Assignment

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Sample Project Report

Overview

In this project we will investigate the exponential distribution and compare it with the Central Limit Theorem. We will estimate a statistic (mean) from our observations and get an idea about its distribution. We will investigate the distribution of averages of 40 exponentials. For this purpose, we will run 1,000 simulations.

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

1.1 We will create a simulated data set by sampling n observations with replacement from the observed data

```
# Set variables
set.seed(2340)

n <-  40
B <- 1000
lamb <- 0.2

# Run simulation
sim.data = NULL
for(i in 1:1000) {
    sim.data = c(sim.data,mean(rexp(n,lamb)))
}
```

1.2 We will take the sample mean

```
resampledMeans <- mean(sim.data)
```

1.3 We will compare the estimated distribution of means with the theoretical mean.

```
theor <- 1/lamb
empirical <- resampledMeans
diff <- round(abs(empirical - theor),3)
```

The difference between the estimated- and the theoretical mean of the distribution is **0.031**. So, we see how close they are.

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

The variance of the estimated mean from our simulation is:

```r
var(sim.data)
```

```
## [1] 0.6062894
```

Again, our estimate is pretty close to the the theoretical variance of the distribution:

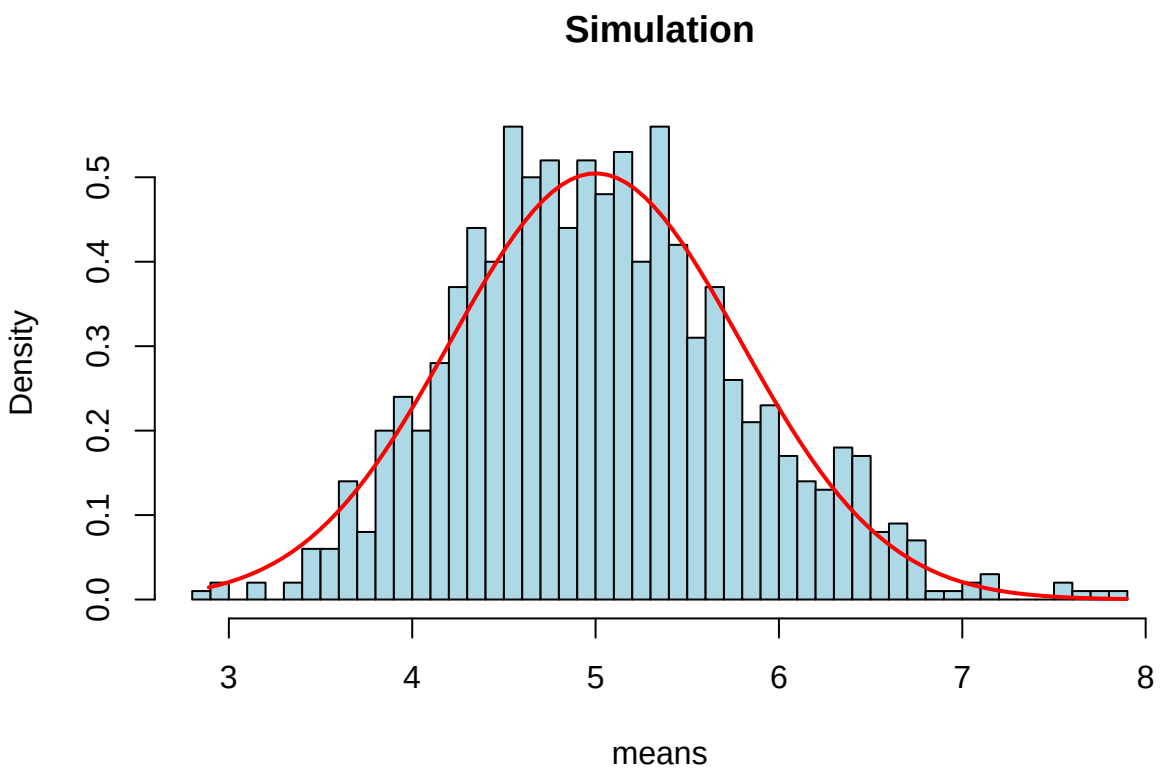
```r
theor.var <- (1/(lamb*sqrt(n)))**2
theor.var
```

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

- Question 3. Show that the distribution is approximately normal
  We can compare the distribution of our simulation data (large collection of averages of 40 exponentials) with the theoretical normal distribution.

```r
#Simulated data
hist(sim.data, breaks=n, probability = TRUE, col="lightblue",
    xlab="means", main="Simulation")

#Normal distribution
x = seq(min(sim.data), max(sim.data), length=100)
lines(x, dnorm(x, mean=1/lamb, sd=(1/(lamb*sqrt(n)))), col=2, lwd=2)
```



Also, we could compare the quantiles of the simulated data with the normal distribution. We can see how the distribution is approximately normal

```r
qqnorm(sim.data)
qqline(sim.data, col=2, lwd=2)
```