

Statistical Inference Project

Overview

This project investigates the Exponential distribution in R and compares it with the Central Limit Theorem. The mean of the Exponential distribution is $\frac{1}{\lambda}$ and the standard deviation is also $\frac{1}{\lambda}$. A thousand simulations of the distribution of 40 exponentials would be investigated.

Simulation

The exponential distribution can be simulated in R with `rexp(n, lambda)`, where `lambda` is the rate parameter and `n` is the number of observations. For the purpose of all the simulations in this project, value of `lambda` is set to 0.2. First we load the `ggplot2` plotting library.

```
library(ggplot2)
```

Then we will initialize the variables

```
lamb <- 0.2  
n <- 1000  
sampsiz<= 40
```

set seed for random variable

```
set.seed(3)
```

create a matrix with 1000 rows and 40 column

```
samp<=Matrix <- matrix(rexp(sampsiz*n , lamb) ,n, sampsiz)
```

We find the means for each simulation

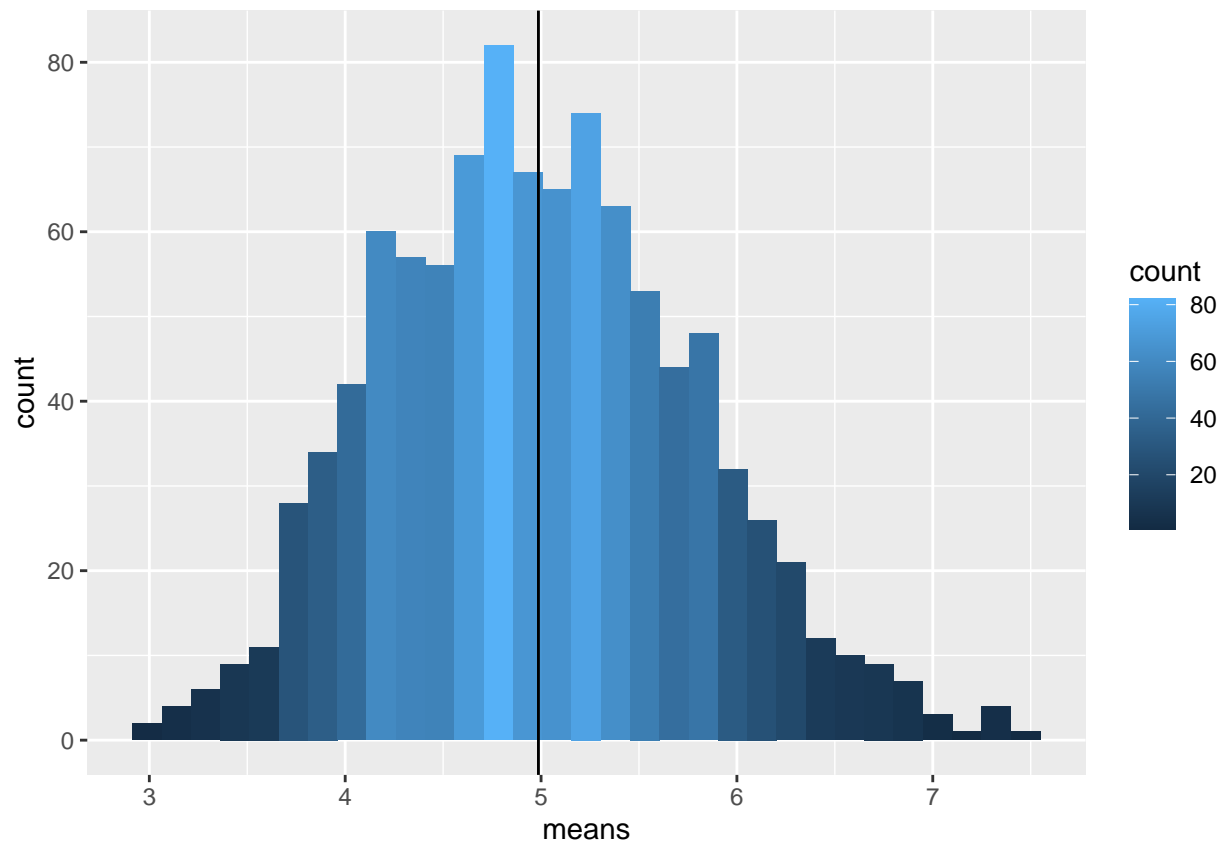
```
means <- apply(samp<=Matrix,1,mean)
```

calculate the simulated data

```
sampleData <- data.frame(cbind(samp<=Matrix,means))
```

plot the simulated means data

```
ggplot(data = sampleData , aes(means)) + geom_histogram(aes(fill=..count..) , bins = round(sqrt(1000),1))
```



```
actualMean <- mean(sampleData$means)
theoreticalMean <- 1/lamb
```

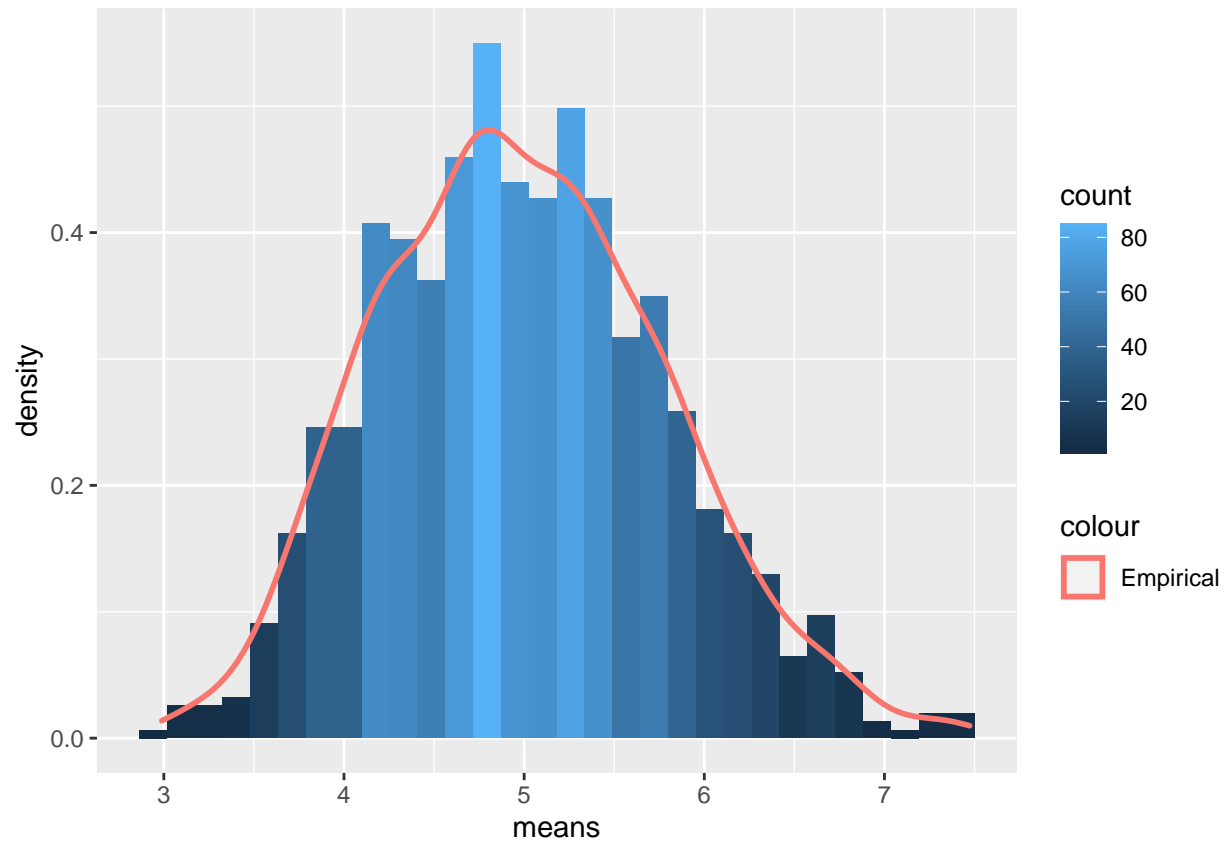
The Actual Mean is 4.9866197

The Theoretical Mean is 5

```
ggplot(data = sampleData , aes(means)) + geom_histogram(aes(y = ..density.. ,fill=..count.. , bins = sq
```

```
## Warning: Ignoring unknown aesthetics: bins
```

```
## 'stat_bin()' using 'bins = 30'. Pick better value with 'binwidth'.
```



as we see it is nearly normal

```
actualVariance <- var(means)
theoreticalVariance <- (1/lamb)^2/40
```

the actual Variance is 0.6257575

the theoretical Variance is 0.625

```
actualConf <- actualMean + c(-1,1)*qnorm(0.95)*sqrt(actualVariance)
theoreticalConf <- theoreticalMean + c(-1,1)*qnorm(0.95)*sqrt(theoreticalVariance)
```

the actual 95% Conf is 3.6854609, 6.2877785 and the theoretical conf is 3.699629, 6.300371