STAT 4224 HW #5

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```
rm(list = ls())
set.seed(1)
knitr::opts_chunk$set(echo = TRUE)
```

1.

```
library(mcmcse)
```

```
## Warning: package 'mcmcse' was built under R version 4.0.5
```

```
chain.length <- 1000
J<-6

y1<-c(83,92,92,46,77)
y2<-c(117,109,114,104,87)
y3<-c(101,93,92,86,67)
y4<-c(105,119,116,102,116)
y5<-c(79,97,103,79,92)
y6<-c(57,92,104,77,100)

n <- c(length(y1), length(y2), length(y3), length(y4), length(y5),length(y6))
ybar<-c(mean(y1), mean(y2), mean(y3), mean(y4), mean(y5),mean(y6))
s<-c(sd(y1), sd(y2), sd(y3), sd(y4), sd(y5),sd(y6))
rm(y1,y2,y3,y4,y5,y6)

theta.update <- function(mu, sigma, tau, J, n, ybar)
{
 V.theta <- 1 / (1/tau^2 + n/sigma^2)
 theta.hat <- V.theta * (mu/tau^2 + n*ybar/sigma^2)
 rnorm(J, mean=theta.hat, sd=sqrt(V.theta))
}


mu.update <- function(theta, tau, J)
{
 mu.hat <- mean(theta)
 rnorm(1, mean=mu.hat, sd=tau/sqrt(J))
}


sigma.update <- function(theta, n, ybar, s)
{
```

```
 sigma2.hat <- sum((n-1)*s^2 + n*(ybar-theta)^2) / sum(n)
 sigma2 <- sum(n) * sigma2.hat / rchisq(1, df=sum(n))
 sqrt(sigma2)
}


tau.update <- function(J, theta, mu)
{
 tau2.hat <- sum((theta-mu)^2) / (J-1)
 tau2 <- (J-1) * tau2.hat / rchisq(1, df=J-1)
 sqrt(tau2)
}

build.chain <- function(chain.length, J, n, y, s, theta0, mu0, sigma0, tau0)
{
 T <- chain.length
 theta.chain <- matrix(NA, T, J)
 mu.chain <- rep(NA, T); sigma.chain <- rep(NA, T); tau.chain <- rep(NA, T);
 theta <- theta0; mu <- mu0; sigma <- sigma0; tau <- tau0;
 for(t in 1:T)
 {
  theta <- theta.update(mu, sigma, tau, J, n, ybar)
  mu <- mu.update(theta, tau, J)
  sigma <- sigma.update(theta, n, ybar, s)
  tau <- tau.update(J, theta, mu)
  theta.chain[t,] <- theta; mu.chain[t] <- mu;
  sigma.chain[t] <- sigma; tau.chain[t] <- tau;
 }
 list(theta.chain=theta.chain, mu.chain=mu.chain,
     sigma.chain=sigma.chain, tau.chain=tau.chain)
}

theta0 <- ybar; mu0 <- mean(theta0);

sigma0 <- sqrt(mean(s^2)); tau0 <- sd(ybar);

chain <- build.chain(chain.length, J, n, y, s, theta0, mu0, sigma0, tau0)

theta.chain <- chain$theta.chain; mu.chain <- chain$mu.chain;

sigma.chain <- chain$sigma.chain; tau.chain <- chain$tau.chain;
```