Statistical Inference Project 1

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A Simulation Excercise

The exponential distribution can be simulated in R with `rexp(n, lambda)` where `lambda` is the rate parameter. The mean of exponential distribution is `1/lambda` and the standard deviation is also `1/lambda`. For this simulation we will investigate the distribution of averages of 40 exponentials over a thousand observations, assuming the `lambda = 0.2`

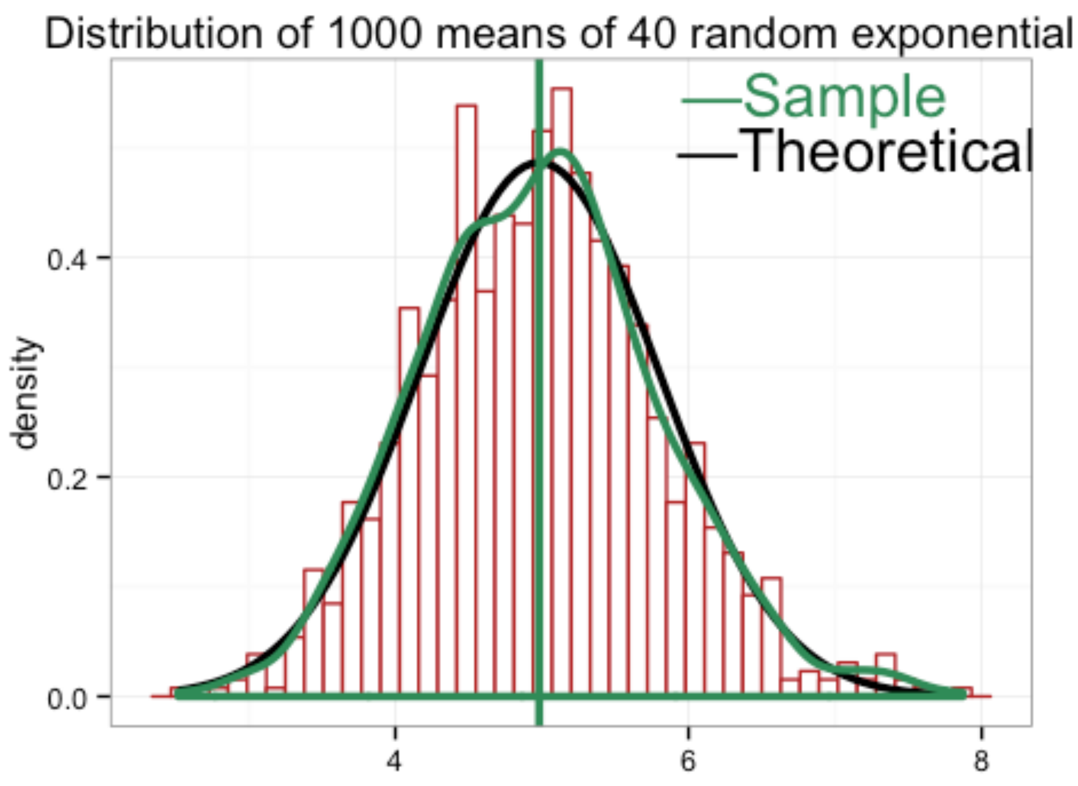
Simulations

We start by doing a thousand simulated averages of 40 exponentials.

```
lambda <- 0.2
n <- 1000
s.size <- 40
simulation <- matrix(rexp(n*s.size, rate=lambda), n, s.size)
sample.means <- rowMeans(simulation)
```

Sample Mean versus Theoretical Mean

We find that the sample mean is centered at 4.981 which is very close to the theoretical mean of 5.




```
round(mean(sample.means), 3)
```

```
## [1] 4.981
```

```
1/lambda
```

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

Sample Variance versus Theoretical Variance

We find the standard deviation of our sample

```
sd(sample.means)
```

```
## [1] 0.8198767
```

And our predicted standard deviation

```
(1/lambda)/sqrt(s.size)
```

```
## [1] 0.7905694
```

Next we can find the variance of our sample mean

```
var(sample.means)
```

```
## [1] 0.6721978
```

Then we can find the theoretical variance of our distribution.

```
((1/lambda)^2)/s.size
```

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

This show us that our distribution of sample means, which is centered around the population mean of 5, has a variance of 0.672 which is in accord with the theoretical variance of 0.625 as predicted by the Central Limit Theorem.

Distribution

The Q-Q plot below shows two probability distributions where any point `(X,Y)` denotes a data point from our sample distribution plotted against our theoretical distribution. The linearity suggests that normality is a good approximation.

```
gg_qq(sample.means)
```