Hw6

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2.4.1

(a)

$\overline{Y}\,\frac{n}{n+m} \pm 1.96\,\sigma\,(n+m)^{-.5}$

(b)

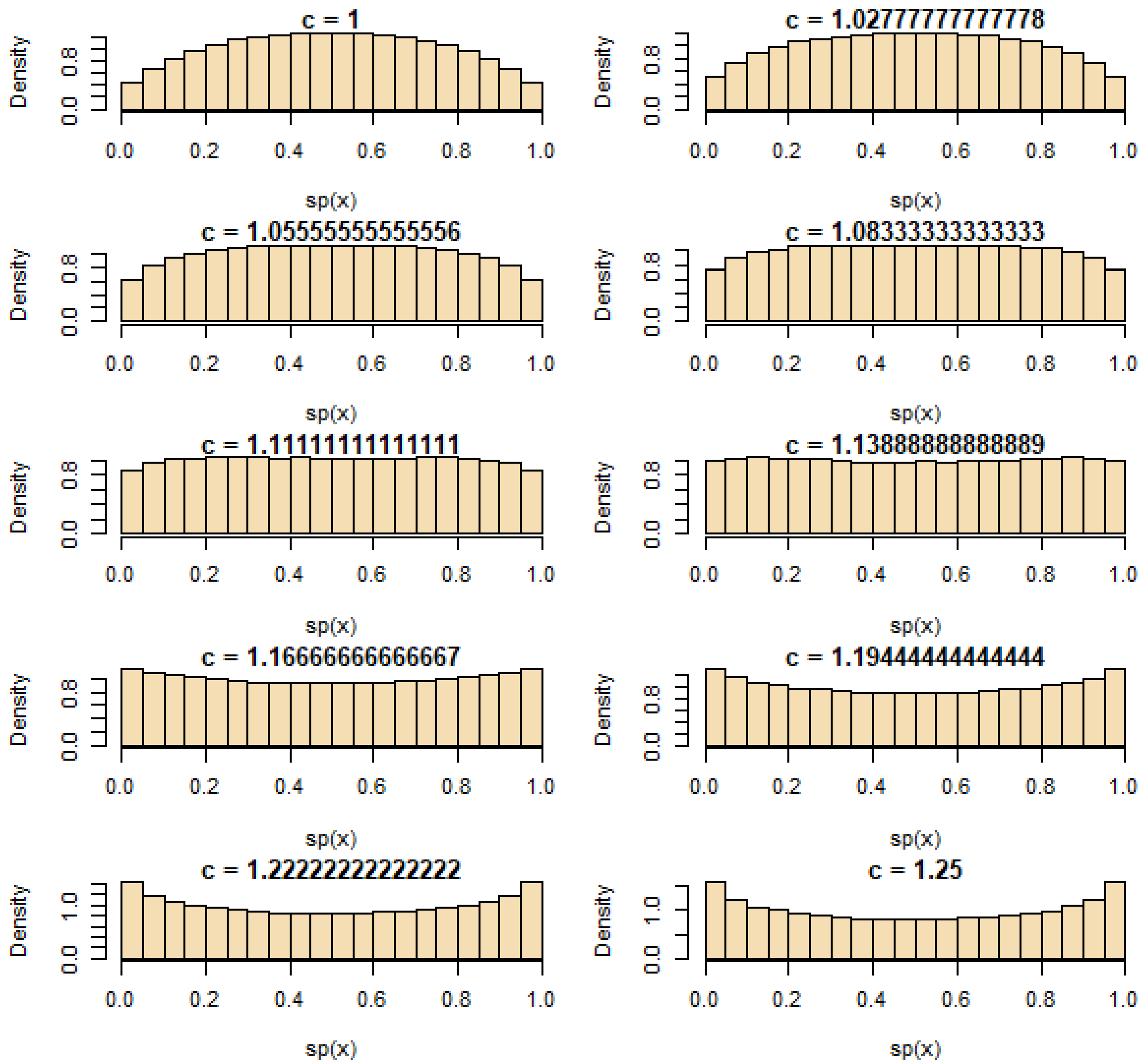
```
n<- 100000
set.seed(100)
#random numbers generated
data<- rnorm(n, 0, 1)
#mean
me<- mean(data)
#variance
v<- var(data)


#frequentist ci
#y-bar +/- (var/n)^.5

fLow<-  me-1.96* (v/n)^.5;

fHigh<- me+1.96 * (v/n)^.5;fHigh

## [1] 0.007754023

#frequentist ci
cbind(fLow, fHigh)

##              fLow       fHigh
## [1,] -0.004631306 0.007754023

#using formula from a with m = 0
bCi<- function(m){
  w = n/(n+m)
  bm= (w * me) + (1-w) * 0
  bv=  (v/(n+m))^.5
  return(cbind("bLow" = bm- 1.96* bv, "bHi" = bm+ 1.96* bv))
}
```

```
#bayes ci
bCi(0)

##              bLow         bHi
## [1,] -0.004631306 0.007754023
```

We can achieve the frequentist confidence interval by using m = 0.As shown in the above simulation, when m = 0 the frequentist ci upper and lower bounds matches the upper and lower bounds after using the formula in part a.

2.4.5

```
#function used to do simulation
sp<- function( c){
  x<- rnorm(1000000, 0,1)
  a = rnorm(1000000, 0,c^2)
  b = rnorm(1000000, 0, c^ 2)
  return(exp(a + x* b)/ (1 + exp(a + x* b)))
}





#plots
op <- par(pty="m", mfrow=c(5, 2), mar=c(4.2, 4.2, 1, 1))

  pwalk(list((seq(1, 1.25, length = 10))), ~{hist(sp(..1), col = "wheat",
freq= F, main = paste("c =", ..1))})
```




```
par(op)
```

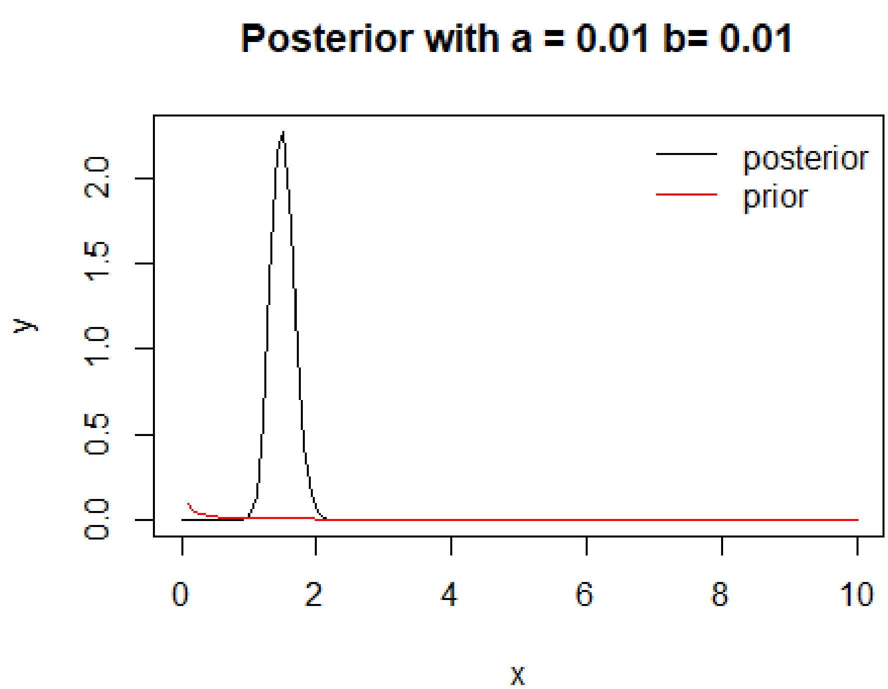
The final c = 1.13889, and since the histogram looks uniform I would say the prior is uninformative.

2.4.6

(a)

```
#question 6

#y = 1.5 * 50 = 75
#n = 50

#function to plot
gammaPost<- function(a, b){
  x<- seq(0,10, length = 100)
  y<- dgamma(x, 75 + a, 50 + b)
```

```
  plot(x,y , type = "l", main = paste("Posterior with a =", a, "b=", b))
  lines(x, dgamma(x, a,b), col = "red")
  legend("topright", legend = c("posterior", "prior"),col=c("black", "red"),
lty=c(1,1), bty = "n")
}

#funcation for summary
postSum<- function(a,b){
  #ci
  ci =  qgamma(c(.025, .975), 75 + a, 50 + b);
  #mean
  mean= (75 + a)/ (50 + b)
  #std
  std= sqrt((75 + a)/ (50 + b)^2)
  cbind("a" = a, "b" = b, "lowCi" = ci[1], "upperCi" = ci[2], "mean" = mean,
"std" = std)%>%as.data.frame()%>%return()
}


#a
# a=b=.01
gammaPost(.01, .01)
```

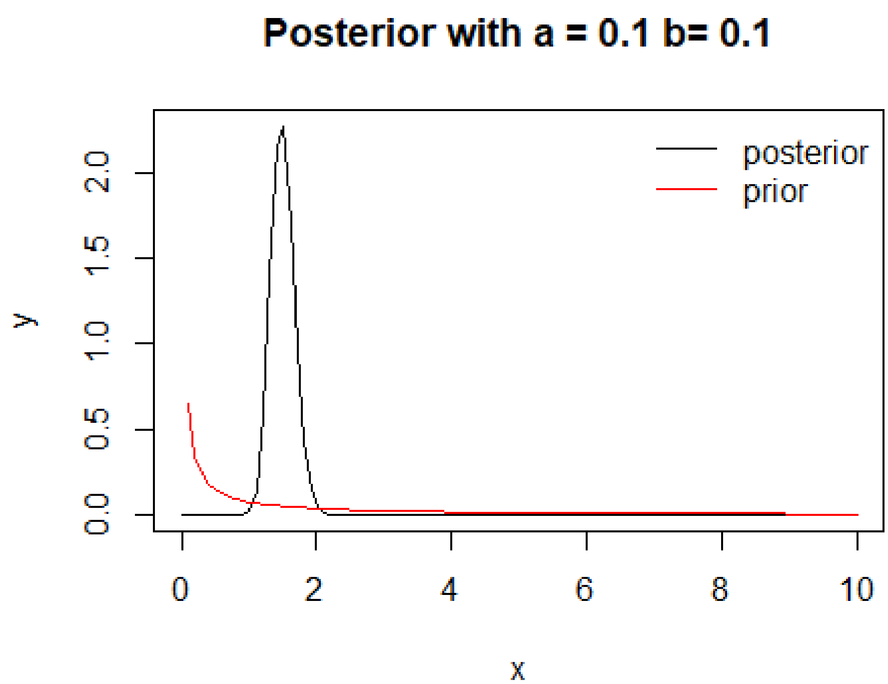



```
postSum(.01, .01)
```

```
##       a    b    lowCi  upperCi   mean      std
## 1 0.01 0.01 1.179787 1.857856 1.4999 0.173182
```

(b)

```r
#b
# a=b=.1
gammaPost(.1, .1)
```

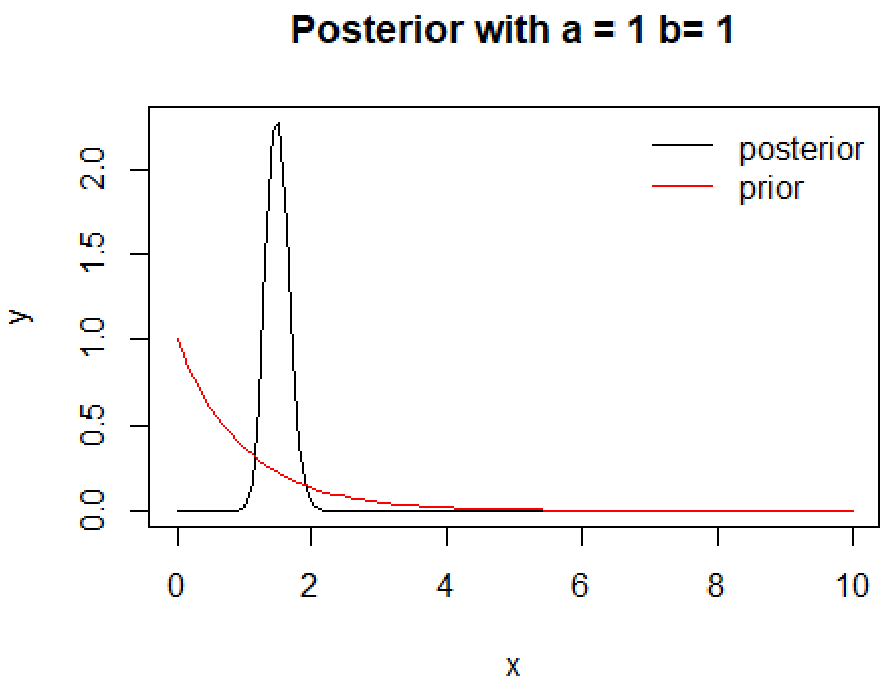



```r
postSum(.1, .1)
```

```
##     a   b   lowCi  upperCi    mean      std
## 1 0.1 0.1 1.17926 1.856518 1.499002 0.1729746
```

When a=b=.1 it appears the posterior is not too sensitive to the prior. The summary statistics have not changed too much when compared to part(a)

```r
# a= b = 1
gammaPost(1, 1)
```




```
postSum(1, 1)

##   a b    lowCi  upperCi     mean       std
## 1 1 1 1.174105 1.843395 1.490196 0.1709372
```

Comapred to a=b=.01 and a=b=.1, the summary has changed slightly. So it appears the posterior is slightly sensitive to the prior when a=b=1.

(c)

(i) Gamma(.015, .01) gives an expectation of 1.5.

(ii) Gamma(.014, .01) gives an expectation of 1.4 which is within the 10% range of the mayo rate.

(iii) Uniform(0,1), gives a prior that is not a function of the mayo rate.