# Investigate the exponential distribution in R and compare it with the Central Limit Theorem

## AIM

To investigate the exponential distribution and compare it to the Central Limit Theorem.For this analysis,the lambda will be set to 0.2 for all of thr simulations.This investigation will compare the distribution of averages of 40 exponentials over 1000 simulations

## Simulations

Set the simulation variables lambda,exponentials and seed

```
ECHO=TRUE
set.seed(1337)
lambda = 0.2
exponentials = 40
```

Run Simulations with variables

```
simMeans = NULL
for (i in 1 : 1000) simMeans = c(simMeans, mean(rexp(exponentials, lambda)))
```

## Sample Mean vs Theoretical Mean

### Sample Mean

Calculating the mean from the simulations with given sample mean

```
mean(simMeans)
```

```
## [1] 5.055995
```

### Theoretical Mean

```
lambda^-1
```

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

### Comparison

There is only a slight difference between the simulations sample mean and the exponential distribution theoretical mean

```
abs(mean(simMeans)-lambda^-1)
```

```
## [1] 0.05599526
```

# Sample Variance vs Theoretical Variance

## Sample variance

Calculating the variance from the simulation with the given sample variance

```
var(simMeans)
```

```
## [1] 0.6543703
```

## Theoretical Variance

The theoretical variance of an exponential distribution is :

```
(lambda * sqrt(exponentials))^-2
```

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

## Comparison

There is only a slight difference between the simulations sample variance and the exponential distribution theoretical variance

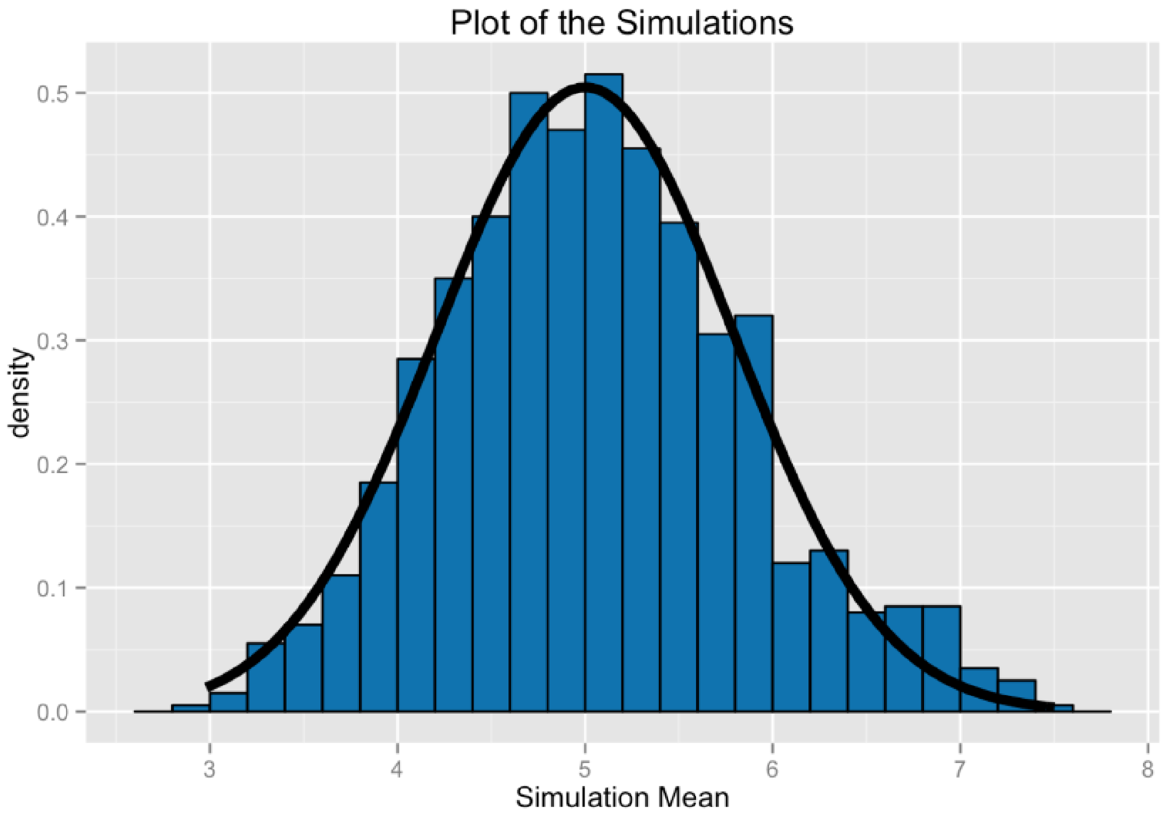
```
abs(var(simMeans)-(lambda * sqrt(exponentials))^-2)
```

```
## [1] 0.0293703
```

## Distributiuon

This is a density histogram of the 1000 simulations.There is an overlay with a normal distribution and std deviation :

```
library(ggplot2)
ggplot(data.frame(y=simMeans), aes(x=y)) +
  geom_histogram(aes(y=..density..), binwidth=0.2, fill="#0072B2",
                 color="black") +
  stat_function(fun=dnorm, arg=list(mean=lambda^-1,
                                    sd=(lambda*sqrt(exponentials))^-1),
                size=2) +
  labs(title="Plot of the Simulations", x="Simulation Mean")
```



Plot of the Simulations
0.5
0.4
0.3
0.2
0.1
0.0
density
3
4
5
6
7
8
Simulation Mean