Statistical Inference Project Part 1

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Report Overivew

The purpose of this will illustrate through a simulation exercise the properties of the distribution of the mean of 40 exponentials. It will include details on (a) Sample Mean versus Theoretical Mean, (b) Sample Variance versus Theoretical Variance and (c) Show that the distribution is approximately normal. To make it easier to understand the results I've combined the report and figured together.

Execute the simulation

First we will execute the simulation. Lets start by setting the working directory and referencing libraries.

```
#set working directory
setwd("~/CourseraRClass/StatInf")
#reference necessary libs
library(ggplot2)
```

Then execute the simulations using the parameters below.

```
set.seed(9867)
lambda <-.2
number_sim <-1000
```

```
sample_size <- 40
data<-matrix(rexp(number_sim*sample_size, lambda),number_sim,sample_size)
```

Results

Sample Mean versus Theoretical Mean

```
data_means<-apply(data, 1, mean)
sample_mean<-mean(data_means)
sample_mean
```

```
## [1] 4.995101
```

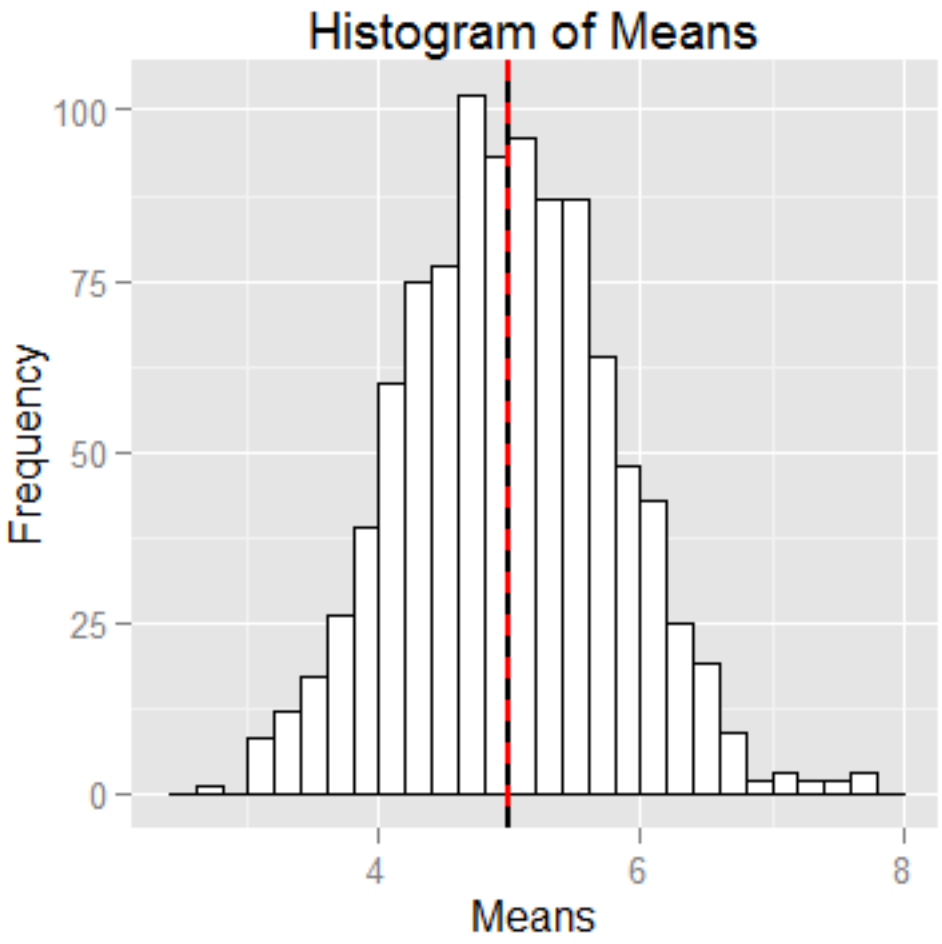
```
theo_mean<-1/lambda
theo_mean
```

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

Using the above code the sample mean is 4.995101 and the theorectical mean is 5. The plot below gives a visual of the simulation along with the sample (“black line”) and theorectical mean (“red line”).

```
q<-ggplot() +
  aes(data_means) +
  geom_histogram(binwidth=.2, colour="black", fill="white") +
  geom_vline(aes(xintercept=theo_mean),
             color="red", linetype="solid", size=1) +
```

```
  geom_vline(aes(xintercept=sample_mean),
             color="black", linetype="dashed", size=1) +
  labs(list(title = "Histogram of Means", x = "Means", y = "Frequency"))
q
```



Sample Variance versus Theoretical Variance

The sample variance is the variance of the sample means

```
data_var<-var(data_means)
data_var
```

```
## [1] 0.6376136
```

with a value of 0.6376136. The theorectical variance is variance of the exponential distribution (1/lambad)^2 divided by the sample size. See calculation below.

```
theo_var<-(1/lambda)^2 / sample_size
theo_var
```

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

Show the distribution is normal.

The distribution of sample means are normally distributed. To demonstrate this below is the probability density of the sample means (black line) of 40 exponentials from 1000 simulations along side the normal distribution with a mean of 5 and variance of 0.625. You'll notice they are very close. The key to this being normal is that we are taking averages of 40 exponentials vs. a large collection of exponentials.

```
p<-ggplot() +   aes(data_means) +   geom_density() +   stat_function(geom="line",
                fun=dnorm, colour = "red", arg=list(mean=theo_mean,sd=sqrt(theo_var))) +
  labs(list(title = "Probabilty Density"))
p
```