Exponential Distribution Simulation

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In this project I 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 rate used in this project is lambda = `0.2` . A 1000 simulations each of sample size 40 would be investigated. The mean of exponential distribution is 1/lambda and the standard deviation is also 1/lambda and we hopr to get same via simulation.

Libraries

```
library(ggplot2)
```

Initialize simulation variables. This is important for reproducibility

```
set.seed(1)
lambda <- .2
nsims = 1e4
sample_size = 40
```

Generate a random exponential of 40 with lambda = `0.2`

Now we will simulate an exponential distribution of 1000 with lambda = `0.2` with 40 bootstraps

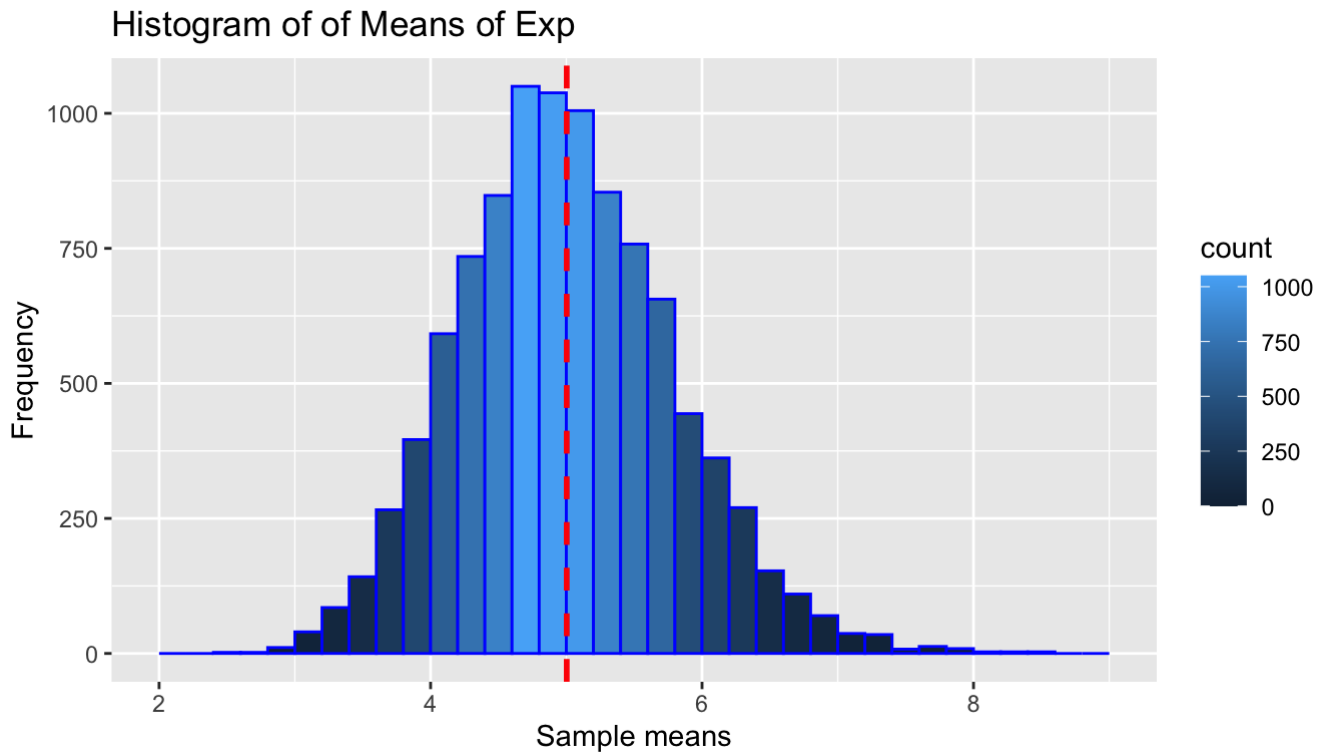
```
resamples <- matrix(rexp(nsims*sample_size, rate = lambda), nrow = nsims, ncol = sample_
        size)
```

Calculate means of rows in the simulation

```
resamplesMean <- apply(resamples, 1, mean)
```

Let's visualize our sampling distribution and compare it to the `CLT`

```
g <- ggplot(data.frame(x = resamplesMean), aes(x=x))
g = g + geom_histogram(breaks = seq(2,9, .2), col = 'blue', aes(fill = ..count..))
g = g + geom_vline(xintercept = mean(resamplesMean), size = 1, linetype = 'dashed', col
         = 'red')
g = g+ labs(title = 'Histogram of of Means of Exp', x = 'Sample means', y = 'Frequency')
print(g)
```



Compare means:

now we will compare the actual mean to the theoretical mean respectively We can see the actual mean of 5 `.002` is close to the theoretical mean of `5.0` calculated below

```
c(mean(resamplesMean), 1/lambda)
```

```
## [1] 5.002873 5.000000
```

Compare variance:

We can also see the actual variance of `0.626` is closer to the theoretical variance of `0.625` calculated below

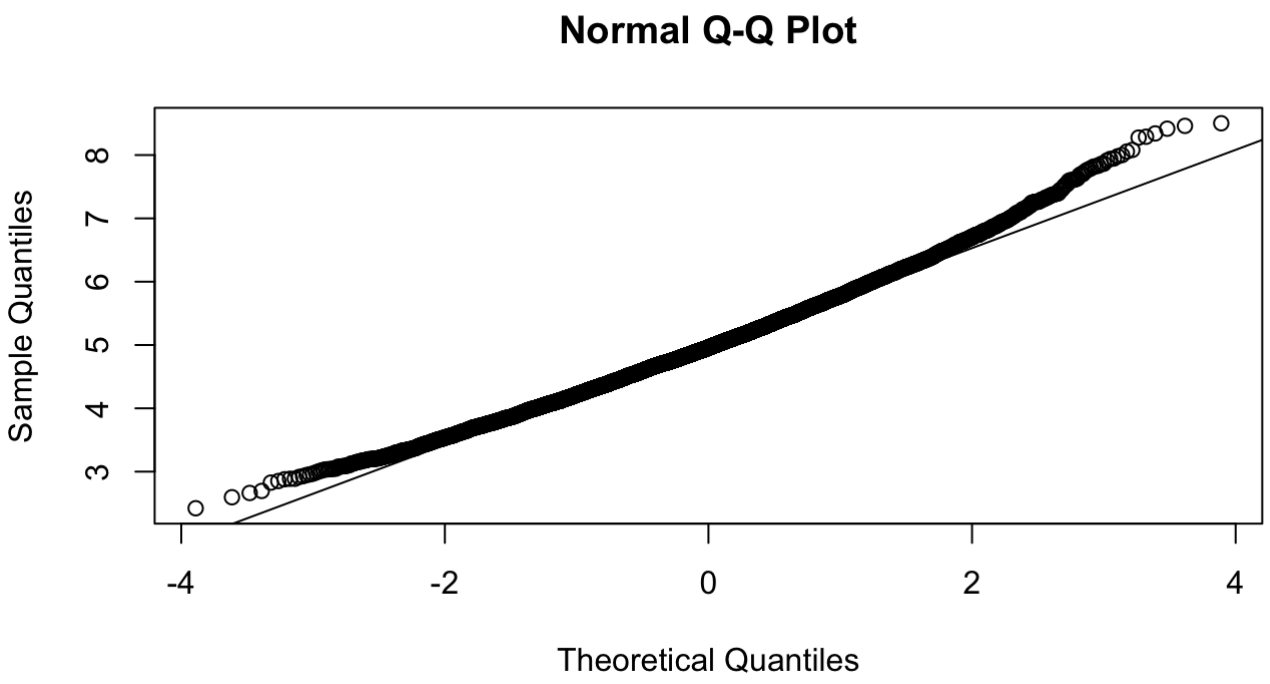
```
c(var(resamplesMean), ((1/lambda)^2)/sample_size)
```

```
## [1] 0.6261976 0.6250000
```

Show that the distribution is approximately normal

use qqplot to check normality We can infer that the theoretical quantiles is approximately close to the sample quantiles for the plot below

```
qqnorm(resamplesMean)
qqline(resamplesMean)
```



Check `95%` confidence interval if theoretical and actual mean

```
samp_ci <- mean(resamplesMean) + c(-1,1)*1.96*sqrt(var(resamplesMean)/sample_size)
theor_ci <- 1/lambda+ c(-1,1)*1.96*sqrt(( ((1/lambda) ^2) /sample_size)/sample_size)

rbind(samp_ci, theor_ci)
```

```
##              [,1]     [,2]
## samp_ci  4.757639 5.248108
## theor_ci 4.755000 5.245000
```

We can also infer that the theoretical CI is approximately close to the sample CI