Exponential Distribution

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Overview

The purpose of the project is to investigate the exponential distribution 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 the exponential distribution is 1/lambda and the standard deviation is also 1/lambda. Lambda will be set at 0.2 for all simulations. The investigation will compare the distribution of averages of 40 exponentials over 1,000 simulations.

The Simulations

We set the variables for the simulations as follows:

```
set.seed(108)
n<-40
lambda<-0.2
sims<-1000
```

Perform the simulations using the variables as follows:

```
means = NULL
for (i in 1:sims) {
    means = c(means, mean(rexp(n, lambda)))
}
```

Sample Mean vs. Theoretical Mean

Sample Mean

Calculate the sample mean from the simulations.

```
samMean<-mean(means)
```

Theoretical Mean

Calculate the theoretical mean.

```
theoMean<-1/lambda

meanComp<-samMean-theoMean
```

Comparison

The sample mean of 5.0581079 versus the theoretical mean of 5 for a difference of 0.0581079.

Sample Variance vs. Theoretical Variance

Sample Variance

Calculate the sample variance from the simulations.

```
samVar<-var(means)
```

Theoretical Variance

Calculate the theoretical variance.

```
theoVar<-(1/lambda)^2/n

varComp<-samVar-theoVar
```

Comparison

The sample variance of 0.6435606 versus the theoretical variance of 0.625 for a difference of 0.0185606.

Distribution

The following is a density histogram of the simulated means. The density histogram has an overlay of a normal distribution with mean of 1/lambda and standard deviation of (1/lambda)*sqrt(n).

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.5.2
```

```
df<-data.frame(means)
ggplot(df, aes(x = means)) + geom_histogram(aes(y = ..density..), binwidth = 0.2, fill
= "red", color = "black") + stat_function(geom = "line", fun = dnorm, args = list(mean
= theoMean, sd = sd(means)), size = 1) + labs(x = "Simulated Means", y = "Density", ti
tle = "Density of Simulated Means")
```