Comparison of the exponential distribution and the central limit theorem

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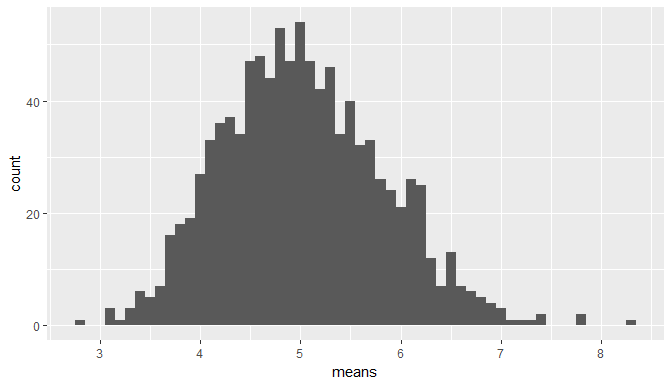
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## Part 1: Simulation Exercise Instructions

In this project you will investigate the exponential distribution in R 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. The mean of exponential distribution is 1/lambda and the standard deviation is also 1/lambda. Set lambda = 0.2 for all of the simulations. You will investigate the distribution of averages of 40 exponentials. Note that you will need to do a thousand simulations.

## Simulations

# load neccesary libraries  
library(ggplot2)  
  
# set constants  
lambda <- 0.2 # lambda for rexp  
n <- 40 # number of exponetials  
numberOfSimulations <- 1000 # number of tests  
  
# set the seed to create reproducability  
set.seed(11081979)  
  
# run the test resulting in n x numberOfSimulations matrix  
exponentialDistributions <- matrix(data=rexp(n \* numberOfSimulations, lambda), nrow=numberOfSimulations)  
exponentialDistributionMeans <- data.frame(means=apply(exponentialDistributions, 1, mean))



## Sample Mean versus Theoretical Mean

The expected mean of a exponential distribution of rate is

mu <- 1/lambda  
mu

## [1] 5

Let be the average sample mean of 1000 simulations of 40 randomly sampled exponential distributions.

meanOfMeans <- mean(exponentialDistributionMeans$means)  
meanOfMeans

## [1] 5.027126

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

## Sample Variance versus Theoretical Variance

The expected standard deviation of a exponential distribution of rate is

The e

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

## [1] 0.7905694

The variance of standard deviation is

Var <- sd^2  
Var

## [1] 0.625

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

sd\_x <- sd(exponentialDistributionMeans$means)  
sd\_x

## [1] 0.8020334

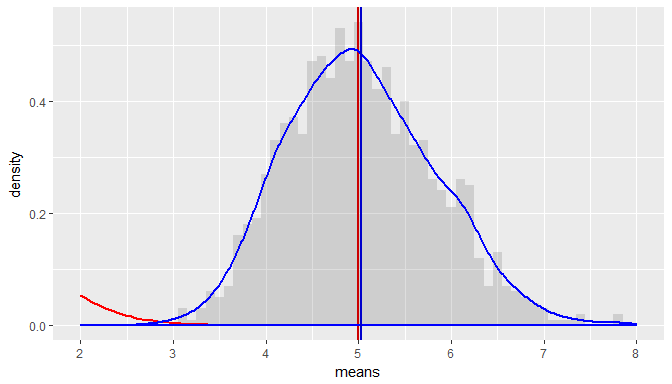
Var\_x <- var(exponentialDistributionMeans$means)  
Var\_x

## [1] 0.6432577

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



As you can see from the graph, 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