Statistical Inference Course Project

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1 Overview

We will investigate the exponential distribution using lambda = 0.2.

2. Setup

Setting up environment

```
# Set the seed
set.seed(1234)

# Packages
library(knitr)
```

3. Simulations

The theoretical mean of the exp distribution

The theoretical mean of the exponential distribution is 1/lamba. For our analysis in which we use lambda = 0.2, this means that the theoretical mean is:

```
# Theoretical mean:
theoreticalmean <- 1/0.2
```

The theoretical standard deviation of exp distribution

The theoretical standard deviation of the exponential distribution is 1/lambda. Here we also use lambda = 0.2, which gives us a theoretical sd of:

```
# Theoretical standard deviation:
theoreticalsd <- 1/0.2

# The theoretical variance:
theoreticalsd^2
```

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

A distribution of single set of 40 random exponentials

```
# Create a vector with 40 random exponentials
single_exp <- rexp(40, 0.2) #0.2 = lambda

# Mean of the exponentials
(single_exp_mean <- mean(single_exp))

## [1] 4.969024

# Variance of the exponentials to the mean
(single_exp_var <- var(single_exp))

## [1] 25.99297

# Standard deviation for the single sample
# Variance of the exponentials to the mean
(single_exp_sd <- sd(single_exp))

## [1] 5.09833
```

Running 1000 simulations

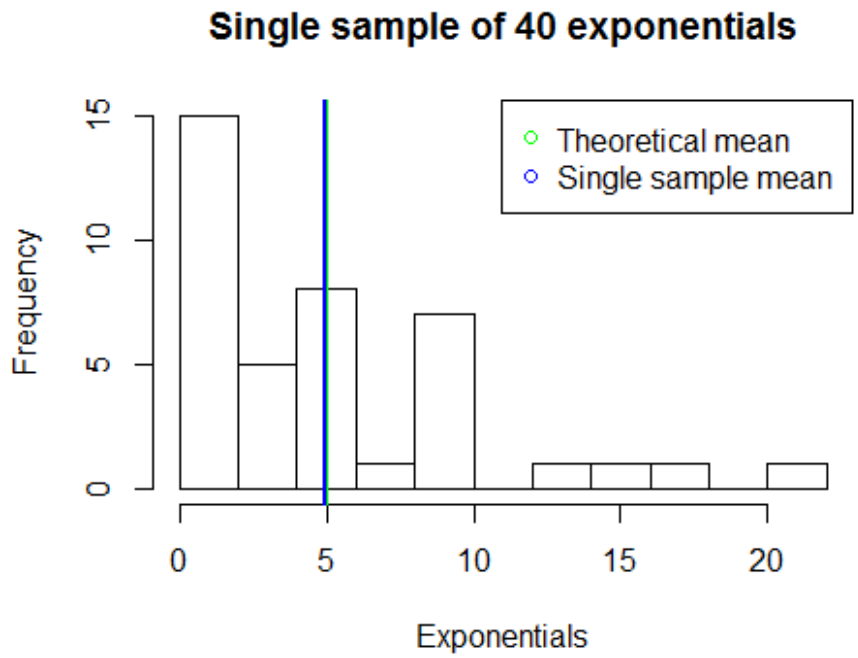
```
# Run 1000 simulations of a vector of 40 random exponentials and
store the mean
sim_exp_means = NULL

for (i in 1 : 1000) sim_exp_means = c(sim_exp_means, mean(rexp(40,
0.2)))

# Mean of the means from the 1000 exponential simulations
(mean_of_sim_exp_means <- mean(sim_exp_means))

## [1] 4.973641
```

4. Sample Mean versus Theoretical Mean

We start by comparing the results of the single sample to the theoretical mean

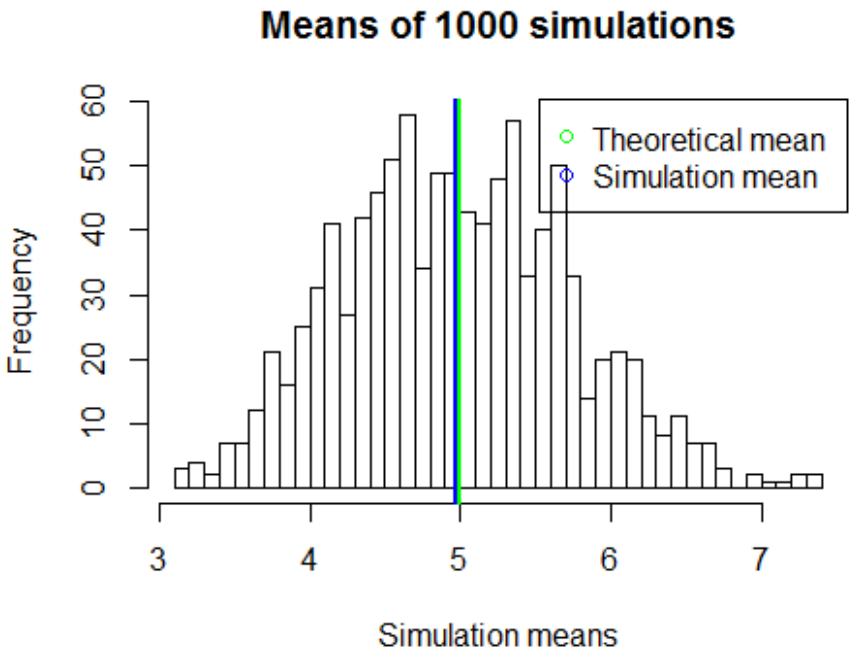
```
hist(single_exp, xlab="Exponentials", main=NULL, breaks=10)
abline(v = theoreticalmean, lwd = 2, col="green")
```

```
abline(v = single_exp_mean, lwd = 2, col="blue")
legend("topright", pch=1, col=c("green", "blue"),
legend=c("Theoretical mean", "Single sample mean"))
title("Single sample of 40 exponentials")
```



We compare the sample means from the 1000 simulations

```
hist(sim_exp_means, xlab="Simulation means", main=NULL, breaks=40)
abline(v = theoreticalmean, lwd = 2, col="green")
abline(v = mean_of_sim_exp_means, lwd = 2, col="blue")
legend("topright", pch=1, col=c("green", "blue"),
legend=c("Theoretical mean", "Simulation mean"))
title("Means of 1000 simulations")
```



From the plot we cannot distinquish the theoretical and the simulation mean. The simulation means is approaching the theoretical mean.

```
#Theoretical mean
theoreticalmean
```

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

```
#Simulation mean
mean_of_sim_exp_means
```

```
## [1] 4.973641
```

5. Sample Variance versus Theoretical Variance

Variance is the square distance from the mean

6. Distribution

Explain how one can tell the distribution is approximately normal.