require(jagsUI)

require(HDInterval)

# gdp and unemployment are centred

setwd("C:/R files BHMRA")

attach("DS\_9\_3.Rdata")

**#**

**# Full Dimension Covariance**

**#**

set.seed=1234

**cat("**model { for (i in 1:n) {

**# unit-variable random effects**

b[i,1:p] ~ dmnorm(nought[1:p],inv.D[,]);

bmix[i,1:p] ~ dmnorm(nought[1:p],inv.D[,])

for (j in 1:p) {y[i,j] ~ dpois(mu[i,j]);

mu[i,j] <- pop[i]\*rho[i,j];

eta[i,j] <- alpha[j]+beta.term[i,j]

beta.term[i,j] <- beta[j,1]\*unem[i]+beta[j,2]\*border[i]

+beta[j,3]\*gdp[i]+beta[j,4]\*urb[i]

log(rho[i,j]) <- eta[i,j]+b[i,j]

**# unit-variable deviance terms**

h[i,j] <- equals(y[i,j],0)

dv[i,j] <- y[i,j]\*log((y[i,j]+h[i,j])/(mu[i,j]+h[i,j]))-(y[i,j]-mu[i,j])

**# mixed predictive exceedance checks**

ymix[i,j] ~ dpois(mu.mix[i,j]);

mu.mix[i,j] <- pop[i]\*rho.mix[i,j];

exc.mix[j,i] <- step(y[i,j]-(ymix[i,j]+0.001))+0.5\*equals(y[i,j],ymix[i,j])

log(rho.mix[i,j]) <- eta[i,j]+bmix[i,j]}}

**# Priors**

for (j in 1:p) {alpha[j] ~ dnorm(0,0.01)

for (k in 1:r) {beta[j,k] ~ dnorm(0,0.1)}}

inv.D[1:p,1:p] ~ dwish(R[1:p,1:p],p)

D[1:p,1:p] <- inverse(inv.D[,])

for (j in 1:p) { for (k in 1:p) {corr[j,k] <- D[j,k]/sqrt(D[j,j]\*D[k,k])}}

**# Scaled Deviance**

ScDev <- 2\*sum(dv[,])}

**", file="model1.jag")**

**# initial values and estimation**

beta0 <- matrix(0,4,4)

inits1 <- list(alpha=c(2.5,1.5,3.5,1),beta = beta0,inv.D=diag(0.1,4))

inits2 <- list(alpha=c(2,1,3,1.5),beta = beta0,inv.D=diag(1,4))

inits=list(inits1,inits2)

pars = c("alpha","beta","inv.D","corr","ScDev")

R = autojags(DS\_9\_3, inits, pars,model.file="model1.jag",2,iter.increment=5000, n.burnin=500,Rhat.limit=1.1, max.iter=50000, seed=1234)

R$summary

hdi(R,credMass=0.9)

**# exceedance checks**

pars <- c("exc.mix")

R <- autojags(DS\_9\_3, inits, pars,model.file="model1.jag",2,iter.increment=5000, n.burnin=500,Rhat.limit=1.1, max.iter=50000, seed=1234)

samps <- as.matrix(R$samples)

exc.mn <- matrix(,4,49)

for (j in 1:4){for (i in 1:49) {exc.mn[j,i] <- mean(samps[,i+(j-1)\*49])}}

sum(exc.mn>0.95)+sum(exc.mn<0.05)

**# Fit**

R$DIC; R$pD

#

**# Univariate Factor MIMIC Model**

**#**

set.seed=1234

**cat("**model { for (i in 1:n) {

**# factor scores and unstructured residuals**

F[i] ~ dnorm(mu.F[i],tau.F)

mu.F[i] <- b[1]\*unem[i]+b[2]\*border[i]+b[3]\*gdp[i] +b[4]\*urb[i]

u[i] ~ dnorm(0,tau.u)

**# replicate scores and residuals**

Fmix[i] ~ dnorm(mu.F[i],tau.F)

umix[i] ~ dnorm(0,tau.u);

for (j in 1:p) {y[i,j] ~ dpois(mu[i,j]);

mu[i,j] <- pop[i]\*rho[i,j];

log(rho[i,j]) <- alpha[j]+lambda[j]\*F[i]+kappa[j]\*u[i]

**# unit-variable deviance terms**

yp[i,j] <- y[i,j]+0.00001;

mh[i,j] <- mu[i,j]+0.00001

dv[i,j] <- y[i,j]\*log(yp[i,j]/mh[i,j])-(y[i,j]-mu[i,j])

**# mixed predictive exceedance checks**

ymix[i,j] ~ dpois(mu.mix[i,j]);

mu.mix[i,j] <- pop[i]\*rho.mix[i,j]

log(rho.mix[i,j]) <- alpha[j]+lambda[j]\*Fmix[i]+kappa[j]\*umix[i]

exc.mix[i,j] <- step(y[i,j]-(ymix[i,j]+0.001))+0.5\*equals(y[i,j],ymix[i,j])}}

**# Priors**

tau.F ~ dgamma(1,0.01)

tau.u ~ dgamma(1,0.01)

for (k in 1:4) {b[k] ~ dnorm(0,0.001)}

kappa[1] <- kap[1]

kappa[2] <- 1;

kappa[3] <- kap[2]

kappa[4] <- kap[3]

lambda[1] <- 1;

for (k in 2:p) {lambda[k] <- lam[k-1] }

for (k in 1:pm) {lam[k]~ dnorm(0,1)

kap[k]~ dnorm(0,1) }

for (k in 1:p) {alpha[k] ~ dnorm(0,0.001);

tau[k] ~ dgamma(1,0.001)}

# **Scaled Deviance**

ScDev <- 2\*sum(dv[,])}**",**

**file="model2.jag")**

**# Initial Values**

inits1 <- list(b=rep(0,4),alpha=rep(0,4),tau.F=1,tau.u=1,lam=rep(1,3),

kap=rep(1,3),F=rep(0,49))

inits2 <- list(b=rep(0.25,4),alpha=rep(0.5,4),tau.F=10,tau.u=10,lam=rep(1,3),

kap=rep(1,3),F=rep(0.1,49))

inits=list(inits1,inits2)

pars <- c("b","lambda","kappa","ScDev","F")

R <- autojags(DS\_9\_3, inits, pars,model.file="model2.jag",2,iter.increment=5000, n.burnin=500,Rhat.limit=1.05, max.iter=50000, seed=1234)

R$summary

hdi(R,credMass=0.9)

**# Factor Scores**

F.mn=apply(R$sims.list$F,2,mean)

range(F.mn)

**# exceedance checks**

pars <- c("exc.mix")

R <- autojags(DS\_9\_3, inits, pars,model.file="model2.jag",2,iter.increment=5000, n.burnin=500,Rhat.limit=1.05, max.iter=50000, seed=1234)

samps <- as.matrix(R$samples)

exc.mn <- matrix(,4,49)

for (j in 1:4){for (i in 1:49) {exc.mn[j,i] <- mean(samps[,i+(j-1)\*49])}}

sum(exc.mn>0.95)+sum(exc.mn<0.05)

**# Fit**

R$DIC; R$pD