# Statistical Inference Project Part 1

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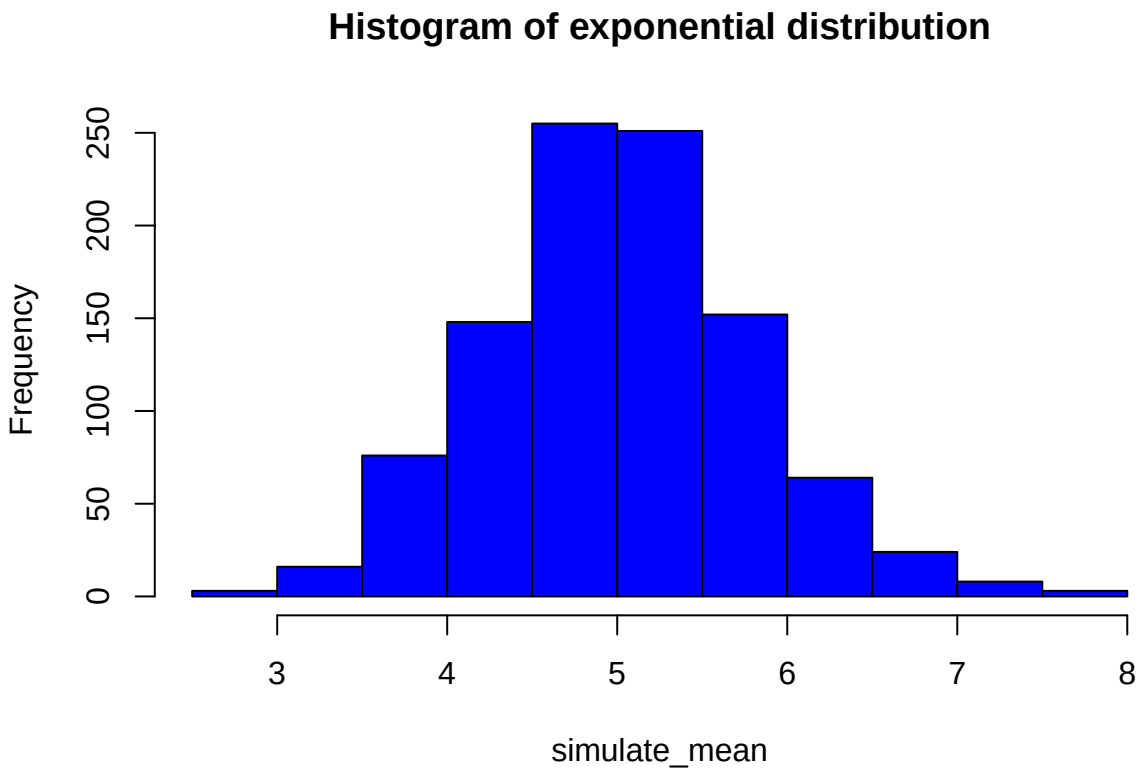
This project will investigate the exponential distribution in R and compare it with the Central Limit Theorem. The exponential distribution function is rexp(n,lambda) and lambda is the rate parameter.The mean of exponential distribution is 1/lambda and the standard deviation is also 1/lambda. Set lambda = 0.2 for all of the simulations.

The simulation shown below in R used to calculate the mean:

```
lambda = 0.2
n = 40
nsims = 1000
set.seed(240)
## Theoretical values
theo_mean <- 1/lambda
theo_sigma <- 1/lambda /sqrt(n)
```

```
simulate_matrix <- matrix(rexp(nsims * n, rate=lambda), nsims, n)
simulate_mean <- rowMeans(simulate_matrix)
```

The simulation matrix data is shown below for expoloration



## Comparison of Sample Mean and Theoretical Mean

```
compare_mean<-mean(simulate_mean)
theo_mean <- 1/lambda
```

```
## Mean value to compare
compare_mean
```

```
## [1] 5.026972
```

```
## Theoretical mean value
theo_mean
```

```
## [1] 5
```

The distribution based on the simulations is 5.026972 and the theoretical mean value is 5. The means are close to the same center of distribution.

## Comparison of Variance for the sample data and Theoretical variance

```
actual_var <- var(simulate_mean)
theo_var <- (1/lambda)^2/n
## Actual variance
actual_var
```

```
## [1] 0.5990234
```

```
## Theoretical variance
theo_var
```

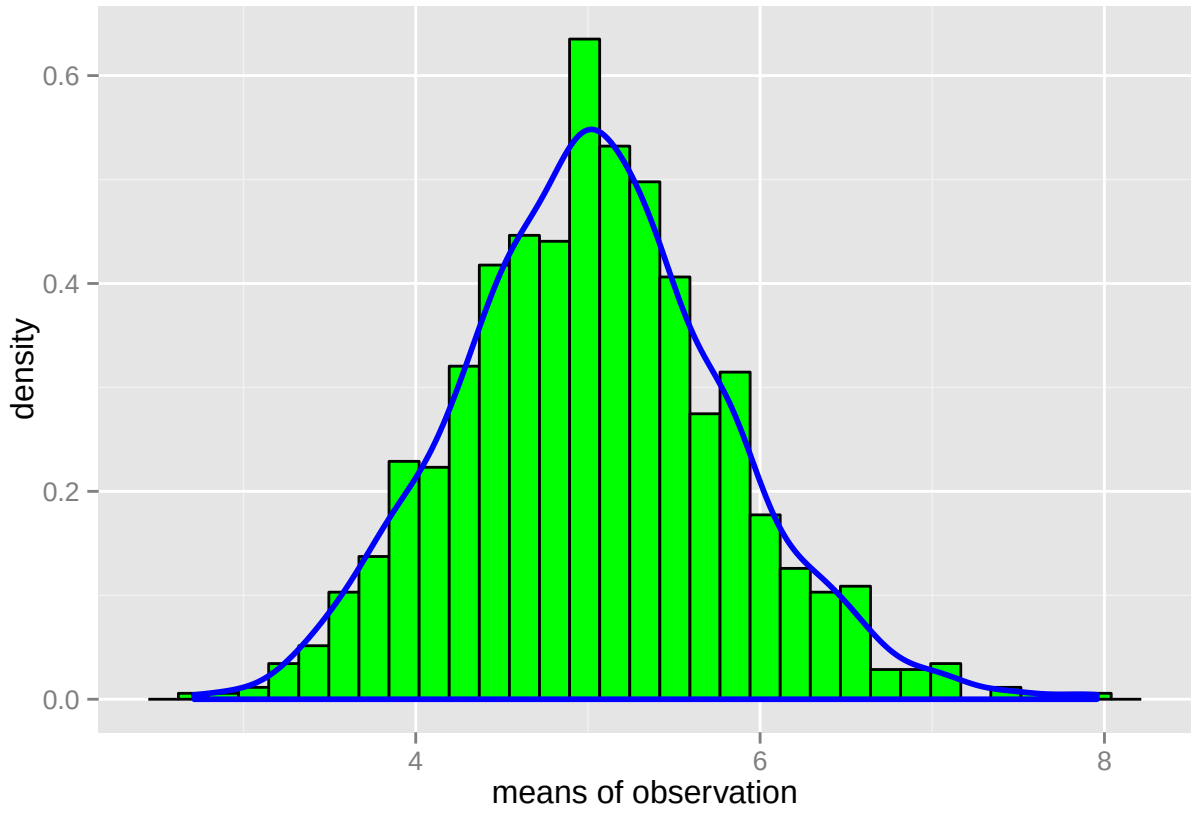
```
## [1] 0.625
```

The actual variance value is .599 and the theoretical variance is .625. The values are close.

## The distribution is approximately normal

The histogram plot of the means of the 1000 simulations of rexp(n, lambda) shown below.

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```




##

The variance and mean of the sample data are similar and resemble a normal distribution. Below is the confidence intervals calculated:

```
actual_interval <- round (mean(simulate_mean) + c(-1,1)*1.96*sd(simulate_mean)/sqrt(n),3)
theory_interval <- theo_mean + c(-1,1)*1.96*sqrt(theo_var)/sqrt(n);

##Actual confidence interval
actual_interval
```

```
## [1] 4.787 5.267
```

```
## Theoretical confidence interval
theory_interval
```

```
## [1] 4.755 5.245
```

Actual 95% confidence interval [4.787, 5.267]. Theoretical 95% confidence interval [4.755, 5.245] This shows the distribution is approximately normal.