A simulation exercise

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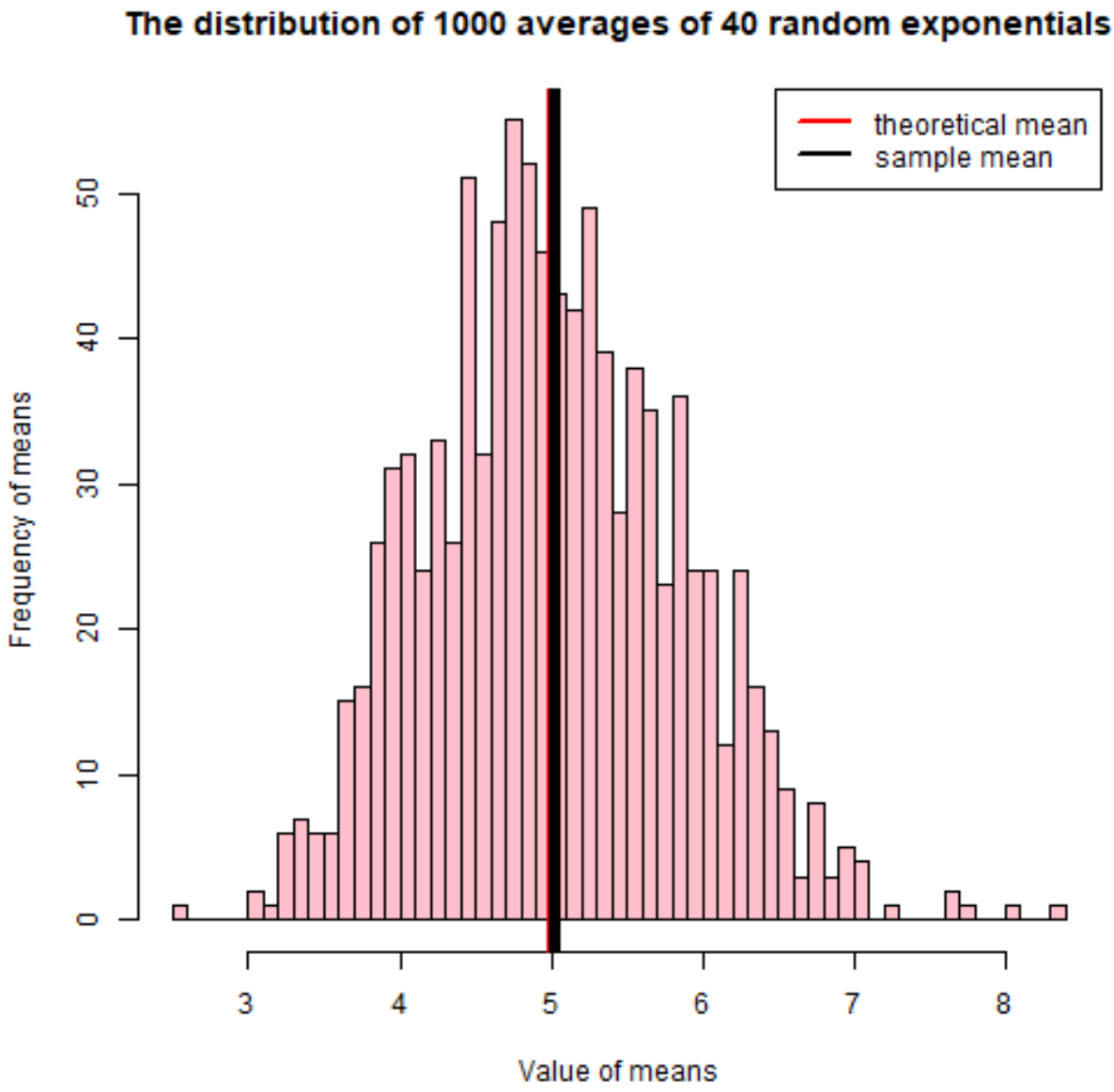
In this project you will investigate the exponential distribution in R and compare it with the Central Limit Theorem. The exponential distribution can be simulated in R with rexp(n, lambda) where lambda is the rate parameter.

```
lambda <- 0.2
simData <- matrix(rexp(1000*40, lambda), nrow = 1000, ncol = 40)
```

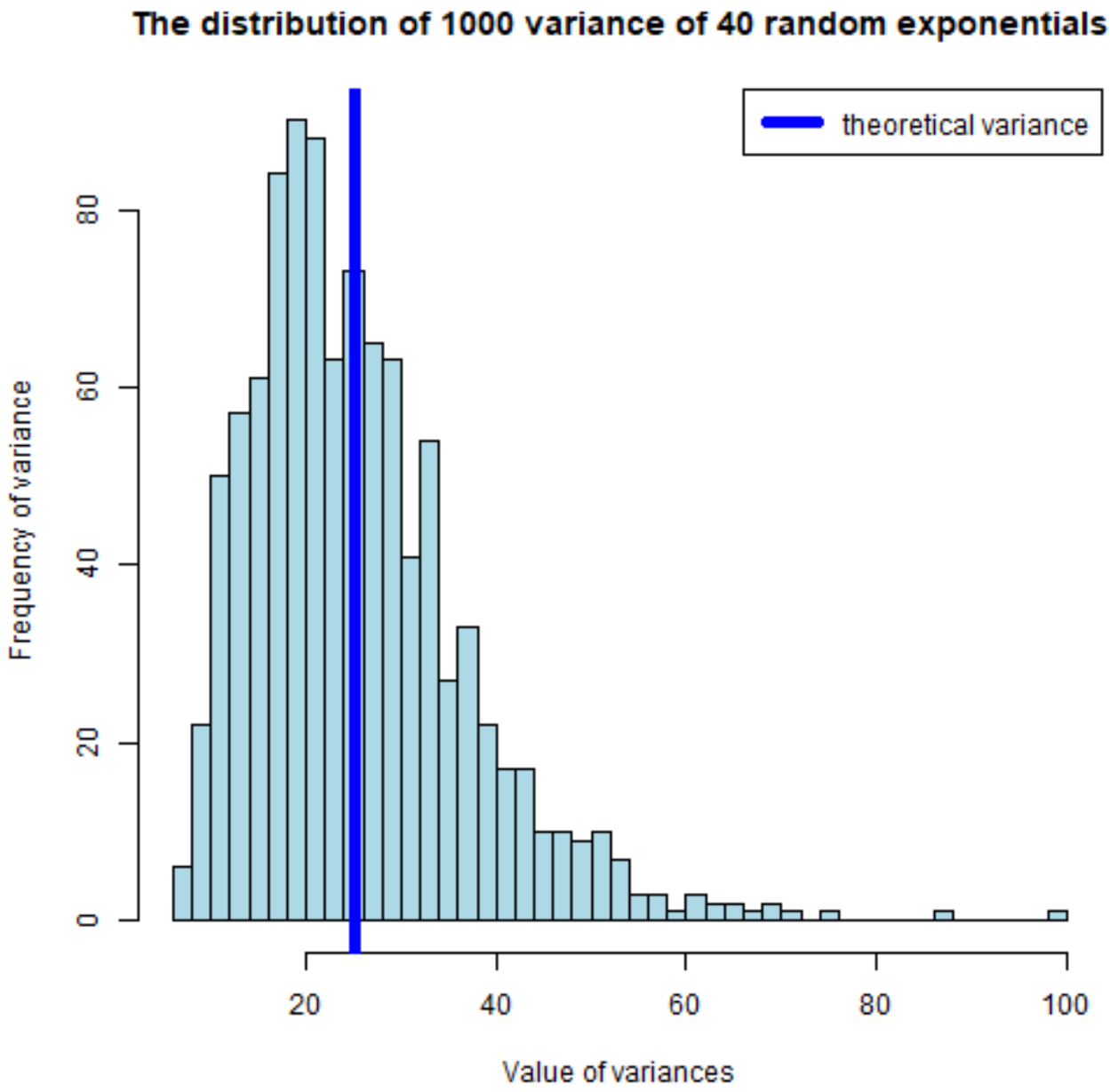
Show the sample mean and compare it to the theoretical mean of the distribution.

```
distMean <- apply(simData, 1, mean)
par(mar=c(2,1,2,8))
hist(distMean, breaks = 50, main = "The distribution of 1000 averages of 40
random exponentials", xlab = "Value of means", ylab = "Frequency of means", col =
"pink")
abline(v = 1/lambda, lty = 1, lwd = 5, col = "red")
abline(v=mean(distMean),lty=1,lwd=5,col="black")
legend(6,60, lty = 1, lwd = 2, col = c("red","black"), legend = c("theoretical
mean","sample mean"))
```



Show how variable the sample is (via variance) and compare it to the theoretical variance of the distribution.

```
distVar <- apply(simData, 1, var)
par(mar=c(2,1,2,10))
hist(distVar, breaks = 50, main = "The distribution of 1000 variance of 40 random
exponentials", xlab = "Value of variances", ylab = "Frequency of variance", col =
"light blue")
abline(v = (1/lambda)^2, lty = 1, lwd = 5, col = "blue")
legend(40,100, lty = 1, lwd = 5, col = "blue", legend = "theoretical variance")
```



Show that the distribution is approximately normal.

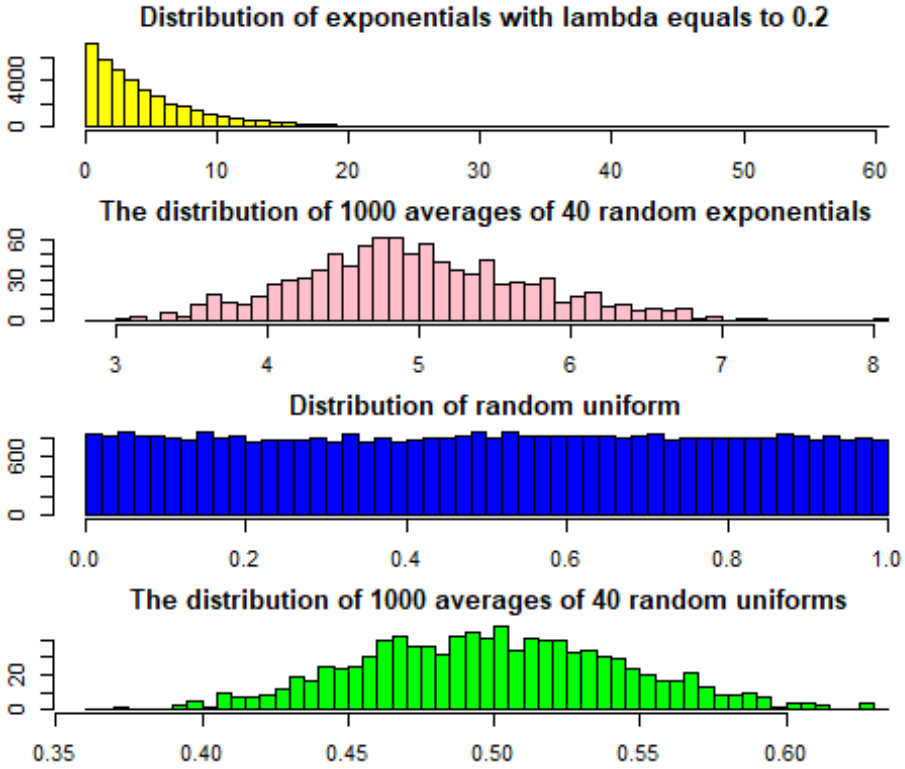
```
par(mfrow = c(4,1),mar=c(2,2,2,2))

hist(simData, breaks = 50, main = "Distribution of exponentials with lambda
equals to 0.2", xlab = "Exponentials", col = "yellow")
hist(distMean, breaks = 50, main = "The distribution of 1000 averages of 40
random exponentials", xlab = "Value of means", ylab = "Frequency of means", col =
"pink")

uniform_Data <- matrix(runif(1000*40), nrow = 1000, ncol = 40)
```

```
hist(uniform_Data,breaks=50,main="Distribution of random
uniform",xlab="Uniforms",col="blue")

average_uniform_Data<-apply(uniform_Data,1,mean)
hist(average_uniform_Data, breaks=50, main=" The distribution of 1000 averages of
40 random uniforms",xlab="Value of means",ylab="Frequency of means",col="green")
```



The first histogram is the distribution of the exponentials with lambda equals to 0.2. The second histogram is the distribution of 1000 averages of 40 random exponentials.

If we compare first histogram with second we can see that distribution becomes normally distributed

The third histogram is the distribution of the uniforms. The fourth histogram is the distribution of 1000 averages of 40 random uniforms.

In this case as well ditribution becomes approximatelly normal