Analysis of the Exponential Distribution Function Using Simulation

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Overview

In this file, we explore the Exponential distribution function via simulation. Data is generated and the mean distribution is plotted. The obtained result from the sample set is also compared to the expected(theoretical) results.

The Exponential Distribution Function

```r
hist(rexp(1000, .2), breaks = 100, main = "Exponential Distribution function",
     xlab = "Rexp(1000) values")
```

Exponential Distribution function
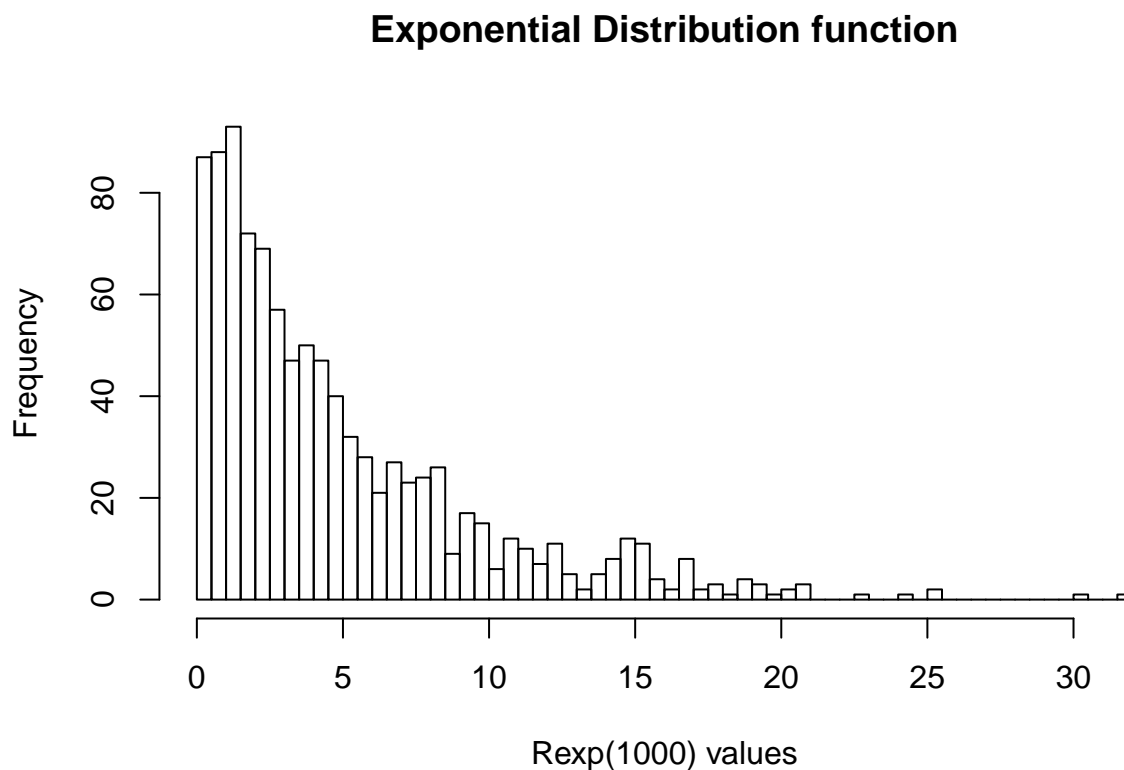
Above is the distribution of the values of the exponential distribution function, with lambda = 0.2. It doesn't look very Gaussian.

We can also check the distribution of the means. First we need to setup the values we will use.

```
lambda <- 0.2                          # We set lambda equal to 0.2,
n <- 40                                # sample size equal to 40,
ns <- 1000                             # number of sample sets equal to 1000
sd <- 1/lambda                         # standard deviation
theoretical.mean = 1/lambda            # expected mean by definition
theoretical.var = 1/lambda^2           # expected variance by definition
```

We now generate the data and compute for the sample means and sample variance.

```
x = NULL
rexp.data <- matrix(nrow = ns, ncol = 2)
set.seed(666)                          #set seed for reproducibility
for(i in 1:ns){x <- rexp(n, lambda)
    rexp.data[i,1] <- mean(x)          #mean is computed separately for each sample set
    rexp.data[i,2] <- var(x)}          #variance is computed separately for each sample set
sample.mean <- mean(rexp.data[,1])     #compute for the mean of the means
sample.var <- mean(rexp.data[,2])      #compute for the mean of variances
cat("The theoretical mean is", theoretical.mean,
    ", the mean from the generated sample set is", sample.mean, ".")
```

```
## The theoretical mean is 5 , the mean from the generated sample set is 4.987818 .
```

```
cat("The theoretical variance is", theoretical.var,
    ", the variance obtained from the sample set is", sample.var, ".")
```

```
## The theoretical variance is 25 , the variance obtained from the sample set is 25.38717 .
```

The sample mean and the sample variance does look close enough to the theoretical.

```
hist(rexp.data[,1], breaks = 100, prob = TRUE,
    main="Mean Distribution of the Exponential Function", xlab="Means")
abline(v = theoretical.mean, col= 4, lwd = 2)
abline(v = sample.mean, col = 2,lwd = 2)
legend('topright', c("Sample Mean", "Theoretical Mean"), bty = "n", lty = c(1,1),
        col = c(col = 4, col = 2))
```

Mean Distribution of the Exponential Function
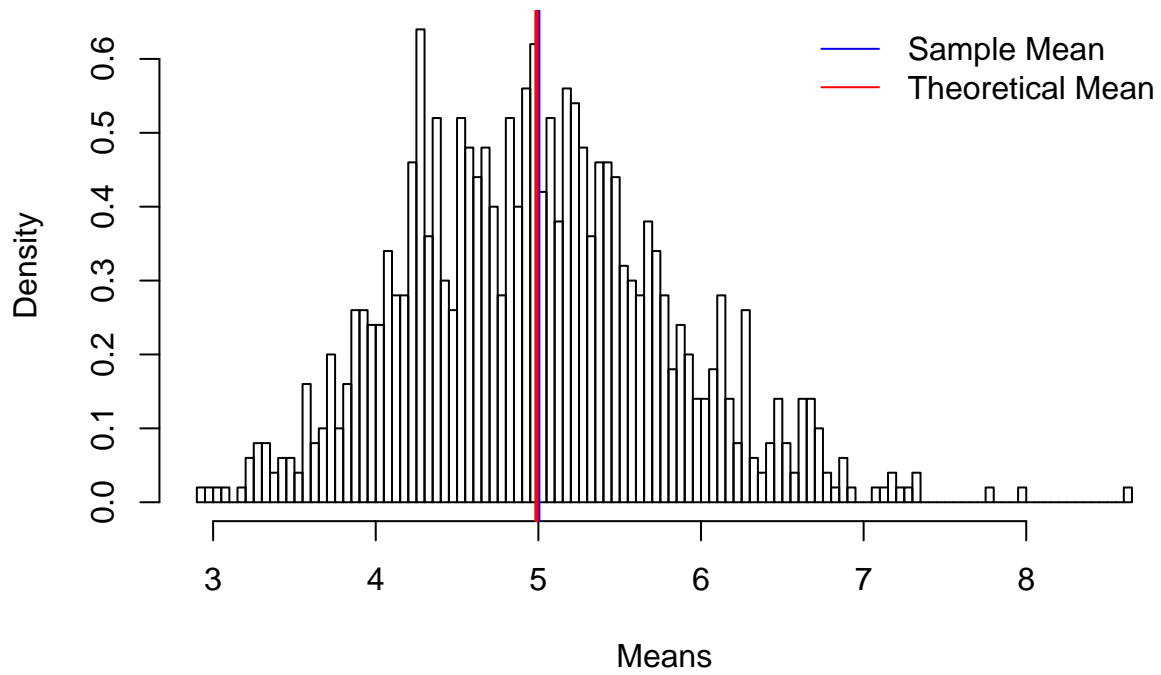
Above is the distribution of the means of the exponential distribution function from the dataset that was generated earlier. It looks a lot more like the normal distribution function.