Statistical Inference Course Project, Part 1

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Overview

Part 1: Simulation Exercise Instructions

In this project you 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. Set lambda = 0.2 for all of the simulations. You will investigate the distribution of averages of 40 exponentials. Note that you will need to do a thousand simulations.

Illustrate via simulation and associated explanatory text the properties of the distribution of the mean of 40 exponentials. You should

1. Show the sample mean and compare it to the theoretical mean of the distribution.
2. Show how variable the sample is (via variance) and compare it to the theoretical variance of the distribution.
3. Show that the distribution is approximately normal.

Simulations

```
lambda = 0.2
n = 40
sims = 1:1000
set.seed(100)
means <- data.frame(x = sapply(sims, function(x) {mean(rexp(n, lambda))}))
```

```
mean(means$x)
```

```
## [1] 4.999702
```

```
1/lambda
```

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

Center of distribution = 4.9997 is very close to the expected mean = 5.0000

```
sd(means$x)
```

```
## [1] 0.8020251
```

```
(1/lambda)/sqrt(n)
```

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

Standard deviation = 0.8020 is very close to the expected standard deviation = 0.7906

```
var(means$x)
```

```
## [1] 0.6432442
```

```
((1/lambda)/sqrt(n))^2
```

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

Variance of distribution = 0.6432 is very close to the expected variance of distribution = 0.625

Based on the graphic below we can verify that the distribution of our simulations seems to be approximately normal.

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.3.2
```

```
ggplot(data = means, aes(x = x)) + geom_histogram(aes(y=..density..),
        fill = 'lightgreen', color = 'black', binwidth = 0.20)
```