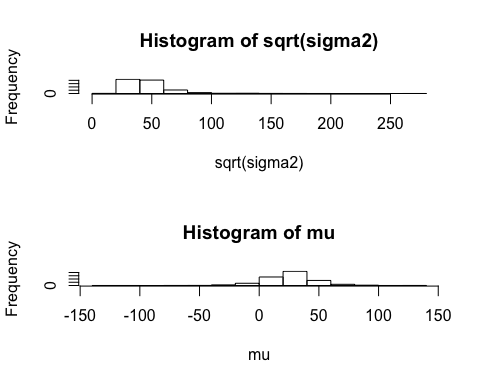
Homework2.R

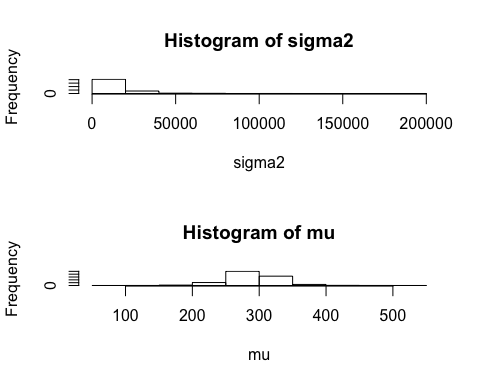
EmilyErnst

Tue Feb 28 00:34:27 2017

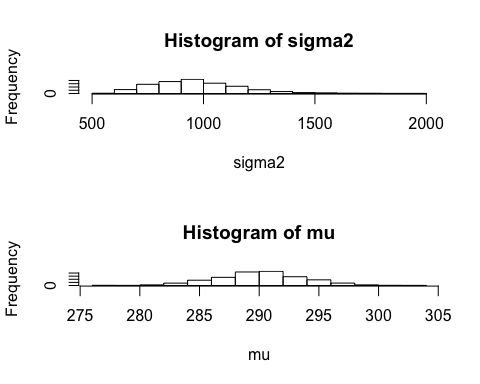
# Homework 2   
# Emily Ernst  
  
#Problem 1: Refer to Lab 4. Re-analyze Newcomb’s speed of light experiment, but this time  
#using a conjugate prior for μ,σ2. For σ2, select a prior scale parameter that is in  
#agreement with the sample variance and for the prior degrees of freedom, choose a value  
#that, relative to the sample size, does not reflect much confidence in the prior scale.  
#For μ, choose whatever values of the prior parameters seem reasonable to you, and  
#justify your choices.  
  
newcomb\_data = c(28, 26, 33, 24, 34, -44, 27, 16, 40, -2,  
 29, 22, 24, 21, 25, 30, 23, 29, 31, 19,  
 24, 20, 36, 32, 36, 28, 25, 21, 28, 29,  
 37, 25, 28, 26, 30, 32, 36, 26, 30, 22,  
 36, 23, 27, 27, 28, 27, 31, 27, 26, 33,  
 26, 32, 32, 24, 39, 28, 24, 25, 32, 25,  
 29, 27, 28, 29, 16, 23)  
  
y = newcomb\_data  
  
#degrees of freedom = 5 because less degrees of freedom decreases confidence in the data  
#sigma2 and mu = based on data variance and mean because I don't have any more info than that   
  
S=sum((y-mean(y))^2)  
n=length(y)  
sigma2=S/rchisq(1000, 5)  
par(mfrow=c(2,1))  
hist(sqrt(sigma2))  
  
k = 5  
  
mu = rnorm(1000, mean = mean(y), sd = sqrt(sigma2)/sqrt(k))  
hist(mu)



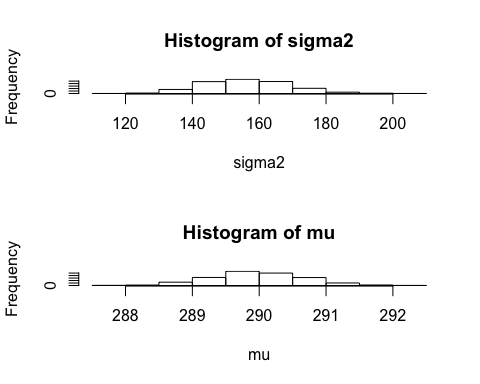
#Problem 2: Albert (2011) describes a dataset that includes marathon completion times  
#(in minutes) for men aged 20 to 29 years who participate in the New York marathon. The  
#dataset has times for 20 runners and you can access the data from R by issuing the  
#commands:  
  
library(LearnBayes)  
data(marathontimes)  
attach(marathontimes)  
  
#Let y1, y2, ..., y20 denote the completion times for the 20 runners and assume that yi ∼  
#N(μ,σ2), where both μ and σ2 are unknown. Use a conjugate prior for μ,σ2 and select  
#values for the prior parameters which you think are good choices. Justify those choices.  
#Carry out a test of sensitivity to the prior by setting ν0, κ0 at three different values  
#reflecting low, medium and high confidence in your prior guesses for μ,σ2.  
  
x = marathontimes$time  
  
#mean and variance are based on the data again because I have no other data to compare to  
  
#Low  
  
S=sum((x-mean(x))^2)  
n=length(x)  
sigma2=S/rchisq(1000, 5)  
  
k = 10  
  
mu = rnorm(1000, mean = mean(290), sd = sqrt(sigma2)/sqrt(k))  
  
par(mfrow=c(2,1))  
hist(sigma2)  
hist(mu)



#Medium  
  
S=sum((x-mean(x))^2)  
n=length(x)  
sigma2=S/rchisq(1000, 50)  
  
k = 70  
  
mu = rnorm(1000, mean = mean(290), sd = sqrt(sigma2)/sqrt(k))  
  
par(mfrow=c(2,1))  
hist(sigma2)  
hist(mu)



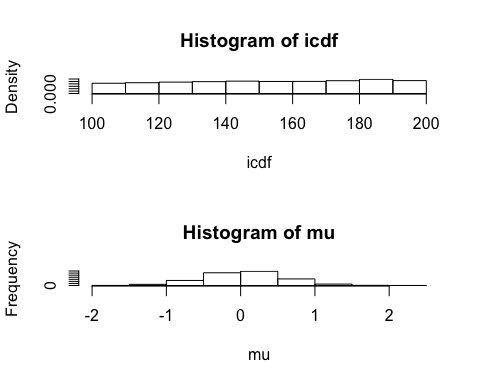
#High  
  
S=sum((x-mean(x))^2)  
n=length(x)  
sigma2=S/rchisq(1000, 300)  
  
k = 350  
  
mu = rnorm(1000, mean = mean(290), sd = sqrt(sigma2)/sqrt(k))  
  
par(mfrow=c(2,1))  
hist(sigma2)  
hist(mu)



#Problem 3: Revisit the football scores example, where now we consider non-conjugate  
#prior distributions for μ, σ2 (see Notes, pp 27-33). We wish to obtain the posterior  
#distributions for the two parameters μ,σ2, and we do so under two different priors.  
  
#3.a First choose a standard non-informative prior for μ, σ2, with p(μ, σ2) ∝ σ−2.  
#Approximate the posterior distribution of μ, σ2 by first drawing values of σ2 from its  
#marginal posterior distribution p(σ2|y) using the inverse CDF method (see Notes, p. 33)  
#and then drawing values of μ from its conditional posterior distribution p(μ|σ2,y). Draw  
#histograms of the posterior distributions of μ and of σ2.  
  
data("footballscores")  
attach(footballscores)  
  
z = favorite - underdog - spread  
  
par(mfrow=c(2,1))  
  
sig2 = seq(from=100, to=200, length=1000)  
  
nu0 = 0  
n = length(z)  
nun = nu0  
  
S=sum((z-mean(z))^2)  
n=length(z)  
sigma2n=S/rchisq(1000, n-1)  
  
p=seq(from=0, to=1, length=length(sig2))  
lp = p   
for(i in 1:length(lp)){  
 lp[i] = -(nun+1)\*log(sig2[i]) - sigma2n/sig2[i]  
}

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p <- exp(lp - max(lp))  
p <- p/sum(p)  
  
cdf <- cumsum(p)  
  
u <- runif(5000)  
icdf <- rep(0,5000)  
for (i in 1:5000) {  
 icdf[i] <- sig2[1]  
 for (j in 1:1000) {  
 if (cdf[j] < u[i]) icdf[i] <- sig2[j]  
 }  
}  
  
hist(icdf,freq=F)  
  
mu = rnorm(1000, mean = mean(z), sd = sqrt(sigma2n)/sqrt(n))  
hist(mu)



#3.b Consider now a non-conjugate prior for μ, σ2 of the form   
#p(μ, σ2) = p(μ)p(σ2) = N(μ|μ0, τ02)Inv − χ2(ν0, σ02)  
#for some reasonable choices of μ0,τ02,ν0,σ02. Implement the inverse CDF method to draw  
#values from the marginal posterior distribution of σ2, and given those draws, generate  
#values of μ from its conditional posterior distribution, as in part [3.a].  
  
sig2 = seq(from=100, to=200, length=1000)  
  
nu0 = 600  
n = length(z)  
nun = nu0 + 0.5\*n  
  
sigma20 = 200  
sigma2n = sigma20 + 0.5\*(n-1)\*var(z) + 0.5\*n\*mean(z)\*mean(z)/(n)  
  
p=seq(from=0, to=1, length=length(sig2))  
lp = p   
for(i in 1:length(lp)){  
 lp[i] = -(nun+1)\*log(sig2[i]) - sigma2n/sig2[i]  
}  
  
p <- exp(lp - max(lp))  
p <- p/sum(p)  
  
cdf <- cumsum(p)  
  
u <- runif(5000)  
icdf <- rep(0,5000)  
for (i in 1:5000) {  
 icdf[i] <- sig2[1]  
 for (j in 1:1000) {  
 if (cdf[j] < u[i]) icdf[i] <- sig2[j]  
 }  
}  
  
hist(icdf,freq=F)  
  
tau0 = 250  
taun = 1/((1/tau0)+(n/sigma20))  
  
mu0 = 0  
mun = ((1/tau0)\*mu0) + ((n/sigma20)\*mean(z))/((1/taun)+(n/sigma2n))  
  
mu = rnorm(1000, mean = mean(mun), sd = sqrt(taun)/sqrt(n))  
hist(mu)

