STAT 46700/CS 5900 Topics in Data Science Spring 2025

Lab 4

[Vaishak Balachandra]

Q.N. 1) An economist studied 10 mutual firms and 10 stock firms. Let y= Number of months elapsed, X1= Size of the firm and x2= Type of firm. Below is the data

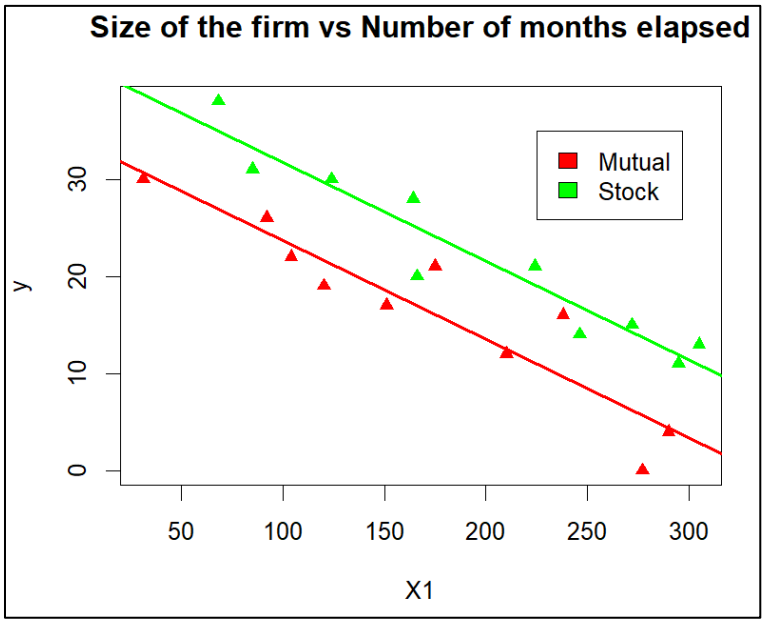
y	X1	X2
17	151	Mutual
26	92	Mutual
21	175	Mutual
30	31	Mutual
22	104	Mutual
0	277	Mutual
12	210	Mutual
19	120	Mutual
4	290	Mutual
16	238	Mutual
28	164	Stock
15	272	Stock
11	295	Stock
38	68	Stock
31	85	Stock
21	224	Stock
20	166	Stock
13	305	Stock
30	124	Stock
14	246	Stock

a) Draw a scatter plot of Size of the firm vs. Number of months elapsed. Also choose different colors to display Type of the firm.

b) Fit a regression model with indicator variable and write out the regression models.

```
> ##################### Q1
>
> install.packages("readxl")
> library(readxl)
> # file.choose()
> Q1 <- read_excel("C:/Users/PNW_checkout/Downloads/sem2/0. Coursework/Data science/Lab/Lab 4/Q1.xl
sx")
> head(Q1,5)
# A tibble: 5 × 3
      y    X1 X2
  <dbl> <dbl> <chr>
1    17   151 Mutual
2    26    92 Mutual
3    21   175 Mutual
4    30    31 Mutual
5    22   104 Mutual
```

```
> names(Q1)
[1] "y"  "X1" "X2"
> dim(Q1)
[1] 20  3
> attach(Q1)
>
> # a
> plot(X1,y,pch = 17, main = "Size of the firm vs Number of months elapsed", col = ifelse(X2 == "Mu
tual", "red", "green"))
> legend(225,35,fill = c("red","green"), c("Mutual","Stock"))
>
> # b
> model = lm(y~X1+X2)
> model

Call:
lm(formula = y ~ X1 + X2)

Coefficients:
(Intercept)           X1      X2Stock
    33.8741      -0.1017       8.0555

> cat("Fitted Model Equation:
+
+ for Mutual:
+ y = 33.8741 -0.1017*Size
+
+ for Stock:
+ y = 41.9296 -0.1017*Size")
Fitted Model Equation:

for Mutual:
y = 33.8741 -0.1017*Size

for Stock:
y = 41.9296 -0.1017*Size
> abline(33.8741, -0.1017, lwd = 2, col = "red") # for Mutual
> abline(41.9296, -0.1017, lwd = 2, col = "green") # for Stock
```



Q. N. 2) The dataset *mtcars* in R was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973–74 models).

a. Import the data in R and extract the variables included in the dataset.
b. Fit a multiple linear regression model to model mpg using disp, hp, wt and qsec as the predictor variables.
c. Preform marginal t-test to check the significance of each predictor variables.
d. Determine the coefficient of determination.

```
> ################### Q2
>
> # a
> data("mtcars")
> head(mtcars)
                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
> colnames(mtcars)
 [1] "mpg"  "cyl"  "disp" "hp"   "drat" "wt"   "qsec" "vs"   "am"   "gear" "carb"
> dim(mtcars)
[1] 32 11
> attach(mtcars)
>
> # b
> model2 <- lm(mpg~disp+hp+wt+qsec)
> model2

Call:
lm(formula = mpg ~ disp + hp + wt + qsec)

Coefficients:
(Intercept)         disp           hp           wt         qsec
  27.329638     0.002666    -0.018666    -4.609123     0.544160

> cat("Fitted Model Equation:
+ mpg =   27.329638 + 0.002666*disp - 0.018666*hp - 4.609123*wt + 0.544160*qsec")
Fitted Model Equation:
mpg =   27.329638 + 0.002666*disp - 0.018666*hp - 4.609123*wt + 0.544160*qsec
>
> # c
> summary(model2)

Call:
lm(formula = mpg ~ disp + hp + wt + qsec)

Residuals:
    Min      1Q  Median      3Q     Max
-3.8664 -1.5819 -0.3788  1.1712  5.6468

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 27.329638   8.639032   3.164  0.00383 **
disp         0.002666   0.010738   0.248  0.80576
hp          -0.018666   0.015613  -1.196  0.24227
wt          -4.609123   1.265851  -3.641  0.00113 **
qsec         0.544160   0.466493   1.166  0.25362
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Residual standard error: 2.622 on 27 degrees of freedom
Multiple R-squared:  0.8351, Adjusted R-squared:  0.8107
F-statistic: 34.19 on 4 and 27 DF,  p-value: 3.311e-10

> cat("From the model summary, using the pvalue = 0.00113(**),
+ 'wt' is the only variable that is significant, while other variables have pvalue > 0.05, that's m
akes them insignificant!!")
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'wt' is the only variable that is significant, while other variables have pvalue > 0.05, that's mak
es them insignificant!!
>
>
> # d
> # anova(model2)
> summary(model2)

Call:
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> cat("Coefficient of Determination:
+ Multiple R^2 squared value: 83.51%
+ Adjusted R^2 squared value: 81.07%")
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Adjusted R^2 squared value: 81.07%
```