Simulate CLT

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Part 1. Sampling Exponential Distribution

Overview

In this project I will investigate the exponential distribution and compare it with the Central Limit Theorem. The exponential distribution can be simulated in R with *rexp(n, lambda)* where lambda is the rate parameter. I will investigate the distribution of averages of 40 exponentials.

Project

The mean of exponential distribution is $\frac{1}{\lambda}$ and the standard deviation is also $\frac{1}{\lambda}$. I will use lambda $= 0.2$ for all of the simulations. In this study I will investigate the distribution of averages of 40 exponentials.

Theoretical Mean of the distribution

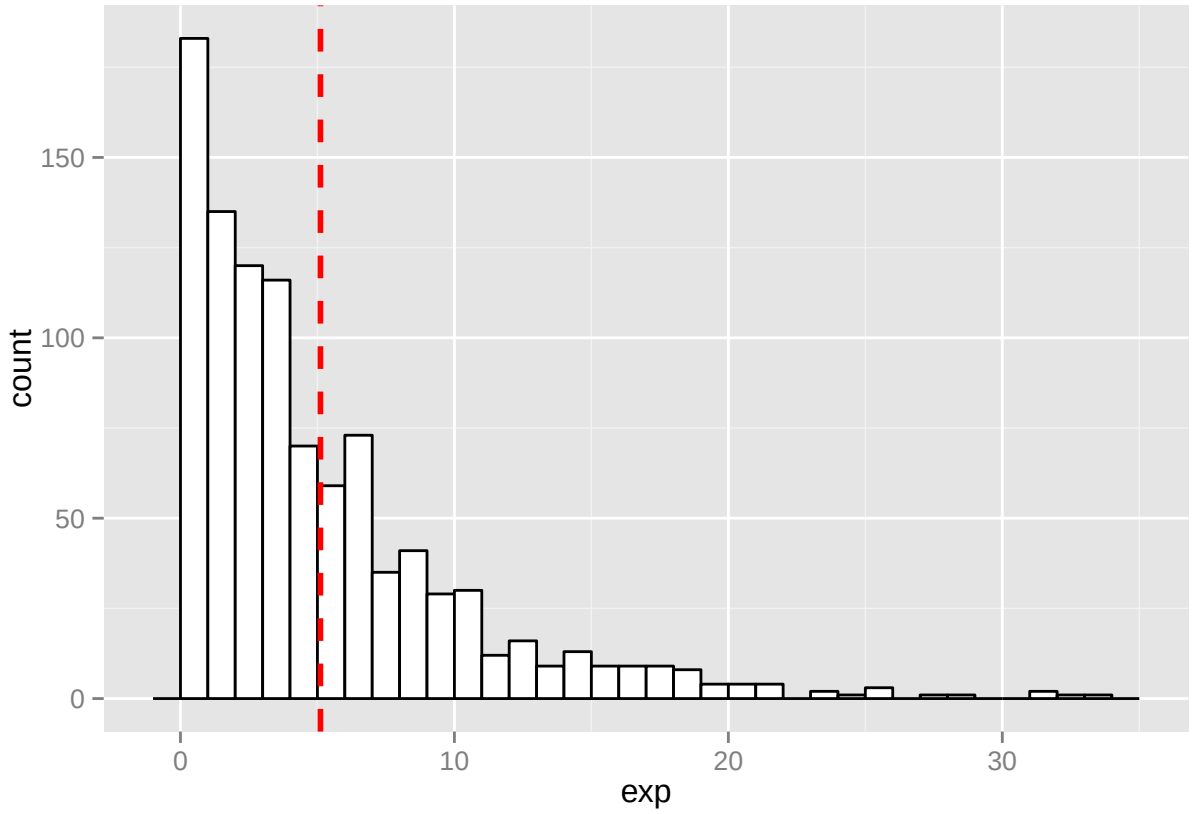
Creating 1000 values from the exponential distribution

```
lambda <- 0.2
exp <- rexp(n=1000, rate = lambda)
exp_mean <- mean(exp)
theoretical_mean <- (1/lambda)
```

The sample mean is `5.1100757`. Theoretical mean is `5` (calculated as 1/lambda).

Let's plot a histogram to show the sample mean and compare it to the theoretical mean of the distribution.

```
ggplot() + aes(exp)+
  geom_histogram( binwidth=1, colour="black", fill="white") +
  geom_vline(aes(xintercept=exp_mean), color="red", linetype="dashed", size=1)
```



Theoretical Variance of the Sample

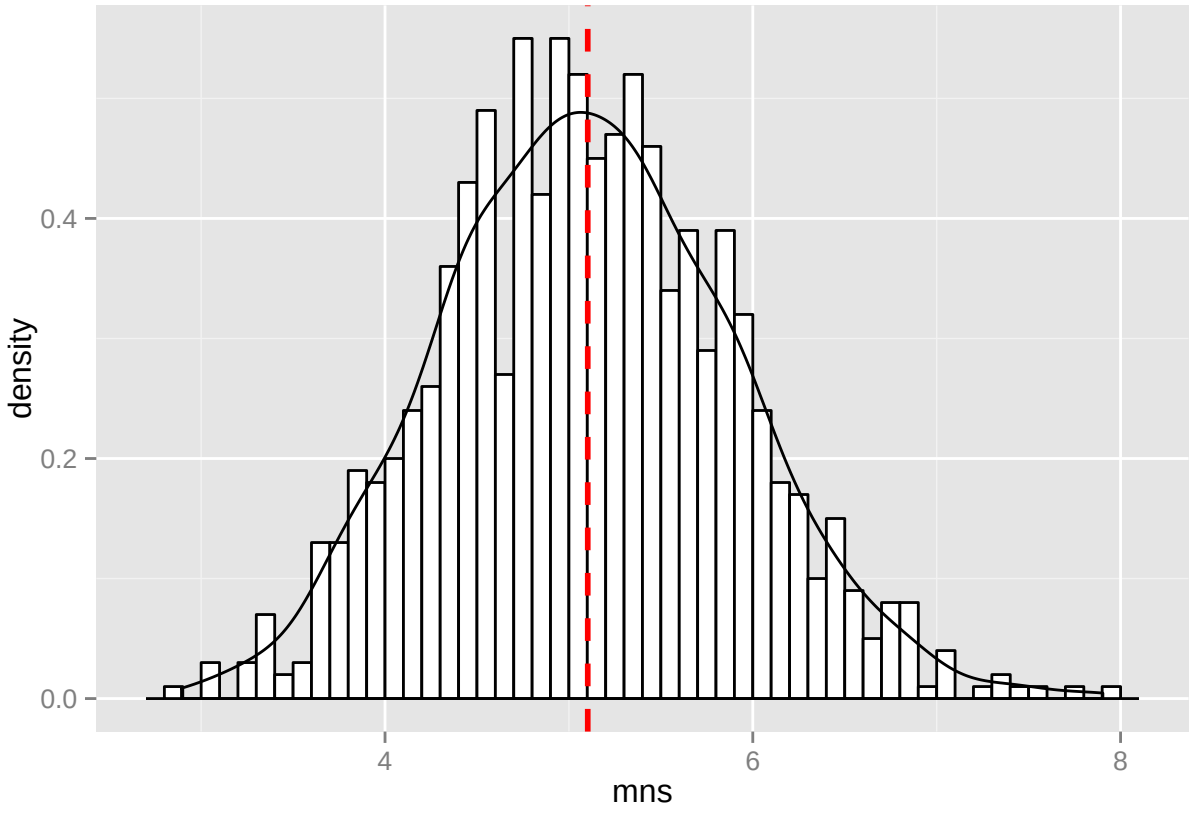
2. Show how variable the sample is (via variance) and compare it to the theoretical variance of the distribution.

```
sample_size <- 40
mns <- rep(0,1000)
for (i in 1:1000) {
  mns[i] <- mean(exp[sample(1:1000, sample_size, replace=FALSE)])
}

sample_var <- var(mns)
theoretical_var <- (1/lambda)^2 / sample_size
```

Distribution is approximately normal

```
p1 <-
  ggplot() + aes(mns)+
  geom_histogram(aes(y=..density..), binwidth=0.1, colour="black", fill="white") +
  geom_vline(aes(xintercept=mean(mns, na.rm=T)), color="red", linetype="dashed", size=1) +
  geom_density(alpha=.2)
print(p1)
```


density
0.4
0.2
0.0
4
6
8
mns