Exponential Distribution

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Overview

In this project I investigate the exponential distribution in R and compare it with the Central Limit Theorem.
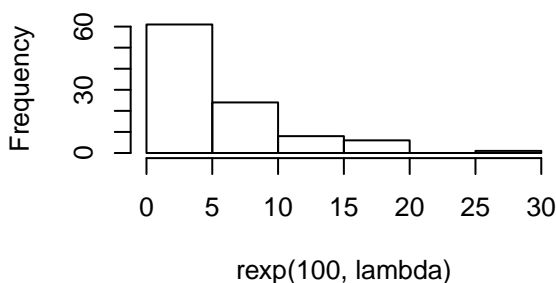
Simulations

The exponential distribution can be simulated in R with rexp(n, lambda) where lambda is the rate parameter. We generate some random samples to see how the distribution looks like.

```
set.seed(5)
lambda <- .2
par(mfrow=c(2,2))
hist(rexp(10, lambda))
hist(rexp(100, lambda))
hist(rexp(1000, lambda))
hist(rexp(10000, lambda))
```
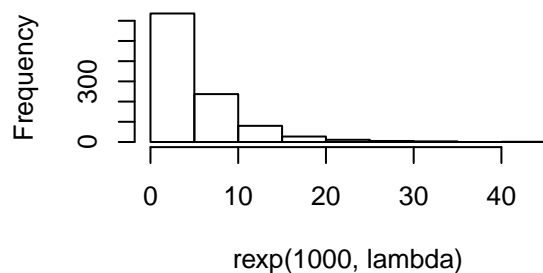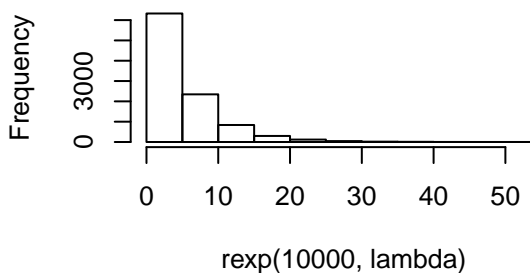
Histogram of rexp(10, lambda)
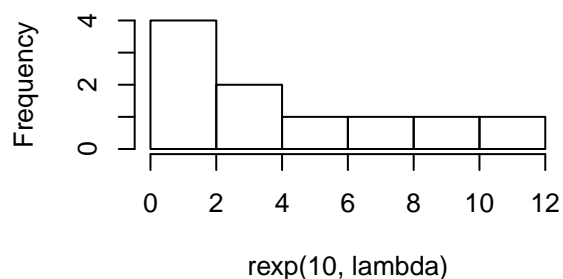
Histogram of rexp(100, lambda)

Histogram of rexp(1000, lambda)

Histogram of rexp(10000, lambda)

Sample Mean versus Theoretical Mean

The distribution of 1000 averages of 40 exponentials.

```
mns = NULL
for (i in 1 : 1000) mns = c(mns, mean(rexp(40, 0.2)))
```

```
sampleMean <- mean(mns)
teoreticalMean <- 1/0.2
sampleMean
```

```
## [1] 5.05725
```

```
teoreticalMean
```

```
## [1] 5
```

Conclusion: The mean of the simulated samples is close to theoretical mean.

Sample Variance versus Theoretical Variance

```
sampleVar <- var(mns)
teoreticalVar <- ((1/0.2)/sqrt(40))^2
sampleVar
```

```
## [1] 0.637314
```

```
teoreticalVar
```

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

Conclusion: The variance of the simulated samples is close to theoretical variance.
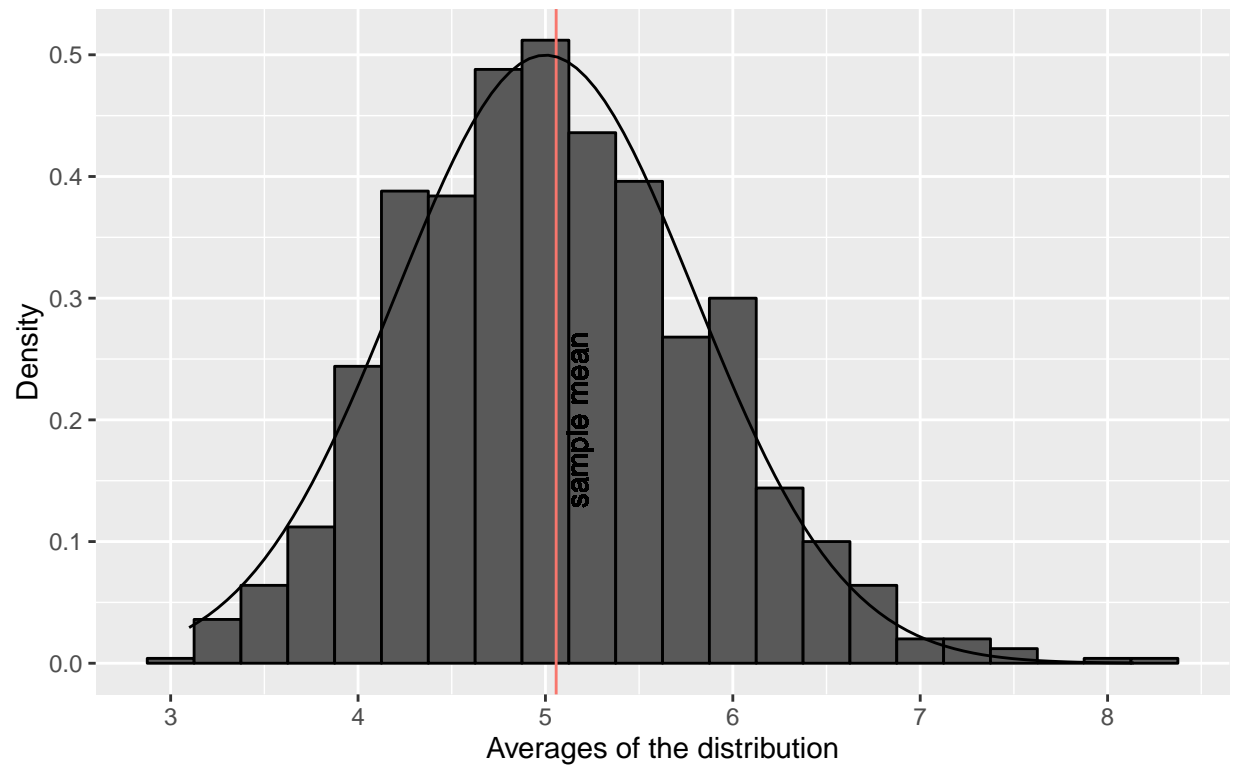
Distribution

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.2.4
```

```
data <- as.data.frame(mns)
```

```
ggplot(data = data, aes(x=mns)) +
        geom_histogram(aes(y=..density..), binwidth=.25, col="black") +
        geom_vline(aes(xintercept=mean(mns),colour="red")) +
        geom_text(aes(x=mean(mns),label="\nsample mean",y=0.2),colour="black",angle=90)+
        xlab("Averages of the distribution") + ylab("Density")+
        ggtitle("Figure 1: Distribution of the averages of \n40 random exponentials (1000 simulations)
        theme(legend.position="none") +
        stat_function(fun=dnorm,args=list(mean=5,sd=sd(mns)))
```

Figure 1: Distribution of the averages of
40 random exponentials (1000 simulations)

Conclusion: The distribution is standard normal.