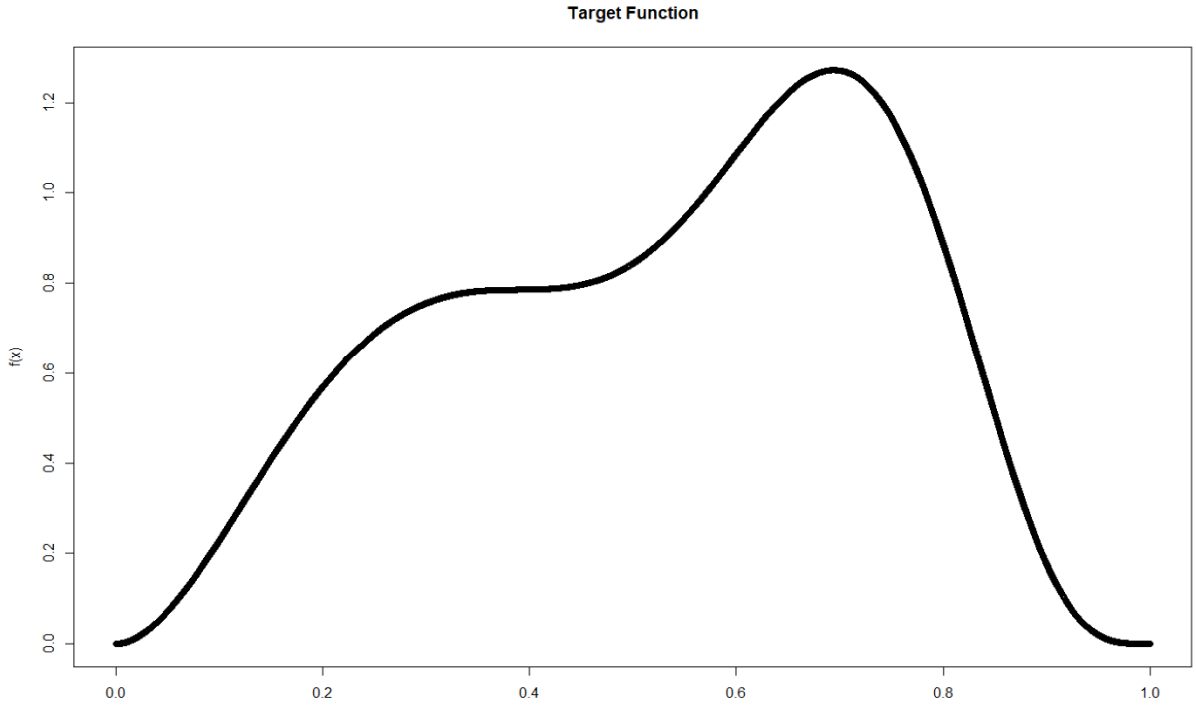
Assignment 2

1. Plot the density $f(x)$.

Given original function f(x) = $\frac{1}{3}$ Be($\alpha_1 = 0, \beta_1 = 5$) + $\frac{1}{3}$ Be($\alpha_2 = 3, \beta_2 = 5$) + $\frac{1}{3}$ Be($\alpha_3 = 11, \beta_3 = 3$)

The probability density graph of this function is



Mode of the target distribution = = 0.6942694

Mean of the target distribution = 0.3517807

2. Implement an accept/reject algorithm, with $Unif(0,1)$ proposal distribution.

```
#ACCEPTANCE AND REJECTION ALGORITHM
n = 10000
theta = runif(n)
asd=runif(n,0,0.33*dbeta(K,0,5)+0.33*dbeta(K,3,5)+0.33*dbeta(K,11,5))
qwe= asd<0.33*dbeta(theta,0,5)+0.33*dbeta(theta,3,5)+0.33*dbeta(theta,11,5)
sum(qwe ==T)/n
mean(theta[qwe])
```

The value of K = 0.6942694

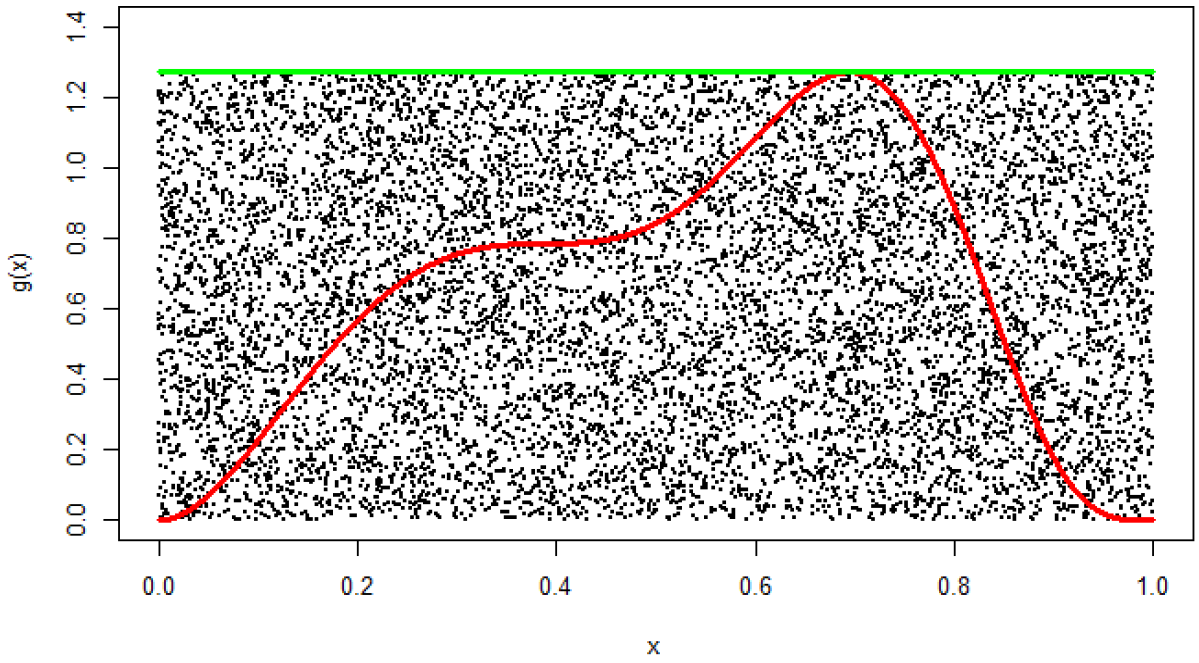
3. Compute the observed acceptance rate and compare it with the theoretical o ne

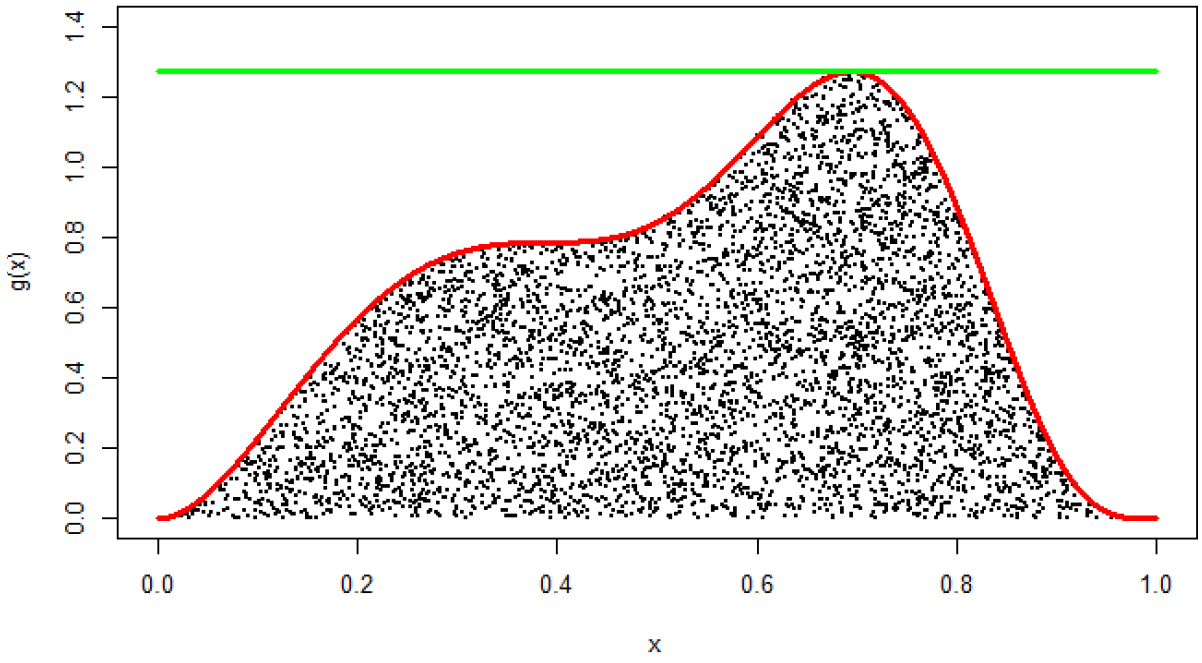
The theoretical acceptance probability or rate = 0.7859938
The observed acceptance probability or rate = 0.5166
The mean of this accept/reject algorithm = 0.5348017

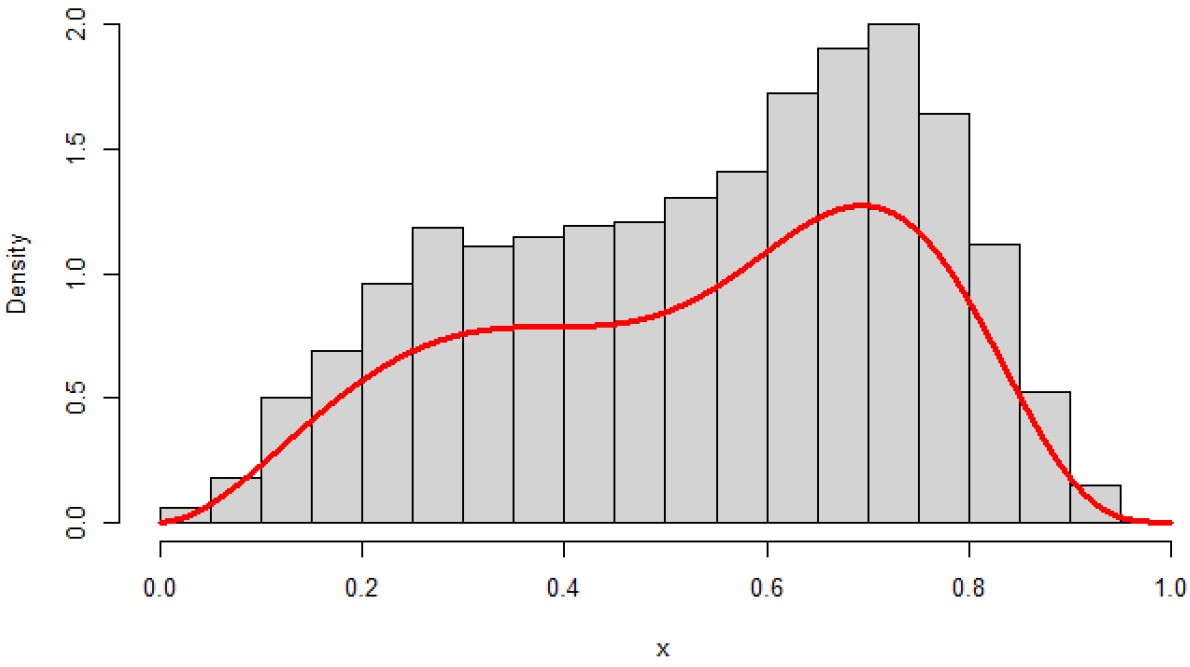
4. Implement an importance sampling algorithm.

```
#IMPORTANCE SAMPLING
w = 0.33*dbeta(K,0,5)+0.33*dbeta(K,3,5)+0.33*dbeta(K,11,5)/dunif(theta)
wmean = sum(w*theta)/sum(w)
zxc = w/sum(w)
wmean
```

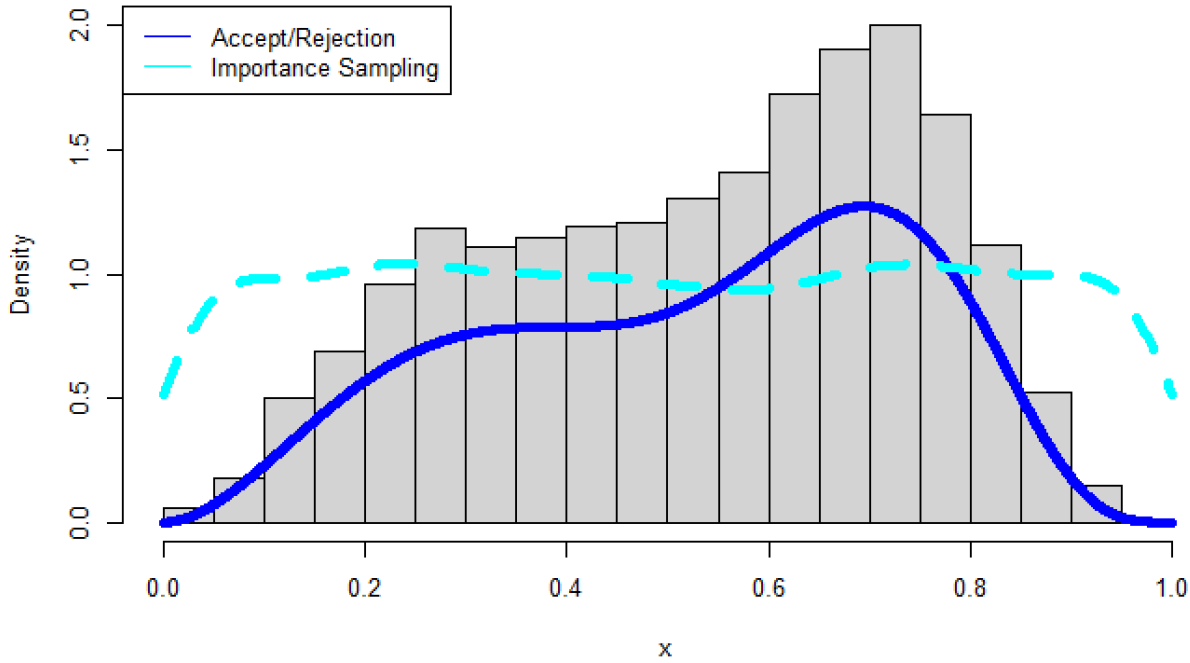
The mean of the importance sampling = 0.5032358







5. Compare on the same plot the target density, the density of the accepted values for the accept/reject algorithm, and the density of the values weighted by importance sampling.



6. Which of the two algorithms seems to approximate the target distribution better? Which one you would use and why?

From the graph above it can be seen that the acceptance/ rejection algorithm approximates the target function better than the importance sampling algorithm. Although both the algorithms have approximately similar mean values, the observed acceptance rate generated by the monte

Carlo simulations simulate the target function better. This is because the trendline generated from the acceptance/ rejection algorithm if following the same trend of distribution of probability density as shown by the histogram in the same graph