Student Name	Imaad Hajwane
SRN No	202101132
Roll No	23
Program	Computer Engineering
Year	Third Year
Division	A
Subject	DMPM
Assignment No	Three

DMPM Lab Assignment -3

Linear Regression Model

1. Read the dataset that is provided to you.
2. Build a suitable linear regression model using R.
3. Analyze the predicted values of the response variable.
4. Compute the residuals and plot the residual values.
5. Develop some metrics to determine the accuracy of your regression model
6. Save your R command file.
7. Save your code and results in a Word file and submit it on the VOLP.

The R function **lm** is used to fit linear (regression) models. The syntax for this command is given below:

lm(formula, data, subset, weights, na.action, method = "qr", model = TRUE, x = FALSE, y = FALSE, qr = TRUE, singular.ok = TRUE, contrasts = NULL, offset, …)

Type >help(lm) in Rstudio to get detailed help on **lm** command.

In help also check for *"An object of class "lm" is a list containing at least the following components"* how to retrieve various components of object of class lm.

Code:

```
rm(list = ls())

DF <- read_excel("P:/College/SEM - 6/LAB/DMPM_Lab/Titanic_DFset.xlsx")
View(DF)

DF$age[is.na(DF$age)] <- mean(DF$age, na.rm = TRUE)
DF$fare[is.na(DF$fare)] <- mean(DF$fare, na.rm = TRUE)

plot(DF$age, DF$fare,
    xlab = "Age",
    ylab = "Fare",
    main = "Scatter Plot of Age vs Fare")

install.packages('caTools')
library(caTools)

split = sample.split(DF$fare, SplitRatio = 0.7)
trainingset = subset(DF, split == TRUE)
testset = subset(DF, split == FALSE)

lm.r = lm(fare ~ age, DF)
lm.r

summary(lm.r)

Pre = predict(lm.r, DF)
Pre

library(ggplot2)

ggplot() + geom_point(aes(x = trainingset$age, y = trainingset$fare), colour = 'red') +
  geom_line(aes(x = trainingset$age,      y = predict(lm.r, newdata = trainingset)), colour = 'blue') +
  ggtitle('Fare vs Age (Training set)') +
  xlab('Age') +
  ylab('Fare')

ggplot() + geom_point(aes(x = testset$age, y = testset$fare), colour = 'red') +
  geom_line(aes(x = testset$age, y = predict(lm.r, newdata = testset)), colour = 'blue') +
  ggtitle('Fare vs Age (Test set)') +
  xlab('Age') +
  ylab('Fare')

DIFF = (DF$fare) - (Pre)
DIFF

#parameter's to evaluate linear model
MSE = mean((DIFF)^2) #mean square error
```

```
MSE

MAE = mean(abs(DIFF)) #mean absolute error
MAE

RMSE = sqrt(MSE) #root mean square error
RMSE

R_2 = 1 - (sum((DIFF)^2) / sum((DF$fare - mean(DF$fare))^2))
R_2

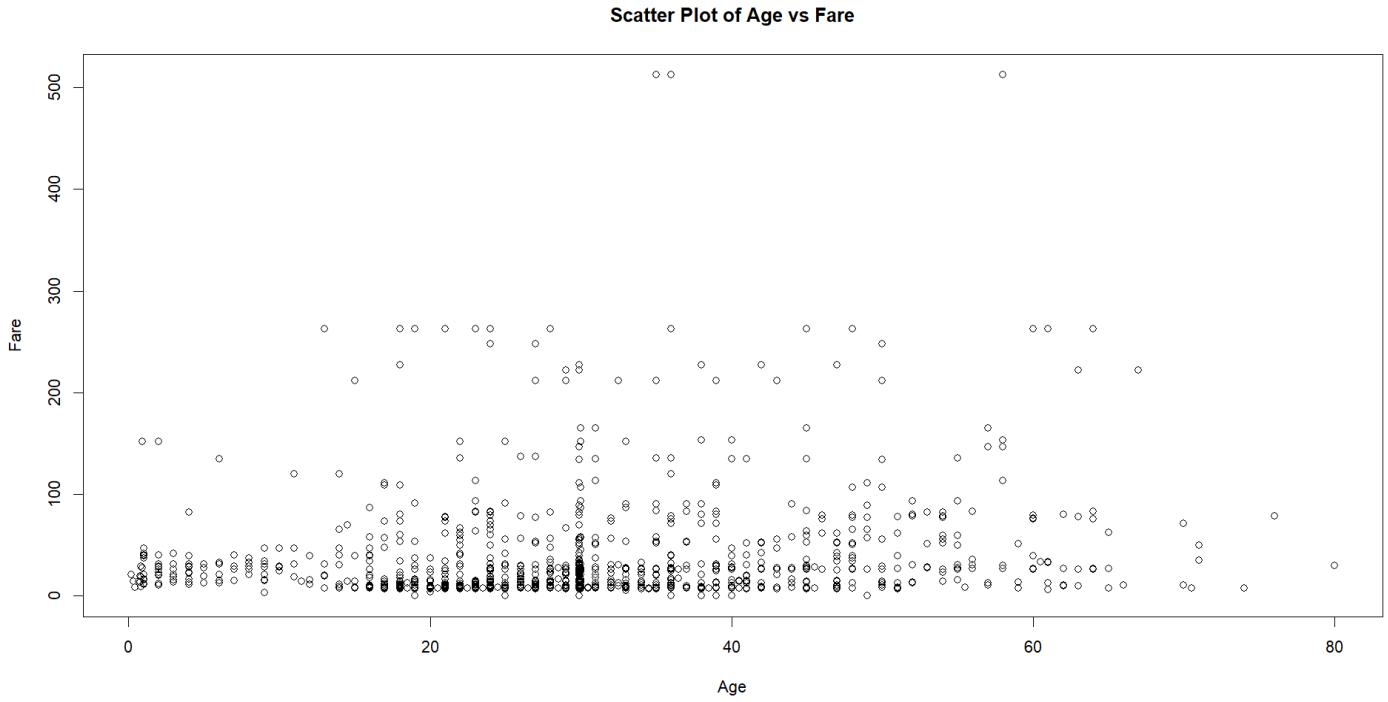
cat("MAE: ", MAE, "\n", "MSE: ", MSE, "\n", "RMSE: ", RMSE, "\n", "R-squared: ", R_2)
```

Output:

	pclass	survived	name	sex	age	sibsp	parch	ticket	fare	cabin	embarked	boat
1	1	1	Allen, Miss. Elisabeth Walton	female	29.00000	0	0	24160	211.3375	B5	S	2
2	1	1	Allison, Master. Hudson Trevor	male	0.91670	1	2	113781	151.5500	C22 C26	S	11
3	1	0	Allison, Miss. Helen Loraine	female	2.00000	1	2	113781	151.5500	C22 C26	S	*NA*
4	1	0	Allison, Mr. Hudson Joshua Creighton	male	30.00000	1	2	113781	151.5500	C22 C26	S	*NA*
5	1	0	Allison, Mrs. Hudson J C (Bessie Waldo Daniels)	female	25.00000	1	2	113781	151.5500	C22 C26	S	*NA*
6	1	1	Anderson, Mr. Harry	male	48.00000	0	0	19952	26.5500	E12	S	3
7	1	1	Andrews, Miss. Kornelia Theodosia	female	63.00000	1	0	13502	77.9583	D7	S	10
8	1	0	Andrews, Mr. Thomas Jr	male	39.00000	0	0	112050	0.0000	A36	S	*NA*
9	1	1	Appleton, Mrs. Edward Dale (Charlotte Lamson)	female	53.00000	2	0	11769	51.4792	C101	S	D
10	1	0	Artagaveytia, Mr. Ramon	male	71.00000	0	0	PC 17609	49.5042	*NA*	C	*NA*
11	1	0	Astor, Col. John Jacob	male	47.00000	1	0	PC 17757	227.5250	C62 C64	C	*NA*
12	1	1	Astor, Mrs. John Jacob (Madeleine Talmadge Force)	female	18.00000	1	0	PC 17757	227.5250	C62 C64	C	4
13	1	1	Aubart, Mme. Leontine Pauline	female	24.00000	0	0	PC 17477	69.3000	B35	C	9
14	1	1	Barber, Miss. Ellen "Nellie"	female	26.00000	0	0	19877	78.8500	*NA*	S	6
15	1	1	Barkworth, Mr. Algernon Henry Wilson	male	80.00000	0	0	27042	30.0000	A23	S	B
16	1	0	Baumann, Mr. John D	male	29.88113	0	0	PC 17318	25.9250	*NA*	S	*NA*
17	1	0	Baxter, Mr. Quigg Edmond	male	24.00000	0	1	PC 17558	247.5208	B58 B60	C	*NA*
18	1	1	Baxter, Mrs. James (Helene DeLaudeniere Chaput)	female	50.00000	0	1	PC 17558	247.5208	B58 B60	C	6
19	1	1	Bazzani, Miss. Albina	female	32.00000	0	0	11813	76.2917	D15	C	8
20	1	0	Beattie, Mr. Thomson	male	36.00000	0	0	13050	75.2417	C6	C	A
21	1	1	Beckwith, Mr. Richard Leonard	male	37.00000	1	1	11751	52.5542	D35	S	5
22	1	1	Beckwith, Mrs. Richard Leonard (Sallie Monypeny)	female	47.00000	1	1	11751	52.5542	D35	S	5
23	1	1	Behr, Mr. Karl Howell	male	26.00000	0	0	111369	30.0000	C148	C	5

Figure 1 - View(DF)

```
> DF$age[is.na(DF$age)] <- mean(DF$age, na.rm = TRUE)
> DF$fare[is.na(DF$fare)] <- mean(DF$fare, na.rm = TRUE)
> plot(DF$age, DF$fare,
+      xlab = "Age",
+      ylab = "Fare",
+      main = "Scatter Plot of Age vs Fare")
```




```
> install.packages('caTools')
Error in install.packages : Updating loaded packages
> install.packages("caTools")
Warning in install.packages :
  package ‘caTools’ is in use and will not be installed
> library(caTools)
> split = sample.split(DF$fare, SplitRatio = 0.7)
> trainingset = subset(DF, split == TRUE)
> testset = subset(DF, split == FALSE)
> lm.r = lm(fare ~ age, DF)
> lm.r
Call:
lm(formula = fare ~ age, data = DF)

Coefficients:
(Intercept)          age
    12.7126       0.6888

> summary(lm.r)
Call:
lm(formula = fare ~ age, data = DF)

Residuals:
   Min     1Q Median     3Q    Max
-55.91 -24.75 -17.19   3.10 475.51

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  12.7126     3.5609   3.570  0.00037 ***
age           0.6888     0.1094   6.294 4.21e-10 ***
---
```

```
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 50.99 on 1307 degrees of freedom
Multiple R-squared:  0.02942,     Adjusted R-squared:  0.02868
F-statistic: 39.62 on 1 and 1307 DF,  p-value: 4.21e-10

> Pre = predict(lm.r, DF)
> Pre
       1        2        3        4        5        6        7        8
32.68853 13.34403 14.09023 33.37736 29.93323 45.77622 56.10861 39.57679
       9       10       11       12       13       14       15       16
49.22035 61.61922 45.08740 25.11145 29.24440 30.62205 67.81865 33.29548
      17       18       19       20       21       22       23       24
29.24440 47.15388 34.75501 37.51031 38.19914 45.08740 30.62205 41.64327
      25       26       27       28       29       30       31       32
32.68853 29.93323 29.93323 25.80027 36.82149 31.99971 43.70975 40.26562
      33       34       35       36       37       38       39       40
33.37736 52.66448 41.64327 43.70975 27.86675 33.29548 40.95444 45.77622
      41       42       43       44       45       46       47       48
33.29548 43.02092 53.35331 54.04214 40.95444 43.70975 33.29548 41.64327
      49       50       51       52       53       54       55       56
49.22035 37.51031 52.66448 35.44383 31.99971 24.42262 20.28966 22.35614
      57       58       59       60       61       62       63       64
37.51031 37.51031 46.46505 33.29548 37.51031 65.06335 44.39857 45.08740
      65       66       67       68       69       70       71       72
31.31088 35.44383 37.51031 33.37736 43.70975 33.29548 33.29548 31.31088
      73       74       75       76       77       78       79       80
30.62205 27.86675 33.29548 45.08740 39.57679 38.19914 56.79744 50.59801
      81       82       83       84       85       86       87       88
33.29548 60.93039 37.51031 56.79744 39.57679 38.88796 47.84270 31.31088
      89       90       91       92       93       94       95       96
35.44383 34.06618 31.31088 34.06618 24.42262 49.22035 15.46788 49.90918
      97       98       99      100      101      102      103      104
47.15388 31.31088 45.77622 45.77622 46.46505 39.57679 28.55558 38.88796
     105      106      107      108      109      110      111      112
49.90918 37.51031 33.29548 33.29548 33.29548 37.51031 33.37736 29.24440
     113      114      115      116      117      118      119      120
31.99971 28.55558 25.80027 56.79744 54.04214 33.37736 33.29548 47.15388
     121      122      123      124      125      126      127      128
42.33209 33.29548 27.86675 54.04214 45.77622 33.29548 38.19914 36.82149
     129      130      131      132      133      134      135      136
45.08740 36.82149 27.86675 43.70975 29.24440 46.46505 33.29548 61.61922
     137      138      139      140      141      142      143      144
49.22035 25.80027 38.88796 52.66448 28.55558 43.70975 44.39857 29.93323
     145      146      147      148      149      150      151      152
29.93323 45.77622 46.46505 33.29548 43.70975 36.82149 40.26562 31.31088
     153      154      155      156      157      158      159      160
33.29548 29.24440 50.59801 48.53153 41.64327 33.29548 50.59801 23.73379
     161      162      163      164      165      166      167      168
43.02092 47.84270 41.64327 36.82149 36.82149 38.88796 33.29548 36.82149
     169      170      171      172      173      174      175      176
38.88796 47.15388 46.46505 44.39857 47.15388 35.09942 52.66448 40.95444
     177      178      179      180      181      182      183      184
33.29548 41.64327 43.70975 33.29548 39.57679 46.46505 33.37736 36.82149
     185      186      187      188      189      190      191      192
33.29548 41.64327 50.59801 23.73379 47.84270 32.68853 27.17792 33.37736
     193      194      195      196      197      198      199      200
52.66448 23.04497 33.37736 23.73379 33.29548 25.80027 25.11145 29.24440
     201      202      203      204      205      206      207      208
44.39857 49.90918 37.51031 31.99971 33.29548 57.48627 43.02092 35.44383
     209      210      211      212      213      214      215      216
38.19914 33.37736 50.59801 45.08740 38.19914 34.06618 28.55558 52.66448
     217      218      219      220      221      222      223      224
25.80027 56.79744 39.57679 33.29548 27.86675 57.48627 32.34412 33.29548
     225      226      227      228      229      230      231      232
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44.05416 28.55558 32.68853 27.86675 25.11145 24.42262 33.37736 48.53153
     233      234      235      236      237      238      239      240
45.08740 51.28683 38.88796 33.29548 27.86675 33.29548 42.33209 34.06618
     241      242      243      244      245      246      247      248
43.70975 33.29548 35.44383 44.39857 37.51031 35.44383 50.59801 49.90918
     249      250      251      252      253      254      255      256
35.44383 21.66732 25.11145 27.17792 54.73096 45.77622 33.29548 29.24440
     257      258      259      260      261      262      263      264
33.29548 36.82149 33.37736 36.13266 40.26562 36.82149 47.15388 39.57679
     265      266      267      268      269      270      271      272
51.28683 31.99971 51.28683 51.28683 29.24440 33.29548 25.11145 29.24440
     273      274      275      276      277      278      279      280
28.55558 16.84553 43.70975 40.26562 51.97566 33.29548 34.75501 55.41979
     281      282      283      284      285      286      287      288
49.90918 42.33209 48.53153 33.29548 55.41979 58.86392 56.10861 54.73096
     289      290      291      292      293      294      295      296
45.77622 25.11145 48.53153 39.57679 45.77622 33.29548 46.46505 24.42262
     297      298      299      300      301      302      303      304
39.57679 33.29548 34.06618 40.26562 54.73096 45.08740 36.82149 56.79744
     305      306      307      308      309      310      311      312
54.04214 54.04214 49.90918 27.17792 50.59801 34.06618 51.97566 43.70975
     313      314      315      316      317      318      319      320
47.15388 31.31088 47.15388 27.17792 47.84270 27.17792 33.29548 34.06618
     321      322      323      324      325      326      327      328
33.29548 55.41979 37.51031 33.37736 31.99971 33.37736 25.11145 29.93323
     329      330      331      332      333      334      335      336
36.13266 37.51031 51.97566 25.11145 28.55558 37.51031 31.99971 47.84270
     337      338      339      340      341      342      343      344
34.75501 25.80027 31.99971 13.40140 15.46788 20.97849 37.51031 36.13266
     345      346      347      348      349      350      351      352
25.80027 28.55558 30.62205 41.64327 31.31088 29.24440 23.04497 54.04214
     353      354      355      356      357      358      359      360
40.26562 26.48910 29.93323 37.51031 29.93323 41.64327 41.64327 13.28658
     361      362      363      364      365      366      367      368
30.62205 27.86675 36.82149 33.29548 25.80027 43.02092 49.90918 48.53153
     369      370      371      372      373      374      375      376
38.19914 32.68853 29.93323 43.70975 32.68853 31.99971 32.68853 31.99971
     377      378      379      380      381      382      383      384
29.24440 18.22319 34.06618 34.06618 27.86675 33.37736 33.29548 27.17792
     385      386      387      388      389      390      391      392
33.29548 18.22319 25.11145 45.77622 31.99971 34.75501 24.42262 32.68853
     393      394      395      396      397      398      399      400
29.24440 29.93323 25.11145 25.11145 36.13266 49.90918 18.22319 41.64327
     401      402      403      404      405      406      407      408
36.13266 31.31088 33.37736 28.55558 27.17792 25.11145 40.26562 32.68853
     409      410      411      412      413      414      415      416
25.11145 37.51031 33.29548 38.88796 36.82149 38.88796 36.13266 36.13266
     417      418      419      420      421      422      423      424
23.73379 30.62205 45.08740 27.17792 27.17792 29.24440 29.24440 36.13266
     425      426      427      428      429      430      431      432
33.37736 48.53153 33.37736 13.17182 29.24440 43.02092 16.84553 31.99971
     433      434      435      436      437      438      439      440
55.41979 33.37736 17.53436 42.33209 43.70975 29.24440 29.24440 46.46505
     441      442      443      444      445      446      447      448
45.77622 50.59801 29.24440 34.75501 27.17792 25.11145 26.48910 28.55558
     449      450      451      452      453      454      455      456
37.51031 49.90918 47.15388 43.02092 32.68853 27.17792 41.64327 56.10861
     457      458      459      460      461      462      463      464
54.04214 35.44383 24.42262 41.64327 29.24440 45.08740 29.24440 27.86675
     465      466      467      468      469      470      471      472
34.75501 28.55558 36.13266 29.24440 27.86675 33.29548 36.82149 43.70975
     473      474      475      476      477      478      479      480
51.97566 33.29548 34.06618 30.62205 33.37736 33.29548 13.40140 14.77906
     481      482      483      484      485      486      487      488
```

```
29.93323 27.86675 24.42262 33.29548 36.13266 37.51031 29.24440 54.73096
     489       490       491       492       493       494       495       496
47.15388 41.64327 51.97566 33.29548 13.40140 34.06618 29.24440 33.29548
     497       498       499       500       501       502       503       504
33.37736 40.26562 34.75501 33.37736 44.39857 21.66732 40.95444 25.80027
     505       506       507       508       509       510       511       512
39.57679 45.77622 60.93039 31.31088 49.90918 39.57679 23.73379 55.41979
     513       514       515       516       517       518       519       520
35.09942 22.35614 14.09023 14.77906 37.85473 30.62205 25.80027 31.99971
     521       522       523       524       525       526       527       528
26.48910 32.68853 39.57679 27.86675 33.29548 28.55558 32.68853 31.99971
     529       530       531       532       533       534       535       536
33.29548 47.15388 25.80027 33.29548 40.95444 27.17792 25.80027 42.33209
     537       538       539       540       541       542       543       544
34.75501 36.13266 33.37736 31.31088 14.09023 18.22319 35.44383 37.51031
     545       546       547       548       549       550       551       552
36.13266 33.37736 31.99971 28.55558 13.28658 14.77906 29.24440 47.15388
     553       554       555       556       557       558       559       560
25.80027 27.17792 30.62205 29.93323 31.31088 29.93323 25.11145 26.48910
     561       562       563       564       565       566       567       568
33.37736 53.35331 33.37736 36.82149 40.26562 29.93323 40.95444 29.93323
     569       570       571       572       573       574       575       576
25.45586 22.35614 47.15388 28.55558 31.99971 31.31088 32.68853 31.31088
     577       578       579       580       581       582       583       584
40.26562 34.06618 33.37736 28.55558 34.06618 33.29548 20.97849 40.26562
     585       586       587       588       589       590       591       592
35.09942 31.31088 32.68853 14.09023 15.46788 32.68853 13.34403 16.15671
     593       594       595       596       597       598       599       600
37.51031 35.44383 58.17509 33.29548 34.06618 33.29548 30.62205 29.24440
     601       602       603       604       605       606       607       608
41.64327 21.66732 23.73379 36.82149 23.73379 29.93323 26.48910 25.11145
     609       610       611       612       613       614       615       616
33.37736 30.62205 40.26562 13.28658 25.11145 30.62205 30.62205 26.48910
     617       618       619       620       621       622       623       624
29.24440 29.93323 36.82149 25.11145 34.75501 25.80027 15.46788 16.84553
     625       626       627       628       629       630       631       632
14.09023 24.42262 38.88796 18.91201 20.28966 39.57679 31.31088 30.62205
     633       634       635       636       637       638       639       640
39.57679 26.48910 30.62205 29.93323 25.11145 29.24440 36.82149 16.15671
     641       642       643       644       645       646       647       648
18.91201 14.77906 21.66732 16.15671 40.26562 28.55558 38.88796 43.70975
     649       650       651       652       653       654       655       656
27.17792 28.55558 24.42262 33.37736 28.55558 21.66732 26.48910 34.75501
     657       658       659       660       661       662       663       664
35.44383 13.22920 13.22920 16.15671 29.24440 25.11145 40.26562 30.62205
     665       666       667       668       669       670       671       672
26.48910 25.11145 43.70975 31.31088 27.86675 25.80027 30.62205 27.86675
     673       674       675       676       677       678       679       680
33.29548 26.48910 34.75501 27.17792 25.11145 30.62205 16.84553 18.91201
     681       682       683       684       685       686       687       688
33.29548 33.29548 33.29548 40.26562 34.75501 27.17792 27.86675 26.48910
     689       690       691       692       693       694       695       696
32.68853 27.86675 27.86675 36.82149 25.45586 27.17792 25.80027 25.11145
     697       698       699       700       701       702       703       704
27.17792 33.37736 25.11145 38.88796 24.42262 24.42262 27.17792 27.17792
     705       706       707       708       709       710       711       712
27.17792 33.29548 33.29548 31.99971 29.24440 23.73379 38.19914 31.99971
     713       714       715       716       717       718       719       720
29.24440 27.17792 34.75501 32.68853 30.62205 25.11145 26.48910 25.11145
     721       722       723       724       725       726       727       728
29.24440 37.51031 29.24440 34.06618 34.06618 27.86675 33.37736 61.27481
     729       730       731       732       733       734       735       736
42.33209 36.82149 31.31088 25.80027 33.37736 18.91201 14.77906 37.51031
     737       738       739       740       741       742       743       744
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53.35331 25.80027 24.42262 43.02092 24.42262 28.21116 43.70975 27.86675
     745      746      747      748      749      750      751      752
25.80027 33.37736 32.68853 12.94216 36.13266 31.99971 31.31088 29.93323
     753      754      755      756      757      758      759      760
29.24440 27.86675 27.17792 24.42262 33.29548 33.29548 37.85473 37.51031
     761      762      763      764      765      766      767      768
33.37736 23.73379 13.40140 12.82741 30.62205 35.44383 29.93323 33.29548
     769      770      771      772      773      774      775      776
33.29548 27.86675 37.51031 25.80027 24.42262 41.64327 42.33209 33.29548
     777      778      779      780      781      782      783      784
34.75501 25.80027 33.37736 29.24440 28.55558 35.44383 57.48627 29.24440
     785      786      787      788      789      790      791      792
28.55558 27.86675 25.11145 23.73379 43.70975 33.29548 39.57679 24.42262
     793      794      795      796      797      798      799      800
23.04497 45.08740 16.15671 33.29548 40.61003 40.61003 33.29548 25.11145
     801      802      803      804      805      806      807      808
33.29548 33.29548 33.29548 30.62205 33.29548 33.29548 27.17792 18.91201
     809      810      811      812      813      814      815      816
33.29548 25.11145 23.73379 45.77622 33.29548 33.29548 29.93323 33.29548
     817      818      819      820      821      822      823      824
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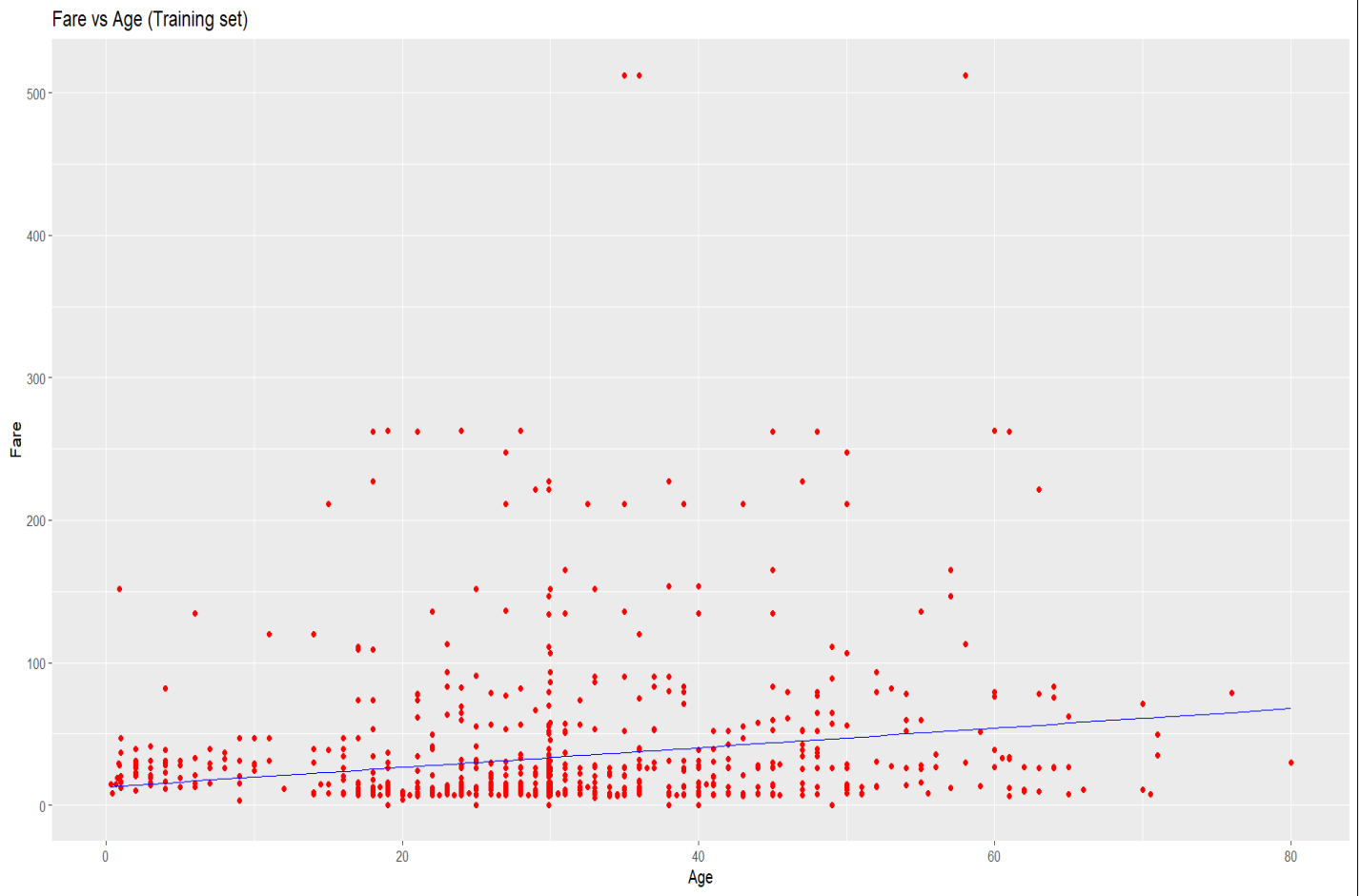
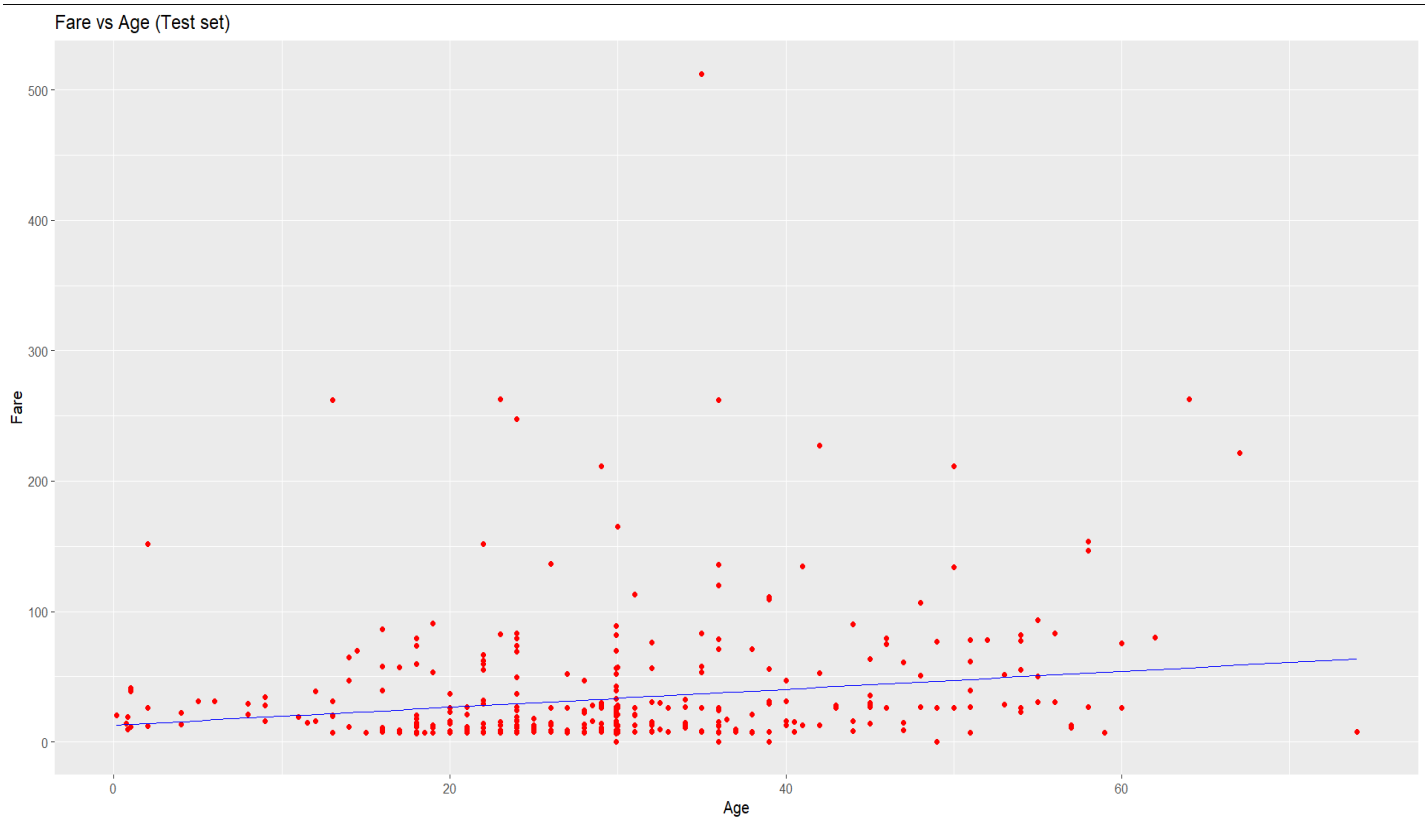
     993      994      995      996      997      998      999     1000
```

```
33.72177 33.29548 33.29548 36.82149 35.44383 33.29548 33.29548 33.29548
> library(ggplot2)
> ggplot() + geom_point(aes(x = trainingset$age, y = trainingset$fare), colour
= 'red') +
+   geom_line(aes(x = trainingset$age,    y = predict(lm.r, newdata =
trainingset)), colour = 'blue') +
+   ggtitle('Fare vs Age (Training set)') +
+   xlab('Age') +
+   ylab('Fare')
```




```
> ggplot() + geom_point(aes(x = testset$age, y = testset$fare), colour = 'red')
+
+   geom_line(aes(x = testset$age, y = predict(lm.r, newdata = testset)), colour
= 'blue') +
+   ggtitle('Fare vs Age (Test set)') +
+   xlab('Age') +
+   ylab('Fare')
```

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> DIFF = (DF$fare) - (Pre)
> DIFF
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 -7.37047928 218.27639877 200.36692414  41.53669119  37.73138740
           21            22            23            24            25
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           36            37            38            39            40
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           41            42            43            44            45
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           56            57            58            59            60
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-33.29547928 105.46832093 106.15714688 123.68325066  18.70452072
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          91           92           93           94           95
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          96           97           98           99          100
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         101          102          103          104          105
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> #parameter's to evaluate linear model
> MSE = mean((DIFF)^2) #mean square error
> MSE
[1] 2596.174
> MAE = mean(abs(DIFF)) #mean absolute error
> MAE
[1] 29.4845
> RMSE = sqrt(MSE) #root mean square error
> RMSE
[1] 50.95266
> R_2 = 1 - (sum((DIFF)^2) / sum((DF$fare - mean(DF$fare))^2))
> R_2
[1] 0.0294193
>cat("MAE:",MAE,"\n", "MSE:", MSE,"\n", "RMSE: ", RMSE,"\n", "R-squared:", R_2)
MAE:  29.4845
 MSE:  2596.174
 RMSE:  50.95266
 R-squared:  0.0294193
```