Statistical Inference : Course Project

Simulation Exercises :

Distibution of the mean of 40 exponential (0.2)s:

Generate Simulated Data :

```r
# Evaluation of the mean of the distribution of 40 exponentials
# with lambda=0.2. Mean and standard deviation of the exponential
# distribution is 1/lamda

n=40        # sample size
lambda=0.2  # Lambda value
numsim=1:1000 # Number of Simulations
set.seed(2014)

simdata=sapply(numsim,function(x) rexp(n,lambda)) # generate the simulations.

simmean=apply(simdata,2,mean) # Mean of columns of 40 x 1000 simulated data
```

Attributes of the mean of Simulations :

```r
meansimmean=mean(simmean) # mean of mean distribution of 40 exponential (0.2)s

simsd = sd(simmean) # Standard Deviation of the mean distribution

simvar = simsd^2/n # variance of the mean distribution
```

Expected values of the distribution :

```r
expmean=1/lambda # Expected value of the sample mean

expsd=1/lambda/sqrt(n) # Expected value of the standard deviation

expvar=expsd^2/n # Expected variance

conint=expmean+c(-1,1)*1.96*expsd  #Confidence interval for 1.96*s/sqrt(n) for lambda

coverage=length(simmean[(conint[1]<=simmean)&(conint[2]>=simmean)])/length(simmean)*100
```

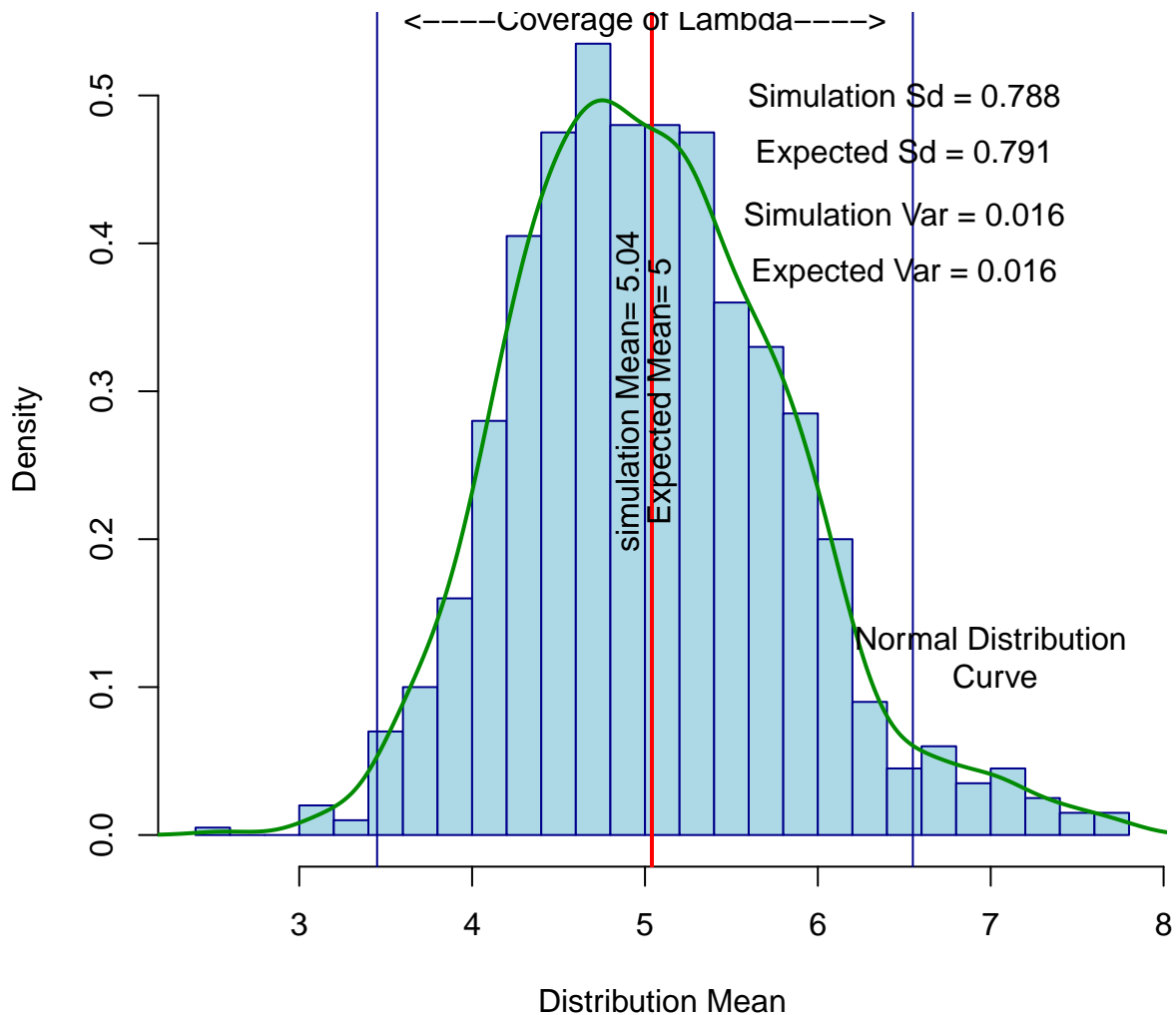**Plot of the Simulation :**

```r
hist(simmean,breaks=20,
     col="lightblue",freq=F,
     border="darkblue",
     xlab="Distribution Mean",
     main="Density Plot Of Mean of Exponential 40(0.2)s")
abline(v=meansimmean,col="red",lwd=2)
abline(v=conint[1],col="darkblue")
abline(v=conint[2],col="darkblue")
text(4.9,0.3,paste("simulation Mean=",round(meansimmean,3)),srt=90)
```

```
text(5.1,0.3,paste("Expected Mean=",expmean),srt=90)
text(6.5,0.5,paste("Simulation Sd =",round(simsd,3)))
text(6.5,0.46,paste("Expected Sd =",round(expsd,3)))
text(6.5,0.42,paste("Simulation Var =",round(simvar,3)))
text(6.5,0.38,paste("Expected Var =",round(expvar,3)))
lines(density(simmean),col="green4",lwd=2)
text(7.0,0.12,"Normal Distribution\n Curve")
text(5,0.55,"<----Coverage of Lambda---->")
```

Density Plot Of Mean of Exponential 40(0.2)s

Evaluation Of simulation :

The simulation mean, **5.04** and expected mean, **5** are in very close range, indicating that the simulation and theoritical distribution are centred around the same mean.

The simulation standard deviation, **0.7877** and variance, **0.0155** are in very close range of expected standard deviation, **0.7906** and variance, **0.0156**, indicating that the the simulation matches the distribution

The superimposed normal distribution curve shows that the simulation histogram follows the normal distribution very closely. Hence, we can conclude that the distribution is approximately normal.

Confidence Interval Coverage :

Confidence interval of **1.96*s/sqrt(n)** for $1/\lambda$ is **3.45, 6.55**. This is a **95.1%** interval of the simulation means.