Statistical Inference Course Project Part 1

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April 1, 2018

Overview

This report aims to prove that the samples mean and variance, when approaching infinity, will converage on the theoretical mean and the theoretical variance. The formula is lambda*e^(-lambda*x)

Procedure

1000 simulations are run where 40 samples are taken from an exponential distribution. The mean and variance for the 40 samples is calculated and then compared to the theoretical mean and variance. As n increases and goes towards infinity, the Central Limit Theorem that the sample mean and variance should tend to their theoretical counterparts.

```
set.seed(123)
lambda <- 0.2
n  <- 40
sample_means = NULL
sample_variances= NULL
for (i in 1 : 1000) {
        sample_40 <- rexp(n,lambda)
        sample_means <- c(sample_means, mean(sample_40))
        sample_variances <- c(sample_variances, var(sample_40))
}

myMean <- mean(sample_means)
theory_Mean <- 1/lambda
myVar<- mean(sample_variances)
theory_Var <- (1/lambda)^2
myMean
```

```
## [1] 5.011911
```

```
theory_Mean
```

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

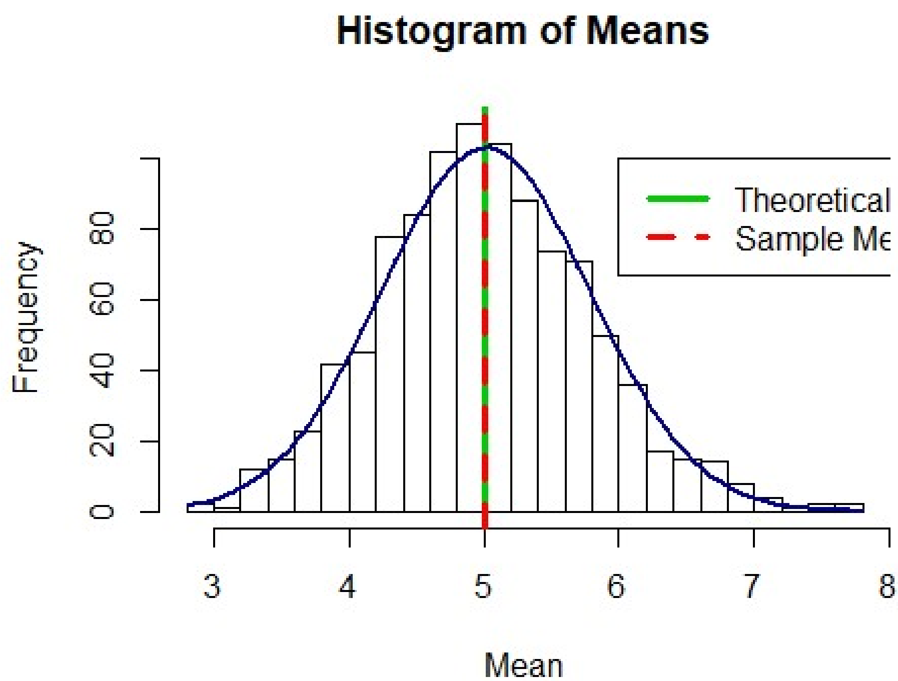
```
myVar
```

```
## [1] 24.84317
```

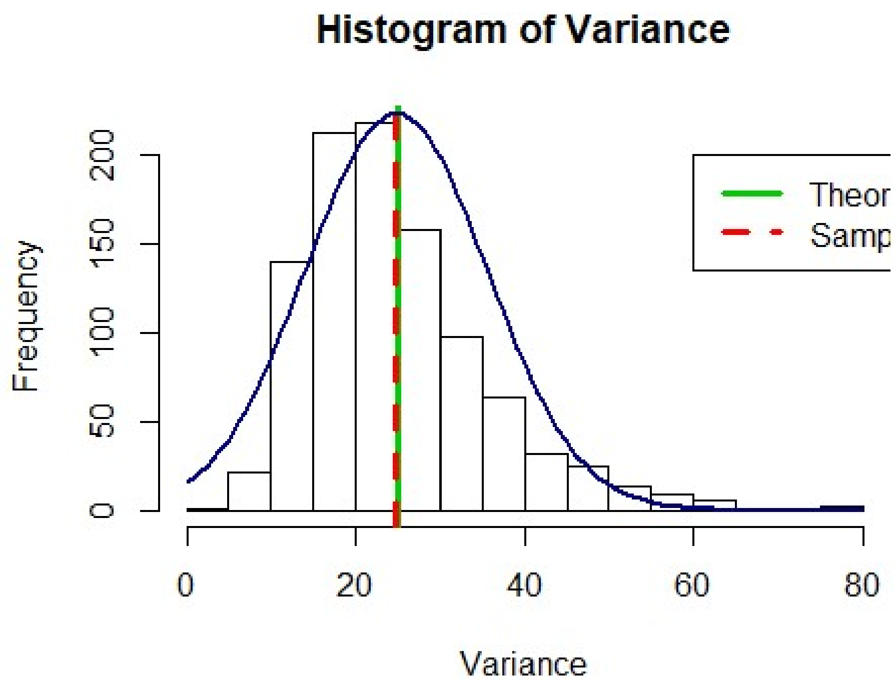
```
theory_Var
```

```
## [1] 25
```

There is a .01 difference between the mean sample mean and the theoretical mean. There is a .16 difference between the mean sample variance and the theoretical variance. Below there plots showing the difference between the mean sample and the theoretical statistics.



Displayed is a histogram of the sample means. Overlayed on top of it is a curve that resemebles a normal distribution.



The sample variances look less normal than the means do but this is mostly likely because the variance cannot be less than 0, thus causing a hard cutoff.

Conclusion

Both graphs show that a sample mean or variance will be normally distributed and adhear to the Central Limit Theorem. Increasing the sample or increase the number of samples to create the mean will draw the sample mean and sample mean variance closer to the theoretical mean for the exponential function.