# STATISTICAL INFERENCE_WEEK 4 PROJECT

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2022-10-05

# Overview

The purpose of this data analysis is to investigate the exponential distribution and compare it to the Central Limit Theorem.

# Simulations

Set the simulation variables

```
ECHO=TRUE
set.seed(1337)
lambda = 0.2
exponentials = 40
```

Run Simulations with variables

```
simMean = NULL
for (i in 1 : 1000) simMean = c(simMean, mean(rexp(exponentials, lambda)))
```

# Sample Mean versus Theoretical Mean

## Sample Mean

Calculating the mean from the simulations

```
mean(simMean)
```

```
## [1] 5.055995
```

## Theoretical Mean

The theoretical mean of an exponential distribution is lambda^-1.

```
lambda^-1
```

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

## Comparison

There is only a slight difference between the simulations sample mean and the exponential distribution theoretical mean.

```
abs(mean(simMean)-lambda^-1)
```

```
## [1] 0.05599526
```

# Sample Variance versus Theoretical Variance

## Sample Variance

Calculating the variance from the simulation means with give the sample variance.

```
var(simMean)
```

```
## [1] 0.6543703
```

## Theoretical Variance

theoretical variance of exponential distribution
(lambda * sqrt(n))^-2.

```
(lambda * sqrt(exponentials))^-2
```

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

## Comparison between Sample and Theoretical Variance

There is only a slight difference between the simulations sample variance and the exponential distribution theoretical variance.

```
abs(var(simMean)-(lambda * sqrt(exponentials))^-2)
```

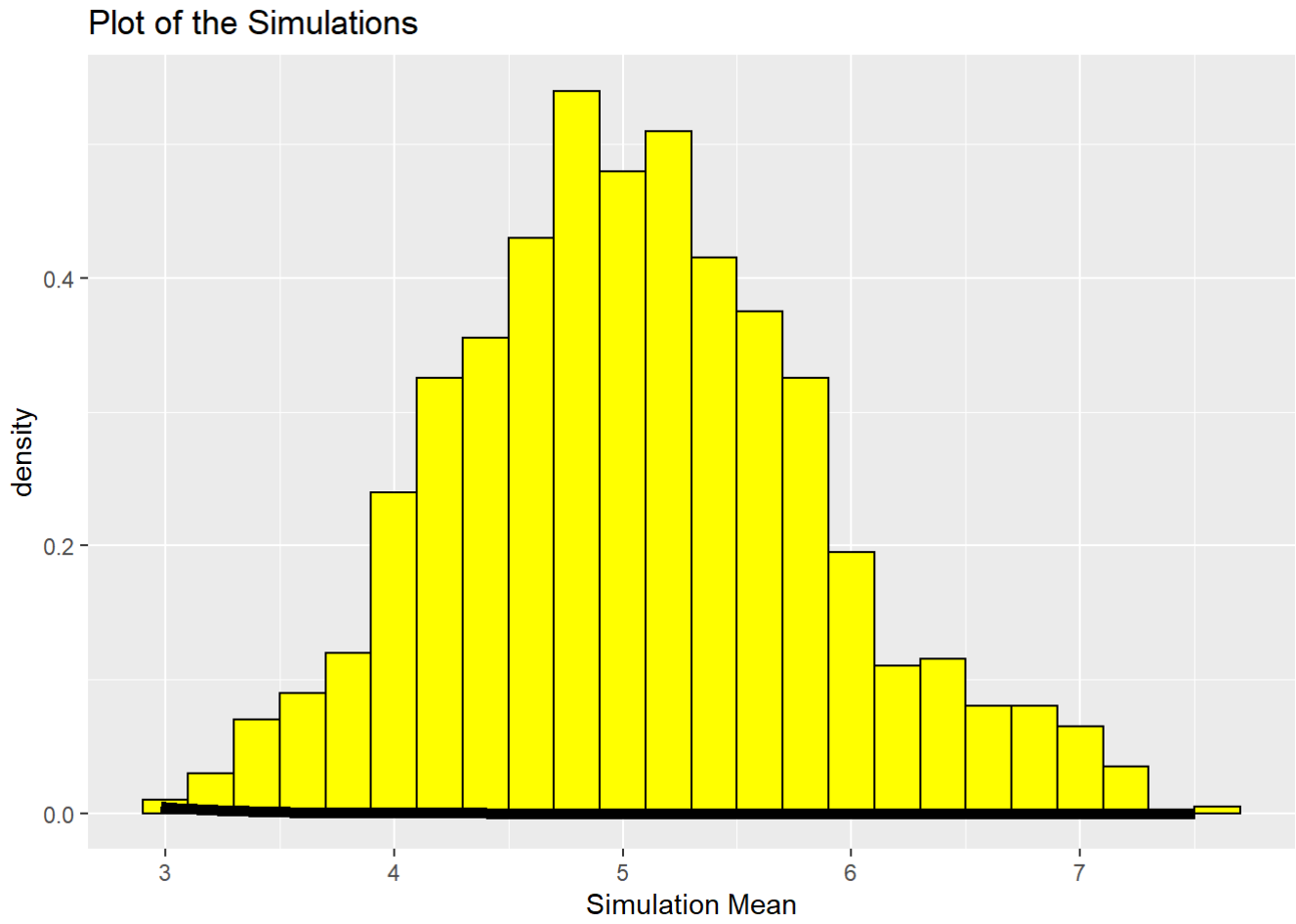
```
## [1] 0.0293703
```

# Distribution using a Density Histogram

This is a density histogram of the 1000 simulations. There is an overlay with a normal distribution that has a mean of lambda^-1 and standard deviation of (lambda*sqrt(n))^-1, the theoretical normal distribution for the simulations.

```
library(ggplot2)
ggplot(data.frame(y=simMean), aes(x=y)) +
  geom_histogram(aes(y=..density..), binwidth=0.2, fill="yellow",
                 color="black") +
  stat_function(fun=dnorm, arg=list(mean=lambda^-1,
                                    sd=(lambda*sqrt(exponentials))^-1),
                size=2) +
  labs(title="Plot of the Simulations", x="Simulation Mean")
```

```
## Warning: Ignoring unknown parameters: arg
```


Plot of the Simulations
density
0.0
0.2
0.4
3
4
5
6
7
Simulation Mean