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Assignment: Advanced Statistics-Feb 20 batch

Business Report

1) Perform exploratory data analysis on the dataset. Showcase some charts, graphs. Check for outliers and missing values.

This project uses the csv file “Factor hair” which has 12 variables of market segmentation. Below are the varibles:

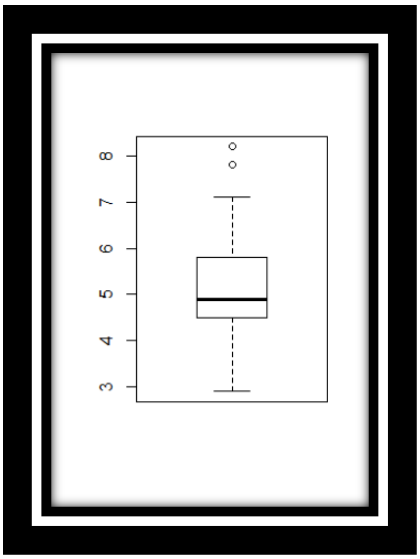
1. Product Quality
2. E-Commerce
3. Technical support
4. Complaint Resolution
5. Advertising
6. Product Line
7. Salesforce Image
8. Competitive pricing
9. Warranty and claims
10. Order and billing
11. Delivery speed
12. Customer satisfaction

There is a rating scale for each ranging 0-10 with 100 IDs.

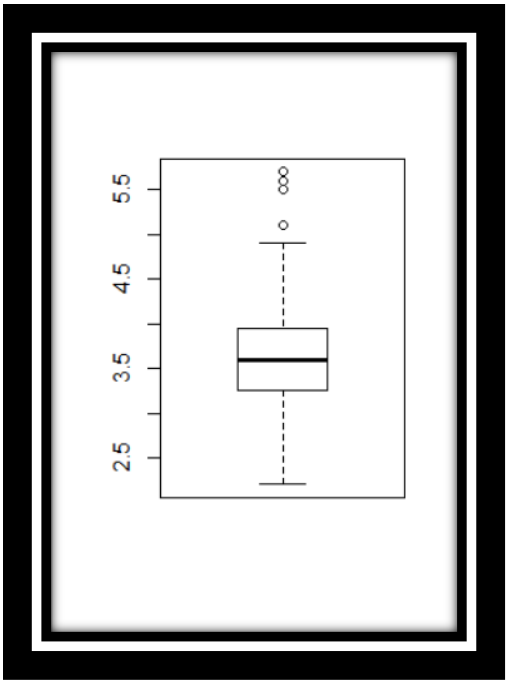
Here, Customer Satisfaction which is a dependent variable is a function of other variables. We need to see if this is highly correlated with other variables i.e multicollinearity.

We need to remove this multicollinearity. We can use Factor Analysis and PCA for to resolve this and reduce the number of variables using factors.

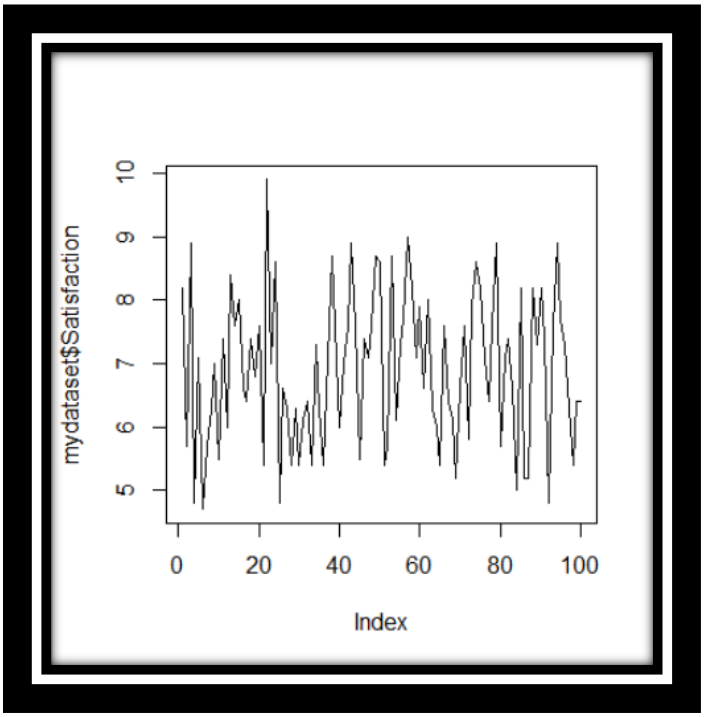
- The csv file is read in R and the necessary libraries are loaded.
- The outliers in the dataset can be found using **boxplot** and the respective values are computed using "**out**" function.
- Missing values are computed using "**sum**" and "**is.na**" funcions. **There were no missing values.**
- The summary of the variables are computed using "**summary**" function.
- It is found that the variables Ecommerce,Delivery speed,Order and Billing, SalesForce image has outliers.
- Below is the boxplot of Salesforce where outliers are shown as circles. Values : 7.8 7.8 8.2



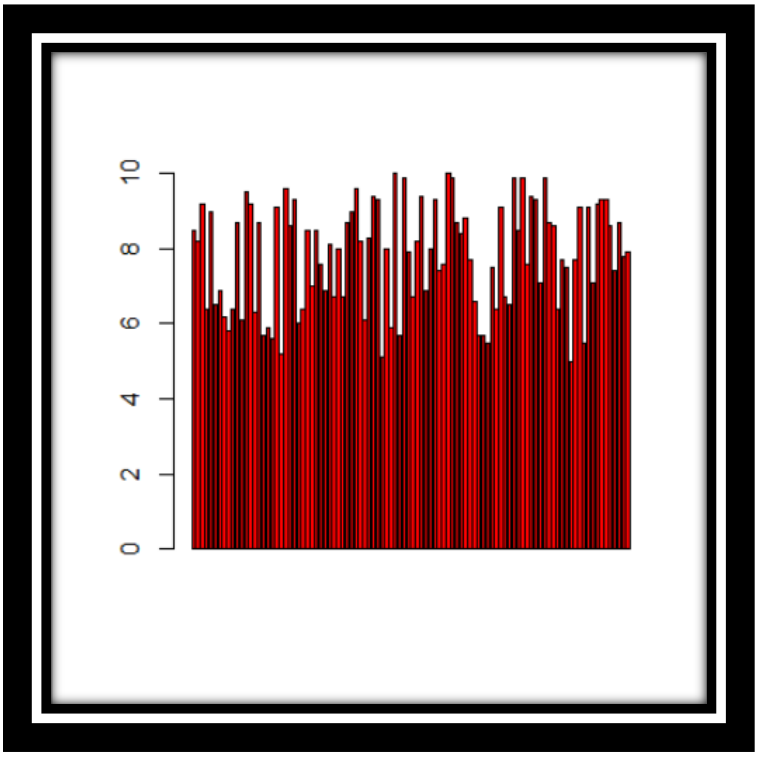
Below is the boxplot of ecommerce where outliers are shown as circles. Values: 5.6 5.7 5.1 5.1 5.1 5.5



Plotting of Customer Satisfaction using “plot” function.

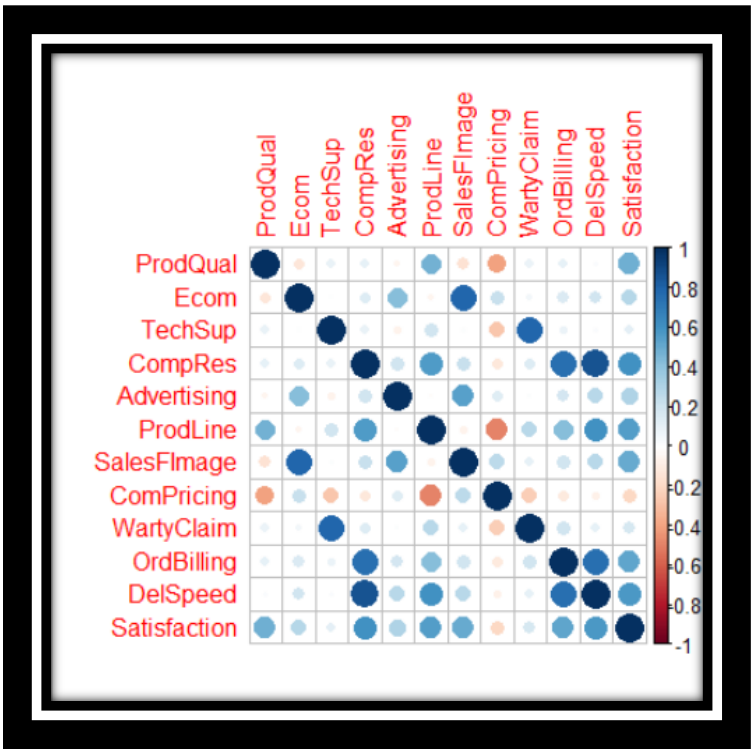


Plotting product quality using “barplot” function.



2) Is there evidence of multicollinearity? Showcase your analysis.

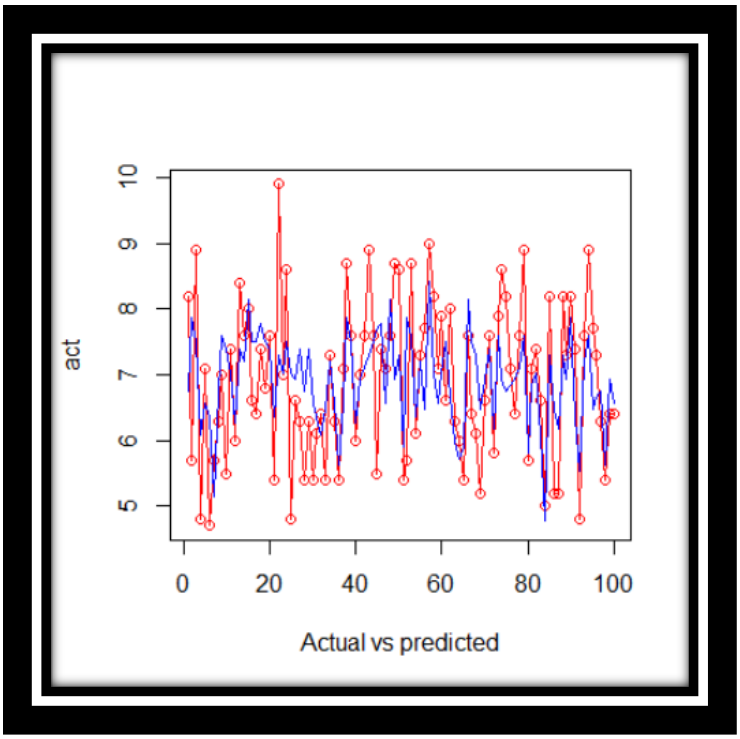
- Checking for pair wise correlation in variables.
- Used “cor” function to find correlation
- Used “corrplot” function to plot the correlation



- High correlation between the below variables were found:
  - Salesforce image and E-commerce
  - Warranty claim and tech support
  - Complaint resolution and delivery speed

3) Perform simple linear regression for the dependent variable with every independent variable.

- Simple linear regression is performed using "**lm**" function with Customer satisfaction as dependent variable with other variables individually.
- The summary of this is found by "**summary**" function.
- The output gives **the intercept (b0),and slope(b1,b2)** so that equation is formed by substituting these values.
- The output also give the Multiple R squared value which is the percent of variation of dependent variable explained by independent variable.
- **Multiple R squared** is the square of correlation between x and y.
- **Analysis of fit** for Customer satisfaction and delivery speed using "**predict**" function.
- The actual and predicted is plotted.

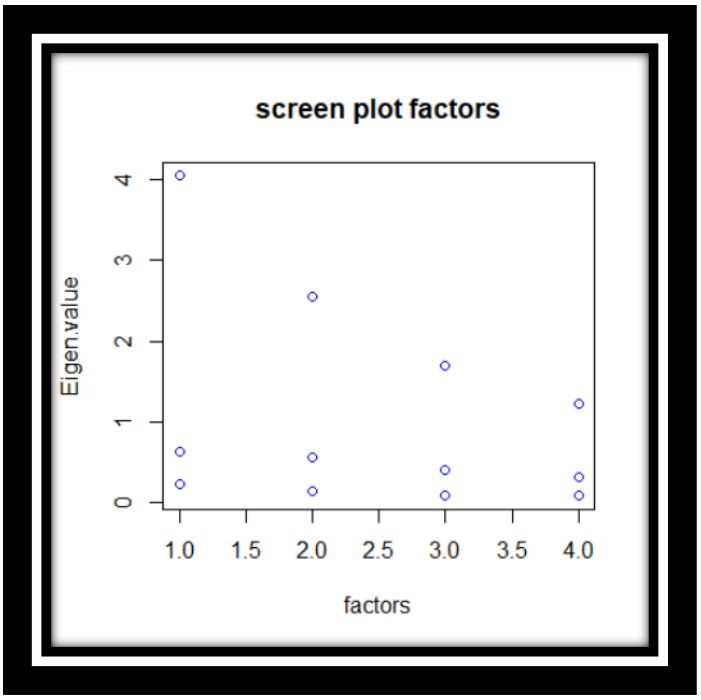


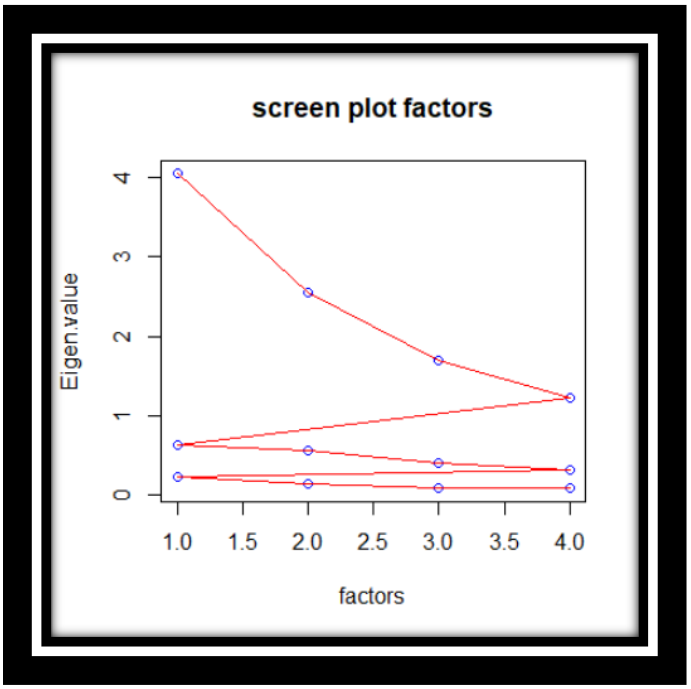
4) Perform PCA/Factor analysis by extracting 4 factors. Interpret the output and name the Factors.

- Eigen values computed using "**eigen**" function.
- "**ev$values**" gives the eigen values.
- Here, count how many eigen values are greater than 1.
- We get 4 such values.

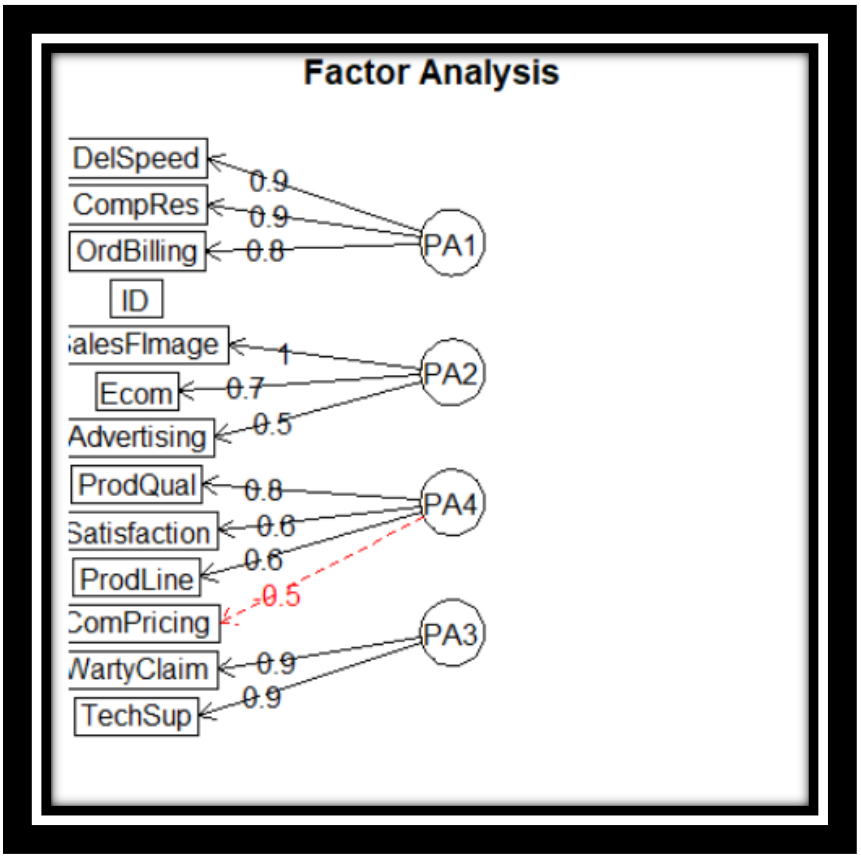
```
4.04285997 2.55292440 1.69222417 1.21754639
```

- So 4 factors are ideal.
- Plot the screeplot with factors in x axis and eigen values in y axis.


screen plot factors
Eigen.value
0
1
2
3
4
1.0
1.5
2.0
2.5
3.0
3.5
4.0
factors

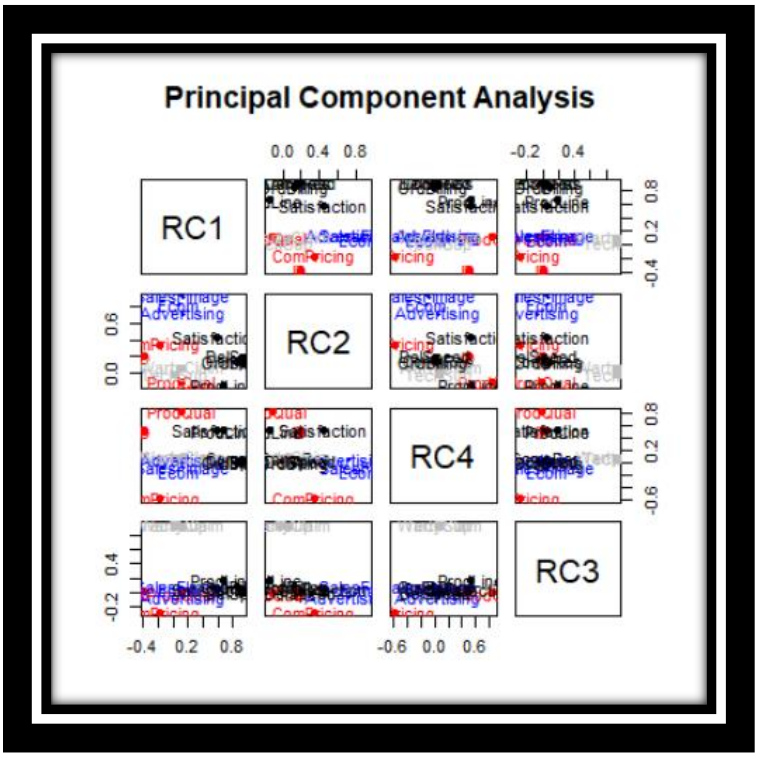

screen plot factors
Eigen.value
0
1
2
3
4
1.0
1.5
2.0
2.5
3.0
3.5
4.0
factors

- Factor analysis is performed using the "**fa**" function.
- It generates factor loadings. "**fa.diagram**" groups the variables to create factors.



- Also, cumulative variance and hypothesis test is obtained.
- PCA is done using "**principal**" command. Rotation is performed to get better result of component values.
- It gives the same result as factor analysis result.
- It generates factor loadings. Group the high loadings to get new factors
- Also, cumulative variance and hypothesis test is obtained.

- Plot this with the loadings.



- The 4 factors are grouped as below:
- Factor 1: **Good Product service factor**
  - Complaint Resolution
  - Delivery speed
  - order billing
- Factor 2**: Internet sales factor**
  - Salesforceimage
  - E-commerce
  - advertising
- Factor 3: **Technical assistance factor**
  - technical support
  - Warranty claims

- Factor 4: **Product quality factor**
  - Product quality
  - Product line
  - Customer satisfaction

5) Perform Multiple linear regression with customer satisfaction as dependent variables and the four factors as independent variables. Comment on the Model output and validity.

- Created data frame with customer satisfaction and 4 factors using "**data.frame**" function
- Scores of factors are obtained by taking the result of PCA and then applying **"$scores**" to it.
- Multiple linear regression is performed using "**lm**" function with Customer Satisfaction as dependent variable and 4 factors obtained with above data frame.

- Using FA, we get below results:
- Residual standard error: 0.4117 on 95 degrees of freedom
- p-value: < 2.2e-16
- Multiple R-squared: 0.8855, Adjusted R-squared: 0.8807
- F-statistic: 183.7 on 4 and 95 DF

- Using PCA, we get below results:
- Residual standard error: 0.5174 on 95 degrees of freedom
- p-value: < 2.2e-16
- Multiple R-squared: 0.8192, Adjusted R-squared: 0.8116
- F-statistic: 107.6 on 4 and 95 DF

Output Interpretation:

- Multiple R squared implies 81.92% of variations (PCA) or 88.5% of variations (FA) in customer satisfaction is explained by the independent variables.
- P value is much smaller (2.2e-16) than alpha of 5% level
- Reject null hypothesis of all betas are zero.
- At least one beta value is non zero and alternative hypothesis is accepted.
- Regression model exists in the population.
- Model is robust and statistically valid.

R Output:

```
Copyright (C) 2019 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
```

```
Type 'q()' to quit R.

[Workspace loaded from ~/.RData]

> setwd("C:/Users/Vikee/Desktop/PGP-BABI-Great Lakes/Chapter 3 Advanced Statistics/Projec
> getwd()
[1] "C:/Users/Vikee/Desktop/PGP-BABI-Great Lakes/Chapter 3 Advanced Statistics/Project"
> install.packages("nFactors")
WARNING: Rtools is required to build R packages but is not currently installed. Please do
and install the appropriate version of Rtools before proceeding:

https://cran.rstudio.com/bin/windows/Rtools/
Installing package into 'C:/Users/Vikee/Documents/R/win-library/3.6'
(as 'lib' is unspecified)
trying URL 'https://cran.rstudio.com/bin/windows/contrib/3.6/nFactors_2.4.1.zip'
Content type 'application/zip' length 212018 bytes (207 KB)
downloaded 207 KB

package 'nFactors' successfully unpacked and MD5 sums checked

The downloaded binary packages are in
        C:\Users\Vikee\AppData\Local\Temp\RtmpoVILV8\downloaded_packages
> library(readr)
> library(psych)
Warning message:
package 'psych' was built under R version 3.6.3
> library(ggplot2)

Attaching package: 'ggplot2'

The following objects are masked from 'package:psych':

    %+%, alpha

> library(reshape2)
> library(corrplot)
corrplot 0.84 loaded
> library(caTools)
Warning message:
package 'caTools' was built under R version 3.6.3
> library(nFactors)
Loading required package: lattice

Attaching package: 'nFactors'

The following object is masked from 'package:lattice':

    parallel

Warning message:
package 'nFactors' was built under R version 3.6.3
> library(caTools)
> mydataset=read.csv("Factor-Hair-Revised.csv",header=TRUE)
> attach(mydataset)
> summary(mydataset)
       ID              ProdQual          Ecom          TechSup         CompRes
 Min.   :  1.00   Min.   : 5.000   Min.   :2.200   Min.   :1.300   Min.   :2.600
 1st Qu.: 25.75   1st Qu.: 6.575   1st Qu.:3.275   1st Qu.:4.250   1st Qu.:4.600
 Median : 50.50   Median : 8.000   Median :3.600   Median :5.400   Median :5.450
 Mean   : 50.50   Mean   : 7.810   Mean   :3.672   Mean   :5.365   Mean   :5.442
 3rd Qu.: 75.25   3rd Qu.: 9.100   3rd Qu.:3.925   3rd Qu.:6.625   3rd Qu.:6.325
 Max.   :100.00   Max.   :10.000   Max.   :5.700   Max.   :8.500   Max.   :7.800
  Advertising       ProdLine      SalesFImage      ComPricing      WartyClaim
 Min.   :1.900   Min.   :2.300   Min.   :2.900   Min.   :3.700   Min.   :4.100
```

```
 1st Qu.:3.175   1st Qu.:4.700   1st Qu.:4.500   1st Qu.:5.875   1st Qu.:5.400
 Median :4.000   Median :5.750   Median :4.900   Median :7.100   Median :6.100
 Mean   :4.010   Mean   :5.805   Mean   :5.123   Mean   :6.974   Mean   :6.043
 3rd Qu.:4.800   3rd Qu.:6.800   3rd Qu.:5.800   3rd Qu.:8.400   3rd Qu.:6.600
 Max.   :6.500   Max.   :8.400   Max.   :8.200   Max.   :9.900   Max.   :8.100
   OrdBilling       DelSpeed      Satisfaction
 Min.   :2.000   Min.   :1.600   Min.   :4.700
 1st Qu.:3.700   1st Qu.:3.400   1st Qu.:6.000
 Median :4.400   Median :3.900   Median :7.050
 Mean   :4.278   Mean   :3.886   Mean   :6.918
 3rd Qu.:4.800   3rd Qu.:4.425   3rd Qu.:7.625
 Max.   :6.700   Max.   :5.500   Max.   :9.900
> names(mydataset)
 [1] "ID"           "ProdQual"     "Ecom"         "TechSup"      "CompRes"
 [6] "Advertising"  "ProdLine"     "SalesFImage"  "ComPricing"   "WartyClaim"
[11] "OrdBilling"   "DelSpeed"     "Satisfaction"
> str(mydataset)
'data.frame':  100 obs. of  13 variables:
 $ ID          : int  1 2 3 4 5 6 7 8 9 10 ...
 $ ProdQual    : num  8.5 8.2 9.2 6.4 9 6.5 6.9 6.2 5.8 6.4 ...
 $ Ecom        : num  3.9 2.7 3.4 3.3 3.4 2.8 3.7 3.3 3.6 4.5 ...
 $ TechSup     : num  2.5 5.1 5.6 7 5.2 3.1 5 3.9 5.1 5.1 ...
 $ CompRes     : num  5.9 7.2 5.6 3.7 4.6 4.1 2.6 4.8 6.7 6.1 ...
 $ Advertising : num  4.8 3.4 5.4 4.7 2.2 4 2.1 4.6 3.7 4.7 ...
 $ ProdLine    : num  4.9 7.9 7.4 4.7 6 4.3 2.3 3.6 5.9 5.7 ...
 $ SalesFImage : num  6 3.1 5.8 4.5 4.5 3.7 5.4 5.1 5.8 5.7 ...
 $ ComPricing  : num  6.8 5.3 4.5 8.8 6.8 8.5 8.9 6.9 9.3 8.4 ...
 $ WartyClaim  : num  4.7 5.5 6.2 7 6.1 5.1 4.8 5.4 5.9 5.4 ...
 $ OrdBilling  : num  5 3.9 5.4 4.3 4.5 3.6 2.1 4.3 4.4 4.1 ...
 $ DelSpeed    : num  3.7 4.9 4.5 3 3.5 3.3 2 3.7 4.6 4.4 ...
 $ Satisfaction: num  8.2 5.7 8.9 4.8 7.1 4.7 5.7 6.3 7 5.5 ...
> boxplot(mydataset$DelSpeed)$out
[1] 1.6
> out
Error: object 'out' not found
> boxplot(mydataset$Ecom)$out
[1] 5.6 5.7 5.1 5.1 5.1 5.5
> boxplot(mydataset$SalesFImage)$out
[1] 7.8 7.8 8.2
> boxplot(mydataset$WartyClaim)$out
numeric(0)
> boxplot(mydataset$OrdBilling)$out
[1] 6.7 6.5 2.0 2.0
> boxplot(mydataset$Satisfaction)$out
numeric(0)
> ##to see the value of outliers
> boxplot(mydataset$ProdQual)$out
numeric(0)
> summary(mydataset)
       ID           ProdQual          Ecom          TechSup         CompRes
 Min.   :  1.00   Min.   : 5.000   Min.   :2.200   Min.   :1.300   Min.   :2.600
 1st Qu.: 25.75   1st Qu.: 6.575   1st Qu.:3.275   1st Qu.:4.250   1st Qu.:4.600
 Median : 50.50   Median : 8.000   Median :3.600   Median :5.400   Median :5.450
 Mean   : 50.50   Mean   : 7.810   Mean   :3.672   Mean   :5.365   Mean   :5.442
 3rd Qu.: 75.25   3rd Qu.: 9.100   3rd Qu.:3.925   3rd Qu.:6.625   3rd Qu.:6.325
 Max.   :100.00   Max.   :10.000   Max.   :5.700   Max.   :8.500   Max.   :7.800
  Advertising       ProdLine      SalesFImage      ComPricing      WartyClaim
 Min.   :1.900   Min.   :2.300   Min.   :2.900   Min.   :3.700   Min.   :4.100
 1st Qu.:3.175   1st Qu.:4.700   1st Qu.:4.500   1st Qu.:5.875   1st Qu.:5.400
 Median :4.000   Median :5.750   Median :4.900   Median :7.100   Median :6.100
 Mean   :4.010   Mean   :5.805   Mean   :5.123   Mean   :6.974   Mean   :6.043
 3rd Qu.:4.800   3rd Qu.:6.800   3rd Qu.:5.800   3rd Qu.:8.400   3rd Qu.:6.600
 Max.   :6.500   Max.   :8.400   Max.   :8.200   Max.   :9.900   Max.   :8.100
   OrdBilling       DelSpeed      Satisfaction
```

```
 Min.   :2.000   Min.   :1.600   Min.   :4.700
 1st Qu.:3.700   1st Qu.:3.400   1st Qu.:6.000
 Median :4.400   Median :3.900   Median :7.050
 Mean   :4.278   Mean   :3.886   Mean   :6.918
 3rd Qu.:4.800   3rd Qu.:4.425   3rd Qu.:7.625
 Max.   :6.700   Max.   :5.500   Max.   :9.900
> summary(mydataset$ProdQual)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  5.000   6.575   8.000   7.810   9.100  10.000
> summary(mydataset$Advertising)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.900   3.175   4.000   4.010   4.800   6.500
> summary(mydataset$SalesFImage)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  2.900   4.500   4.900   5.123   5.800   8.200
> summary(mydataset$WartyClaim)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  4.100   5.400   6.100   6.043   6.600   8.100
> summary(mydataset$Satisfaction)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  4.700   6.000   7.050   6.918   7.625   9.900
> missing.values=sum(is.na(mydataset))
> missing.values
[1] 0
> mydataset.correlation=cor(mydataset[,2:13])
> mydataset.correlation
                ProdQual          Ecom       TechSup    CompRes Advertising    ProdLine
ProdQual      1.00000000 -0.1371632174  0.0956004542  0.1063700 -0.05347313  0.47749341
Ecom         -0.13716322  1.0000000000  0.0008667887  0.1401793  0.42989071 -0.05268784
TechSup       0.09560045  0.0008667887  1.0000000000  0.0966566 -0.06287007  0.19262546
CompRes       0.10637000  0.1401792611  0.0966565978  1.0000000  0.19691685  0.56141695
Advertising  -0.05347313  0.4298907110 -0.0628700668  0.1969168  1.00000000 -0.01155082
ProdLine      0.47749341 -0.0526878383  0.1926254565  0.5614170 -0.01155082  1.00000000
SalesFImage  -0.15181287  0.7915437115  0.0169905395  0.2297518  0.54220366 -0.06131553
ComPricing   -0.40128188  0.2294624014 -0.2707866821 -0.1279543  0.13421689 -0.49494840
WartyClaim    0.08831231  0.0518981915  0.7971679258  0.1404083  0.01079207  0.27307753
OrdBilling    0.10430307  0.1561473316  0.0801018246  0.7568686  0.18423559  0.42440825
DelSpeed      0.02771800  0.1916360683  0.0254406935  0.8650917  0.27586308  0.60185021
Satisfaction  0.48632500  0.2827450147  0.1125971788  0.6032626  0.30466947  0.55054594
              SalesFImage  ComPricing  WartyClaim  OrdBilling    DelSpeed Satisfaction
ProdQual      -0.15181287 -0.40128188  0.08831231  0.10430307  0.02771800    0.4863250
Ecom           0.79154371  0.22946240  0.05189819  0.15614733  0.19163607    0.2827450
TechSup        0.01699054 -0.27078668  0.79716793  0.08010182  0.02544069    0.1125972
CompRes        0.22975176 -0.12795425  0.14040830  0.75686859  0.86509170    0.6032626
Advertising    0.54220366  0.13421689  0.01079207  0.18423559  0.27586308    0.3046695
ProdLine      -0.06131553 -0.49494840  0.27307753  0.42440825  0.60185021    0.5505459
SalesFImage    1.00000000  0.26459655  0.10745534  0.19512741  0.27155126    0.5002053
ComPricing     0.26459655  1.00000000 -0.24498605 -0.11456703 -0.07287173   -0.2082957
WartyClaim     0.10745534 -0.24498605  1.00000000  0.19706512  0.10939460    0.1775448
OrdBilling     0.19512741 -0.11456703  0.19706512  1.00000000  0.75100307    0.5217319
DelSpeed       0.27155126 -0.07287173  0.10939460  0.75100307  1.00000000    0.5770423
Satisfaction   0.50020531 -0.20829569  0.17754482  0.52173191  0.57704227    1.0000000
> print(mydataset.correlation,digits=4)
             ProdQual       Ecom    TechSup  CompRes Advertising ProdLine SalesFImage
ProdQual      1.00000 -0.1371632  0.0956005  0.10637    -0.05347  0.47749    -0.15181
Ecom         -0.13716  1.0000000  0.0008668  0.14018     0.42989 -0.05269     0.79154
TechSup       0.09560  0.0008668  1.0000000  0.09666    -0.06287  0.19263     0.01699
CompRes       0.10637  0.1401793  0.0966566  1.00000     0.19692  0.56142     0.22975
Advertising  -0.05347  0.4298907 -0.0628701  0.19692     1.00000 -0.01155     0.54220
ProdLine      0.47749 -0.0526878  0.1926255  0.56142    -0.01155  1.00000    -0.06132
SalesFImage  -0.15181  0.7915437  0.0169905  0.22975     0.54220 -0.06132     1.00000
ComPricing   -0.40128  0.2294624 -0.2707867 -0.12795     0.13422 -0.49495     0.26460
WartyClaim    0.08831  0.0518982  0.7971679  0.14041     0.01079  0.27308     0.10746
OrdBilling    0.10430  0.1561473  0.0801018  0.75687     0.18424  0.42441     0.19513
```

```
DelSpeed      0.02772  0.1916361  0.0254407  0.86509     0.27586  0.60185     0.27155
Satisfaction  0.48632  0.2827450  0.1125972  0.60326     0.30467  0.55055     0.50021
             ComPricing WartyClaim OrdBilling DelSpeed Satisfaction
ProdQual       -0.40128    0.08831     0.1043  0.02772       0.4863
Ecom            0.22946    0.05190     0.1561  0.19164       0.2827
TechSup        -0.27079    0.79717     0.0801  0.02544       0.1126
CompRes        -0.12795    0.14041     0.7569  0.86509       0.6033
Advertising     0.13422    0.01079     0.1842  0.27586       0.3047
ProdLine       -0.49495    0.27308     0.4244  0.60185       0.5505
SalesFImage     0.26460    0.10746     0.1951  0.27155       0.5002
ComPricing      1.00000   -0.24499    -0.1146 -0.07287      -0.2083
WartyClaim     -0.24499    1.00000     0.1971  0.10939       0.1775
OrdBilling     -0.11457    0.19707     1.0000  0.75100       0.5217
DelSpeed       -0.07287    0.10939     0.7510  1.00000       0.5770
Satisfaction   -0.20830    0.17754     0.5217  0.57704       1.0000
> r1=lm(Satisfaction~ProdQual)
> summary(r1)

Call:
lm(formula = Satisfaction ~ ProdQual)

Residuals:
     Min       1Q   Median       3Q      Max
-1.88746 -0.72711 -0.01577  0.85641  2.25220

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.67593    0.59765   6.151 1.68e-08 ***
ProdQual     0.41512    0.07534   5.510 2.90e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.047 on 98 degrees of freedom
Multiple R-squared:  0.2365,   Adjusted R-squared:  0.2287
F-statistic: 30.36 on 1 and 98 DF,  p-value: 2.901e-07

> r2=lm(Satisfaction~Ecom)
> summary(r2)

Call:
lm(formula = Satisfaction ~ Ecom)

Residuals:
     Min       1Q   Median       3Q      Max
-2.37200 -0.78971  0.04959  0.68085  2.34580

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   5.1516     0.6161   8.361 4.28e-13 ***
Ecom          0.4811     0.1649   2.918  0.00437 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.149 on 98 degrees of freedom
Multiple R-squared:  0.07994,  Adjusted R-squared:  0.07056
F-statistic: 8.515 on 1 and 98 DF,  p-value: 0.004368

> r3=lm(Satisfaction~TechSup)
> summary(r3)

Call:
lm(formula = Satisfaction ~ TechSup)

Residuals:
```

```
     Min       1Q   Median       3Q      Max
-2.26136 -0.93297  0.04302  0.82501  2.85617

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.44757    0.43592  14.791   <2e-16 ***
TechSup      0.08768    0.07817   1.122    0.265
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.19 on 98 degrees of freedom
Multiple R-squared:  0.01268,  Adjusted R-squared:  0.002603
F-statistic: 1.258 on 1 and 98 DF,  p-value: 0.2647

> r4=lm(Satisfaction~CompRes)
> summary(r4)

Call:
lm(formula = Satisfaction ~ CompRes)

Residuals:
     Min       1Q   Median       3Q      Max
-2.40450 -0.66164  0.04499  0.63037  2.70949

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.68005    0.44285   8.310 5.51e-13 ***
CompRes      0.59499    0.07946   7.488 3.09e-11 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9554 on 98 degrees of freedom
Multiple R-squared:  0.3639,   Adjusted R-squared:  0.3574
F-statistic: 56.07 on 1 and 98 DF,  p-value: 3.085e-11

> r5=lm(Satisfaction~Advertising)
> summary(r5)

Call:
lm(formula = Satisfaction ~ Advertising)

Residuals:
     Min       1Q   Median       3Q      Max
-2.34033 -0.92755  0.05577  0.79773  2.53412

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   5.6259     0.4237  13.279  < 2e-16 ***
Advertising   0.3222     0.1018   3.167  0.00206 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.141 on 98 degrees of freedom
Multiple R-squared:  0.09282,  Adjusted R-squared:  0.08357
F-statistic: 10.03 on 1 and 98 DF,  p-value: 0.002056

> r6=lm(Satisfaction~ProdLine)
> summary(r6)

Call:
lm(formula = Satisfaction ~ ProdLine)

Residuals:
    Min      1Q  Median      3Q     Max
```

```
-2.3634 -0.7795  0.1097  0.7604  1.7373

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.02203    0.45471   8.845 3.87e-14 ***
ProdLine     0.49887    0.07641   6.529 2.95e-09 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1 on 98 degrees of freedom
Multiple R-squared:  0.3031,   Adjusted R-squared:  0.296
F-statistic: 42.62 on 1 and 98 DF,  p-value: 2.953e-09

> r7=lm(Satisfaction~SalesFImage)
> summary(r7)

Call:
lm(formula = Satisfaction ~ SalesFImage)

Residuals:
    Min      1Q  Median      3Q     Max
-2.2164 -0.5884  0.1838  0.6922  2.0728

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.06983    0.50874   8.000 2.54e-12 ***
SalesFImage  0.55596    0.09722   5.719 1.16e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.037 on 98 degrees of freedom
Multiple R-squared:  0.2502,   Adjusted R-squared:  0.2426
F-statistic:  32.7 on 1 and 98 DF,  p-value: 1.164e-07

> r8=lm(Satisfaction~ComPricing)
> summary(r8)

Call:
lm(formula = Satisfaction ~ ComPricing)

Residuals:
    Min      1Q  Median      3Q     Max
-1.9728 -0.9915 -0.1156  0.9111  2.5845

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  8.03856    0.54427  14.769   <2e-16 ***
ComPricing  -0.16068    0.07621  -2.108   0.0376 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.172 on 98 degrees of freedom
Multiple R-squared:  0.04339,  Adjusted R-squared:  0.03363
F-statistic: 4.445 on 1 and 98 DF,  p-value: 0.03756

> r9=lm(Satisfaction~WartyClaim)
> summary(r9)

Call:
lm(formula = Satisfaction ~ WartyClaim)

Residuals:
     Min       1Q   Median       3Q      Max
-2.36504 -0.90202  0.03019  0.90763  2.88985
```

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   5.3581     0.8813   6.079 2.32e-08 ***
WartyClaim    0.2581     0.1445   1.786   0.0772 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.179 on 98 degrees of freedom
Multiple R-squared:  0.03152,  Adjusted R-squared:  0.02164
F-statistic:  3.19 on 1 and 98 DF,  p-value: 0.0772

> summary(r10)
Error in summary(r10) : object 'r10' not found
> r10=lm(Satisfaction~OrdBilling)
> summary(r10)

Call:
lm(formula = Satisfaction ~ OrdBilling)

Residuals:
    Min      1Q  Median      3Q     Max
-2.4005 -0.7071 -0.0344  0.7340  2.9673

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.0541     0.4840   8.377 3.96e-13 ***
OrdBilling    0.6695     0.1106   6.054 2.60e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.022 on 98 degrees of freedom
Multiple R-squared:  0.2722,   Adjusted R-squared:  0.2648
F-statistic: 36.65 on 1 and 98 DF,  p-value: 2.602e-08

> r11=lm(Satisfaction~DelSpeed)
> summary(r11)

Call:
lm(formula = Satisfaction ~ DelSpeed)

Residuals:
     Min       1Q   Median       3Q      Max
-2.22475 -0.54846  0.08796  0.54462  2.59432

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   3.2791     0.5294   6.194 1.38e-08 ***
DelSpeed      0.9364     0.1339   6.994 3.30e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9783 on 98 degrees of freedom
Multiple R-squared:  0.333,    Adjusted R-squared:  0.3262
F-statistic: 48.92 on 1 and 98 DF,  p-value: 3.3e-10

> pred=predict(r11)
> act=Satisfaction
> b=data.frame(pred,act)
> b
       pred act
1   6.743826 8.2
2   7.867530 5.7
3   7.492962 8.9
```

```
4   6.088332 4.8
5   6.556542 7.1
6   6.369258 4.7
7   5.151912 5.7
8   6.743826 6.3
9   7.586604 7.0
10  7.399320 5.5
11  7.024752 7.4
12  6.275616 6.0
13  7.399320 8.4
14  7.212036 7.6
15  8.148456 8.0
16  7.492962 6.6
17  7.492962 6.4
18  7.773888 7.4
19  7.492962 6.8
20  7.399320 7.6
21  6.369258 5.4
22  7.305678 9.9
23  7.024752 7.0
24  7.492962 8.6
25  7.024752 4.8
26  6.931110 6.6
27  7.399320 6.3
28  6.743826 5.4
29  7.399320 6.3
30  6.556542 5.4
31  6.369258 6.1
32  6.088332 6.4
33  6.462900 5.4
34  7.212036 7.3
35  6.556542 6.3
36  5.620122 5.4
37  6.556542 7.1
38  7.867530 8.7
39  7.492962 7.6
40  6.275616 6.0
41  6.931110 7.0
42  7.118394 7.6
43  7.305678 8.9
44  7.492962 7.6
45  7.680246 5.5
46  7.773888 7.4
47  6.556542 7.1
48  8.148456 7.6
49  6.931110 8.7
50  7.305678 8.6
51  5.901048 5.4
52  7.867530 5.7
53  7.586604 8.7
54  6.369258 6.1
55  7.212036 7.3
56  6.462900 7.7
57  8.429382 9.0
58  7.024752 8.2
59  6.556542 7.1
60  7.024752 7.9
61  7.492962 6.6
62  6.650184 8.0
63  5.994690 6.3
64  5.713764 6.0
65  5.901048 5.4
66  8.148456 7.6
67  7.492962 6.4
```

```
68  7.305678 6.1
69  6.462900 5.2
70  6.931110 6.6
71  7.399320 7.6
72  6.181974 5.8
73  7.586604 7.9
74  6.931110 8.6
75  6.743826 8.2
76  6.837468 7.1
77  6.931110 6.4
78  7.118394 7.6
79  7.586604 8.9
80  5.807406 5.7
81  6.837468 7.1
82  7.024752 7.4
83  6.088332 6.6
84  4.777344 5.0
85  7.305678 8.2
86  6.462900 5.2
87  6.181974 5.2
88  7.305678 8.2
89  6.931110 7.3
90  7.867530 8.2
91  6.369258 7.4
92  5.526480 4.8
93  7.212036 7.6
94  7.586604 8.9
95  6.462900 7.7
96  6.650184 7.3
97  6.743826 6.3
98  5.620122 5.4
99  6.931110 6.4
100 6.556542 6.4
> multiple.regression=lm(Satisfaction~ProdQual+Ecom+TechSup+CompRes+Advertising+ProdLine+
Image+ComPricing+WartyClaim+OrdBilling+DelSpeed)
> summary(multiple.regression)

Call:
lm(formula = Satisfaction ~ ProdQual + Ecom + TechSup + CompRes +
    Advertising + ProdLine + SalesFImage + ComPricing + WartyClaim +
    OrdBilling + DelSpeed)

Residuals:
     Min       1Q   Median       3Q      Max
-1.43005 -0.31165  0.07621  0.37190  0.90120

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.66961    0.81233  -0.824  0.41199
ProdQual     0.37137    0.05177   7.173 2.18e-10 ***
Ecom        -0.44056    0.13396  -3.289  0.00145 **
TechSup      0.03299    0.06372   0.518  0.60591
CompRes      0.16703    0.10173   1.642  0.10416
Advertising -0.02602    0.06161  -0.422  0.67382
ProdLine     0.14034    0.08025   1.749  0.08384 .
SalesFImage  0.80611    0.09775   8.247 1.45e-12 ***
ComPricing  -0.03853    0.04677  -0.824  0.41235
WartyClaim  -0.10298    0.12330  -0.835  0.40587
OrdBilling   0.14635    0.10367   1.412  0.16160
DelSpeed     0.16570    0.19644   0.844  0.40124
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5623 on 88 degrees of freedom
```

```
Multiple R-squared:  0.8021,   Adjusted R-squared:  0.7774
F-statistic: 32.43 on 11 and 88 DF,  p-value: < 2.2e-16

> mydataset.correlation
                ProdQual          Ecom       TechSup    CompRes Advertising    ProdLine
ProdQual      1.00000000 -0.1371632174  0.0956004542  0.1063700 -0.05347313  0.47749341
Ecom         -0.13716322  1.0000000000  0.0008667887  0.1401793  0.42989071 -0.05268784
TechSup       0.09560045  0.0008667887  1.0000000000  0.0966566 -0.06287007  0.19262546
CompRes       0.10637000  0.1401792611  0.0966565978  1.0000000  0.19691685  0.56141695
Advertising  -0.05347313  0.4298907110 -0.0628700668  0.1969168  1.00000000 -0.01155082
ProdLine      0.47749341 -0.0526878383  0.1926254565  0.5614170 -0.01155082  1.00000000
SalesFImage  -0.15181287  0.7915437115  0.0169905395  0.2297518  0.54220366 -0.06131553
ComPricing   -0.40128188  0.2294624014 -0.2707866821 -0.1279543  0.13421689 -0.49494840
WartyClaim    0.08831231  0.0518981915  0.7971679258  0.1404083  0.01079207  0.27307753
OrdBilling    0.10430307  0.1561473316  0.0801018246  0.7568686  0.18423559  0.42440825
DelSpeed      0.02771800  0.1916360683  0.0254406935  0.8650917  0.27586308  0.60185021
Satisfaction  0.48632500  0.2827450147  0.1125971788  0.6032626  0.30466947  0.55054594
             SalesFImage  ComPricing  WartyClaim  OrdBilling    DelSpeed Satisfaction
ProdQual     -0.15181287 -0.40128188  0.08831231  0.10430307  0.02771800    0.4863250
Ecom          0.79154371  0.22946240  0.05189819  0.15614733  0.19163607    0.2827450
TechSup       0.01699054 -0.27078668  0.79716793  0.08010182  0.02544069    0.1125972
CompRes       0.22975176 -0.12795425  0.14040830  0.75686859  0.86509170    0.6032626
Advertising   0.54220366  0.13421689  0.01079207  0.18423559  0.27586308    0.3046695
ProdLine     -0.06131553 -0.49494840  0.27307753  0.42440825  0.60185021    0.5505459
SalesFImage   1.00000000  0.26459655  0.10745534  0.19512741  0.27155126    0.5002053
ComPricing    0.26459655  1.00000000 -0.24498605 -0.11456703 -0.07287173   -0.2082957
WartyClaim    0.10745534 -0.24498605  1.00000000  0.19706512  0.10939460    0.1775448
OrdBilling    0.19512741 -0.11456703  0.19706512  1.00000000  0.75100307    0.5217319
DelSpeed      0.27155126 -0.07287173  0.10939460  0.75100307  1.00000000    0.5770423
Satisfaction  0.50020531 -0.20829569  0.17754482  0.52173191  0.57704227    1.0000000
> ev=eigen(mydataset.correlation)
> print(ev,digits=5)
eigen() decomposition
$values
 [1] 4.042860 2.552924 1.692224 1.217546 0.635963 0.568531 0.402828 0.324480 0.236139
[10] 0.144224 0.099138 0.083141

$vectors
           [,1]       [,2]      [,3]     [,4]      [,5]      [,6]       [,7]      [,8]
 [1,] -0.15855  0.3131315 -0.073561  0.61407 -0.249645  0.364995  0.1264077 -0.326878
 [2,] -0.16619 -0.4405926  0.236520  0.19628 -0.188869 -0.465405  0.0082478 -0.507852
 [3,] -0.12514  0.2382898  0.616312 -0.17941 -0.039771  0.123928 -0.0134608  0.081828
 [4,] -0.42263 -0.0013412 -0.196654 -0.27970 -0.033409  0.014952 -0.0046382  0.149299
 [5,] -0.18076 -0.3572453  0.089867  0.20600  0.761076  0.418908 -0.0715506 -0.122829
 [6,] -0.35284  0.2977867 -0.111227  0.10009  0.025061 -0.195823 -0.6339791 -0.223191
 [7,] -0.21795 -0.4648888  0.240942  0.19949 -0.142092 -0.167118  0.0216503  0.334110
 [8,]  0.13484 -0.4177632 -0.051667 -0.24079 -0.489648  0.585575 -0.3428053 -0.163388
 [9,] -0.17499  0.2011842  0.605460 -0.18960 -0.021586  0.142296 -0.0401192 -0.107016
[10,] -0.38798 -0.0090616 -0.155037 -0.30669 -0.049084  0.091175  0.6287422 -0.334984
[11,] -0.42234 -0.0544574 -0.217990 -0.28990  0.062220 -0.030606 -0.2369277 -0.001464
[12,] -0.41302 -0.0239038 -0.028739  0.33119 -0.229674  0.142966  0.0752066  0.528542
           [,9]     [,10]     [,11]     [,12]
 [1,]  0.186024 -0.203703  0.228853 -0.217876
 [2,]  0.215750 -0.037187 -0.028811  0.353237
 [3,]  0.547531  0.424752 -0.017665 -0.105801
 [4,]  0.436975 -0.586018 -0.378534 -0.056276
 [5,]  0.041765  0.028361 -0.096877  0.048241
 [6,] -0.232461  0.253918 -0.347287 -0.186009
 [7,] -0.170366 -0.039935  0.073884 -0.665006
 [8,] -0.028514  0.086426 -0.106601  0.011391
 [9,] -0.504499 -0.453923  0.082778  0.158683
[10,] -0.251975  0.321051 -0.157547 -0.147168
[11,]  0.075448  0.057932  0.783212  0.060699
[12,] -0.137066  0.215571 -0.106233  0.532523
```

```
> Eigen.value=ev$values
> Eigen.value
 [1] 4.04285997 2.55292440 1.69222417 1.21754639 0.63596293 0.56853132 0.40282774 0.32448
 [9] 0.23613948 0.14422355 0.09913845 0.08314143
> factors=c(1,2,3,4)
> scree.plot=data.frame(factors,Eigen.value)
> scree.plot
   factors Eigen.value
1        1  4.04285997
2        2  2.55292440
3        3  1.69222417
4        4  1.21754639
5        1  0.63596293
6        2  0.56853132
7        3  0.40282774
8        4  0.32448016
9        1  0.23613948
10       2  0.14422355
11       3  0.09913845
12       4  0.08314143
> fa1<- fa(r=mydataset, nfactors = 4, rotate="varimax",fm="pa")
Warning messages:
1: In fa.stats(r = r, f = f, phi = phi, n.obs = n.obs, np.obs = np.obs,  :
  The estimated weights for the factor scores are probably incorrect.  Try a different fa
core estimation method.
2: In fac(r = r, nfactors = nfactors, n.obs = n.obs, rotate = rotate,  :
  An ultra-Heywood case was detected.  Examine the results carefully
> print(fa1)
Factor Analysis using method =  pa
Call: fa(r = mydataset, nfactors = 4, rotate = "varimax", fm = "pa")
Standardized loadings (pattern matrix) based upon correlation matrix
                PA1   PA2   PA4   PA3    h2     u2 com
ID            -0.23  0.06  0.19  0.03 0.091  0.909 2.1
ProdQual       0.01 -0.08  0.81  0.01 0.665  0.335 1.0
Ecom           0.06  0.74 -0.10  0.03 0.568  0.432 1.1
TechSup        0.02 -0.03  0.10  0.87 0.772  0.228 1.0
CompRes        0.89  0.16  0.15  0.06 0.841  0.159 1.1
Advertising    0.14  0.54 -0.01 -0.05 0.316  0.684 1.1
ProdLine       0.55 -0.10  0.58  0.17 0.682  0.318 2.2
SalesFImage    0.08  1.02 -0.06  0.06 1.056 -0.056 1.0
ComPricing    -0.11  0.27 -0.49 -0.24 0.386  0.614 2.2
WartyClaim     0.09  0.06  0.11  0.90 0.831  0.169 1.1
OrdBilling     0.77  0.15  0.10  0.09 0.632  0.368 1.1
DelSpeed       0.94  0.20  0.08  0.01 0.936  0.064 1.1
Satisfaction   0.47  0.47  0.61  0.05 0.821  0.179 2.8

                       PA1  PA2  PA4  PA3
SS loadings           2.90 2.30 1.72 1.68
Proportion Var        0.22 0.18 0.13 0.13
Cumulative Var        0.22 0.40 0.53 0.66
Proportion Explained  0.34 0.27 0.20 0.20
Cumulative Proportion 0.34 0.60 0.80 1.00

Mean item complexity =  1.5
Test of the hypothesis that 4 factors are sufficient.

The degrees of freedom for the null model are  78  and the objective function was  8.29 w
i Square of  777.84
The degrees of freedom for the model are 32  and the objective function was  0.57

The root mean square of the residuals (RMSR) is  0.02
The df corrected root mean square of the residuals is  0.04
```

```
The harmonic number of observations is  100 with the empirical chi square  9.11  with pro
The total number of observations was  100  with Likelihood Chi Square =  52  with prob <

Tucker Lewis Index of factoring reliability =  0.928
RMSEA index =  0.078  and the 90 % confidence intervals are  0.036 0.118
BIC =  -95.36
Fit based upon off diagonal values = 0.99
> unrotate=principal(mydataset,nfactors=4,rotate="none")
> unrotate.plotting=plot(unrotate,row.names(unrotate$loadings))
> rotate=principal(mydataset,nfactors=4,rotate="varimax")
> print(rotate,digits=4)
Principal Components Analysis
Call: principal(r = mydataset, nfactors = 4, rotate = "varimax")
Standardized loadings (pattern matrix) based upon correlation matrix
                RC1     RC2     RC4     RC3     h2     u2   com
ID          -0.3791  0.1965  0.5137  0.0143 0.4464 0.5536 2.171
ProdQual     0.1141 -0.1108  0.8422 -0.0035 0.7346 0.2654 1.072
Ecom         0.0744  0.8327 -0.1272  0.0527 0.7178 0.2822 1.071
TechSup      0.0253 -0.0238  0.0687  0.9402 0.8899 0.1101 1.013
CompRes      0.9064  0.1383  0.0632  0.0474 0.8470 0.1530 1.062
Advertising  0.1259  0.7161  0.0468 -0.0738 0.5363 0.4637 1.093
ProdLine     0.6579 -0.1453  0.5233  0.1774 0.7592 0.2408 2.185
SalesFImage  0.1347  0.9215 -0.0722  0.0632 0.8765 0.1235 1.065
ComPricing  -0.1728  0.3428 -0.5814 -0.2895 0.5692 0.4308 2.383
WartyClaim   0.1042  0.0601  0.0823  0.9317 0.8894 0.1106 1.049
OrdBilling   0.8469  0.1239 -0.0056  0.0830 0.7394 0.2606 1.063
DelSpeed     0.9177  0.1910  0.0086 -0.0031 0.8787 0.1213 1.087
Satisfaction 0.5794  0.4401  0.5356  0.0539 0.8192 0.1808 2.886

                       RC1    RC2    RC4    RC3
SS loadings          3.3870 2.5135 1.9110 1.8918
Proportion Var       0.2605 0.1933 0.1470 0.1455
Cumulative Var       0.2605 0.4539 0.6009 0.7464
Proportion Explained 0.3491 0.2590 0.1969 0.1950
Cumulative Proportion 0.3491 0.6081 0.8050 1.0000

Mean item complexity =  1.5
Test of the hypothesis that 4 components are sufficient.

The root mean square of the residuals (RMSR) is  0.0651
 with the empirical chi square  66.0468  with prob <  0.0003717

Fit based upon off diagonal values = 0.9601
> ##using PCA
> mydf=data.frame(mydataset[13],rotate$scores)
> mydf
   Satisfaction          RC1         RC2         RC4         RC3
1           8.2  0.628866541  0.50632227 -0.04139754 -1.84743543
2           5.7  1.465363263 -2.14345723 -0.29694062 -0.46650161
3           8.9  1.229241568  0.12988856  0.86170318  0.10933002
4           4.8 -0.719038572 -0.46882542 -1.91046070  1.28424113
5           7.1  0.143573337 -1.06619790 -0.09255049  0.01794317
6           4.7 -0.522025722 -1.23007125 -1.59101334 -1.28602508
7           5.7 -2.202725746 -0.26337206 -1.35597472 -0.62646569
8           6.3 -0.092517281 -0.21406354 -1.34414949 -0.76151467
9           7.0  1.035724527  0.01831366 -1.78316507 -0.17691640
10          5.5  0.486391986  0.44022025 -1.61983709 -0.37987820
11          7.4  0.298636535 -0.97399812  0.16280430 -0.43535243
12          6.0 -1.163741114  1.13068938 -1.50927276  0.45466910
13          8.4  1.055823649  1.63876043  0.22805642 -0.06813379
14          7.6  0.828225623 -0.70283232  0.29952298  0.49321754
15          8.0  1.492697736  0.75123960 -1.19735048 -0.30994340
16          6.6  1.207164092 -1.49865757  0.31530039 -0.42528458
17          6.4  0.568988578 -0.34170438 -1.45575307  1.10603357
```

18	7.4	1.618291183	0.04821766	-1.59342894	0.18471851
19	6.8	1.034810785	-0.15472256	-1.76293805	-0.46972418
20	7.6	0.547717700	1.47093507	-0.12912726	-0.90610517
21	5.4	-0.659636445	-0.08681349	-2.05658089	1.47377155
22	9.9	0.632644335	2.19192217	1.58898009	0.79073816
23	7.0	0.469822636	-0.81716845	0.52675763	1.27558855
24	8.6	2.089438200	-1.52659035	0.45888454	-0.90684348
25	4.8	0.005188833	-0.17644318	-1.79805622	0.50691026
26	6.6	0.497921600	-0.08328040	-1.43978160	0.56405106
27	6.3	0.974616571	-1.35439253	0.13660472	1.16292505
28	5.4	-0.009817284	-0.97789056	-1.51541906	0.32248663
29	6.3	1.262938535	-1.87710229	0.12544126	0.03865615
30	5.4	-0.434005691	-0.09958759	-0.71601556	-1.49015735
31	6.1	-0.603668095	-0.44424184	-0.33525972	2.32897489
32	6.4	-0.865556650	-1.53661460	-0.15545601	1.14413593
33	5.4	-0.553720906	0.21749469	-1.22841017	0.16300638
34	7.3	0.280764231	0.21158280	-0.56072909	-0.09242642
35	6.3	-1.070248118	0.57082972	-0.75949237	0.24951820
36	5.4	-1.072400412	-1.47288100	0.40970187	0.39307215
37	7.1	-0.362132168	-0.40290073	0.44746266	0.33940156
38	8.7	1.496098761	0.05511988	0.54341497	0.09347698
39	7.6	0.582518476	0.57680274	-0.28987278	-1.33578311
40	6.0	-0.607485926	1.37145355	-1.15709041	-1.16926158
41	7.0	0.176838826	-0.21442354	-0.35845981	-2.05555922
42	7.6	0.218933118	0.01618495	0.52102823	-1.16266428
43	8.9	0.687007257	1.72109458	0.89742091	-1.03990067
44	7.6	0.657730046	1.71311399	-1.15131490	1.48533118
45	5.5	1.158610385	-2.02681964	0.17457725	-0.87150431
46	7.4	0.858216714	0.87484336	-0.97139141	0.27857252
47	7.1	0.125403588	-0.44079143	0.94741721	1.10077366
48	7.6	1.683783833	0.85785105	-1.40063470	0.74216996
49	8.7	0.422054141	0.74103630	1.34856959	-0.81444940
50	8.6	0.478693686	0.39589812	1.04059991	-0.83543867
51	5.4	-1.007658824	-0.37787215	-0.71459614	0.19099122
52	5.7	1.383501389	-2.08236412	0.28355056	-1.08298450
53	8.7	0.953682731	-0.90059245	1.15519319	-0.29066965
54	6.1	-0.744216617	-0.65831641	0.14224043	0.58966532
55	7.3	0.361962764	-0.30929279	-0.33372887	-1.17192654
56	7.7	-0.251468159	0.27568476	0.70852542	0.90488742
57	9.0	1.737628512	1.76424566	-0.38496411	-0.17865320
58	8.2	0.317411542	0.44770262	0.88084821	0.38970395
59	7.1	-0.974260007	0.08994809	1.57263558	0.46674149
60	7.9	0.829732404	-1.38916349	0.94307757	0.52744871
61	6.6	0.874958259	-1.34288200	0.51538791	1.75746207
62	8.0	-0.938815151	0.78679624	0.77278723	-0.18906993
63	6.3	-0.696342594	0.03290197	0.68295688	-1.11616881
64	6.0	-1.156992633	-1.70932185	0.16195328	0.36366745
65	5.4	-1.353829139	0.14736894	-0.46016905	0.58610978
66	7.6	0.955174308	0.93154411	-0.70436855	-1.12851751
67	6.4	0.483914454	-0.23527280	-1.08257458	1.99186433
68	6.1	0.100372441	-0.07985775	-0.67425428	-0.31234819
69	5.2	-1.078960245	-0.52977507	-0.35256621	-1.01170257
70	6.6	-0.155090347	0.16527872	-0.50369353	-1.34967173
71	7.6	0.164661557	2.04252764	0.31350111	0.68454837
72	5.8	-1.152685121	-0.38431530	0.65977245	-1.11583833
73	7.9	0.645171757	1.54285527	-0.03545928	-1.91150925
74	8.6	-0.430786149	1.33094800	1.61981935	1.23950074
75	8.2	-0.332122128	1.03983252	0.82681672	-0.33960805
76	7.1	-0.806214844	0.02768261	1.62044901	1.11102832
77	6.4	-0.662734262	0.37825834	-0.27910304	2.00243698
78	7.6	0.025755240	0.50781800	0.70174602	1.03321718
79	8.9	1.077354020	0.63560305	1.69844773	0.47600742
80	5.7	-1.708189701	0.37678491	0.05206993	0.00623234
81	7.1	-0.791416424	-0.36196024	1.66850541	0.50124226

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82           7.4 -0.125745389 -0.66136771  0.87415016  0.44046952
83           6.6 -1.418577141 -0.84992663  1.04441989  0.18222128
84           5.0 -2.773848635 -0.30321551 -0.74160130  1.49627835
85           8.2  0.713415731 -1.22238641  0.74457870  0.67462450
86           5.2 -1.167219334 -0.28476043 -0.08369810 -1.09880830
87           5.2 -1.773422094  0.01248194 -0.62169389 -2.22146246
88           8.2  0.736227785 -0.78670569  0.74975454  1.29687654
89           7.3 -0.178428977  0.18259704  0.79246880  0.08398629
90           8.2  0.621767405  2.69512745 -0.44351912  1.83572993
91           7.4 -0.912083520  0.59212934  1.09187866  1.36604840
92           4.8 -2.657469202  0.04229964 -0.50782983 -0.62676889
93           7.6  0.143904530  0.21115096  1.52827756 -0.33620779
94           8.9  0.951066791  0.48535332  1.91922938  0.06307822
95           7.7 -0.855759766  0.76626577  1.62507659 -1.08779785
96           7.3 -0.336381564  0.55445037  0.84116563  0.02772237
97           6.3 -0.608851439  0.03436396  0.35689489 -1.92853877
98           5.4 -1.679639415 -1.23744970  1.43494387 -1.26249494
99           6.4 -0.709821673  1.92327328  0.27058064  0.15374396
100          6.4 -1.100653870  0.62955318  0.21319280 -0.85323219
> ##using FA
> mydf1=data.frame(mydataset[13],fa1$scores)
> mydf1
    Satisfaction         PA1          PA2         PA4         PA3
1            8.2 -0.09158623  0.938157667  0.57839695 -1.78027124
2            5.7  1.72471636 -1.974779717 -0.20932468 -0.43343603
3            8.9  0.44021618  0.820274001  1.38042338  0.04175064
4            4.8 -1.15684316 -0.486070075 -1.29500513  1.29644724
5            7.1 -0.38897537 -0.543640276  0.60346860 -0.04161991
6            4.7 -0.53243104 -1.254824917 -1.25649279 -1.14811453
7            5.7 -2.49416488  0.433872060 -0.77400523 -0.79619498
8            6.3 -0.09064395 -0.031691768 -1.07389698 -0.77352227
9            7.0  0.95847209  0.526206005 -1.13711761 -0.12414125
10           5.5  0.61023346  0.566188221 -1.48745367 -0.38318035
11           7.4  0.03184088 -0.484121755  0.69912917 -0.45266115
12           6.0 -1.16583237  1.079856385 -1.16713290  0.24504045
13           8.4  0.73394331  1.057375891  0.78209977 -0.02384039
14           7.6  0.32828750 -0.438446321  1.02594967  0.47100966
15           8.0  1.67810906  0.178615235 -0.53411476 -0.31304450
16           6.6  1.21395416 -1.396634471  0.44627684 -0.34459761
17           6.4  0.99448964 -0.464698305 -1.22735976  0.90912558
18           7.4  1.46651510 -0.035192857 -0.87386726  0.15175446
19           6.8  0.79938466  0.496317066 -1.20860500 -0.44987253
20           7.6  0.40068676  2.254668146 -0.11230203 -0.70426401
21           5.4 -0.45234315 -0.511305452 -1.62476489  1.40237719
22           9.9 -0.10672900  2.358474962  2.02912321  0.52434146
23           7.0  0.06624458 -0.347745984  0.67359613  1.04686767
24           8.6  1.30164421 -0.411445992  1.08820451 -0.64790560
25           4.8  0.05689087  0.320784555 -1.79681018  0.51222456
26           6.6  0.37097149  0.150759661 -1.15374384  0.45144307
27           6.3  0.79343321 -1.312251525  0.22887144  1.09976996
28           5.4  0.16202359 -0.938473517 -1.21411302  0.40964711
29           6.3  0.89356307 -1.133614486  0.22439199 -0.04295672
30           5.4 -0.51997882 -0.215962843 -0.78699046 -1.38403134
31           6.1 -0.85639773 -0.539856927 -0.10680945  2.15509019
32           6.4 -0.88908742 -1.311976731  0.19249487  1.05974433
33           5.4 -0.60174429 -0.187242067 -1.00482484  0.19268874
34           7.3  0.49757938 -0.539592707 -0.25579371 -0.05380814
35           6.3 -1.16069659  1.962826388 -0.74615075  0.23897145
36           5.4 -1.31912834 -2.324006331  0.65439255  0.32542958
37           7.1 -0.51610600 -0.633066599  0.71176085  0.32409948
38           8.7  1.33316901  0.255202938  0.97524567  0.06897220
39           7.6  0.88631671 -0.265251853 -0.11331484 -1.18075087
40           6.0 -0.86588863  1.233422644 -1.10706145 -1.12887293
41           7.0  0.02563103  0.440874165 -0.20918857 -1.97349933
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42           7.6  0.11435585 -0.153601658  0.79359721 -1.13659778
43           8.9  0.49103674  0.814786834  1.18944013 -1.05748775
44           7.6  0.69941000  2.313048321 -1.20905035  1.31790925
45           5.5  1.44843784 -1.893076825 -0.20208693 -0.79333888
46           7.4  1.02388207 -0.064309086 -0.66037784  0.27975263
47           7.1  0.12515112 -0.778902259  0.80141607  0.90019272
48           7.6  1.75970876  0.670748701 -1.21409936  0.75002906
49           8.7 -0.30917315  1.995596272  1.42537951 -0.62792404
50           8.6  0.33399526  0.506146247  1.04229621 -0.95257383
51           5.4 -1.32437339 -0.136856590 -0.67807009  0.10625672
52           5.7  1.79787703 -1.860729260 -0.16150927 -0.94904389
53           8.7  0.86790837 -0.417188046  1.30992891 -0.18744147
54           6.1 -0.81780768 -0.440261915  0.02191898  0.49507231
55           7.3  0.63313838 -0.425617714 -0.25226984 -1.07194123
56           7.7 -0.66953772  0.453274825  0.94500452  0.87442489
57           9.0  1.94023570  1.263688436 -0.06228871 -0.09495174
58           8.2  0.16363903 -0.003850638  0.85070593  0.36829429
59           7.1 -0.53535208 -0.836388600  1.10907347  0.32451261
60           7.9  0.81513215 -1.651916616  1.04376234  0.43185466
61           6.6  0.92828875 -1.254830405  0.34486455  1.61479335
62           8.0 -0.68588852  0.765207236  0.59200244 -0.37633053
63           6.3 -0.97073116 -0.108934322  0.38066766 -1.08861500
64           6.0 -1.25203475 -1.563591307  0.17216020  0.31417972
65           5.4 -1.36373236 -0.316489677 -0.63974836  0.60703009
66           7.6  1.54006782  0.634262589 -0.94826411 -1.01749184
67           6.4  1.08462954 -0.418566057 -1.30286314  1.80315208
68           6.1  0.58199432 -0.389219013 -1.10136289 -0.39051413
69           5.2 -0.74527595 -0.258328327 -0.86832329 -0.99831373
70           6.6  0.19091124  0.180814625 -0.88385995 -1.27359701
71           7.6  0.20084299  2.285332075 -0.12769878  0.85515720
72           5.8 -1.22269572 -0.498225720  0.19481940 -1.07234714
73           7.9  0.79361818  0.562453517 -0.08933252 -1.74987645
74           8.6 -0.81402187  1.950516058  1.41811741  1.26884414
75           8.2 -0.35752005  0.888430973  0.63070000 -0.35235364
76           7.1 -0.32443760 -0.119145258  0.88574023  1.17670914
77           6.4 -0.05728336 -0.228558188 -0.67029802  2.01604450
78           7.6  0.32718009 -0.410627131  0.64477971  1.15265842
79           8.9  0.89509038  0.852881804  1.33235905  0.52311683
80           5.7 -1.85815497  1.218026285 -0.40538843  0.13048863
81           7.1 -0.46561501  0.117778835  0.91421339  0.38661101
82           7.4 -0.04922639 -0.392394123  0.70180858  0.38153836
83           6.6 -1.18379181 -1.051633281  0.73974628  0.14496521
84           5.0 -2.67128344 -0.047572562 -0.93795959  1.52108684
85           8.2  0.76731019 -0.950252830  0.76488122  0.59988756
86           5.2 -0.59275449 -0.333560534 -0.84767015 -1.05132460
87           5.2 -1.25583010 -0.225456916 -1.16045011 -2.14555922
88           8.2  0.72142815 -0.967911496  0.76344102  1.21797956
89           7.3  0.02545169 -0.555038341  0.60627102  0.21265284
90           8.2  0.94653252  2.687588774 -0.95687290  1.65660066
91           7.4 -1.12028137  0.410534131  0.90505406  1.40631126
92           4.8 -1.94475582 -0.703667779 -0.92209772 -0.61403882
93           7.6  0.12012677 -0.356267016  1.27940841 -0.22180198
94           8.9  0.96512517  0.842244455  1.35150022  0.14618725
95           7.7 -0.99812602  0.573595343  1.26471142 -0.97770812
96           7.3 -0.38451470  0.561361582  0.49447726 -0.10246182
97           6.3 -0.19410159 -0.095050529 -0.38485351 -1.81522481
98           5.4 -1.61950477 -2.118097336  0.91048217 -1.23418190
99           6.4 -0.52146446  2.339815778 -0.61550442  0.19225423
100          6.4 -0.55297511 -0.153998855 -0.34001051 -0.56971605
> multiple.linear.regression=lm(Satisfaction~.,mydf)
> summary(multiple.linear.regression)

Call:
lm(formula = Satisfaction ~ ., data = mydf)
```

```
Residuals:
     Min       1Q   Median       3Q      Max
-1.21919 -0.33259 -0.01384  0.35002  1.34714

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.91800    0.05174 133.717   <2e-16 ***
RC1          0.69061    0.05200  13.282   <2e-16 ***
RC2          0.52452    0.05200  10.088   <2e-16 ***
RC4          0.63832    0.05200  12.276   <2e-16 ***
RC3          0.06423    0.05200   1.235     0.22
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5174 on 95 degrees of freedom
Multiple R-squared:  0.8192,   Adjusted R-squared:  0.8116
F-statistic: 107.6 on 4 and 95 DF,  p-value: < 2.2e-16

> anova(multiple.linear.regression)
Analysis of Variance Table

Response: Satisfaction
          Df Sum Sq Mean Sq  F value Pr(>F)
RC1        1 47.217  47.217 176.4041 <2e-16 ***
RC2        1 27.237  27.237 101.7607 <2e-16 ***
RC4        1 40.337  40.337 150.7023 <2e-16 ***
RC3        1  0.408   0.408   1.5261 0.2197
Residuals 95 25.428   0.268
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1



>
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