HW07 Report

Ninh (Vincent) DO

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Problem 2b

```
library(MCMCpack)
```

```
## Loading required package: coda
```

```
## Loading required package: MASS
```

```
## ##
## ## Markov Chain Monte Carlo Package (MCMCpack)
```

```
## ## Copyright (C) 2003-2019 Andrew D. Martin, Kevin M. Quinn, and Jong Hee Park
```

```
## ##
## ## Support provided by the U.S. National Science Foundation
```

```
## ## (Grants SES-0350646 and SES-0350613)
## ##
```

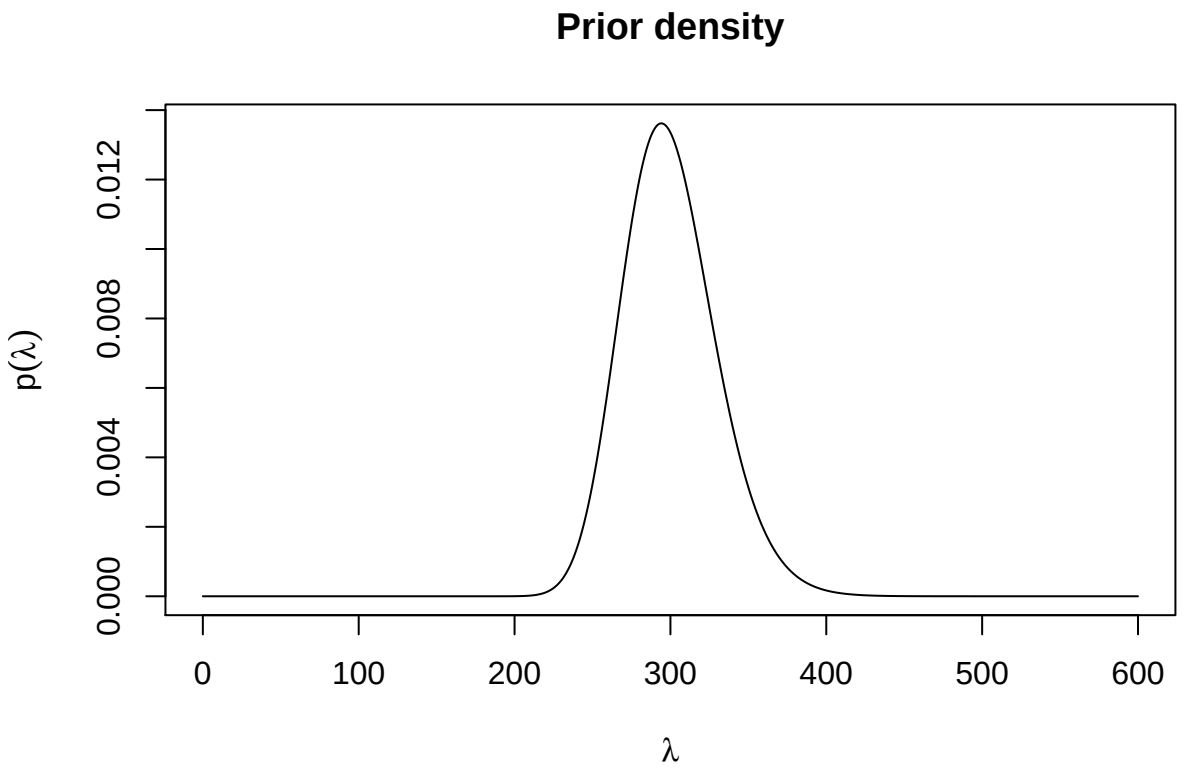
```
## Specify the prior distribution: Inverse Gamma

m <- 300    # Prior mean
v <- 900    # Prior variance

alpha = m ^ 2 / v + 2
beta = m * (alpha - 1)

alpha
```

```
## [1] 102
```

```
beta
```

```
## [1] 30300
```

```
## Plot the prior density

x <- seq(0.01, 600, length = 1000)
prior <- dinvgamma(x, shape = alpha, scale = beta) # the prior pdf
plot(x, prior, type = "l", xlab = expression(lambda),
     ylab = expression(p(lambda)), main = "Prior density")
```



The choice of m and v is based on my current knowledge that, over a couple of years, there were around ~4, 5 earthquakes in Berkeley.

Problem 2c

```
## The data

load("BerkeleyEarthquakes.RData")
head(earthquakes)
```

```
##            Date        Time     Lat       Lon Depth  Mag         Lag
## 46   1969/04/14 04:22:36.21 37.8740 -122.2260 11.41 3.00          NA
## 590  1971/05/10 00:52:01.51 37.8863 -122.2432  9.51 3.15 755.8537650
## 591  1971/05/13 01:39:13.28 37.8708 -122.2330 13.29 3.18   3.0327751
## 722  1971/09/17 18:43:33.75 37.8692 -122.2345 11.36 3.05 127.7113480
## 723  1971/09/17 21:34:35.44 37.8660 -122.2332 10.78 3.06   0.1187696
## 2184 1973/10/04 12:24:10.09 37.8643 -122.2335  9.85 3.10 747.6177622
```

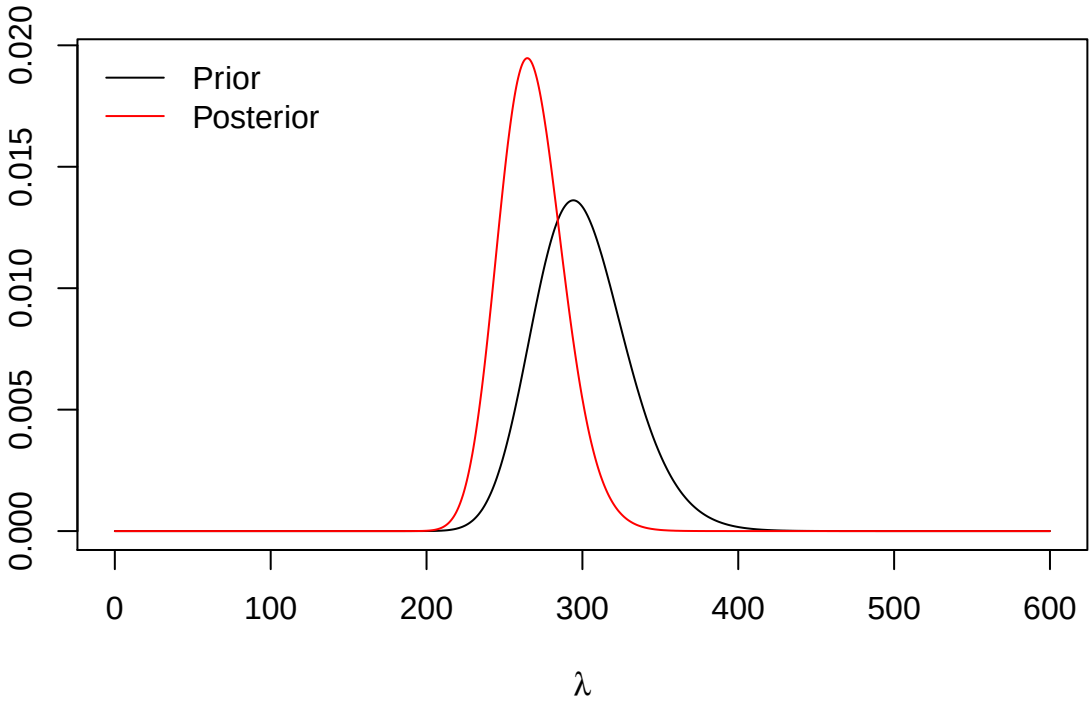
```
data <- earthquakes$Lag[-1]    # First element is NA

n <- length(data)    # number of data points
s <- sum(data)    # sum of data points

## Update the parameters to get the posterior distribution

alpha_new <- alpha + n
beta_new <- beta + s

alpha_new
```

```
## [1] 168
```

```
beta_new
```

```
## [1] 44724.79
```

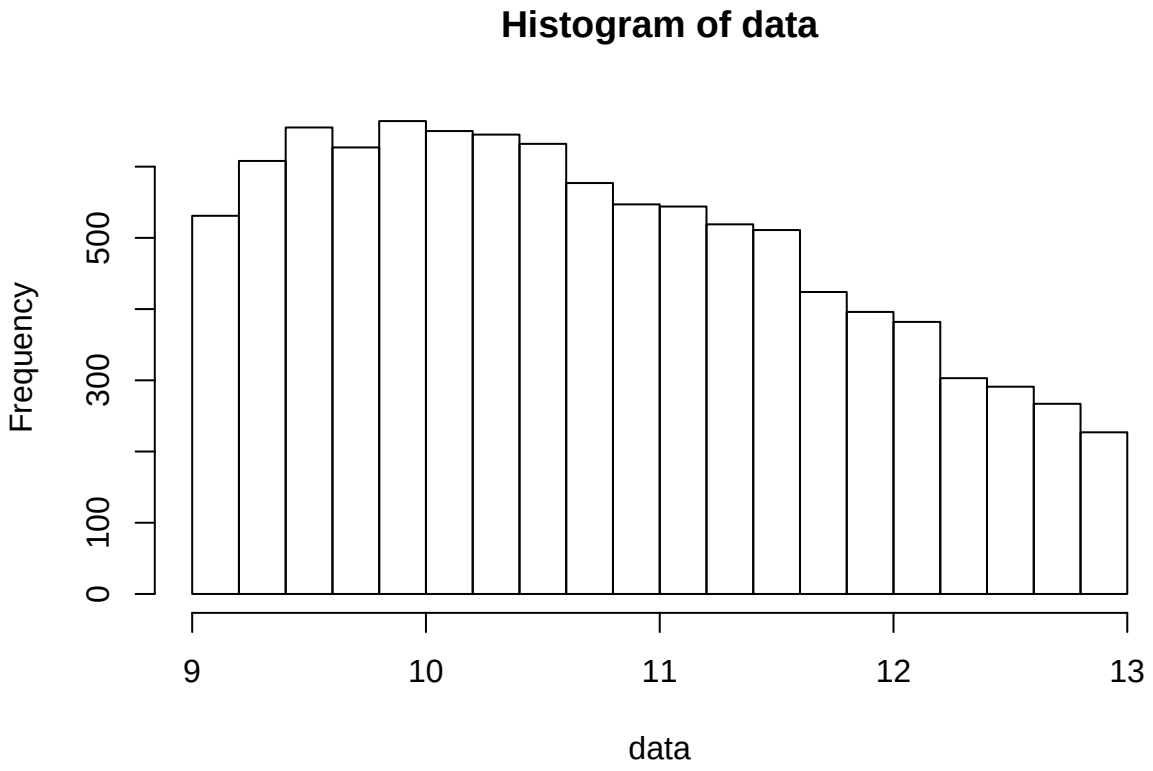
```
posterior <- dinvgamma(x, shape = alpha_new, scale = beta_new)

## Plot the prior and posterior densities

plot(x, prior, type = "l", xlab = expression(lambda), ylab = "",
     ylim = range(c(prior, posterior)))
lines(x, posterior, col = 2)
legend("topleft", lty = rep(1, 2), col = 1:2,
       legend = c("Prior", "Posterior"), bty = "n")
```



The data updates my knowledge towards reducing the mean and the variance because the data have smaller average time between earthquakes and smaller variance.

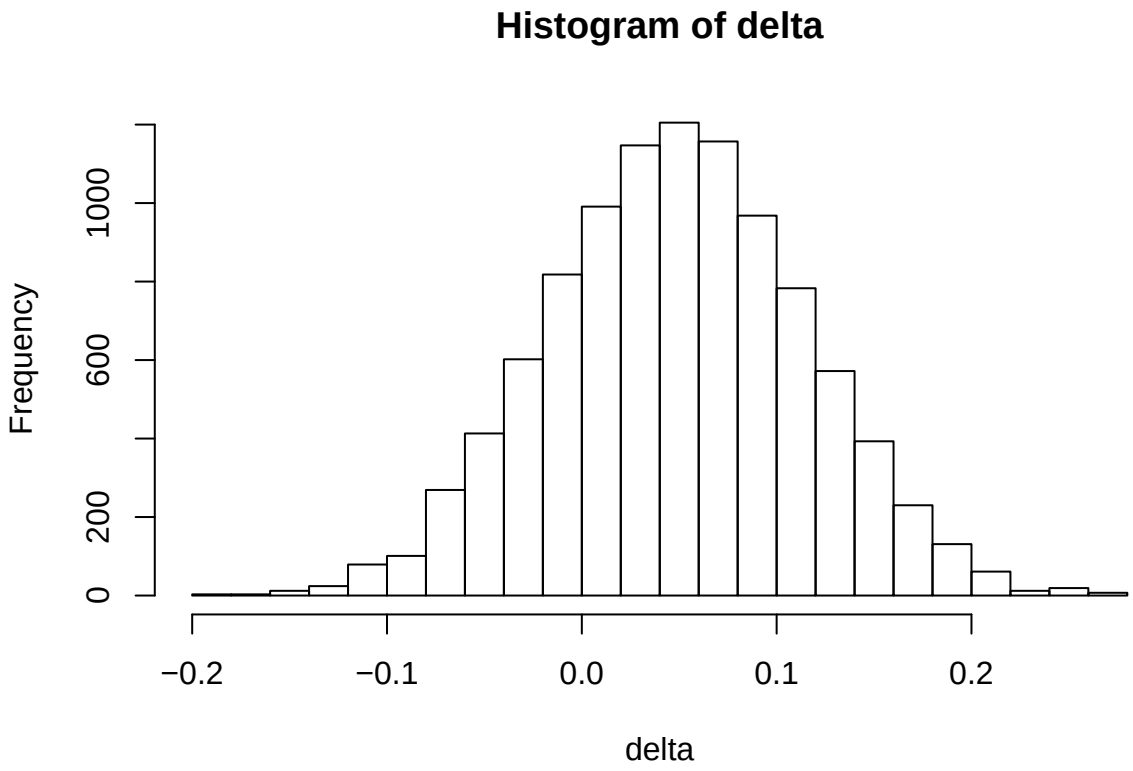
Problem 5c

```
N = 10000

mu = 10
sigma2 = 4
alpha = 9
beta = 13

data = rep(0, 1000)
i = 1
while (i <= N) {
  x = rnorm(1, mean = mu, sd = sigma2 ^ 0.5)
  if (x > alpha & x < beta) {
    data[i] = x
    i = i + 1
  }
}

hist(data, breaks = 20)
```



Problem 6b

```
N = 10000
p1 = rbeta(N, shape1 = 34, shape2 = 68)
p2 = rbeta(N, shape1 = 39, shape2 = 63)
delta = p2 - p1
hist(delta, breaks = 20)
```



Problem 6c

```
# Posterior probability that delta > 0.04
p = sum(delta > 0.04) / N
p
```

```
## [1] 0.5538
```