homework 2

Yi Chen(yc3356)

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Name: Yi Chen

UNI: yc3356

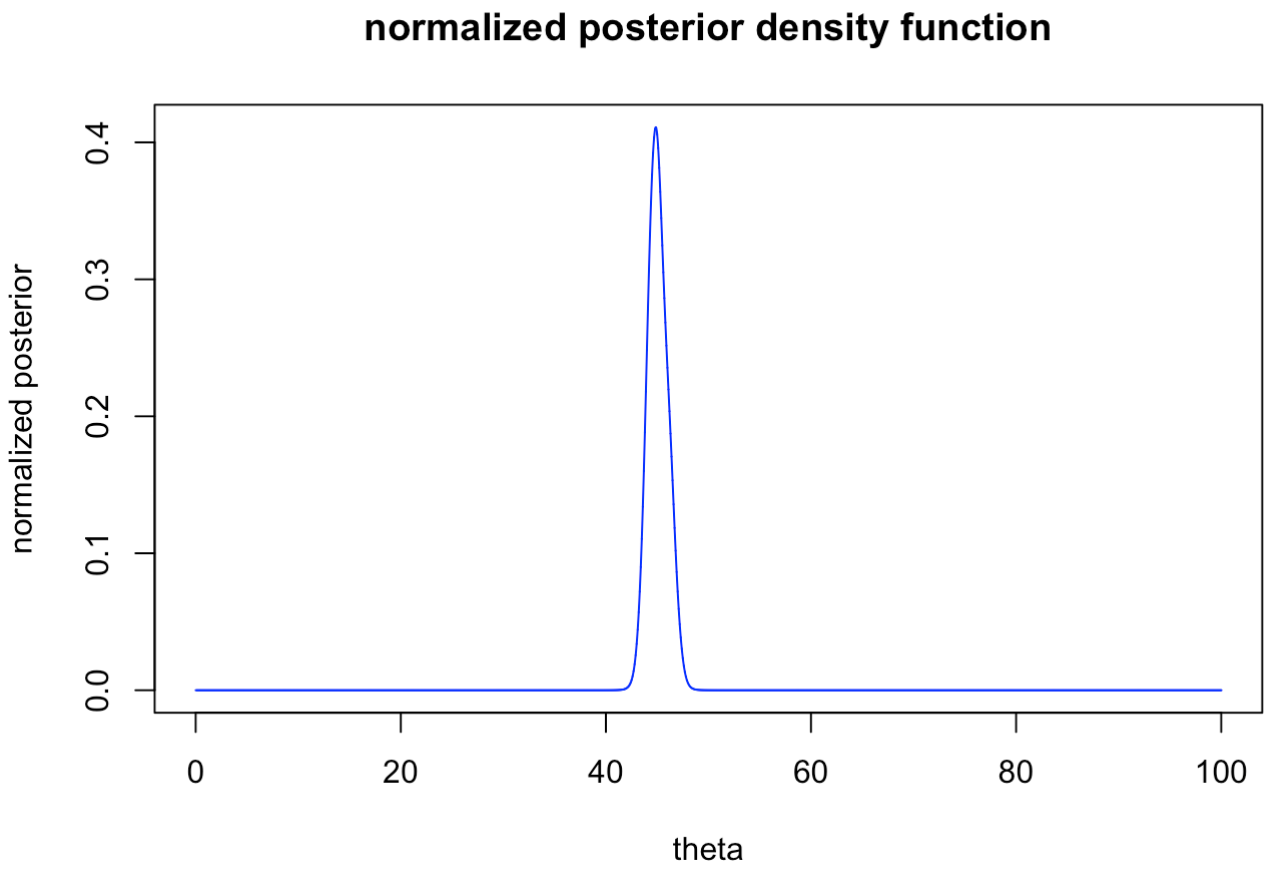
Email: yc3356@columbia.edu (mailto:yc3356@columbia.edu)

2.11 of BDA

(a)

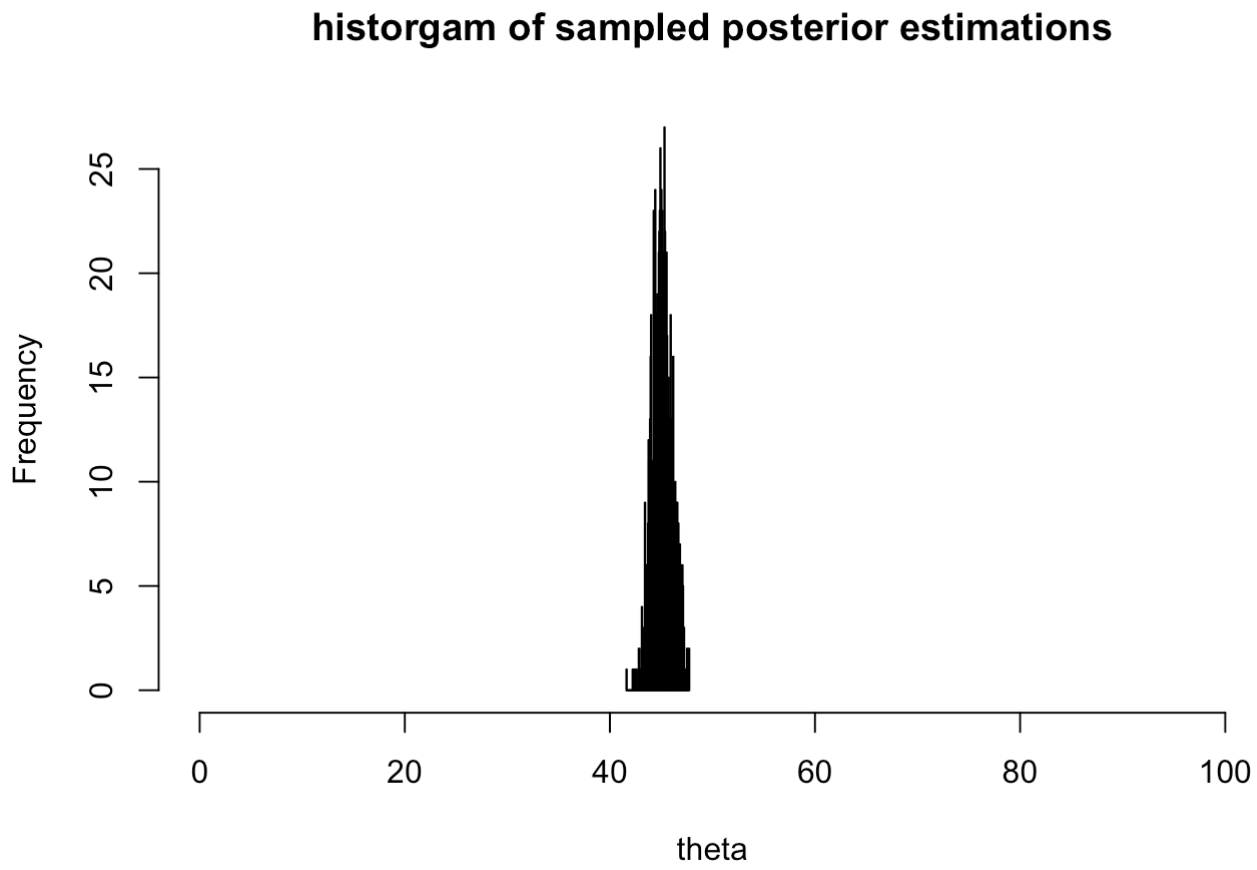
```
# prior distribution is unif(0,100)
# p(theta) = 1/100 for theta belongs to 0~100
# the likelihood of theta follows the cauchy distribution
unnormalized_posterior <- function(y,theta){
        return((1/(1+(y-theta)^2)) *(1/100))
}
# assume that m = 1000

normalized_posterior <- function(y,grid_points,m){
        # find the normalizing constant C which is the area under the unnormalized posterior
        unnormalized_post_ord <- c()
        for(i in grid_points){
                unnormalized_post_ord <- c(unnormalized_post_ord, prod(unnormalized_posterior(theta = i,y = y)))}
        step <- 100/length(unnormalized_post_ord) # the width of each grid
        normal_constant <- sum(step*unnormalized_post_ord)
        # get the normalized posterior points
        normalized_posterior <- unnormalized_post_ord/normal_constant
        return(normalized_posterior)
}
m=1000
grid_points <- seq(from=0,to=100,length.out = 100*m+1) # when m = 10000, there are 10*10000 + 1 points
probs <- normalized_posterior(y=c(43,44,45,46.5,47.5),grid_points=grid_points,m=m)
```

```
plot(grid_points,probs,type='l',xlab='theta',ylab='normalized posterior',col='blue',main='normalized posterior de
nsity function')
```



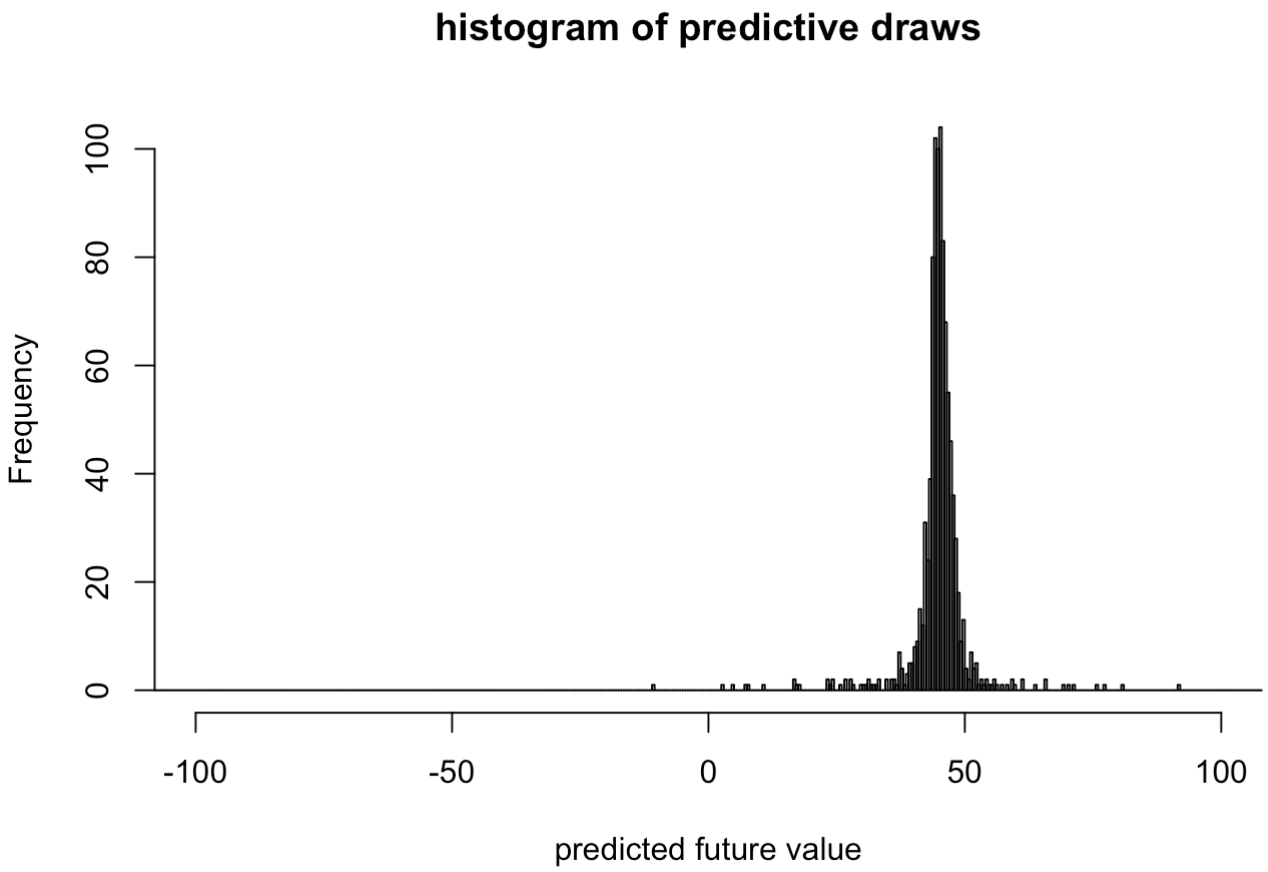
(b)

```
#sampling, in order to get 1000 point and their probabilities:
theta_sample <- sample(x =  grid_points,size = 1000,prob = probs ,replace = TRUE)
# histogran
hist(theta_sample,xlab='theta',main='historgam of sampled posterior estimations',breaks = 100,xlim =c(0,100))
```



(b)

```
#sampling, in order to get 1000 point and their probabilities:
y6 <- rcauchy(scale = 1,n = length(theta_sample),location = theta_sample)
hist(y6,xlab='predicted future value',breaks = 1000,main='histogram of predictive draws',xlim=c(-100,100))
```


histogram of predictive draws
Frequency
0
20
40
60
80
100
-100
-50
0
50
100
predicted future value