BUGS Code for Stat 415 Examples Taken from "An Introduction to Statistical Issues and Methods in Metrology for Physical Science and Engineering"

**Code Set #1**

#here is the model statement
model {
  muw~dflat()
  logsigmaw~dflat()
  sigmaw<-exp(logsigmaw)
  tauw<-exp(-2*logsigmaw)
  for (i in 1:N) {
    W[i]~dnorm(muw,tauw)
  }
  #WinBUGS parameterizes normal distributions with the second parameter inverse variances, not variances
}

#here are some hypothetical data
list(N=5,W=c(4,3,3,2,3))

#here is a possible initialization
list(muw=7,logsigmaw=2)

**Code Set #2**

model {
  mu~dflat()
  logsigma~dflat()
  sigma<-exp(logsigma)
  tau<-exp(-2*logsigma)
  for (i in 1:N) {
    L[i]<-R[i]-.5
    U[i]<-R[i]+.5
  }
  for (i in 1:N) {
    Y[i]~dnorm(mu,tau) I(L[i],U[i])
  }
}

#here are the hypothetical data again
list(N=5,R=c(4,3,3,2,3))

#here is a possible initialization
list(mu=7,logsigma=2)
Code Set #2 OpenBUGS

model {
mu~dflat()
lomsigma~dflat()
sigma<-exp(logsigma)
tau<-exp(-2*logsigma)
for (i in 1:N) {
L[i]<-R[i]-.5
U[i]<-R[i]+.5
}
for (i in 1:N) {
Y[i]~dnorm(mu,tau) C(L[i],U[i])
}
}

# here are the hypothetical data again
list(N=5,R=c(4,3,3,2,3))

# here is a possible initialization
list(mu=7,logsigma=2)

Code Set #3

# here is the model statement
model {
muw1~dflat()
lomsigmaw1~dflat()
sigmaw1<-exp(logsigmaw1)
tauw1<-exp(-2*logsigmaw1)
for (i in 1:N1) { W1[i]~dnorm(muw1,tauw1) }
muw2~dflat()
lomsigmaw2~dflat()
sigmaw2<-exp(logsigmaw2)
tauw2<-exp(-2*logsigmaw2)
for (j in 1:N2) { W2[j]~dnorm(muw2,tauw2) }
mudiff<-muw1-muw2
sigratio<-sigmaw1/sigmaw2
}

# here are some hypothetical data
list(N1=5,W1=c(4,3,3,2,3),N2=4,W2=c(7,8,4,5))
#here is a possible initialization
list(muw1=6,logsigmaw1=2,muw2=8,logsigmaw2=3)

**Code Set #4**

#here is the model statement
model {
  k1~dflat()
  k<-abs(k1)
  logsigma~dflat()
  for (i in 1:r) {
    tau[i]<-1/(phi[i]*phi[i]*(.0001))
  }
  for (i in 1:r) {
    w[i]~dnorm(phi[i],tau[i])
  }
  sigma<-exp(logsigma)
  taudeltaL<-exp(-2*logsigma)
  for (i in 1:r) {
    mu[i]<-w[i]/k
  }
  for (i in 1:r) {
    for (j in 1:m) {
      deltaL[i,j] ~ dnorm (mu[i],taudeltaL)
    }
  }
  }

#here are some example data taken from an online Baylor
#University sample lab report
list(r=10,m=4,phi=c(.0294,.0491,.0981,.196,.392,.589,.785,.981,1.18,1.37),
  deltaL=structure(.Data=c(.94,1.05,1.02,1.03,
                   1.60,1.68,1.67,1.69,
                   3.13,3.35,3.34,3.35,
                   6.65,6.66,6.65,6.62,
                   13.23,13.33,13.25,13.32,
                   19.90,19.95,19.94,19.95,
                   26.58,26.58,26.60,26.60,
                   33.23,33.25,33.23,33.23,
                   39.92,39.85,39.83,39.83,
                   46.48,46.50,46.45,46.43), .Dim=c(10,4)))

#here is a possible initialization
list(w=c(.0294,.0491,.0981,.196,.392,.589,.785,.981,1.18,1.37),k1
  =2.95,logsigma=-3)
**Code Set #5**

```r
# here is the model statement
model {
  beta0~dflat()
  beta1~dflat()
  logsigma~dflat()
  for (i in 1:n) {
    mu[i]<-beta0+(beta1*x[i])
  }
  sigma<-exp(logsigma)
  tau<-exp(-2*logsigma)
  for (i in 1:n) {
    y[i]~dnorm(mu[i],tau)
  }
  munew<-(ynew-beta0)/beta1
  taunew<-(beta1*beta1)*tau
  xnew~dnorm(munew,taunew)
}

# here are the calibration data
list(n=6,ynew=.2,x=c(0,1,2,4,6,8),y=c(.002,.078,.163,.297,.464,.600))

# here is a possible initialization
list(beta0=0,beta1=.1,logsigma=-4,xnew=3)
```

**Code Set #6**

```r
# here is the model statement
model {
  muy~dflat()
  logsigmax~dflat()
  sigmax<-exp(logsigmax)
  sigmasqx<-exp(2*logsigmax)
  muyprime~dflat()
  logsigma~dflat()
  sigma<-exp(logsigma)
  sigmasq<-exp(2*logsigma)
  tau<-exp(-2*logsigma)
  sigmasqy<-sigmasqx+sigmasq
  tauy<-1/sigmasqy
  for (i in 1:n) { y[i]~dnorm(muy,tauy) }
  for (i in 1:m) { yprime[i]~dnorm(muyprime,tau) }
```
Code Set #7

model {
  MU ~ dflat()

  # The following are proper prior approximations to our standard
  # improper prior device of letting log standard deviations be
  # uniform on the whole real line (this seems to be required here
  # to get WinBUGS to run in the case where I=3 is so small)
  tau ~ dgamma(.001, .001)
  sigma <- 1/sqrt(tau)
  taualpha ~ dgamma(.001, .001)
  sigmaalpha <- 1/sqrt(taualpha)
  for (i in 1:I) {
    mu[i] ~ dnorm(MU, taualpha)
  }
  for (k in 1:n) {
    w[k] ~ dnorm(mu[sample[k]], tau)
  }
}

# The data here are Argon sensitivities for a mass spectrometer
# produced on 3 different days, taken from a 2006 Quality
# Engineering paper of Vardeman, Wendelberger and Wang
list(n=44, I=3, w=c(31.3, 31.0, 29.4, 29.2, 29.0, 28.8, 28.8, 27.7, 27.7, 27.8, 28.2, 28.4, 28.7, 29.7, 30.8, 30.1, 29.9, 32.5, 32.2, 31.9, 30.2, 30.2, 29.5, 30.8, 30.5, 28.4, 28.5, 28.8, 28.8, 30.6, 31.0, 31.7, 29.8, 29.6, 29.0, 28.8, 29.6, 28.9, 28.3, 28.3, 29.2, 29.7, 31.1),
  sample = c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3))

list(MU = 30, tau = 1, taualpha = 1, mu = c(30, 30, 30))