TITLE: Part A--A Simulation Exercise
AUTHOR: Rekha Mishra
DATE: 20th of June, 2015

OVERVIEW:
In this project we 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.** We will investigate the distribution of averages of 40 exponentials. Note that we will need to do a thousand simulations.

SIMULATIONS:
Set global options

```
library(knitr)
opts_chunk$set(echo=TRUE)
set.seed(1)
```

Set variables

```
lambda <- 0.2
n  <- 40
numsim <- 1000
```

Generate dataset

```
dataset <- matrix(rexp(n*numsim,lambda),numsim)
```

Calculate descriptive statistics

```
TheoryMean <- 1/lambda
RowMeans <- apply(dataset,1,mean)
ActualMean <- mean(RowMeans)
TheorySD <- ((1/lambda) * (1/sqrt(n)))
ActualSD <- sd(RowMeans)
TheoryVar <- TheorySD^2
ActualVar <- var(RowMeans)
```

Illustrate via simulation and associated explanatory text the properties of the distribution of the mean of 40 exponentials.
So we:

1. Show the sample mean and compare it to the theoretical mean of the distribution.

```
ActualMean
## [1] 4.990025
TheoryMean
## [1] 5
```

ActualMean=4.990
Theoretical Mean = 5

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

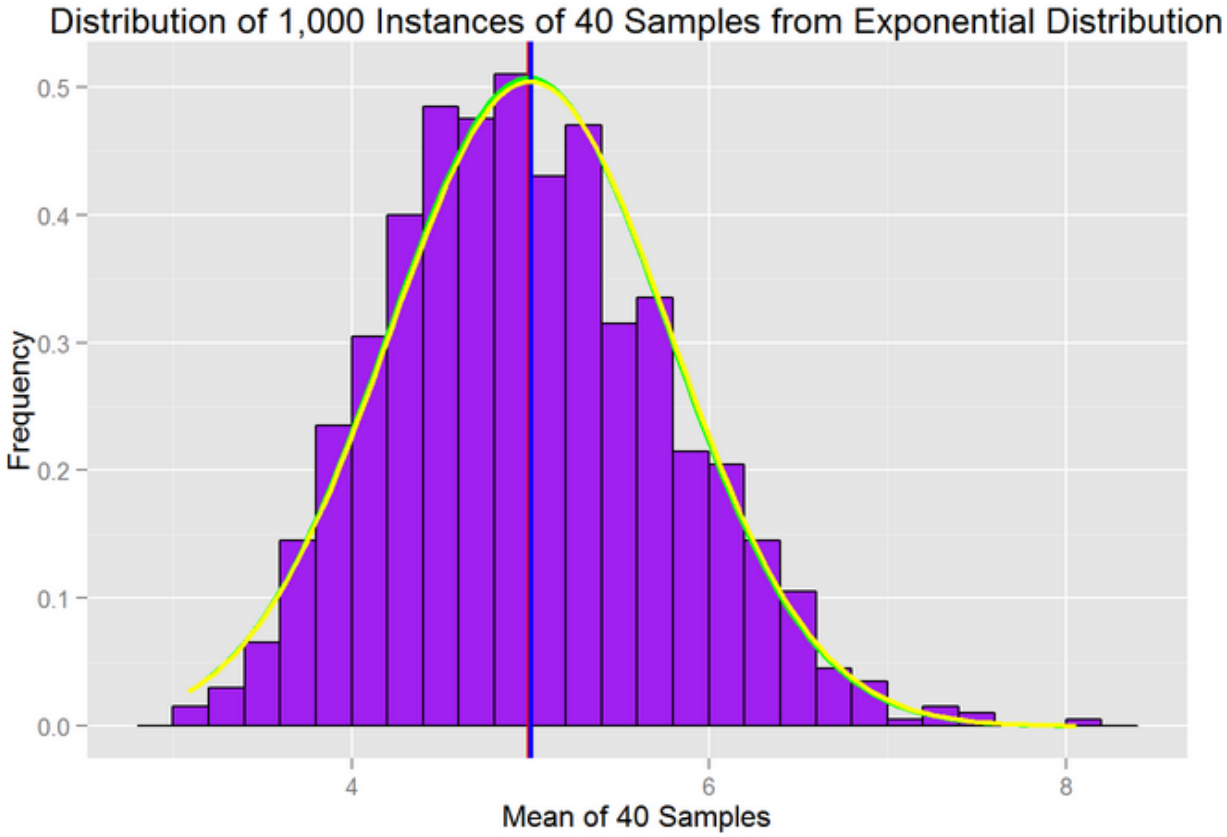
```
ActualVar
## [1] 0.6177072
TheoryVar
## [1] 0.625
```

ActualVariance=0.6177
Theoretical Variance = 0.625

3. Show that the distribution is approximately normal.

Plot distribution

```
library(ggplot2)
dfRowMeans <- data.frame(RowMeans)
mp <- ggplot(dfRowMeans,aes(x=RowMeans))
mp <- mp+geom_histogram(binwidth = lambda,fill="purple",color="black",aes(y = ..density..))
mp <- mp + labs(title="Distribution of 1,000 Instances of 40 Samples from Exponential Distribution", x="Mean of 40 Samples", y="Frequency")
mp <- mp + geom_vline(xintercept=ActualMean, size=1.0, color="red")
mp <- mp + stat_function(fun=dnorm,args=list(mean=ActualMean, sd=ActualSD),color = "green", size = 1.0)
mp <- mp + geom_vline(xintercept=TheoryMean,size=1.0,color="blue")
mp <- mp + stat_function(fun=dnorm,args=list(mean=TheoryMean, sd=TheorySD),color = "yellow", size = 1.0)
mp
```



- The actual mean is shown by a red line.
- The theoretical mean is shown by a blue line
- The actual curve formed by the mean and standard deviation is shown in green.
- The normal curve formed by the theoretical mean and standard deviation is shown in yellow.

The actual data is approximately normally distributed as predicted by the Central Limit Theorem**.**