Statistical Inference Course Project 1

Overview

This project I'm intenting to investigate the exponential distribution in R and compare it with the Central Limit Theorem. The exponential distribution will be simulate in R with rexp(n, lambda) where lambda, is rate parameter. The mean of exponential distribution is 1/lambda and the standard deviation is also 1/lambda. It will set lambda = 0.2 for all of the simulations. Also I'm going to investigate the distribution of averages of 40 exponentials.

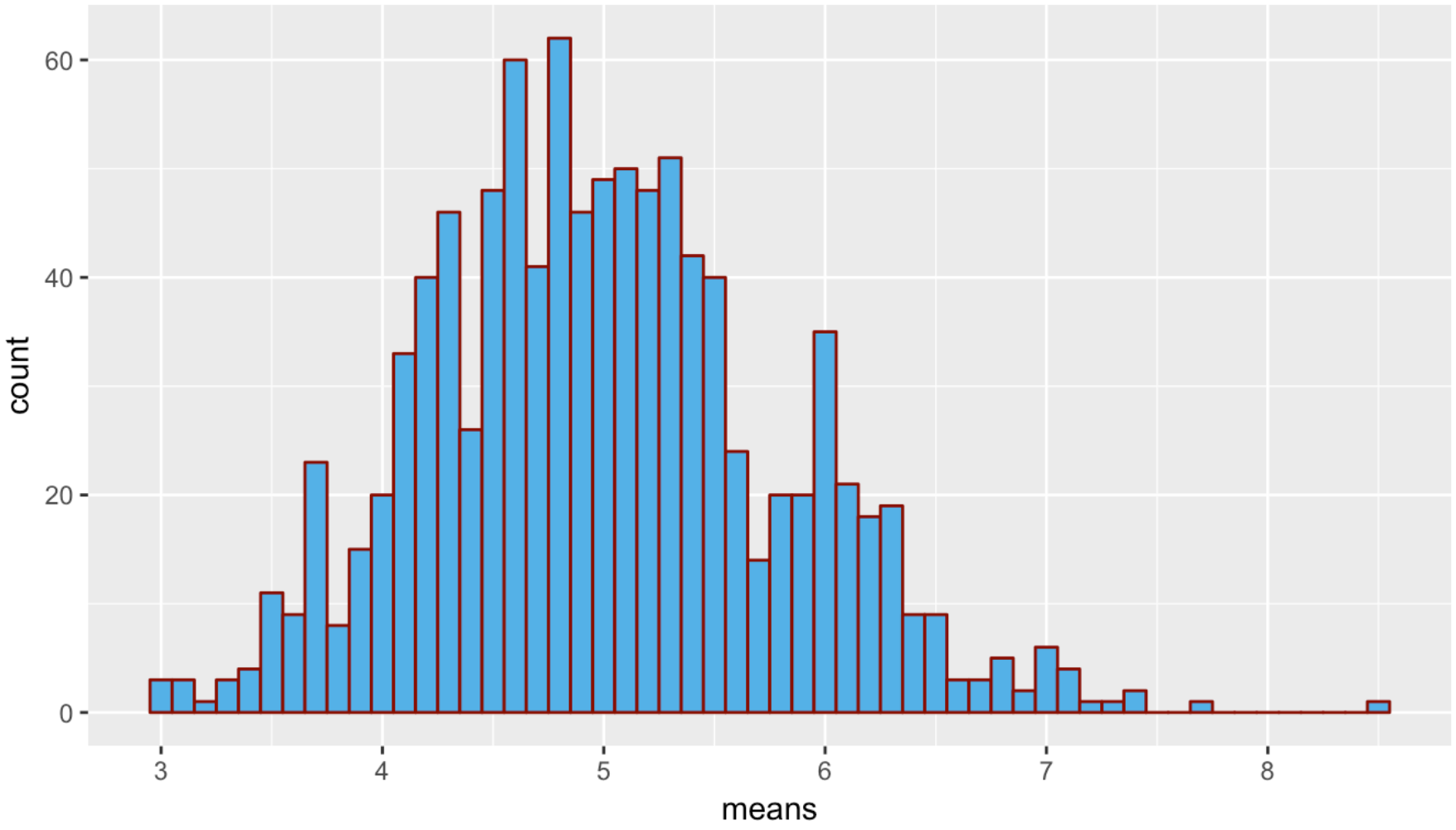
Simulations

```
# load libraries
library(ggplot2)

# set constants
lambda <- 0.2 # lambda
n <- 40 # exponetials
numberOfSimulations <- 1000 # quant of tests

# set the seed to create reproducability
set.seed(100)

# run the test resulting in n x numberOfSimulations
exponentialDistributions <- matrix(data=rexp(n * numberOfSimulations, lambda), nro
w=numberOfSimulations)
exponentialDistributionMeans <- data.frame(means=apply(exponentialDistributions, 1
, mean))
```



Sample Mean vs Theoretical Mean

Expected mean μ of a exponential distribution of rate λ is

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

```
mu <- 1/lambda
mu
```

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

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

```
meanOfMeans <- mean(exponentialDistributionMeans$means)
meanOfMeans
```

```
## [1] 4.999702
```

You can see the expected mean and the avarage sample are close

Sample Variance vs Theoretical Variance

Expected standard deviation σ of a exponential distribution of rate λ is

$\sigma = \frac{1/\lambda}{\sqrt{n}}$

The e

```
sd <- 1/lambda/sqrt(n)
sd
```

```
## [1] 0.7905694
```

The variance Var of standard deviation σ is

$Var = \sigma^2$

```
Var <- sd^2
Var
```

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

Let Var_x be the variance of the average sample mean of 1000 simulations of 40 randomly sampled exponential distribution, and σ_x the corresponding standard deviation.

```
sd_x <- sd(exponentialDistributionMeans$means)
sd_x
```

```
## [1] 0.7959461
```

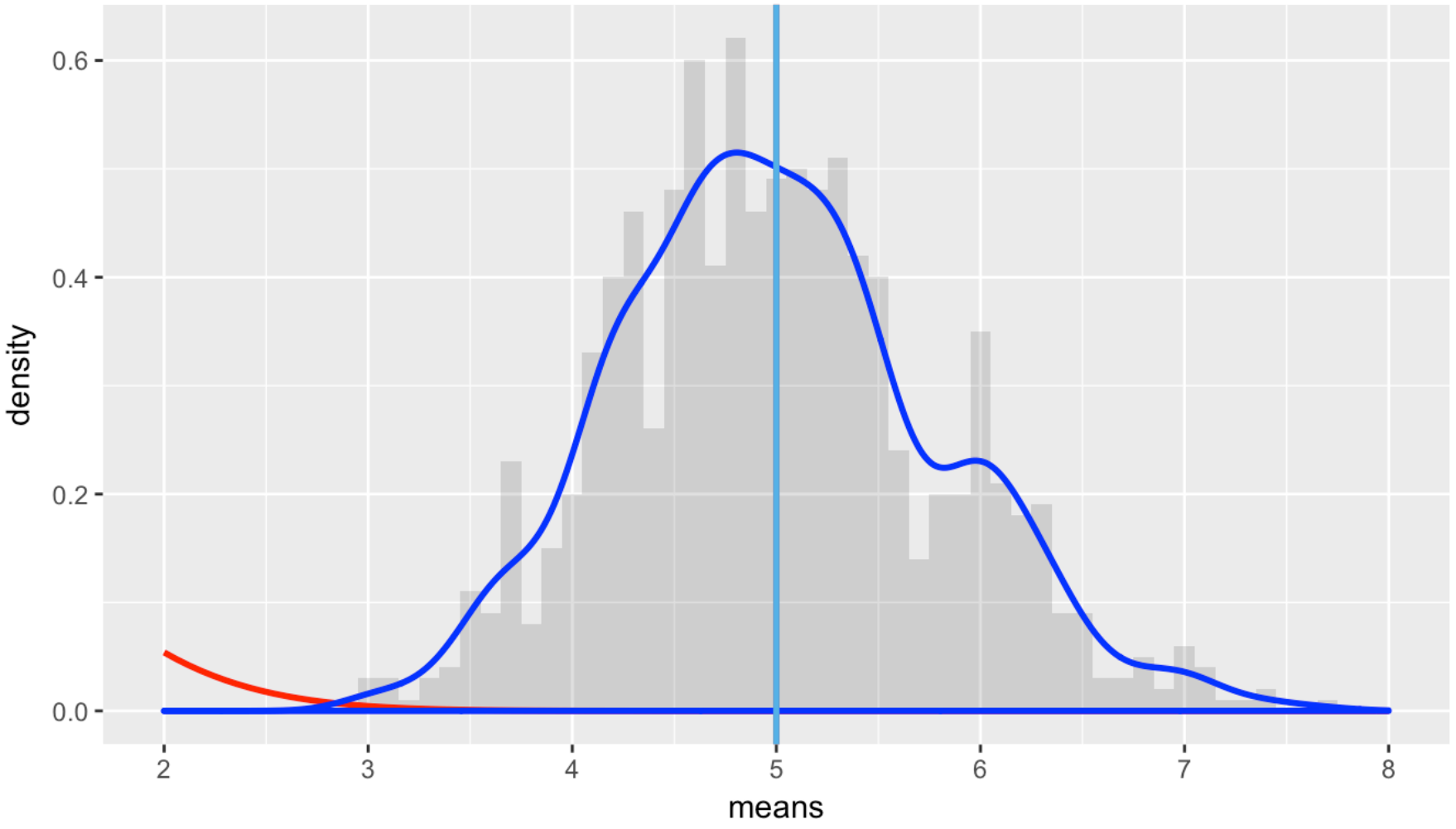
```
Var_x <- var(exponentialDistributionMeans$means)
Var_x
```

```
## [1] 0.6335302
```

As you can see the standard deviations are very close Since variance is the square of the standard deviations, minor differnces will we enhanced, but are still pretty close.

Distribution

Comparing the population means & standard deviation with a normal distribution of the expected values. Added lines for the calculated and expected means



The graph shows the calculated distribution of means of random sampled exponantial distributions, overlaps quite nice with the normal distribution with the expected values based on the given lamba