

# Exponential distribution Simulation

This is the first part of the project for the Statistical inference course. The exponential distribution was simulated with the function `rexp(n,lambda)`, using `lambda = 0.2`

## 0. The simulation

First run thousand times the simulated data for `n=40`, `lambda=0.2` and stored the mean of each sample in a vector

```
lambda = 0.2
n = 40
times = 1000

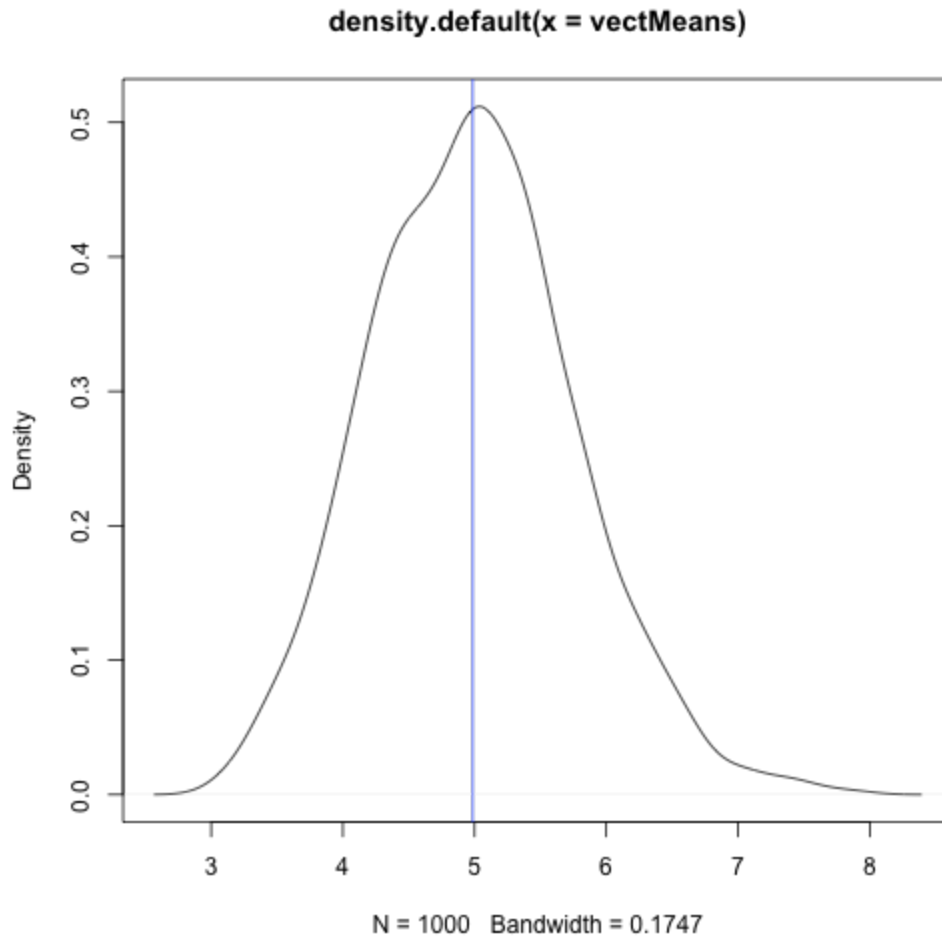
vectMeans <- NULL
vectVar <- NULL
vectStDev <- NULL

samples <- replicate(times, rexp(n, lambda))

for (i in 1:times) {
  vectMeans <- c(vectMeans, mean(samples[, i]))
  vectVar <- c(vectVar, var(samples[, i]))
  vectStDev <- c(vectStDev, sd(samples[, i]))
}
```

## 1. Where the distribution is centered at and compare it to the theoretical center of the distribution

```
theMean <- mean(vectMeans)
theDensity <- density(vectMeans)
plot(theDensity)
abline(v = theMean, col = "blue")
```



The mean of the simulated data was 4.9859 , which is very close to the theoretical center of the distribution:  $1/0.2=5$

## 2. How variable it is and compare it to the theoretical variance of the distribution

The theoretical variance for the exponential distribution is  $1/(\lambda * \lambda)$ , in this case:  $1/(0.2 * 0.2)=25$

```
variance <- mean(vectVar)
```

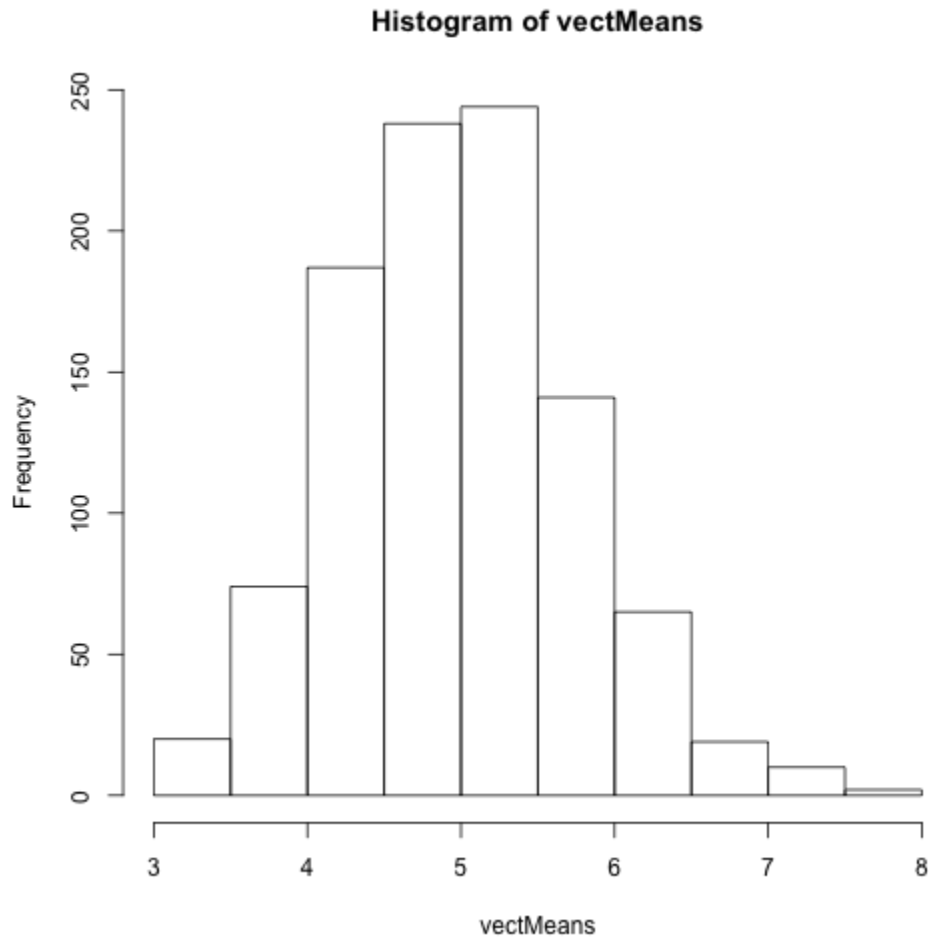
The variance for the simulated data is 24.7191, again very close to the theoretical value.

## 3. Show that the distribution is approximately normal

The next graph is a qqplot that evaluates the fit of the sample data with a normal distribution.

It uses the theoretical quantiles of the distribution

```
hist(vectMeans)
```



As seen in the histogram above, the data seems to follow a normal distribution.

#### 4. Evaluate the coverage of the confidence interval

```
coverage <- array(0, 1000)
cs <- array(0, 100)
for (k in 1:1000) {
  oneSample <- samples[, k]
  Maxisample <- max(oneSample)
  Minisample <- min(oneSample)
  C = (Maxisample - Minisample)/(2 * sqrt(n))

  cinterval <- ((vectMeans[k] - C < 1) & (vectMeans[k] + C >
1))

  coverage[k] <- mean(cinterval)
}
```