METHODIST
COLLEGE OF ENGINEERING & TECHNOLOGY
[Autonomous Institution]

Accredited by NAAC with A+ and NBA
Affiliated to Osmania University & Approved by AICTE

Estd : 2008

LABORATORY MANUAL

DATA STRUCTRURES LABORATORY

BE VII Semester AY 2022-23

NAME: ____

ROLL NO:____

BRANCH:________________ **SEM:**_______________________

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERNG

Empower youth- Architects of Future World

VISION

To produce ethical, socially conscious and innovative professionals who would contribute to sustainable technological development of the society.

MISSION

To impart quality engineering education with latest technological developments and interdisciplinary skills to make students succeed in professional practice.

To encourage research culture among faculty and students by establishing state of art laboratories and exposing them to modern industrial and organizational practices.

To inculcate humane qualities like environmental consciousness, leadership, social values, professional ethics and engage in independent and lifelong learning for sustainable contribution to the society.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION & MISSION

VISION

To become a leader in providing Computer Science & Engineering education with emphasis on knowledge and innovation.

MISSION

- To offer flexible programs of study with collaborations to suit industry needs.
- To provide quality education and training through novel pedagogical practices.
- To expedite high performance of excellence in teaching, research and innovations.
- To impart moral, ethical values and education with social responsibility.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES

After 3-5 years of graduation, the graduates will be able to

PEO1: Apply technical concepts, Analyze, Synthesize data to Design and create novel products and solutions for the real life problems.

PEO2: Apply the knowledge of Computer Science Engineering to pursue higher education with due consideration to environment and society.

PEO3: Promote collaborative learning and spirit of team work through multidisciplinary projects

PEO4: Engage in life-long learning and develop entrepreneurial skills.

METHODIST COLLEGE OF ENGINEERING & TECHNOLOGY
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CSE Department

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROGRAM OUTCOMES

Engineering graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

At the end of 4 years, Computer Science and Engineering graduates at MCET will be able to:

PSO1: Apply the knowledge of Computer Science and Engineering in various domains like networking and data mining to manage projects in multidisciplinary environments.

PSO2: Develop software applications with open-ended programming environments**.**

PSO3: Design and develop solutions by following standard software engineering principles and implement by using suitable programming languages and platforms

Data Science Lab Syllabus

DATA SCIENCE LABORATORY

VII Semester: CSE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
PC 751 CS	Core	-	-	3	1.5	25	50	75

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

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

2 DESCRIPTIVE STATISTICS IN R

a. Write an R script to find basic descriptive statistics using summary, str,quartile functions on MT Cars data set.
b. Write an R script to find subset of dataset by using subset ()

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.

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

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

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).

7	**MULTIPLE REGRESSION MODEL**

Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset.

8	**REGRESSION MODEL FOR PREDICTION**

Apply regression Model techniques to predict the data on above dataset

9	**CLASSIFICATION MODEL**

a. Install relevant package for classification.
b. Choose classifier for classification problem.
c. Evaluate the performance of classifier.

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

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Course Outcomes (CO's):

SUBJECT NAME: DATA SCIENCE LAB

CODE: PC 751 CS

SEMESTER: VII

CO No.	Course Outcome	Taxonomy Level
PC751CS.1	Show the installation of R Programming Environment.	Understanding
PC751CS.2	Utilize R Data types for developing programs	Applying
PC751CS.3	Make use of different R Data Structures.	Applying
PC751CS.4	Develop programming logic using R Packages.	Creating
PC751CS.6	Analyze the datasets using R programming capabilities	Analyze

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

GENERAL LABORATORY INSTRUCTIONS

1. Students are advised to come to the laboratory at least 5 minutes before (to starting time), those who come after 5 minutes will not be allowed into the lab.
2. Plan your task properly much before to the commencement, come prepared to the lab with the program / experiment details.
3. Student should enter into the laboratory with:
   a. Laboratory observation notes with all the details (Problem statement, Aim, Algorithm, Procedure, Program, Expected Output, etc.,) filled in for the lab session.
   b. Laboratory Record updated up to the last session experiments.
   c. Formal dress code and Identity card.
4. Sign in the laboratory login register, write the TIME-IN, and occupy the computer system allotted to you by the faculty.
5. Execute your task in the laboratory, and record the results / output in the lab observation note book, and get certified by the concerned faculty.
6. All the students should be polite and cooperative with the laboratory staff, must maintain the discipline and decency in the laboratory.
7. Computer labs are established with sophisticated and high end branded systems, which should be utilized properly.
8. Students / Faculty must keep their mobile phones in SWITCHED OFF mode during the lab sessions. Misuse of the equipment, misbehaviours with the staff and systems etc., will attract severe punishment.
9. Students must take the permission of the faculty in case of any urgency to go out. If anybody found loitering outside the lab / class without permission during working hours will be treated seriously and punished appropriately.
10. Students should SHUT DOWN the computer system before he/she leaves the lab after completing the task (experiment) in all aspects. He/she must ensure the system / seat is kept properly.

Head of the Department **Principal**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CODE OF CONDUCT FOR THE LABORATORY

- All students must observe the dress code while in the laboratory
- Footwear is NOT allowed
- Foods, drinks and smoking are NOT allowed
- All bags must be left at the indicated place
- The lab timetable must be strictly followed
- Be PUNCTUAL for your laboratory session
- All programs must be completed within the given time
- Noise must be kept to a minimum
- Workspace must be kept clean and tidy at all time
- All students are liable for any damage to system due to their own negligence
- Students are strictly PROHIBITED from taking out any items from the laboratory
- Report immediately to the lab programmer if any damages to equipment

BEFORE LEAVING LAB:

- Arrange all the equipment and chairs properly.
- Turn off / shut down the systems before leaving.
- Please check the laboratory notice board regularly for updates.

Lab In – charge

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LIST OF EXPERIMENTS

S. No.	Name of Experiment	Date of Experiment	Date of Submission	Page No.	Faculty Signature
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				
2	**DESCRIPTIVE STATISTICS IN R** **a.** Write an R script to find basic descriptive statistics using summary, str,quartile functions on MT Cars data set. **b.** Write an R script to find subset of dataset by using subset ()				
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.				
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				

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				
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).				
7	Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset.				
8	Apply regression Model techniques to predict the data on above dataset				
9	a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier.				
10	a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.				

ADDITIONAL EXPERIMENTS

S. No.	Name of Experiment	Date of Experiment	Date of Submission	Page No.	Faculty Signature
11	Implementation of Decision Tree				
12	Implementation of Logistic Regression				

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 indisk.

```
getwd()
[1] "C:/Users/Administrator/Documents"
>write.csv(a,'a.csv')
>write.csv(a,'C:\\Users\\Administrator\\Documents')
```

2 - DESCRIPTIVE STATISTICS IN R

a. Write an R script to find basic descriptive statistics using summary, str, quantile 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
```

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

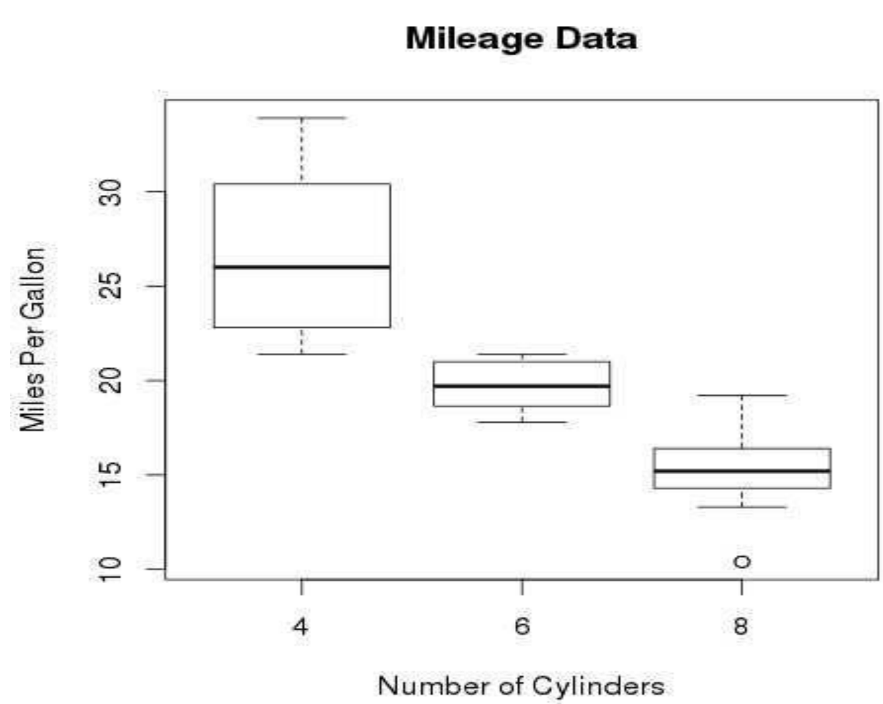
4 – VISUALIZATIONS

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()
```

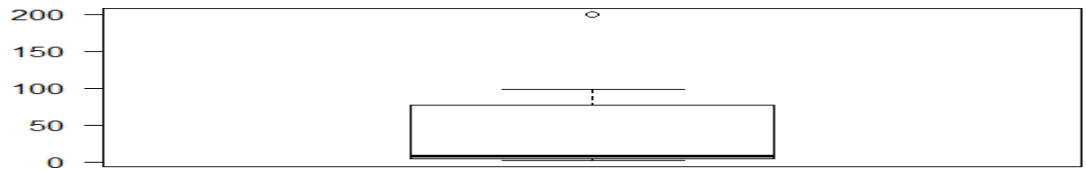
Output :-

```
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)
```

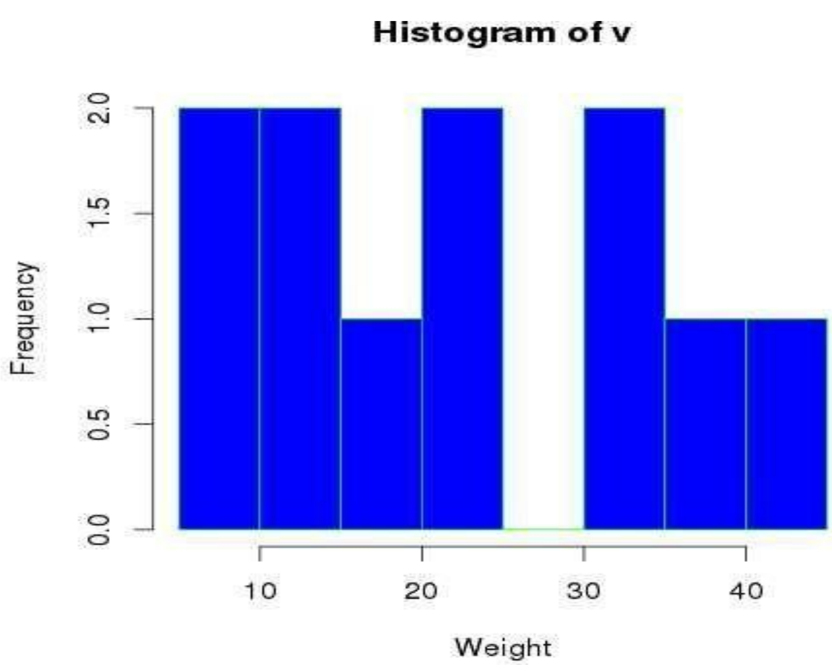


c. Plot the histogram, bar chart and pie chart on sample data.

<u>Histogram</u>

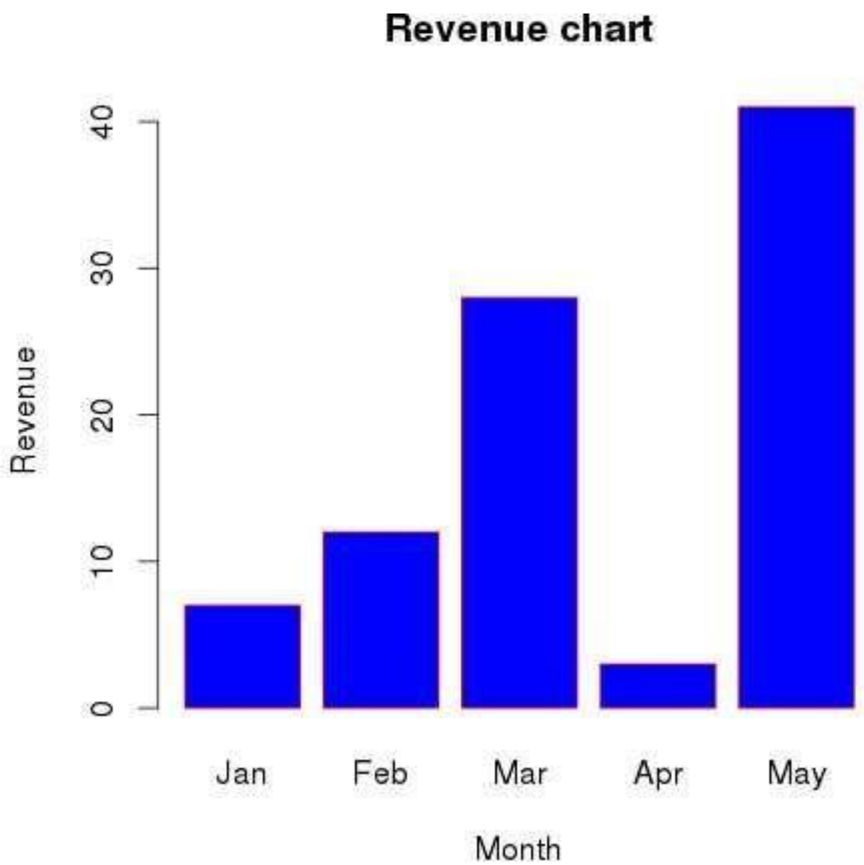
```
library(graphics)
v <-  c(9,13,21,8,36,22,12,41,31,33,19)

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

Output:-



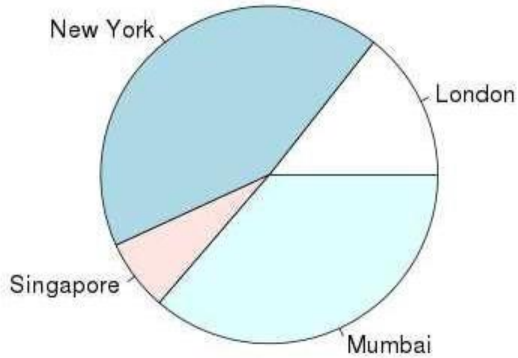
Bar chart

```
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()
```



5

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 amongdata 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:

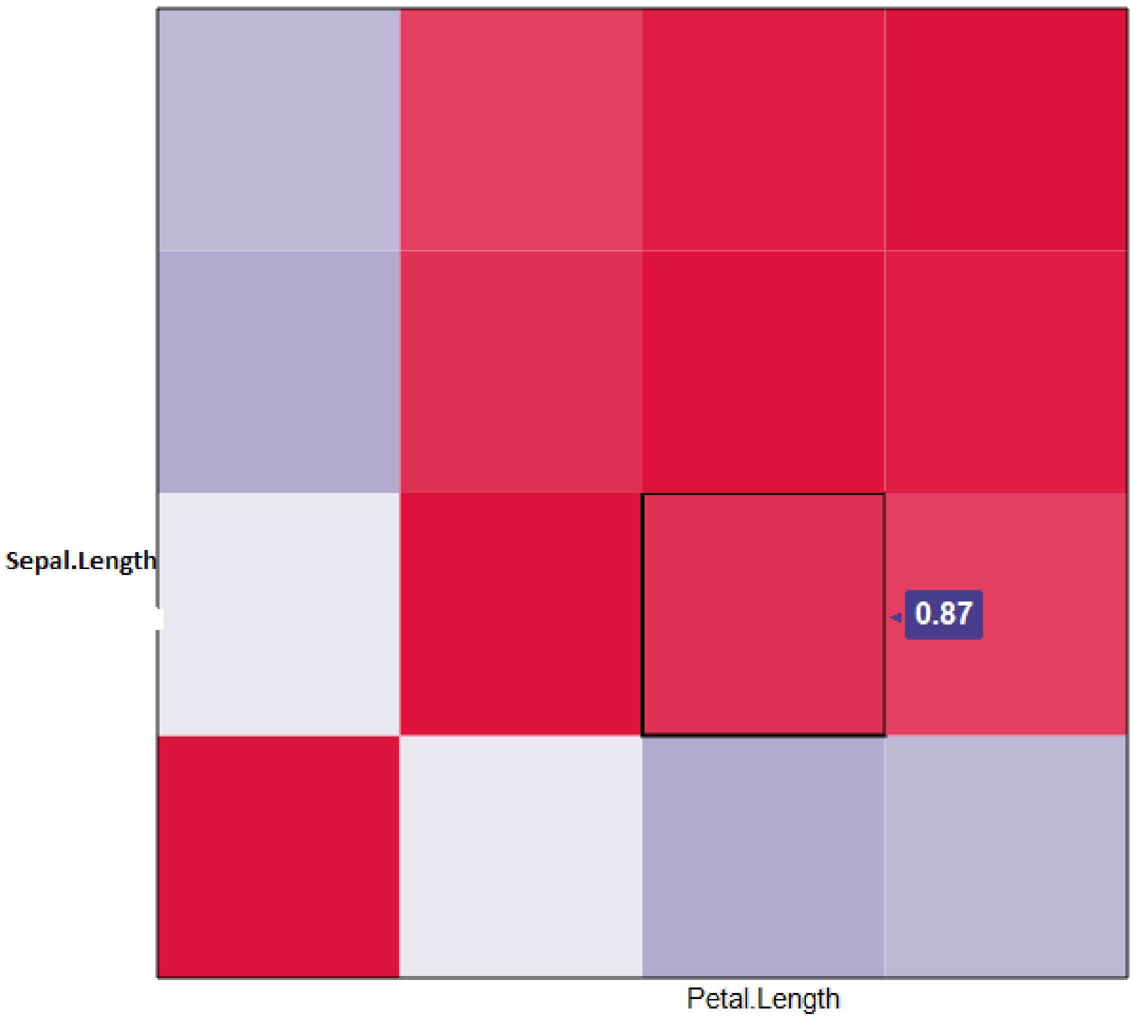
c) Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.

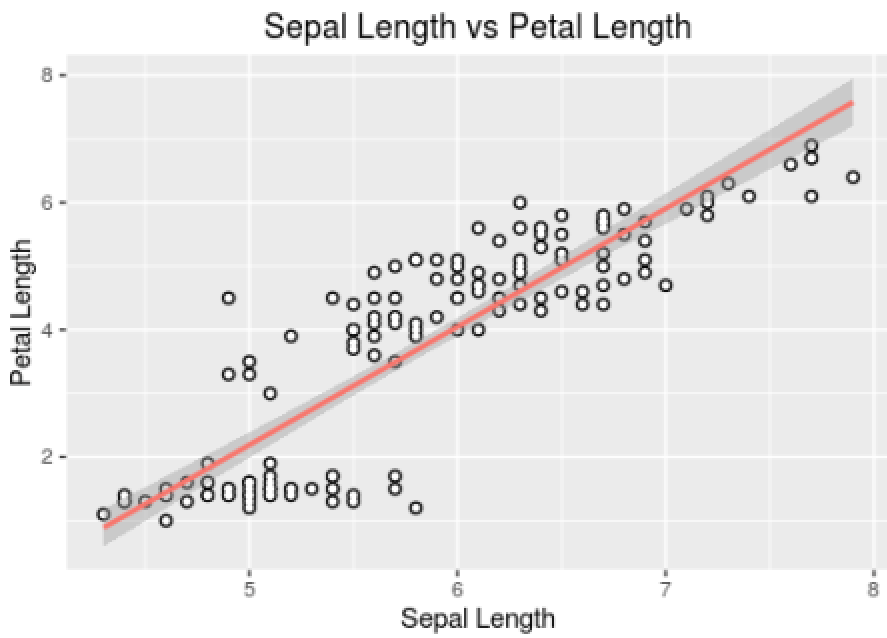
SOURCE CODE:

```
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:





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
```

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

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
>
```

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)
```

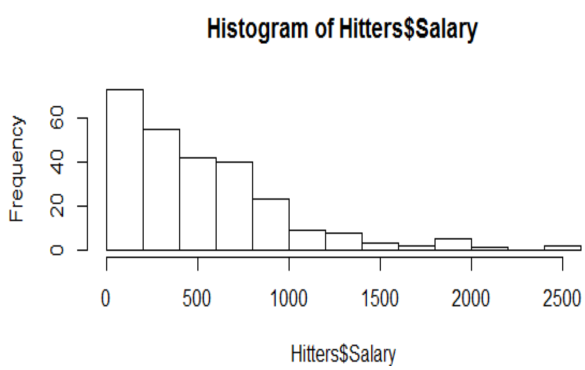
PROBLEM DEFINATION:

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)
```

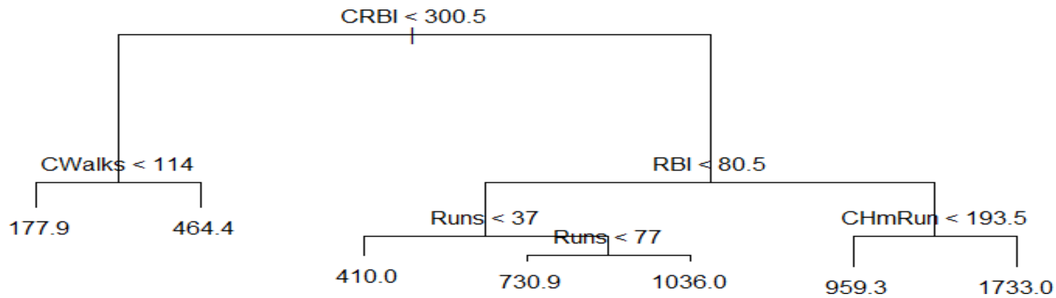
output:



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
```

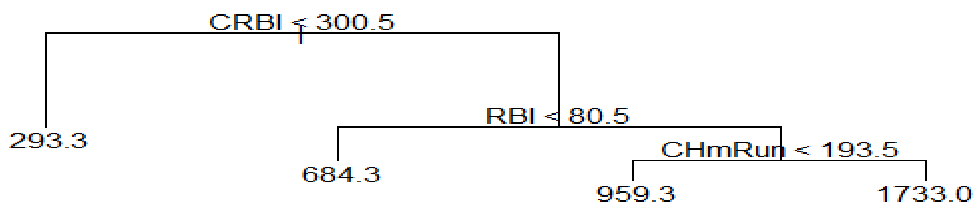
OUTPUT:



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)
```

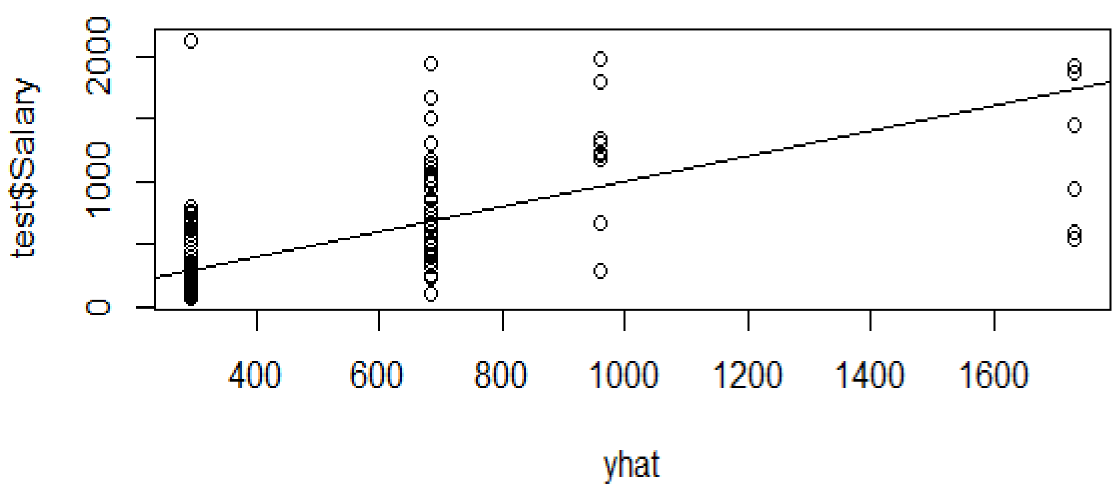
OUTPUT:



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

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 %)
```

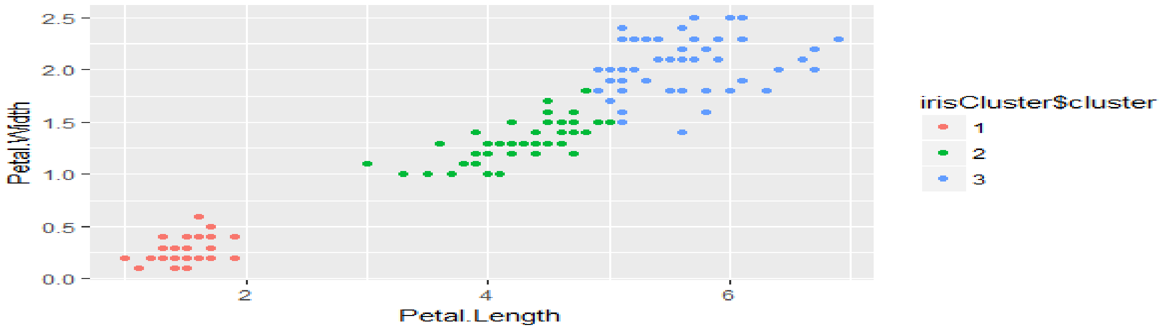
Available components:

```
[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()
```

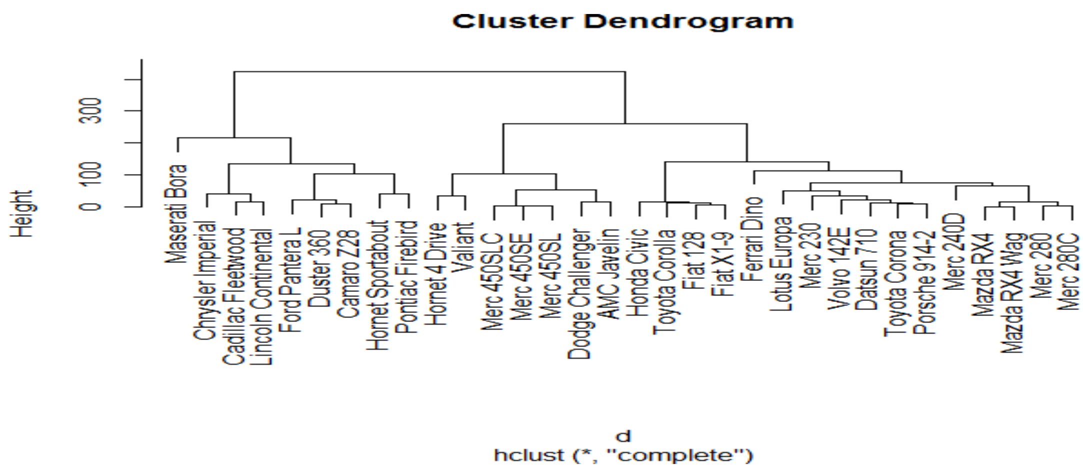
OUTPUT:



SOURCE CODE:

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

OUTPUT:

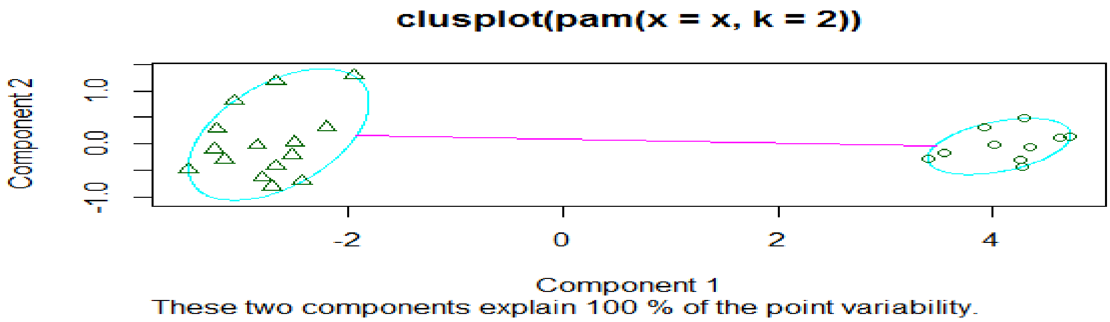


2. Plot the cluster data using R visualizations.

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))
```

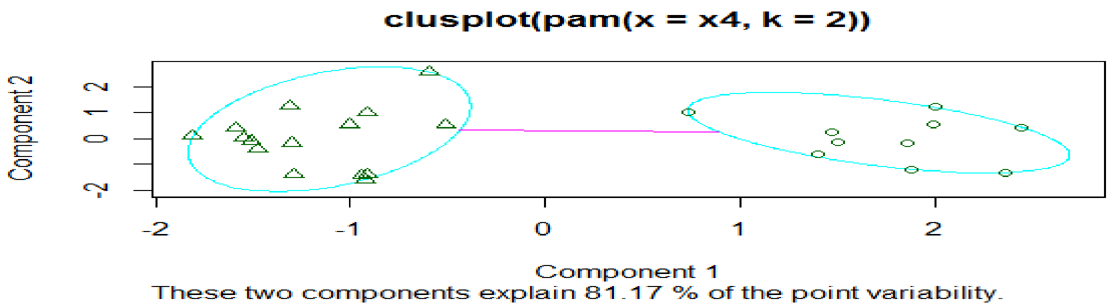
OUTPUT:



SOURCE CODE:

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

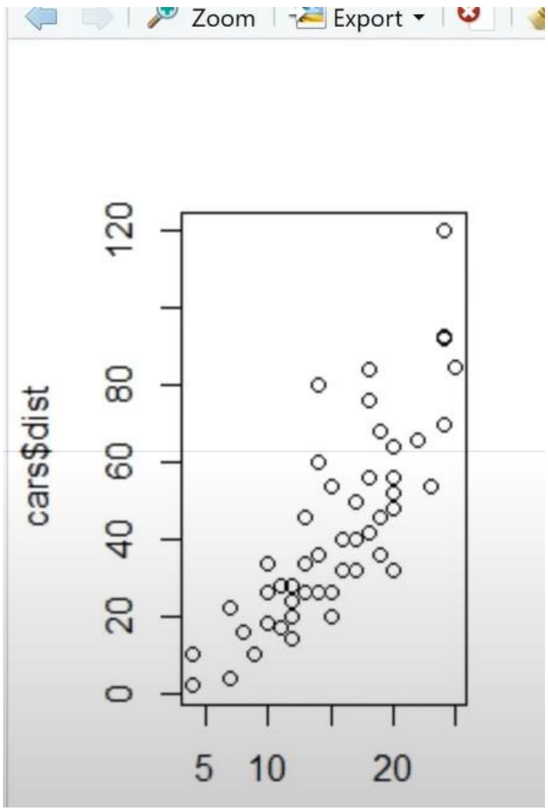
OUTPUT:



List of Additional Programs

1. DECISION TREE

```
> library(rpart)
> library(rpart.plot)
> data('iris')
> head(iris)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa
> str(iris)
'data.frame':   150 obs. of  5 variables:
 $ Sepal.Length: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
 $ Sepal.Width : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
 $ Petal.Length: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
 $ Petal.Width : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
 $ Species     : Factor w/ 3 levels "setosa","versicolor",..: 1 1 1 1 1 1 1 1 1 1 .
```



```
K_means
# Installing Packages
install.packages("ClusterR")
install.packages("cluster")

# Loading package
library(ClusterR)
library(cluster)

# Removing initial label of
# Species from original dataset
iris_1 <- iris[, -5]
str(iris_1)

# Fitting K-Means clustering Model
# to training dataset
set.seed(240) # Setting seed
kmeans.re <- kmeans(iris_1, centers = 3, nstart = 20)
kmeans.re

# Cluster identification for
# each observation
kmeans.re$cluster
```

```
# Confusion Matrix
cm <- table(iris$Species, kmeans.re$cluster)
cm

# Model Evaluation and visualization
plot(iris_1[c("Sepal.Length", "Sepal.Width")])
plot(iris_1[c("Sepal.Length", "Sepal.Width")],
     col = kmeans.re$cluster)
plot(iris_1[c("Sepal.Length", "Sepal.Width")],
     col = kmeans.re$cluster,
     main = "K-means with 3 clusters")

## Plotiing cluster centers
kmeans.re$centers
kmeans.re$centers[, c("Sepal.Length", "Sepal.Width")]

# cex is font size, pch is symbol
points(kmeans.re$centers[, c("Sepal.Length", "Sepal.Width")],
       col = 1:3, pch = 8, cex = 3)

## Visualizing clusters
y_kmeans <- kmeans.re$cluster
clusplot(iris_1[, c("Sepal.Length", "Sepal.Width")],
         y_kmeans,
```

```
lines = 0,
shade = TRUE,
color = TRUE,
labels = 2,
plotchar = FALSE,
span = TRUE,
main = paste("Cluster iris"),
xlab = 'Sepal.Length',
ylab = 'Sepal.Width')
```