Exponential Distribution vs. Central Limit Theorem

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Overview

This project is comparing the exponential distribution to the Central Limit Theorem. We are first comparing the sample mean to the theoretical mean of the distribution. Second, comparing how variable the sample is (via variance) to the theoretical variance of the distribution. Lastly, showing that the distribution is approximately normal.

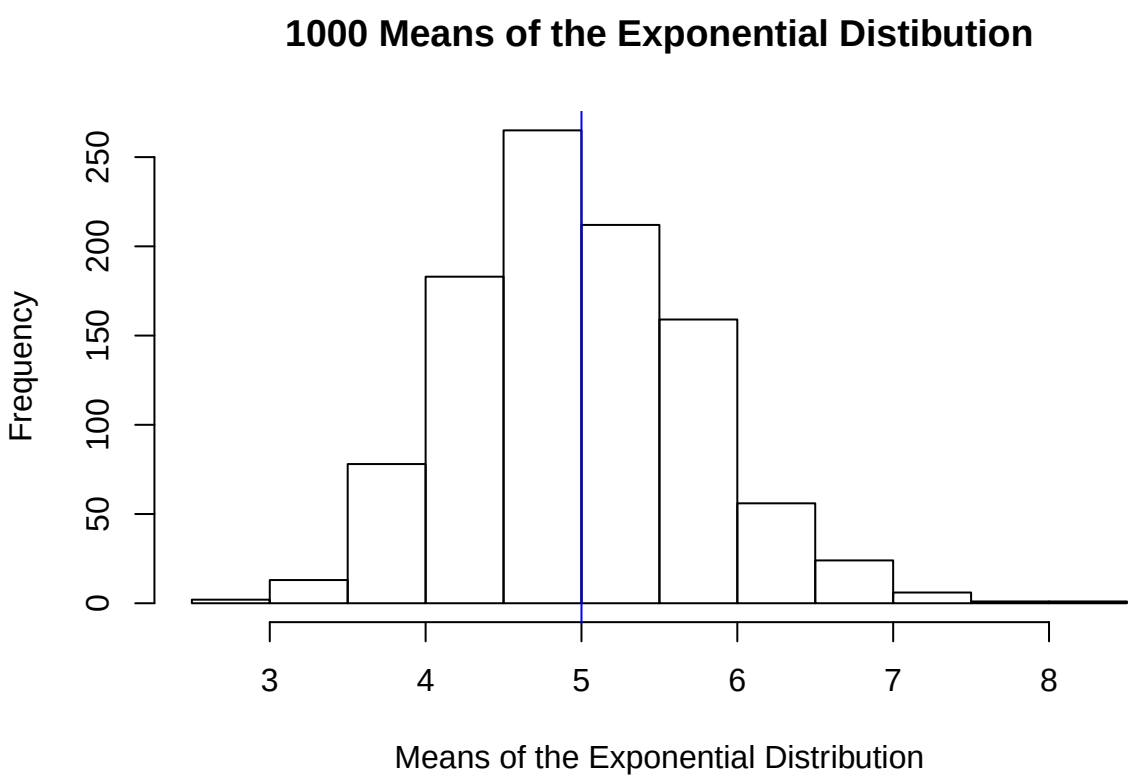
Simulations

The below is the given data for comparison purposes:

```
#Number of exponentials
exps <- 40

#Lambda
lbda <- 0.2

#Simulating the exponential distribution
experiment <- rexp(exps, lbda)

#Finding the mean for the experiment
mean(experiment)
```

```
## [1] 6.05919
```

```
#Set the seed to make sure research is reproducible
set.seed(12345)

#Run experiment 1000 times and run histogram
experiment1k <- replicate(1000, mean(rexp(exps, lbda)))
hist(experiment1k, xlab = "Means of the Exponential Distribution", ylab = "Frequency", main = "1000 Mea

#Theoretical mean and include in histogram
abline(v = 1/lbda, col = "blue")
```




```
#Variance vs Theoretical Variance
variance <- sd(experiment1k)^2
variance
```

```
## [1] 0.5954369
```

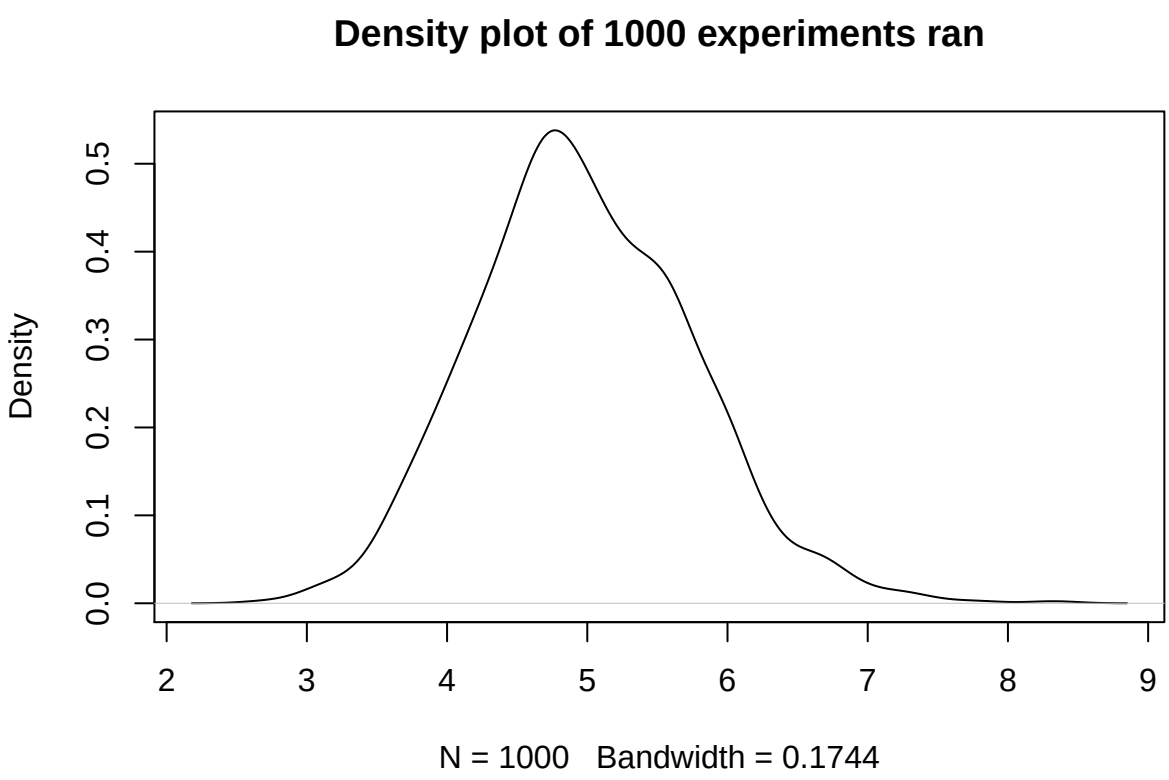
```
theoVar <- (1/(lbda^2))/exps
theoVar
```

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

Both the actual and theoretical variance are close.

Plot of Experiments

```
plot(density(experiment1k), main = "Density plot of 1000 experiments ran")
```



The above density plot is showing where the most values are concentrated over the interval, and showing the shape of the distribution is mostly normal. This density plot does allow for smoothing out some of the noise, but with more experiments ran, the smoother and more normal the plot will become.