Simulation of Exponential Distribution

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Overview

This is an exercise for comparing simulations of means of 40 exponentials with the Central Limit Theorem. It is divided into 4 parts:
1. The simulations performed
2. The sample mean compared with the theoretical mean of the distribution
3. The sample variance compared with the theoretical variance of the distribution
4. An illustration via plot that shows the distribution is approximately normal

Simulations

Note that
1. **n**, the number of exponentials per iteration for getting the mean is set to 40
2. **lambda**, the rate parameter is set to 0.2

The following code produces 10,000 means of 40 exponentials

```
n <- 40
lambda <- 0.2

mns = NULL
for (i in 1:10000)
  mns = c(mns, mean(rexp(n,lambda)))
```

Sample Mean versus Theoretical Mean

After running the simulation, we can now get the sample mean in R by:

```
# sample mean
meanS <- mean(mns)
meanS
```

```
## [1] 4.988164
```

Meanwhile, the theoretical mean of Exponential distribution can be calculated by:

```
# theoretical mean
meanT = 1/lambda
meanT
```

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

We can see the sample mean **meanS** approximates the theoretical mean **meanT** quite closely. This means the distribution is centered at 4.9881642 and is very close to the theoretical mean 5.

Sample Variance versus Theoretical Variance

Let's now calculate the sample variance. This can be done in R by:

```
# sample variance
varS <- var(mns)
varS
```

```
## [1] 0.6240104
```

The theoretical variance on the other hand, is simply the standard deviation (1/lambda) squared over n samples

```
# theoretical variance
varT <- (1/lambda)^2/n
varT
```

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

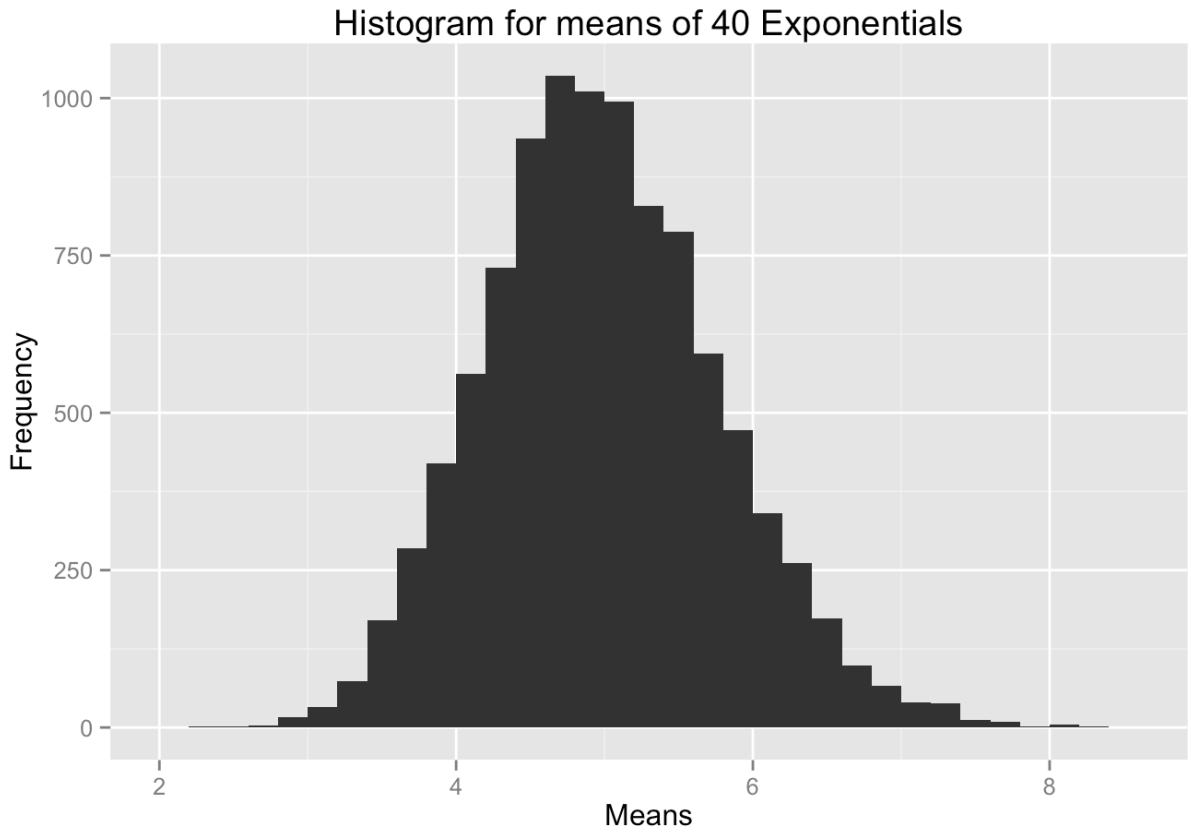
Here we can also see that the sample variance **varS** : 0.6240104 is very close to the theoretical variance **varT** : 0.625.

Distribution

By plotting the means using a simple histogram we can see quite clearly that the distribution is approximately normal.

This can be done in R using ggplot:

```
library(ggplot2)
qplot(mns, geom="histogram",
      binwidth=0.2,
      xlab="Means", ylab="Frequency",
      main="Histogram for means of 40 Exponentials")
```


Histogram for means of 40 Exponentials
Frequency
1000
750
500
250
0
2
4
6
8
Means