# Bayes

December 9, 2018

```
In [30]: # BAYESIAN ESTIMATION ASSIGNMENT
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         library(Rlab)
         library(actuar)
         library(tidyverse)
         par(mfrow = c(2,1))
```

## 0.1 Binomial Distribution

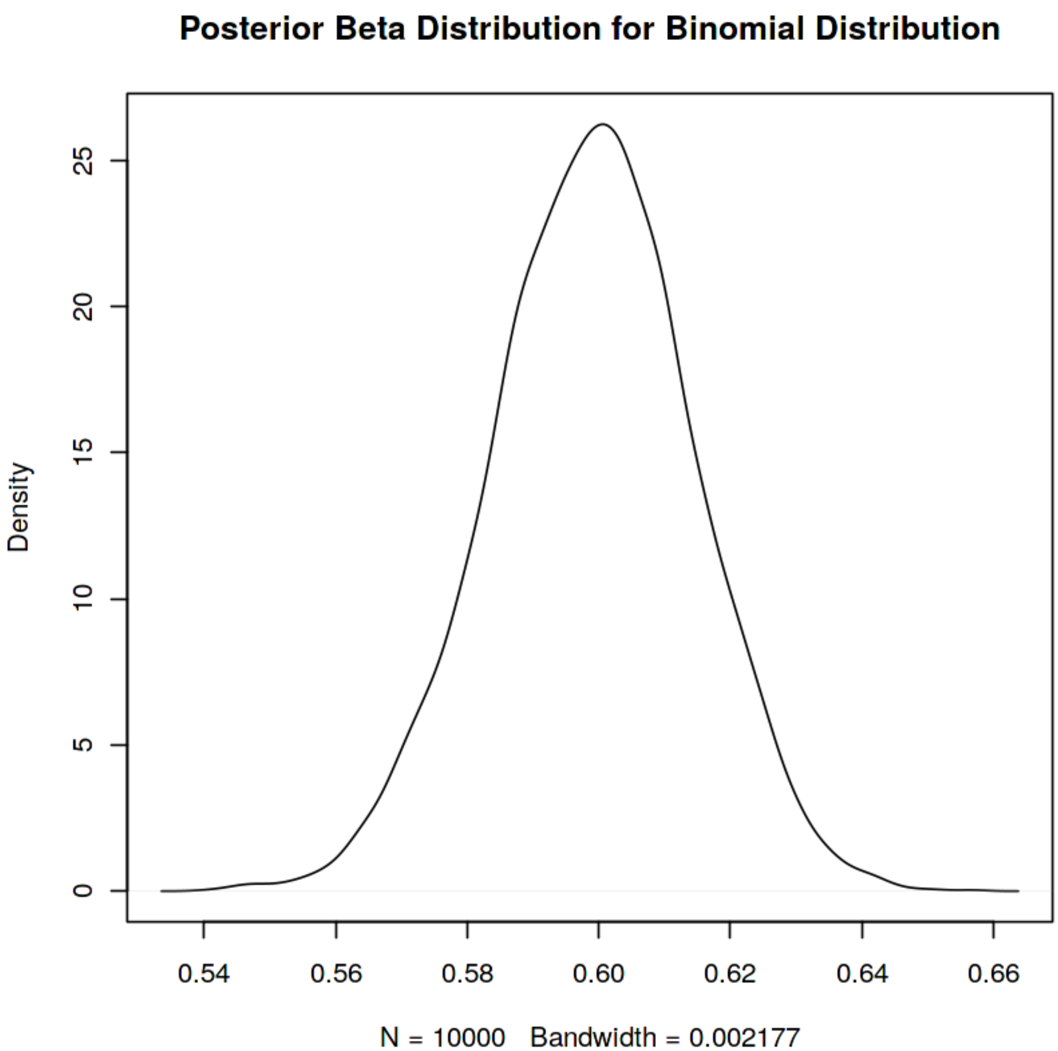
```
In [31]: sample <- rbinom(n = 1000, size = 1, prob = 0.6)

         # Assuming alpha and beta for the prior distribution to be 1
         prior_alpha <- 1
         prior_beta <- 1
         r <- 1

         # Getting the posterior distribution parameters
         posterior_alpha <- prior_alpha + sum(sample)
         posterior_beta <- prior_beta + r*length(sample) - sum(sample)
         print("The parameters of the posterior beta distribution are:")
         print(c(posterior_alpha, posterior_beta))

         posterior_distribution_sample <- rbeta(n = 10000, shape1 = posterior_alpha,
                                                shape2 = posterior_beta)
         plot(density(posterior_distribution_sample), main = "Posterior Beta
                                             Distribution for Binomial Distribution")
```

```
[1] "The parameters of the posterior beta distribution are:"
[1] 600 402
```




## 0.2 Poisson Distribution

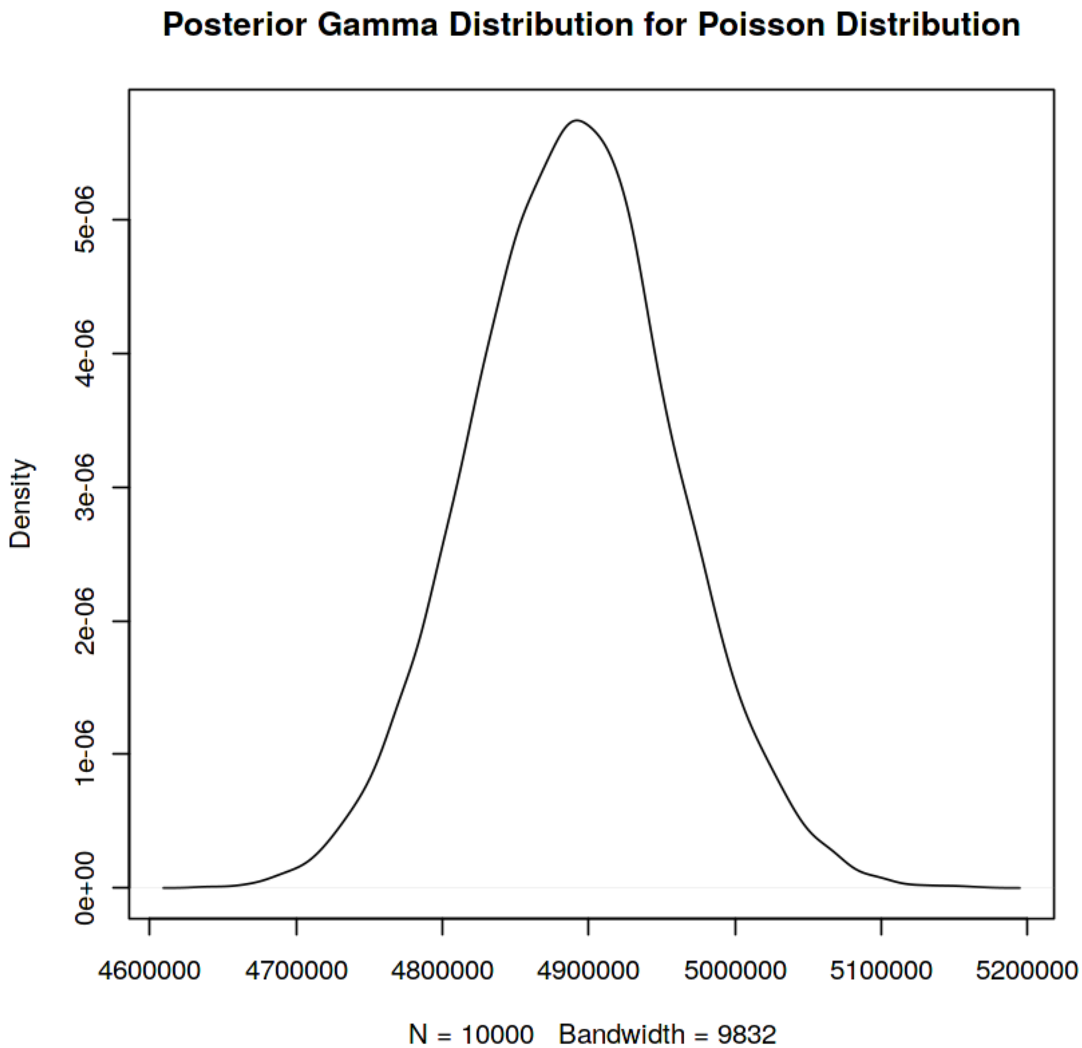
In [32]:
```
sample <- rpois(n = 1000, lambda = 5)

# Assuming alpha and beta for the prior distribution to be 1
prior_alpha <- 1
prior_beta <- 1

# Getting the posterior distribution parameters
posterior_alpha <- prior_alpha + sum(sample)
posterior_beta <- 1/(1/prior_beta + length(sample))
print("The parameters of the posterior gamma distribution are:")
print(c(posterior_alpha, posterior_beta))
```

```
        posterior_distribution_sample <- rgamma(n = 10000, posterior_alpha, posterior_beta)
        plot(density(posterior_distribution_sample), main = "Posterior Gamma Distribution
                                                            for Poisson Distribution")
```

```
[1] "The parameters of the posterior gamma distribution are:"
[1] 4.88300e+03 9.99001e-04
```




### 0.3 Uniform Distribution

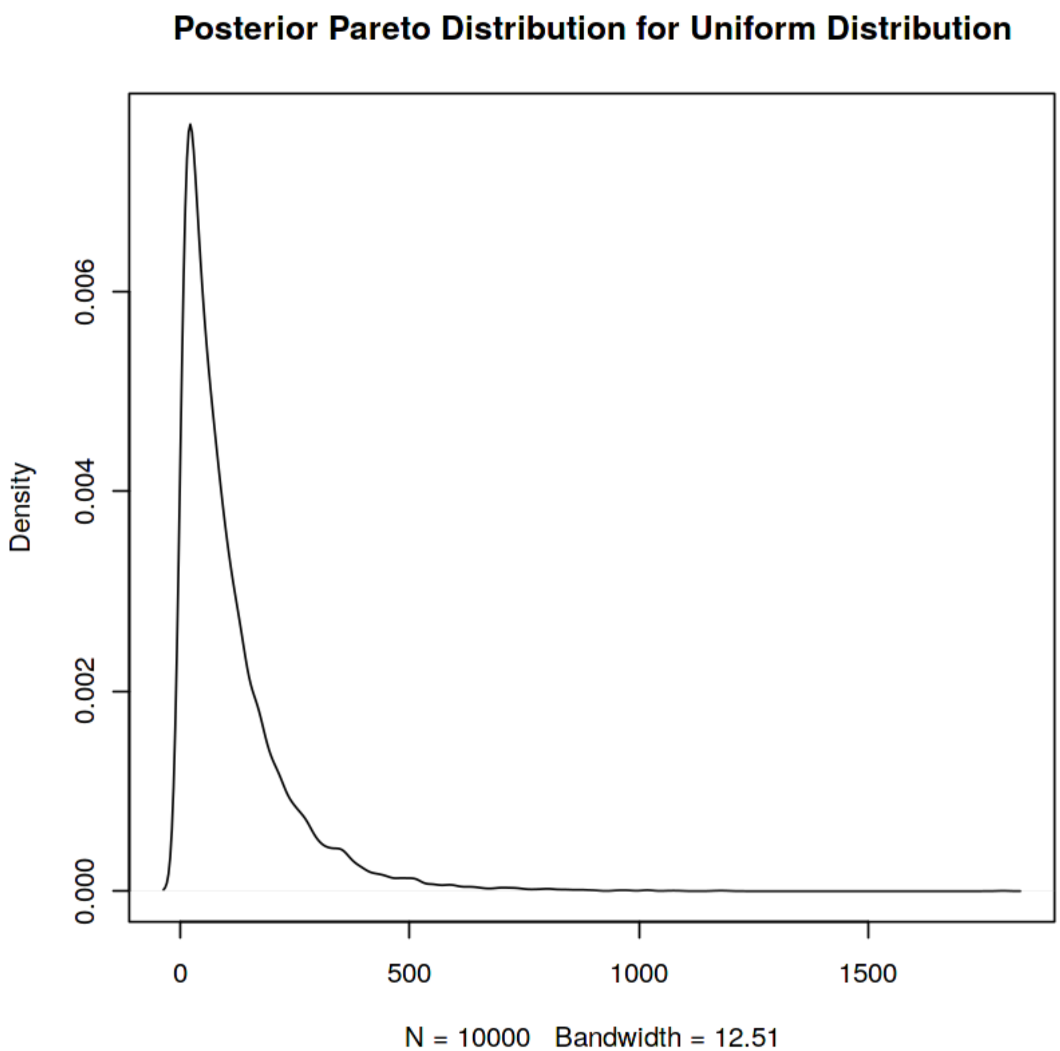
```
In [33]: sample <- runif(n = 1000, min = 0, max = 10)
```

```r
# Assuming alpha and beta for the prior distribution to be 1
prior_w0 <- 1
prior_alpha <- 1

# Getting the posterior distribution parameters
posterior_w0 <- max(c(prior_w0, sample))
posterior_alpha <- prior_alpha + length(sample)
print("The parameters of the posterior pareto distribution are:")
print(c(posterior_w0, posterior_alpha))

posterior_distribution_sample <- rpareto(n = 10000, posterior_w0, posterior_alpha)
plot(density(posterior_distribution_sample), main = "Posterior Pareto Distribution
                                                    for Uniform Distribution")
```

```
[1] "The parameters of the posterior pareto distribution are:"
[1]    9.993898 1001.000000
```




## 0.4 Normal Distribution

In [ ]:
```
sample <- rnorm(n = 1000, mean = 10, sd = 20)

# Assuming alpha and beta for the prior distribution to be 1
r <- 1
tau <- 5
mu <- 4
prior_alpha <- 1
prior_beta <- 2

# Getting the posterior distribution parameters
M_conditional_distribution_mu <- (tau*mu + length(sample)*mean(sample))
```

```
                                                /(tau + length(sample))
M_conditional_distribution_precision <- (tau + length(sample))*r
print("The parameters of the conditional posterior normal distribution
                                                of M when R = r is:")
print(c(M_conditional_distribution_mu,
        M_conditional_distribution_precision))

R_marginal_distribution_alpha <- prior_alpha + length(sample)/2
R_marginal_distribution_beta <- 1/(1/prior_beta +
                                1/2*(sum((sample - mean(sample))**2)))
                                + tau*length(sample)*
                                ((mean(sample) - mu)**2)
                                /2*(tau + length(sample))
print("The parameters of the marginal posterior gamma distribution of
                                                                R is:")
print(c(R_marginal_distribution_alpha, R_marginal_distribution_beta))

# Generate the distibutions
conditional_joint_distribution_of_M <- rnorm(n = 10000,
                            mean = M_conditional_distribution_mu,
                            1/sqrt(M_conditional_distribution_precision))
marginal_joint_distribution_of_R <- rgamma(n = 10000,
                                        R_marginal_distribution_alpha,
                                        R_marginal_distribution_beta)

plot(density(conditional_joint_distribution_of_M),
     main = "Conditional Joint Probability Distribution for Mean M")
plot(density(marginal_joint_distribution_of_R),
     main = "Marginal Joint Probability Distribution for Precision R")
```

```
[1] "The parameters of the conditional posterior normal distribution of M when R = r is:"
[1]    9.88799 1005.00000
[1] "The parameters of the marginal posterior gamma distribution of R is:"
[1]      501 87977656
```

## 0.5 Exponential Distribution

In [36]:
```
sample <- rexp(n = 1000, rate = 10)

# Assuming alpha and beta for the prior distribution to be 1
prior_alpha <- 1
prior_beta <- 1

# Getting the posterior distribution parameters
posterior_alpha <- prior_alpha + length(sample)
posterior_beta <- 1/(1/prior_beta + sum(sample))
print("The parameters of the posterior gamma distribution are:")
```

```r
print(c(posterior_alpha, posterior_beta))

posterior_distribution_sample <- rgamma(n = 10000, posterior_alpha, posterior_beta)
plot(density(posterior_distribution_sample), main = "Posterior Gamma Distribution
                                                       for Exponential Distribution")
```

```
[1] "The parameters of the posterior gamma distribution are:"
[1] 1.001000e+03 1.005551e-02
```