Statistical_Inference_Project

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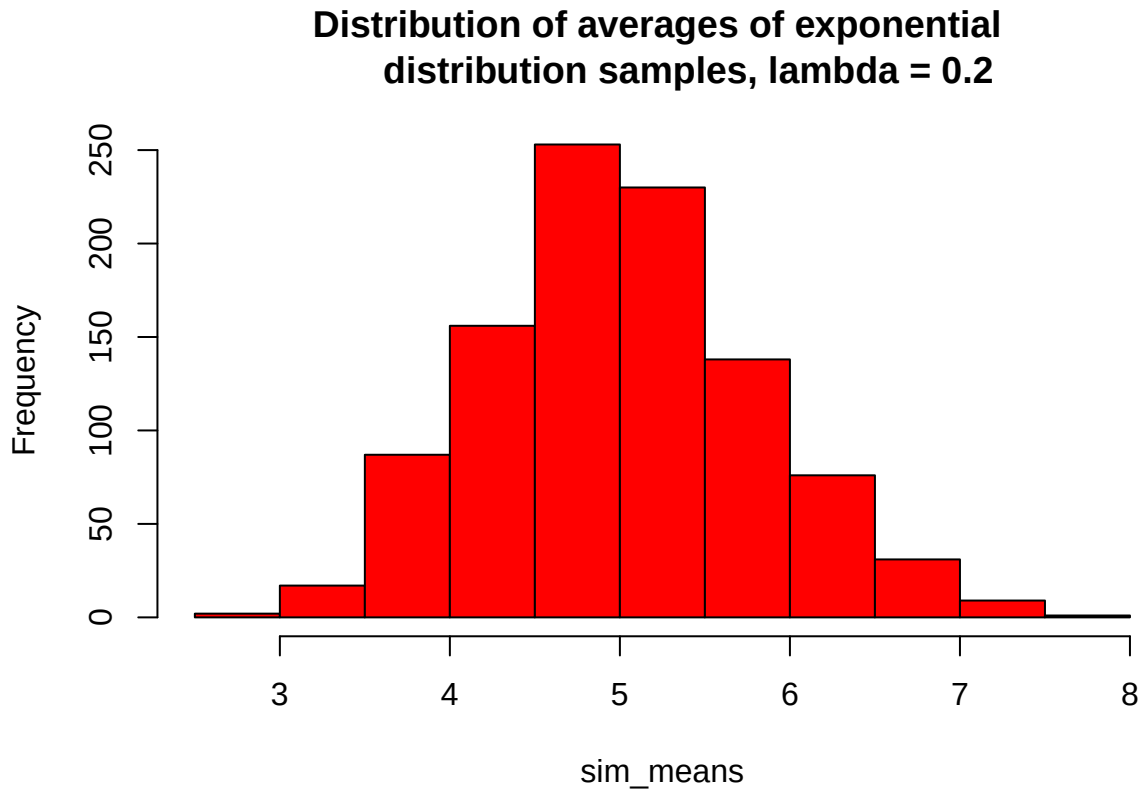
Step1: simulate the distribution of means of 40 exponential distributions with mean = 1/lambda & stddev = 1/lambda

```
nosim <- 1000
n <- 40
lambda <- 0.2
set.seed(8180)
#
#create nosim x n matrix to hold simulated random variables
simdata <- matrix(rexp(nosim * n, rate = lambda), nosim, n)
sim_means <- rowMeans(simdata)
#
#Plot distribution of simulation averages:
hist(sim_means, col = "red", main = "Distribution of averages of exponential
     distribution samples, lambda = 0.2")
```



Compare simulated and theoretical means

```r
#create matrix to store simulated and theoretical means
df_summary <- data.frame(mean(sim_means), 1/lambda)
colnames(df_summary) <- c("simulated", "theoretical")
print(round(df_summary,3))
```

```
##   simulated theoretical
## 1     5.012           5
```

As observed the mean of the simulation is close to the theoretically expected mean

Step2: compare variance

```r
df_summary[2,] <- c(var(sim_means), (1/lambda)^2/n)
rownames(df_summary) <- c("mean", "variance")
print(round(df_summary,3))
```

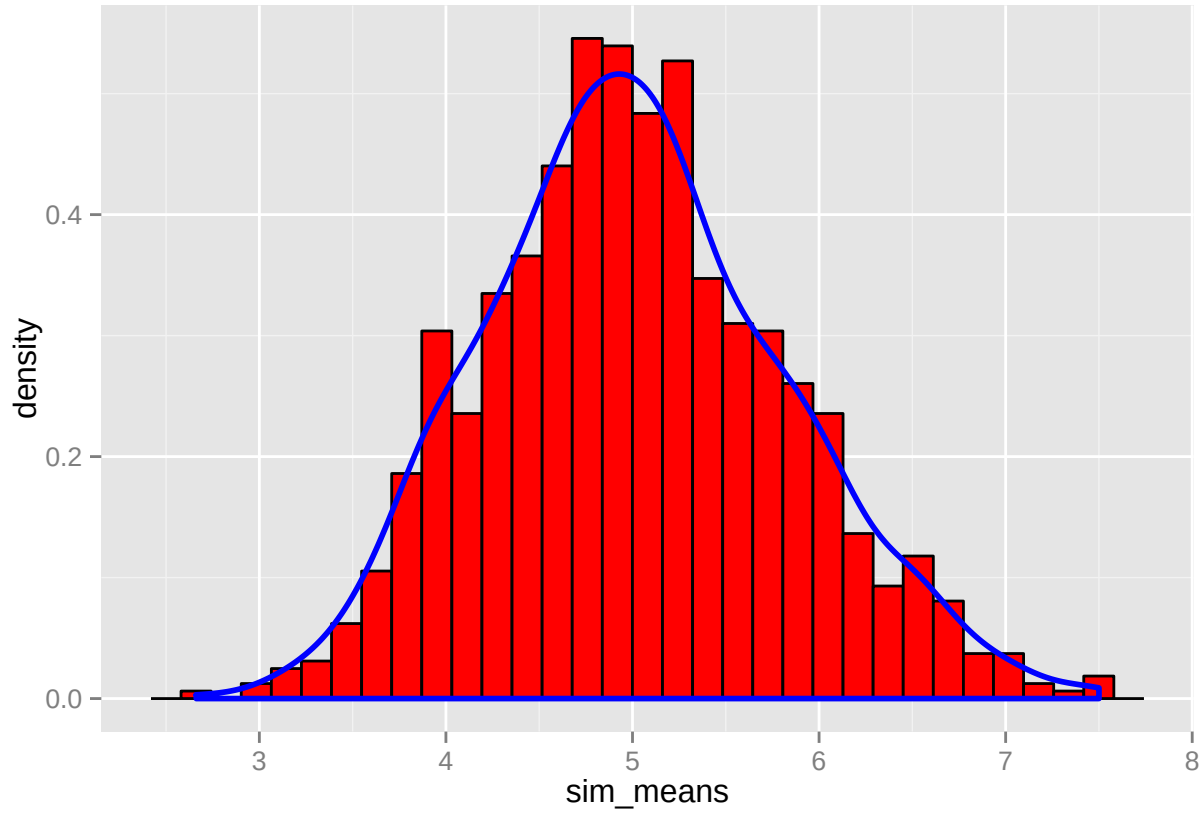
```
##          simulated theoretical
## mean         5.012       5.000
## variance     0.640       0.625
```

As observed the variance of the simulation is close to the theoretically expected variance

Step3: show the variable approximately follows a normal distribution

```r
library(ggplot2)
sim_means_g <- data.frame(sim_means)
g <- ggplot(sim_means_g, aes(x=sim_means))
g <- g + geom_histogram(aes(y=..density..), col = "black", fill = "red")
g <- g + geom_density(col = "blue", size = 1)
print (g)
```

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



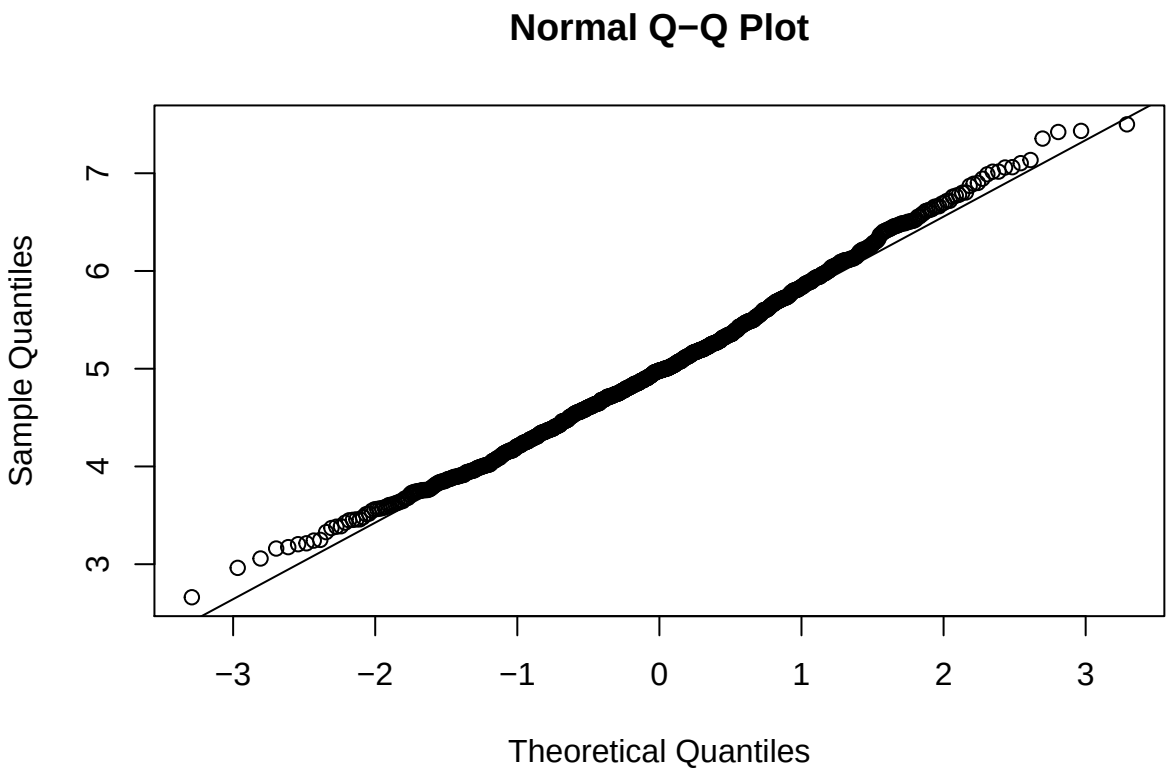
The shape of the curve is approximately Gaussian

construct simulated confidence interval and compare to theoretical CI

```
sim_CI <- mean(sim_means) + c(-1,1)*1.96*sd(sim_means)/sqrt(n)
theo_CI <- 1/lambda + c(-1,1)*1.96*((1/lambda^2)/n)/sqrt(n)
CI_summary <- data.frame(rbind(sim_CI, theo_CI), row.names = c("simulated", "theoretical"))
colnames(CI_summary) <- c("Lower Bound", "Upper Bound")
print(CI_summary)
```

```
##             Lower Bound Upper Bound
## simulated      4.763686    5.259412
## theoretical    4.806310    5.193690
```

```
#
#normal quintile plot
qqnorm(sim_means); qqline(sim_means)
```


Normal Q−Q Plot
Sample Quantiles
Theoretical Quantiles
3
4
5
6
7
−3
−2
−1
0
1
2
3