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.

Execute the simulation

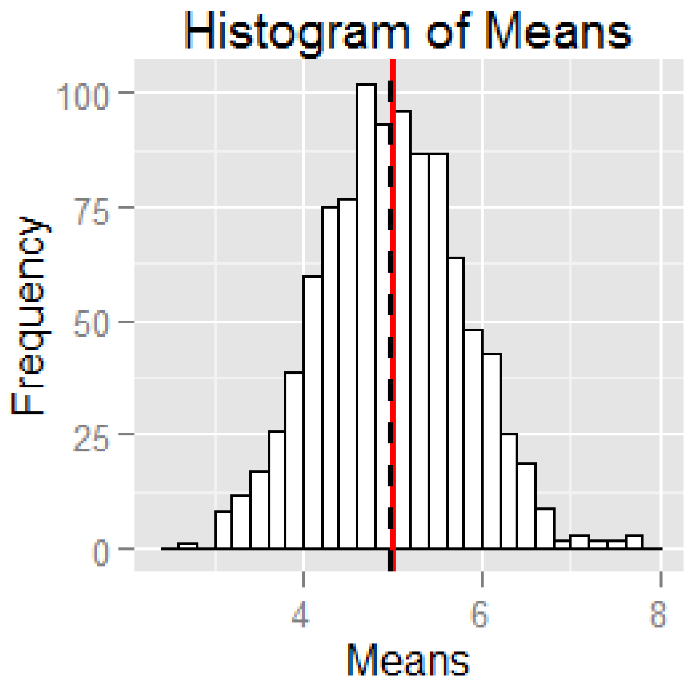
First we will execute the simulation.

```
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

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").

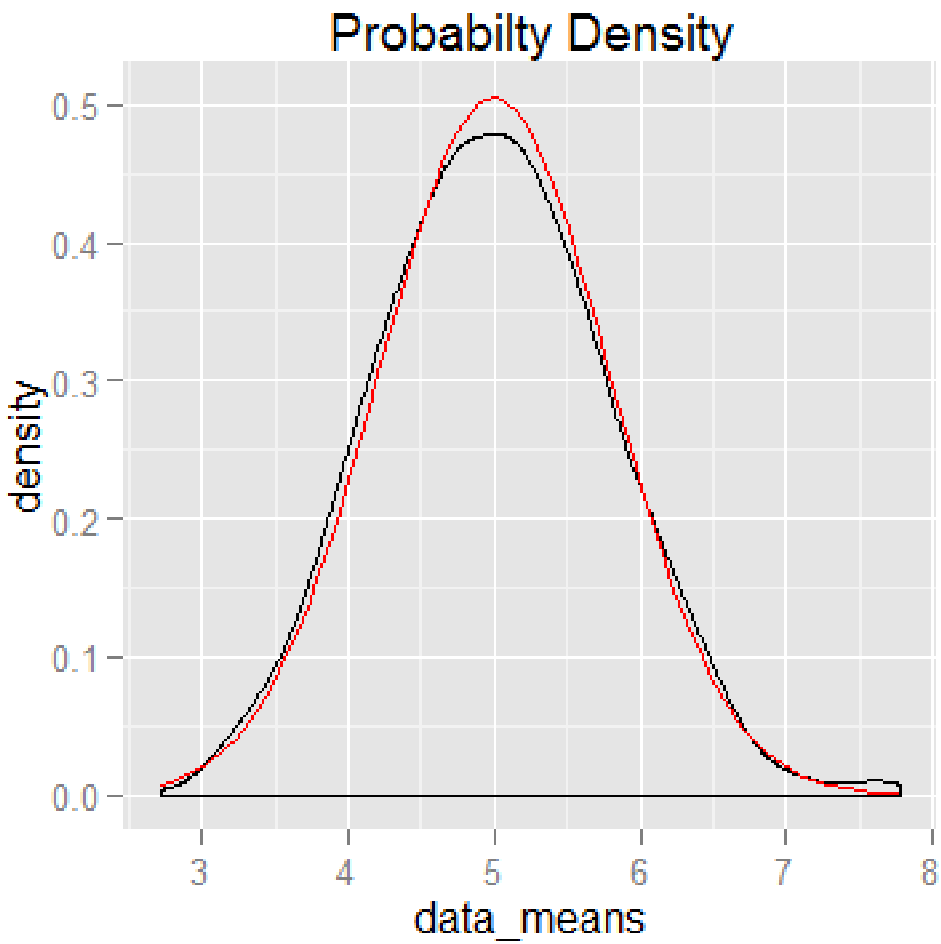


Sample Variance versus Theoretical Variance

The sample variance is the variance of the sample means with a value of 0.6376136. The theorectical variance is variance of the exponential distribution (1/lambad)^2 divided by the sample size, 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 versus a large collection of exponentials.



Appendix (Full set of code used)

{r set work directory and reference libraries, echo=FALSE}

setwd("~/CourseraRClass/StatInf")

library(ggplot2)

{r execute simulations}

set.seed(9867)

lambda <-.2

number_sim <-1000

sample_size <- 40

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

{r sample means, echo=FALSE}

data_means<-apply(data, 1, mean)

sample_mean<-mean(data_means)

theo_mean<-1/lambda

{r sample means plot, fig.height=3, fig.width=3, echo=FALSE}

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

{r variances, echo=FALSE}

data_var<-var(data_means)

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

{r show normal, fig.height=4, fig.width=4, echo=FALSE}

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