MATHS LAB EXPERIMENT 1 TO 5

NAME: ADARSH GAURAV **REG NO: 21BCE1628**

LAB-1

Introduction: Understanding Data types; importing/exporting data

CODE

```
#Generate data
1:10

#Assign variable name to the value
X = 10

# Combine numeric values into vector
c(1,2,5)

#Arithmetic operations on vectors
a = c(1, 3, 5, 7)
b = c(2, 4, 6, 8)

#Addition
a+b

#Subtraction
a-b

#Constant multiplication
5*a

#Product
a*b

#Division
a/b

#String values
X = as.character(5.2)
X
```

OUTPUT

```
 [1]  1  2  3  4  5  6  7  8  9 10
[1] 1 2 5
[1]  3  7 11 15
[1] -1 -1 -1 -1
[1]  5 15 25 35
[1]  2 12 30 56
[1] 0.5000000 0.7500000 0.8333333 0.8750000
[1] "5.2"
```

CODE

```
#Generate data
1:10

#Assign variable name to the value
X <- 5

# Combine numeric values into vector
c(12,43,14,54,100)
c

#Arithmetic operations on vectors
a = c(12, 43, 11, 14, 9, 10)
b = c(59, 110, 2, 19, 6, 39)

#Addition
a+b

#Subtraction
a-b

#Constant multiplication
10*a

#Product
a*b

#Division
a/b
```

```
#String values
X = as.character(12.9)
X

#Concatenation of strings
paste("Hello", "World")
```

OUTPUT

```
 [1]  1  2  3  4  5  6  7  8  9 10
[1]  12  43  14  54 100
function (...)  .Primitive("c")
[1]  71 153  13  33  15  49
[1] -47 -67   9  -5   3 -29
[1] 120 430 110 140  90 100
[1]  708 4730   22  266   54  390
[1] 0.2033898 0.3909091 5.5000000 0.7368421 1.5000000 0.2564103
[1] "12.9"
[1] "Hello World"
```

LAB-2

NAME: ADARSH GAURAV REG NO: 21BCE1628

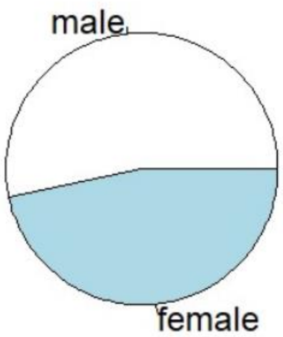
Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations

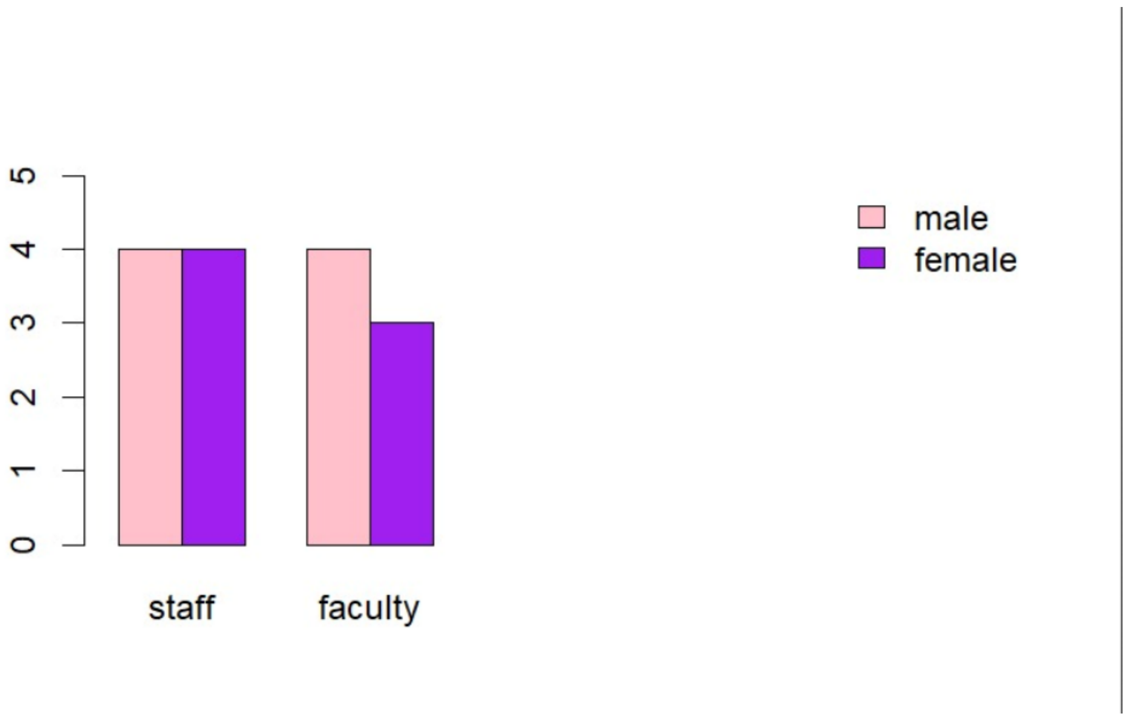
CODE

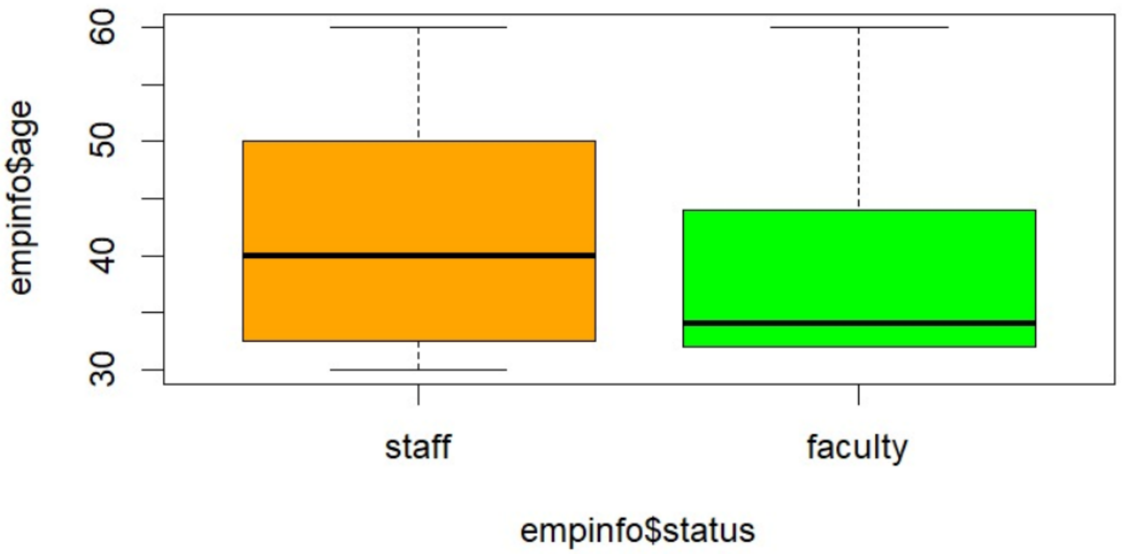
```
empid
age = c(30, 37, 45, 32, 50, 60, 35, 32, 34, 43, 32, 30, 43, 50, 60)
age
gender = c(0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0)
gender
 x
status = c(1, 1, 2, 2, 1, 1, 1, 2, 2, 1, 2, 1, 2, 1, 2)
status
empinfo = data.frame(empid, age, gender, status)
empinfo

empinfo$gender = factor(empinfo$gender, labels=c("male", "female"))
empinfo
empinfo$status = factor(empinfo$status, labels=c("staff", "faculty"))
empinfo$status
empinfo
male = subset(empinfo, empinfo$gender=="male")
male
female = subset(empinfo, empinfo$gender=="female")
female
staff = subset(empinfo, empinfo$status=="staff")
staff
faculty = subset(empinfo, empinfo$status=="faculty")
faculty
faculty_and_female = subset(female, female$status=="faculty")
faculty_and_female
summary(empinfo)
summary(male)
summary(faculty_and_female)
summary(age)
table1 = table(empinfo$gender)
table1
table2 = table(empinfo$status)
table2
table3 = table(empinfo$gender, empinfo$status)
table3
```

```
plot(empinfo$age, type="l", main="Age of employees", xlab="empid", ylab="age in years", col="blue")

pie(table1)
pie(table2)
pie(table3)
barplot(table3, beside=T, xlim=c(1, 15), ylim=c(0, 5), col=c("pink", "purple"))
legend("topright", legend=rownames(table3), fill=c('pink', 'purple'), bty="n")
boxplot(empinfo$age~empinfo$status, col=c('orange', 'green'))
```

OUTPUT






60
50
40
30
empinfo$age
staff
faculty
empinfo$status


Age of employees
60
50
40
30
age in years
2
4
6
8
10
12
14
empid

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LAB-3

Applying correlation and simple linear regression model to real data set; computing and interpreting the coefficient of determination

```
data=cars

data

summary(data)

regression1=lm(data$speed ~data$dist)

regression1

plot(data$speed,data$dist)

abline(regression1)

regression2=lm(data$dist ~data$speed)

regression2

plot(data$dist,data$speed)

abline(regression2)
```

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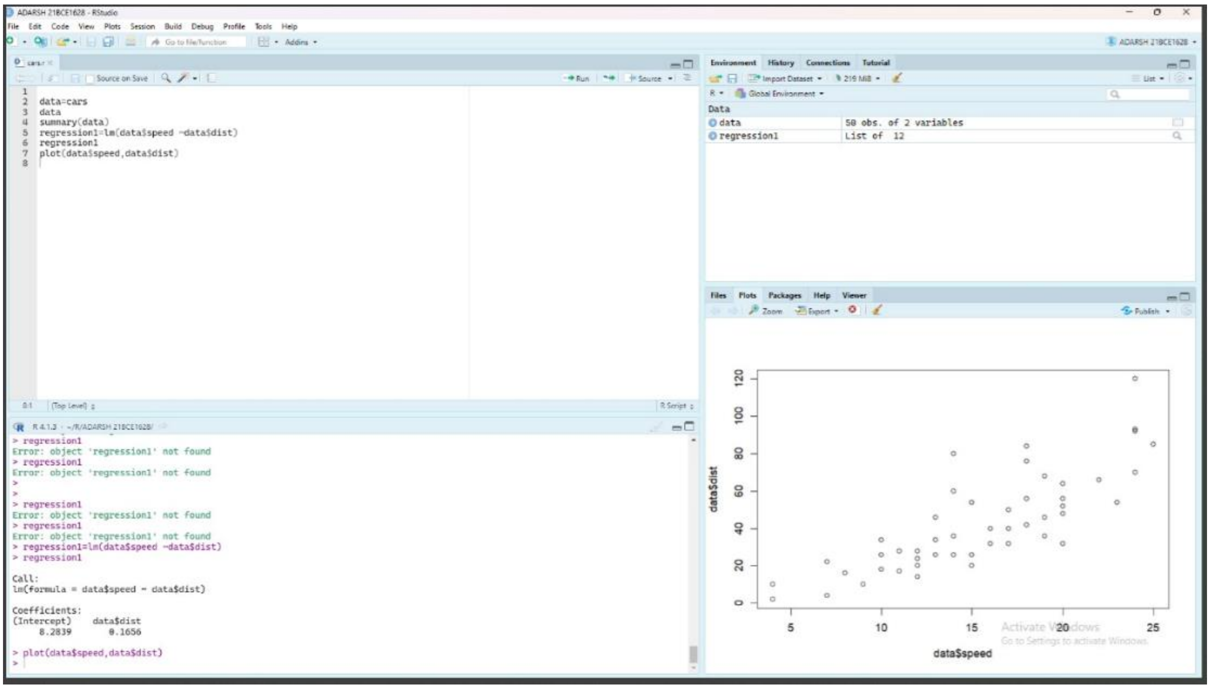

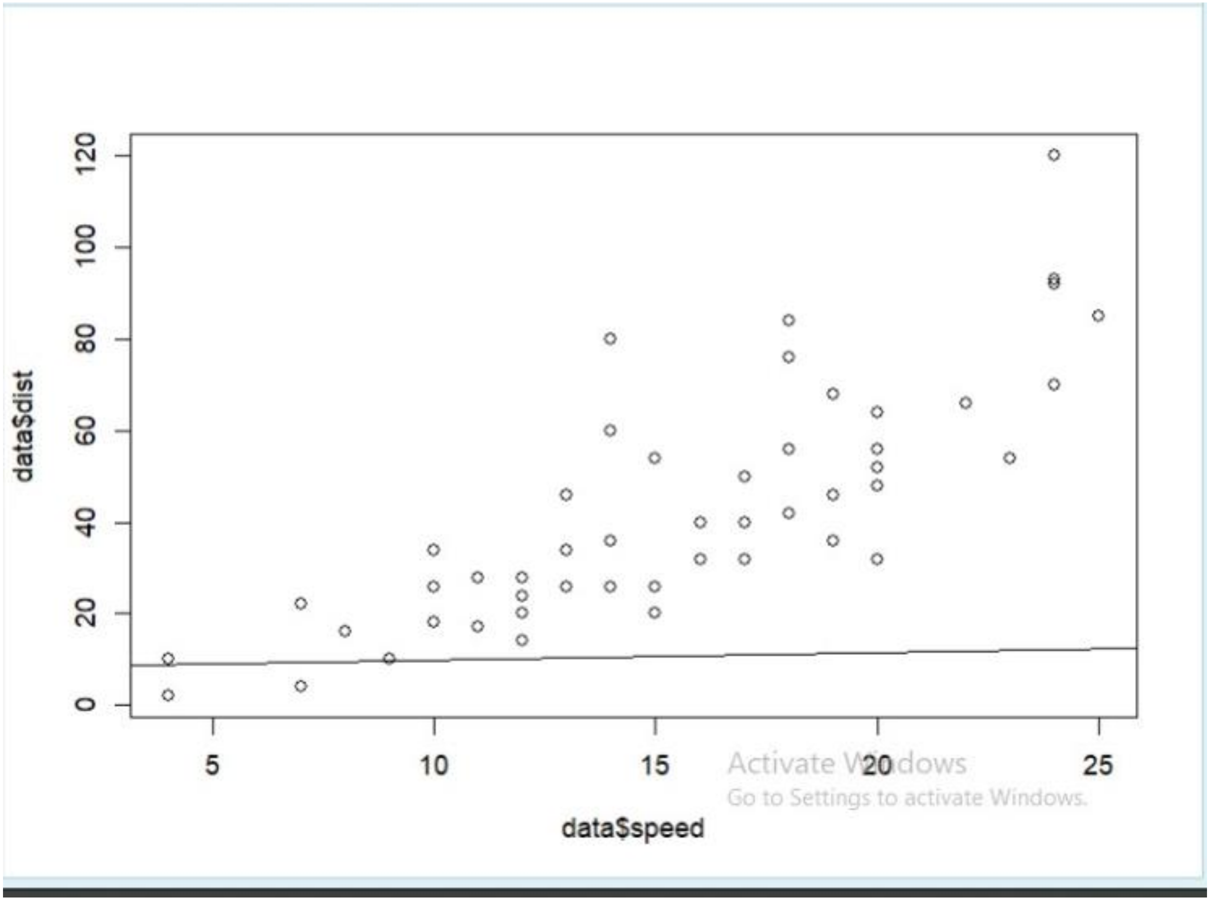

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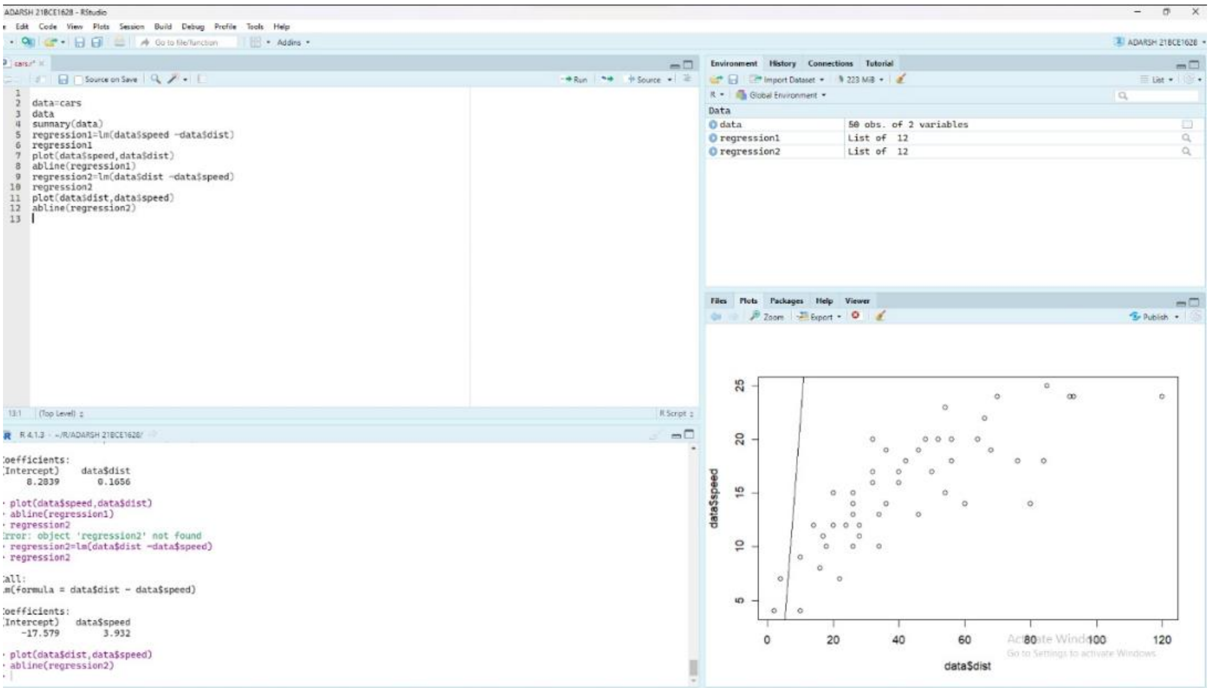
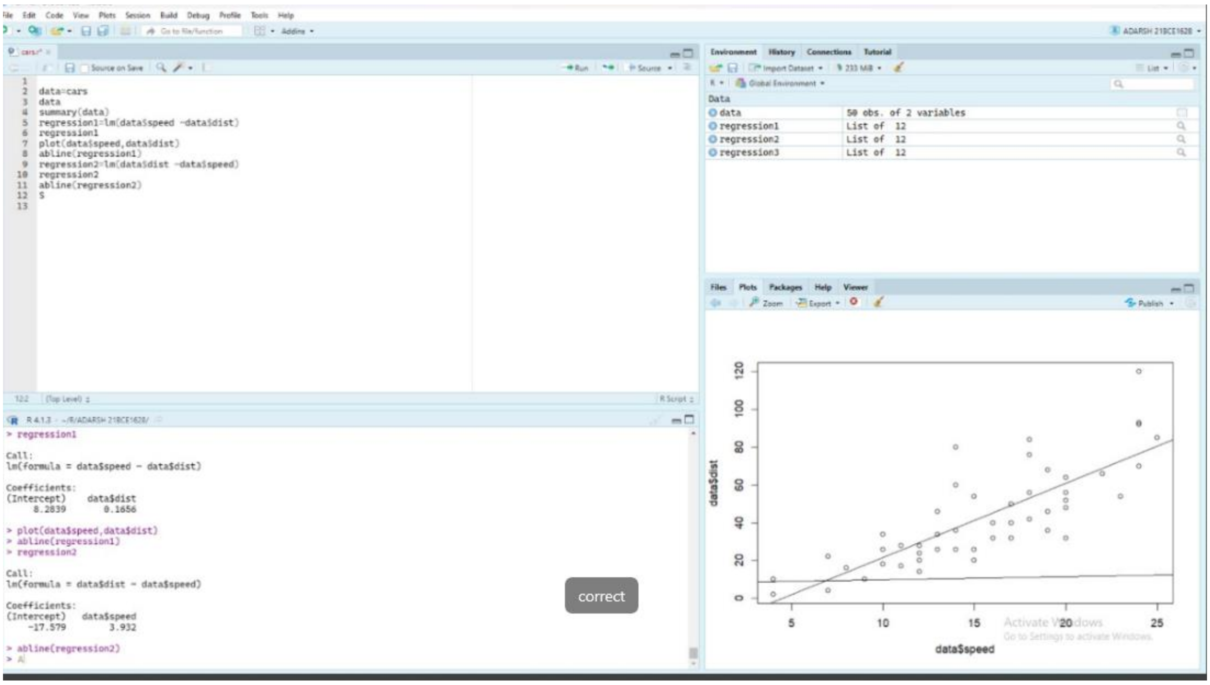




CODE

NAME: ADARSH GAURAV REG NO: 21BCE1628

weight = c(15,26,27,25,25.5,27,32,18,22,20,26,24)

weight

bmi =c(13.35,16.12,16.74,16,13.59,15.73,15.65,13.85,16.07,12.8,13.65,14.42)

bmi

cor(weight,bmi)

Regression1 = lm(bmi~weight)

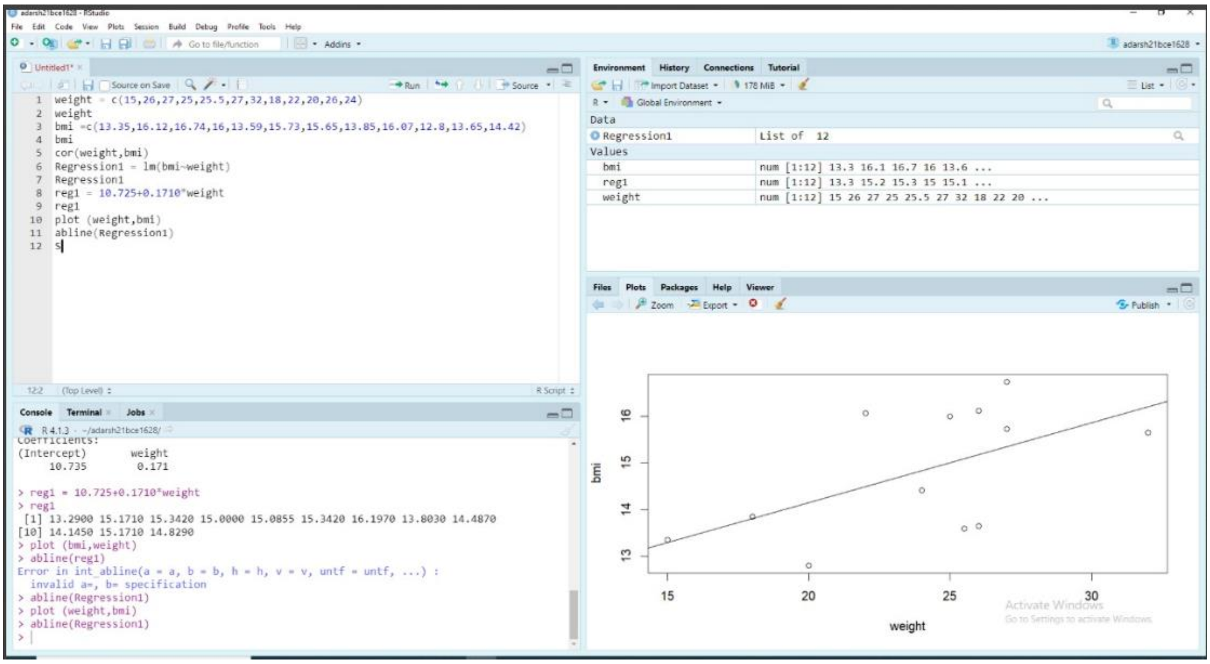
Regression1

reg1 = 10.725+0.1710*weight

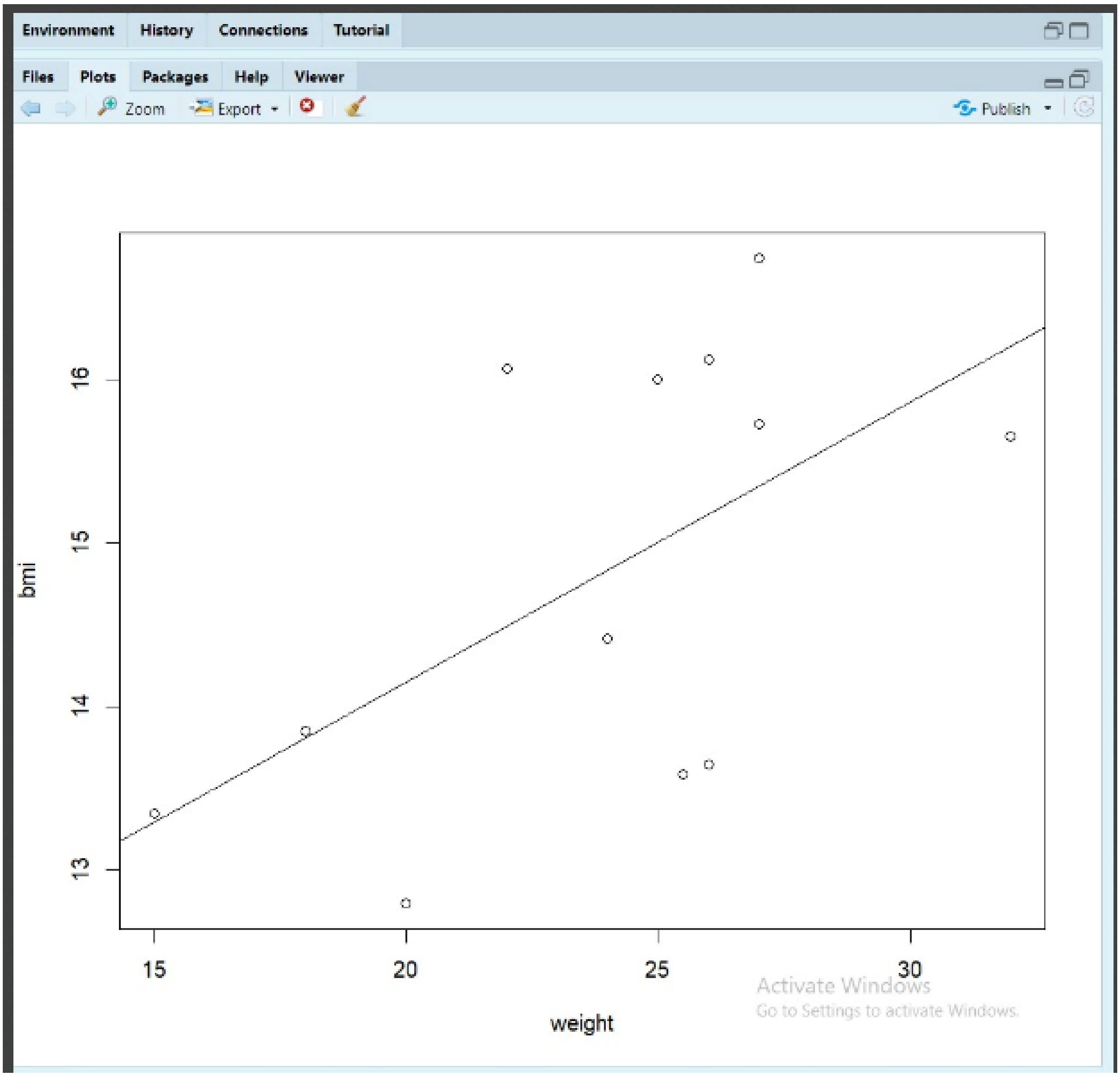
reg1

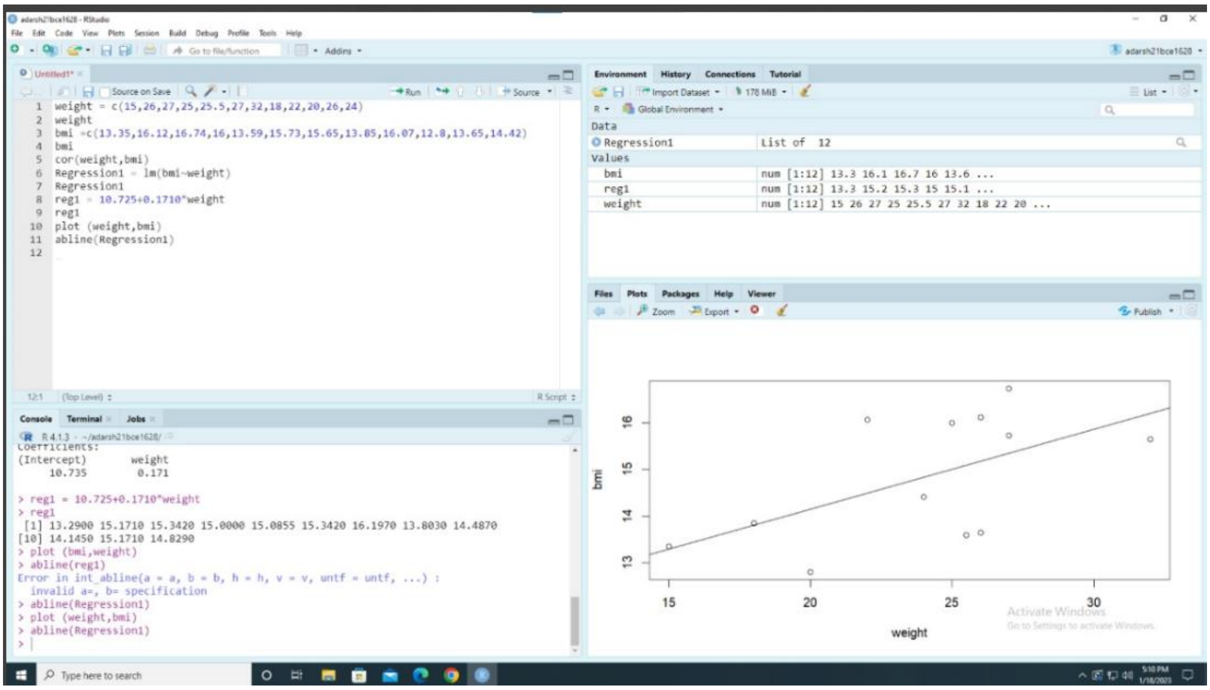
plot (weight,bmi)

abline(Regression1)



NAME: ADARSH GAURAV REG NO: 21BCE1628





LAB 4

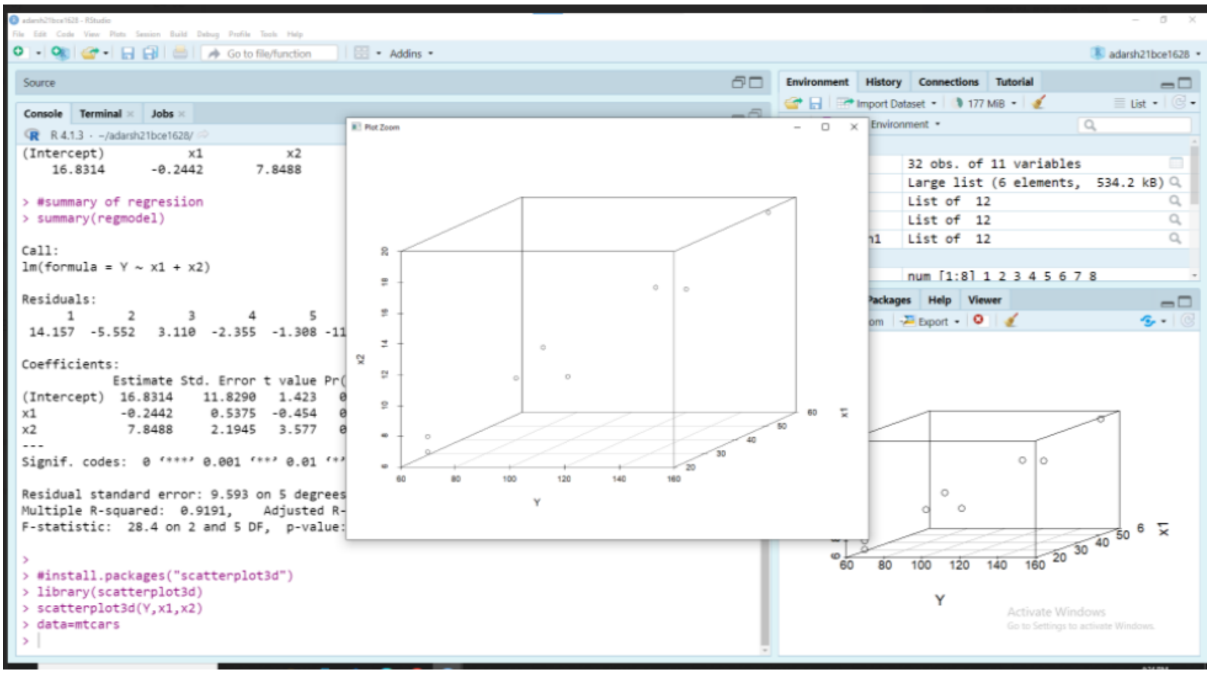
Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficients of determination

CODE

```
Y=c(110,80,70,120,150,90,70,120)
Y
x1=c(30,40,20,50,60,40,20,60)
x1
x2=c(11,10,7,15,19,12,8,14)
x2
# linera regression model of y on x1 and x2
regmodel=lm(Y~x1+x2)
regmodel
#summary of regresiion
summary(regmodel)
#install.packages("scatterplot3d")
library(scatterplot3d)
scatterplot3d(Y,x1,x2)
```

NAME: ADARSH GAURAV REG NO: 21BCE1628

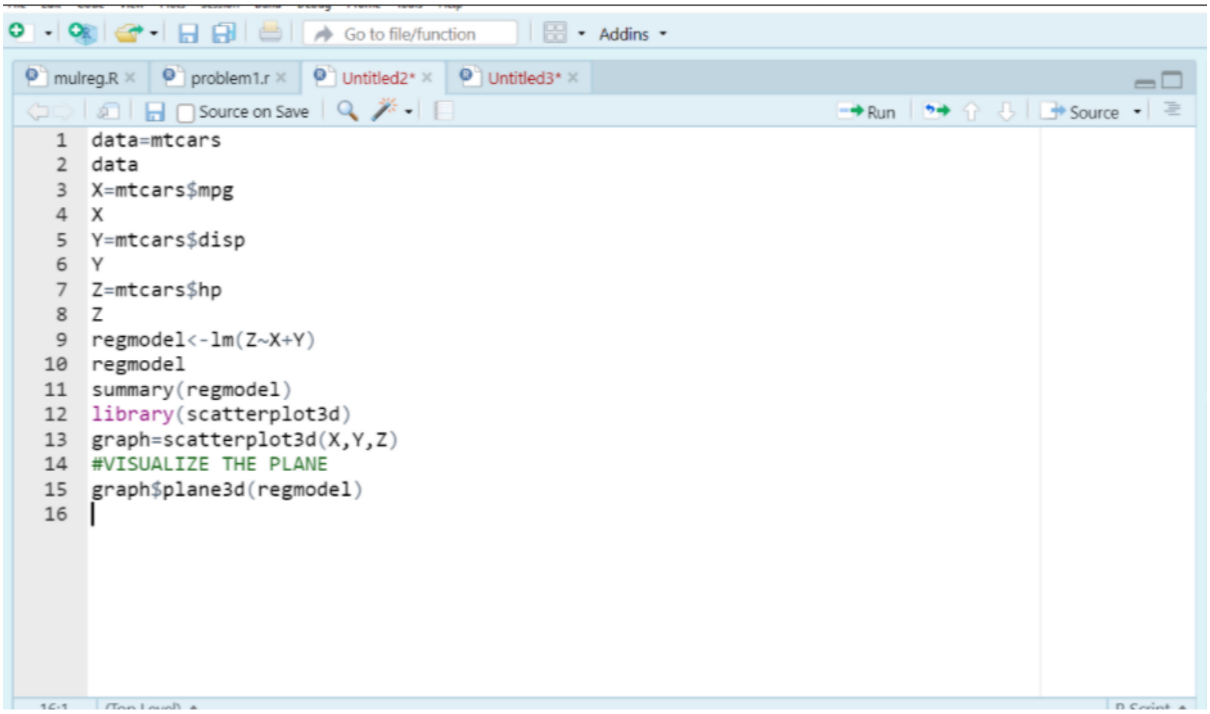
```
R 4.1.3 · ~/adarsh21bce1628/
>
>
> Y=c(110,80,70,120,150,90,70,120)
> Y
[1] 110  80  70 120 150  90  70 120
> x1=c(30,40,20,50,60,40,20,60)
> x1
[1] 30 40 20 50 60 40 20 60
> x2=c(11,10,7,15,19,12,8,14)
> x2
[1] 11 10  7 15 19 12  8 14
> regmodel=lm(Y1-x1+x2)
Error in stats::model.frame(formula = Y1 - x1 + x2, drop.unused.levels = TRUE) :
  object 'Y1' not found
> regmodel

Call:
lm(formula = y ~ x1 + x2)

Coefficients:
(Intercept)           x1           x2
    16.8314      -0.2442       7.8488

> regmodel=lm(Y-x1+x2)
Error in formula.default(object, env = baseenv()) : invalid formula
> regmodel

Call:
lm(formula = y ~ x1 + x2)

Coefficients:
```



NAME: ADARSH GAURAV REG NO: 21BCE1628

CODE

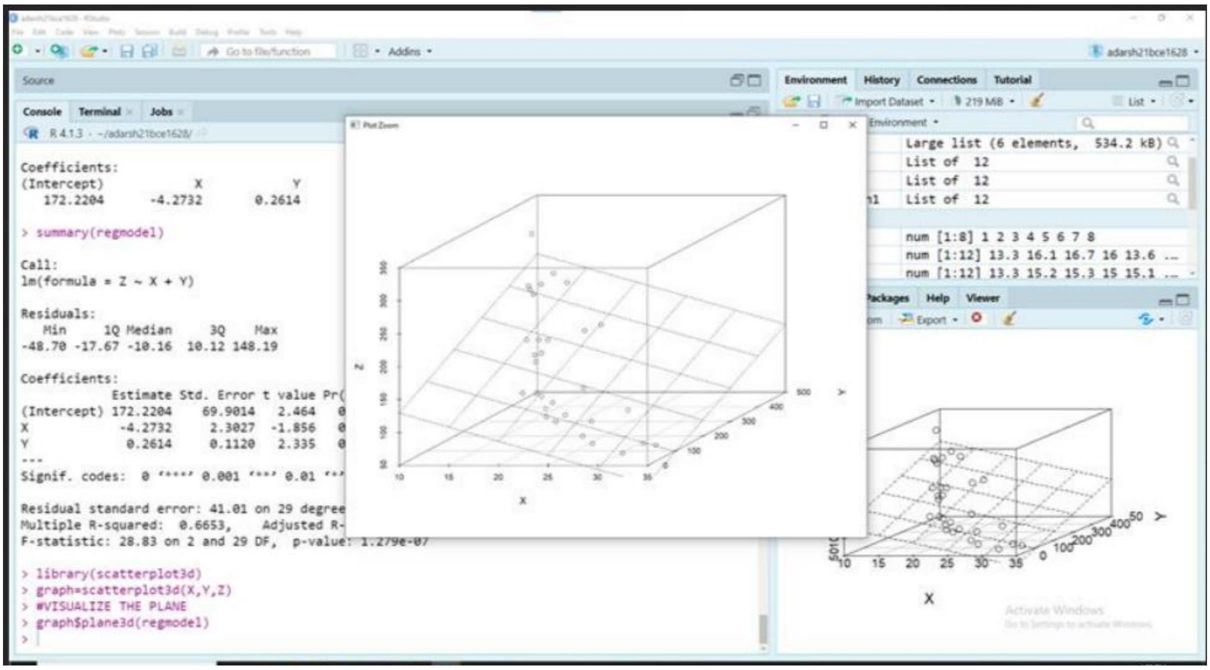
```
data=mtcars
data
X=mtcars$mpg
X
Y=mtcars$disp
Y
Z=mtcars$hp
Z
regmodel<-lm(Z~X+Y)
regmodel
summary(regmodel)
library(scatterplot3d)
graph=scatterplot3d(X,Y,Z)
#VISUALIZE THE PLANE
graph$plane3d(regmodel)
```



```
                     mpg cyl  disp  hp drat    wt  qsec 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
```

```
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
> X=mtcars$mpg
> X
 [1] 21.0 21.0 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 17.8 16.4 17.3 15.2 10.4 10.4 14.7 32.4
[19] 30.4 33.9 21.5 15.5 15.2 13.3 19.2 27.3 26.0 30.4 15.8 19.7 15.0 21.4
> Y=mtcars$disp
> Y
 [1] 160.0 160.0 108.0 258.0 360.0 225.0 360.0 146.7 140.8 167.6 167.6 275.8 275.8 275.8 472.0
[16] 460.0 440.0  78.7  75.7  71.1 120.1 318.0 304.0 350.0 400.0  79.0 120.3  95.1 351.0 145.0
[31] 301.0 121.0
> Z=mtcars$hp
> Z
 [1] 110 110  93 110 175 105 245  62  95 123 123 180 180 180 205 215 230  66  52  65  97 150
[23] 150 245 175  66  91 113 264 175 335 109
> regmodel<-lm(Z~X+Y)
> regmodel

Call:
lm(formula = Z ~ X + Y)

Coefficients:
(Intercept)            X            Y
   172.2204      -4.2732       0.2614

> summary(regmodel)

Call:
lm(formula = Z ~ X + Y)
```

```
Coefficients:
(Intercept)            X            Y
   172.2204      -4.2732       0.2614

> summary(regmodel)

Call:
lm(formula = Z ~ X + Y)

Residuals:
   Min      1Q Median      3Q     Max
-48.70 -17.67 -10.16  10.12 148.19

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 172.2204    69.9014   2.464   0.0199 *
X            -4.2732     2.3027  -1.856   0.0737 .
Y             0.2614     0.1120   2.335   0.0267 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 41.01 on 29 degrees of freedom
Multiple R-squared:  0.6653,	Adjusted R-squared:  0.6423
F-statistic: 28.83 on 2 and 29 DF,  p-value: 1.279e-07

> library(scatterplot3d)
> graph=scatterplot3d(X,Y,Z)
> #VISUALIZE THE PLANE
> graph$plane3d(regmodel)
>
```



LAB – 5

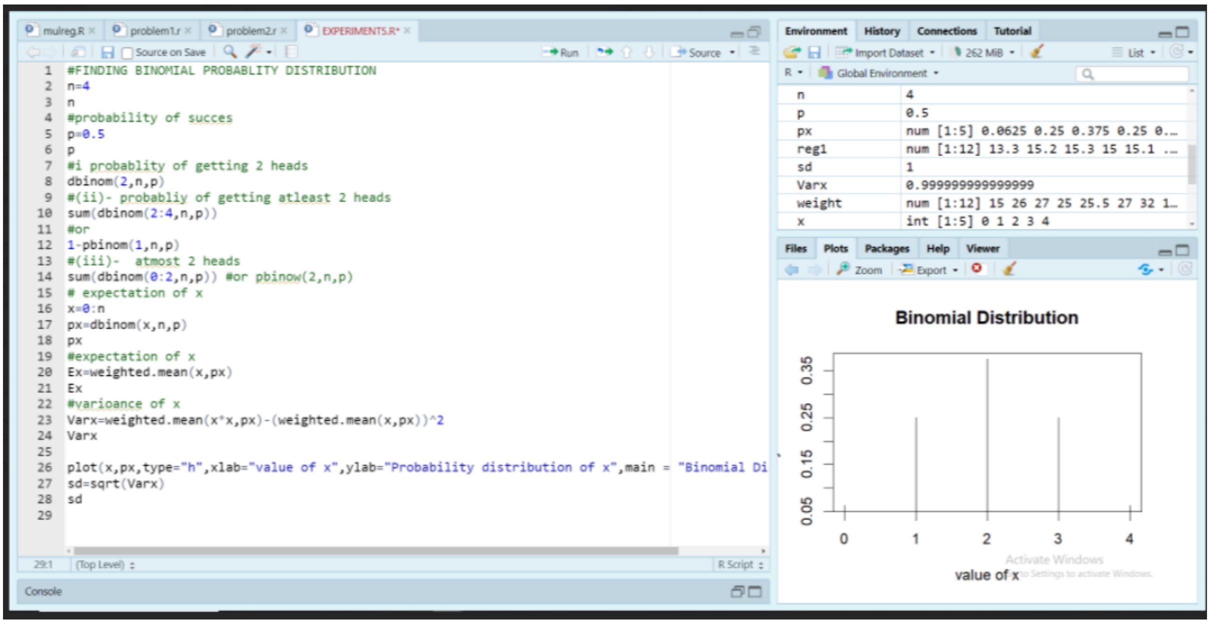
Fitting the probability distributions: Binomial distribution

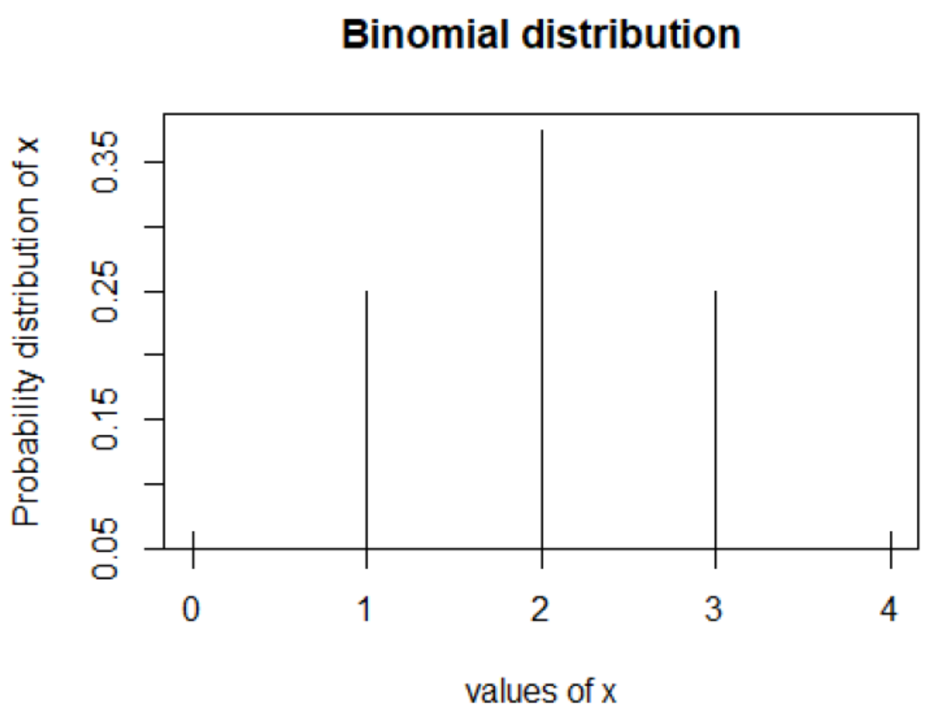
CODE

```
#FINDING BINOMIAL PROBABLITY DISTRIBUTION
n=4
n
#probability of succes
p=0.5
p
#i probablity of getting 2 heads
dbinom(2,n,p)
#(ii)- probabliy of getting atleast 2 heads
sum(dbinom(2:4,n,p))
#or
1-pbinom(1,n,p)
#(iii)-  atmost 2 heads
sum(dbinom(0:2,n,p)) #or pbinow(2,n,p)
# expectation of x
x=0:n
px=dbinom(x,n,p)
px
#expectation of x
Ex=weighted.mean(x,px)
Ex
#varioance of x
```

```
Varx=weighted.mean(x*x,px)-(weighted.mean(x,px))^2
Varx
```

```
plot(x,px,type="h",xlab="value of x",ylab="Probability distribution of x",main = "Binomial Distribution")
```





ALL EXPERIMENT R CODE

#Experiment-1: Understanding data types, importing and exporting data

#Generate data

#Class Code

#Generate data

1:10

#Assign variable name to the value

X = 10

Combine numeric values into vector

c(1,2,5)

#Arithmetic operations on vectors

a = c(1, 3, 5, 7)

b = c(2, 4, 6, 8)

#Addition

a+b

#Subtraction

a-b

#Constant multiplication

5*a

#Product

a*b

```
#Division
a/b

#String values
X = as.character(5.2)
X

#Concatenation of strings
paste("Baa", "Baa", "Black", "Sheep")


#Practice code

#Generate data
1:10

#Assign variable name to the value
X <- 5

# Combine numeric values into vector
c(12,43,14,54,100)
c

#Arithmetic operations on vectors
a = c(12, 43, 11, 14, 9, 10)
b = c(59, 110, 2, 19, 6, 39)

#Addition
a+b

#Subtraction
```

```
a-b

#Constant multiplication
10*a

#Product
a*b

#Division
a/b

#String values
X = as.character(12.9)
X

#Concatenation of strings
paste("Hello", "World")

#-----------------------------------------------------------------------------
# Experiment-2: Plotting and visualizing data

#Class Question

#Put data into vectors
empid = c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15)
empid
age = c(30,37,45,32,50,60,35,32,34,43,32,30,43,50,60)
age
gender = c(0,1,0,1,1,1,0,0,1,0,0,1,1,0,0)
gender
status = c(1,1,2,2,1,1,1,2,2,1,2,1,2,1,2)
```

```
status

#Create dataframe
empinfo = data.frame(empid, age, gender, status)
empinfo

# labeling character to numeric
empinfo$gender = factor(empinfo$gender, labels = c("male", "female"))
empinfo$gender
empinfo$status = factor(empinfo$status, labels = c("staff", "faculty"))
empinfo$status
empinfo

# extract male data
male = subset(empinfo,empinfo$gender=="male")
male

# extract female data
female = subset(empinfo, empinfo$gender == "female")
female

# summary statistics for empinfo data
summary(empinfo)
summary(male)
summary(female)
summary(age)

#creating table (one-way)
table1 = table(empinfo$gender)
table1
table2 = table(empinfo$status)
```

table2

#creating table (two-way)

table3 = table(empinfo$gender, empinfo$status)

table3

#Graphical representation

plot(empinfo$age, type="l", main="Age of employees", xlab="empid", ylab="Age in years", col = "blue") pie(table1) barplot(table3, beside=T, xlim=c(1,15), ylim=c(0,5), col=c("blue", "red")) legend("topright", legend=rownames(table3), fill=c('blue', 'red'), bty="n") boxplot(empinfo$age~empinfo$status, col=c('red', 'blue'))

pie(table1)

barplot(table3, beside=T, xlim=c(1,15), ylim=c(0,5), col=c("blue", "red")) legend("topright", legend=rownames(table3), fill=c('blue', 'red'), bty="n")

boxplot(empinfo$age~empinfo$status, col=c('red', 'blue'))

#Practice question

#Put data into dataframe

name = c('p1', 'p2', 'p3', 'p4', 'p5', 'p6', 'p7', 'p8', 'p9', 'p10')

age = c(20, 20, 21, 20, 21, 22, 21, 21, 20, 22)

math = c(100, 90, 95, 98, 92, 99, 95, 100, 93, 90)

phy = c(90, 100, 91, 92, 98, 92, 98, 99, 100, 93)

chem = c(93,89,99,92,94,95,99,85,)

Create dataframe for student marks

studMarks = data.frame(name, age, math, phy, chem)

studMarks

summary(studMarks)

Plot math marks of students

plot(studMarks$math, type="l", main="Marks in math", xlab="Student", ylab="Marks", col = "blue")

```
#creating table (one-way)
tableAge = table(studMarks$age)
tableAge

#Pie chart for age
pie(tableAge)
tablePhyMarks = table(studMarks$phy)
tablePhyMarks

#Bar plot for physics marks
barplot(tablePhyMarks, beside=T, xlim=c(0,10), ylim=c(0,5), col=c("blue", "red"))

#Box plot for math marks and age
boxplot(studMarks$math~studMarks$age, col=c('red', 'blue'))

#------------------------------------------------------------------------------
#Experiment-3: Apply correlation and simple linear regression model to real data
#Class question

#Problem-1
#Import the inbuilt dataset cars
data=cars
data

#Summary of data set
summary(data)

#Variance of speed
v1=var(data$speed)
v1
```

```
#variance of "dist"
v2=var(data$dist)
v2

#covariance between speed and dist
covariance=cov(data$speed,data$dist)
covariance

#Standard deviation
stdDevSpeed=sd(data$speed)
stdDevSpeed

stdDevDist = sd(data$dist)
stdDevDist

#correlation coefficient
corr = covariance/(stdDevSpeed*stdDevDist)
corr

#or

corr2 = cor(data$speed, data$dist)
corr2

cor.test(data$speed, data$dist)
cor.test(data$speed, data$dist, method="pearson")
cor.test(data$speed, data$dist, method="spearman")

regression1 = lm(data$speed~data$dist)
regression1
```

```
#Plot regression2
plot(data$speed, data$dist)
abline(regression1)

regression2 = lm(data$dist~data$speed)
regression2

#Plot regression1
plot(data$dist, data$speed)
abline(regression2)

#Problem-2
weight = c(15, 26, 27, 25, 25.5, 27, 32, 18, 22, 20, 26, 24)
weight

bmi = c(13.35, 16.12, 16.74, 16, 13.59, 15.73, 15.65, 13.85, 16.07, 12.8, 13.65, 14.42);
bmi

#Apply correlation
cor(weight, bmi)

#Find regression
Regression1 = lm(bmi~weight)
Regression1
reg1 = lm(bmi~weight)
reg1 = 10.735+0.1710*weight
reg1

#Plot regression
plot(weight, bmi)
```

```
abline(Regression1)



#Practice problem


#Vector for age of husbands
ageHusbands = c(23,27,28,29,30,31,33,35,36,39)
#Vector for age of wives
ageWives = c(18,22,23,24,25,26,28,29,30,32)
#Create dataframe
data = data.frame(ageHusbands, ageWives)
#Summary of data set
summary(data)

#Variance of husbands' age
v1=var(data$ageHusbands)
v1

#variance of wives' age
v2=var(data$ageWives)
v2

#covariance between husbands' age and wives' age
covariance=cov(data$ageHusbands,data$ageWives)
covariance

#Standard deviation
stdDevHusbAge=sd(data$ageHusbands)
stdDevHusbAge

stdDevWivesAge = sd(data$ageWives)
```

```
stdDevWivesAge

#correlation coefficient
corr = covariance/(stdDevHusbAge*stdDevWivesAge)
corr

#or

corr2 = cor(data$ageHusbands, data$ageWives)
corr2 = cor(data)

cor.test(data$ageHusbands, data$ageWives)
cor.test(data$ageHusbands, data$ageWives, method="pearson")
cor.test(data$ageHusbands, data$ageWives, method="spearman")


regression1 = lm(data$ageHusbands~data$ageWives)
regression1

#Plot regression1
plot(data$ageHusbands, data$ageWives)
abline(regression1)

regression2 = lm(data$ageWives~data$ageHusbands)
regression2

#Plot regression2
plot(data$ageWives, data$ageHusbands)
abline(regression2)

#-----------------------------------------------------------------------------
```

NAME: ADARSH GAURAV REG NO: 21BCE1628

#Experiment-4: Apply multiple linear regression model to real data set

#Class question

#Problem-1

Input the variables

Y = c(110, 80, 70, 120, 150, 90, 70, 120)

Y

X1 = c(30, 40, 20, 50, 60, 40, 20, 60)

X1

X2 = c(11, 10, 7, 15, 19, 12, 8, 14)

X2

Linear regression model of Y on X1 and X2\

RegModel = lm(Y~X1+X2) RegModel

Summary of the data

summary(RegModel)

install.packages("scatterplot3d")

library(scatterplot3d)

plot the data set

scatterplot3d(Y,X1,X2)

#Problem-2

data = mtcars

data

X = mtcars$mpg

X

Y = mtcars$disp

Y

Z = mtcars$hp

Z

```
RegModel <- lm(Z~X+Y)

RegModel

summary(RegModel)

graph = scatterplot3d(X,Y,Z)

# Visualize the plane

graph$plane3d(RegModel)



#Practice question

Y = c(240,236,290,274,301,316,300,296,267,276,288,261)

X1 = c(25,31,45,60,65,72,80,84,75,60,50,38)

X2 = c(24,21,24,25,25,26,25,25,24,25,25,25)


# Linear regression model of Y on X1 and X2

RegModel = lm(Y~X1+X2)

RegModel


# Summary of the data

summary(RegModel)


library(scatterplot3d)

# plot the data set scatterplot3d(Y,X1,X2)

graph$plane3d(RegModel)


#-----------------------------------------------------------------------------

#Experiment-5: Binomial Distribution

#Class Question

#Four coins are tossed simultaneously. What is the probability of getting

#(i) 2 heads

#(ii) atleast 2 heads

#(iii) atmost 2 heads
```

```
#(iv) Expectation of x

#(v) Variance of x

#(vi) Visualize the probability distribution


# number of trials

n = 4

n


# probability of success

p = 0.5

p


# (i) probabilty of gettting exactly two heads

dbinom(2,n,p)


# (ii) probabilty of getting atleast two heads

sum(dbinom(2:4, n, p))

# or

1 - pbinom(1, n, p)


# (iii) probability of getting atmost two heads

sum(dbinom(0:2,n,p))


# (iv) Expectation of x

x = 0:n

px = dbinom(x, n, p)

px

Ex = weighted.mean(x, px)

Ex


# (v) variance of x
```

```
varx = weighted.mean(x*x, px) - (weighted.mean(x, px))^2

varx

std <- sqrt(varx)

std


# (vi) visualize probability distribution

plot(x, px, type = "h", xlab = "values of x", ylab = "Probability distribution of x", main =
    "Binomial distribution")



#Practice question

#The incidence of an occupational disease in an industry is such that the workers have a 20% chance

#of suffering from it. What is the probability that out of 6 workers chosen at random 4 or more will suffer

#disease?


# number of trials

n = 6

n

# probability of success

p = 0.2

p

sum(dbinom(4:6, n, p))

x = 0:n

px = dbinom(x, n, p)

px

# visualize probability distribution

plot(x, px, type = "h", xlab = "values of x", ylab = "Probability distribution of x", main =
    "Binomial distribution")
```
