Bayesian Statistics

Converting OpenBUGS to RJAGS

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Introduction

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What is RJAGS?

RJAGS is an R package that allows an interface to the JAGS MCMC library.

Advantage: Models are specified nearly the same way as in OpenBUGS/WinBUGS, so it is easy to transfer between languages in most situations. Data may need to be changed to a list format.

Disadvantage: You can do some things in BUGS that you can't do in JAGS. ☹ Just need to be careful about this! Fortunately there are only a few such situations.

Documentation: https://cran.r-project.org/web/packages/rjags/rjags.pdf

JAGS User Manual: https://sourceforge.net/projects/mcmc-jags/postdownload

Example Translation – Unit 1 Ex

BUGS

Notice that the model{} is the same for both!

A Simple Regression

```
model{
  for (i in 1:N) {
  Y[i] ~ dnorm(mu[i],tau)
  mu[i] <- alpha + beta * (x[i] - x.bar)
  }
x.bar <- mean(x[])
alpha ~ dnorm(0, 0.0001)
beta  ~ dnorm(0, 0.0001)
tau ~ dgamma(0.001, 0.001)
sigma <- 1.0/sqrt(tau)
beta0 <- alpha - beta * x.bar #intercept
}
#----------------------------
```

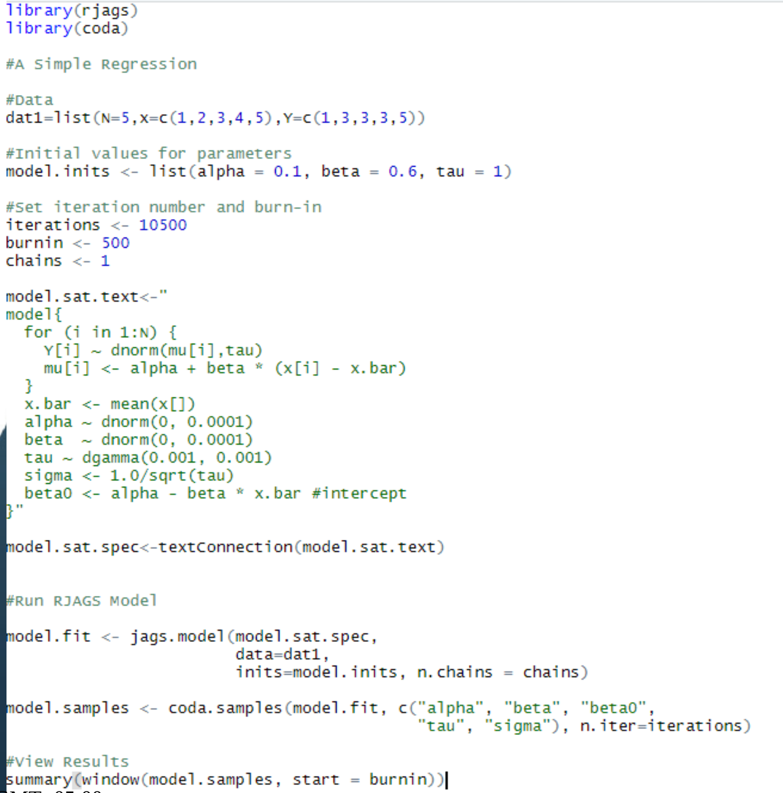
Data

```
list(N=5, x=c(1,2,3,4,5), Y=c(1,3,3,3,5))
#----------------------------
```

Inits

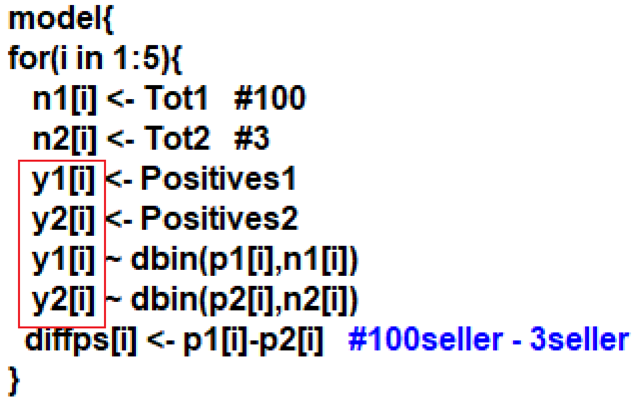
```
list(alpha = 0.1, beta = 0.6, tau = 1)
```

RJAGS



```
library(rjags)
library(coda)

#A Simple Regression

#Data
dat1=list(N=5,x=c(1,2,3,4,5),Y=c(1,3,3,3,5))

#Initial values for parameters
model.inits <- list(alpha = 0.1, beta = 0.6, tau = 1)

#Set iteration number and burn-in
iterations <- 10500
burnin <- 500
chains <- 1

model.sat.text<-"
model{
  for (i in 1:N) {
    Y[i] ~ dnorm(mu[i],tau)
    mu[i] <- alpha + beta * (x[i] - x.bar)
  }
  x.bar <- mean(x[])
  alpha ~ dnorm(0, 0.0001)
  beta  ~ dnorm(0, 0.0001)
  tau ~ dgamma(0.001, 0.001)
  sigma <- 1.0/sqrt(tau)
  beta0 <- alpha - beta * x.bar #intercept
}"

model.sat.spec<-textConnection(model.sat.text)


#Run RJAGS Model

model.fit <- jags.model(model.sat.spec,
                        data=dat1,
                        inits=model.inits, n.chains = chains)

model.samples <- coda.samples(model.fit, c("alpha", "beta", "beta0",
                                           "tau", "sigma"), n.iter=iterations)

#View Results
summary(window(model.samples, start = burnin))
```

BUGS commands that don’t work in RJAGS



```
model{
for(i in 1:5){
  n1[i] <- Tot1   #100
  n2[i] <- Tot2   #3
  y1[i] <- Positives1
  y2[i] <- Positives2
  y1[i] ~ dbin(p1[i],n1[i])
  y2[i] ~ dbin(p2[i],n2[i])
 diffps[i] <- p1[i]-p2[i]   #100seller - 3seller
}
```

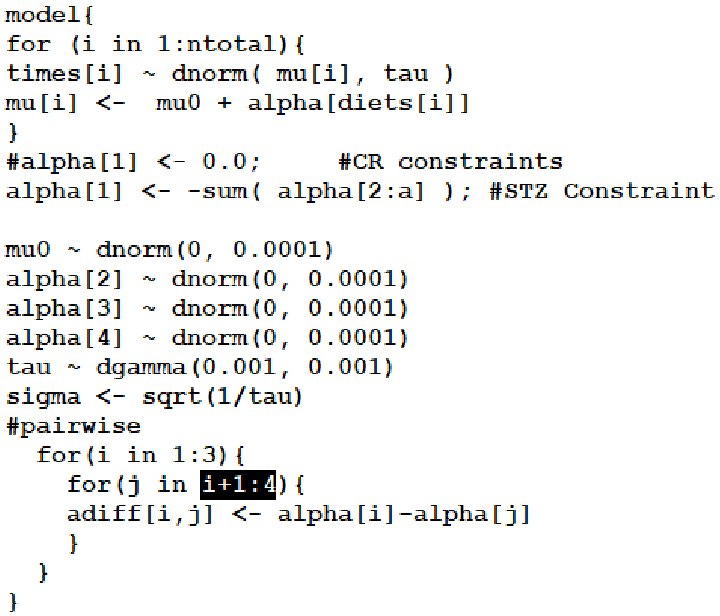
Taken from Unit 4 Ebay example

Other files with this problem:
Unit6 Psoriasis
Unit6 zerotrickjeremy

RJAGS gives an error message when you define a node multiple times (both deterministically and stochastically)! Fortunately, this is only an issue in a few of the example files.

Other problems in RJAGS

One must be more careful defining bounds for a loop in RJAGS than in BUGS. To illustrate, the following model specification generated an error:

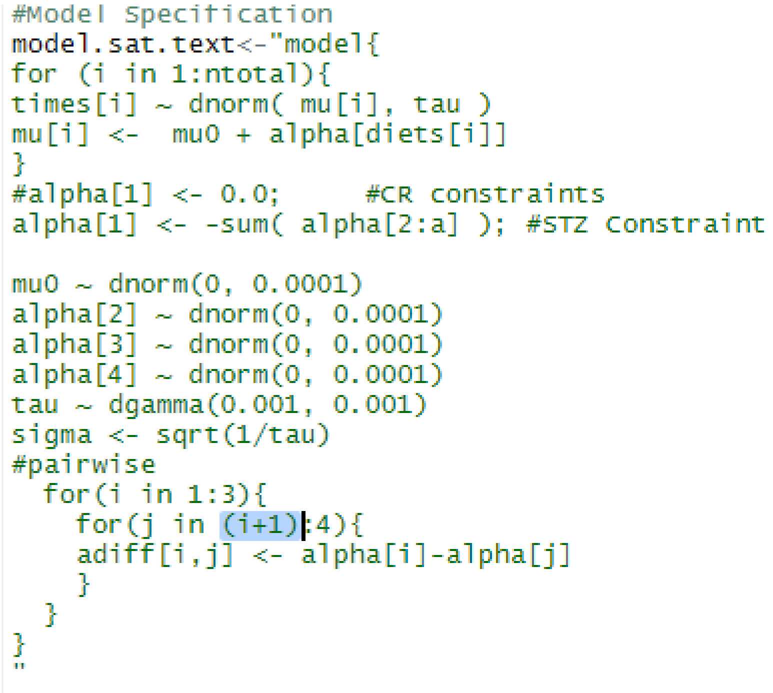


```
model{
for (i in 1:ntotal){
times[i] ~ dnorm( mu[i], tau )
mu[i] <-  mu0 + alpha[diets[i]]
}
#alpha[1] <- 0.0;     #CR constraints
alpha[1] <- -sum( alpha[2:a] ); #STZ Constraint

mu0 ~ dnorm(0, 0.0001)
alpha[2] ~ dnorm(0, 0.0001)
alpha[3] ~ dnorm(0, 0.0001)
alpha[4] ~ dnorm(0, 0.0001)
tau ~ dgamma(0.001, 0.001)
sigma <- sqrt(1/tau)
#pairwise
  for(i in 1:3){
    for(j in i+1:4){
    adiff[i,j] <- alpha[i]-alpha[j]
    }
  }
}
```

From Unit 7 anovacoagulation example

Other problems in RJAGS

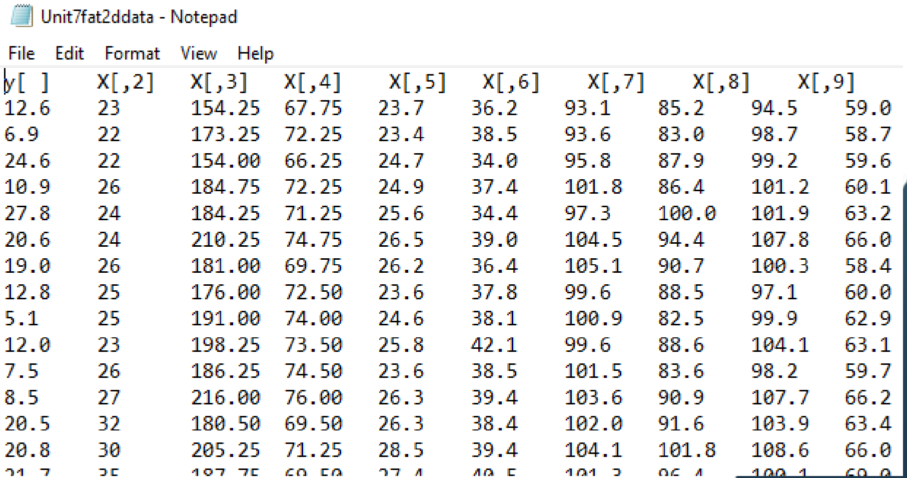
This was fixed by adding parentheses around the lower bound:



```
#Model Specification
model.sat.text<-"model{
for (i in 1:ntotal){
times[i] ~ dnorm( mu[i], tau )
mu[i] <-  mu0 + alpha[diets[i]]
}
#alpha[1] <- 0.0;     #CR constraints
alpha[1] <- -sum( alpha[2:a] ); #STZ Constraint

mu0 ~ dnorm(0, 0.0001)
alpha[2] ~ dnorm(0, 0.0001)
alpha[3] ~ dnorm(0, 0.0001)
alpha[4] ~ dnorm(0, 0.0001)
tau ~ dgamma(0.001, 0.001)
sigma <- sqrt(1/tau)
#pairwise
  for(i in 1:3){
    for(j in (i+1):4){
    adiff[i,j] <- alpha[i]-alpha[j]
    }
  }
}
"
```

Problems with data specification

When the data is specified as a data matrix and not a list, R cannot read it!



```
y[ ]    X[,2]   X[,3]   X[,4]    X[,5]   X[,6]    X[,7]    X[,8]    X[,9]
12.6    23      154.25  67.75   23.7    36.2    93.1    85.2    94.5    59.0
6.9     22      173.25  72.25   23.4    38.5    93.6    83.0    98.7    58.7
24.6    22      154.00  66.25   24.7    34.0    95.8    87.9    99.2    59.6
10.9    26      184.75  72.25   24.9    37.4    101.8   86.4    101.2   60.1
27.8    24      184.25  71.25   25.6    34.4    97.3    100.0   101.9   63.2
20.6    24      210.25  74.75   26.5    39.0    104.5   94.4    107.8   66.0
19.0    26      181.00  69.75   26.2    36.4    105.1   90.7    100.3   58.4
12.8    25      176.00  72.50   23.6    37.8    99.6    88.5    97.1    60.0
5.1     25      191.00  74.00   24.6    38.1    100.9   82.5    99.9    62.9
12.0    23      198.25  73.50   25.8    42.1    99.6    88.6    104.1   63.1
7.5     26      186.25  74.50   23.6    38.5    101.5   83.6    98.2    59.7
8.5     27      216.00  76.00   26.3    39.4    103.6   90.9    107.7   66.2
20.5    32      180.50  69.50   26.3    38.4    102.0   91.6    103.9   63.4
20.8    30      205.25  71.25   28.5    39.4    104.1   101.8   108.6   66.0
21.7    35      187.75  69.50   27.4    40.5    101.3   96.4    100.1   69.0
```

Affected files from Unit7:
fat2d
fatmulti
NHANESmulti

Other problems – Censored Data

RJAGS has no equivalent to OpenBUGS C() censoring function, so models with censored data do not work reliably! The indicator function I() is also problematic with non-fixed parameters.

This affects the Unit 8 material. Recommend some other program for this!

Summary

OpenBUGS and MATLAB are still the way to go for the course, but perhaps this will make it easier for MAC users to use R with the course. There are also other R implementations of MCMC algorithms that may have functionality this package does not. Please read the RJAGS documentation to see if it is right for you!

As a reminder, the links to the documentation and user guide are

Documentation: https://cran.r-project.org/web/packages/rjags/rjags.pdf

JAGS User Manual: https://sourceforge.net/projects/mcmc-jags/postdownload