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Statistical Inference Course Project (Part_1)

Overview

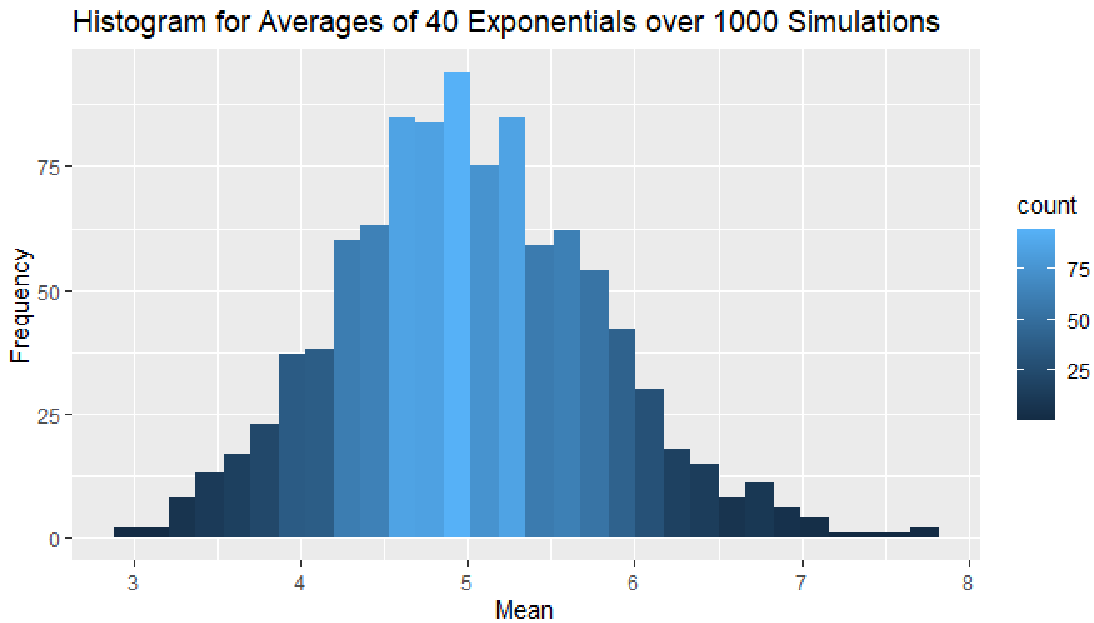
This project will investigate the exponential distribution in R and compare it with the Central Limit Theorem. Given that lambda = 0.2 for all of the simulations. Part 1 of the project will investigate the distribution of averages of 40 exponentials over a thousand simulations.

Simulations

```
# load neccesary libraries
library(ggplot2)
# Using pre-defined parameters
lambda <- 0.2
n <- 40
sims <- 1:1000
set.seed(123)

# Simulate the population
population <- data.frame(x=sapply(sims, function(x) {mean(rexp(n, lambda))}))

# Plot the histogram
hist.pop <- ggplot(population, aes(x=x)) +
  geom_histogram(aes(y=..count.., fill=..count..)) +
  labs(title="Histogram for Averages of 40 Exponentials over 1000
Simulations", y="Frequency", x="Mean")
hist.pop
```



Sample Mean versus Theoretical Mean

The expected mean μ of a exponential distribution of rate λ is

$$\mu = \frac{1}{\lambda}$$

```
theoretical.mean <- 1/lambda
theoretical.mean

## [1] 5
```

Let $\overline{X}$ be the average sample mean of 1000 simulations of 40 randomly sampled exponential distributions.

```
# Tabulating the Sample Mean & Theoretical Mean
sample.mean <- mean(population$x)
cbind(sample.mean, theoretical.mean)

##      sample.mean theoretical.mean
## [1,]    5.011911                5
```

As you can see the expected mean and the avarage sample mean are very close

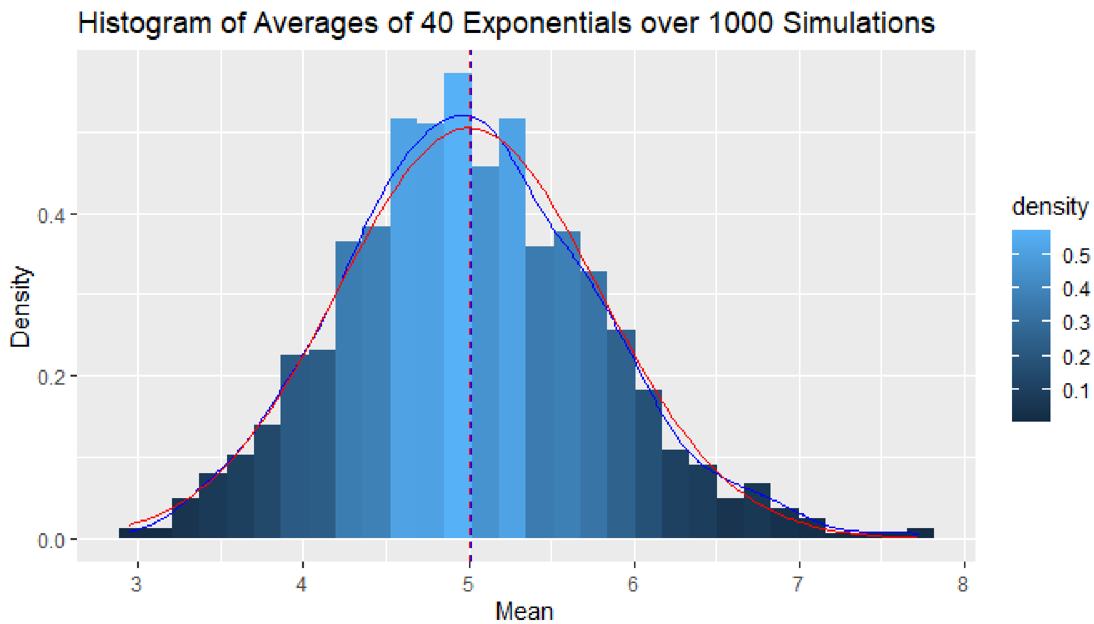
Sample Variance versus Theoretical Variance

```
sample.variance <- var(population$x)
theoretical.variance <- ((1/lambda)^2)/n
cbind(sample.variance, theoretical.variance)

##      sample.variance theoretical.variance
## [1,]       0.6004928                0.625
```

As we can see below both Sample Variance and Theoretical Variance are very close.

Distribution



As we can see, the Sampled mean for 40 exponentials simulated 1000 times are very close to the Theoretical mean for a normal distribution.