

# Statistical Inference Course Project

MK

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Simulations: In this analysis, 40000 random exponential numbers are created using rexp function in R. Then, these numbers are rearranged in a 1000(row) by 40(column) matrix.

Sample Mean versus Theoretical Mean: The mean of each row is calculated which yields a 1000 by 1 matrix. It is shown that the mean of the samples means is almost equal to the theoretical mean of the distribution.

Sample Variance versus Theoretical Variance: The distribution variance is also almost equal to the theoretical variance.

Distribution: The histograms of the random exponential numbers distribution and the samples means are also shown. From the histograms, it can be concluded that the samples means distribution is almost normal, but the random exponential numbers distribution is not normal.

In the end, the 95% confidence interval of the distribution is calculated.

```
lambda <- 0.2
n <- 40

exps <- rexp(1000*n, lambda)
expsMatrix <- matrix(exps, 1000, 40)
```

```
samplesMean <- apply(expsMatrix, 1, mean)
sprintf("distribution center (mean): %s", round( mean(samplesMean),3 ))
```

```
## [1] "distribution center (mean): 4.988"
```

```
theoryMean = 1/lambda
sprintf("theoretical center (mean): %s", round( theoryMean,3 ))
```

```
## [1] "theoretical center (mean): 5"
```

As shown in the above analysis, the distribution mean (center) and theoretical mean (center) are almost equal.

```
sprintf("distribution variance: %s", round( var(exps),3 ))
```

```
## [1] "distribution variance: 25.074"
```

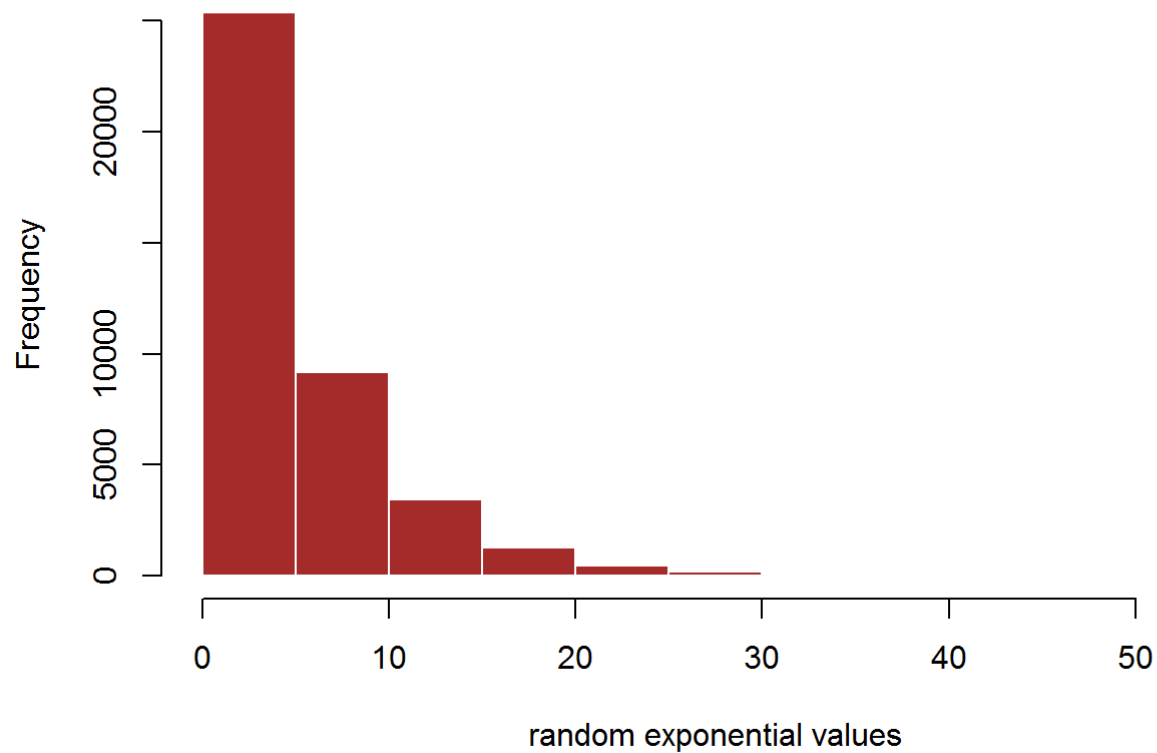
```
theoryVar <- (1/lambda)^2
sprintf("theoretical variance: %s", round( theoryVar,3 ))
```

```
## [1] "theoretical variance: 25"
```

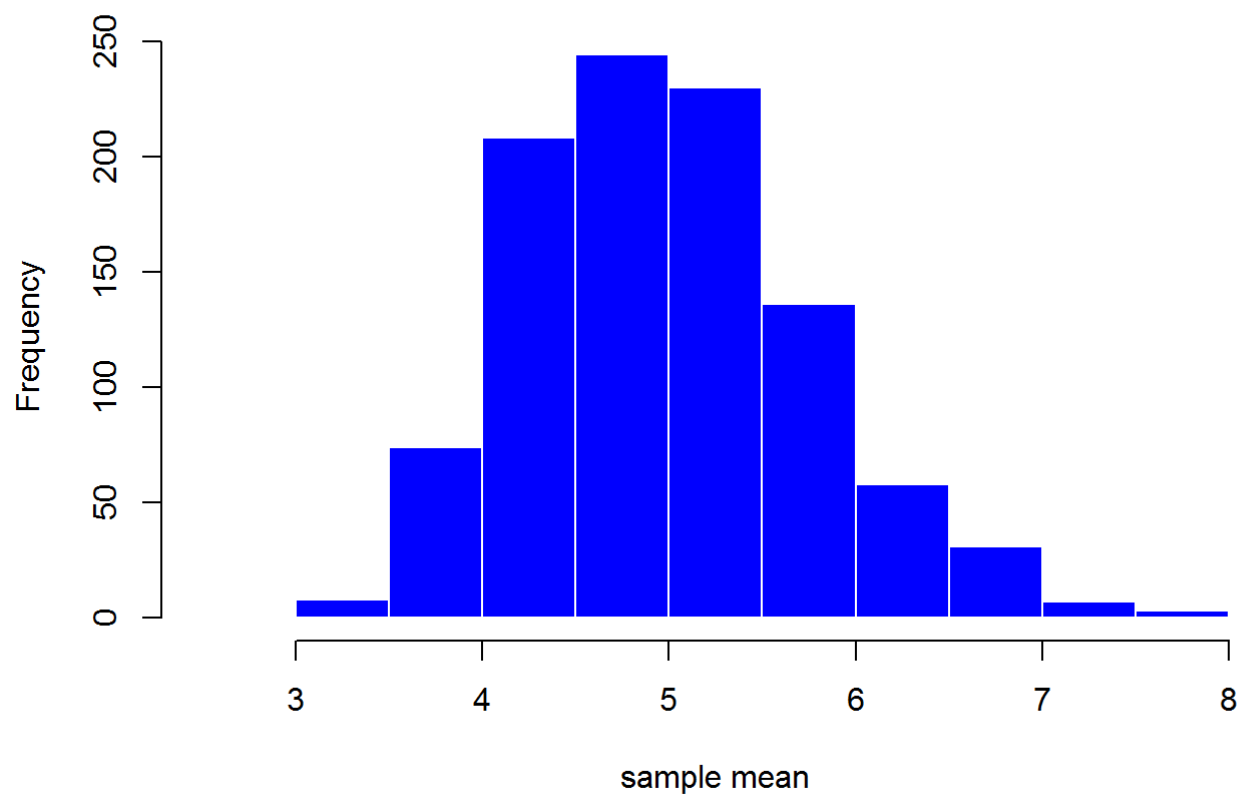
As shown in the above analysis, the distribution variance and theoretical variance are almost equal.

## Histograms:

## Histogram of Simuated Values



## Histogram of Samples Means



As obvious in the histograms, the distribution of the samples means is normal, while the distribution of the random exponential values is not.

## Confidence Interval:

```
confidenceInterval <- mean(samplesMean) + c(-1,1)*qt(.975, 1000-1)*sqrt(var(exps)/40)
```

```
## [1] "confidence interval:"
```

```
## [1] 3.434182 6.541501
```