SIW4 Part 1:Simulation Exercize

Pratik Patil

17/10/2020

##Setting values

```
set.seed(31) # set seed for reproducability
lam <- 0.2 # lambda=0.2
x <- 40 #samples=40
sim <- 1000 #simulations=1000
sim_exp <- replicate(sim, rexp(x, lam)) # simulate
mean_exp <- apply(sim_exp, 2, mean) # calculate mean of exponentials
```

Question 1

Show where the distribution is centered at and compare it to the theoretical center of the distribution.

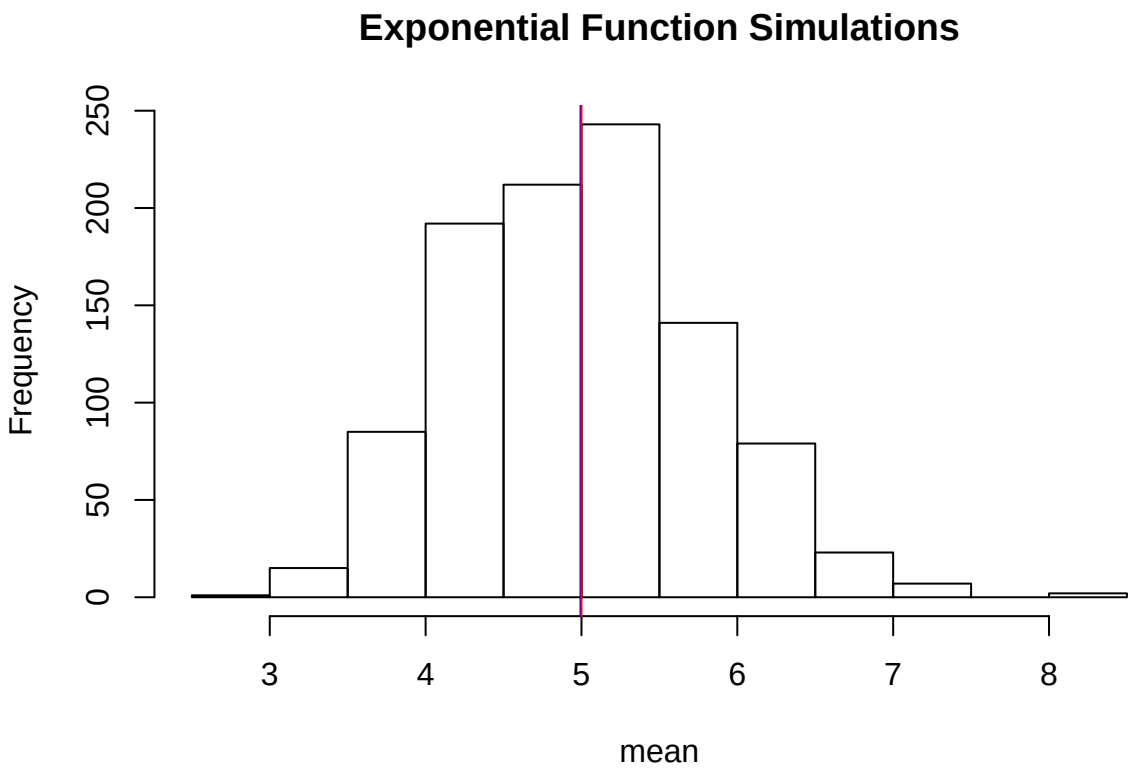
```
ana_mean <- mean(mean_exp)
ana_mean
```

```
## [1] 4.993867
```

```
# analytical mean
th_mean <- 1/lam
th_mean
```

```
## [1] 5
```

```
# visualization
hist(mean_exp, xlab = "mean", main = "Exponential Function Simulations")
abline(v = ana_mean, col = "blue")
abline(v = th_mean, col = "red")
```



The analytics mean is 4.993867 the theoretical mean 5. The center of distribution of averages of 40 exponentials is very close to the theoretical center of the distribution.

Question 2

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

```
# standard deviation of distribution
stan_dev_dist <- sd(mean_exp)
stan_dev_dist
```

```
## [1] 0.7931608
```

```
# standard deviation from analytical expression
stan_dev_th <- (1/lam)/sqrt(x)
stan_dev_th
```

```
## [1] 0.7905694
```

```
# variance of distribution
var_dist <- stan_dev_dist^2
var_dist
```

```
## [1] 0.6291041
```

```r
# variance from analytical expression
var_th <- ((1/lam)*(1/sqrt(x)))^2
var_th
```

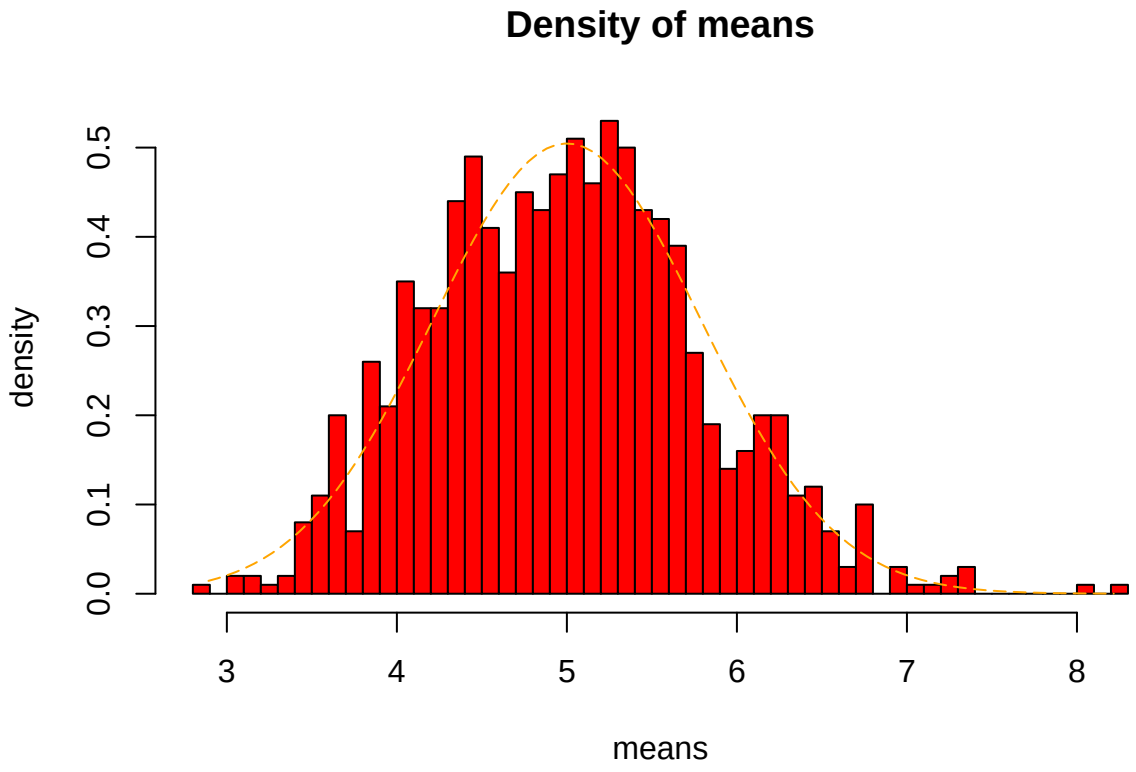
```
## [1] 0.625
```

Standard Deviation of the distribution is 0.7931608 with the theoretical SD calculated as 0.7905694. The Theoretical variance is calculated as ((1 / ??) * (1/???n))2 = 0.625. The actual variance of the distribution is 0.6291041

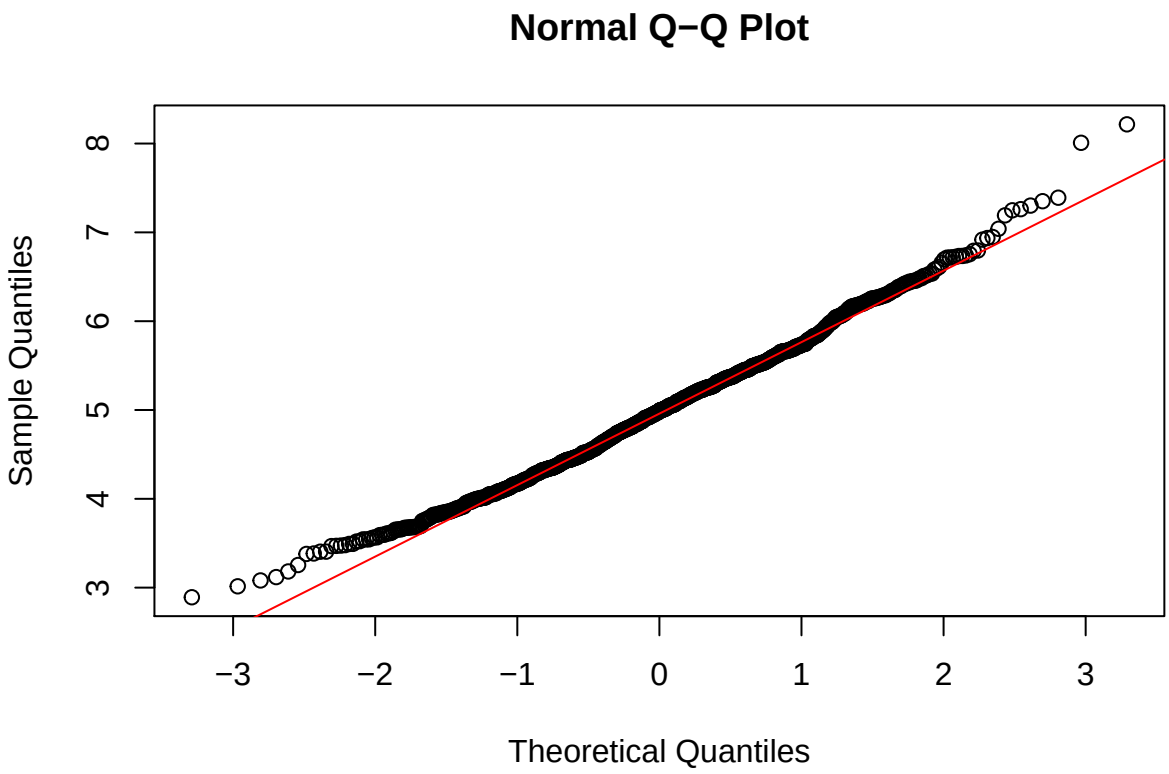
Question 3

Show that the distribution is approximately normal.

```r
xf <- seq(min(mean_exp), max(mean_exp), length=100)
yf <- dnorm(xf, mean=1/lam, sd=(1/lam/sqrt(x)))
hist(mean_exp,breaks=x,prob=T,col="red",xlab = "means",main="Density of means",ylab="density")
lines(xf, yf, pch=22, col="orange", lty=5)
```




```r
# compare the distribution of averages of 40 exponentials to a normal distribution
qqnorm(mean_exp)
qqline(mean_exp, col = 2)
```



Due to Due to the central limit theorem (CLT), the distribution of averages of 40 exponentials is very close to a normal distribution.