library(rjags);

setwd("C:/R files **BHMRA**");

library(jagsUI)

attach("DS\_7\_11.Rdata")

attach("DS\_7\_11\_MC.Rdata")

# Poisson Model

cat("model {for (t in 1:140){y[t] ~ dpois(mu[t]);

ynew[t] ~ dpois(mu[t])

mu[t] <- nu[t]\*Hours[t]

# standardised error

e[t] <- (y[t]-mu[t])/sqrt(mu[t])

e2[t] <- e[t]\*e[t]

enew[t] <- (ynew[t]-mu[t])/sqrt(mu[t])

enew2[t] <- enew[t]\*enew[t]

LL[t] <- -mu[t] + y[t]\*log(mu[t])-logfact(y[t])

G[t] <- 1/exp(LL[t])

x3[t] <- log(Day[t])

x4[t] <- log(Day[t])\*Tr[t]

log(nu[t]) <- beta[1]+beta[2]\*Tr[t]+beta[3]\*(x3[t]-mean(x3[]))

+beta[4]\*(x4[t]-mean(x4[]))}

# indicator for posterior predictive check

ptest <- step(DWnew-DW)

DW <- sum(elag[2:140])/sum(e2[1:140])

DWnew <- sum(enewlag[2:140])/sum(enew2[1:140])

for (t in 2:140){elag[t] <- pow(e[t]-e[t-1],2);

enewlag[t] <- pow(enew[t]-enew[t-1],2)}

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

",file="seizures1.jag")

init1 <- list(beta=c(-5,3,-0.2,-1)); init2 <- list(beta=c(-4,4,-0.2,-2)); inits <- list(init1,init2)

params =c("DW","beta","ptest","G")

R =autojags(DS\_7\_11, inits, params,model.file="seizures1.jag",2,iter.increment=1000, n.burnin=250,Rhat.limit=1.1, max.iter=10000, seed=1234, codaOnly= c('G'))

R$summary

**# Fit**

G.samps=as.array(R$sims.list$G)

G.mn=apply(G.samps,2,mean)

CPO <- -log(G.mn)

# LPML

sum(CPO)

# AR1 Errors

cat("model {# likelihood

for (t in 1:140){mu[t] <- nu[t]\*Hours[t]

y[t] ~ dpois(mu[t]);

ynew[t] ~ dpois(mu[t])

# log-likelihood

LL[t] <- -mu[t] + y[t]\*log(mu[t])-logfact(y[t]);

G[t] <- 1/exp(LL[t])

x3[t] <- log(Day[t])

x4[t] <- log(Day[t])\*Tr[t]

log(nu[t]) <- beta[1]+beta[2]\*Tr[t]+beta[3]\*(x3[t]-mean(x3[]))

+beta[4]\*(x4[t]-mean(x4[]))+r[t]

e[t] <- (y[t]-mu[t])/sqrt(mu[t]);

e2[t] <- e[t]\*e[t]

enew[t] <- (ynew[t]-mu[t])/sqrt(mu[t]);

enew2[t] <- enew[t]\*enew[t]}

# indicator for posterior predictive check

ptest <- step(DWnew-DW)

DW <- sum(elag[2:140])/sum(e2[1:140])

DWnew <- sum(enewlag[2:140])/sum(enew2[1:140])

for (t in 2:140){elag[t] <- pow(e[t]-e[t-1],2);

enewlag[t] <- pow(enew[t]-enew[t-1],2)}

# Prior on AR errors

r[1] ~ dnorm(0,(1-rho\*rho)/(sig.r\*sig.r))

for (t in 2:140){r[t] ~ dnorm(rho\*r[t-1], 1/(sig.r\*sig.r)) }

sig.r ~ dunif(0,100);

rho ~ dunif(-1,1)

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

",file="seizures2.jag")

init1 <- list(rho=0.25,sig.r=1, beta=c(-5,3,-0.2,-1),r=rep(0,140));

init2 <- list(rho=0.30,sig.r=0.8, beta=c(-4,4,-0.2,-2) ,r=rep(0,140))

inits <- list(init1,init2); set.seed(1234)

params =c("DW","beta","ptest","rho","G")

R =autojags(DS\_7\_11, inits, params,model.file="seizures2.jag",2,iter.increment=1000, n.burnin=250,Rhat.limit=1.1, max.iter=10000, seed=1234, codaOnly= c('G'))

R$summary

# Fit

G.samps=as.array(R$sims.list$G)

G.mn=apply(G.samps,2,mean)

CPO <- -log(G.mn)

# LPML

sum(CPO)

# Markov Chain

cat("model {

# initial condition for state indicators

S[1] ~ dcat(pi.1[])

pi.1[1:K] ~ ddirch(U.1[]);

# state indicators

for (t in 2:T){S[t] ~ dcat(pi[S[t-1],1:K])}

for (t in 1:T){mu[t] <- nu[t]\*Hours[t]

y[t] ~ dpois(mu[t])

ynew[t] ~ dpois(mu[t])

# log-likelihood

LL[t] <- -mu[t]+ y[t]\*log(mu[t])-logfact(y[t])

G[t] <- 1/exp(LL[t])

x3[t] <- log(Day[t])

x4[t] <- log(Day[t])\*Tr[t]

log(nu[t]) <- beta0[S[t]]+beta[1,S[t]]\*Tr[t]+beta[2,S[t]]\* (x3[t]-mean(x3[]))

+beta[3,S[t]]\* (x4[t]-mean(x4[]))}

# Prior on Markov probs

for (j in 1:K) {U.1[j] <- 1

for (k in 1:K){ pi[j,k] <- U.pi[j,k]/sum(U.pi[j,])

U.pi[j,k] ~ dgamma(1,1)}}

# constrained intercepts

beta0s[1] ~ dnorm(0,0.001)

beta0s[2] ~ dnorm(0,0.001)

beta0 <- sort(beta0s)

for (j in 1:3) { for (k in 1:K) {beta[j,k] ~ dnorm(0,0.0001)}}}

",file="seizures3.jag")

init1 <- list(U.pi = structure(.Data = c(1,1,1,1),.Dim = c(2,2)),pi.1 = c(0.5,0.5),beta0s=c(0,0),beta= structure(.Data = c(0,0,0,0,0,0),.Dim = c(3,2)))

init2 <- list(U.pi = structure(.Data = c(5,5,5,5),.Dim = c(2,2)),pi.1 = c(0.3,0.7),beta0s=c(0.5,0.5),beta= structure(.Data = c(0,0,0,0,0,0),.Dim = c(3,2)))

inits <- list(init1,init2)

params =c("beta0","pi","beta","G")

R =autojags(DS\_7\_11\_MC, inits, params,model.file="seizures3.jag",2,iter.increment=5000, n.burnin=250,Rhat.limit=1.1, max.iter=50000, seed=1234, codaOnly= c('G'))

R$summary

# Fit

G.samps=as.array(R$sims.list$G)

G.mn=apply(G.samps,2,mean)

CPO <- -log(G.mn)

# LPML

sum(CPO)