Assignment Part 1

Introduction

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 also 1/lambda. Set lambda = 0.2 for all of the simulations.

In this simulation, you will investigate the distribution of averages of 40 exponential(0.2)s. Note that you will need to do a thousand or so simulated averages of 40 exponentials.

Illustrate via simulation and associated explanatory text the properties of the distribution of the mean of 40 exponential(0.2)s. You should ### Q1: Show where the distribution is centered at and compare it to the theoretical center of the distribution.

```
set.seed(1)
n <- 40
lambda <- .2
nsim <-1000
sim <- replicate(nsim, rexp(n,.2))
mns <- colMeans(sim)
```

```
center <- mean(sim)
center
```

```
## [1] 4.990025
```

we see the distribution is centered at 4.990025,which is approximatley equal to 5.

Q2. Show how variable it is and compare it to the theoretical variance of the distribution.

The theoretical variance of exponential distribution with $\lambda = .2$ is $S_{The} = \frac{1}{\lambda} = 5$. The theoretical variance of the distribution of the mean of 40 exponential distribution with $\lambda = .2$ is $S_{The.mean} = \frac{S^2_{The}}{n} = \frac{5}{8}$

```
(1/lambda^2) / n
```

```
## [1] 0.625
```

The variance of the simulations

```
var(mns)
```

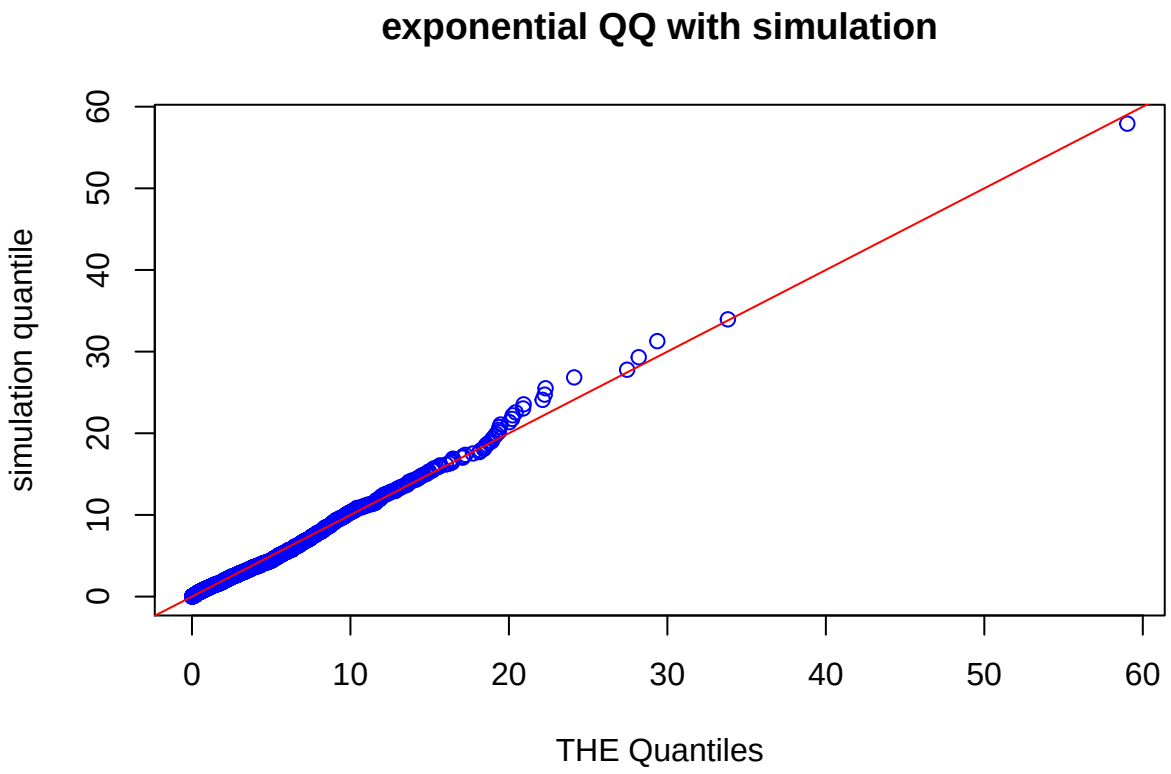
```
## [1] 0.6111165
```

They are very close.

Q3. Show that the distribution is approximately normal.

As we know when n is large and lambda is small, the exponential distribution can be approxiately regarded as normal distribution as CLT indicates. Here we use the Quantile-Quantile plot to compare the distribution of mean exponential with distribution of exponential.

```
qqplot(rexp(nsim, lambda),sim, col="blue", main="exponential QQ with simulation", xlab="THE Quantiles",
abline(0,1,col="red")
```



The result is as expected, since the blue part is around the red line.