Statistical Inference - Simulation

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Overview

In this project, we will examine whether an exponential distribution is comparable to the Central Limit Theorem. The exponential distribution will simulate 1000 trails with a sample size of 40, while a lambda rate is set to 0.2. As we investigate the distribution of averages, we will conclude whether its comparability satifies the Central Limit Theorem.

Simulations

We are doing a thousand simulations of the average (**means**) of 40 samples drawn from the exponential distribution.

```
sim <- 1000 #number of simulations
lambda <- 0.2 #lambda rate
n <- 40 #number of samples
m_exp <- 1/lambda #exponential mean
sd_exp <- 1/lambda #exponential standard deviation


set.seed(348) #seed for reporoducibility
dat_simulation <- matrix(rexp(n * sim, lambda), sim) #calculation
means <- rowMeans(dat_simulation) #simulation
```

Sample Mean vs. Theoretical Mean

The sample mean or the simulated mean is 5.035, while the theoretical mean is 5. Notice, that this gives us a close estimate of the population mean.

```
## [1] "Sample mean: 5.035"
```

```
## [1] "Theoretical mean: 5"
```

Sample Variance vs. Theoretical Variance

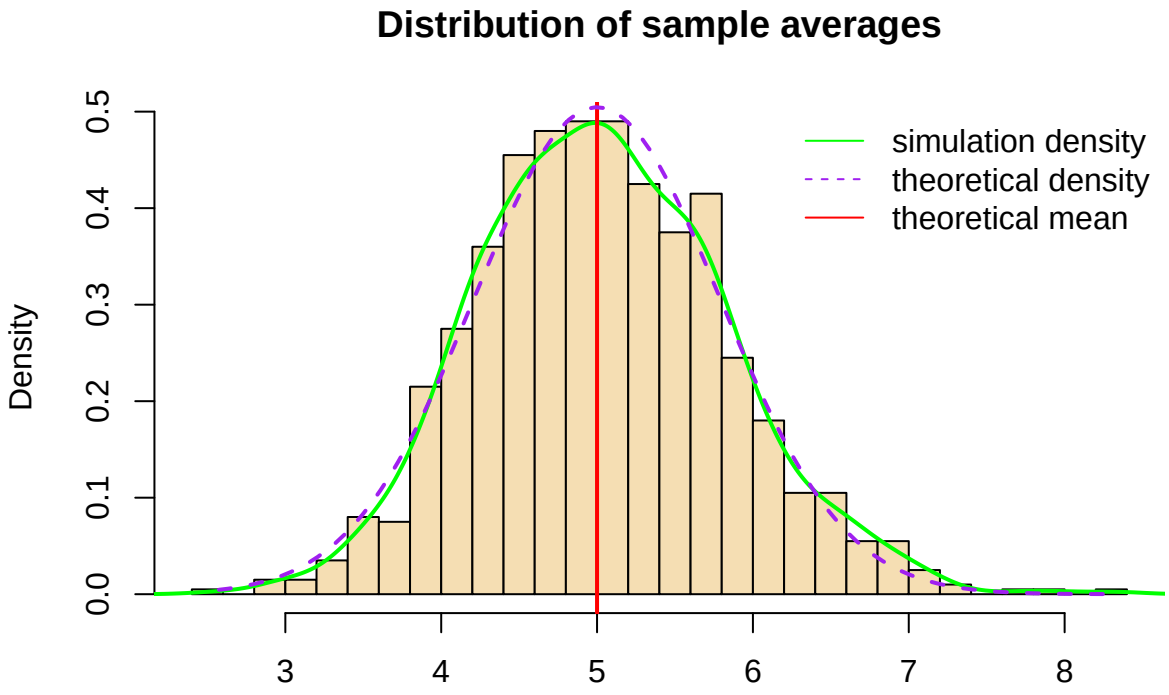
The sample variance or the simulated variance is 0.634, while the theoretical variance is 0.625. Again, these numbers are fairly close.

```
## [1] "Sample variance: 0.634"
```

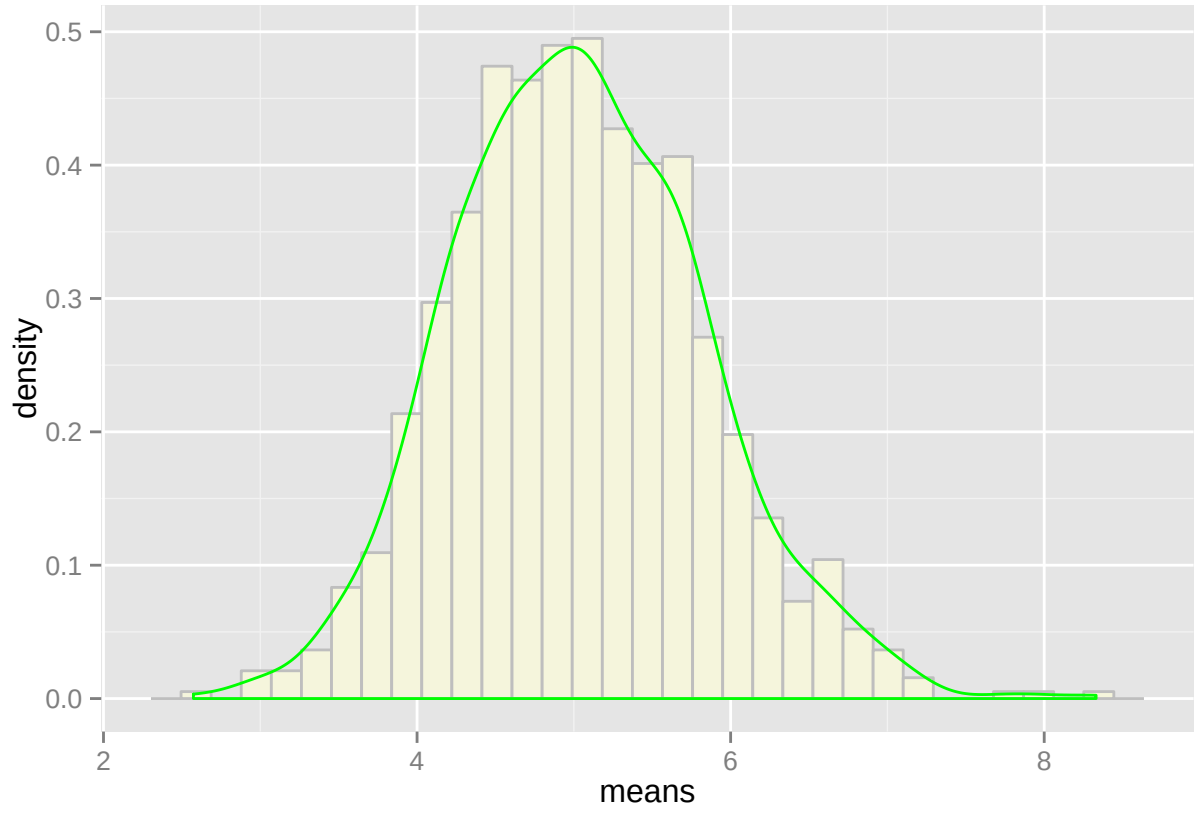
```
## [1] "Theoretical variance: 0.625"
```

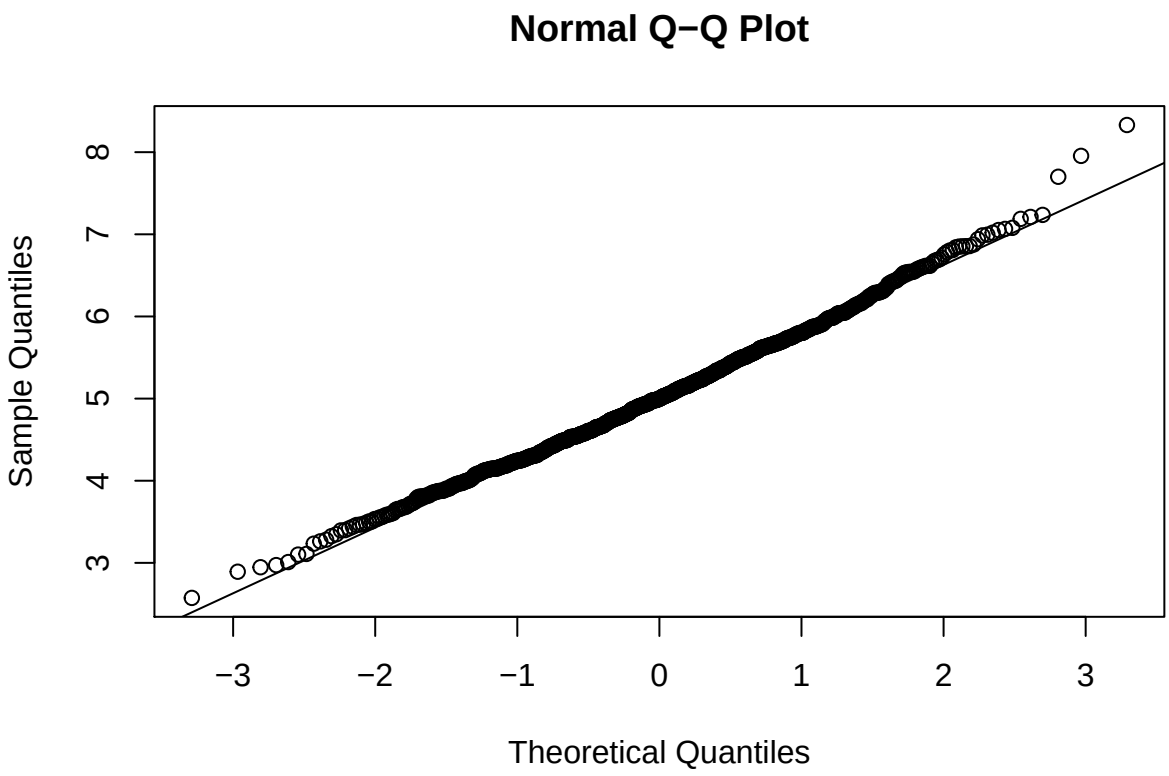
Distribution

The diagrams below showcase the exponential distribution being approximately normal. The Central Limit Theorem tells us that the averages of samples will follow a normal distribution. The two histograms prove the sample density follows a normal distribution. The qqplot double checks whether our simulation is in agreeance with the Central Limit Theorem.




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


0.5
0.4
0.3
0.2
0.1
0.0
density
2
4
6
8
means


Normal Q−Q Plot
Sample Quantiles
3
4
5
6
7
8
−3
−2
−1
0
1
2
3
Theoretical Quantiles