# Assignment Number 1 - Part A

## Set up steps

Set up the values for the simulation

```
set.seed(667)
sims <- 1000
n <- 40
lambda <- 0.2
```

Create a Matrix of the values for better visualization.

```
sim <- matrix(rexp(sims * n, rate = lambda), sims)
```

## Question 1: Show the sample mean and compare it to the theoretical mean of the distribution.

Take the mean for each row

```
row_means<-rowMeans(sim)
mean(row_means)
```

```
## [1] 5.025859
```

The theoretical mean of the sample:

```
1/lambda
```

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

## Question 2: Show how variable the sample is (via variance) and compare it to the theoretical variance of the distribution.

Calculate the sd of each rowMeans

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

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

The theoretical sd

```
var(row_means)
```

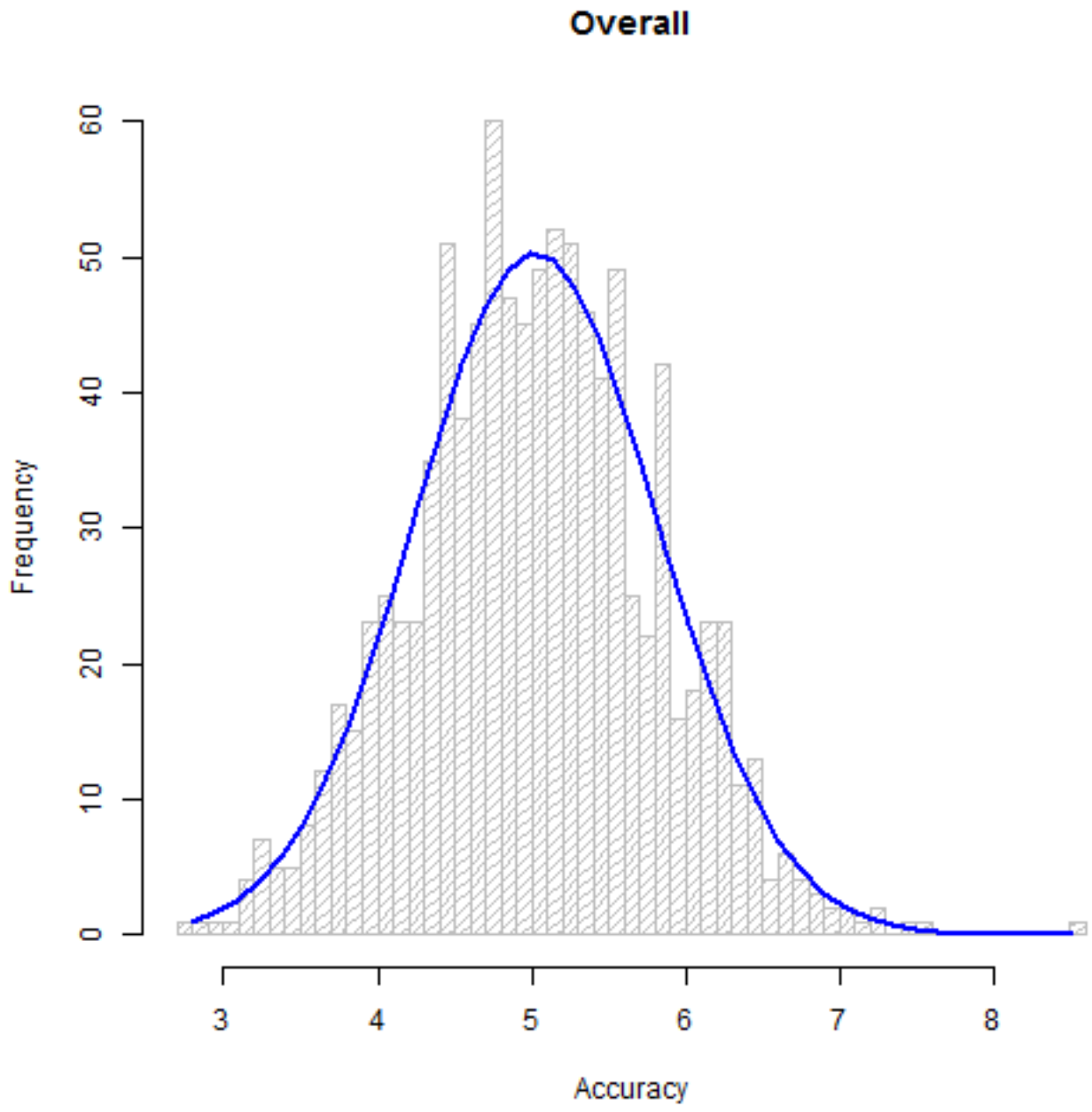
```
## [1] 0.6286297
```

# Question 3: Show that the distribution is approximately normal.

This histogram visually shows how the exponential distribution closely resembles a curve of the Central Limit Theorum.

```
h<-hist(means, breaks=50, density=20, col="gray", xlab="Accuracy", main="Overall")
    xfit<-seq(min(means),max(means),length=40)
    yfit<-dnorm(xfit,mean=mean(means),sd=sd(means))
    yfit <- yfit*diff(h$mids[1:2])*length(means)
```

```
    lines(xfit, yfit, col="blue", lwd=2)
```



# Assignment Number 1 - Part B

First load the required libraries

```
library(ggplot2)
library(datasets)
data(ToothGrowth)
```

Here are some basic exploratory data Analyses.

```
str(ToothGrowth)
```

```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: num  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
```

```
head(ToothGrowth)
```

```
##    len supp dose
## 1  4.2   VC  0.5
## 2 11.5   VC  0.5
## 3  7.3   VC  0.5
## 4  5.8   VC  0.5
## 5  6.4   VC  0.5
## 6 10.0   VC  0.5
```

```
ToothGrowth$dose <- as.factor(ToothGrowth$dose)
table(ToothGrowth$supp, ToothGrowth$dose)
```

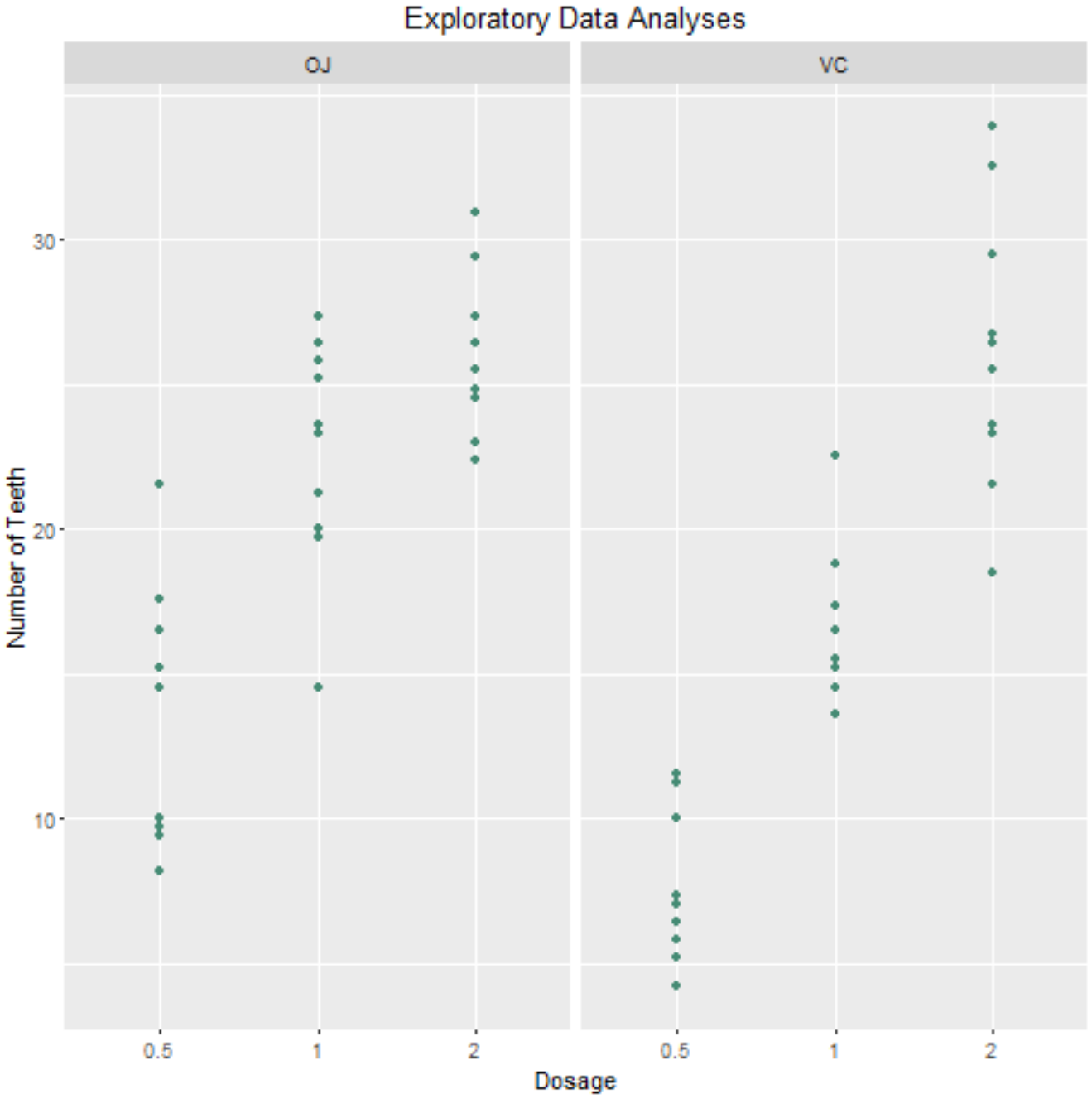
```
##
##      0.5  1  2
##   OJ  10 10 10
##   VC  10 10 10
```

```
summary(ToothGrowth)
```

```
##       len        supp     dose
##  Min.   : 4.20   OJ:30   0.5:20
##  1st Qu.:13.07   VC:30   1  :20
##  Median :19.25           2  :20
##  Mean   :18.81
##  3rd Qu.:25.27
##  Max.   :33.90
```

A point chart to start visualizing the outcome of the data. We can get a general idea of what we may expect to see.

```
ggplot(ToothGrowth, aes(x=dose, y=len))+geom_point(color="aquamarine4")+facet_wrap(~supp, nrow=1) +
     labs(x="Dosage", y="Number of Teeth")+
     ggtitle("Exploratory Data Analyses")
```




We perform a variety of t-tests one for each dosage level.

95% confidence interval with dosage of .5

```
AC = ToothGrowth$len[ToothGrowth$supp == 'VC' & ToothGrowth$dose == 0.5]
OJ = ToothGrowth$len[ToothGrowth$supp == 'OJ' & ToothGrowth$dose == 0.5]
t.test(AC,OJ)
```

Confidence interval: -8.780943 to -1.719057 Does not contain 0, therefore there is a 95% confidence in the difference between AC and OJ.

95% confidence interval with dosage of 1

```
AC = ToothGrowth$len[ToothGrowth$supp == 'VC' & ToothGrowth$dose == 1]
OJ = ToothGrowth$len[ToothGrowth$supp == 'OJ' & ToothGrowth$dose == 1]
t.test(AC,OJ)
```

Confidence interval: -9.057852 to -2.802148 Does not contain 0, therefore there is a 95% confidence in the difference between AC and OJ.

95% confidence interval with dosage of 2

```
AC = ToothGrowth$len[ToothGrowth$supp == 'VC' & ToothGrowth$dose == 2]
OJ = ToothGrowth$len[ToothGrowth$supp == 'OJ' & ToothGrowth$dose == 2]
t.test(AC,OJ)
```

Confidence interval: -3.63807 to 3.79807 Does contain 0, therefore we can not be confident in a difference between AC and OJ.

##Conclusion

At doses of 0.5 and 1.0 we can be confident that the treatment has made a difference. However at the 2.0 dosage there is no evidence to suggest that the treatment made any difference.