Stastical Inference Assignment

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Part 1: Simulation Exercise

In this project you will investigate the exponential distribution in R and compare it with the Central Limit Theorem. The exponential distribution can be simulated in R with rexp(n, lambda) where lambda is the rate parameter. The mean of exponential distribution is 1/lambda and the standard deviation is also 1/lambda. Set lambda = 0.2 for all of the simulations. You will investigate the distribution of averages of 40 exponentials. Note that you will need to do a thousand simulations.

```
library(ggplot2)
library(tinytex)
set.seed(1234)
lambda <- 0.2
n <- 40
sim_data <- replicate(1000,rexp(n,lambda))
mean_sim_data <- apply(sim_data, 2, mean)
```

Mean Comparision

Sample Mean vs Theoretical Mean of the Distribution

```
#Finding the sample Mean

sampleMean <- mean(mean_sim_data)
print(paste("Sample Mean = ",sampleMean))
```

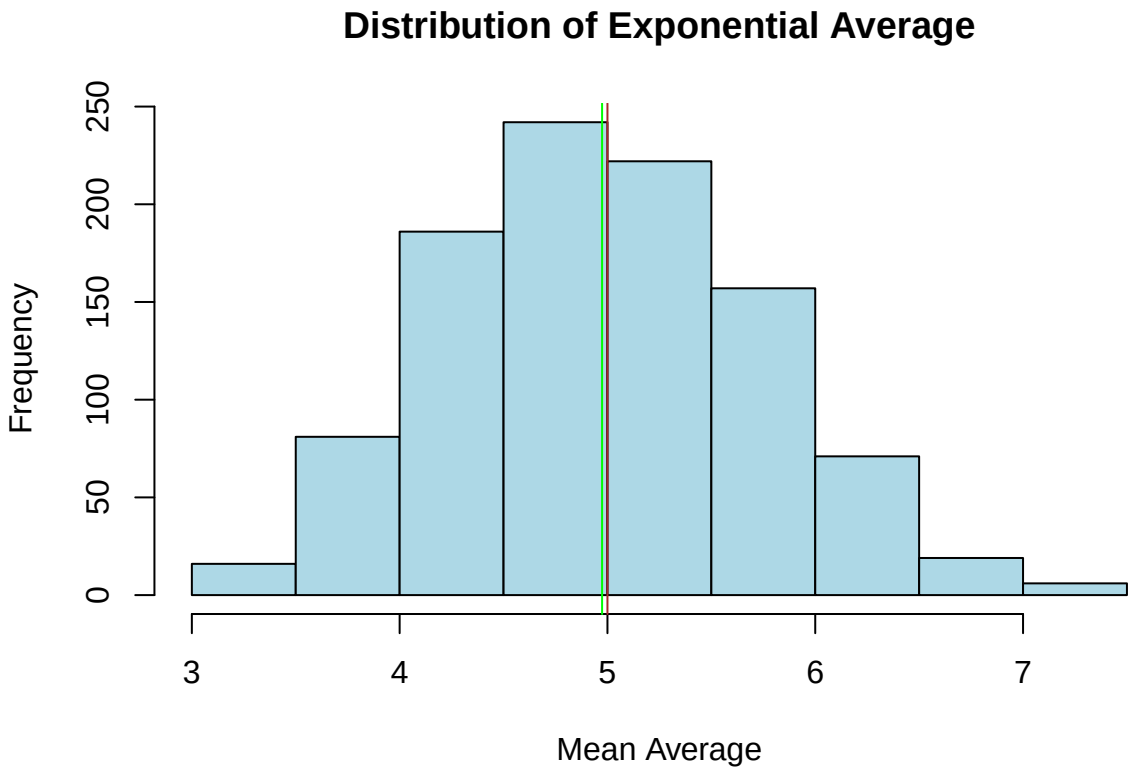
```
## [1] "Sample Mean =  4.97423877125153"
```

```
# Theoretical Mean
theoretical_mean <- (1/lambda)

print(paste("Theoretical Mean = ",theoretical_mean))
```

```
## [1] "Theoretical Mean =  5"
```

Histogram shows difference



Question 2: Show how variable the sample is (via variance) and compare it to the theoretical variance of the distribution

Calculating the theoretical and sample variance

```
# sample deviation & variance
sample_dev <- sd(mean_sim_data)
sample_dev
```

```
## [1] 0.7554171
```

```
sample_variance <- sample_dev^2
sample_variance
```

```
## [1] 0.5706551
```

```
# theoretical deviation & variance
theoretical_dev <- (1/lambda)/sqrt(n)
theoretical_dev
```

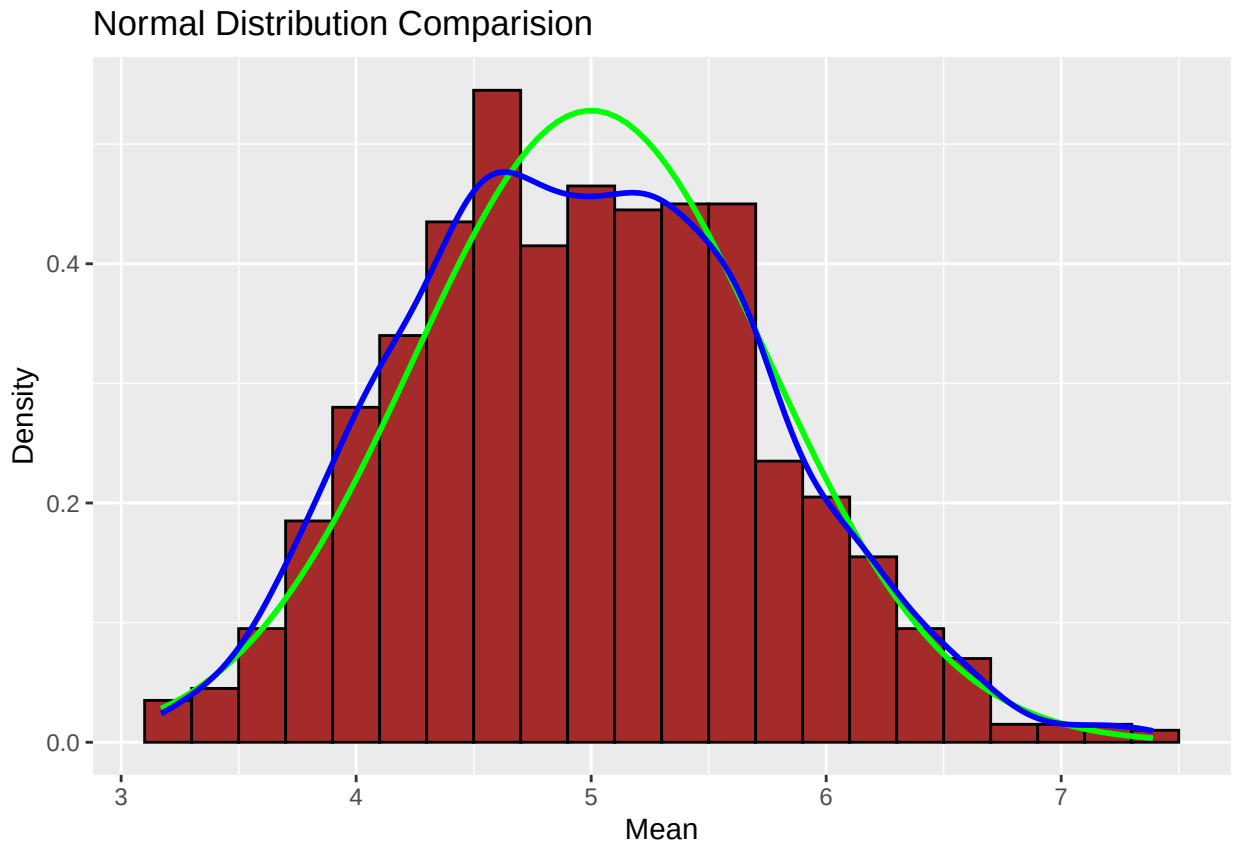
```
## [1] 0.7905694
```

```
theoretical_variance <- ((1/lambda)*(1/sqrt(n)))^2
theoretical_variance
```

```
## [1] 0.625
```

Question 3: Show that the distribution is approximately normal Histogram with Density and sample means:

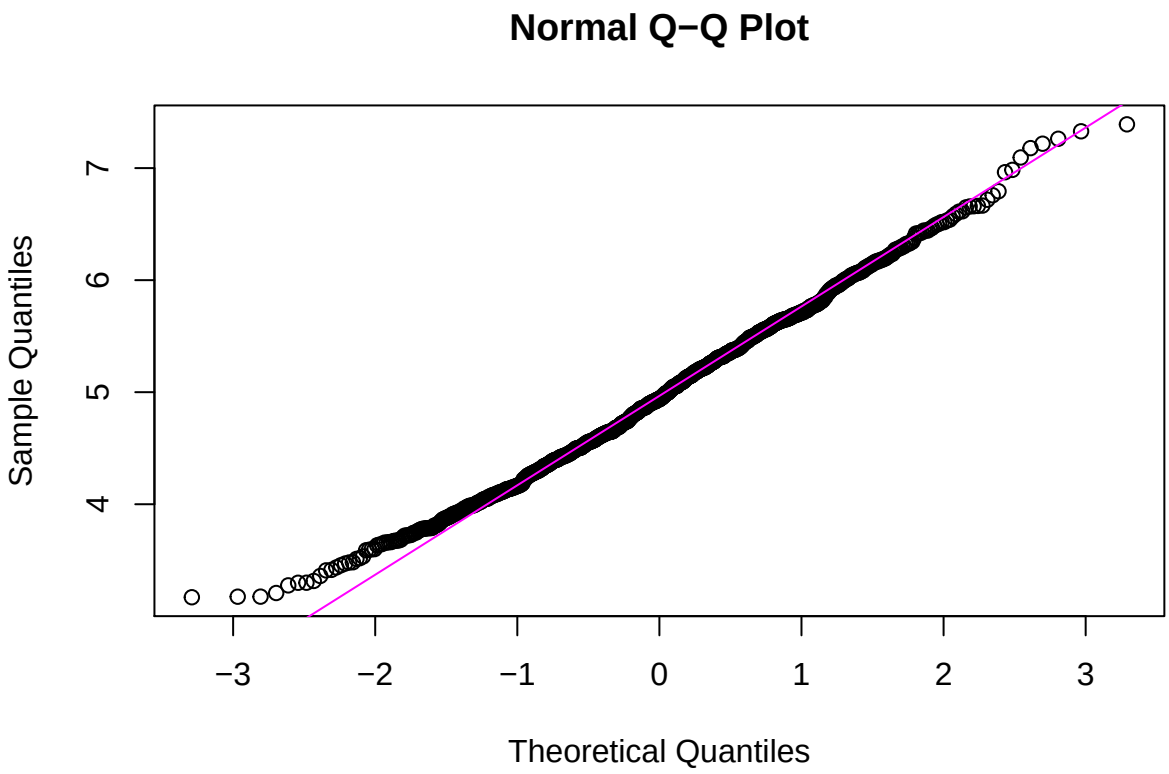
```
d <- data.frame(mean_sim_data)
t <- data.frame(theoretical_mean)
g <- ggplot(d, aes(x = mean_sim_data)) +
geom_histogram(binwidth = .2, color="black", fill="brown" , aes(y=..density..))+stat_function(fun=dnorm
g
```



The above plot indicated that density curve is similar to normal distribution curve.

Q-Q Normal Plot also indicates the normal distribution

```
qqnorm(mean_sim_data)
 qqline(mean_sim_data, col = "magenta")
```


Normal Q−Q Plot
Sample Quantiles
Theoretical Quantiles
4
5
6
7
−3
−2
−1
0
1
2
3