DATA SCIENCE LABORATORY
LAB MANUAL

Course Code	:	BCSB10
Regulations	:	**IARE - R18**
Semester	:	**I**
Branch	:	**CSE**

Prepared By

Dr. R Obulakonda Reddy, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal – 500 043, Hyderabad

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal – 500 043, Hyderabad

COMPUTER SCIENCE AND ENGINEERING

1. PROGRAM OUTCOMES:

M.TECH-PROGRAM OUTCOMES(POS)	
PO1	Analyze a problem, identify and define computing requirements, design and implement appropriate solutions
PO2	Solve complex heterogeneous data intensive analytical based problems of real time scenario using state of the art hardware/software tools
PO3	Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc.
PO4	Write and present a substantial technical report/document
PO5	Independently carry out research/investigation and development work to solve practical problems
PO6	Function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk and produce deliverables
PO7	Engage in life-long learning and professional development through self-study, continuing education, professional and doctoral level studies.

2. OBJECTIVES OF THE DEPARTMENT

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Program Educational Objectives (PEOs)

A Post Graduate of the Computer Science and Engineering Program should:

PEO – I	Independently design and develop computer software systems and products based on sound theoretical principles and appropriate software development skills.
PEO–II	Demonstrate knowledge of technological advances through active participation in life-long learning.
PEO– III	Accept to take up responsibilities upon employment in the areas of teaching, research,and software development.
PEO– IV	Exhibit technical communication, collaboration and mentoring skills and assume rolesboth as team members and as team leaders in an organization.

3. ATTAINMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

S. No	Experiment	Program Outcomes Attained
1	**R AS CALCULATOR APPLICATION** a. Using with and without R objects on console b. Using mathematical functions on console c. Write an R script, to create R objects for calculator application and save in a specified location in disk.	**PO1, PO5**
2	**DESCRIPTIVE STATISTICS IN R** a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets. b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.	**PO2, PO5**
3	**READING AND WRITING DIFFERENT TYPES OF DATASETS** a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. b. Reading Excel data sheet in R. c. Reading XML dataset in R.	**PO1, PO6**
4	**VISUALIZATIONS** **a.** Find the data distributions using box and scatter plot. b. Find the outliers using plot. c. Plot the histogram, bar chart and pie chart on sample data.	**PO1, PO6**
5	**CORRELATION AND COVARIANCE** a. Find the correlation matrix. b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data. c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.	**PO3, PO7**
6	**REGRESSION MODEL** Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. Require (foreign), require (MASS).	**PO6**
7	**MULTIPLE REGRESSION MODEL** Apply multiple regressions, if data have a continuous Independent variable. Apply on above dataset.	**PO5**
8	**REGRESSION MODEL FOR PREDICTION** Apply regression Model techniques to predict the data on above dataset.	**PO6, PO7**
9	**CLASSIFICATION MODEL** a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier.	**PO4, PO5**
10	**CLUSTERING MODEL** a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.	**PO4, PO5**

4. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Objectives	Program Outcomes						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
I	√	√	√				√
II	√	√	√	√	√		
III	√		√		√	√	

5. SYLLABUS:

DATA SCIENCE LABORATORY

I Semester: CSE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCSB10	Core	-	-	3	2	30	70	100
Contact Classes: Nil	Total Tutorials: Nil	Total Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand the R Programming Language.
II. Exposure on Solving of data science problems.
III. Understand The classification and Regression Model.

LIST OF EXPERIMENTS

Week-1 R AS CALCULATOR APPLICATION

a. Using with and without R objects on console
b. Using mathematical functions on console
c. Write an R script, to create R objects for calculator application and save in a specified location in disk

Week-2 DESCRIPTIVE STATISTICS IN R

a. Write an R script to find basic descriptive statistics using summary
b. Write an R script to find subset of dataset by using subset ()

Week-3 READING AND WRITING DIFFERENT TYPES OF DATASETS

a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location.
b. Reading Excel data sheet in R.
c. Reading XML dataset in R.

Week-4 VISUALIZATIONS

a. Find the data distributions using box and scatter plot.
b. Find the outliers using plot.
c. Plot the histogram, bar chart and pie chart on sample data

Week-5 CORRELATION AND COVARIANCE

a. Find the correlation matrix.
b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.

c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data	
Week-6	**REGRESSION MODEL**
Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. require (foreign), require(MASS).	
Week-7	**MULTIPLE REGRESSION MODEL**
Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset.	
Week-8	**REGRESSION MODEL FOR PREDICTION**
Apply regression Model techniques to predict the data on above dataset	
Week-9	**CLASSIFICATION MODEL**
a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier.	
Week-10	**CLUSTERING MODEL**
a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.	
Reference Books:	
Yanchang Zhao, "R and Data Mining: Examples and Case Studies", Elsevier, 1st Edition, 2012	
Web References:	
1.http://www.r-bloggers.com/how-to-perform-a-logistic-regression-in-r/ 2.http://www.ats.ucla.edu/stat/r/dae/rreg.htm 3.http://www.coastal.edu/kingw/statistics/R-tutorials/logistic.html 4. http://www.ats.ucla.edu/stat/r/data/binary.csv	
SOFTWARE AND HARDWARE REQUIREMENTS FOR 18 STUDENTS: SOFTWARE: R Software , R Studio Software HARDWARE: 18 numbers of Intel Desktop Computers with 4 GB RAM	

INDEX

Week 1 - R AS CALCULATOR APPLICATION

a. Using without R objects on console

```
> 2587+2149
```

```
Output:-
```

```
[1] 4736
```

```
> 287954-135479
```

```
Output:-
```

```
[1] 152475
> 257*52
[1] 13364
```

```
> 257/21
```

```
Output:-
```

```
[1] 12.2381
```

Using with R objects on console:

```
>A=1000
>B=2000
>C=A+B
>C
```

```
Output:-
```

```
[1] 3000
```

b. Using mathematical functions on console

```
>a=100

>class(a)

[1] "numeric"

>b=500

>c=a-b

>class(b)

[1] "numeric"

>sum<a-b
```

```
[1] FALSE

>sum

[1] -400
```

c. **Write an R script, to create R objects for calculator application andsave in a specified location in disk.**

```
getwd()

[1] "C:/Users/Administrator/Documents"

>write.csv(a,'a.csv')

>write.csv(a,'C:\\Users\\Administrator\\Documents')
```

Week 2 - <u>DESCRIPTIVE STATISTICS IN R</u>

a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets.

```
>mtcars
mpgcyldisphp drat    wtqsec vs am gear carb
Mazda RX4            21.0   6 160.0 110 3.90 2.620 16.46  0  1    4
4
Mazda RX4 Wag        21.0   6 160.0 110 3.90 2.875 17.02  0  1    4
4
Datsun 710           22.8   4 108.0  93 3.85 2.320 18.61  1  1    4
1
Hornet 4 Drive       21.4   6 258.0 110 3.08 3.215 19.44  1  0    3
1
Hornet Sportabout   18.7   8 360.0 175 3.15 3.440 17.02  0  0    3
2
Valiant              18.1   6 225.0 105 2.76 3.460 20.22  1  0    3
1
Duster 360           14.3   8 360.0 245 3.21 3.570 15.84  0  0    3
4
Merc 240D            24.4   4 146.7  62 3.69 3.190 20.00  1  0    4
2
Merc 230             22.8   4 140.8  95 3.92 3.150 22.90  1  0    4
2
Merc 280             19.2   6 167.6 123 3.92 3.440 18.30  1  0    4
4
Merc 280C            17.8   6 167.6 123 3.92 3.440 18.90  1  0    4
4
Merc 450SE           16.4   8 275.8 180 3.07 4.070 17.40  0  0    3
3
Merc 450SL           17.3   8 275.8 180 3.07 3.730 17.60  0  0    3
3
Merc 450SLC          15.2   8 275.8 180 3.07 3.780 18.00  0  0    3
3
Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  0  0    3
4
Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3
4
Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3
4
Fiat 128             32.4   4  78.7  66 4.08 2.200 19.47  1  1    4
1
Honda Civic          30.4   4  75.7  52 4.93 1.615 18.52  1  1    4
2
Toyota Corolla       33.9   4  71.1  65 4.22 1.835 19.90  1  1    4
1
Toyota Corona        21.5   4 120.1  97 3.70 2.465 20.01  1  0    3
1
Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3
2
AMC Javelin          15.2   8 304.0 150 3.15 3.435 17.30  0  0    3
```

```
2
Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0     3
4
Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0     3
2
Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1     4
1
Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1     5
2
Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1     5
2
Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1     5
4
Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1     5
6
Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1     5
8
Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1     4
2

>summary(mtcars)

mpgcyldisphp             drat
Min.:10.40   Min.   :4.000   Min.   : 71.1   Min.: 52.0   Min.:2.760
 1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5   1st
Qu.:3.080
Median :19.20   Median :6.000   Median :196.3   Median :123.0   Median
:3.695
 Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7   Mean
:3.597
 3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0   3rd
Qu.:3.920
 Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0   Max.
:4.930
wtqsec             vs               am               gear
Min.:1.513   Min.   :14.50   Min.   :0.0000   Min.   :0.0000   Min.
:3.000
 1st Qu.:2.581   1st Qu.:16.89   1st Qu.:0.0000   1st Qu.:0.0000   1st
Qu.:3.000
Median  :3.325    Median  :17.71    Median  :0.0000    Median  :0.0000
Median :4.000
 Mean    :3.217    Mean    :17.85    Mean    :0.4375    Mean    :0.4062
Mean   :3.688
 3rd Qu.:3.610   3rd Qu.:18.90   3rd Qu.:1.0000   3rd Qu.:1.0000   3rd
Qu.:4.000
 Max.    :5.424    Max.    :22.90    Max.    :1.0000    Max.    :1.0000
Max.   :5.000
carb
Min.:1.000
 1st Qu.:2.000
Median :2.000
 Mean   :2.812
 3rd Qu.:4.000
 Max.   :8.000


>str(mtcars)
```

```
'data.frame': 32 obs. of  11 variables:
$ mpg :num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
 $ cyl :num  6 6 4 6 8 6 8 4 4 6 ...
 $ disp: num  160 160 108 258 360 ...
 $ hp  :num  110 110 93 110 175 105 245 62 95 123 ...
 $ drat: num  3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...
 $ wt  :num  2.62 2.88 2.32 3.21 3.44 ...
 $ qsec: num  16.5 17 18.6 19.4 17 ...
 $ vs  :num  0 0 1 1 0 1 0 1 1 1 ...
 $ am  :num  1 1 1 0 0 0 0 0 0 0 ...
 $ gear: num  4 4 4 3 3 3 3 4 4 4 ...
 $ carb: num  4 4 1 1 2 1 4 2 2 4 ...

>quantile(mtcars$mpg)

    0%    25%    50%    75%   100%
10.400 15.425 19.200 22.800 33.900

>cars

speeddist
1      4    2
2      4   10
3      7    4
4      7   22
5      8   16
6      9   10
7     10   18
8     10   26
9     10   34
10    11   17
11    11   28
12    12   14
13    12   20
14    12   24
15    12   28
16    13   26
17    13   34
18    13   34
19    13   46
20    14   26
21    14   36
22    14   60
23    14   80
24    15   20
25    15   26
26    15   54
27    16   32
28    16   40
29    17   32
30    17   40
31    17   50
32    18   42
33    18   56
34    18   76
35    18   84
36    19   36
```

```
37    19   46
38    19   68
39    20   32
40    20   48
41    20   52
42    20   56
43    20   64
44    22   66
45    23   54
46    24   70
47    24   92
48    24   93
49    24  120
50    25   85
```

```
>summary(cars)

speeddist
Min.: 4.0   Min.   :  2.00
 1st Qu.:12.0   1st Qu.: 26.00
Median :15.0   Median : 36.00
 Mean   :15.4   Mean   : 42.98
 3rd Qu.:19.0   3rd Qu.: 56.00
 Max.   :25.0   Max.   :120.00

>class(cars)
[1] "data.frame"

>dim(cars)

[1] 50  2

>str(cars)

'data.frame': 50 obs. of  2 variables:
 $ speed: num  4 4 7 7 8 9 10 10 10 11 ...
 $ dist :num  2 10 4 22 16 10 18 26 34 17 ...
```

>quantile(cars$speed)

```
  0%  25%  50%  75% 100%
   4   12   15   19   25
```

b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.

>aggregate(. ~ Species, data = iris, mean)

Output:

```
Species Sepal.LengthSepal.WidthPetal.LengthPetal.Width
1     setosa        5.006       3.428        1.462       0.246
2 versicolor        5.936       2.770        4.260       1.326
3  virginica        6.588       2.974        5.552       2.026
```

>subset(iris,iris$Sepal.Length==5.0)

Output:

```
Sepal.LengthSepal.WidthPetal.LengthPetal.WidthSpecies
5              5         3.6          1.4         0.2     setosa
8              5         3.4          1.5         0.2     setosa
26             5         3.0          1.6         0.2     setosa
27             5         3.4          1.6         0.4     setosa
36             5         3.2          1.2         0.2     setosa
41             5         3.5          1.3         0.3     setosa
44             5         3.5          1.6         0.6     setosa
50             5         3.3          1.4         0.2     setosa
61             5         2.0          3.5         1.0 versicolor
94             5         2.3          3.3         1.0 versicolor
```

Week 3 - READING AND WRITING DIFFERENT TYPES OF DATASETS

a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk location.

```
library(utils)
data<- read.csv("input.csv")
data
```

Output :-

```
id,   name,    salary,   start_date,     dept
1      1    Rick     623.30    2012-01-01      IT
2      2    Dan      515.20    2013-09-23      Operations
3      3    Michelle 611.00    2014-11-15      IT
4      4    Ryan     729.00    2014-05-11      HR
5     NA    Gary     843.25    2015-03-27      Finance
6      6    Nina     578.00    2013-05-21      IT
7      7    Simon    632.80    2013-07-30      Operations
8      8    Guru     722.50    2014-06-17      Finance
```

```
data<- read.csv("input.csv")

print(is.data.frame(data))
print(ncol(data))
print(nrow(data))
```

Output:-

```
[1] TRUE
[1] 5
[1] 8
```

```
# Create a data frame.
data<- read.csv("input.csv")

# Get the max salary from data frame.
sal<- max(data$salary)
sal
```

Output:-

```
[1] 843.25
```

```
# Create a data frame.
data<- read.csv("input.csv")


# Get the max salary from data frame.
sal<- max(data$salary)

# Get the person detail having max salary.
retval<- subset(data, salary == max(salary))
retval
```

Output:-

```
id    name  salary  start_datedept
5     NA    Gary  843.25  2015-03-27    Finance
```

Get all the people working in IT department

```
# Create a data frame.
data<- read.csv("input.csv")

retval<- subset( data, dept == "IT")
retval
```

Output:-

```
id   name      salary   start_datedept
1      1    Rick      623.3    2012-01-01   IT
3      3    Michelle  611.0    2014-11-15   IT
6      6    Nina      578.0    2013-05-21   IT
```

```
#Create a data frame.

data<- read.csv("input.csv")
retval<- subset(data, as.Date(start_date) >as.Date("2014-01-01"))

# Write filtered data into a new file.

write.csv(retval,"output.csv")
newdata<- read.csv("output.csv")
newdata
```

Output:-

```
  X      id   name      salary   start_datedept
1 3      3    Michelle  611.00   2014-11-15    IT
```

```
2 4      4    Ryan       729.00   2014-05-11    HR
3 5     NA    Gary      843.25   2015-03-27    Finance
4 8      8    Guru      722.50   2014-06-17    Finance
```

b. Reading Excel data sheet in R.

```
install.packages("xlsx")
library("xlsx")
data<- read.xlsx("input.xlsx", sheetIndex = 1)
data
```

Output:-

```
id,   name,    salary,   start_date,     dept
1      1    Rick     623.30    2012-01-01      IT
2      2    Dan      515.20    2013-09-23      Operations
3      3    Michelle 611.00    2014-11-15      IT
4      4    Ryan     729.00    2014-05-11      HR
5     NA    Gary     843.25    2015-03-27      Finance
6      6    Nina     578.00    2013-05-21      IT
7      7    Simon    632.80    2013-07-30      Operations
8      8    Guru     722.50    2014-06-17      Finance
```

c. Reading XML dataset in R.

```
install.packages("XML")
library("XML")
library("methods")
result<- xmlParse(file = "input.xml")
result
```

Output:-

```
1
   Rick
   623.3
   1/1/2012
   IT


   2
   Dan
   515.2
   9/23/2013
```

Operations

3
Michelle
611
11/15/2014
IT

4
Ryan
729
5/11/2014
HR

5
Gary
843.25
3/27/2015
Finance

6
Nina
578
5/21/2013
IT

7
Simon
632.8
7/30/2013
Operations

8
Guru
722.5
6/17/2014
Finance

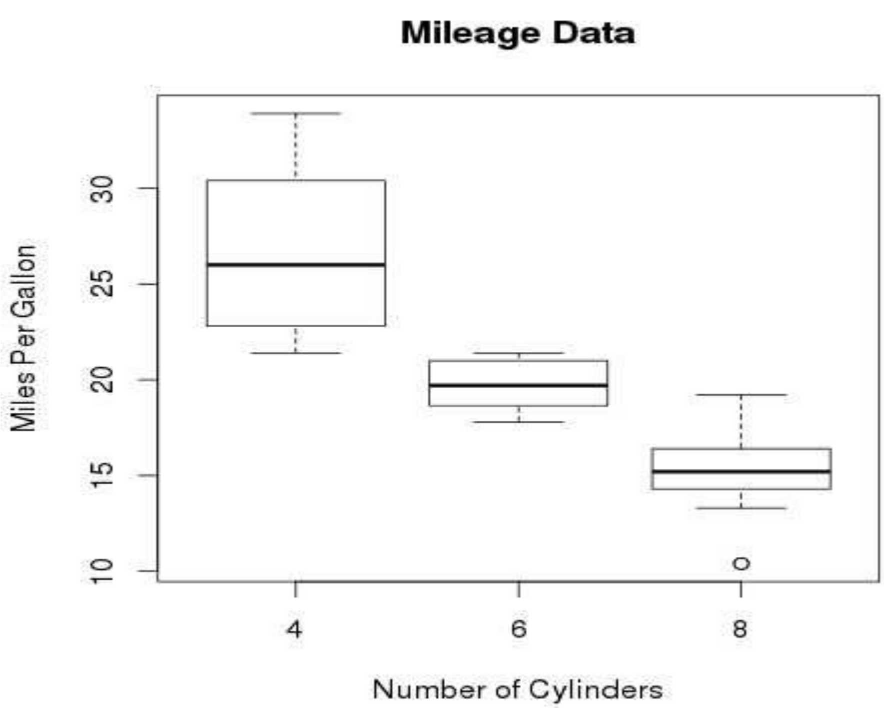
Week 4 – VISUALIZATIONS

a. Find the data distributions using box and scatter plot.

```
Install.packages("ggplot2")
Library(ggplot2)
Input <- mtcars[,c('mpg','cyl')]
input

Boxplot(mpg ~ cyl, data = mtcars, xlab = "number of cylinders",
ylab = "miles per gallon", main = "mileage data")

Dev.off()
```

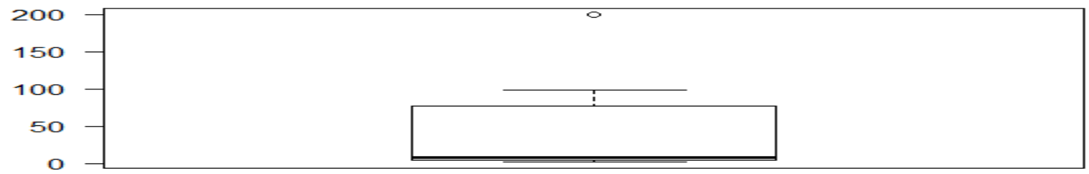
Output :-

```
mpg  cyl
Mazda rx4         21.0   6
Mazda rx4 wag     21.0   6
Datsun 710        22.8   4
Hornet 4 drive    21.4   6
Hornet sportabout 18.7   8
Valiant           18.1   6
```



b. Find the outliers using plot.

```
v=c(50,75,100,125,150,175,200)
boxplot(v)
```

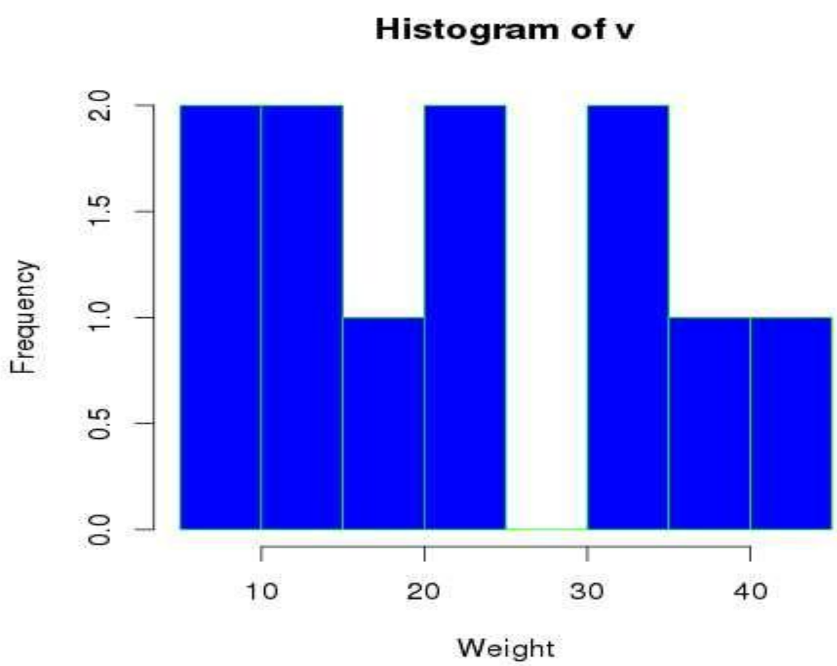


c. Plot the histogram, bar chart and pie chart on sample data.

Histogram

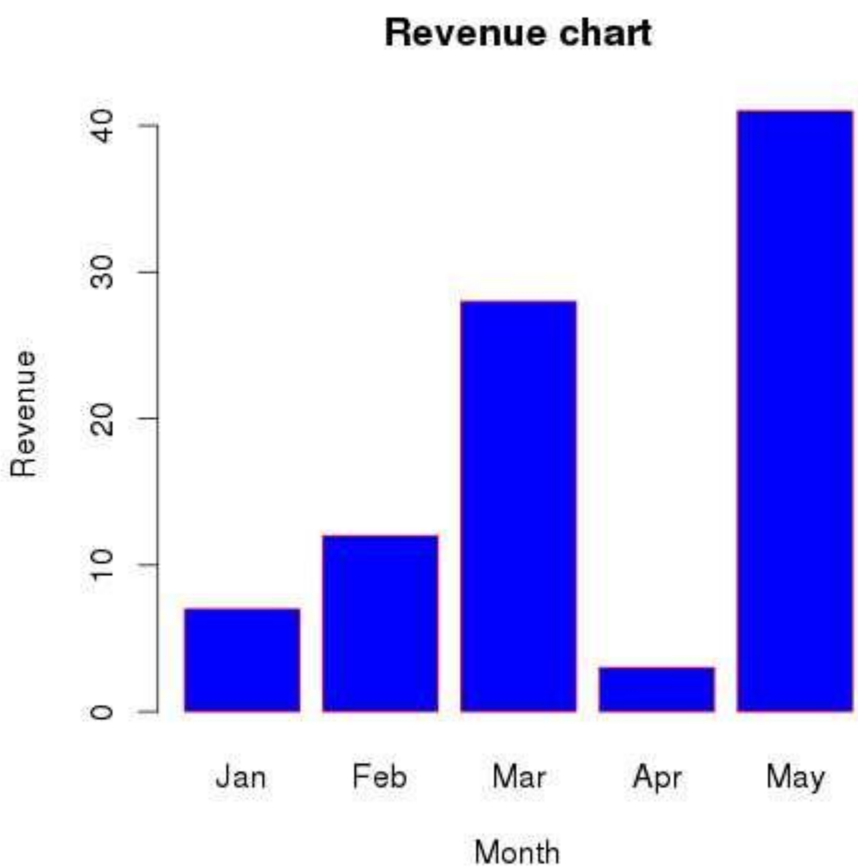
```
library(graphics)
v <-  c(9,13,21,8,36,22,12,41,31,33,19)

# Create the histogram.
hist(v,xlab = "Weight",col = "blue",border = "green")
dev.off()
```

Output:-



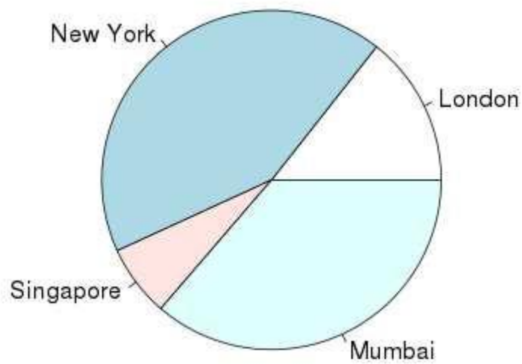
Bar chart

```
library(graphics)
H <- c(7,12,28,3,41)
M <- c("Jan","Feb","Mar","Apr","May")
# Plot the bar chart.
barplot(H,names.arg = M,xlab = "Month",ylab = "Revenue",col = "blue",main = "Revenue chart",border
= "red")
dev.off()
```



Pie Chart

```
library(graphics)
x <- c(21, 62, 10, 53)
labels<- c("London", "NewYork", "Singapore", "Mumbai")
# Plot the Pie chart.
pie(x,labels)
dev.off()
```


New York
London
Singapore
Mumbai

WEEK5:

PROBLEM DEFINATION:

a)How to find a corelation matrix and plot the correlation on iris data set

SOURCE CODE:

```
d<-data.frame(x1=rnorm(!0),x2=rnorm(10),x3=rnorm(10))
cor(d)
m<-cor(d)  #get correlations
library(‘corrplot’)
corrplot(m,method=”square”)
x<-matrix(rnorm(2),,nrow=5,ncol=4)
y<-matrix(rnorm(15),nrow=5,ncol=3)
COR<-cor(x,y)
COR
```

PROBLEM DEFINATION:

b) Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.

SOURCE CODE:

```
Image(x=seq(dim(x)[2])
Y<-seq(dim(y)[2])
Z=COR,xlab=”xcolumn”,ylab=”y column”)
Library(gtlcharts)
Data(iris)
Iris$species<-NULL
Iplotcorr(iris,reoder=TRUE
```

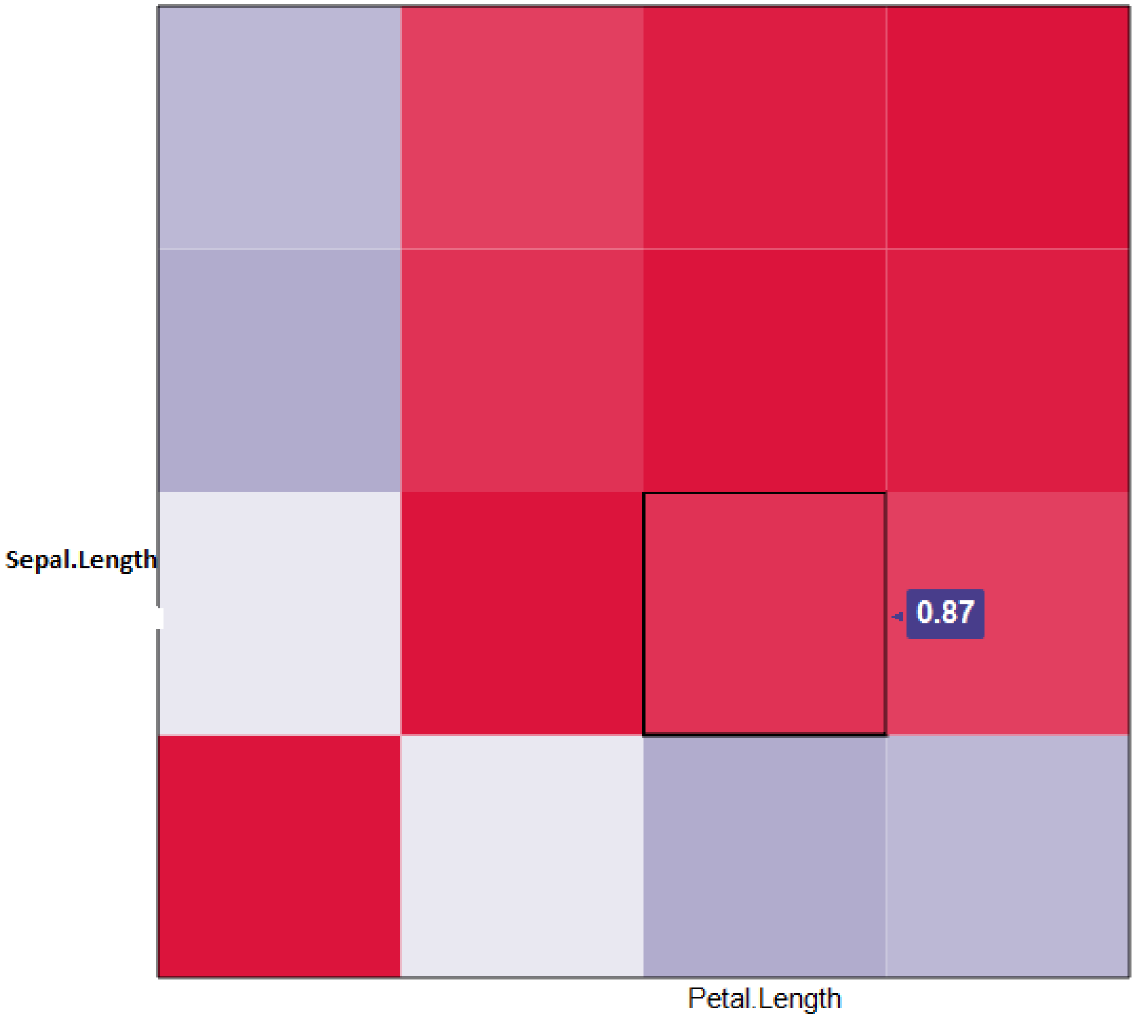
PROBLEM DEFINATION:

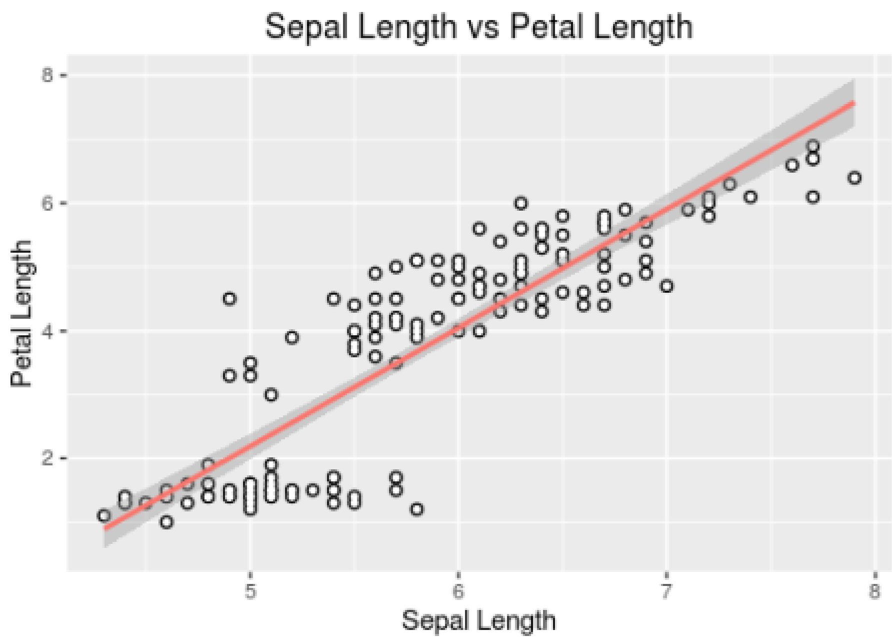
c) Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.

SOURCE CODE:

```
library(ggplot2)
data(iris)
str(iris)
ggplot(data=iris,aes(x=sepal.length,y=petal.length))+geom_point(size=2,colour=”black”)+geom_point(size=1,colour=”white”)+geom_smooth(aes(colour=”black”),method=”lm’)+ggtitle(“sepal.lengthvspetal.length”)+xlab(“sepal.length”)+ylab(“petal.length”)+these(legend.position=”none”)
```

OUTPUT:




Sepal Length vs Petal Length
Petal Length
8
6
4
2
5
6
7
8
Sepal Length

WEEK 6

PROBLEM DEFINATION:

REGRESSION MODEL: Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. require (foreign), require(MASS)

SOURCE CODE:

mydata<-read.csv(http://www.ats.ucla.edu/stat/data/binary.csv")
Head(my data)

OUTPUT:

```
>
> mydata <- read.csv("http://www.ats.ucla.edu/stat/data/binary.csv")
> head(mydata)
  admit gre  gpa rank
1     0 380 3.61    3
2     1 660 3.67    3
3     1 800 4.00    1
4     1 640 3.19    4
5     0 520 2.93    4
6     1 760 3.00    2
```

WEEK 7: CLASSIFICATION MODEL

PROBLEM DEFINATION:
Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset.
SOURCE CODE:
>mydata$rank<-factor(mydata$rank)
>mylogit<-glm(admit~gre+gpa+rank,data=mydata,family=”binomial”)
>summary(mylogit)
OUTPUT:

```
> mydata$rank <- factor(mydata$rank)
> mylogit <- glm(admit ~ gre + gpa + rank, data = mydata, family = "binomial")
> summary(mylogit)

Call:
glm(formula = admit ~ gre + gpa + rank, family = "binomial",
    data = mydata)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.6268  -0.8662  -0.6388   1.1490   2.0790

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -3.989979   1.139951  -3.500 0.000465 ***
gre          0.002264   0.001094   2.070 0.038465 *
gpa          0.804038   0.331819   2.423 0.015388 *
rank2       -0.675443   0.316490  -2.134 0.032829 *
rank3       -1.340204   0.345306  -3.881 0.000104 ***
rank4       -1.551464   0.417832  -3.713 0.000205 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 499.98  on 399  degrees of freedom
Residual deviance: 458.52  on 394  degrees of freedom
AIC: 470.52

Number of Fisher Scoring iterations: 4
```

1

Week 8 - REGRESSION MODEL FOR PREDICTION

Apply regression Model techniques to predict the data on above dataset.

```
># make sure R knows region is categorical
>str(states.data$region)
 Factor w/ 4 levels "West","N. East",..: 3 1 1 3 1 1 2 3 NA 3 ...
>states.data$region<- factor(states.data$region)
> #Add region to the model
>sat.region<- lm(csat ~ region,
+                 data=states.data)
> #Show the results
>coef(summary(sat.region)) # show regression coefficients table
```

Out put:

```
              Estimate Std. Error t value Pr(>|t|)
(Intercept)      946.3       14.8  63.958 1.35e-46
regionN. East    -56.8       23.1  -2.453 1.80e-02
regionSouth      -16.3       19.9  -0.819 4.17e-01
regionMidwest     63.8       21.4   2.986 4.51e-03
>anova(sat.region) # show ANOVA table
Analysis of Variance Table

Response: csat
Df Sum Sq Mean Sq F value   Pr(>F)
region     3  82049   27350    9.61 0.000049
Residuals 46 130912    2846
>
```

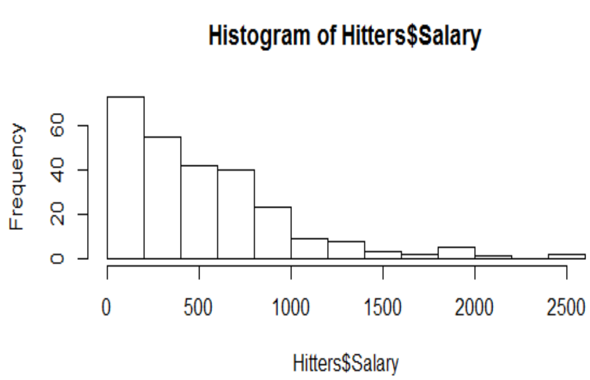
WEEK 9 :CLASSIFICATION MODEL

PROBLEM DEFINATION:
g. Install relevant package for classification.

SOURCE CODE:
```
install.packages("rpart.plot")
install.packages("tree")
install.packages("ISLR")
install.packages("rattle")

library(tree)
library(ISLR)
library(rpart.plot)
library(rattle)
```

PROBLEM DEFINATION:
h. Choose classifier for classification problem.
Evaluate the performance of classifier**.**
SOURCE CODE:
```
attach(Hitters)
View(Hitters)
# Remove NA data
Hitters<-na.omit(Hitters)

# log transform Salary to make it a bit more normally distributed
hist(Hitters$Salary)

Hitters$Salary <- log(Hitters$Salary)
hist(Hitters$Salary)
```

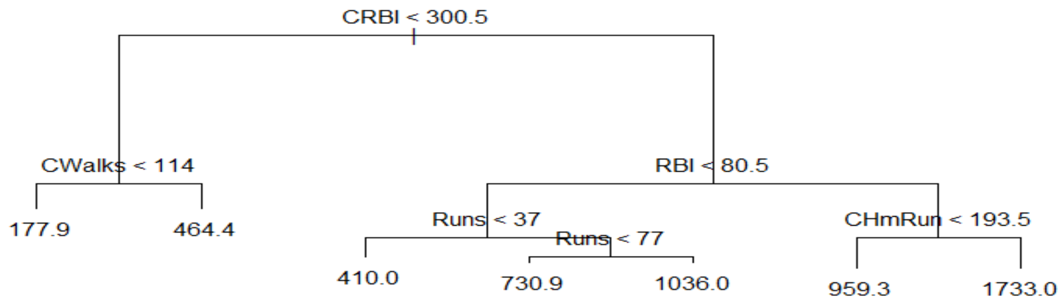
output:



SOURCE CODE:

```
> tree.fit <- tree(Salary~Hits+Years, data=Hitters)
> summary(tree.fit)


Regression tree:
tree(formula = Salary ~ Hits + Years, data = Hitters)
Number of terminal nodes:  8
Residual mean deviance:  101200 = 25820000 / 255
Distribution of residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-1238.00  -157.50   -38.84     0.00    76.83  1511.00

plot(tree.fit, uniform=TRUE,margin=0.2)
text(tree.fit, use.n=TRUE, all=TRUE, cex=.8)
#plot(tree.fit)
>split <- createDataPartition(y=Hitters$Salary, p=0.5, list=FALSE)
> train <- Hitters[split,]
> test <- Hitters[-split,]
#Create tree model
> trees <- tree(Salary~., train)
> plot(trees)
> text(trees, pretty=0)

# Cross validate to see whether pruning the tree will improve
  Performance
```

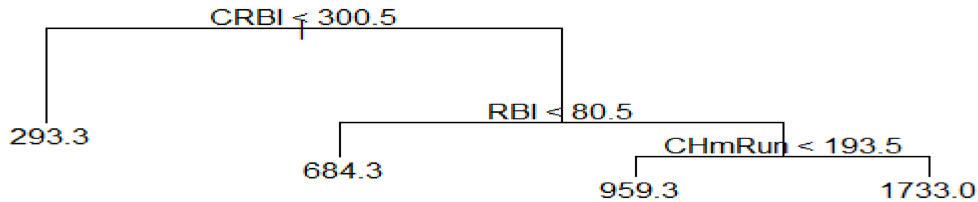
OUTPUT:



SOURCE CODE:

```
#Cross validate to see whether pruning the tree will improve performance
> cv.trees <- cv.tree(trees)
> plot(cv.trees)
> prune.trees <- prune.tree(trees, best=4)
> plot(prune.trees)
> text(prune.trees, pretty=0)
```

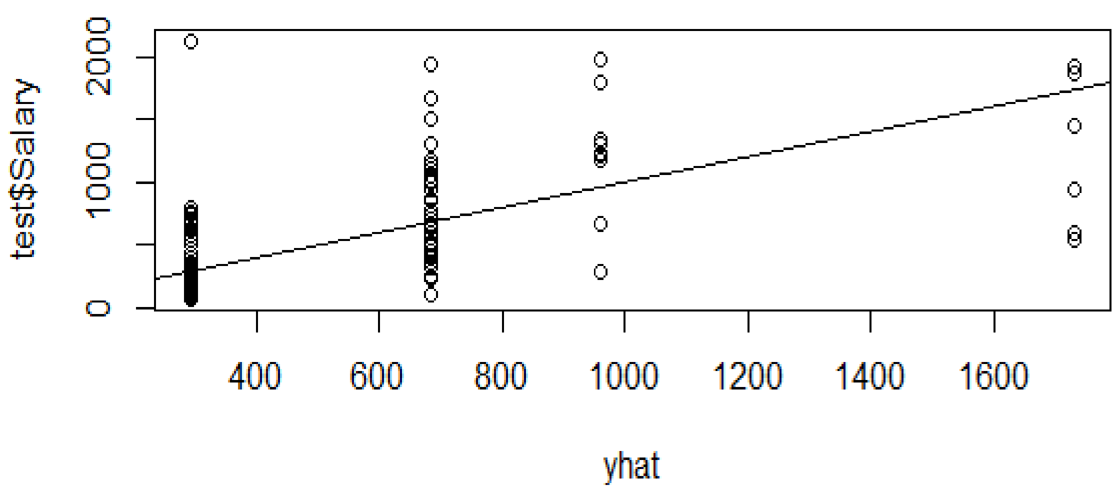
OUTPUT:



SOURCE CODE:

```
> yhat <- predict(prune.trees, test)
> plot(yhat, test$Salary)
> abline(0,1
[1] 150179.7
> mean((yhat - test$Salary)^2)
[1] 150179.7
```

OUTPUT:




```
> mean((yhat - test$Salary)^2)
[1] 150179.7
```

WEEK 10

PROBLEM DEFINATION:

CLUSTERING MODEL

e. Clustering algorithms for unsupervised classification.

Plot the cluster data using R visualizations

SOURCE CODE:

1. Clustering algorithms for unsupervised classification.

```
library(cluster)

> set.seed(20)
> irisCluster <- kmeans(iris[, 3:4], 3, nstart = 20)
# nstart = 20. This means that R will try 20 different random starting assignments and then select the one
with the lowest within cluster variation.
> irisCluster
```

OUTPUT:

```
  Petal.Length Petal.Width
1     1.462000    0.246000
2     4.269231    1.342308
3     5.595833    2.037500
```

Clustering vector:

```
  [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 [42] 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 2
 [83] 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3
[124] 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 3 3
```

Within cluster sum of squares by cluster:

```
[1]  2.02200 13.05769 16.29167
 (between_SS / total_SS =  94.3 %)
```

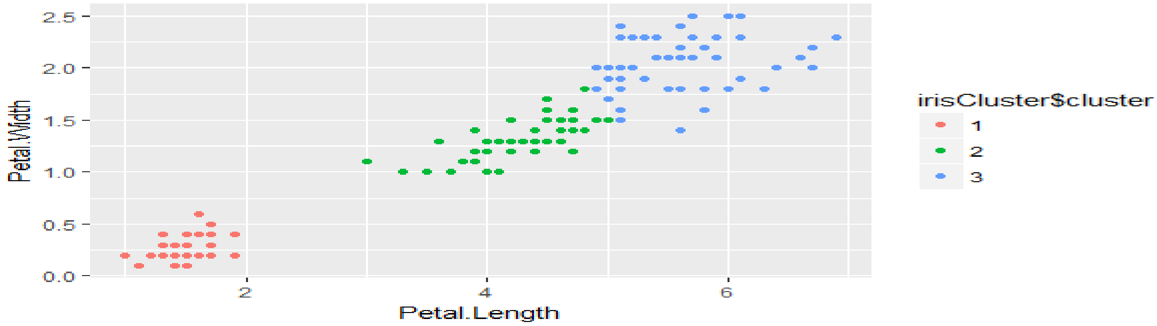
Available components:

```
[1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"

[6] "betweenss"    "size"         "iter"         "ifault"
```

SOURCE CODE:

```
> irisCluster$cluster <- as.factor(irisCluster$cluster)
> ggplot(iris, aes(Petal.Length, Petal.Width, color = irisCluster$cluster)) + geom_point()
```

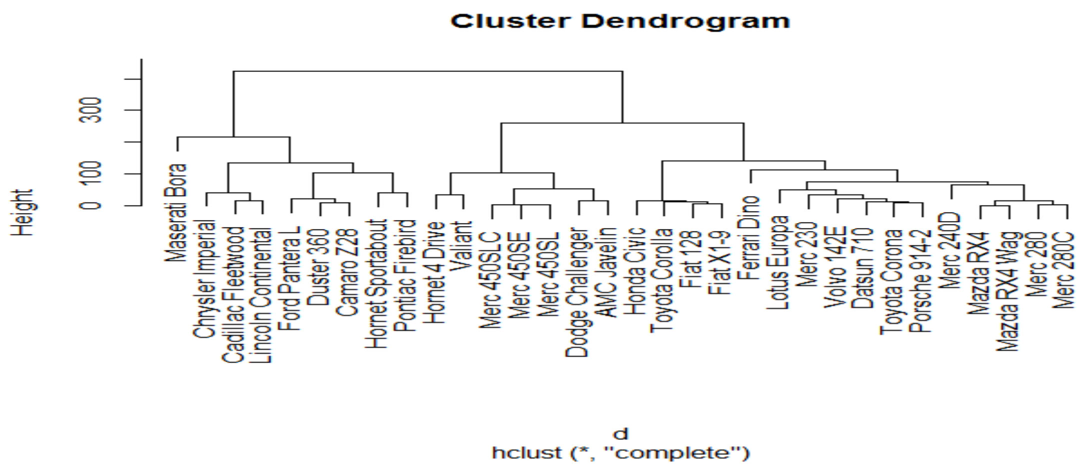
OUTPUT:



SOURCE CODE:

> d <- dist(as.matrix(mtcars))   # find distance matrix
> hc <- hclust(d)   # apply hirarchical clustering
> plot(hc)   # plot the dendrogram

OUTPUT:

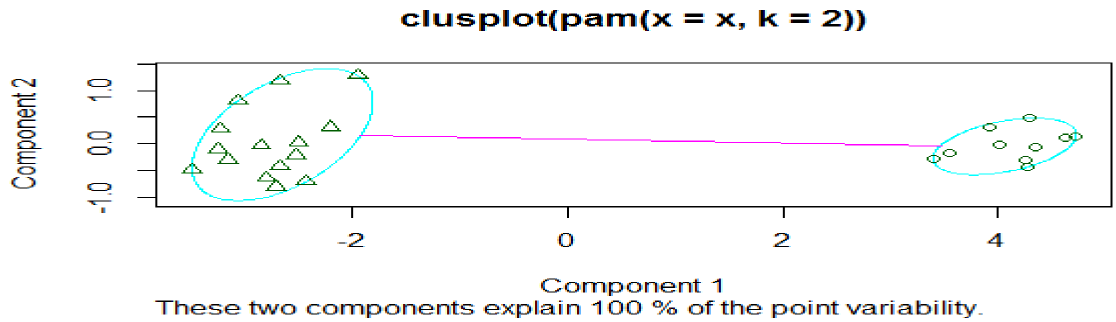


2. Plot the cluster data using R visualizations.

SOURCE CODE:

generate 25 objects, divided into 2 clusters.
x <- rbind(cbind(rnorm(10,0,0.5), rnorm(10,0,0.5)),
 cbind(rnorm(15,5,0.5), rnorm(15,5,0.5)))
clusplot(pam(x, 2))

OUTPUT:



SOURCE CODE:

```
## add noise, and try again :
x4 <- cbind(x, rnorm(25), rnorm(25))
clusplot(pam(x4, 2))
```

OUTPUT: