Investigation of exponential distribution

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This report provides the results of investigation of the properties of the distribution of the mean of 40 exponentials. It contains:

1. comparison of the sample mean to the theoretical mean of the distribution;
2. variability of the sample (via variance) and its comparison to the theoretical variance of the distribution;
3. confirmation that the distribution is approximately normal.

```
library(ggplot2)

set.seed(1234)
```

Sample Mean versus Theoretical Mean Calculate the sample mean of 1000 averages of 40 exponentials.

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

```
## [1] 4.974239
```

Calculate the theoretical mean (1/lambda)

```
theoretical_mean <- 1 / 0.2
theoretical_mean
```

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

Calculate the difference between the sample mean and the theoretical mean.

```
results <- sample_mean - theoretical_mean
results
```

```
## [1] -0.02576123
```

The results shows that the difference between the sample mean of large collection of averages of a number of randoms and the theoretical mean is very low. What prooves the Law of Large Numbers.

Sample Variance versus Theoretical Variance Calculate the variance of the distribution of 1000 averages of 40 random exponentials.

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

```
## [1] 0.5815859
```

Calculate the theoretical variance ((1/lambda)^2/n)

```
theoretical_var <- (1/0.2)^2/40
theoretical_var
```

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

Calculate the difference between the sample variance and the theoretical variance.

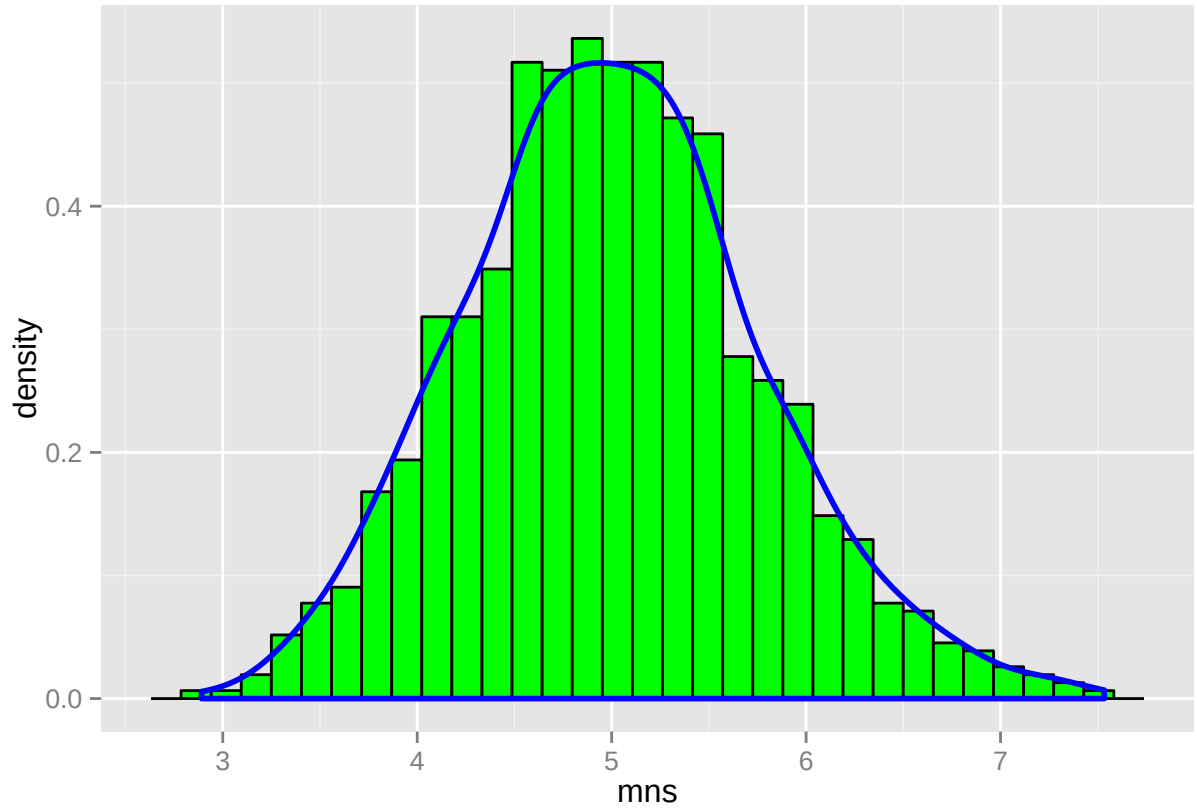
```
results <- sample_var - theoretical_var
results
```

```
## [1] -0.04341407
```

The results shows that the difference between the sample variance of large collection of averages of a number of randoms and the theoretical variance is very low. What prooves the Law of Large Numbers.

Distribution Plot the distribution of averages of 40 random exponentials and approximate it to the normal distirbution.

```
plot <- ggplot(data.frame(mns), aes(x = mns))
plot <- plot + geom_histogram(aes(y=..density..), color = "black", fill = "green")
plot + geom_density(colour="blue", size=1);
```



The plot above shows that the distribution fits the bell curve pretty well and thus is approximately normal.