Statistical Inference Course Project-1

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Sunday, May 24, 2015

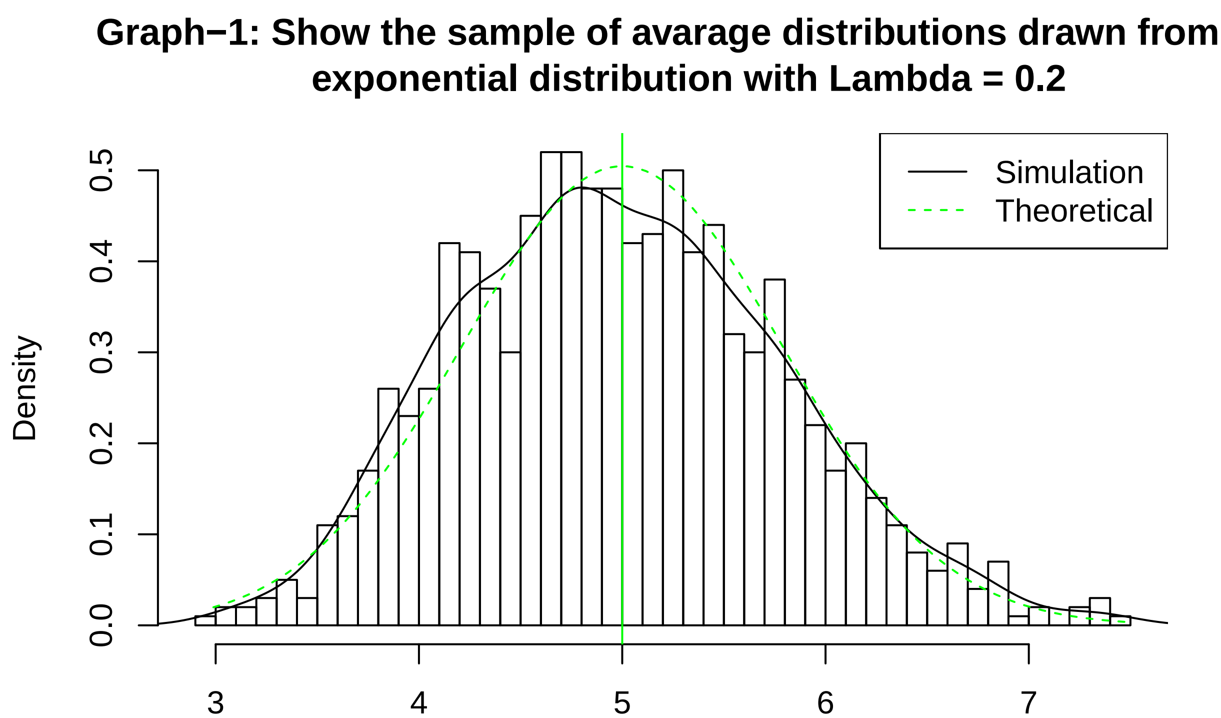
OVERVIEW

In this project I 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. The mean of exponential distribution is 1/lambda and the standard deviation is also 1/lambda. I will set lambda = 0.2 for all of the simulations. I will investigate the distribution of averages of 40 exponentials. Note that I will need to do a thousand simulations.

Simulate averages of 40 exponetials from 1000 random uniforms.

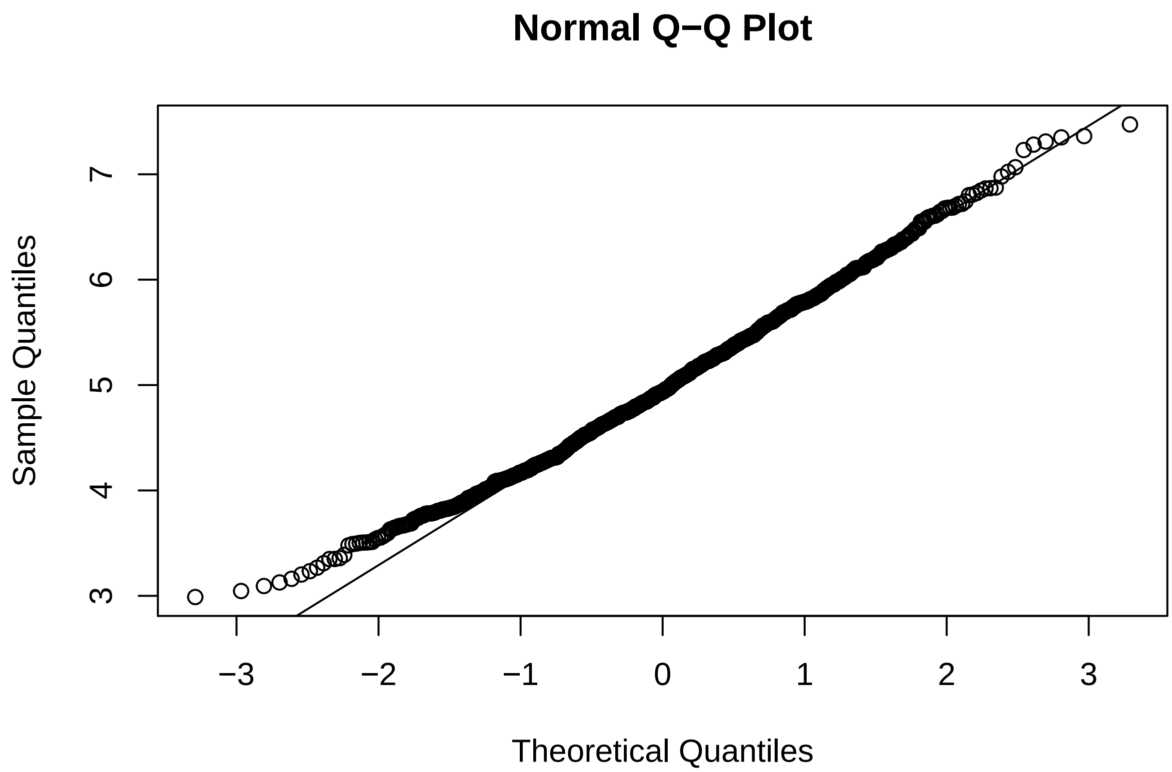
```
set.seed(3)
lambda <- 0.2
simu_num <- 1000
average_size <- 40
sim <- matrix(rexp(simu_num*average_size, rate=lambda), simu_num, average_size)
row_means <- rowMeans(sim)
```

The distribution of sample means as shown below:



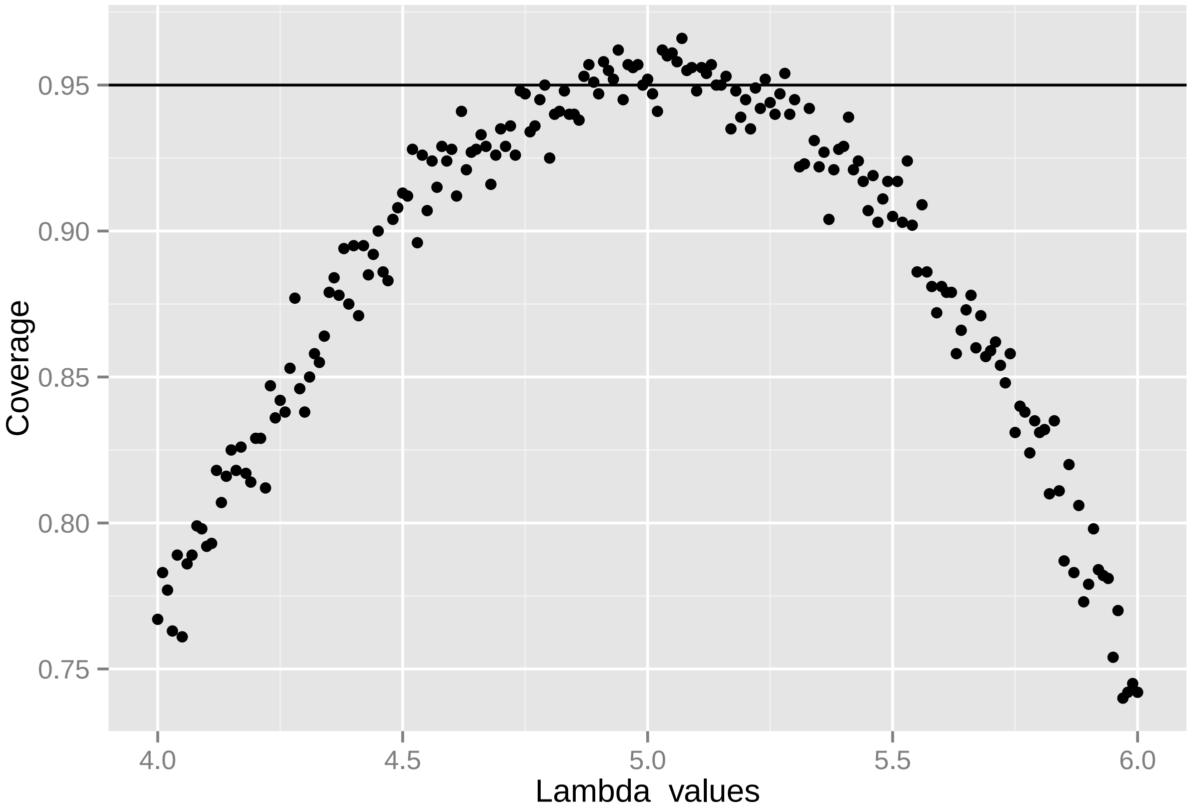
The sample means from distribution is centered at 4.9866197, theoretical center of the distribution is $\lambda^{-1} = 5$. sample means of variance is 0.6257575, here theoretical variance of the distribution is $\sigma^2/n = 1/(\lambda^2 n) = 1/(0.04 \times 40) = 0.625$. With this theoretical central limit is the average of samples normal distribution. From above Graph-1 explains the density calculated using the histogram, normal density plotted with theoretical mean and its variance values.

Below Q-Q Graph-2 explains the normality.



Examine coverage of the confidence interval for $1/\lambda = \bar{X} \pm 1.96 \frac{S}{\sqrt{n}}$

```
## Warning: package 'ggplot2' was built under R version 3.1.2
```



The rate parameter (λ) is estimated from 95% confidence intervals ($\hat{\lambda}$) are $\hat{\lambda}_{low} = \hat{\lambda}(1 - \frac{1.96}{\sqrt{n}})$ and $\hat{\lambda}_{upp} = \hat{\lambda}(1 + \frac{1.96}{\sqrt{n}})$. From Graph-3 plot, selection for $\hat{\lambda}$ is around 5, sample mean avarage is within the confidence interval 95% of the time. And note that the real rate is λ is 5.

The report including the code for plots is available at