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# Simulation Excercise

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Simulate the exponential distribution:

First set seed, so that same simulation can be reproduced.

Then generate random exponential numbers with lambda = 0.2 & take its mean.

Repeat the above process 1000 times with 'replicate' function.

And store this data in 'data' variable.

size = 1000  
n = 40  
lambda = 0.2  
  
set.seed(2506)  
data <- (replicate(size, mean(rexp(n,lambda))))

## 1. Sample mean Vs Theoretical mean

Calculate the mean of data and store it in sample\_mean

Calculate the theoretical mean and store it in theoretical\_mean

Print both of them

sample\_mean = mean(data)  
theoretical\_mean = 1/lambda  
  
sample\_mean

## [1] 4.957994

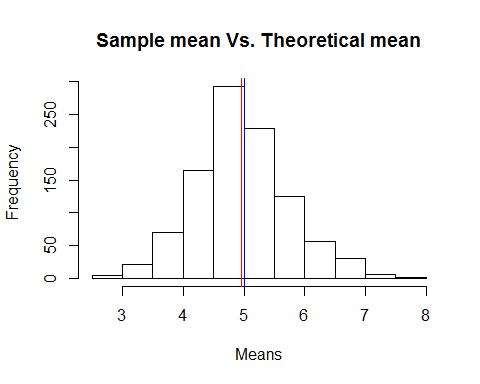
theoretical\_mean

## [1] 5

We can see that the sample mean is sligthly less than theoretical mean

Plot the histogram of the means exponential data & add vertical lines at sample mean and theoretical mean

my\_plot1 <- hist(data, main = "Sample mean Vs. Theoretical mean", xlab = "Means", ylab = "Frequency")  
abline(my\_plot1, v=sample\_mean , col="red")  
abline(my\_plot1, v=theoretical\_mean , col="blue")



If zoomed in, it can be observed that the red line(indicating sample mean) is slightly to the left of blue line(indicating theoretical mean)

## 2. Sample variance Vs. Theoretical Variance

Store the sample variance of data in sample\_variance

Store the theoretical variance in theoretical\_variance

sample\_variance = var(data)  
theoretical\_variance = ((1/lambda)^2/n)

Print sample variance & theoretical variance

sample\_variance

## [1] 0.5798728

theoretical\_variance

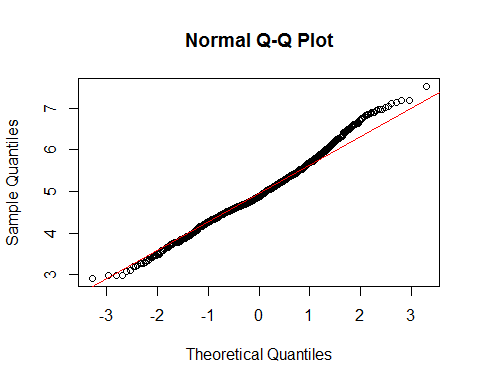
## [1] 0.625

We can clearly see that theoretical variance is greater than sample variance.

## 3. Showing that the distribution is approximately normal

To confirm if the distribution is approximatley normal, plot Sample quantile Vs. Theoretical quantiles. The plot should lie on the 45 degree line of the QQ plot if its normal.

qqnorm(data, main="Normal Q-Q Plot")  
qqline(data, col="2")



Since the line is approximately 45 degrees, we can say that our distributions is approimately normal.