# exponential distribution

In this report 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.

** Run Simulation **

```
nsim = 1:1000
n = 40
lambda = 0.2

mns = NULL
for (i in nsim) mns = c(mns, mean(rexp(n, lambda)))
hist(mns, xlab="mean", main="Mean Distribution")
```
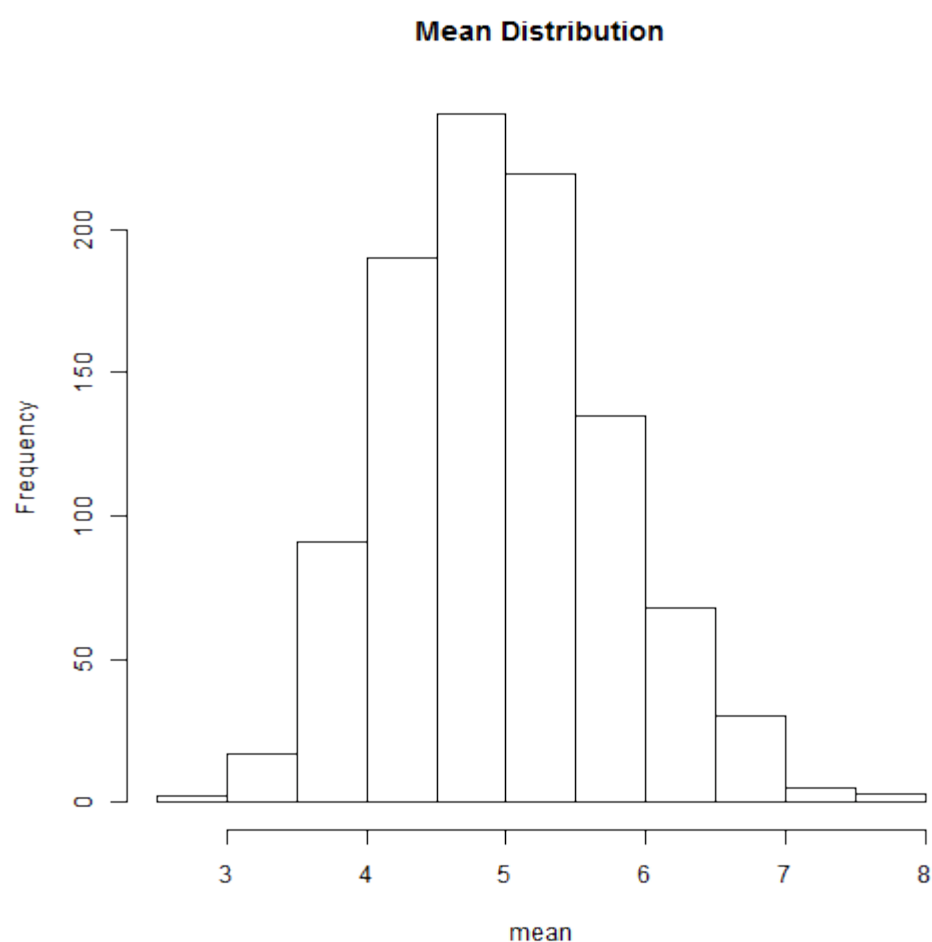

Center is around 5.

```
# Mean of means
meanofmean = mean(mns)

# Expected Mean
expectedmean = 1/lambda

# Standard Deviation
standard = sd(mns)
```

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```
# Expected sd
expectedstandard = (1/lambda) / sqrt(n)

# Varaince
variance = var(mns)

# Expected variance
expectedvariance = ((1/lambda) / sqrt(n))^2
```

the Mean of means is 4.99 compared to an expected mean (1/Lambda => 1/0.2) of 5 which is almost the same.

The Standard deviation of the simulation is 0.79 and the expected standard deviation (theoratical) of the distribution is also 0.79

Variance of the simluation is 0.62 same as the expected variance of the distribution.

The below chart shows that the distrbution is approximately normal with the Mean and Theoratical Means displayed as Long Dash (in Green and Yellow)

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.0.3
```

```
plotdata <- data.frame(mns);
plot1 <- ggplot(plotdata, aes(x =mns))
plot1 <- plot1 +geom_histogram(aes(y=..density..), colour="black",
                               fill = "blue")
plot1<-plot1+labs(title="Density of 40 Numbers from Exp. Distribution", x="Mean of 40 Selections",
y="Density")
plot1<-plot1 +geom_vline(xintercept=expectedmean,size=1.0, color="green",linetype ="longdash")
plot1<-plot1 +geom_vline(xintercept=meanofmean,size=1.0, color="yellow",linetype = "longdash")
plot1<-plot1 +stat_function(fun=dnorm,args=list( mean=expectedmean, sd=sqrt(expectedvariance)),color
= "green", size = 1.0)
plot1<-plot1 +stat_function(fun=dnorm,args=list( mean=meanofmean, sd=sqrt(variance)),color =
"yellow", size = 1.0)
print(plot1)
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```

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Density of 40 Numbers from Exp. Distribution