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HW 6
February 24, 2015

CODE

Print Function

#printPDF function receives two vectors and a filename. It prints three plots for each vector to the specified filename: ts plot, hist, acf.

```
printPDF <- function(m.s,s.s,filename) {

  pdf(filename)
   #PLOTS to PDF
     par(mfrow=c(3,2)) #split plotting window into 3 rows and 2 columns
     ts.plot(m.s,xlab="Iterations")
     ts.plot(s.s,xlab="Iterations")
     hist(m.s,probability=T, cex.lab=1.5, cex.axis=1.5)
     hist(s.s,probability=T, cex.lab=1.5, cex.axis=1.5)
     acf(m.s)
   acf(s.s)
  dev.off()

}
```

Gibbs Function

#Gibbs function receives five parameters: "data" for the data values of interest, "m" for the population mean, "m0","s0","n0","k0" as prior parameters (mu, sigma sqr, nu, kappa), "N" for number of realizations, "lag" for determining how many realizations to skip between saves, and "burnin" for detemrining how many realizations to skip before starting to save. Gibbs generates N independent random normal values.

```
gibbs <- function(data,m,m0,s0,n0,k0,N,lag,burnin) {

     #obtain mean (y.bar), variance (s.sqr), and length (n) of data
     y.bar = mean(data)
   s.sqr = var(data)
   n = length(data)

     #Set N to be N*lag+burnin
     N <- N*lag + burnin

     #Initialize vectors to hold mu and sigma sqr
```

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```
    m.s <- NULL
    s.s <- NULL
    #Vector to hold y values from normal distribution with each mu, sigma sqr as parameters
    y.s <- NULL

  for(i in 1:N) {

    #generate a sigma sqr s using mean (y.bar), variance (s.sqr), length (n) of data, and prior
parameters
    s <- 1/rgamma(1,(n+1+n0)/2,((n-1)*s.sqr + n*(y.bar-m)^2 + ((m-m0)^2)*k0 + n0*s0)/2)
    #generate a mu m using mean (y.bar) and length (n) of data and sigma sqr (s) from last step
    m <- rnorm(1, (y.bar*n + m0*k0)/(n + k0), (sqrt((s/n)/(n + k0))))

    y.s <- c(y.s,rnorm(1,m,sqrt(s)))

  #if i is greater than burnin and if i is a multiple of the lag, store m and s
  if(i > burnin) {
    if(i %% lag == 0) {
            m.s <- c(m.s,m)
            s.s <- c(s.s,s)
   }
  }
  }
  #filename = sprintf("Documents/R-FILES/HW6-%s-%s-%s.pdf",k0,n0,s0)
  #printPDF(m.s,s.s,filename)

  #vectors <- list("mu" = m.s, "sigsqr" = s.s)
  #return(vectors)

  return(y.s)
 }
```

Attach File, Run Gibbs, and Obtain Results

```
data = read.table(file.choose(), header=F)
attach(data)
data = data$V1

#Set burnin to 10 and leave lag=1 and run Gibbs with N=2500
N = 2500
lag = 1
burnin = 10
m = 80
#FIX m0 at 20
m0 = 20
```

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```
#CHOOSE s0,n0,k0
k0 = 1
s0 = 1
n0 = 1

vectors = gibbs(data,m,m0,s0,n0,k0,N,lag,burnin)

mean(vectors$mu)
quantile(vectors$mu, 0.025)
quantile(vectors$mu, 0.975)
mean(vectors$sigsqr)
quantile(vectors$sigsqr, 0.025)
quantile(vectors$sigsqr, 0.975)
```

Posterior Predictive Distribution and Probabilities

```
y.10 = vector > 10
prob = length(y.10[y.10=="TRUE"])/N

quantile(vector, 0.025)
quantile(vector, 0.975)
```

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RESULTS

Plots at κ_0 = 1, υ_0 = 1, σ_0^2 = 1 with Lag=1 and Burnin=10

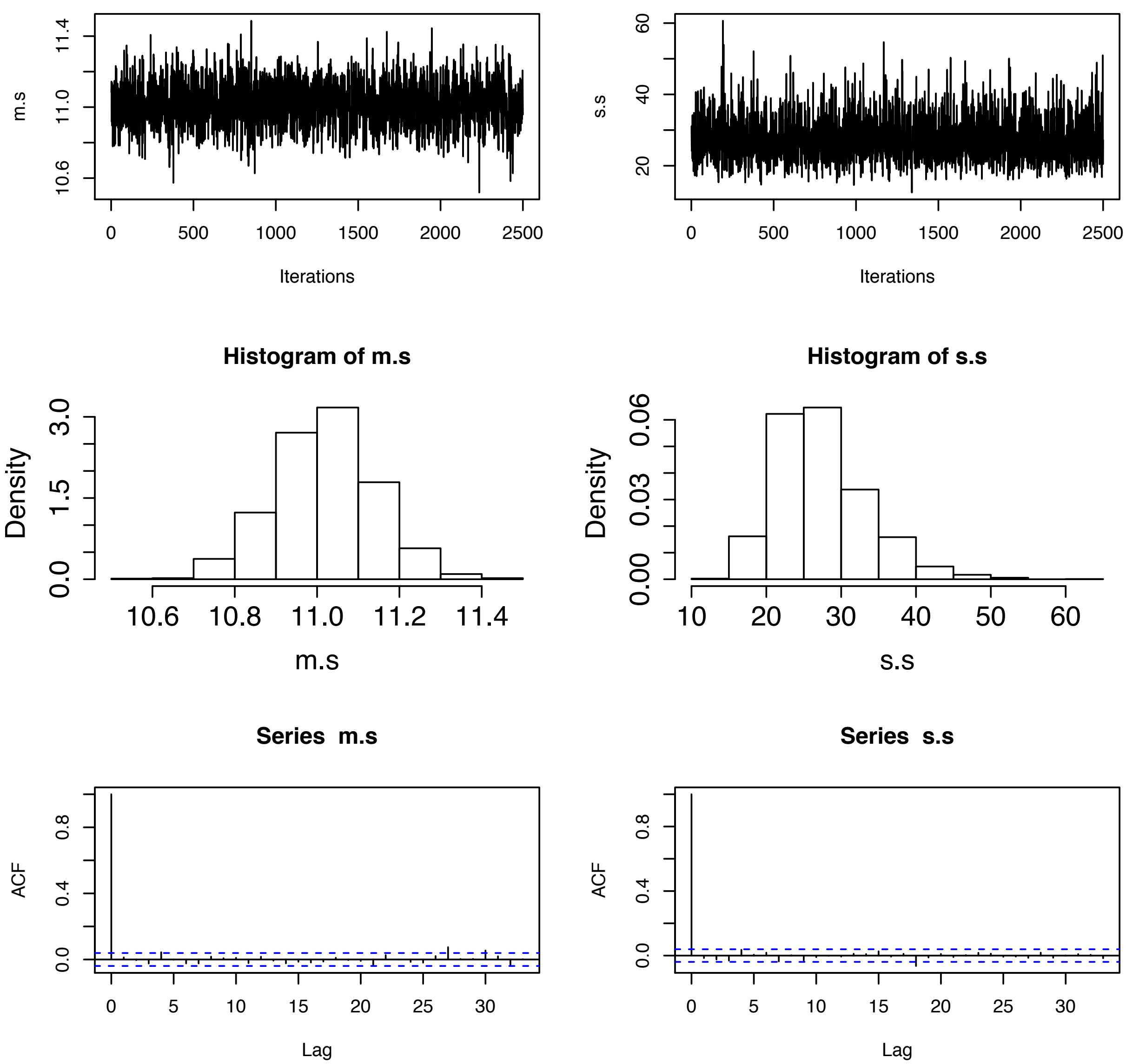

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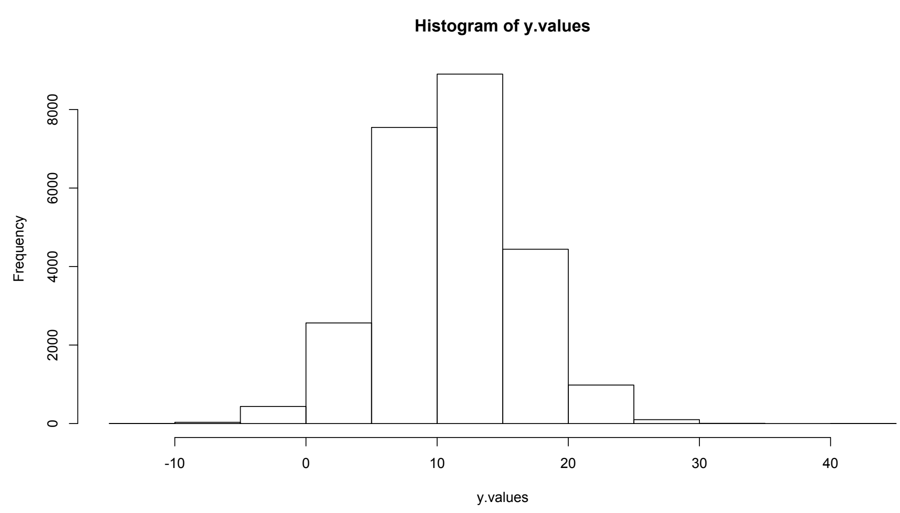
Table of μ and σ^2 Values for Different Combinations of κ_0, υ_0, and, σ_0^2

κ_0	υ_0	σ_0^2	μ	95% CI for μ	σ^2	95% CI for σ^2
1	1	1	11.02	10.78 – 11.26	27.33	17.72 – 40.96
99	1	1	17.22	16.99 – 17.44	84.58	55.21 – 129.50
99	1	777	17.23	16.96 – 17.48	101.45	68.50 – 152.31
99	500	1	17.21	17.15 – 17.29	7.61	6.75 – 8.57
1	1	777	11.02	10.72 – 11.32	45.52	29.93 – 68.34
1	500	1	11.02	10.94 – 11.09	3.09	2.75 – 3.47
1	500	777	11.02	9.84 – 12.23	718.28	638.99 – 807.00
99	500	777	17.23	16.58 – 17.89	721.34	639.50 – 814.46

The parameter μ increases from 11.02 to more than 17 only when κ_0 is large. The parameter σ^2 is affected most significantly when all hyper-parameters are large, i.e., σ^2 increases from 27.33 when all hyper-parameters are small to 721.34 when all hyper-parameters are large. When υ_0 is large and σ_0^2 is small, the value of σ^2 is significantly smaller, i.e., $\sigma^2 < 10$, than when all hyper-parameters are small, i.e., $\sigma^2 = 27.33$.

Posterior Predictive Distribution



Let x be the next observation.
P(x > 10) = 0.5758
The smallest interval that has 95% chance of containing x is (0.9, 21.34)