AMm10%*%solve(sqrt(IM*AMm10)))
corCMm10 <- mxAlgebra(name ="rCMm10", expression =
solve(sqrt(IM*CMm10))%*%CMm10%*%solve(sqrt(IM*CMm10)))
corEMm10 <- mxAlgebra(name ="rEMm10", expression =
solve(sqrt(IM*EMm10))%*%EMm10%*%solve(sqrt(IM*EMm10)))

covPhMm9 <- mxAlgebra(name = "VMm9", expression = AMm9+CMm9+EMm9)

invSDMm9 <- mxAlgebra(name ="iSDMm9", expression = solve(sqrt(IM*VMm9)))
corPhMm9 <- mxAlgebra(name ="rPhMm9", expression = iSDMm9%*%VMm9%*%iSDMm9)
corAMm9 <- mxAlgebra(name ="rAMm9", expression =
solve(sqrt(IM*AMm9))%*%AMm9%*%solve(sqrt(IM*AMm9)))
corCMm9 <- mxAlgebra(name ="rCMm9", expression =
solve(sqrt(IM*CMm9))%*%CMm9%*%solve(sqrt(IM*CMm9)))
corEMm9 <- mxAlgebra(name ="rEMm9", expression =
solve(sqrt(IM*EMm9))%*%EMm9%*%solve(sqrt(IM*EMm9)))

covPhMm8 <- mxAlgebra(name = "VMm8", expression = AMm8+CMm8+EMm8)

invSDMm8 <- mxAlgebra(name ="iSDMm8", expression = solve(sqrt(IM*VMm8)))
corPhMm8 <- mxAlgebra(name ="rPhMm8", expression = iSDMm8%*%VMm8%*%iSDMm8)
corAMm8 <- mxAlgebra(name ="rAMm8", expression =
solve(sqrt(IM*AMm8))%*%AMm8%*%solve(sqrt(IM*AMm8)))

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corCMm8 <- mxAlgebra(name = "rCMm8", expression =
solve(sqrt(IM*CMm8))*%*%CMm8*%*%solve(sqrt(IM*CMm8)))
corEMm8 <- mxAlgebra(name = "rEMm8", expression =
solve(sqrt(IM*EMm8))*%*%EMm8*%*%solve(sqrt(IM*EMm8)))

covPhMm7 <- mxAlgebra(name = "VMm7", expression = AMm7+CMm7+EMm7)

invSDMm7 <- mxAlgebra(name = "iSDMm7", expression = solve(sqrt(IM*VMm7)))
corPhMm7 <- mxAlgebra(name = "rPhMm7", expression = iSDMm7*%*%VMm7*%*%iSDMm7)
corAMm7 <- mxAlgebra(name = "rAMm7", expression =
solve(sqrt(IM*AMm7))*%*%AMm7*%*%solve(sqrt(IM*AMm7)))
corCMm7 <- mxAlgebra(name = "rCMm7", expression =
solve(sqrt(IM*CMm7))*%*%CMm7*%*%solve(sqrt(IM*CMm7)))
corEMm7 <- mxAlgebra(name = "rEMm7", expression =
solve(sqrt(IM*EMm7))*%*%EMm7*%*%solve(sqrt(IM*EMm7)))

covPhMm6 <- mxAlgebra(name = "VMm6", expression = AMm6+CMm6+EMm6)

invSDMm6 <- mxAlgebra(name = "iSDMm6", expression = solve(sqrt(IM*VMm6)))
corPhMm6 <- mxAlgebra(name = "rPhMm6", expression = iSDMm6*%*%VMm6*%*%iSDMm6)
corAMm6 <- mxAlgebra(name = "rAMm6", expression =
solve(sqrt(IM*AMm6))*%*%AMm6*%*%solve(sqrt(IM*AMm6)))
corCMm6 <- mxAlgebra(name = "rCMm6", expression =
solve(sqrt(IM*CMm6))*%*%CMm6*%*%solve(sqrt(IM*CMm6)))
corEMm6 <- mxAlgebra(name = "rEMm6", expression =
solve(sqrt(IM*EMm6))*%*%EMm6*%*%solve(sqrt(IM*EMm6)))

covPhMm5 <- mxAlgebra(name = "VMm5", expression = AMm5+CMm5+EMm5)

invSDMm5 <- mxAlgebra(name = "iSDMm5", expression = solve(sqrt(IM*VMm5)))
corPhMm5 <- mxAlgebra(name = "rPhMm5", expression = iSDMm5*%*%VMm5*%*%iSDMm5)
corAMm5 <- mxAlgebra(name = "rAMm5", expression =
solve(sqrt(IM*AMm5))*%*%AMm5*%*%solve(sqrt(IM*AMm5)))
corCMm5 <- mxAlgebra(name = "rCMm5", expression =
solve(sqrt(IM*CMm5))*%*%CMm5*%*%solve(sqrt(IM*CMm5)))
corEMm5 <- mxAlgebra(name = "rEMm5", expression =
solve(sqrt(IM*EMm5))*%*%EMm5*%*%solve(sqrt(IM*EMm5)))

covPhMm4 <- mxAlgebra(name = "VMm4", expression = AMm4+CMm4+EMm4)

invSDMm4 <- mxAlgebra(name = "iSDMm4", expression = solve(sqrt(IM*VMm4)))
corPhMm4 <- mxAlgebra(name = "rPhMm4", expression = iSDMm4*%*%VMm4*%*%iSDMm4)
corAMm4 <- mxAlgebra(name = "rAMm4", expression =
solve(sqrt(IM*AMm4))*%*%AMm4*%*%solve(sqrt(IM*AMm4)))
corCMm4 <- mxAlgebra(name = "rCMm4", expression =
solve(sqrt(IM*CMm4))*%*%CMm4*%*%solve(sqrt(IM*CMm4)))
corEMm4 <- mxAlgebra(name = "rEMm4", expression =
solve(sqrt(IM*EMm4))*%*%EMm4*%*%solve(sqrt(IM*EMm4)))

covPhMm3 <- mxAlgebra(name = "VMm3", expression = AMm3+CMm3+EMm3)

invSDMm3 <- mxAlgebra(name = "iSDMm3", expression = solve(sqrt(IM*VMm3)))
corPhMm3 <- mxAlgebra(name = "rPhMm3", expression = iSDMm3*%*%VMm3*%*%iSDMm3)

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corAMm3 <- mxAlgebra(name = "rAMm3", expression =
solve(sqrt(IM*AMm3))%*%AMm3%*%solve(sqrt(IM*AMm3)))
corCMm3 <- mxAlgebra(name = "rCMm3", expression =
solve(sqrt(IM*CMm3))%*%CMm3%*%solve(sqrt(IM*CMm3)))
corEMm3 <- mxAlgebra(name = "rEMm3", expression =
solve(sqrt(IM*EMm3))%*%EMm3%*%solve(sqrt(IM*EMm3)))

covPhMm2 <- mxAlgebra(name = "VMm2", expression = AMm2+CMm2+EMm2)

invSDMm2 <- mxAlgebra(name = "iSDMm2", expression = solve(sqrt(IM*VMm2)))
corPhMm2 <- mxAlgebra(name = "rPhMm2", expression = iSDMm2%*%VMm2%*%iSDMm2)
corAMm2 <- mxAlgebra(name = "rAMm2", expression =
solve(sqrt(IM*AMm2))%*%AMm2%*%solve(sqrt(IM*AMm2)))
corCMm2 <- mxAlgebra(name = "rCMm2", expression =
solve(sqrt(IM*CMm2))%*%CMm2%*%solve(sqrt(IM*CMm2)))
corEMm2 <- mxAlgebra(name = "rEMm2", expression =
solve(sqrt(IM*EMm2))%*%EMm2%*%solve(sqrt(IM*EMm2)))

covPhMm1 <- mxAlgebra(name = "VMm1", expression = AMm1+CMm1+EMm1)

invSDMm1 <- mxAlgebra(name = "iSDMm1", expression = solve(sqrt(IM*VMm1)))
corPhMm1 <- mxAlgebra(name = "rPhMm1", expression = iSDMm1%*%VMm1%*%iSDMm1)
corAMm1 <- mxAlgebra(name = "rAMm1", expression =
solve(sqrt(IM*AMm1))%*%AMm1%*%solve(sqrt(IM*AMm1)))
corCMm1 <- mxAlgebra(name = "rCMm1", expression =
solve(sqrt(IM*CMm1))%*%CMm1%*%solve(sqrt(IM*CMm1)))
corEMm1 <- mxAlgebra(name = "rEMm1", expression =
solve(sqrt(IM*EMm1))%*%EMm1%*%solve(sqrt(IM*EMm1)))

covPhMm0 <- mxAlgebra(name = "VMm0", expression = AMm0+CMm0+EMm0)

invSDMm0 <- mxAlgebra(name = "iSDMm0", expression = solve(sqrt(IM*VMm0)))
corPhMm0 <- mxAlgebra(name = "rPhMm0", expression = iSDMm0%*%VMm0%*%iSDMm0)
corAMm0 <- mxAlgebra(name = "rAMm0", expression =
solve(sqrt(IM*AMm0))%*%AMm0%*%solve(sqrt(IM*AMm0)))
corCMm0 <- mxAlgebra(name = "rCMm0", expression =
solve(sqrt(IM*CMm0))%*%CMm0%*%solve(sqrt(IM*CMm0)))
corEMm0 <- mxAlgebra(name = "rEMm0", expression =
solve(sqrt(IM*EMm0))%*%EMm0%*%solve(sqrt(IM*EMm0)))

covAMmodHp10<- mxAlgebra(name = "AMp10", expression = (aM+ (0%x%aLM)+
(0%x%0%x%aLM1)+ (10%x%aLMH)) %*% t(aM+ (0%x%aLM)+ (0%x%0%x%aLM1)+ (10%x%aLMH)))

covPhMp10 <- mxAlgebra(name = "VMp10", expression = AMp10+CMp10+EMp10)

invSDMp10 <- mxAlgebra(name = "iSDMp10", expression = solve(sqrt(IM*VMp10)))
corPhMp10 <- mxAlgebra(name = "rPhMp10", expression = iSDMp10%*%VMp10%*%iSDMp10)
corAMp10 <- mxAlgebra(name = "rAMp10", expression =
solve(sqrt(IM*AMp10))%*%AMp10%*%solve(sqrt(IM*AMp10)))
corCMp10 <- mxAlgebra(name = "rCMp10", expression =
solve(sqrt(IM*CMp10))%*%CMp10%*%solve(sqrt(IM*CMp10)))

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corEMp10 <- mxAlgebra(name = "rEMp10", expression =
solve(sqrt(IM*EMp10))%*%EMp10%*%solve(sqrt(IM*EMp10)))

covPhMp9 <- mxAlgebra(name = "VMp9", expression = AMp9+CMp9+EMp9)

invSDMp9 <- mxAlgebra(name = "iSDMp9", expression = solve(sqrt(IM*VMp9)))
corPhMp9 <- mxAlgebra(name = "rPhMp9", expression = iSDMp9%*%VMp9%*%iSDMp9)
corAMp9 <- mxAlgebra(name = "rAMp9", expression =
solve(sqrt(IM*AMp9))%*%AMp9%*%solve(sqrt(IM*AMp9)))
corCMp9 <- mxAlgebra(name = "rCMp9", expression =
solve(sqrt(IM*CMp9))%*%CMp9%*%solve(sqrt(IM*CMp9)))
corEMp9 <- mxAlgebra(name = "rEMp9", expression =
solve(sqrt(IM*EMp9))%*%EMp9%*%solve(sqrt(IM*EMp9)))

covPhMp8 <- mxAlgebra(name = "VMp8", expression = AMp8+CMp8+EMp8)

invSDMp8 <- mxAlgebra(name = "iSDMp8", expression = solve(sqrt(IM*VMp8)))
corPhMp8 <- mxAlgebra(name = "rPhMp8", expression = iSDMp8%*%VMp8%*%iSDMp8)
corAMp8 <- mxAlgebra(name = "rAMp8", expression =
solve(sqrt(IM*AMp8))%*%AMp8%*%solve(sqrt(IM*AMp8)))
corCMp8 <- mxAlgebra(name = "rCMp8", expression =
solve(sqrt(IM*CMp8))%*%CMp8%*%solve(sqrt(IM*CMp8)))
corEMp8 <- mxAlgebra(name = "rEMp8", expression =
solve(sqrt(IM*EMp8))%*%EMp8%*%solve(sqrt(IM*EMp8)))

covPhMp7 <- mxAlgebra(name = "VMp7", expression = AMp7+CMp7+EMp7)

invSDMp7 <- mxAlgebra(name = "iSDMp7", expression = solve(sqrt(IM*VMp7)))
corPhMp7 <- mxAlgebra(name = "rPhMp7", expression = iSDMp7%*%VMp7%*%iSDMp7)
corAMp7 <- mxAlgebra(name = "rAMp7", expression =
solve(sqrt(IM*AMp7))%*%AMp7%*%solve(sqrt(IM*AMp7)))
corCMp7 <- mxAlgebra(name = "rCMp7", expression =
solve(sqrt(IM*CMp7))%*%CMp7%*%solve(sqrt(IM*CMp7)))
corEMp7 <- mxAlgebra(name = "rEMp7", expression =
solve(sqrt(IM*EMp7))%*%EMp7%*%solve(sqrt(IM*EMp7)))

covPhMp6 <- mxAlgebra(name = "VMp6", expression = AMp6+CMp6+EMp6)

invSDMp6 <- mxAlgebra(name = "iSDMp6", expression = solve(sqrt(IM*VMp6)))
corPhMp6 <- mxAlgebra(name = "rPhMp6", expression = iSDMp6%*%VMp6%*%iSDMp6)
corAMp6 <- mxAlgebra(name = "rAMp6", expression =
solve(sqrt(IM*AMp6))%*%AMp6%*%solve(sqrt(IM*AMp6)))
corCMp6 <- mxAlgebra(name = "rCMp6", expression =
solve(sqrt(IM*CMp6))%*%CMp6%*%solve(sqrt(IM*CMp6)))
corEMp6 <- mxAlgebra(name = "rEMp6", expression =
solve(sqrt(IM*EMp6))%*%EMp6%*%solve(sqrt(IM*EMp6)))

covPhMp5 <- mxAlgebra(name = "VMp5", expression = AMp5+CMp5+EMp5)

invSDMp5 <- mxAlgebra(name = "iSDMp5", expression = solve(sqrt(IM*VMp5)))
corPhMp5 <- mxAlgebra(name = "rPhMp5", expression = iSDMp5%*%VMp5%*%iSDMp5)
corAMp5 <- mxAlgebra(name = "rAMp5", expression =
solve(sqrt(IM*AMp5))%*%AMp5%*%solve(sqrt(IM*AMp5)))

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corCmp5 <- mxAlgebra(name = "rCmp5", expression =
solve(sqrt(IM*Cmp5))*%Cmp5*%solve(sqrt(IM*Cmp5)))
corEmp5 <- mxAlgebra(name = "rEmp5", expression =
solve(sqrt(IM*Emp5))*%Emp5*%solve(sqrt(IM*Emp5)))

covPhMp4 <- mxAlgebra(name = "VMp4", expression = Amp4+Cmp4+Emp4)

invSDMp4 <- mxAlgebra(name = "iSDMp4", expression = solve(sqrt(IM*VMp4)))
corPhMp4 <- mxAlgebra(name = "rPhMp4", expression = iSDMp4*%VMp4*%iSDMp4)
corAmp4 <- mxAlgebra(name = "rAmp4", expression =
solve(sqrt(IM*Amp4))*%Amp4*%solve(sqrt(IM*Amp4)))
corCmp4 <- mxAlgebra(name = "rCmp4", expression =
solve(sqrt(IM*Cmp4))*%Cmp4*%solve(sqrt(IM*Cmp4)))
corEmp4 <- mxAlgebra(name = "rEmp4", expression =
solve(sqrt(IM*Emp4))*%Emp4*%solve(sqrt(IM*Emp4)))

covPhMp3 <- mxAlgebra(name = "VMp3", expression = Amp3+Cmp3+Emp3)

invSDMp3 <- mxAlgebra(name = "iSDMp3", expression = solve(sqrt(IM*VMp3)))
corPhMp3 <- mxAlgebra(name = "rPhMp3", expression = iSDMp3*%VMp3*%iSDMp3)
corAmp3 <- mxAlgebra(name = "rAmp3", expression =
solve(sqrt(IM*Amp3))*%Amp3*%solve(sqrt(IM*Amp3)))
corCmp3 <- mxAlgebra(name = "rCmp3", expression =
solve(sqrt(IM*Cmp3))*%Cmp3*%solve(sqrt(IM*Cmp3)))
corEmp3 <- mxAlgebra(name = "rEmp3", expression =
solve(sqrt(IM*Emp3))*%Emp3*%solve(sqrt(IM*Emp3)))

covPhMp2 <- mxAlgebra(name = "VMp2", expression = Amp2+Cmp2+Emp2)

invSDMp2 <- mxAlgebra(name = "iSDMp2", expression = solve(sqrt(IM*VMp2)))
corPhMp2 <- mxAlgebra(name = "rPhMp2", expression = iSDMp2*%VMp2*%iSDMp2)
corAmp2 <- mxAlgebra(name = "rAmp2", expression =
solve(sqrt(IM*Amp2))*%Amp2*%solve(sqrt(IM*Amp2)))
corCmp2 <- mxAlgebra(name = "rCmp2", expression =
solve(sqrt(IM*Cmp2))*%Cmp2*%solve(sqrt(IM*Cmp2)))
corEmp2 <- mxAlgebra(name = "rEmp2", expression =
solve(sqrt(IM*Emp2))*%Emp2*%solve(sqrt(IM*Emp2)))

covPhMp1 <- mxAlgebra(name = "VMp1", expression = Amp1+Cmp1+Emp1)

invSDMp1 <- mxAlgebra(name = "iSDMp1", expression = solve(sqrt(IM*VMp1)))
corPhMp1 <- mxAlgebra(name = "rPhMp1", expression = iSDMp1*%VMp1*%iSDMp1)
corAmp1 <- mxAlgebra(name = "rAmp1", expression =
solve(sqrt(IM*Amp1))*%Amp1*%solve(sqrt(IM*Amp1)))
corCmp1 <- mxAlgebra(name = "rCmp1", expression =
solve(sqrt(IM*Cmp1))*%Cmp1*%solve(sqrt(IM*Cmp1)))
corEmp1 <- mxAlgebra(name = "rEmp1", expression =
solve(sqrt(IM*Emp1))*%Emp1*%solve(sqrt(IM*Emp1)))

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covPhMp20 <- mxAlgebra(name = "VMp20", expression = AMp20+CMp20+EMp20)

invSDMp20 <- mxAlgebra(name = "iSDMp20", expression = solve(sqrt(IM*VMp20)))
corPhMp20 <- mxAlgebra(name = "rPhMp20", expression = iSDMp20%*%VMp20%*%iSDMp20)
corAMp20 <- mxAlgebra(name = "rAMp20", expression =
solve(sqrt(IM*AMp20))%*%AMp20%*%solve(sqrt(IM*AMp20)))
corCMp20 <- mxAlgebra(name = "rCMp20", expression =
solve(sqrt(IM*CMp20))%*%CMp20%*%solve(sqrt(IM*CMp20)))
corEMp20 <- mxAlgebra(name = "rEMp20", expression =
solve(sqrt(IM*EMp20))%*%EMp20%*%solve(sqrt(IM*EMp20)))

covPhMp19 <- mxAlgebra(name = "VMp19", expression = AMp19+CMp19+EMp19)

invSDMp19 <- mxAlgebra(name = "iSDMp19", expression = solve(sqrt(IM*VMp19)))
corPhMp19 <- mxAlgebra(name = "rPhMp19", expression = iSDMp19%*%VMp19%*%iSDMp19)
corAMp19 <- mxAlgebra(name = "rAMp19", expression =
solve(sqrt(IM*AMp19))%*%AMp19%*%solve(sqrt(IM*AMp19)))
corCMp19 <- mxAlgebra(name = "rCMp19", expression =
solve(sqrt(IM*CMp19))%*%CMp19%*%solve(sqrt(IM*CMp19)))
corEMp19 <- mxAlgebra(name = "rEMp19", expression =
solve(sqrt(IM*EMp19))%*%EMp19%*%solve(sqrt(IM*EMp19)))

covPhMp18 <- mxAlgebra(name = "VMp18", expression = AMp18+CMp18+EMp18)

invSDMp18 <- mxAlgebra(name = "iSDMp18", expression = solve(sqrt(IM*VMp18)))
corPhMp18 <- mxAlgebra(name = "rPhMp18", expression = iSDMp18%*%VMp18%*%iSDMp18)
corAMp18 <- mxAlgebra(name = "rAMp18", expression =
solve(sqrt(IM*AMp18))%*%AMp18%*%solve(sqrt(IM*AMp18)))
corCMp18 <- mxAlgebra(name = "rCMp18", expression =
solve(sqrt(IM*CMp18))%*%CMp18%*%solve(sqrt(IM*CMp18)))
corEMp18 <- mxAlgebra(name = "rEMp18", expression =
solve(sqrt(IM*EMp18))%*%EMp18%*%solve(sqrt(IM*EMp18)))

covPhMp17 <- mxAlgebra(name = "VMp17", expression = AMp17+CMp17+EMp17)

invSDMp17 <- mxAlgebra(name = "iSDMp17", expression = solve(sqrt(IM*VMp17)))
corPhMp17 <- mxAlgebra(name = "rPhMp17", expression = iSDMp17%*%VMp17%*%iSDMp17)
corAMp17 <- mxAlgebra(name = "rAMp17", expression =
solve(sqrt(IM*AMp17))%*%AMp17%*%solve(sqrt(IM*AMp17)))
corCMp17 <- mxAlgebra(name = "rCMp17", expression =
solve(sqrt(IM*CMp17))%*%CMp17%*%solve(sqrt(IM*CMp17)))
corEMp17 <- mxAlgebra(name = "rEMp17", expression =
solve(sqrt(IM*EMp17))%*%EMp17%*%solve(sqrt(IM*EMp17)))

covPhMp16 <- mxAlgebra(name = "VMp16", expression = AMp16+CMp16+EMp16)

invSDMp16 <- mxAlgebra(name = "iSDMp16", expression = solve(sqrt(IM*VMp16)))
corPhMp16 <- mxAlgebra(name = "rPhMp16", expression = iSDMp16%*%VMp16%*%iSDMp16)
corAMp16 <- mxAlgebra(name = "rAMp16", expression =
solve(sqrt(IM*AMp16))%*%AMp16%*%solve(sqrt(IM*AMp16)))
corCMp16 <- mxAlgebra(name = "rCMp16", expression =
solve(sqrt(IM*CMp16))%*%CMp16%*%solve(sqrt(IM*CMp16)))

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corEMp16 <- mxAlgebra(name = "rEMp16", expression =
solve(sqrt(IM*EMp16))%*%EMp16%*%solve(sqrt(IM*EMp16)))

covPhMp15 <- mxAlgebra(name = "VMp15", expression = AMp15+CMp15+EMp15)

invSDMp15 <- mxAlgebra(name = "iSDMp15", expression = solve(sqrt(IM*VMp15)))
corPhMp15 <- mxAlgebra(name = "rPhMp15", expression = iSDMp15%*%VMp15%*%iSDMp15)
corAMp15 <- mxAlgebra(name = "rAMp15", expression =
solve(sqrt(IM*AMp15))%*%AMp15%*%solve(sqrt(IM*AMp15)))
corCMp15 <- mxAlgebra(name = "rCMp15", expression =
solve(sqrt(IM*CMp15))%*%CMp15%*%solve(sqrt(IM*CMp15)))
corEMp15 <- mxAlgebra(name = "rEMp15", expression =
solve(sqrt(IM*EMp15))%*%EMp15%*%solve(sqrt(IM*EMp15)))

covPhMp14 <- mxAlgebra(name = "VMp14", expression = AMp14+CMp14+EMp14)

invSDMp14 <- mxAlgebra(name = "iSDMp14", expression = solve(sqrt(IM*VMp14)))
corPhMp14 <- mxAlgebra(name = "rPhMp14", expression = iSDMp14%*%VMp14%*%iSDMp14)
corAMp14 <- mxAlgebra(name = "rAMp14", expression =
solve(sqrt(IM*AMp14))%*%AMp14%*%solve(sqrt(IM*AMp14)))
corCMp14 <- mxAlgebra(name = "rCMp14", expression =
solve(sqrt(IM*CMp14))%*%CMp14%*%solve(sqrt(IM*CMp14)))
corEMp14 <- mxAlgebra(name = "rEMp14", expression =
solve(sqrt(IM*EMp14))%*%EMp14%*%solve(sqrt(IM*EMp14)))

covPhMp13 <- mxAlgebra(name = "VMp13", expression = AMp13+CMp13+EMp13)

invSDMp13 <- mxAlgebra(name = "iSDMp13", expression = solve(sqrt(IM*VMp13)))
corPhMp13 <- mxAlgebra(name = "rPhMp13", expression = iSDMp13%*%VMp13%*%iSDMp13)
corAMp13 <- mxAlgebra(name = "rAMp13", expression =
solve(sqrt(IM*AMp13))%*%AMp13%*%solve(sqrt(IM*AMp13)))
corCMp13 <- mxAlgebra(name = "rCMp13", expression =
solve(sqrt(IM*CMp13))%*%CMp13%*%solve(sqrt(IM*CMp13)))
corEMp13 <- mxAlgebra(name = "rEMp13", expression =
solve(sqrt(IM*EMp13))%*%EMp13%*%solve(sqrt(IM*EMp13)))

covPhMp12 <- mxAlgebra(name = "VMp12", expression = AMp12+CMp12+EMp12)

invSDMp12 <- mxAlgebra(name = "iSDMp12", expression = solve(sqrt(IM*VMp12)))
corPhMp12 <- mxAlgebra(name = "rPhMp12", expression = iSDMp12%*%VMp12%*%iSDMp12)
corAMp12 <- mxAlgebra(name = "rAMp12", expression =
solve(sqrt(IM*AMp12))%*%AMp12%*%solve(sqrt(IM*AMp12)))
corCMp12 <- mxAlgebra(name = "rCMp12", expression =
solve(sqrt(IM*CMp12))%*%CMp12%*%solve(sqrt(IM*CMp12)))
corEMp12 <- mxAlgebra(name = "rEMp12", expression =
solve(sqrt(IM*EMp12))%*%EMp12%*%solve(sqrt(IM*EMp12)))

covPhMp11 <- mxAlgebra(name = "VMp11", expression = AMp11+CMp11+EMp11)

invSDMp11 <- mxAlgebra(name = "iSDMp11", expression = solve(sqrt(IM*VMp11)))
corPhMp11 <- mxAlgebra(name = "rPhMp11", expression = iSDMp11%*%VMp11%*%iSDMp11)
corAMp11 <- mxAlgebra(name = "rAMp11", expression =
solve(sqrt(IM*AMp11))%*%AMp11%*%solve(sqrt(IM*AMp11)))

```

```

corCMp11 <- mxAlgebra(name = "rCMp11", expression =
solve(sqrt(IM*CMp11))%*%CMp11%*%solve(sqrt(IM*CMp11)))
corEMp11 <- mxAlgebra(name = "rEMp11", expression =
solve(sqrt(IM*EMp11))%*%EMp11%*%solve(sqrt(IM*EMp11)))

# Algebra for expected Mean and Variance/Covariance Matrices in MZ & DZ twins
# Mean structure, Algebra M to store Expected means

depmeanM <- mxMatrix(name="Mdep", type="Full", nrow=1, ncol=1, free=T,
labels="meanDepM", values=c(0.5))
cirmsmeanM <- mxMatrix(name="Mcirs", type="Full", nrow=1, ncol=1, free=T,
labels="meanCirsM", values=c(0.5))

expMeanM <- mxAlgebra(name="expMeanM",
expression=cbind(meanCirsM+(lCirsAge1m%x%age)+(lCirsAge2m%x%olda), meanDepM+(lDep
Age1m%x%age)+(lDepAge2m%x%olda), meanCirsM+(lCirsAge1m%x%age)+(lCirsAge2m%x%olda)
, meanDepM+(lDepAge1m%x%age)+(lDepAge2m%x%olda)))

# Algebra for expected variance/covariance matrix in MZ
###40year olds

expCovMZM <- mxAlgebra(name = "expCovMZM",
expression = rbind (cbind(AM1+CM1+EM1, AM12+CM12),
cbind(AM21+CM21, AM2+CM2+EM2)))

expCovDZM <- mxAlgebra(name = "expCovDZM",
expression = rbind (cbind(AM1+CM1+EM1, 0.5%x%AM12+CM12),
cbind(0.5%x%AM21+CM21,
AM2+CM2+EM2)))

# Objectives for MZ and DZ groups

```

```
MZMObjective <- mxExpectationNormal(covariance="expCovMZM", means="expMeanM",
dimnames=selVars)
DZMObjective <- mxExpectationNormal(covariance="expCovDZM", means="expMeanM",
dimnames=selVars)
```

```
###FITFUNCTION
```

```
fitFunction<-mxFitFunctionML()
```

```
# Combine Groups
#40 yearolds
```

```
parsM      <- list(pathAM, pathCM, pathEM,
pathALM,pathCLM,pathELM,pathALM2,pathCLM2,pathELM2, pathALM3,pathCLM3,pathELM3,
covAMmod40, covCMmod40, covEMmod40,
covAMmod41, covCMmod41, covEMmod41,
covAMmod42, covCMmod42, covEMmod42,
covAMmod43, covCMmod43, covEMmod43,
covAMmod44, covCMmod44, covEMmod44,
covAMmod45, covCMmod45, covEMmod45,
covAMmod46, covCMmod46, covEMmod46,
covAMmod47, covCMmod47, covEMmod47,
covAMmod48, covCMmod48, covEMmod48,
covAMmod49, covCMmod49, covEMmod49,
covAMmod50, covCMmod50, covEMmod50,
covAMmod51, covCMmod51, covEMmod51,
covAMmod52, covCMmod52, covEMmod52,
covAMmod53, covCMmod53, covEMmod53,
covAMmod54, covCMmod54, covEMmod54,
covAMmod55, covCMmod55, covEMmod55,
covAMmod56, covCMmod56, covEMmod56,
covAMmod57, covCMmod57, covEMmod57,
covAMmod58, covCMmod58, covEMmod58,
covAMmod59, covCMmod59, covEMmod59,
covAMmod60, covCMmod60, covEMmod60,
covAMmod61, covCMmod61, covEMmod61,
covAMmod62, covCMmod62, covEMmod62,
covAMmod63, covCMmod63, covEMmod63,
covAMmod64, covCMmod64, covEMmod64,
covAMmod65, covCMmod65, covEMmod65,
covAMmod66, covCMmod66, covEMmod66,
covAMmod67, covCMmod67, covEMmod67,
covAMmod68, covCMmod68, covEMmod68,
covAMmod69, covCMmod69, covEMmod69,
covAMmod70, covCMmod70, covEMmod70,
covAMmod71, covCMmod71, covEMmod71,
covAMmod72, covCMmod72, covEMmod72,
covAMmod73, covCMmod73, covEMmod73,
covAMmod74, covCMmod74, covEMmod74,
covAMmod75, covCMmod75, covEMmod75,
covAMmod76, covCMmod76, covEMmod76,
covAMmod77, covCMmod77, covEMmod77,
```

covAMmod78, covCMmod78, covEMmod78,  
covAMmod79, covCMmod79, covEMmod79,  
covAMmod80, covCMmod80, covEMmod80,  
covAMmod81, covCMmod81, covEMmod81,  
covAMmod82, covCMmod82, covEMmod82,  
covAMmod83, covCMmod83, covEMmod83,  
covAMmod84, covCMmod84, covEMmod84,  
covAMmod85, covCMmod85, covEMmod85,  
covAMmod86, covCMmod86, covEMmod86,  
covAMmod87, covCMmod87, covEMmod87,  
covAMmod88, covCMmod88, covEMmod88,  
covAMmod89, covCMmod89, covEMmod89,  
covAMmod90, covCMmod90, covEMmod90,  
dep40A, dep40C, dep40E, dep40V, dep40H,  
dep41A, dep41C, dep41E, dep41V, dep41H,  
dep42A, dep42C, dep42E, dep42V, dep42H,  
dep43A, dep43C, dep43E, dep43V, dep43H,  
dep44A, dep44C, dep44E, dep44V, dep44H,  
dep45A, dep45C, dep45E, dep45V, dep45H,  
dep46A, dep46C, dep46E, dep46V, dep46H,  
dep47A, dep47C, dep47E, dep47V, dep47H,  
dep48A, dep48C, dep48E, dep48V, dep48H,  
dep49A, dep49C, dep49E, dep49V, dep49H,  
dep50A, dep50C, dep50E, dep50V, dep50H,  
dep51A, dep51C, dep51E, dep51V, dep51H,  
dep52A, dep52C, dep52E, dep52V, dep52H,  
dep53A, dep53C, dep53E, dep53V, dep53H,  
dep54A, dep54C, dep54E, dep54V, dep54H,  
dep55A, dep55C, dep55E, dep55V, dep55H,  
dep56A, dep56C, dep56E, dep56V, dep56H,  
dep57A, dep57C, dep57E, dep57V, dep57H,  
dep58A, dep58C, dep58E, dep58V, dep58H,  
dep59A, dep59C, dep59E, dep59V, dep59H,  
dep60A, dep60C, dep60E, dep60V, dep60H,  
dep61A, dep61C, dep61E, dep61V, dep61H,  
dep62A, dep62C, dep62E, dep62V, dep62H,  
dep63A, dep63C, dep63E, dep63V, dep63H,  
dep64A, dep64C, dep64E, dep64V, dep64H,  
dep65A, dep65C, dep65E, dep65V, dep65H,  
dep66A, dep66C, dep66E, dep66V, dep66H,  
dep67A, dep67C, dep67E, dep67V, dep67H,  
dep68A, dep68C, dep68E, dep68V, dep68H,  
dep69A, dep69C, dep69E, dep69V, dep69H,  
dep70A, dep70C, dep70E, dep70V, dep70H,  
dep71A, dep71C, dep71E, dep71V, dep71H,  
dep72A, dep72C, dep72E, dep72V, dep72H,  
dep73A, dep73C, dep73E, dep73V, dep73H,  
dep74A, dep74C, dep74E, dep74V, dep74H,  
dep75A, dep75C, dep75E, dep75V, dep75H,  
dep76A, dep76C, dep76E, dep76V, dep76H,  
dep77A, dep77C, dep77E, dep77V, dep77H,  
dep78A, dep78C, dep78E, dep78V, dep78H,  
dep79A, dep79C, dep79E, dep79V, dep79H,  
dep80A, dep80C, dep80E, dep80V, dep80H,



dep81A, dep81C, dep81E, dep81V, dep81H,  
dep82A, dep82C, dep82E, dep82V, dep82H,  
dep83A, dep83C, dep83E, dep83V, dep83H,  
dep84A, dep84C, dep84E, dep84V, dep84H,  
dep85A, dep85C, dep85E, dep85V, dep85H,  
dep86A, dep86C, dep86E, dep86V, dep86H,  
dep87A, dep87C, dep87E, dep87V, dep87H,  
dep88A, dep88C, dep88E, dep88V, dep88H,  
dep89A, dep89C, dep89E, dep89V, dep89H,  
dep90A, dep90C, dep90E, dep90V, dep90H,  
covPhMm10, invSDMm10, corPhMm10, corAMm10, corCMm10, corEMm10,  
covAMmodHm10, covCMmodHm10, covEMmodHm10,  
covPhMm9, invSDMm9, corPhMm9, corAMm9, corCMm9, corEMm9,  
covAMmodHm9, covCMmodHm9, covEMmodHm9,  
covPhMm8, invSDMm8, corPhMm8, corAMm8, corCMm8, corEMm8,  
covAMmodHm8, covCMmodHm8, covEMmodHm8,  
covPhMm7, invSDMm7, corPhMm7, corAMm7, corCMm7, corEMm7,  
covAMmodHm7, covCMmodHm7, covEMmodHm7,  
covPhMm6, invSDMm6, corPhMm6, corAMm6, corCMm6, corEMm6,  
covAMmodHm6, covCMmodHm6, covEMmodHm6,  
covPhMm5, invSDMm5, corPhMm5, corAMm5, corCMm5, corEMm5,  
covAMmodHm5, covCMmodHm5, covEMmodHm5,  
covPhMm4, invSDMm4, corPhMm4, corAMm4, corCMm4, corEMm4,  
covAMmodHm4, covCMmodHm4, covEMmodHm4,  
covPhMm3, invSDMm3, corPhMm3, corAMm3, corCMm3, corEMm3,  
covAMmodHm3, covCMmodHm3, covEMmodHm3,  
covPhMm2, invSDMm2, corPhMm2, corAMm2, corCMm2, corEMm2,  
covAMmodHm2, covCMmodHm2, covEMmodHm2,  
covPhMm1, invSDMm1, corPhMm1, corAMm1, corCMm1, corEMm1,  
covAMmodHm1, covCMmodHm1, covEMmodHm1,  
covPhMm0, invSDMm0, corPhMm0, corAMm0, corCMm0, corEMm0,  
covAMmodHm0, covCMmodHm0, covEMmodHm0,  
covPhMp10, invSDMp10, corPhMp10, corAMp10, corCMP10, corEMp10,  
covAMmodHp10, covCMmodHp10, covEMmodHp10,  
covPhMp9, invSDMp9, corPhMp9, corAMp9, corCMP9, corEMp9,  
covAMmodHp9, covCMmodHp9, covEMmodHp9,  
covPhMp8, invSDMp8, corPhMp8, corAMp8, corCMP8, corEMp8,  
covAMmodHp8, covCMmodHp8, covEMmodHp8,  
covPhMp7, invSDMp7, corPhMp7, corAMp7, corCMP7, corEMp7,  
covAMmodHp7, covCMmodHp7, covEMmodHp7,  
covPhMp6, invSDMp6, corPhMp6, corAMp6, corCMP6, corEMp6,  
covAMmodHp6, covCMmodHp6, covEMmodHp6,  
covPhMp5, invSDMp5, corPhMp5, corAMp5, corCMP5, corEMp5,  
covAMmodHp5, covCMmodHp5, covEMmodHp5,  
covPhMp4, invSDMp4, corPhMp4, corAMp4, corCMP4, corEMp4,  
covAMmodHp4, covCMmodHp4, covEMmodHp4,  
covPhMp3, invSDMp3, corPhMp3, corAMp3, corCMP3, corEMp3,  
covAMmodHp3, covCMmodHp3, covEMmodHp3,  
covPhMp2, invSDMp2, corPhMp2, corAMp2, corCMP2, corEMp2,  
covAMmodHp2, covCMmodHp2, covEMmodHp2,  
covPhMp1, invSDMp1, corPhMp1, corAMp1, corCMP1, corEMp1,  
covAMmodHp1, covCMmodHp1, covEMmodHp1,  
covPhMp20, invSDMp20, corPhMp20, corAMp20, corCMP20, corEMp20,  
covAMmodHp20, covCMmodHp20, covEMmodHp20,

```

covPhMp19,invSDMp19, corPhMp19, corAMp19, corCMp19, corEMp19,
covAMmodHp19,covCMmodHp19,covEMmodHp19,
covPhMp18,invSDMp18, corPhMp18, corAMp18, corCMp18, corEMp18,
covAMmodHp18,covCMmodHp18,covEMmodHp18,
covPhMp17,invSDMp17, corPhMp17, corAMp17, corCMp17, corEMp17,
covAMmodHp17,covCMmodHp17,covEMmodHp17,
covPhMp16,invSDMp16, corPhMp16, corAMp16, corCMp16, corEMp16,
covAMmodHp16,covCMmodHp16,covEMmodHp16,
covPhMp15,invSDMp15, corPhMp15, corAMp15, corCMp15, corEMp15,
covAMmodHp15,covCMmodHp15,covEMmodHp15,
covPhMp14,invSDMp14, corPhMp14, corAMp14, corCMp14, corEMp14,
covAMmodHp14,covCMmodHp14,covEMmodHp14,
covPhMp13,invSDMp13, corPhMp13, corAMp13, corCMp13, corEMp13,
covAMmodHp13,covCMmodHp13,covEMmodHp13,
covPhMp12,invSDMp12, corPhMp12, corAMp12, corCMp12, corEMp12,
covAMmodHp12,covCMmodHp12,covEMmodHp12,
covPhMp11,invSDMp11, corPhMp11, corAMp11, corCMp11, corEMp11,
covAMmodHp11,covCMmodHp11,covEMmodHp11,
depmeanBm, cirsmeanBm, depmeanM,cirsmeanM, depmeanB2m, cirsmeanB2m, matIM,
dep75As, dep75Es)

```

```

defsm<-list(defage,defcirs1,defcirs2, defsold,defsolda, expMeanM)

```

```

# MZ en DZ models
##40 year olds

```

```

MZMmodel <- mxModel(name = "MZMmodel", parsM,
covAMmod1,covCMmod1,covEMmod1,
covAMmod2,covCMmod2,covEMmod2,
covAM12,covCM12,covEM12,covAM21,covCM21,covEM21,
defsm, expMeanM, expCovMZM, dataMZM, MZMObjective, fitFunction)

```

```

DZMmodel <- mxModel(name = "DZMmodel", parsM,
covAMmod1,covCMmod1,covEMmod1,
covAMmod2,covCMmod2,covEMmod2,
covAM12,covCM12,covEM12,covAM21,covCM21,covEM21, defsm, expMeanM, expCovDZM,
dataDZM, DZMObjective, fitFunction)

```

```

#

```

```

# Objective
min2sumll <- mxAlgebra( expression = MZMmodel.fitfunction +
DZMmodel.fitfunction, name="sumll" )
objective <- mxFitFunctionAlgebra("sumll")

```

```

# Cholesky ACE model
CholACEModel <- mxModel(name = "Full ACE Sex Limitation",
parsM, MZMmodel, DZMmodel,
min2sumll, objective)

```

```

CholACEModel<-mxOption(CholACEModel, "Calculate Hessian", "No")
CholACEModel<-mxOption(CholACEModel, "Standard Errors", "No")

```

```

CholACEModel<-mxModel(CholACEModel, mxCI(c("aM","eM", "cM" ,
"aLM[2,1]", "aLM[2,2]",
"eLM[2,1]", "eLM[2,2]",
"cLM[2,1]", "cLM[2,2]",
"aLM1[2,1]", "aLM1[2,2]",
"cLM1[2,1]", "cLM1[2,2]",
"eLM1[2,1]", "eLM1[2,2]",
"aLMH",
"cLMH",
"eLMH")))

##run FULL ACE MODEL.....NOTE CHANGE intervals to = T in order to compute 95% CI
of estiamtes
CholACEFit <- mxRun(CholACEModel, intervals=F)

# -----
summary(CholACEFit)
parameterSpecifications(CholACEFit)
expectedMeansCovariances(CholACEFit)
tableFitStatistics(CholACEFit)

CholACEFit$algebras
# drop the cirs covariation turning point

cirsturn<-mxModel(CholACEFit, name="Drop turning point CIRS covariation")
cirsturn<-omxSetParameters(cirsturn, labels=c("c21L2f","e21L2f","a11L2f"),
free=F,values=0)

cirsturnfit<-mxRun(cirsturn)

tableFitStatistics(CholACEFit,cirsturnfit)

##can we equate males and females

AEmodfullLIM<-mxModel(AEmodfullfit, name="Equate males and females")
AEmodfullLIM<-omxSetParameters(AEmodfullLIM,
labels=c("a11F","a21F","a22F","a11L1f","a21L1f", "a22L1f",
"a11L2f","a21L2f","a22L2f","a22H1f","a21H1f"),
free=F,values=c(5.94,1.00,4.05,0.037,-0.05,-0.05,-0.34,-0.007,0.208,0.09,0.026))
AEmodfullLIM<-omxSetParameters(AEmodfullLIM,
labels=c("e11F","e21F","e22F","e11L1f","e21L1f", "e22L1f",
"e11L2f","e21L2f","e22L2f","e22H1f","e21H1f"),

```

```

free=F, values=c(7.918, 1.387, 6.785, -0.0144, 0.0213, -0.039, -0.122, -
0.079, 0.156, 0.076, 0.098))
AEmodfullLIM<-mxModel(AEmodfullLIM, mxCI(c("AF60", "EF60", "AF601", "EF601")))
AEmodfullfitLIM<-mxRun(AEmodfullLIM, intervals=T)
AEmodfullfitLIM<-mxRun(AEmodfullfit)
summary(AEmodfullfitLIM)

tableFitStatistics(AEmodfullfit, AEmodfullfitLIM)

##RUN THE AE MODEL

AEmodfull<-mxModel(CholACEFit, name="Drop C")
AEmodfull<-omxSetParameters(AEmodfull,
labels=c("c11M", "c21M", "c22M", "c21L1m", "c22L1m", "c21L2m", "c22L2m", "c11L2m",
"c11L1m",
"c21H1m", "c22H1m"),
free=F, values=0)

AEmodfull<-mxModel(AEmodfull, mxCI(c("AM75", "EM75", "dep75Asex", "dep75Esex")))

AEmodfull<-mxModel(AEmodfull,
mxCI(c(
"dep40Avar", "dep41Avar",
"dep42Avar", "dep43Avar",
"dep44Avar", "dep45Avar",
"dep46Avar", "dep47Avar",
"dep48Avar", "dep49Avar",
"dep50Avar", "dep51Avar",
"dep52Avar", "dep53Avar",
"dep54Avar", "dep55Avar",
"dep56Avar", "dep57Avar",
"dep58Avar", "dep59Avar",
"dep60Avar", "dep61Avar",
"dep62Avar", "dep63Avar",
"dep64Avar", "dep65Avar",
"dep66Avar", "dep67Avar",
"dep68Avar", "dep69Avar",
"dep70Avar", "dep71Avar",
"dep72Avar", "dep73Avar",
"dep74Avar", "dep75Avar",
"dep76Avar", "dep77Avar",
"dep78Avar", "dep79Avar",
"dep80Avar", "dep81Avar",
"dep82Avar", "dep83Avar",
"dep84Avar", "dep85Avar",
"dep86Avar", "dep87Avar",
"dep88Avar", "dep89Avar", "dep90Avar",
"dep40Evar", "dep41Evar",
"dep42Evar", "dep43Evar",
"dep44Evar", "dep45Evar",
"dep46Evar", "dep47Evar",
"dep48Evar", "dep49Evar",

```

```
"dep50Evar", "dep51Evar",  
"dep52Evar", "dep53Evar",  
"dep54Evar", "dep55Evar",  
"dep56Evar", "dep57Evar",  
"dep58Evar", "dep59Evar",  
"dep60Evar", "dep61Evar",  
"dep62Evar", "dep63Evar",  
"dep64Evar", "dep65Evar",  
"dep66Evar", "dep67Evar",  
"dep68Evar", "dep69Evar",  
"dep70Evar", "dep71Evar",  
"dep72Evar", "dep73Evar",  
"dep74Evar", "dep75Evar",  
"dep76Evar", "dep77Evar",  
"dep78Evar", "dep79Evar",  
"dep80Evar", "dep81Evar",  
"dep82Evar", "dep83Evar",  
"dep84Evar", "dep85Evar",  
"dep86Evar", "dep87Evar",  
"dep88Evar", "dep89Evar", "dep90Evar"))
```

```
AEmodfull<-mxModel (AEmodfull,  
mxCI (c (  
"rPhMm10", "rAMm10", "rEMm10",  
"rPhMm9", "rAMm9", "rEMm9",  
"rPhMm8", "rAMm8", "rEMm8",  
"rPhMm7", "rAMm7", "rEMm7",  
"rPhMm6", "rAMm6", "rEMm6",  
"rPhMm5", "rAMm5", "rEMm5",  
"rPhMm4", "rAMm4", "rEMm4",  
"rPhMm3", "rAMm3", "rEMm3",  
"rPhMm2", "rAMm2", "rEMm2",  
"rPhMm1", "rAMm1", "rEMm1",  
"rPhMm0", "rAMm0", "rEMm0",  
"rPhMp1", "rAMp1", "rEMp1",  
"rPhMp2", "rAMp2", "rEMp2",  
"rPhMp3", "rAMp3", "rEMp3",  
"rPhMp4", "rAMp4", "rEMp4",  
"rPhMp5", "rAMp5", "rEMp5",  
"rPhMp6", "rAMp6", "rEMp6",  
"rPhMp7", "rAMp7", "rEMp7",  
"rPhMp8", "rAMp8", "rEMp8",  
"rPhMp9", "rAMp9", "rEMp9",  
"rPhMp10", "rAMp10", "rEMp10",  
"rPhMp11", "rAMp11", "rEMp11",  
"rPhMp12", "rAMp12", "rEMp12",  
"rPhMp13", "rAMp13", "rEMp13",  
"rPhMp14", "rAMp14", "rEMp14",  
"rPhMp15", "rAMp15", "rEMp15",  
"rPhMp16", "rAMp16", "rEMp16",  
"rPhMp17", "rAMp17", "rEMp17",  
"rPhMp18", "rAMp18", "rEMp18",  
"rPhMp19", "rAMp19", "rEMp19",  
"rPhMp20", "rAMp20", "rEMp20"
```

```
)))
```

```
AEmodfullfit<-mxRun(AEmodfull, intervals=F)
```

```
summary(AEmodfullfit)
```

```
AEmodfullfit$algebras
```

```
tableFitStatistics(CholACEFit,AEmodfullfit)
```

```
####drop A CIRS MODERATION#####
```

```
one<-mxModel(AEmodfullfit, name="drop all CIRS moderation")
```

```
one <- omxSetParameters(one, labels=c("a22H1m", "a21H1m", "e22H1m", "e21H1m"),  
free=FALSE, values=0)
```

```
onefit<-mxRun(one)
```

```
onefit
```

```
summary(onefit)
```

```
tableFitStatistics(AEmodfullfit,onefit)
```

```
####drop AGE 40-75 MODERATION ON COVARIANCE#####
```

```
two<-mxModel(AEmodfullfit, name="drop age 40-75 age moderation covariance")
```

```
two <- omxSetParameters(two, labels=c("a21L1m", "e21L1m"), free=FALSE, values=0)
```

```
twofit<-mxRun(two)
```

```
twofit
```

```
twofit$algebras
```

```
summary(twofit)
```

```
tableFitStatistics(AEmodfullfit,twofit)
```

```
####drop AGE 75-90 MODERATION ON COVARIANCE#####
```

```
three<-mxModel(twofit, name="drop age 75-90 age moderation covariance")
```

```
three <- omxSetParameters(three, labels=c("a21L2m", "e21L2m"), free=FALSE,  
values=0)
```

```
three<- mxModel(three,
```

```
mxCI(c("aM", "eM", "aLM[2,2]", "eLM[2,2]", "aLM1[2,1]", "aLM1[2,2]", "eLM1[2,1]", "eLM1  
[2,2]", "aLMH",  
"eLMH")))
```

```
three<- mxModel(three, mxCI(c("Hdep75", "Hdep90")))
```

```
threefit<-mxRun(three, intervals=F)
```

```
threefit$algebras
```

```
three
```

```
summary(threefit)
```

```
tableFitStatistics(twofit,threefit)
```

```
####drop AGE 40-75 MODERATION ON unique depressionE#####
```

```
four<-mxModel(threefit, name="drop age 40-75 age moderation unique depression")
```

```
four <- omxSetParameters(four, labels=c("a22L1m", "e22L1m"), free=FALSE,  
values=0)
```

```

four<- mxModel(four,
mxCI(c("aM", "eM", "aLM", "eLM", "aLM1[2,1]", "aLM1[2,2]", "eLM1[2,1]", "eLM1[2,2]", "aL
MH[2,1]", "aLMH[2,2]",
"eLMH[2,1]", "eLMH[2,2]")))

fourfit<-mxRun(four)
fourfit

summary(fourfit)
tableFitStatistics(threefit, fourfit)

#####drop AGE 75-90 MODERATION ON unique depressionE#####
five<-mxModel(threefit, name="drop age 75-90 age moderation unique depression")
five <- omxSetParameters(five, labels=c("a22L2m", "e22L2m"), free=FALSE,
values=0)

fivefit<-mxRun(five)
fivefit

summary(threefit)
tableFitStatistics(threefit, fivefit)

#####models in supplement

oneA<-mxModel(AEmodfullfit, name="drop all cirs A moderation")
oneA <- omxSetParameters(oneA, labels=c("a22H1m", "a21H1m"), free=FALSE,
values=0)

oneAfit<-mxRun(oneA)
onefit

summary(oneAfit)
tableFitStatistics(AEmodfullfit, oneAfit)

#####DROP CIRS E MODERATION#####

two<-mxModel(AEmrdfullfit, name="drop CIRS E moderation")
two <- omxSetParameters(two, labels=c("e22H1m", "e21H1m"), free=FALSE, values=0)

twofit<-mxRun(two)
summary(twofit)
tableFitStatistics(AEmodfullfit, twofit)

#####DROP all common MODERATION #####

three<-mxModel(AEmordfullfit, name="drop CIRS and AGE common moderation all")

```

```
three <- omxSetParameters(three,  
labels=c("a21H1m", "e21H1m", "a21L1m", "a21L2m", "e21L2m", "e21L1m"), free=FALSE,  
values=0)
```

```
threefit<-mxRun(three)  
summary(threefit)  
tableFitStatistics(AEmodfullfit,threefit)
```

```
threefit<-mxRun(three)  
threefit<-mxRun(threefit)  
summary(threefit)  
tableFitStatistics(AEmodfullfit,threefit)
```

```
#####DROP A CIRS COMMON MODERATION#####
```

```
threeA<-mxModel(AEmordfullfit, name="drop CIRS A common moderation all")  
threeA <- omxSetParameters(threeA, labels=c("a21H1m"), free=FALSE, values=0)
```

```
threeAfit<-mxRun(threeA)  
summary(threeAfit)  
tableFitStatistics(AEmodfullfit,threeAfit)
```

```
#####DROP A CIRS SLOPE 2 COMMON MODERATION#####
```

```
threeA2<-mxModel(AEmordfullfit, name="drop Age 75-90 A common moderation all")  
threeA2 <- omxSetParameters(threeA2, labels=c("a21L2m"), free=FALSE, values=0)
```

```
threeA2fit<-mxRun(threeA2)  
summary(threeA2fit)  
tableFitStatistics(AEmodfullfit,threeA2fit)
```

```
#####DROP A CIRS SLOPE 1 COMMON MODERATION#####
```

```
threeA3<-mxModel(AEmordfullfit, name="drop Age 40-75 A common moderation")  
threeA3 <- omxSetParameters(threeA3, labels=c("a21L1m"), free=FALSE, values=0)
```

```
threeA3fit<-mxRun(threeA3)  
summary(threeA3fit)  
tableFitStatistics(AEmodfullfit,threeA3fit)
```

```
#####DROP E CIRS COMMON MODERATION#####
```

```
threeE<-mxModel(AEmordfullfit, name="drop CIRS E common moderation all")  
threeE <- omxSetParameters(threeE, labels=c("e21H1m"), free=FALSE, values=0)
```

```
threeEfit<-mxRun(threeE)  
summary(threeEfit)  
tableFitStatistics(AEmodfullfit,threeEfit)
```

```
#####DROP E SLOPE 2 COMMON MODERATION#####
```

```
threeE2<-mxModel(AEmordfullfit, name="drop Age 75-90 E common moderation all")  
threeE2 <- omxSetParameters(threeE2, labels=c("e21L2m"), free=FALSE, values=0)
```



```

threeE2fit<-mxRun(threeE2)
summary(threeE2fit)
tableFitStatistics(AEmodfullfit,threeA2fit)

#####DROP E SLOPE 1 COMMON MODERATION#####

threeE3<-mxModel(AEmordfullfit, name="drop Age 40-75 E common moderation")
threeE3 <- omxSetParameters(threeE3, labels=c("e21L1m"), free=FALSE, values=0)

threeA3fit<-mxRun(threeE3)
summary(threeA3fit)
tableFitStatistics(AEmodfullfit,threeA3fit)

#####DROP A CIRS UNIQUE MODERATION#####

UA<-mxModel(AEmordfullfit, name="drop CIRS A UNIQUE moderation all")
UA <- omxSetParameters(UA, labels=c("a22H1m"), free=FALSE, values=0)

UAfit<-mxRun(UA)
summary(UAfit)
tableFitStatistics(AEmodfullfit,UAfit)

#####DROP A CIRS SLOPE 2 UNIQUE MODERATION#####

UA2<-mxModel(AEmordfullfit, name="drop Age 75-90 A unique moderation all")
UA2 <- omxSetParameters(UA2, labels=c("a22L2m"), free=FALSE, values=0)

UA2fit<-mxRun(UA2)
summary(UA2fit)
tableFitStatistics(AEmodfullfit,UA2fit)

#####DROP A SLOPE 1 UNIQUE MODERATION#####

UA3<-mxModel(AEmordfullfit, name="drop Age 40-75 A unique moderation")
UA3 <- omxSetParameters(UA3, labels=c("a22L1m"), free=FALSE, values=0)

UA3fit<-mxRun(UA3)
summary(UA3fit)
tableFitStatistics(AEmodfullfit,UA3fit)

#####DROP E CIRS UNIQUE MODERATION#####

UE<-mxModel(AEmordfullfit, name="drop CIRS E UNIQUE moderation all")
UE <- omxSetParameters(UE, labels=c("e22H1m"), free=FALSE, values=0)

UEfit<-mxRun(UE)
summary(UEfit)
tableFitStatistics(AEmodfullfit,UEfit)

```

```
#####DROP A CIRS SLOPE 2 UNIQUE MODERATION#####
```

```
UE2<-mxModel(AEmordfullfit, name="drop Age 75-90 E unique moderation all")  
UE2 <- omxSetParameters(UE2, labels=c("e22L2m"), free=FALSE, values=0)
```

```
UE2fit<-mxRun(UE2)  
summary(UE2fit)
```

```
tableFitStatistics(AEmodfullfit,UE2fit)
```

```
#####DROP A SLOPE 1 UNIQUE MODERATION#####
```

```
UE3<-mxModel(AEmordfullfit, name="drop Age 40-75 E unique moderation")  
UE3 <- omxSetParameters(UE3, labels=c("e22L1m"), free=FALSE, values=0)
```

```
UE3fit<-mxRun(UE3)  
summary(UE3fit)
```

```
tableFitStatistics(AEmodfullfit,UE3fit)
```