HAIR-BUSINESS REPORT

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CONTENTS

1. PROJECT OBJECTIVE

The main objective of this report is to explore **HAIR** dataset in **R** and build optimum regression model to predict Customer Satisfaction.

The Business report comprises the following:

- Importing the dataset
- Exploratory data analysis
- Multicollinearity check between the variables
- Building simple and multiple linear regression models
- Performing Principal component analysis/Factor analysis
- Output interpretation and significance

2. ASSUMPTIONS (REGRESSION)

- **Linearity** - The relationship between the dependent and independent variables should be linear.
- **Homoscedasticity** - Constant variance of the errors should be maintained.

- **Multivariate normality** – Multiple Regression assumes that the residuals are normally distributed.
- **Lack of Multicollinearity** – It is assumed that there is little or no multicollinearity in the data.

3. EXPLORATORY DATA ANALYSIS

A typical data exploration consists of the following steps:

1. Environmental setup (working directory) and Data import
2. Variable Identification
3. Univariate analysis
4. Bi-variate analysis
5. Multivariate analysis
6. Missing Values Treatment (not in scope for our project)
7. Outliers Treatment (not in scope for our project)
8. Variable Transformation/Feature Creation
9. Feature Exploration

Follow the above mentioned steps for the given dataset.

3.1 ENVIRONMENTAL SETUP AND DATA IMPORT

3.1.1 INSTALL REQUIRED PACKAGES AND INVOKE LIBRARIES

In this section we install all of the necessary packages and the associated libraries are invoked. Having all the required packages at the same place makes the readability of the codes easier. Please refer Appendix A for the Source code.

3.1.2 SET UP THE WORKING DIRECTORY

Setting up the working directory in R helps to import and export data files and code files easy and effective. Basically, working directory is the location where the data and the codes to be worked on is stored.

3.1.3 IMPORT AND READ THE DATASET

The dataset to be worked on is in .csv format. Hence “read.csv” command is used to import the required dataset. Please refer Appendix A for the source code.

3.1.4 INVOKING NECESSARY LIBRARIES

All the required libraries are called to work on the given dataset. Refer Appendix A (source code).

3.2 VARIABLE IDENTIFICATION

The following functions are used to learn the details about the Variables of the given dataset.

names() – displays all the variable names

dim() - provides the dimension of the dataset (rows and columns)

head() – returns the first n rows of the dataset (default: 6 rows)

tail() – returns the last n rows of the dataset (default: 6 rows)

str() – displays the internal structure of the dataset

summary() – produces statistical summaries of the data

anyNA() – tests for any missing values

hist() – displays a histogram for any given numerical variable

boxplot() – visualizes the correlation between any numerical and categorical variable. It provides the five point summary of the distribution.

3.2.1 VARIABLE IDENTIFICATION INFERENCE

With employing the above functions in R we can simply derive the skeleton and characteristics of the given dataset. **HAIR** dataset is a data frame with 100 rows and 13 columns. The variables are of appropriate datatypes. The 5 point summary is calculated for all the variables (Refer source code). It gives the central value (mean) and dispersed value (standard deviation) for each of the variables.

Histograms shows the frequency distribution of the data whereas boxplot shows the center, shape and spread of the data. The dataset is comprised of only integer and numeric datatypes. No categorical variables available in the given dataset. The variable names are ID, ProdQual, Ecom, TechSup, CompRes, Advertising, Prodline, SalesFImage, ComPricing, WartyClaim, OrdBilling, DelSpeed and Satisfaction. The variables with its Abbreviated form is shown for easy reference.

Variable	Expansion
ProdQual	Product Quality
Ecom	E-Commerce
TechSup	Technical Support
CompRes	Complaint Resolution
Advertising	Advertising
ProdLine	Product Line
SalesFImage	Salesforce Image
ComPricing	Competitive Pricing
WartyClaim	Warranty & Claims
OrdBilling	Order & Billing
DelSpeed	Delivery Speed
Satisfaction	Customer Satisfaction

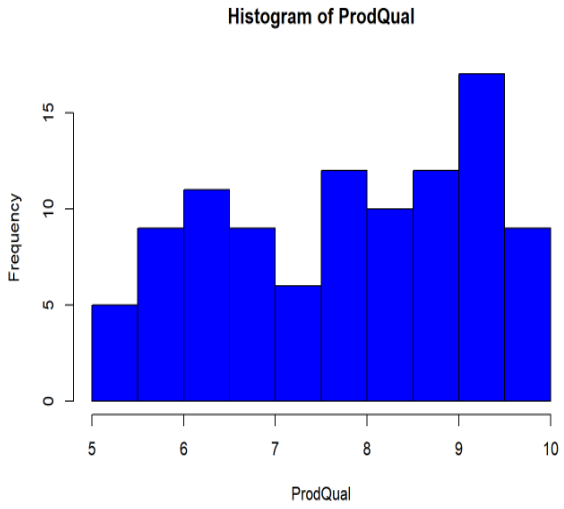
The variable ID is a discrete unique number from 1 to 100.It does not have any explanatory power to explain Satisfaction (dependent variable) in the regression equation. So we can safely drop ID variable from the dataset. Now the dataset will be having 100 rows and 12 columns.

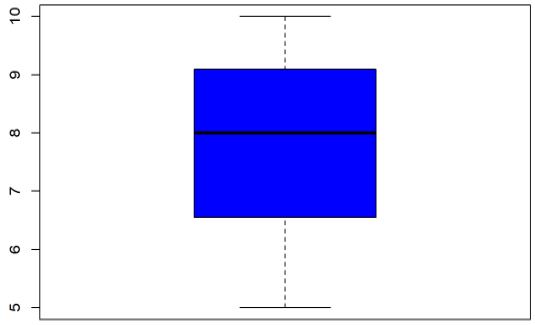
Since the dataset doesn’t have any deformities we can directly call the functions to get the desired results.

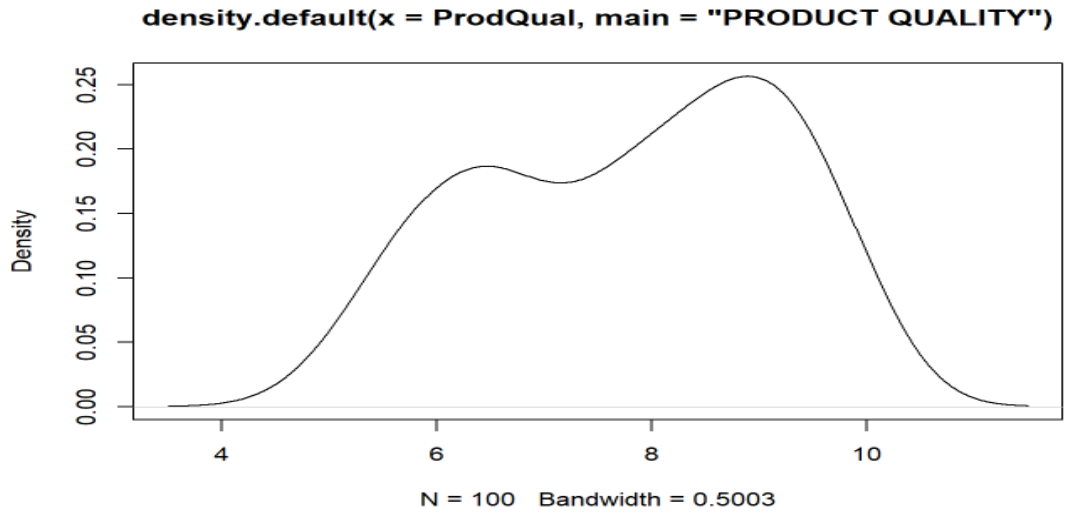
3.3 UNIVARIATE ANALYSIS

The variable Satisfaction is the crucial measure whose relationship with all the other variables are to be determined. The following shows the Univariate analysis of each variable in the dataset to know more about its nature.

PRODUCT QUALITY

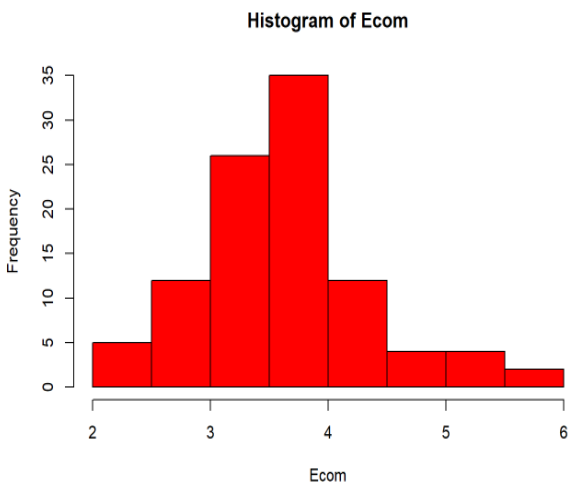


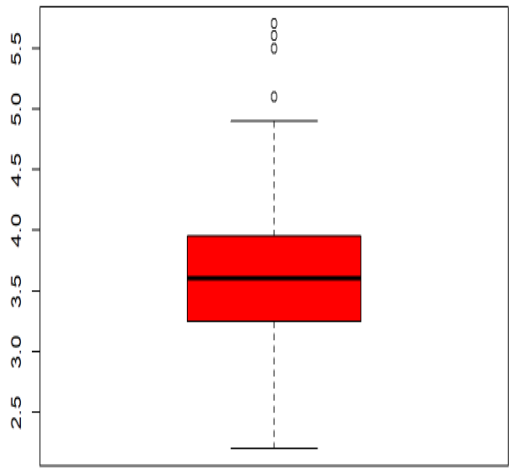


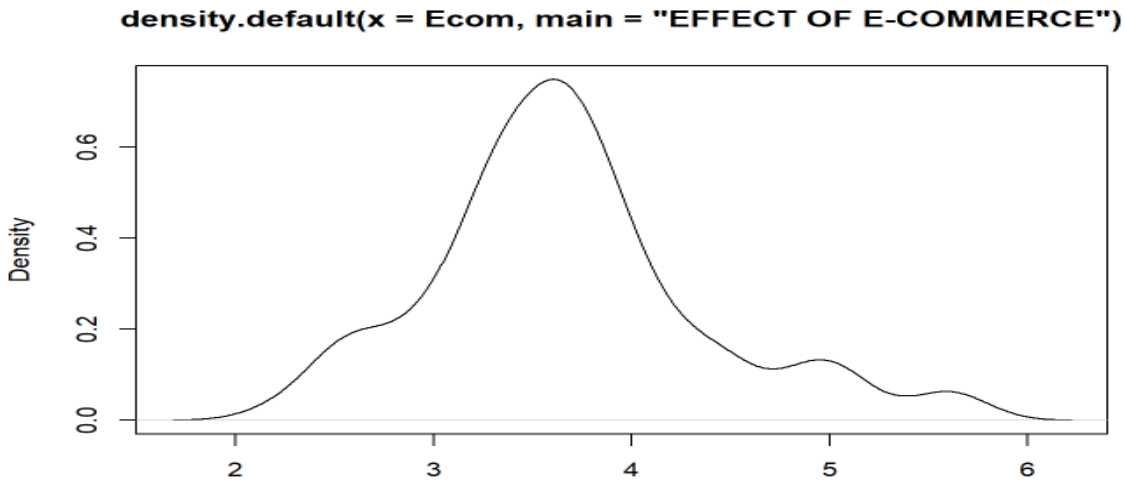


The distribution of ProdQual variable shows slightly left skewed with no outbound values.

E-COMMERCE

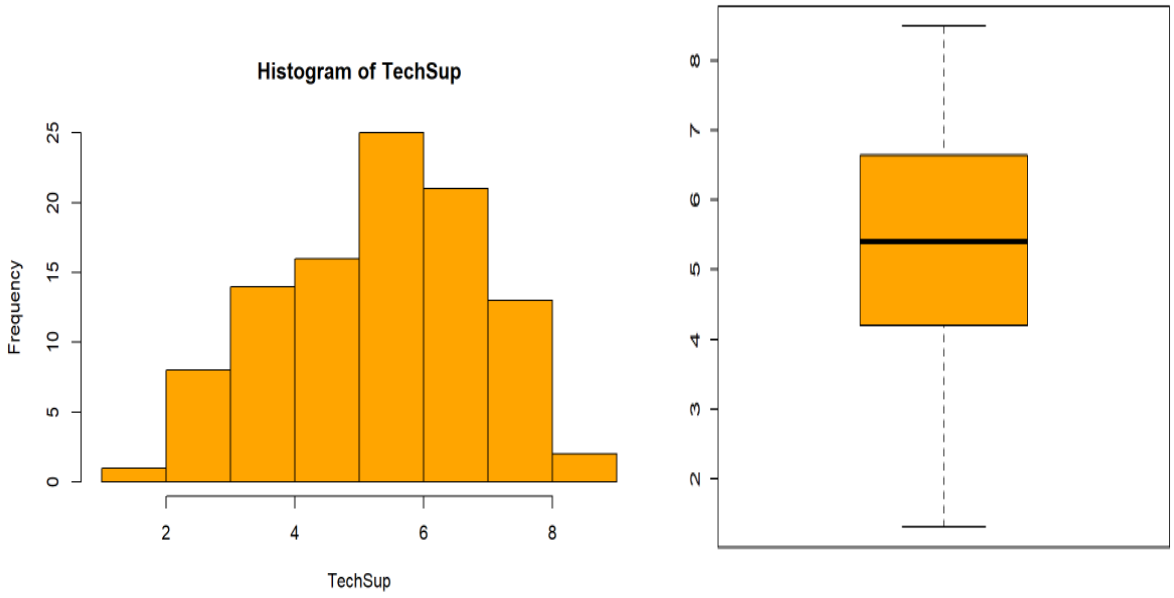


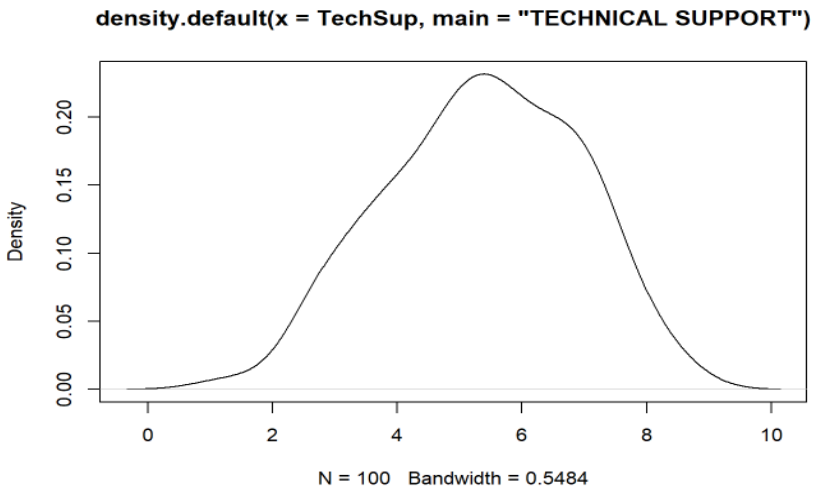




The boxplot of Ecom shows the presence of the outliers. The above picture shows the distribution of Ecom values.

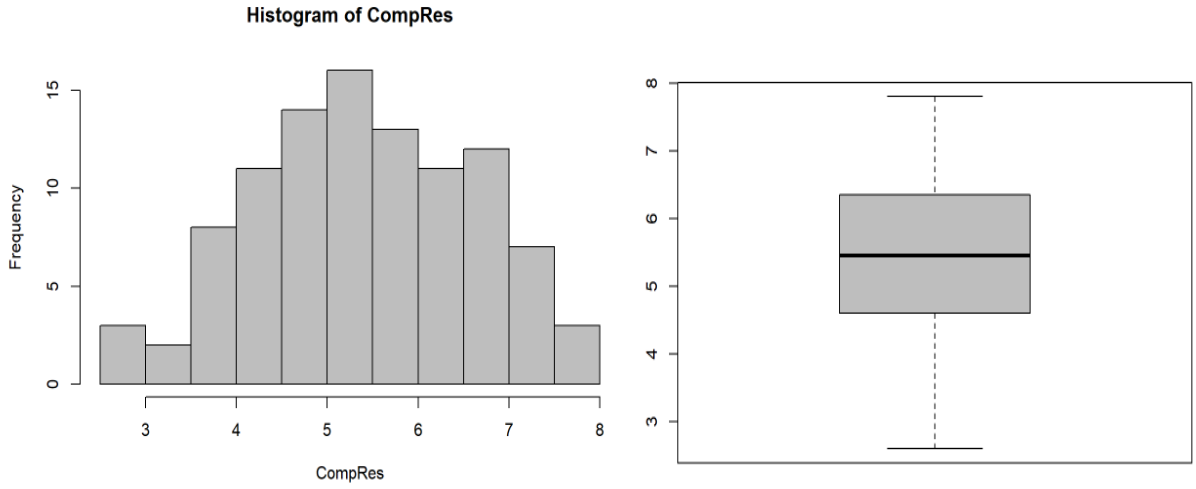
TECHNICAL SUPPORT

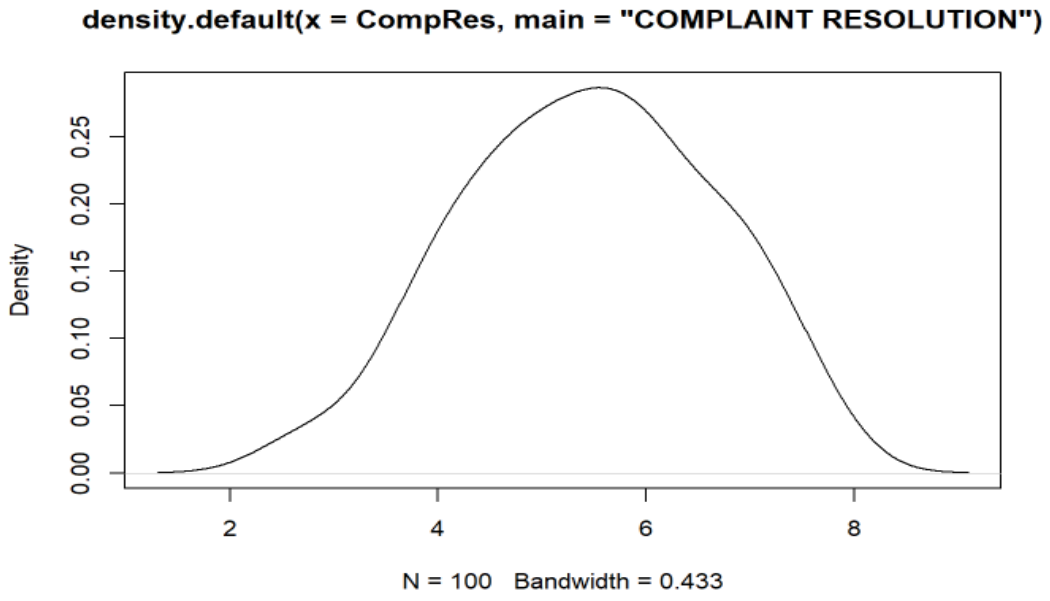




The distribution of TechSup is slightly left skewed with no outbound values.

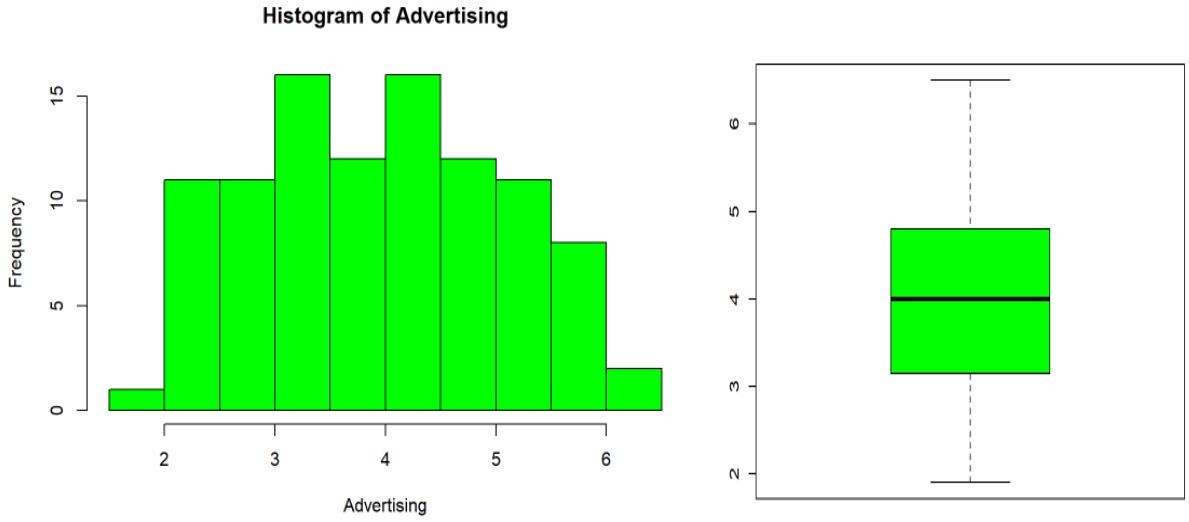
COMPLAINT RESOLUTION

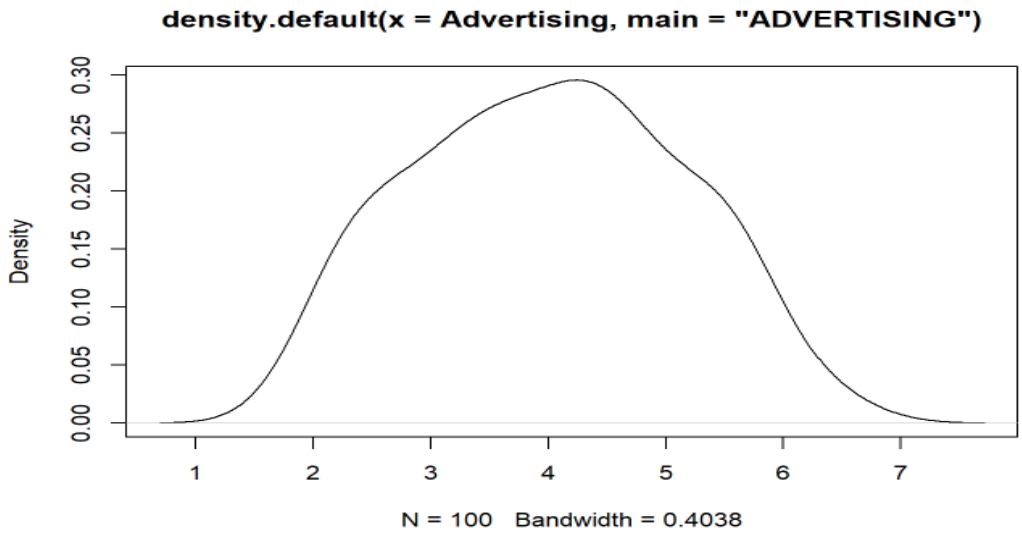




The distribution of CompRes seems to be more or less normal with no outbound values.

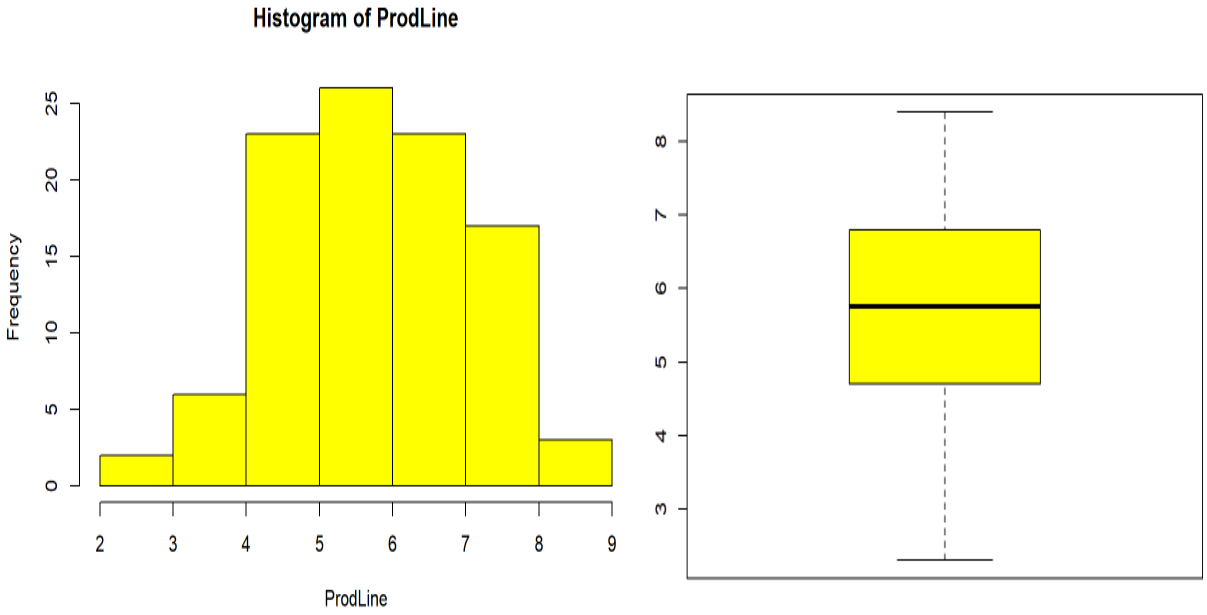
ADVERTISING

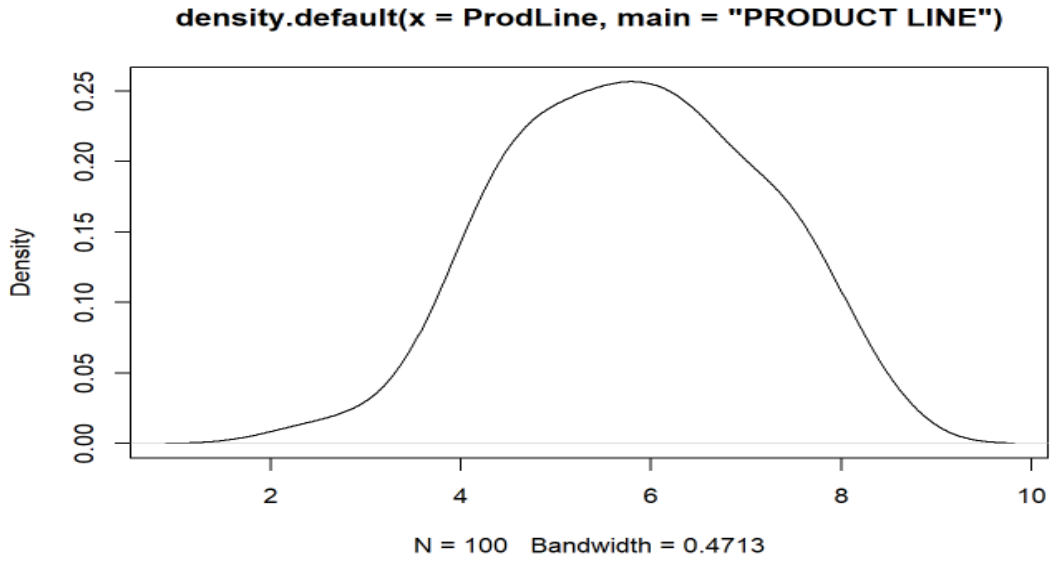




With the above graphs it is known that the variable Advertising doesn't have any outbound values.

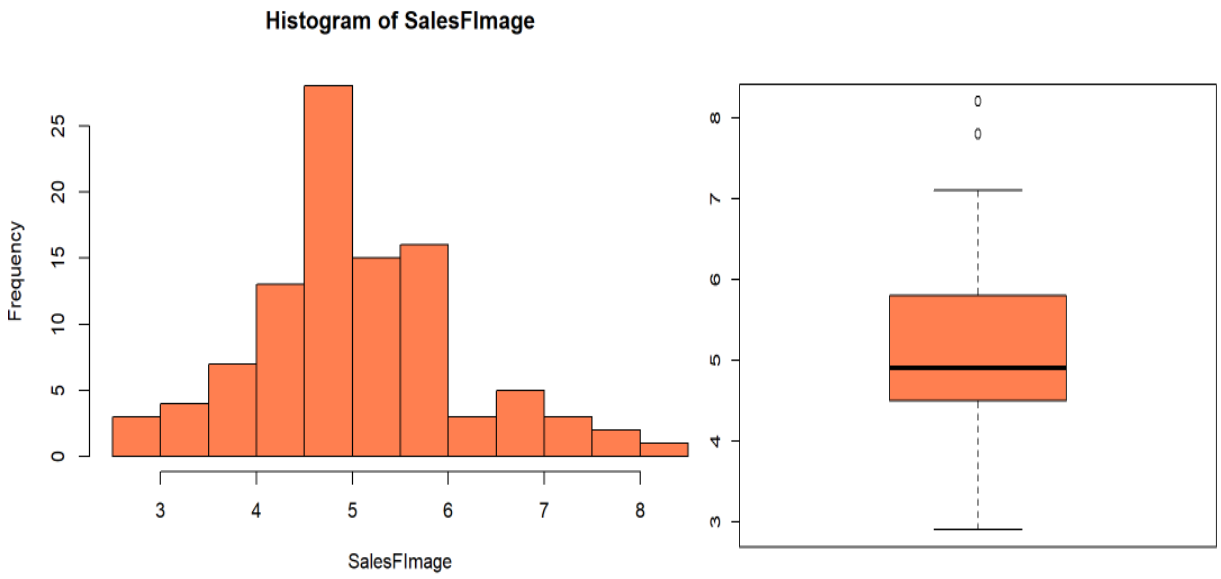
PRODUCT LINE

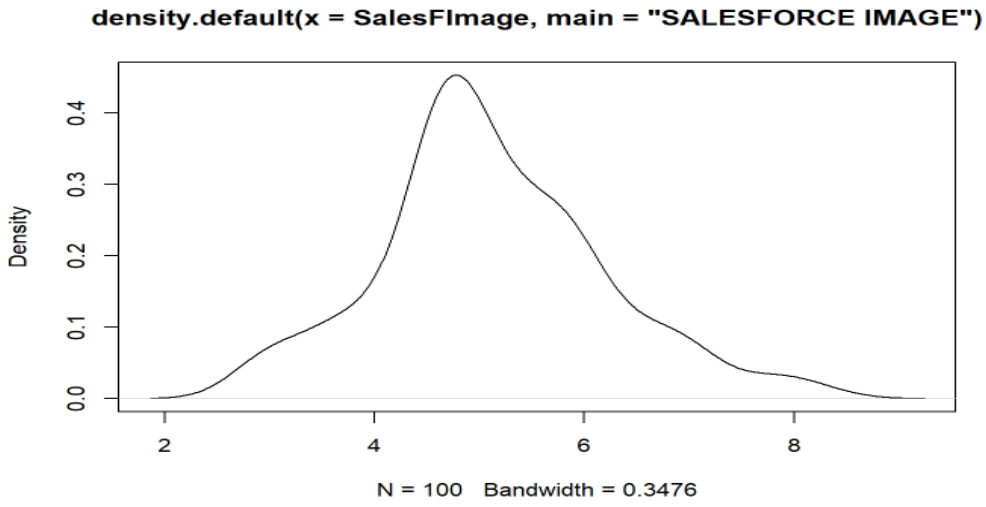




The distribution of variable ProdLine is shown above with no outliers.

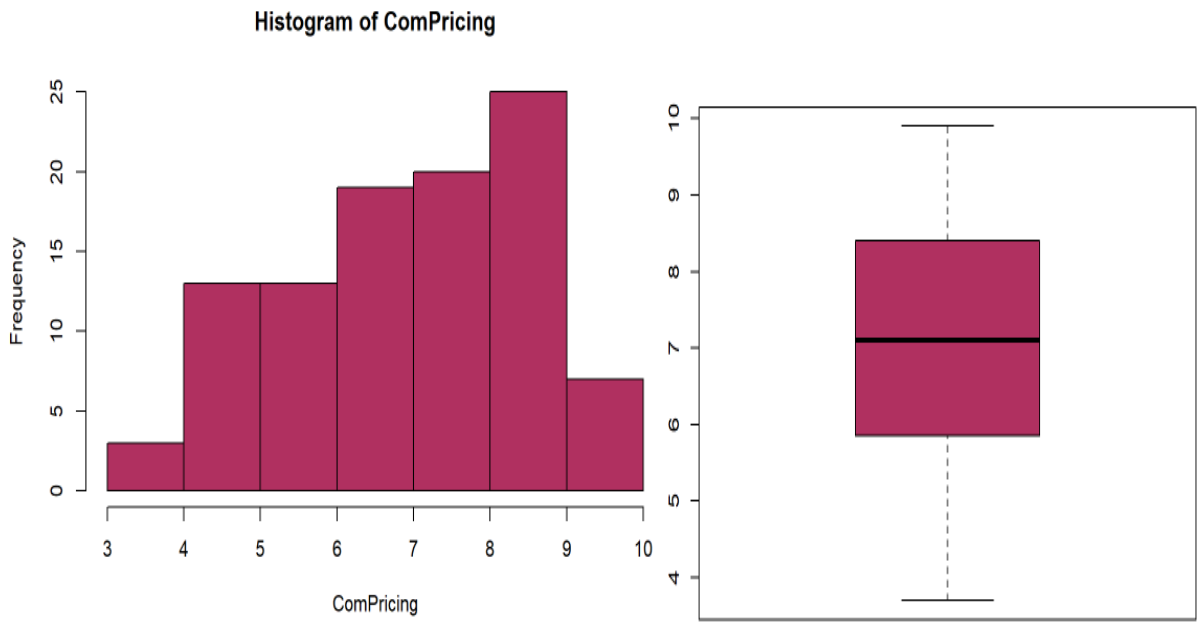
SALES FORCE IMAGE

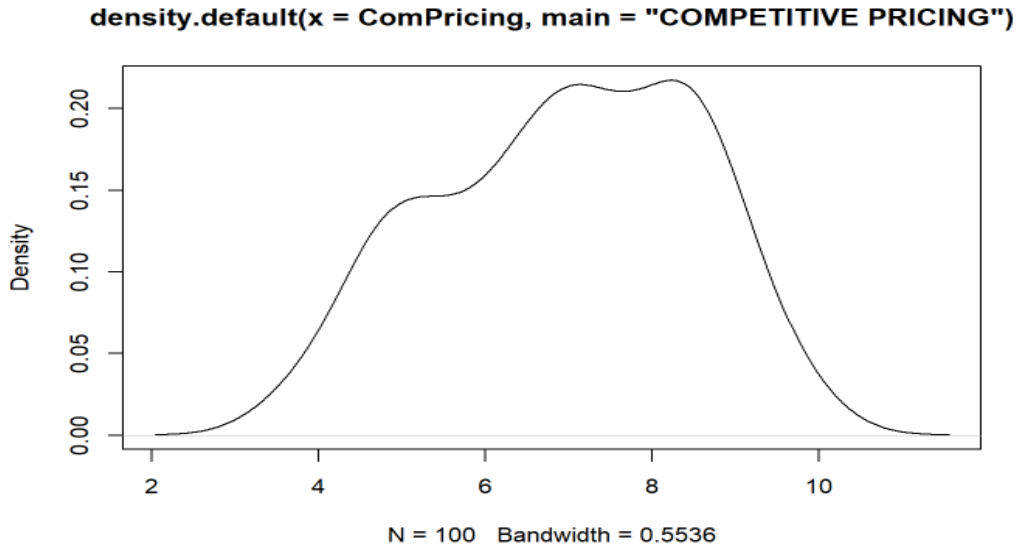




The variable SalesFImage shows a right skewed distribution with couple of outbound values.

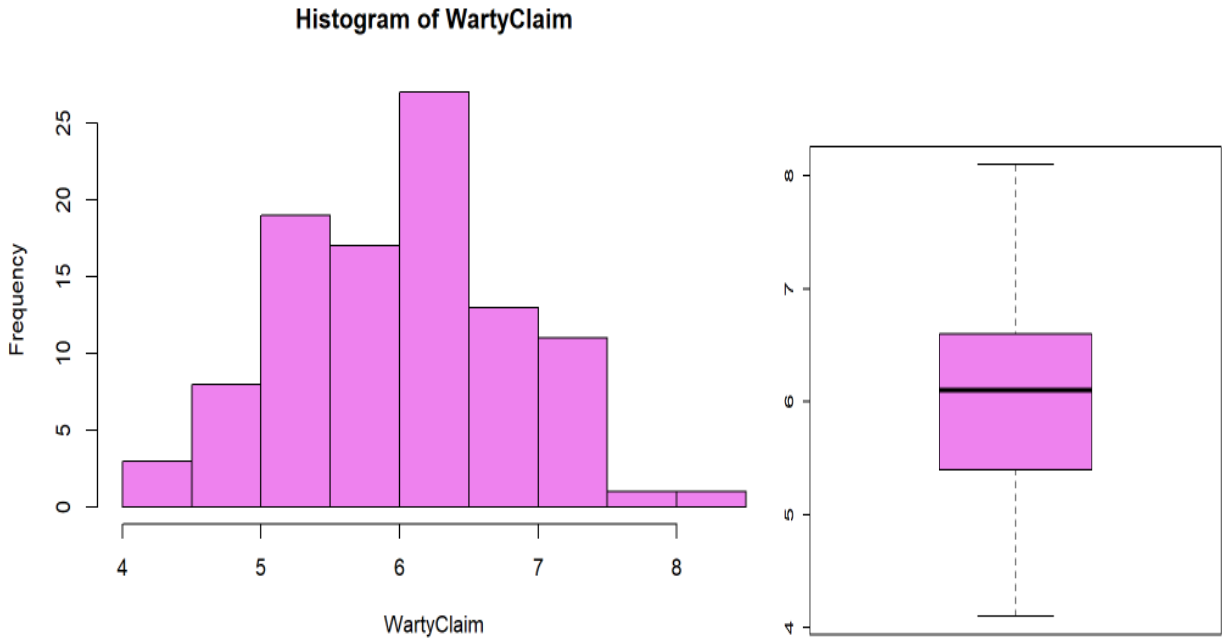
COMPETITIVE PRICING

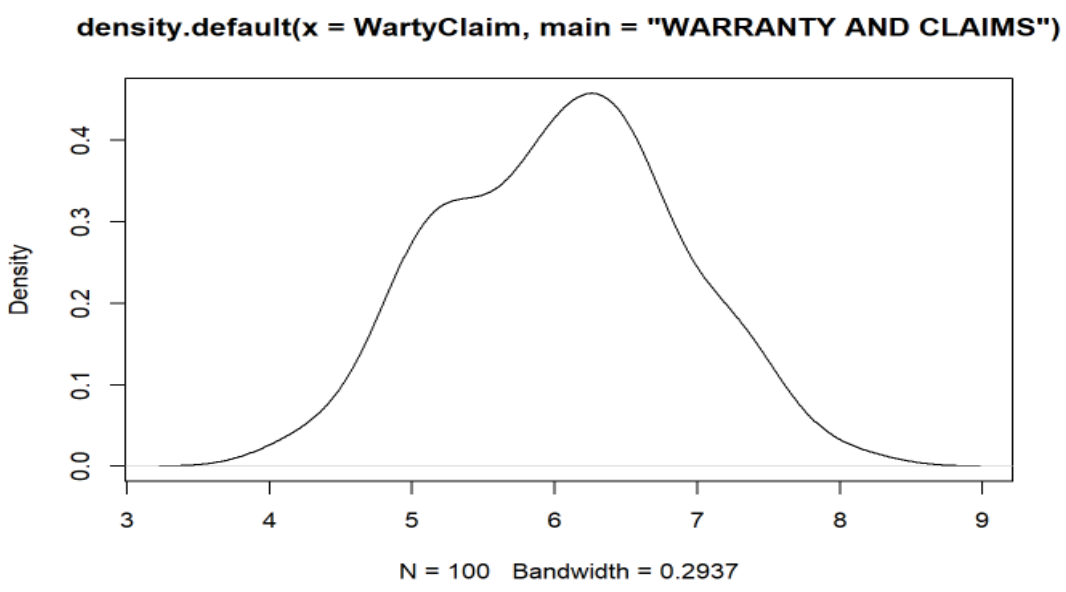




The variable ComPricing is left skewed distribution with no outliers.

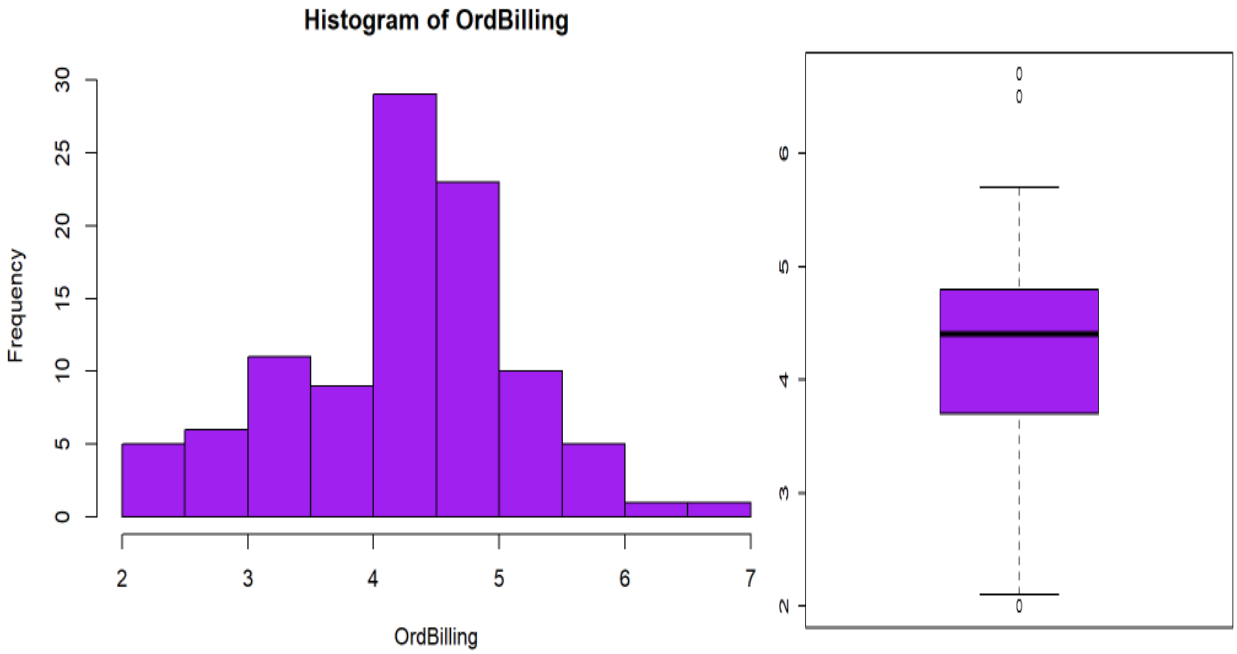
WARRANTY AND CLAIMS

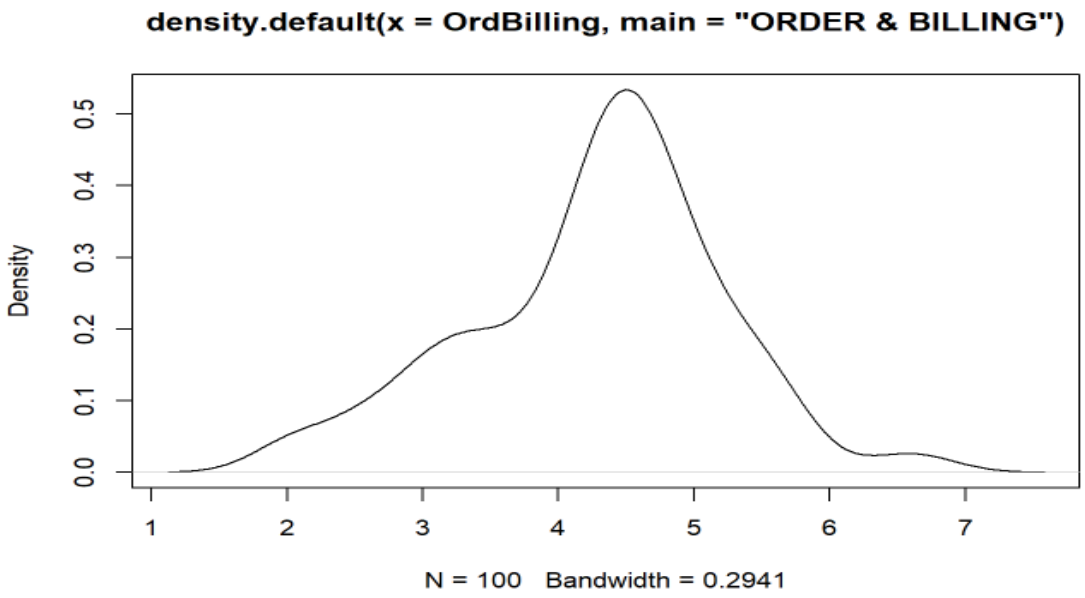




The variable WartyClaim is slightly left skewed with no presence of outliers.

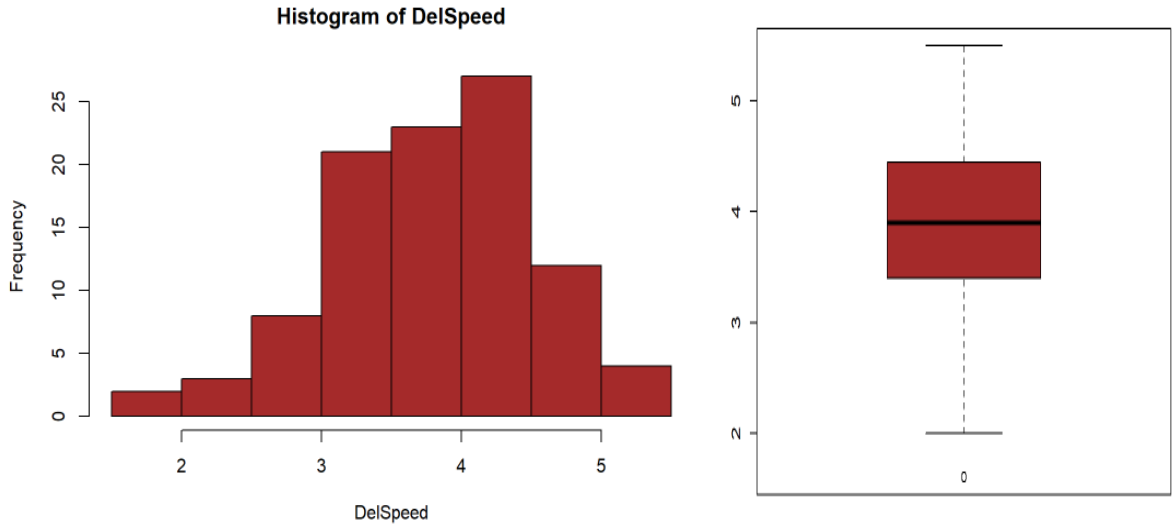
ORDER AND BILLING

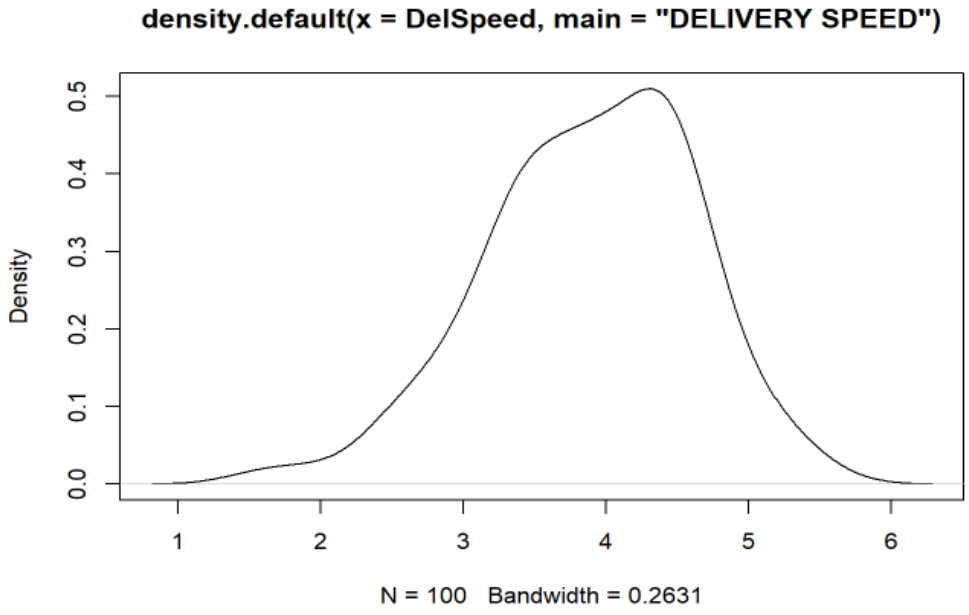




The OrdBilling is left skewed and shows some presence of outliers.

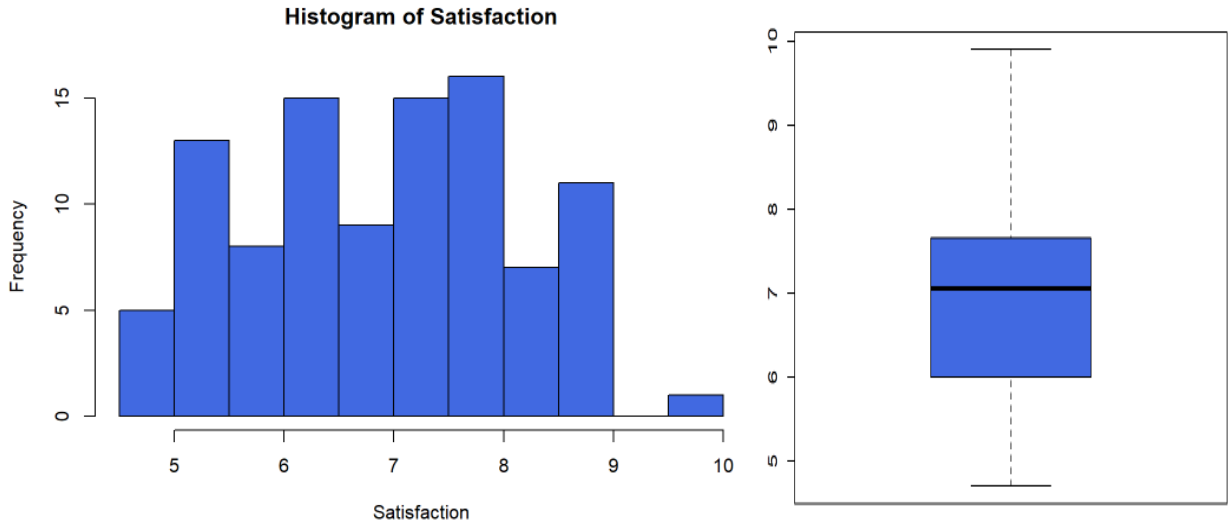
DELIVERY SPEED

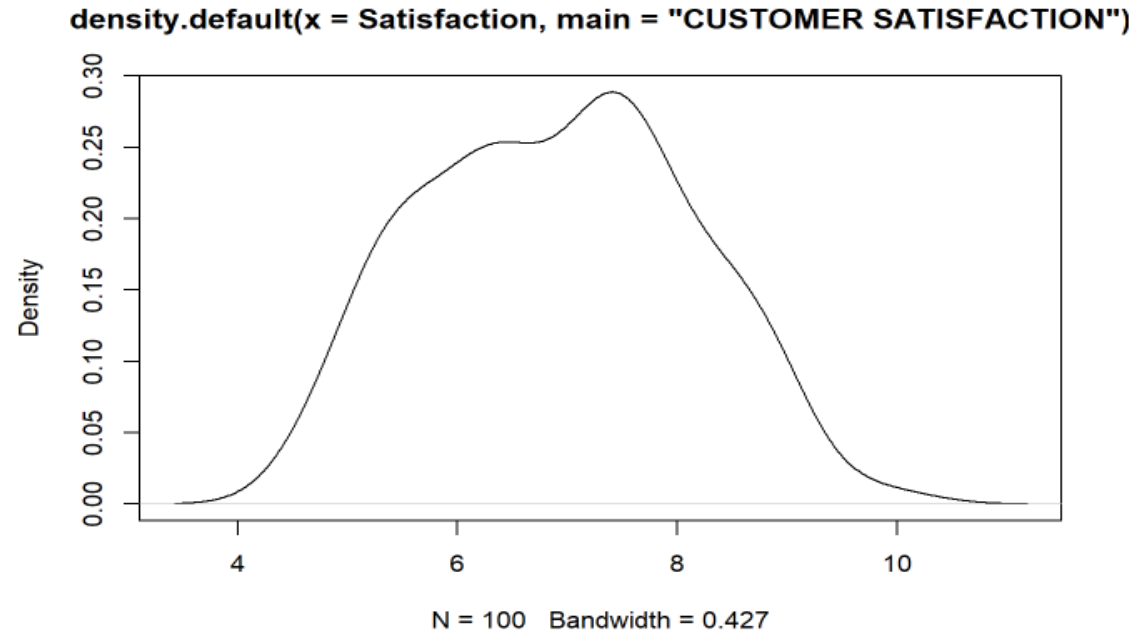




The distribution of variable DelSpeed is left skewed .The graph shows the presence of outliers.

SATISFACTION

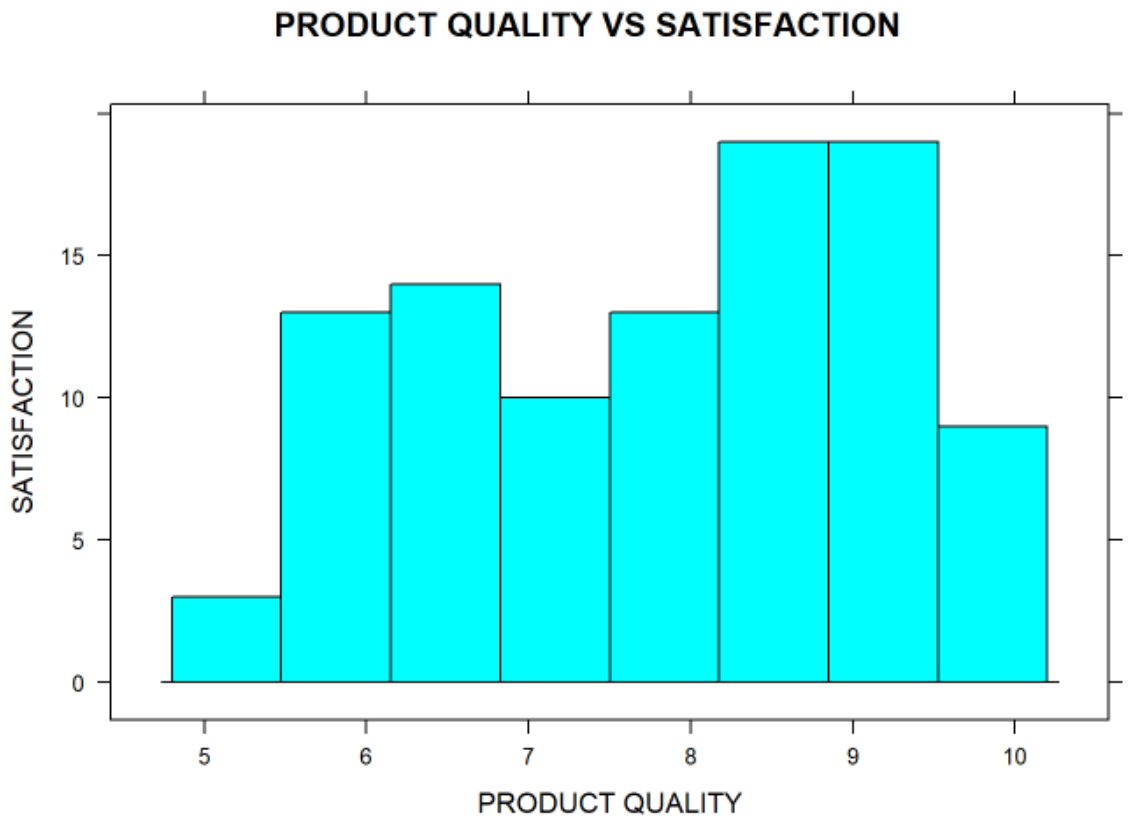




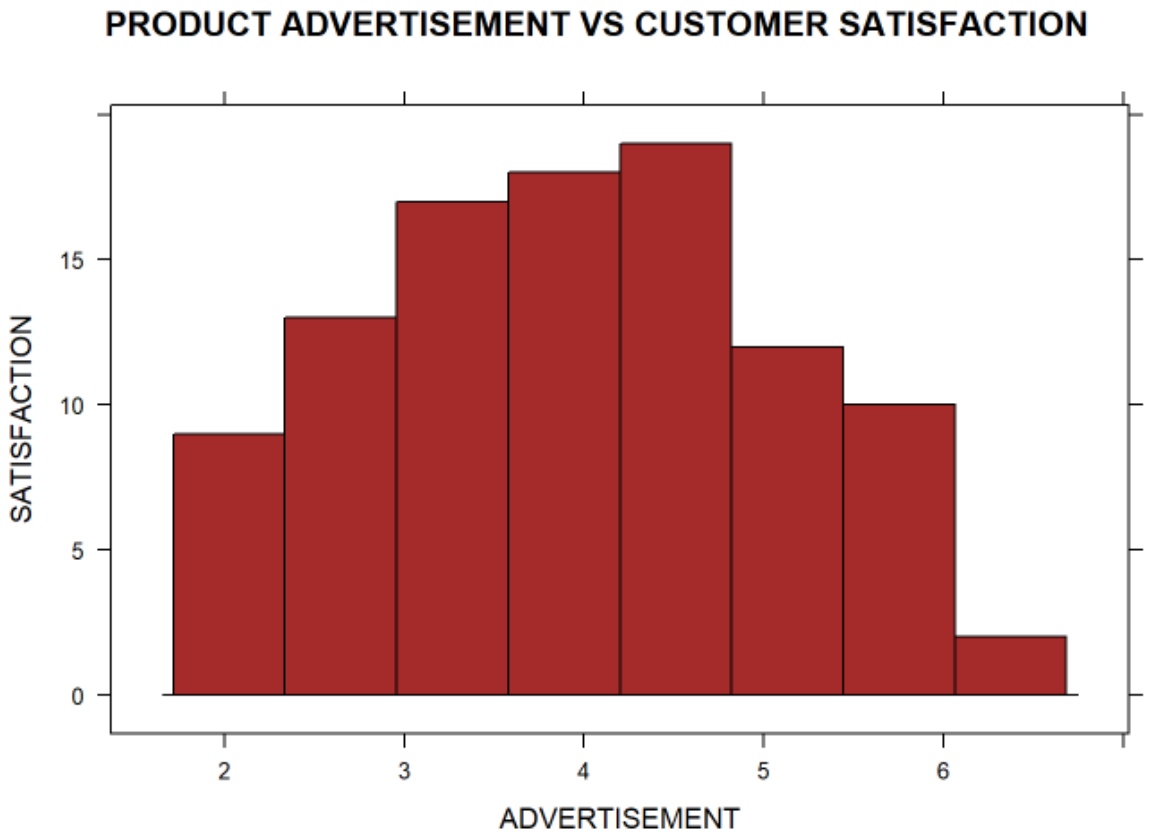
The variable Satisfaction is slightly left skewed with no evidence of presence of outliers.

3.4 BI-VARIATE ANALYSIS

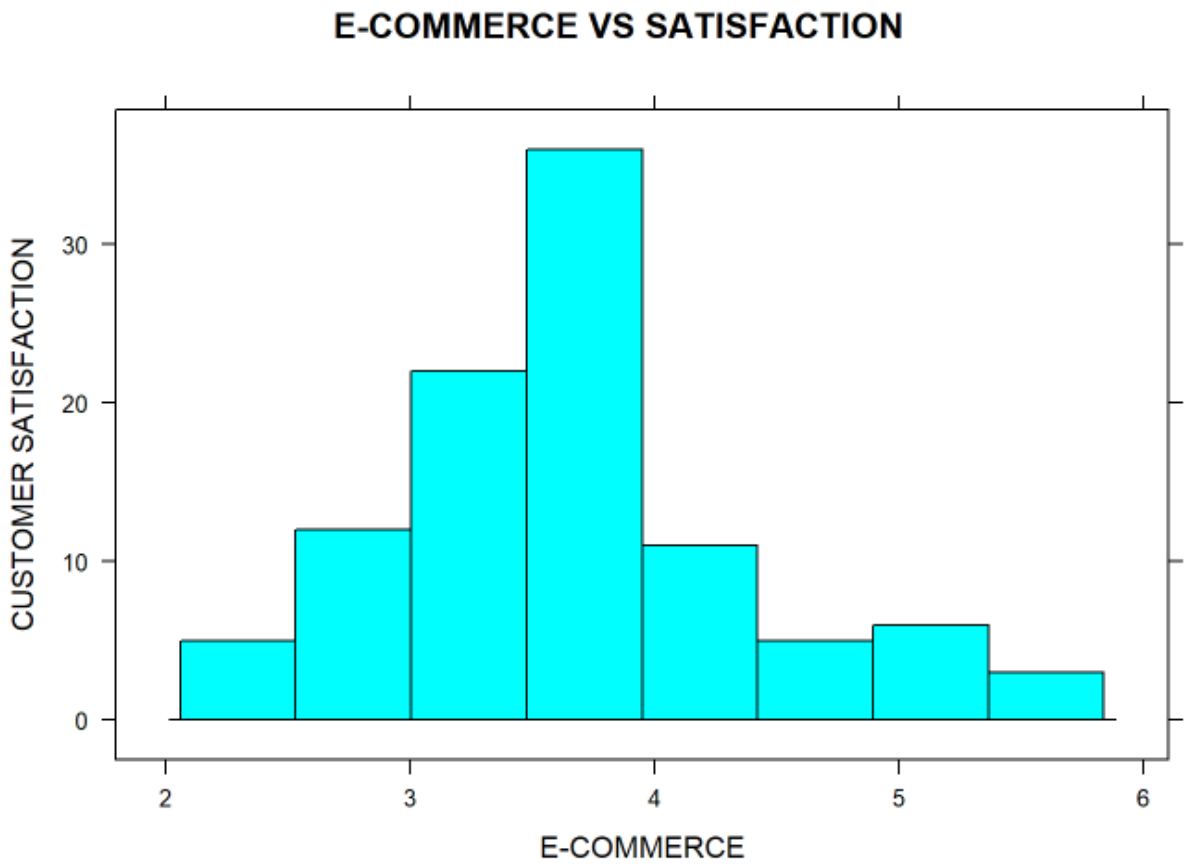
The association between the variables are learnt from the below shown graphs.



As the Product Quality increases, Customer Satisfaction seems to increase .But at a point where Product Quality is more, Customer Satisfaction is deeply less. It shows that there is an amalgamated effect within the variables. Customers expect something else along with the quality.



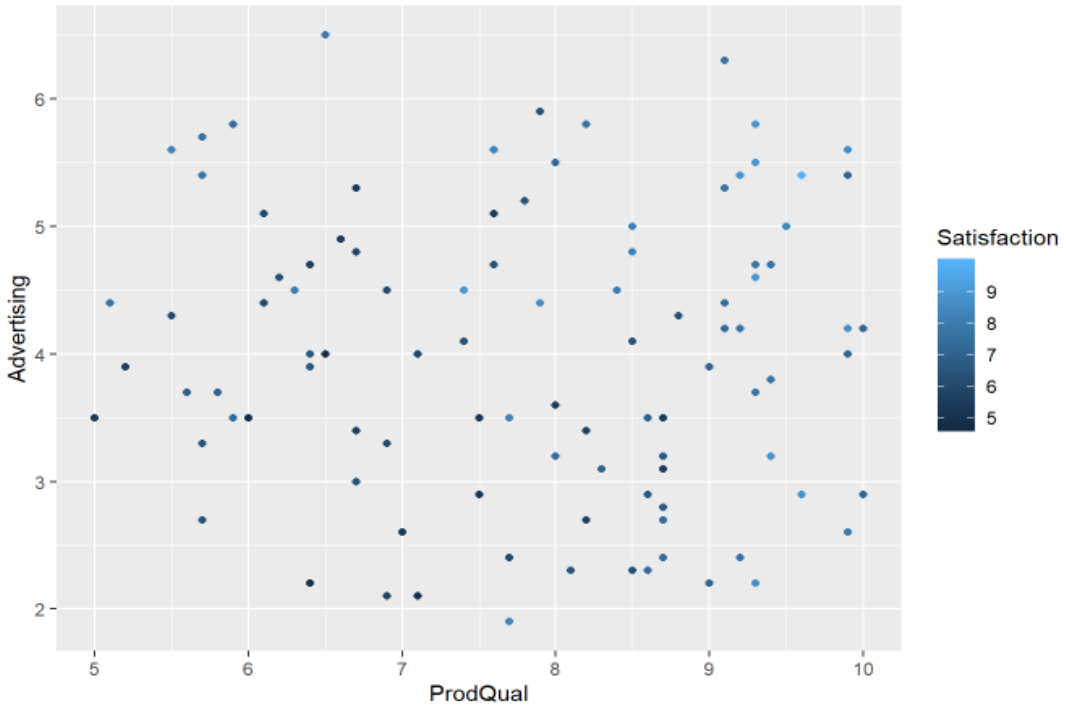
The Customer Satisfaction increases with the good level of Advertisement and suddenly there is a steep decrease in the satisfactory level because there is no use of great advertisement without good quality of the product, brand name, warranty period and smooth delivery options. Here with the above graph we can strongly say that there is an evidence of correlation between the variables.



All the above graphs shows that Satisfaction highly depends on all of the variables which is the strong evidence of Multicollinearity.

3.5 MULTIVARIATE ANALYSIS

The same analysis is done with multiple independent variables with Satisfaction (dependent variable).All the graphs show that the variables are inter-related and are highly correlated with each other. So we can say that all the variables may be important in assessing the Customer Satisfactory level.


Advertising
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Satisfaction
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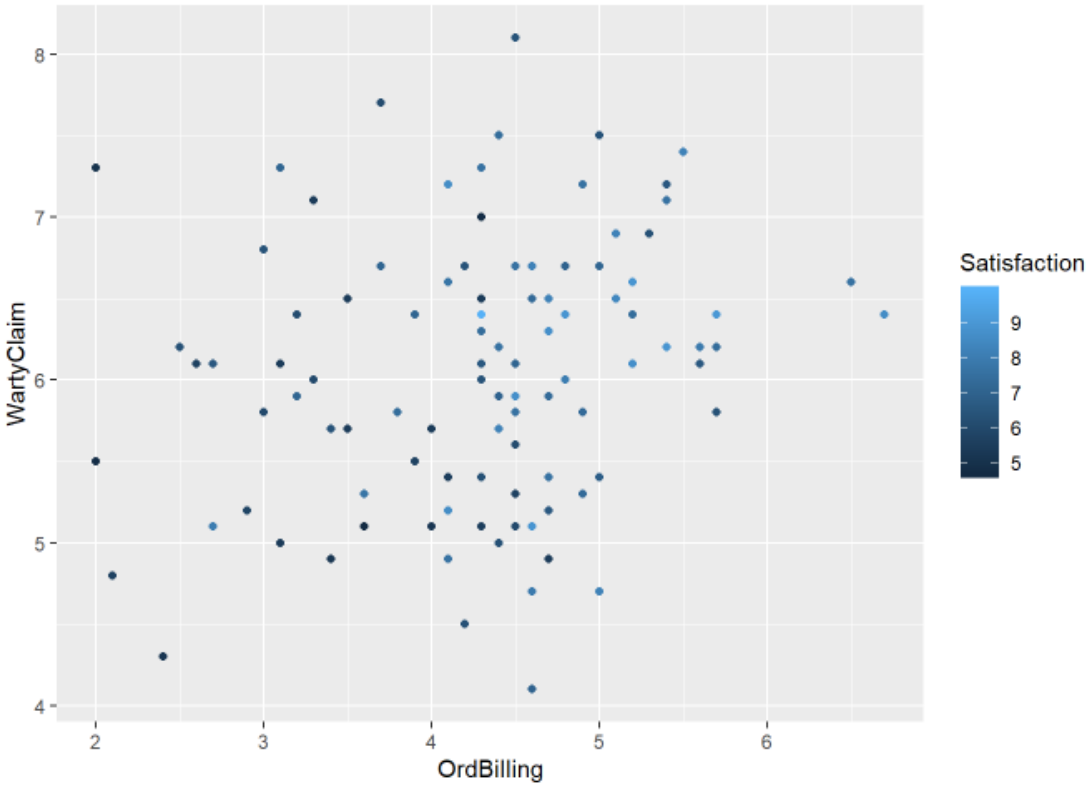
WartyClaim
OrdBilling
Satisfaction
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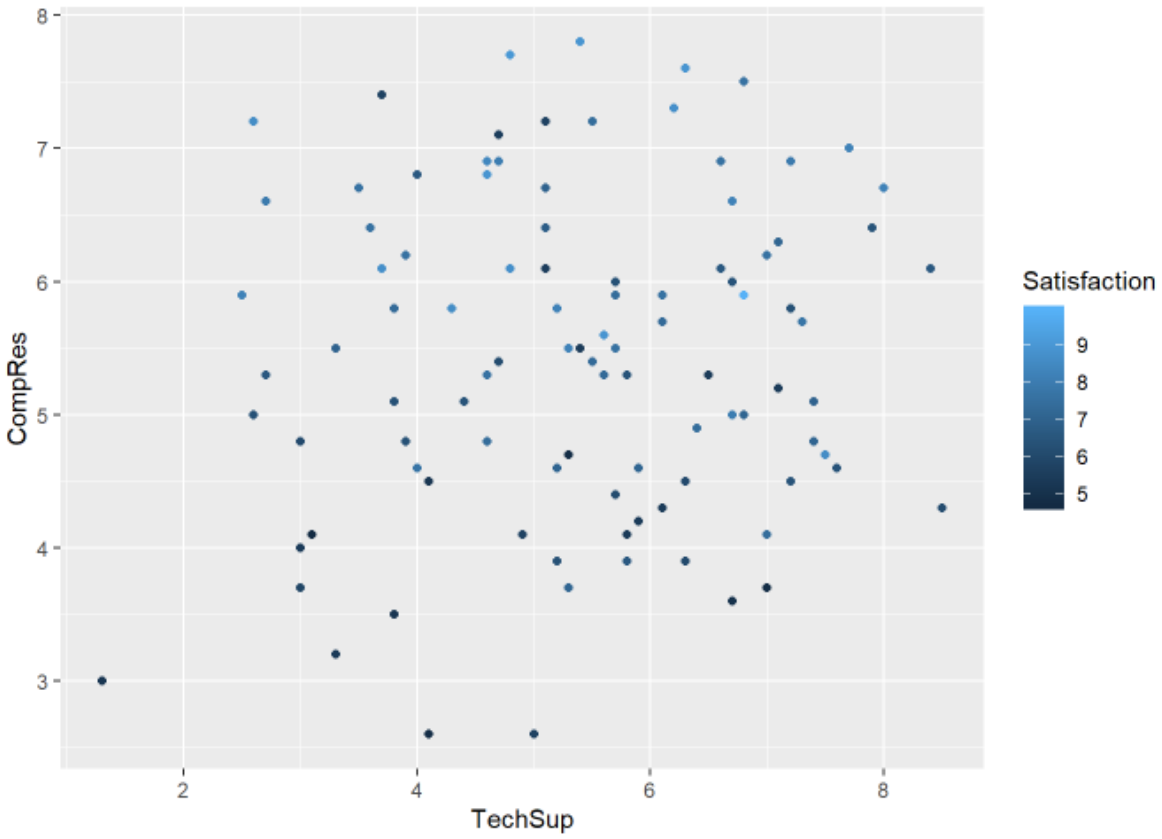


4. MISSING VALUE IDENTIFICATION

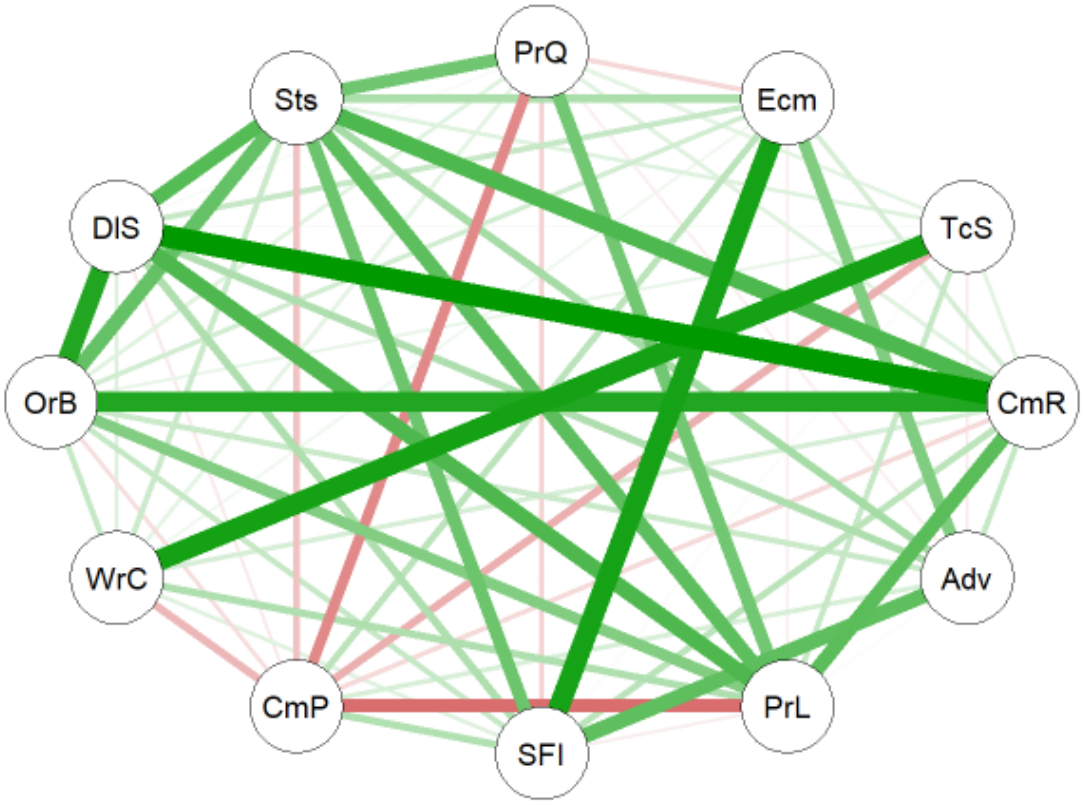
The presence of missing values (NA) can be ascertained. There are no missing values in the given dataset. Hence it doesn't require any of the missing value treatments. If in case of any NA values present in the data, then we can either ignore them or impute them.

5. OUTLIER IDENTIFICATION

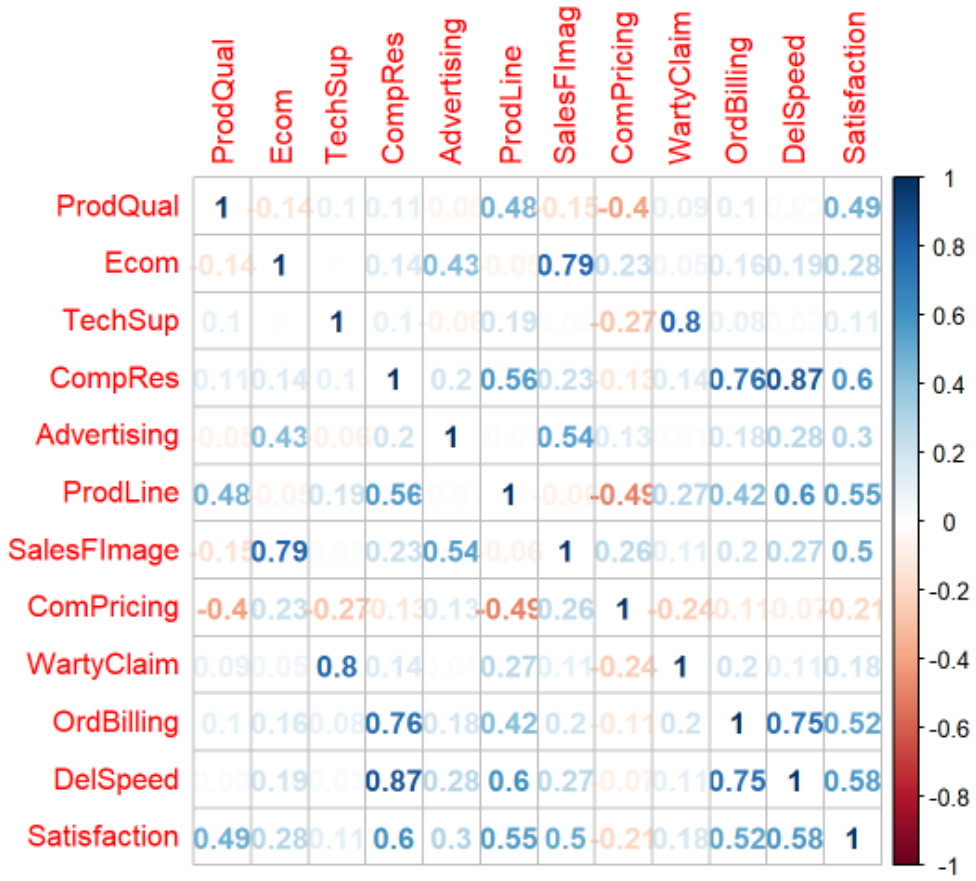
Outliers are the values which bounds out extremely from the overall pattern of the distribution.
Here outliers are present in Ecom, SalesFimage, OrdBilling, and DelSpeed .However treatment of the outlier is not in scope for this project. It in no way alters our analysis.

6. MULTICOLLINEARITY

Multicollinearity refers to a situation in which two or more explanatory variables in a multiple regression model are highly linearly related.



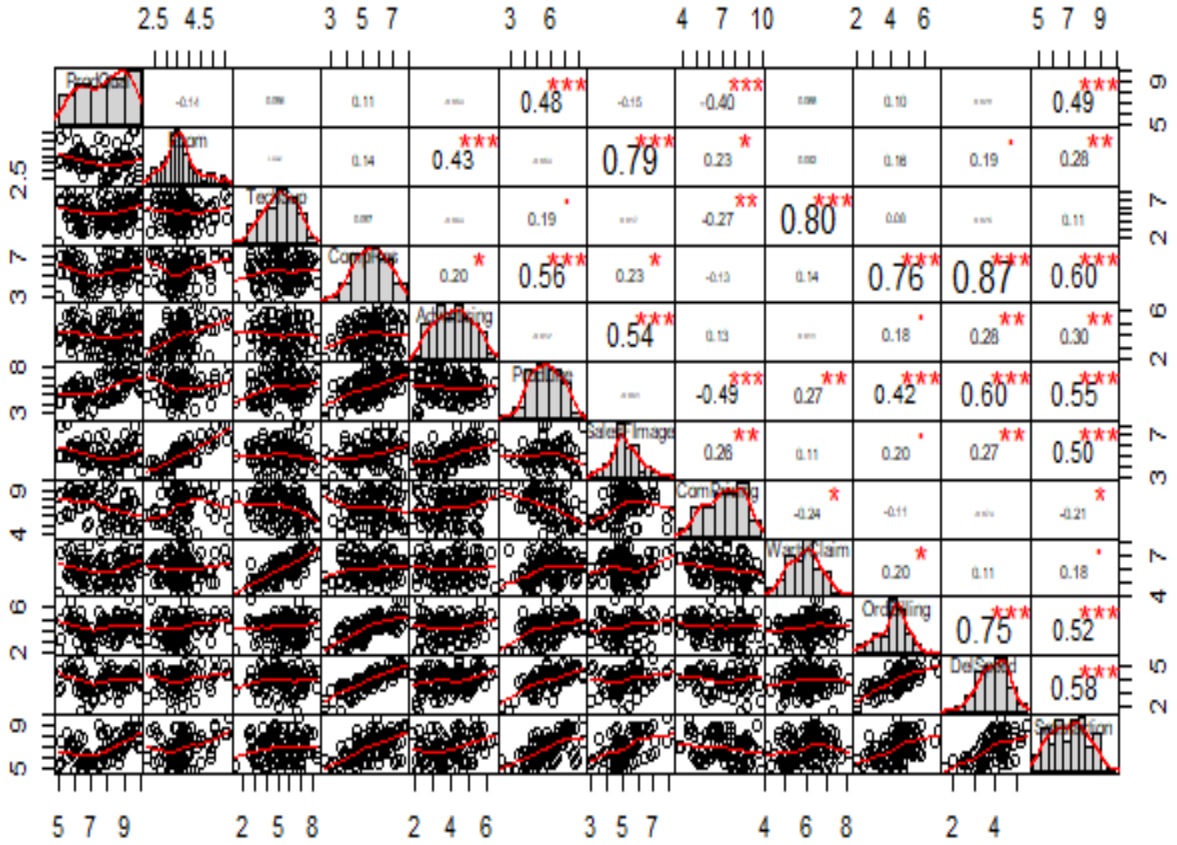
MULTICOLLINEARITY BETWEEN THE VARIABLES



From the above given correlation matrix we can say that,

- Ecom and SalesFImage are highly correlated
- TechSup and WartyClaim are highly correlated
- CompRes and OrdBilling are highly correlated
- CompRes and DelSpeed are highly correlated
- OrdBilling and DelSpeed are highly correlated
- DelSpeed and ProdLine are moderately correlated
- CompRes and Satisfaction are moderately correlated.

CORRELATION COEFFICIENTS WITH p VALUE



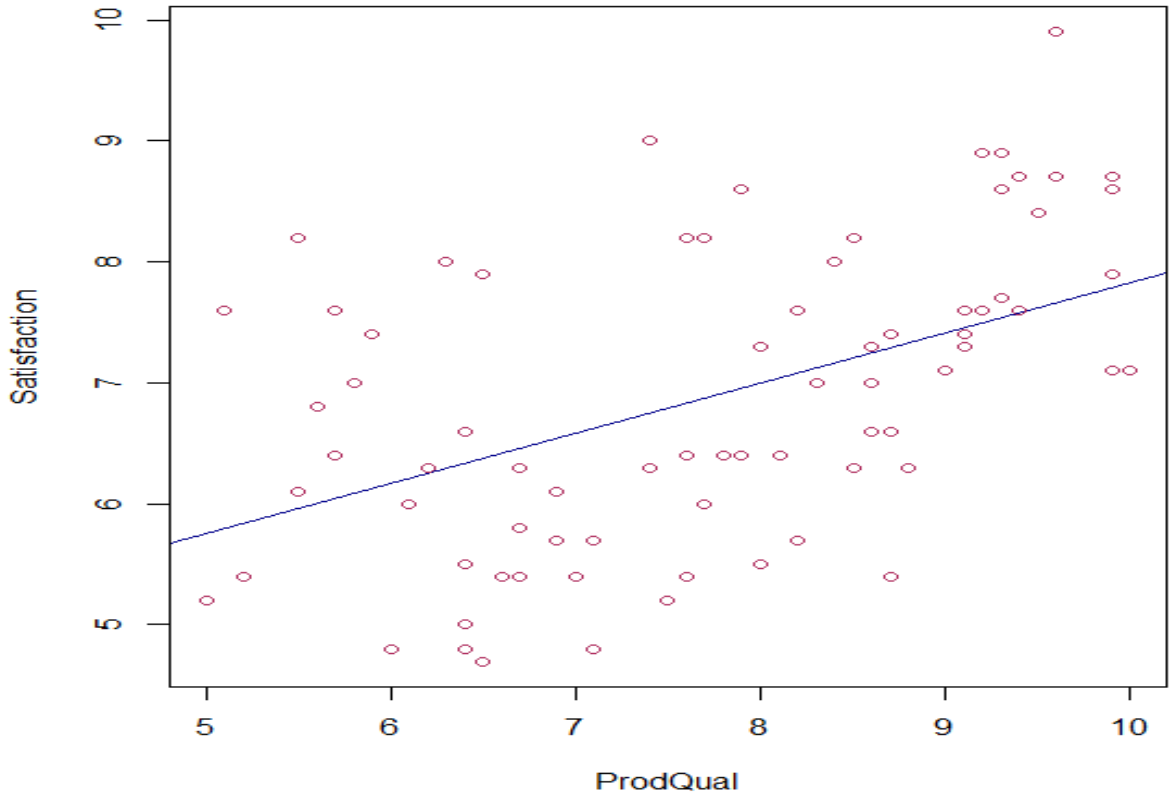
7. SIMPLE LINEAR REGRESSION

The dependent variable Satisfaction is linearly associated with all the independent variables. Hence we build Simple Linear Regression model for Satisfaction with every predictor variable. The mathematical equation for Simple Linear Regression is,

$$Y=b0+b1X+e$$

Which describes a line with slope b1 and y-intercept b0, e is the error term or residual.

LINEAR MODEL FOR SATISFACTION AND PRODUCT QUALITY



The statistical equation for this model is written as,

Y = 0.415X + 3.675

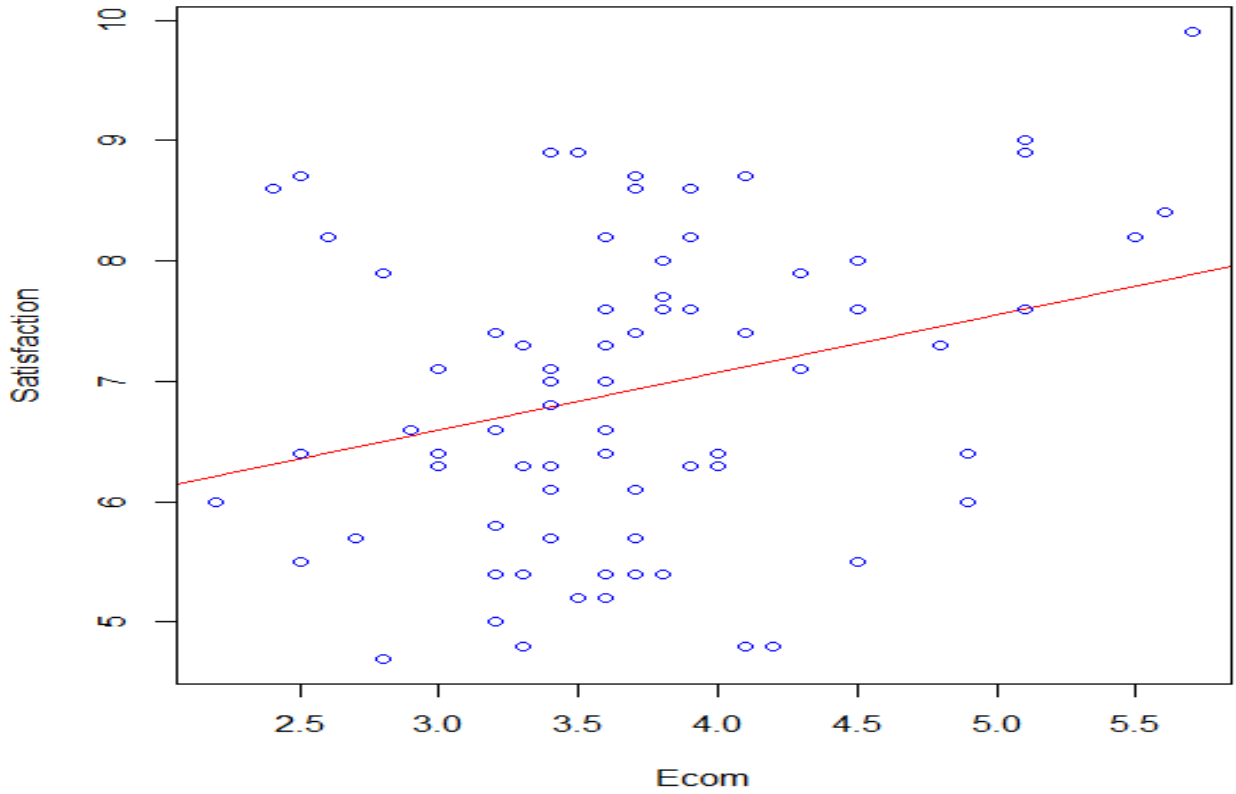
For every unit increase in product quality,

0.415 increase in Satisfaction can be explained.

Coefficient of determination (R2) =23.65

23.65% of variations in Satisfaction is explained by Product quality.

LINEAR MODEL FOR SATISFACTION AND E-COMMERCE



The statistical equation for this model is written as,

Y = 0.4811X + 5.1516

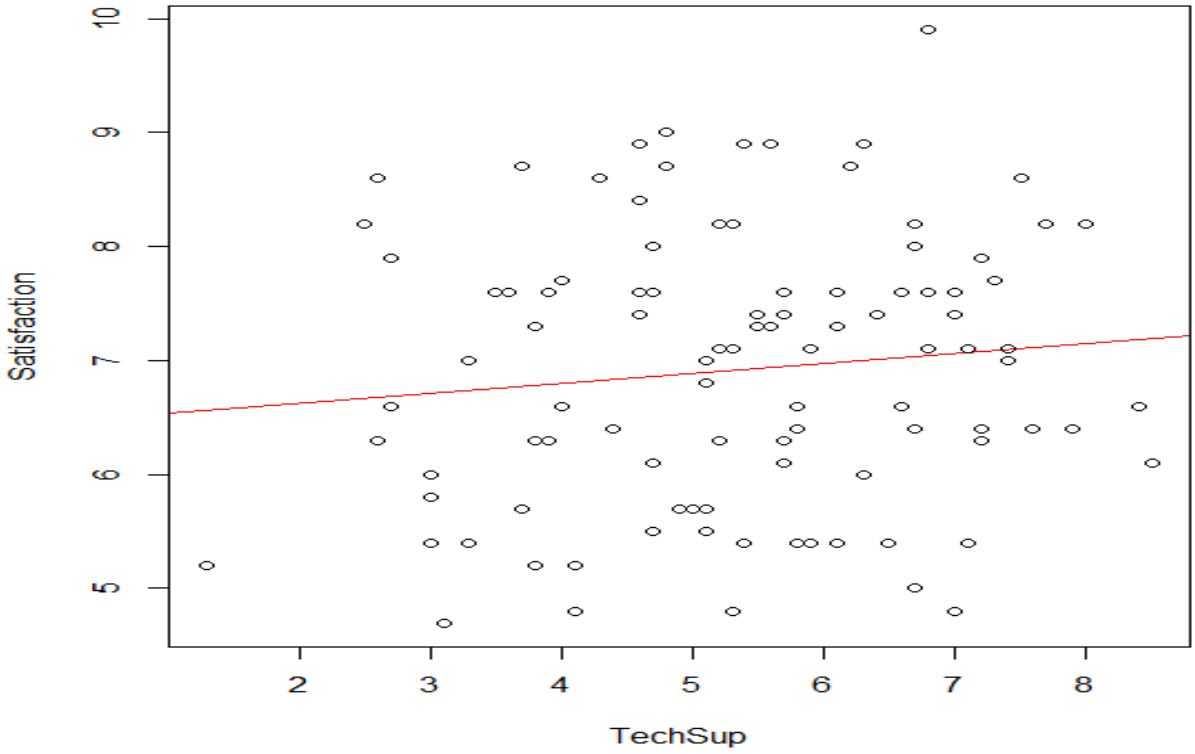
For every unit increase in E-commerce,

0.4811 increase in Satisfaction can be explained.

Coefficient of determination (R2) =7.99

Only 7.99% of variations in Satisfaction is explained by E-commerce.

LINEAR MODEL FOR SATISFACTION AND TECHNICAL SUPPORT



The statistical equation for this model is written as,

Y = 0.08768X + 6.44757

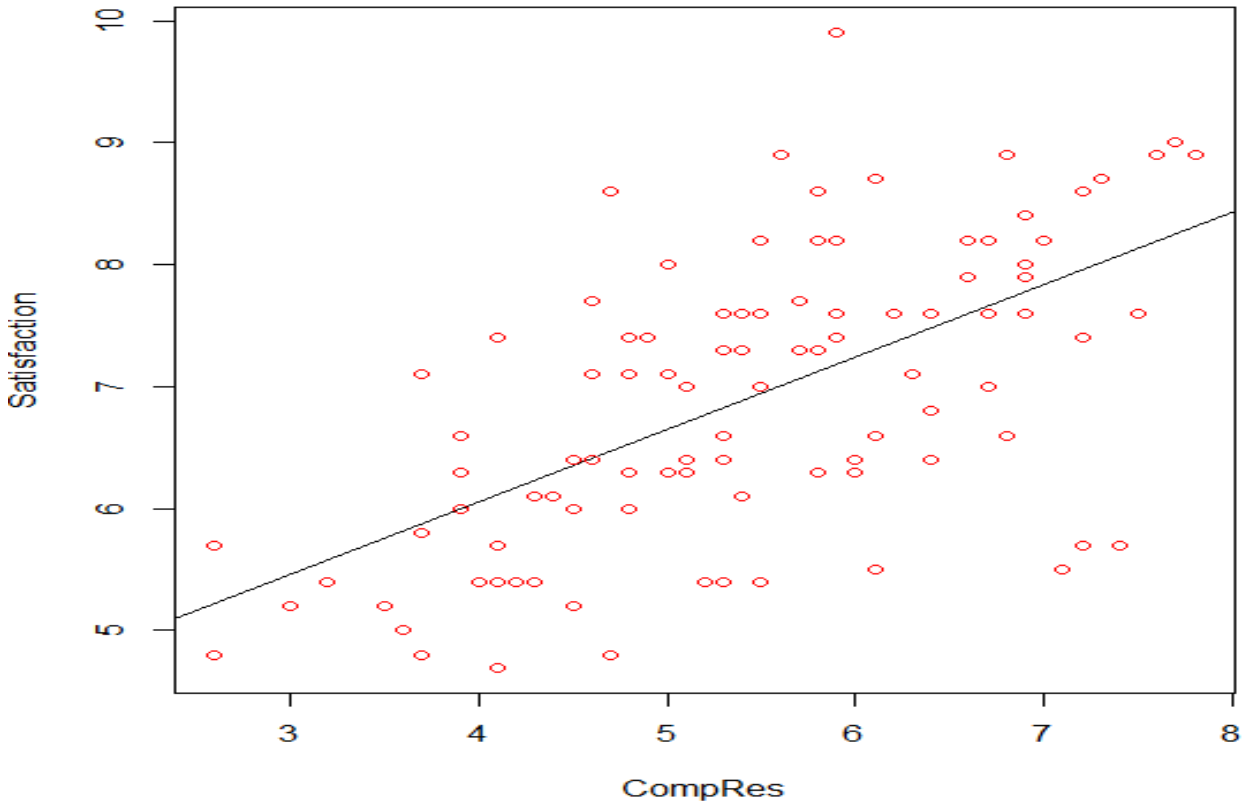
For every unit increase in Technical support,

0.08768 increase in Satisfaction can be explained.

Coefficient of determination (R2) =1.27

Only 1.27% of variations in Satisfaction is explained by TechSup and seems to be least significant model.

LINEAR MODEL FOR SATISFACTION AND COMPLAINT RESOLUTION



The statistical equation for this model is written as,

Y = 0.59499X + 3.68005

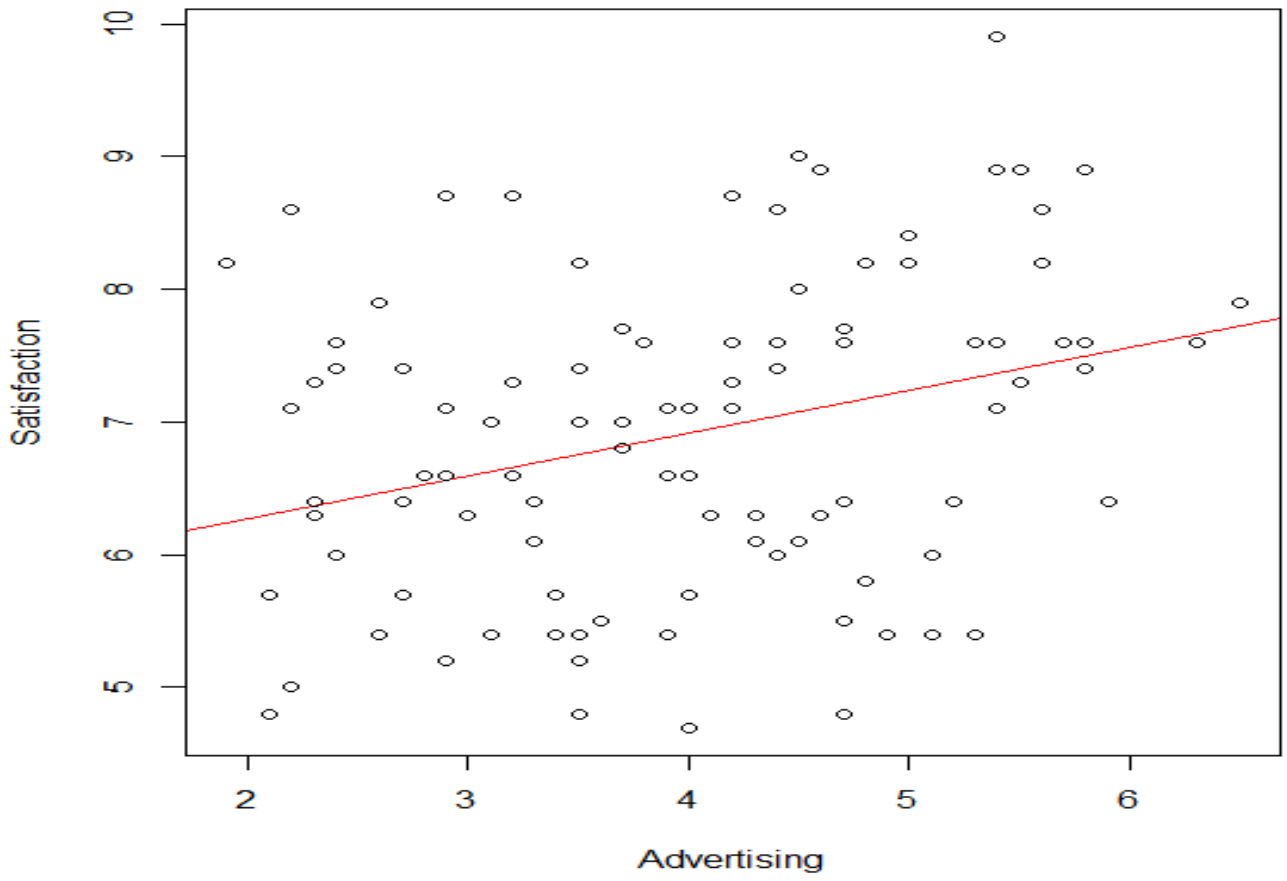
For every unit increase in Complaint resolution,

0.59499 increase in Satisfaction can be explained.

Coefficient of determination (R2) =36.39

36.39% of variations in Satisfaction is explained by Complaint resolution.

LINEAR MODEL FOR SATISFACTION AND ADVERTISING



The statistical equation for this model is written as,

Y = 0.3222X + 5.6259

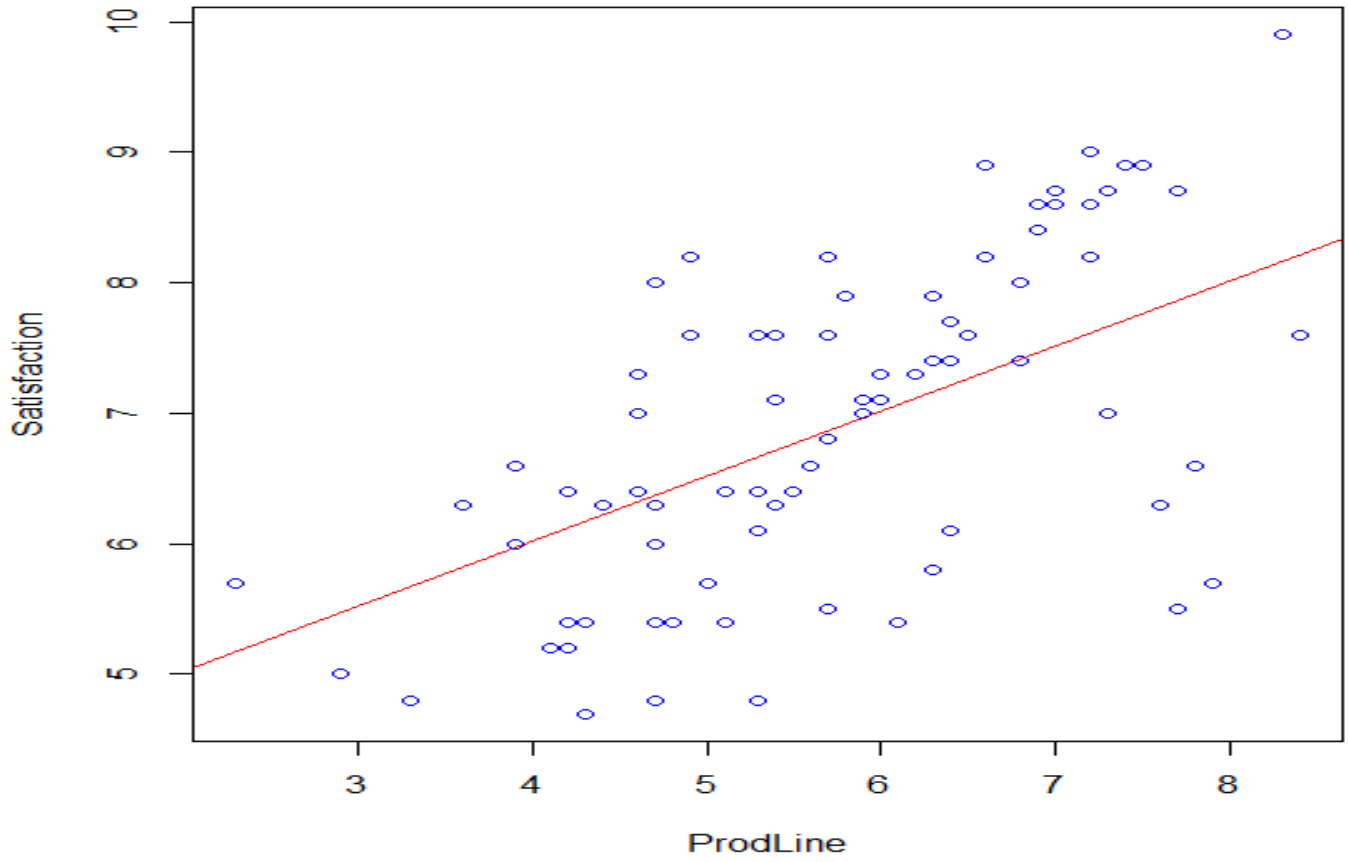
For every unit increase in Advertising,

0.3222 increase in Satisfaction can be explained.

Coefficient of determination (R2) =9.29

Only 9.29% of variations in Satisfaction is explained by Advertising.

LINEAR MODEL OF SATISFACTION AND PRODUCT LINE



The statistical equation for this model is written as,

Y = 0.49887X + 4.02203

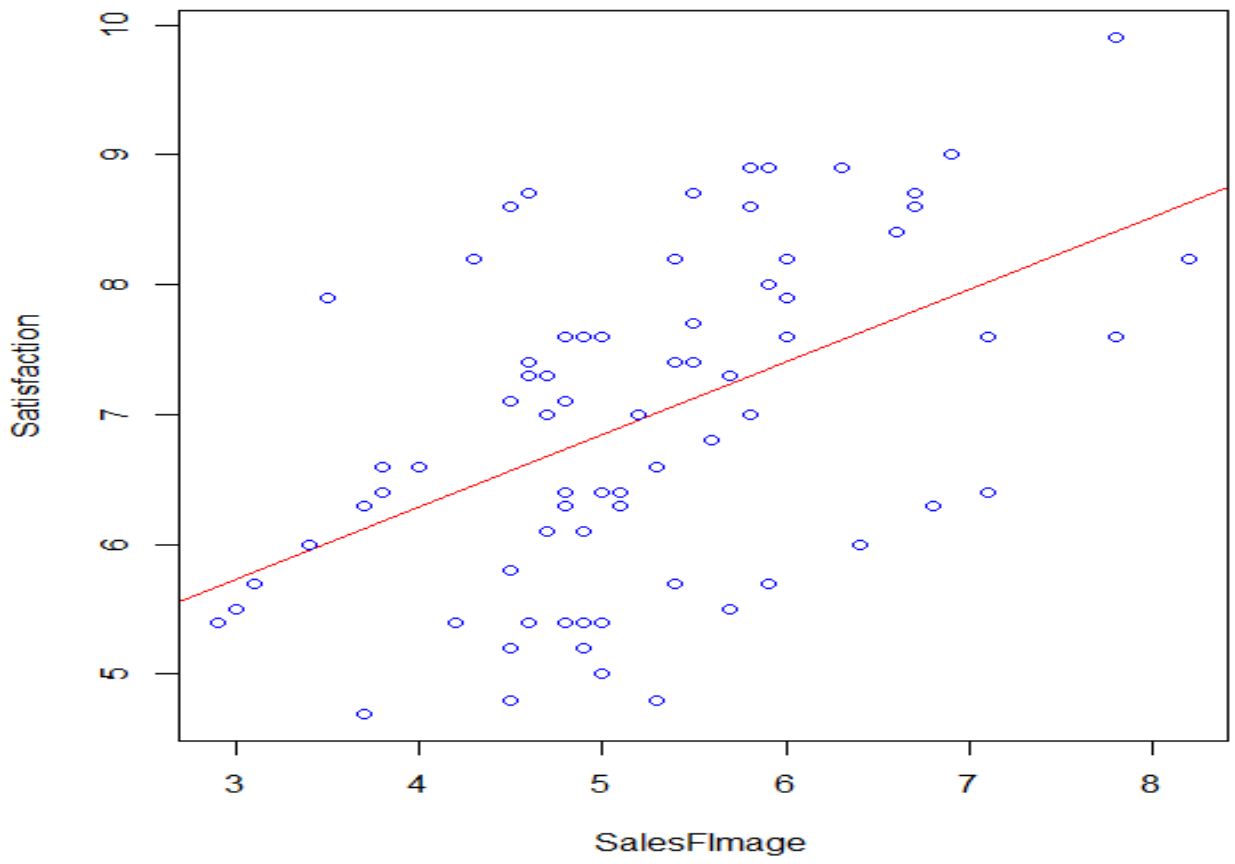
For every unit increase in Prodline,

0.49887 increase in Satisfaction can be explained.

Coefficient of determination (R2) =30.31

30.31% of variations in Satisfaction is explained by Product line.

LINEAR MODEL OF SATISFACTION AND SALES FORCE IMAGE



The statistical equation for this model is written as,

Y = 0.55596X + 4.06983

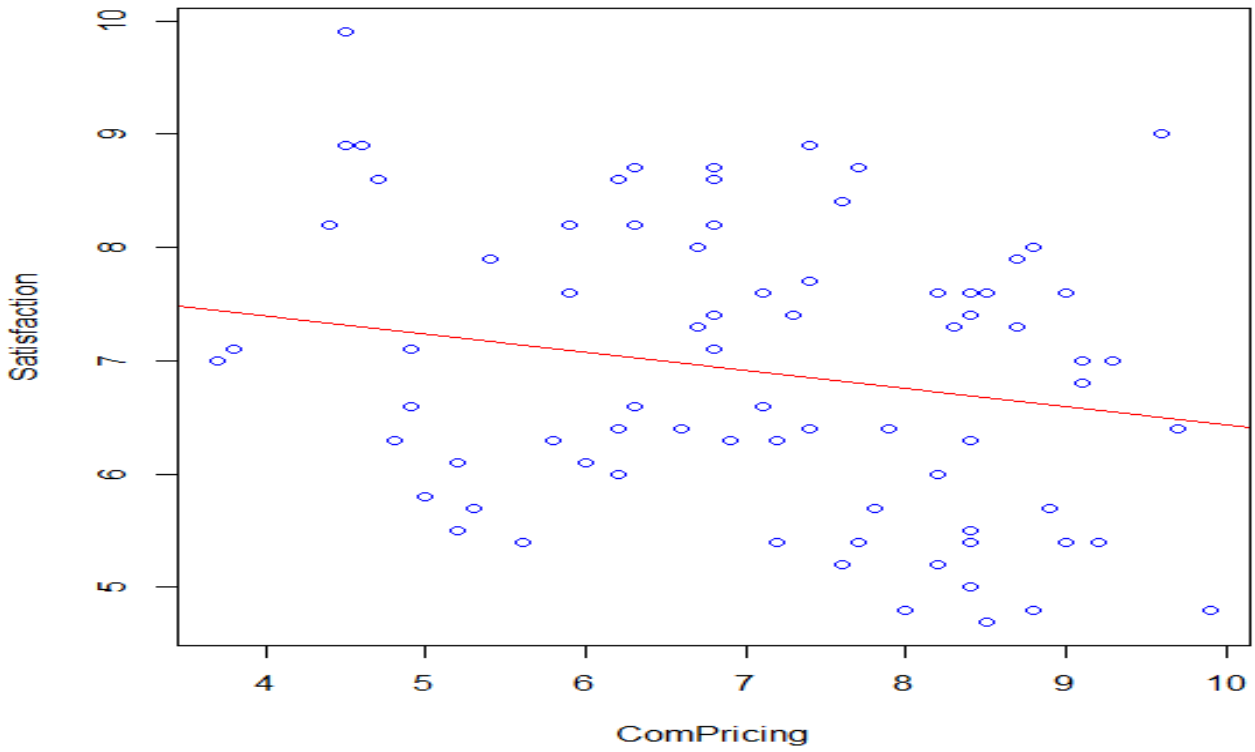
For every unit increase in SalesFImage,

0.55596 increase in Satisfaction can be explained.

Coefficient of determination (R2) =25.02

25.02% of variations in Satisfaction is explained by SalesFImage.

LINEAR MODEL FOR SATISFACTION AND COMPETITIVE PRICING



The statistical equation for this model is written as,

Y = -0.16068X + 8.03856

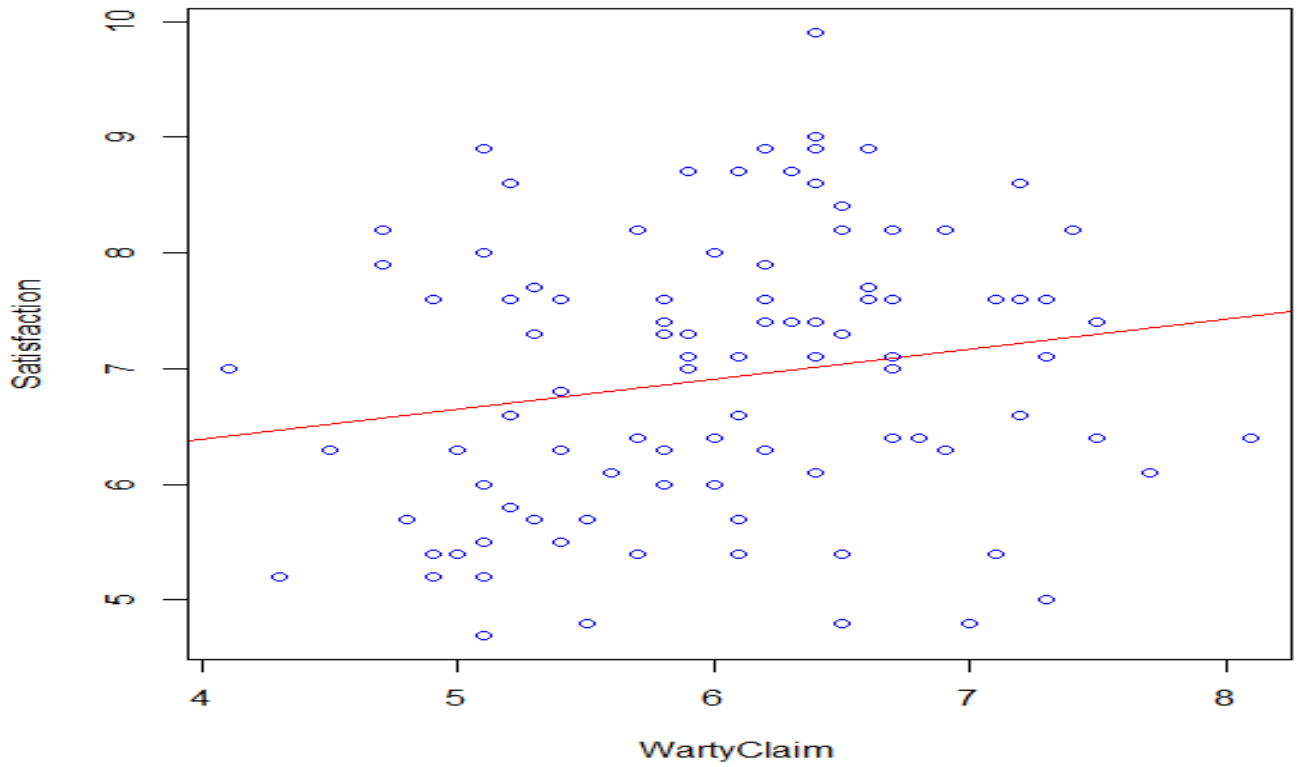
For every unit increase in Competitive pricing,

-0.16068 increase in Satisfaction can be explained.

Coefficient of determination (R2) =4.339

4.339% of variations in Satisfaction is explained by ComPricing.

LINEAR MODEL OF SATISFACTION AND WARRANTY & CLAIMS



The statistical equation for this model is written as,

Y = 0.2581X + 5.3581

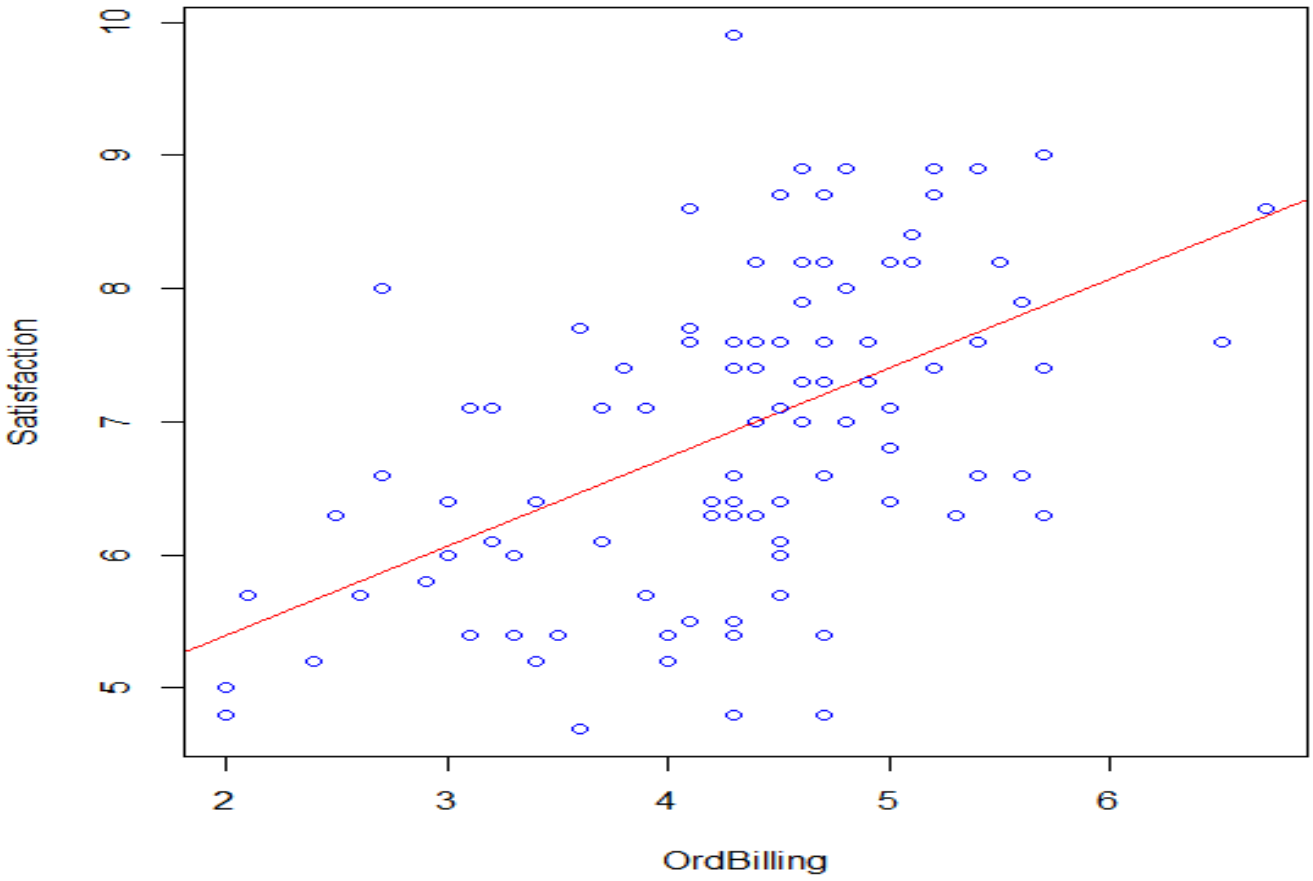
For every unit increase WartyClaim,

0.2581 increase in Satisfaction can be explained.

Coefficient of determination (R2) =3.152

3.152% of variations in Satisfaction is explained by WartyClaim. The variable WartyClaim is least significant in the model.

LINEAR MODEL OF SATISFACTION AND ORDER & BILLING



The statistical equation for this model is written as,

Y = 0.6695X + 4.0541

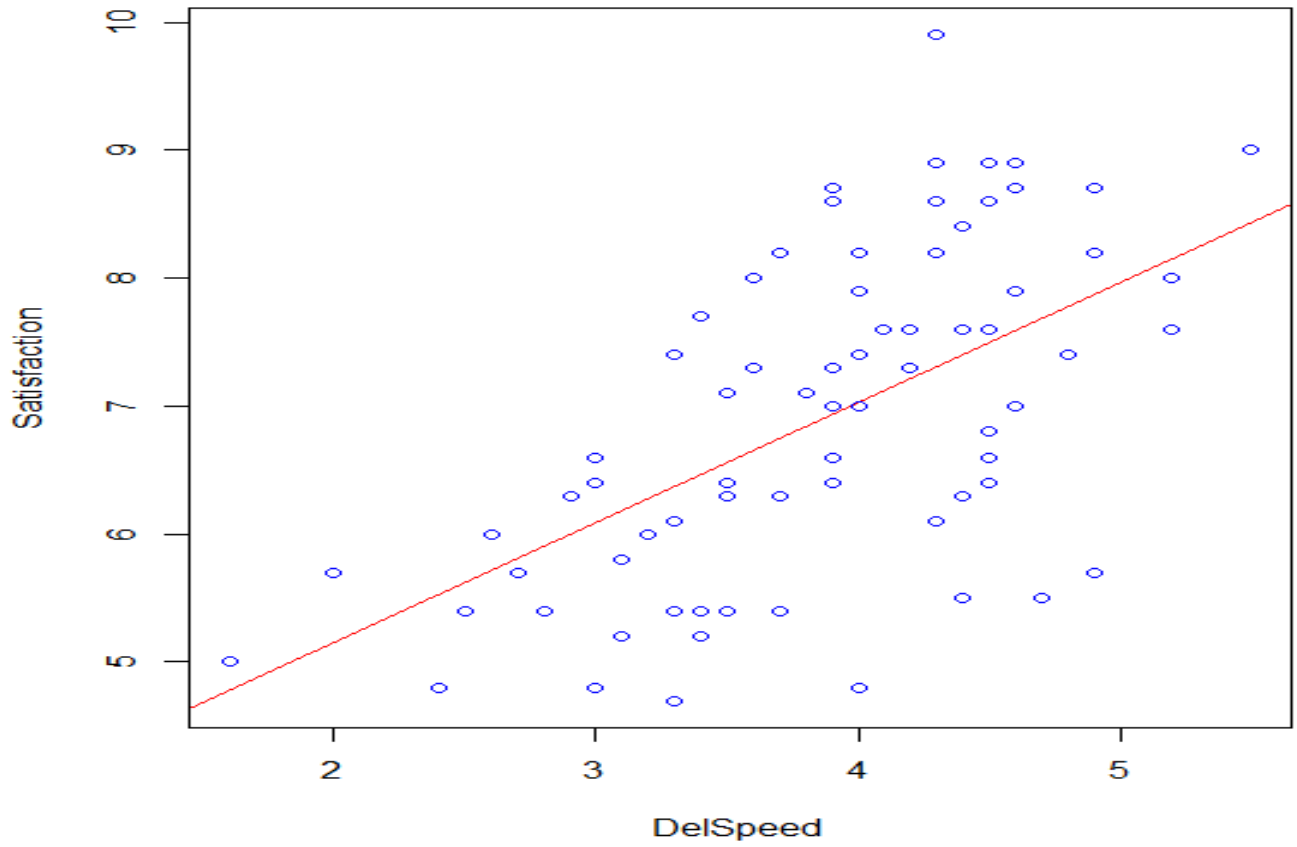
For every unit increase in OrdBilling,

0.6695 increase in Satisfaction can be explained.

Coefficient of determination (R2) =27.22

27.22% of variations in Satisfaction is explained by OrdBilling.

LINEAR MODEL OF SATISFACTION AND DELIVERY SPEED



The statistical equation for this model is written as,

Y = 0.9364X + 3.2791

For every unit increase in DelSpeed,

0.9364 increase in Satisfaction can be explained.

Coefficient of determination (R2) =33.3

33.3% of variations in Satisfaction is explained by DelSpeed.

8.1 PRINCIPAL COMPONENT ANALYSIS &FACTOR ANALYSIS

Principal component analysis – Every factor is a linear combination of input variables.

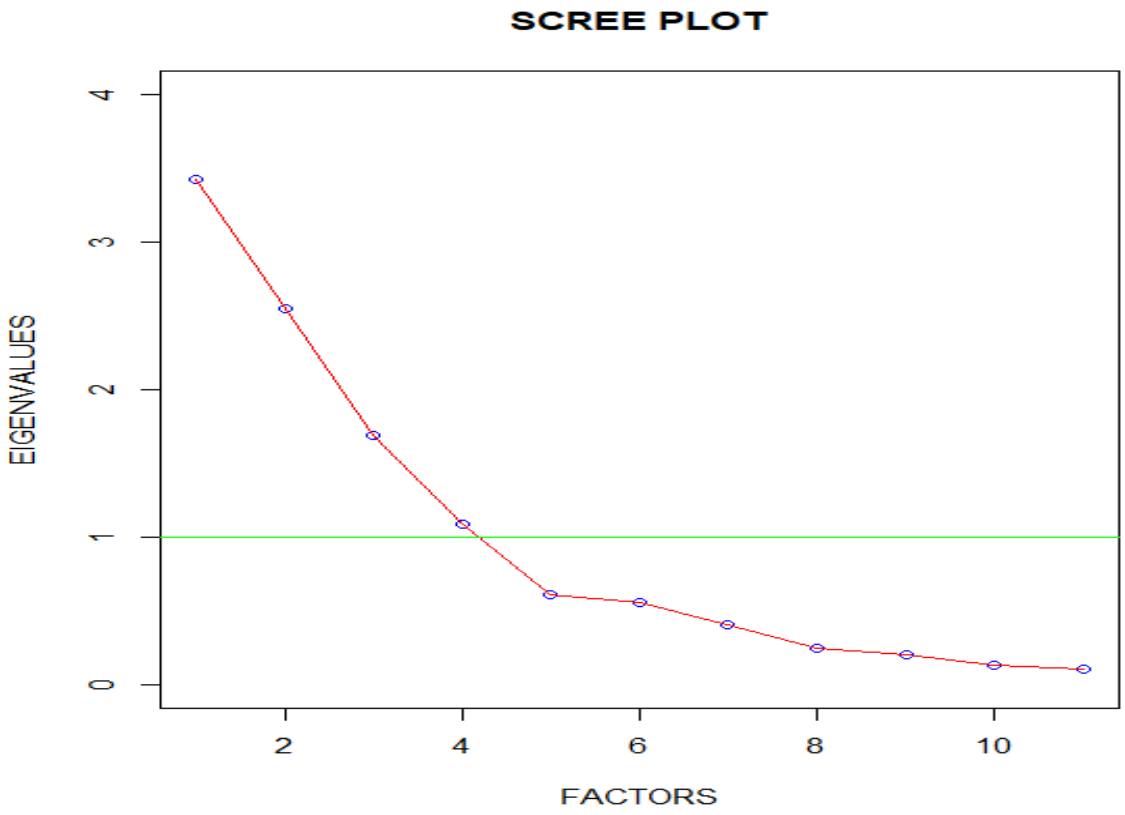
Factor analysis – Every input variable is a linear combination of common factors.

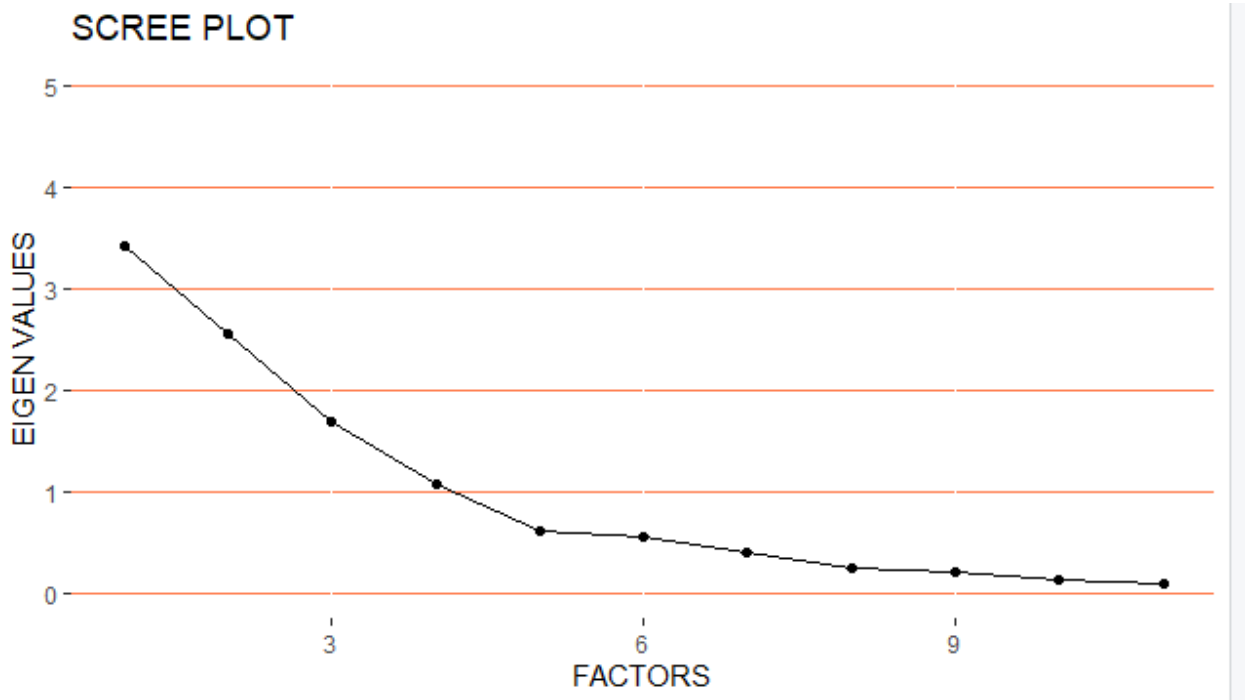
To check the factorability of all the independent variables, we need to perform the Kaiser-Meyer-Olkin test (KMO) and Bartlett's test of sphericity .Since both the tests prove to be significant, factor analysis is the appropriate technique to reduce the input variables into components/factors. One way to determine the number of factors in a correlation matrix is to examine the scree plot of the successive Eigen values.

Eigen values represents the largest variance of the input variables summarized or reduced.

Kaiser-Guttman normalization rule says that it would be appropriate to choose all the factors whose Eigen values are greater than 1.

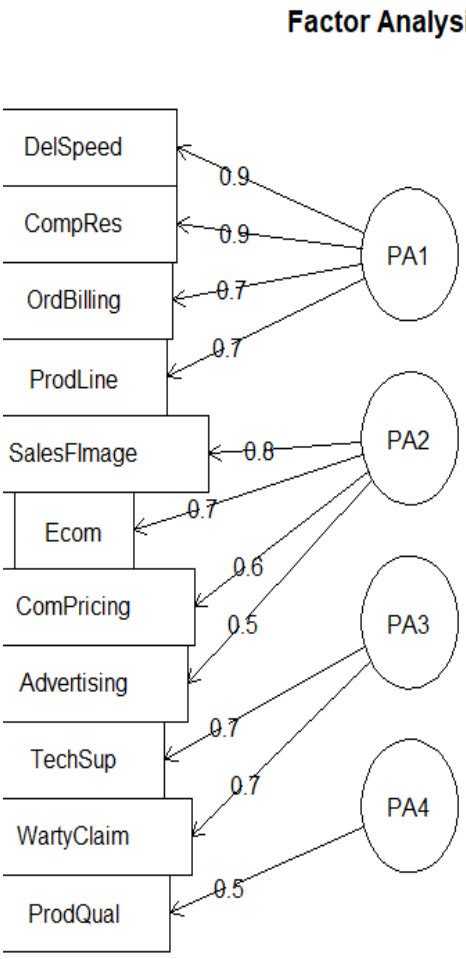
Hence from the graph shown below, we are good to go with 4 factors whose Eigen values are more than or equal to 1.


SCREE PLOT
EIGENVALUES
0
1
2
3
4
2
4
6
8
10
FACTORS

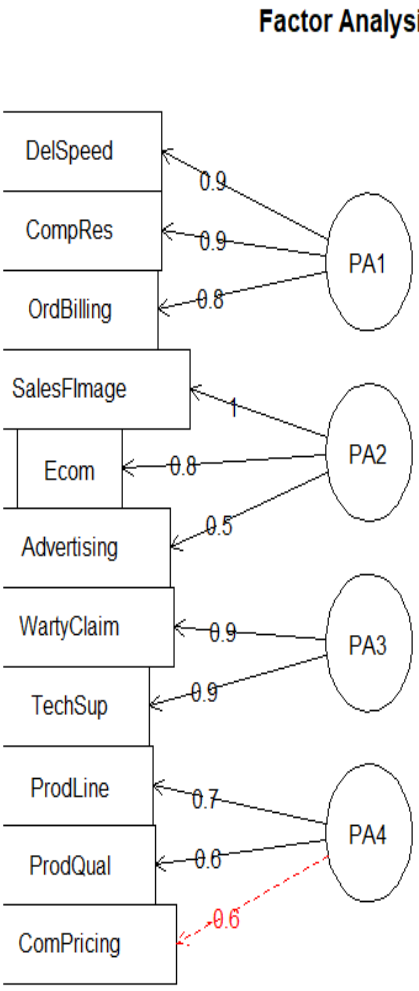

SCREE PLOT
EIGEN VALUES
0
1
2
3
4
5
3
6
9
FACTORS

Refer source code in Appendix A for all the steps involved in performing PCA/FA.

We use orthogonal rotation (varimax) where the rotated factors will remain uncorrelated whereas in oblique rotation the resulting factors will be correlated.



UNROTATED FACTORS



ROTATED FACTORS

FACTOR GRAPHS

The above factor graph shows all the independent variables reduced into factors. The red dotted line means that ComPricing marginally falls under PA4 and the loadings are negative.

The first 4 factors have Eigen value greater than 1 and explains almost 69% of the variance (Refer source code for Eigen values, SS loadings and Cumulative variance).

We can effectively reduce dimensionality from 11 to 4 while losing only about 31% of the variance.

Factor 1 – accounts for 29.20% of the variance

Factor 2 – accounts for 20.20% of the variance

Factor 3 – accounts for 13.60% of the variance

Factor 4 – accounts for 6% of the variance

Together, all the 4 factors explain 69% variance in performance.

Communality (h2) is the common variance of the independent variables captured by the components or factors.

8.2 FACTORS AND ITS INTERPRETATION

There are number of procedures designed to determine the optimal number of factors to retain in Exploratory Factor Analysis. As already discussed above, according to Kaiser - Guttman normalization rule, all the factors whose Eigen values greater than 1 would be appropriate to choose. With the given dataset the Eigen values of the correlation matrix for all the independent variables are calculated. Cattell's scree plot is a graph to determine the last substantial drop in the magnitude of Eigen values. Both Kaiser Rule and Cattell's scree plot shows that only maximum of 4 factors can effectively capture the variance of the regressors. The rest all factors explains insignificant variances which cannot be considered. Hence we tend to choose only 4 factors.

To avoid multicollinearity between all of the independent variables we perform Principal Component Analysis to extract factors which are uncorrelated with one another.

LABELING AND INTERPRETATION OF FACTORS

FACTORS	VARIABLES	LABEL	SHORT INTERPRETATION
PA1	DelSpeed, CompRes, OrdBilling	PRODUCT PURCHASE	All the variables are related to purchasing the product; from placing order, billing, tickets resolving.
PA2	SalesFImage, Ecom, Advertising	MARKETING	Here everything is relevant to marketing options like Image of Salesforce, Ecommerce and advertising on various platforms.
PA3	WartyClaim, TechSup	POST PROCUREMENT	It deals with all the activities related to maintenance and support of the products after delivery like Warranty and Claims, Technical service and support.
PA4	ProdLine, ProdQual, ComPricing	BRAND POSITIONING	This factor includes all the variables related in regard to the product positioning in market

9.1 NEW DATAFRAME WITH 4 FACTORS AND PREDICTAND

A new data frame is created with Customer Satisfaction as the dependent variable and the 4 different factors as the independent variables which are non- multicollinear and balanced.

Refer source code in Appendix A to view the new data frame with 5 columns, out of which 1 is the dependent variable (Satisfaction) and rest 4 are different factors.

9.2 MULTIPLE LINEAR REGRESSION

Multiple Linear Regression is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. The mathematical equation is given by,

$$Y = b0+b1X1+b2X2+b3X3\ldots\ldots\ldots\ldots\ldots\ldots+bnXn+e$$

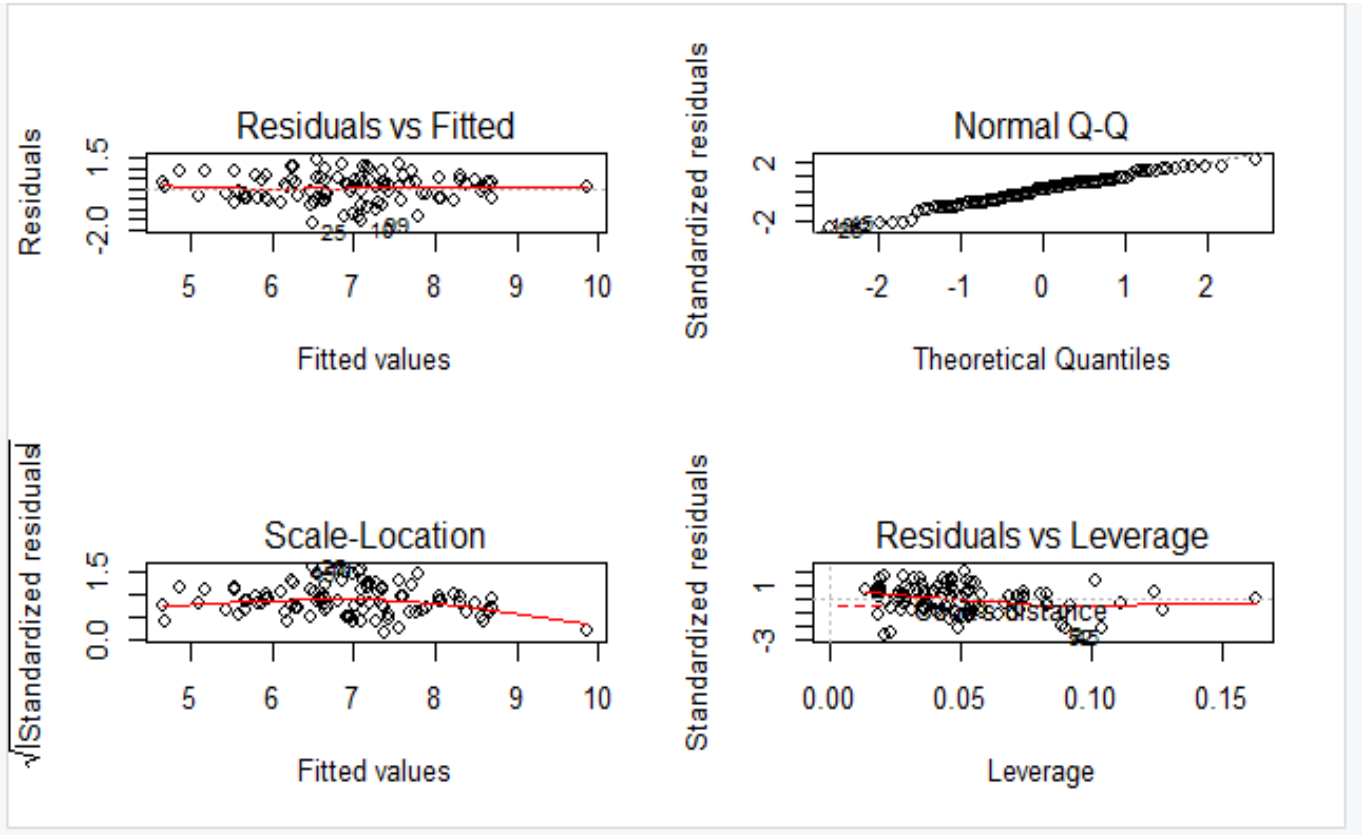
Where Y = dependent variable

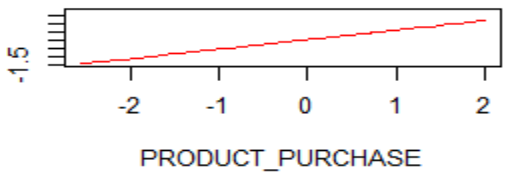
X1, X2, X3……Xn = different independent variables

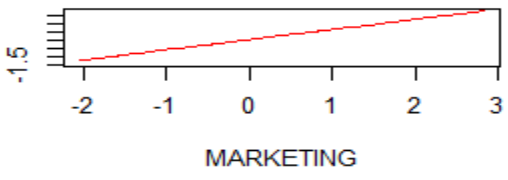
b1, b2, b3…….bn = coefficients of x variables

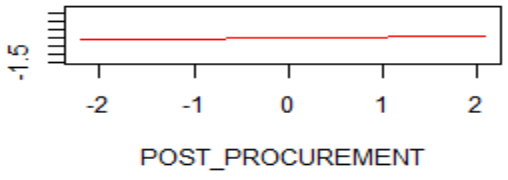
b0 = intercept

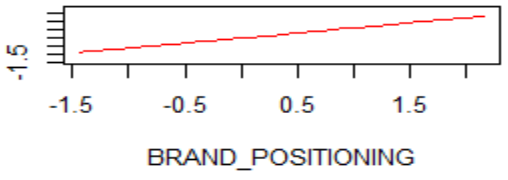
e = random error component











CUSTOMER_SATISFACTION~PRODUCT_PURCHASE+MARKETING+ POST_PROCUREMENT+BRAND_POSITIONING

PLOT FOR MULTIPLE LINEAR REGRESSION MODEL

The regression equation for the regressand Customer Satisfaction and the 4 regressors – Product purchase, Marketing, Post procurement, Brand positioning is given by,

$$Y = 6.918 + 0.579 X1 + 0.619 X2 + 0.056 X3 + 0.611 X4$$

Where Y = CUSTOMER_SATISFACTION

X1 = PRODUCT_PURCHASE

X2 = MARKETING

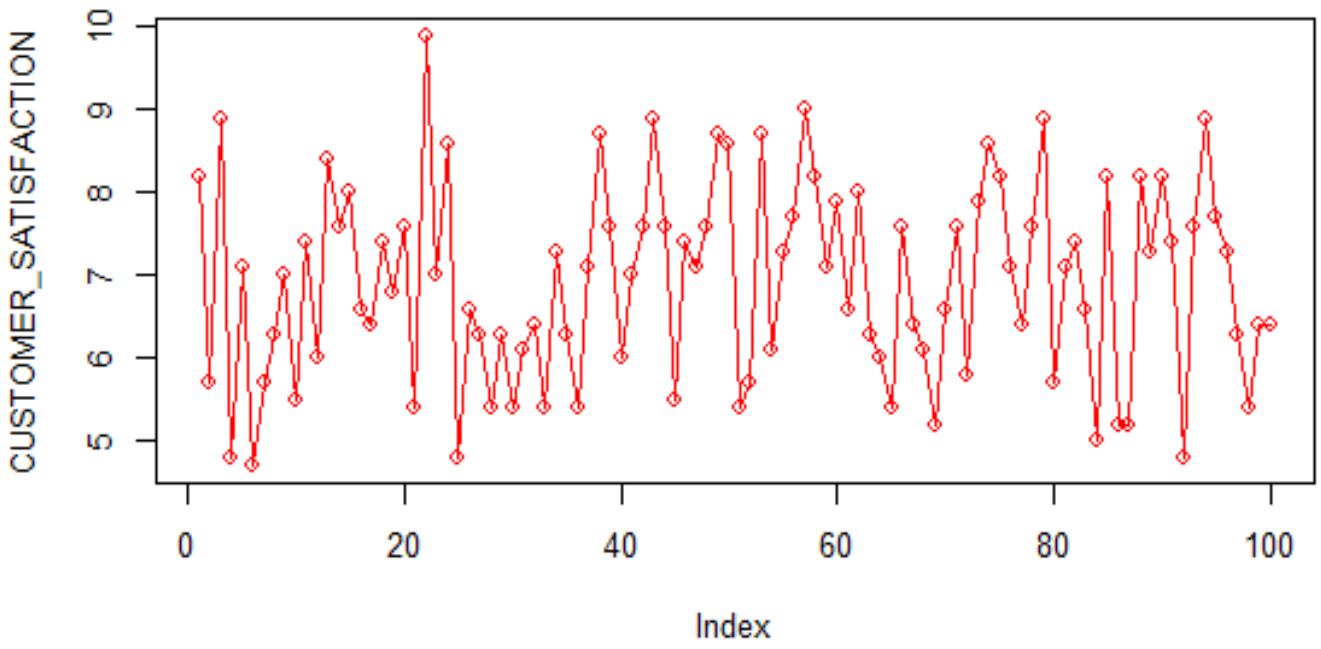
X3 = POST_PROCUREMENT

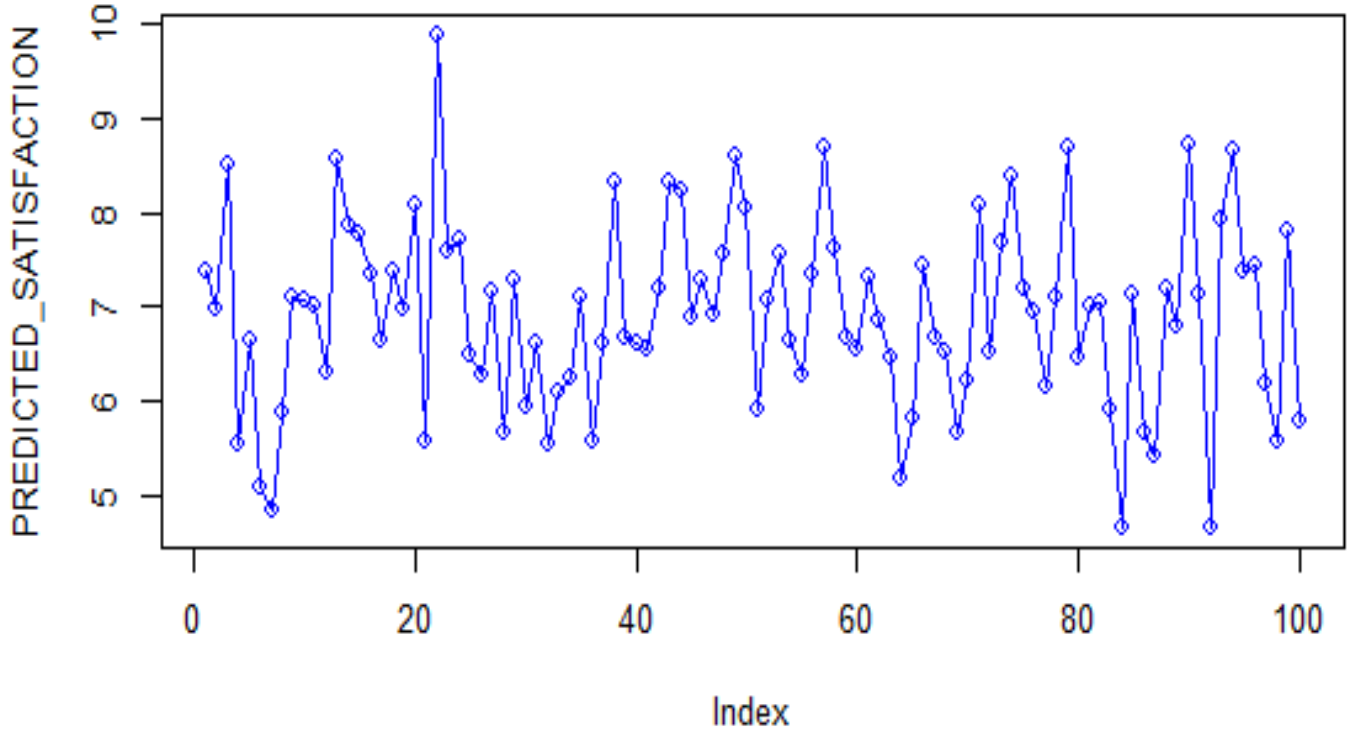
X4 = BRAND_POSITIONING

6.918 is the value of the intercept.

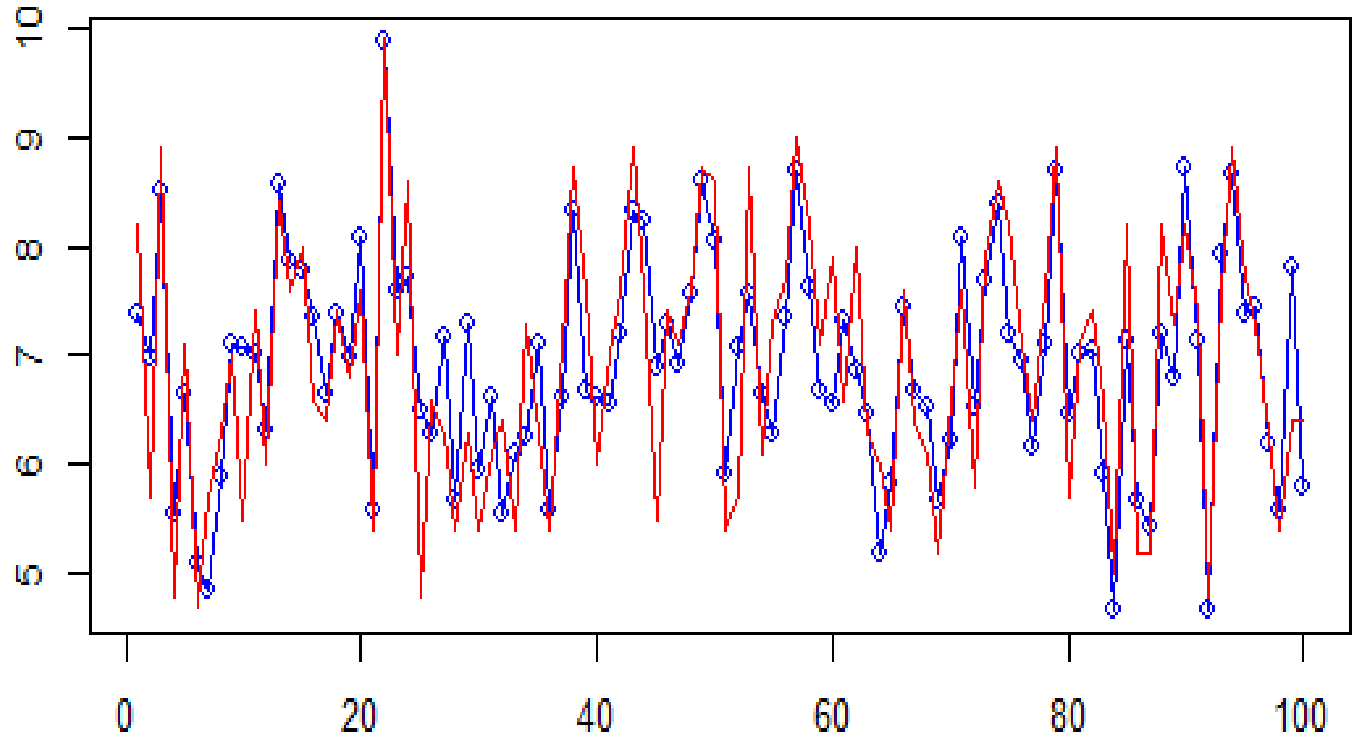
9.3 MLR INTERPRETATION AND SIGNIFICANCE

The regression model to predict Customer Satisfaction is built and we firstly backtrack the original values with the predicted values. The predicted values follow almost the same track pattern of the original values. The graph below shows the pattern of the original variable (CUSTOMER SATISFACTION) and predicted data from the MLR model.


CUSTOMER_SATISFACTION
5
6
7
8
9
10
0
20
40
60
80
100
Index


PREDICTED_SATISFACTION
5
6
7
8
9
10
0
20
40
60
80
100
Index

BACK TRACKING CUSTOMER SATISFACTION WITH THE PREDICTED SATISFACTION



SUMMARY OF THE MULTIPLE LINEAR REGRESSION MODEL

```
Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        6.91800    0.06696 103.317  < 2e-16 ***
PRODUCT_PURCHASE   0.57963    0.06857   8.453 3.32e-13 ***
MARKETING          0.61978    0.06834   9.070 1.61e-14 ***
POST_PROCUREMENT   0.05692    0.07173   0.794    0.429
BRAND_POSITIONING  0.61168    0.07656   7.990 3.16e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6696 on 95 degrees of freedom
Multiple R-squared:  0.6971,    Adjusted R-squared:  0.6844
F-statistic: 54.66 on 4 and 95 DF,  p-value: < 2.2e-16
```

From the above summary we can say that,

- The coefficient of determination (R2) is 0.6971, which means 69.71% of variations in Customer Satisfaction can be explained by the predictors in the model. R2 tend to increase with the more number of predictors, hence adjusted R2 comes to the rescue.
  R2=Regression sum of squares/Total sum of squares
- Adjusted R2 value is 0.6844, which says that 68.44% of variations in Customer Satisfaction can be efficiently explained by the predictors.
- The p value (2.2e-16) of the Fstatistic (54.66) with 4 and 95 degrees of freedom of the overall model is less than 0.05(level of significance), which means the model is significant, with atleast one predictor variable is significantly related to the outcome variable.
- The residual standard error is 0.6696 on 95 degrees of freedom gives the error rate (unexplained variations).
  Error rate=Residual standard error/mean of the predictand
  Error rate for our model = 0.0967
- Intercept is highly significant with the estimate 6.918 with t value 103.317

- PRODUCT_PURCHASE is highly significant with the estimate 0.0579 with t value 8.453
- MARKETING is highly significant with the estimate 0.6197 with t value 9.070
- POST_PROCUREMENT is insignificant with estimate 0.0569 ,t value – 0.794,
  p value – 0.429(>alpha=0.05)
- BRAND_POSITIONING is highly significant with estimate 0.6116 , t value – 7.990

9.4 OUTPUT INTERPRETATION

- As per the project objective, we tried to build an optimum regression model to predict Customer Satisfaction.
- To avoid multicollinearity between the independent variables we performed PCA/FA, in order to reduce the dimensionality of the regressors.
- Now the regression model was built with Satisfaction as dependent variable and 4 different factors as the independent variables.
- The output explains that 68.44 % variations of Satisfaction is effectively explained by the 4 factors.

- Out of 4 factors considered as predictors, only 3 of them proved to be significant .For better results we can drop the factor Post procurement from the data frame and then run the model. Hopefully this might result in a better efficient model to predict Customer Satisfaction.
- There are high chances of getting reliable outputs by including interactive models. It might make closer predictions and increase the model performance measures.

10. CONCLUSION

This report comprises of how Factor Analysis can be used to reduce the dimensionality of the dataset and then we used Multiple Linear Regression on the dimensionally reduced columns/features for further predictive analysis. We also performed,

- Check for multicollinearity
- Run factor analysis and naming the factors
- Perform Multiple Linear Regression and Simple Linear Regression with x(predictor) and y variables(predictand)
- Output interpretation

11. APPENDIX A

SOURCE CODE

```
##### SETUP THE WORKING DIRECTORY #####
setwd("C:/Training")
#### INSTALLING PACKAGES AND INVOKING LIBRARIES ####
library(dplyr)
library(tidyverse)
library(Hmisc)
library(psych)
library(corrplot)
library(nFactors)
library(qgraph)
library(faraway)
library(GGally)
#### IMPORTING THE DATASET INTO R STUDIO ####
data<-read.csv("Factor-Hair-Revised.csv",header = TRUE)
##############################################################
###############################
            # EXPLORATORY DATA ANALYSIS #
##############################################################
###############################
View(data)
dim(data)
# [1] 100  13


str(data)
## '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 ...
```

```
summary(data)
```

```
##        ID            ProdQual          Ecom
TechSup
##  Min.   :  1.00   Min.   : 5.000   Min.   :2.200   M
in.   :1.300
##  1st Qu.: 25.75   1st Qu.: 6.575   1st Qu.:3.275   1
st Qu.:4.250
```

```
##  Median : 50.50   Median : 8.000   Median :3.600   Median :5.400
##  Mean   : 50.50   Mean   : 7.810   Mean   :3.672   Mean   :5.365
##  3rd Qu.: 75.25   3rd Qu.: 9.100   3rd Qu.:3.925   3rd Qu.:6.625
##  Max.   :100.00   Max.   :10.000   Max.   :5.700   Max.   :8.500
##     CompRes       Advertising       ProdLine      SalesFImage
##  Min.   :2.600   Min.   :1.900   Min.   :2.300   Min.   :2.900
##  1st Qu.:4.600   1st Qu.:3.175   1st Qu.:4.700   1st Qu.:4.500
##  Median :5.450   Median :4.000   Median :5.750   Median :4.900
##  Mean   :5.442   Mean   :4.010   Mean   :5.805   Mean   :5.123
##  3rd Qu.:6.325   3rd Qu.:4.800   3rd Qu.:6.800   3rd Qu.:5.800
##  Max.   :7.800   Max.   :6.500   Max.   :8.400   Max.   :8.200
##    ComPricing      WartyClaim      OrdBilling      DelSpeed
##  Min.   :3.700   Min.   :4.100   Min.   :2.000   Min.   :1.600
##  1st Qu.:5.875   1st Qu.:5.400   1st Qu.:3.700   1st Qu.:3.400
##  Median :7.100   Median :6.100   Median :4.400   Median :3.900
##  Mean   :6.974   Mean   :6.043   Mean   :4.278   Mean   :3.886
```

```
##  3rd Qu.:8.400   3rd Qu.:6.600   3rd Qu.:4.800   3rd Qu.:4.425
##  Max.   :9.900   Max.   :8.100   Max.   :6.700   Max.   :5.500
##   Satisfaction
##  Min.   :4.700
##  1st Qu.:6.000
##  Median :7.050
##  Mean   :6.918
##  3rd Qu.:7.625
##  Max.   :9.900
```

```
names(data)
```

```
##  [1] "ID"           "ProdQual"     "Ecom"         "TechSup"      "CompRes"
##  [6] "Advertising"  "ProdLine"     "SalesFImage"  "ComPricing"   "WartyClaim"
## [11] "OrdBilling"   "DelSpeed"     "Satisfaction"
```

```
class(data)
```

```
## [1] "data.frame"
```

```
head(data)
```

```
##   ID ProdQual Ecom TechSup CompRes Advertising ProdLine SalesFImage ComPricing
## 1  1      8.5  3.9     2.5     5.9         4.8      4.9         6.0        6.8
## 2  2      8.2  2.7     5.1     7.2         3.4      7.9         3.1        5.3
```

```
## 3  3       9.2  3.4      5.6      5.6          5.4
7.4          5.8         4.5
## 4  4       6.4  3.3      7.0      3.7          4.7
4.7          4.5         8.8
## 5  5       9.0  3.4      5.2      4.6          2.2
6.0          4.5         6.8
## 6  6       6.5  2.8      3.1      4.1          4.0
4.3          3.7         8.5
##   WartyClaim OrdBilling DelSpeed Satisfaction
## 1        4.7         5.0      3.7          8.2
## 2        5.5         3.9      4.9          5.7
## 3        6.2         5.4      4.5          8.9
## 4        7.0         4.3      3.0          4.8
## 5        6.1         4.5      3.5          7.1
## 6        5.1         3.6      3.3          4.7
```

```
tail(data)
```

```
##       ID ProdQual Ecom TechSup CompRes Advertising Pr
odLine SalesFImage
## 95   95       9.3  3.8      4.0      4.6          4.7
6.4          5.5
## 96   96       8.6  4.8      5.6      5.3          2.3
6.0          5.7
## 97   97       7.4  3.4      2.6      5.0          4.1
4.4          4.8
## 98   98       8.7  3.2      3.3      3.2          3.1
6.1          2.9
## 99   99       7.8  4.9      5.8      5.3          5.2
5.3          7.1
## 100 100       7.9  3.0      4.4      5.1          5.9
4.2          4.8
```

```
##     ComPricing WartyClaim OrdBilling DelSpeed Satisf
action
## 95         7.4        5.3        3.6      3.4
7.7
## 96         6.7        5.8        4.9      3.6
7.3
## 97         7.2        4.5        4.2      3.7
6.3
## 98         5.6        5.0        3.1      2.5
5.4
## 99         7.9        6.0        4.3      3.9
6.4
## 100        9.7        5.7        3.4      3.5
6.4
```

```
describe(data)
```

```
## data
##
##  13  Variables      100  Observations
## ---------------------------------------------------
---------------------------
## ID
##        n  missing distinct     Info     Mean      Gm
d      .05      .10
##      100        0      100        1     50.5    33.6
7     5.95    10.90
##      .25      .50      .75      .90      .95
##    25.75    50.50    75.25    90.10    95.05
##
## lowest :   1   2   3   4   5, highest:  96  97  98
99 100
```

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

## ProdQual

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       43    0.999     7.81     1.6
1    5.595    5.790

##      .25      .50      .75      .90      .95

##    6.575    8.000    9.100    9.410    9.900

##

## lowest :  5.0  5.1  5.2  5.5  5.6, highest:  9.4  9.
5  9.6  9.9 10.0

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

## Ecom

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       27    0.996    3.672   0.767
4    2.595    2.800

##      .25      .50      .75      .90      .95

##    3.275    3.600    3.925    4.530    5.100

##

## lowest : 2.2 2.4 2.5 2.6 2.7, highest: 4.9 5.1 5.5 5
.6 5.7

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

## TechSup

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       50    0.999    5.365    1.75
5    2.700    3.280
```

```
##      .25      .50      .75      .90      .95
##    4.250    5.400    6.625    7.210    7.605
##
## lowest : 1.3 2.5 2.6 2.7 3.0, highest: 7.7 7.9 8.0 8
.4 8.5
## ------------------------------------------------------
----------------------------
## CompRes
##        n  missing distinct     Info     Mean      Gm
d      .05      .10
##      100        0       45    0.999    5.442    1.38
8    3.595    3.900
##      .25      .50      .75      .90      .95
##    4.600    5.450    6.325    7.010    7.305
##
## lowest : 2.6 3.0 3.2 3.5 3.6, highest: 7.4 7.5 7.6 7
.7 7.8
## ------------------------------------------------------
----------------------------
## Advertising
##        n  missing distinct     Info     Mean      Gm
d      .05      .10
##      100        0       41    0.999     4.01    1.30
2    2.200    2.400
##      .25      .50      .75      .90      .95
##    3.175    4.000    4.800    5.510    5.800
##
## lowest : 1.9 2.1 2.2 2.3 2.4, highest: 5.7 5.8 5.9 6
.3 6.5
```

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

## ProdLine

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       42    0.999    5.805    1.50
9    3.900    4.190

##      .25      .50      .75      .90      .95

##    4.700    5.750    6.800    7.600    7.805

##

## lowest : 2.3 2.9 3.3 3.6 3.9, highest: 7.7 7.8 7.9 8
.3 8.4

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

## SalesFImage

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       35    0.997    5.123     1.1
9    3.385    3.790

##      .25      .50      .75      .90      .95

##    4.500    4.900    5.800    6.610    7.100

##

## lowest : 2.9 3.0 3.1 3.4 3.5, highest: 6.8 6.9 7.1 7
.8 8.2

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

## ComPricing

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       45    0.998    6.974    1.77
8    4.500    4.800
```

```
##      .25      .50      .75      .90      .95
##    5.875    7.100    8.400    8.810    9.105
##
## lowest : 3.7 3.8 4.4 4.5 4.6, highest: 9.2 9.3 9.6 9
.7 9.9
## ----------------------------------------------------
---------------------------
## WartyClaim
##        n  missing distinct     Info     Mean      Gm
d      .05      .10
##      100        0       34    0.998    6.043   0.937
2    4.795    5.000
##      .25      .50      .75      .90      .95
##    5.400    6.100    6.600    7.200    7.305
##
## lowest : 4.1 4.3 4.5 4.7 4.8, highest: 7.3 7.4 7.5 7
.7 8.1
## ----------------------------------------------------
---------------------------
## OrdBilling
##        n  missing distinct     Info     Mean      Gm
d      .05      .10
##      100        0       37    0.998    4.278    1.03
3    2.595    3.000
##      .25      .50      .75      .90      .95
##    3.700    4.400    4.800    5.400    5.605
##
## lowest : 2.0 2.1 2.4 2.5 2.6, highest: 5.5 5.6 5.7 6
.5 6.7
```

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

## DelSpeed

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       30    0.997    3.886   0.826
7    2.595    2.990

##      .25      .50      .75      .90      .95

##    3.400    3.900    4.425    4.710    4.900

##

## lowest : 1.6 2.0 2.4 2.5 2.6, highest: 4.7 4.8 4.9 5
.2 5.5

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

## Satisfaction

##        n  missing distinct     Info     Mean      Gm
d      .05      .10

##      100        0       29    0.997    6.918    1.37
1    5.190    5.400

##      .25      .50      .75      .90      .95

##    6.000    7.050    7.625    8.600    8.900

lowest : 4.7 4.8 5.0 5.2 5.4, highest: 8.6 8.7 8.9 9.0
9.9

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


Mydata<-data[,c(2:13)]#### OMITTING THE FIRST COLUMN ##
##

view(Mydata)
```

```
dim(Mydata)
## [1] 100  12

attach(Mydata)

#### UNIVARIATE ANALYSIS ###
#### PRODUCT QUALITY ####
hist(ProdQual,col="blue")
boxplot(ProdQual,col="blue")
plot(density(ProdQual,main="PRODUCT QUALITY"))
#### E-COMMERCE ####
hist(Ecom,col ="red" )
boxplot(Ecom,col = "red")
plot(density(Ecom,main="EFFECT OF E-COMMERCE"))
#### TECHNICAL SUPPORT ####
hist(TechSup,col = "orange")
boxplot(TechSup,col = "orange")
plot(density(TechSup,main="TECHNICAL SUPPORT"))
#### COMPLAINT RESOLUTION ####
hist(CompRes,col="gray")
boxplot(CompRes,col="gray")
plot(density(CompRes,main="COMPLAINT RESOLUTION"))
#### ADVERTISING ####
hist(Advertising,col="green")
boxplot(Advertising,col="green")
plot(density(Advertising,main="ADVERTISING"))
#### PRODUCT LINE ####
```

```
hist(ProdLine,col="yellow")
boxplot(ProdLine,col="yellow")
plot(density(ProdLine,main="PRODUCT LINE"))
#### SALESFORCE IMAGE ####
hist(SalesFImage,col="coral")
boxplot(SalesFImage,col="coral")
plot(density(SalesFImage,main="SALESFORCE IMAGE"))
#### COMPETITIVE PRICING ####
hist(ComPricing,col = "maroon")
boxplot(ComPricing,col="maroon")
plot(density(ComPricing,main="COMPETITIVE PRICING"))
#### WARRANTY & CLAIM ####
hist(WartyClaim,col="violet")
boxplot(WartyClaim,col="violet")
plot(density(WartyClaim,main="WARRANTY AND CLAIMS"))
#### ORDERING & BILLING ####
hist(OrdBilling,col="purple")
boxplot(OrdBilling,col="purple")
plot(density(OrdBilling,main="ORDER & BILLING"))
#### DELIVERY SPEED ####
hist(DelSpeed,col="Brown")
boxplot(DelSpeed,col="Brown")
plot(density(DelSpeed,main="DELIVERY SPEED"))
#### SATISFACTION ####
hist(Satisfaction,col="royal blue")
boxplot(Satisfaction,col="royal blue")
plot(density(Satisfaction,main="CUSTOMER SATISFACTION")
)
```

```
#### BI-VARIATE ANALYSIS ####
histogram(ProdQual,Satisfaction,xlab = "PRODUCT QUALITY
",ylab="SATISFACTION",main="PRODUCT QUALITY VS SATISFAC
TION")
histogram((Satisfaction~Advertising),col="brown",xlab="
ADVERTISEMENT",ylab = "SATISFACTION",main="PRODUCT ADVE
RTISEMENT VS CUSTOMER SATISFACTION")
histogram(Satisfaction~Ecom,xlab ="E-COMMERCE",ylab = "
CUSTOMER SATISFACTION",main="E-COMMERCE VS SATISFACTION
" )


#### MULTIVARIATE ANALYSIS ####
qplot(ProdQual,Advertising,color=Satisfaction)
qplot(OrdBilling,WartyClaim,color=Satisfaction)
qplot(TechSup,CompRes,color=Satisfaction)


#### CHECK FOR NA VALUES ####
anyNA(Mydata)
## [1] FALSE


#### CHECK FOR OUTLIERS ####
boxplot.stats(Mydata$Ecom)$out
## [1] 5.6 5.7 5.1 5.1 5.1 5.5
boxplot.stats(Mydata$SalesFImage)$out
## [1] 7.8 7.8 8.2
boxplot.stats(Mydata$OrdBilling)$out
## [1] 6.7 6.5 2.0 2.0
boxplot.stats(Mydata$DelSpeed)$out
```

```
## [1] 1.6
```

```
#########################################################
# CHECK FOR MULTICOLLINEARITY #
#########################################################
(cor(Mydata))->corr
corr
```

```
##                 ProdQual          Ecom       TechSup
CompRes Advertising
## ProdQual      1.00000000 -0.1371632174  0.0956004542
0.1063700 -0.05347313
## Ecom         -0.13716322  1.0000000000  0.0008667887
0.1401793  0.42989071
## TechSup       0.09560045  0.0008667887  1.0000000000
0.0966566 -0.06287007
## CompRes       0.10637000  0.1401792611  0.0966565978
1.0000000  0.19691685
## Advertising  -0.05347313  0.4298907110 -0.0628700668
0.1969168  1.00000000
## ProdLine      0.47749341 -0.0526878383  0.1926254565
0.5614170 -0.01155082
## SalesFImage  -0.15181287  0.7915437115  0.0169905395
0.2297518  0.54220366
## ComPricing   -0.40128188  0.2294624014 -0.2707866821
-0.1279543  0.13421689
## WartyClaim    0.08831231  0.0518981915  0.7971679258
0.1404083  0.01079207
## OrdBilling    0.10430307  0.1561473316  0.0801018246
0.7568686  0.18423559
```

```
## DelSpeed      0.02771800  0.1916360683  0.0254406935
0.8650917  0.27586308

## Satisfaction  0.48632500  0.2827450147  0.1125971788
0.6032626  0.30466947

##                 ProdLine SalesFImage  ComPricing  Wa
rtyClaim  OrdBilling

## ProdQual      0.47749341 -0.15181287 -0.40128188  0.
08831231  0.10430307

## Ecom         -0.05268784  0.79154371  0.22946240  0.
05189819  0.15614733

## TechSup       0.19262546  0.01699054 -0.27078668  0.
79716793  0.08010182

## CompRes       0.56141695  0.22975176 -0.12795425  0.
14040830  0.75686859

## Advertising  -0.01155082  0.54220366  0.13421689  0.
01079207  0.18423559

## ProdLine      1.00000000 -0.06131553 -0.49494840  0.
27307753  0.42440825

## SalesFImage  -0.06131553  1.00000000  0.26459655  0.
10745534  0.19512741

## ComPricing   -0.49494840  0.26459655  1.00000000 -0.
24498605 -0.11456703

## WartyClaim    0.27307753  0.10745534 -0.24498605  1.
00000000  0.19706512

## OrdBilling    0.42440825  0.19512741 -0.11456703  0.
19706512  1.00000000

## DelSpeed      0.60185021  0.27155126 -0.07287173  0.
10939460  0.75100307

## Satisfaction  0.55054594  0.50020531 -0.20829569  0.
17754482  0.52173191

##                DelSpeed Satisfaction

## ProdQual      0.02771800    0.4863250
```

```
## Ecom           0.19163607    0.2827450
## TechSup        0.02544069    0.1125972
## CompRes        0.86509170    0.6032626
## Advertising    0.27586308    0.3046695
## ProdLine       0.60185021    0.5505459
## SalesFImage    0.27155126    0.5002053
## ComPricing    -0.07287173   -0.2082957
## WartyClaim     0.10939460    0.1775448
## OrdBilling     0.75100307    0.5217319
## DelSpeed       1.00000000    0.5770423
## Satisfaction   0.57704227    1.0000000
```

```
qgraph(corr)
chart.Correlation(Mydata,histogram = TRUE,pch="+",metho
d = c("pearson","kendall","spearman"))
corrplot(corr,method = "number")


#### PAIR-WISE CORRELATION ####
rcorr(as.matrix(Mydata))->c####with p values
c
```

```
##              ProdQual  Ecom TechSup CompRes Advertis
ing ProdLine SalesFImage
## ProdQual         1.00 -0.14    0.10    0.11       -0
.05     0.48       -0.15
## Ecom            -0.14  1.00    0.00    0.14        0
.43    -0.05        0.79
## TechSup          0.10  0.00    1.00    0.10       -0
.06     0.19        0.02
## CompRes          0.11  0.14    0.10    1.00        0
.20     0.56        0.23
```

```
## Advertising     -0.05  0.43   -0.06    0.20         1
.00    -0.01         0.54
## ProdLine         0.48 -0.05    0.19    0.56        -0
.01     1.00        -0.06
## SalesFImage     -0.15  0.79    0.02    0.23         0
.54    -0.06         1.00
## ComPricing      -0.40  0.23   -0.27   -0.13         0
.13    -0.49         0.26
## WartyClaim       0.09  0.05    0.80    0.14         0
.01     0.27         0.11
## OrdBilling       0.10  0.16    0.08    0.76         0
.18     0.42         0.20
## DelSpeed         0.03  0.19    0.03    0.87         0
.28     0.60         0.27
## Satisfaction     0.49  0.28    0.11    0.60         0
.30     0.55         0.50
##              ComPricing WartyClaim OrdBilling DelSpe
ed Satisfaction
## ProdQual          -0.40       0.09       0.10     0.
03         0.49
## Ecom               0.23       0.05       0.16     0.
19         0.28
## TechSup           -0.27       0.80       0.08     0.
03         0.11
## CompRes           -0.13       0.14       0.76     0.
87         0.60
## Advertising        0.13       0.01       0.18     0.
28         0.30
## ProdLine          -0.49       0.27       0.42     0.
60         0.55
## SalesFImage        0.26       0.11       0.20     0.
27         0.50
```

```
## ComPricing         1.00      -0.24      -0.11    -0.
07        -0.21
## WartyClaim        -0.24       1.00       0.20     0.
11         0.18
## OrdBilling        -0.11       0.20       1.00     0.
75         0.52
## DelSpeed          -0.07       0.11       0.75     1.
00         0.58
## Satisfaction      -0.21       0.18       0.52     0.
58         1.00
##
## n= 100
##
##
## P
##              ProdQual Ecom   TechSup CompRes Adverti
sing ProdLine SalesFImage
## ProdQual               0.1736 0.3441  0.2922  0.5972
0.0000   0.1316
## Ecom         0.1736           0.9932  0.1642  0.0000
0.6026   0.0000
## TechSup      0.3441   0.9932         0.3387  0.5343
0.0549   0.8668
## CompRes      0.2922   0.1642 0.3387          0.0496
0.0000   0.0215
## Advertising  0.5972   0.0000 0.5343  0.0496
0.9092   0.0000
## ProdLine     0.0000   0.6026 0.0549  0.0000  0.9092
0.5445
## SalesFImage  0.1316   0.0000 0.8668  0.0215  0.0000
0.5445
```

```
## ComPricing   0.0000   0.0216 0.0064  0.2046  0.1831
0.0000   0.0078

## WartyClaim   0.3823   0.6081 0.0000  0.1635  0.9151
0.0060   0.2873

## OrdBilling   0.3017   0.1208 0.4282  0.0000  0.0665
0.0000   0.0517

## DelSpeed     0.7843   0.0561 0.8016  0.0000  0.0055
0.0000   0.0063

## Satisfaction 0.0000   0.0044 0.2647  0.0000  0.0021
0.0000   0.0000

##              ComPricing WartyClaim OrdBilling DelSpe
ed Satisfaction

## ProdQual     0.0000     0.3823     0.3017     0.7843
0.0000

## Ecom         0.0216     0.6081     0.1208     0.0561
0.0044

## TechSup      0.0064     0.0000     0.4282     0.8016
0.2647

## CompRes      0.2046     0.1635     0.0000     0.0000
0.0000

## Advertising  0.1831     0.9151     0.0665     0.0055
0.0021

## ProdLine     0.0000     0.0060     0.0000     0.0000
0.0000

## SalesFImage  0.0078     0.2873     0.0517     0.0063
0.0000

## ComPricing              0.0140     0.2564     0.4712
0.0376

## WartyClaim   0.0140                0.0494     0.2786
0.0772

## OrdBilling   0.2564     0.0494                0.0000
0.0000
```

```
## DelSpeed     0.4712     0.2786     0.0000
0.0000
## Satisfaction 0.0376     0.0772     0.0000     0.0000
```

```
c$r
```

```
##                 ProdQual          Ecom       TechSup
CompRes Advertising
## ProdQual      1.00000000 -0.1371632174  0.0956004542
0.1063700 -0.05347313
## Ecom         -0.13716322  1.0000000000  0.0008667887
0.1401793  0.42989071
## TechSup       0.09560045  0.0008667887  1.0000000000
0.0966566 -0.06287007
## CompRes       0.10637000  0.1401792611  0.0966565978
1.0000000  0.19691685
## Advertising  -0.05347313  0.4298907110 -0.0628700668
0.1969168  1.00000000
## ProdLine      0.47749341 -0.0526878383  0.1926254565
0.5614170 -0.01155082
## SalesFImage  -0.15181287  0.7915437115  0.0169905395
0.2297518  0.54220366
## ComPricing   -0.40128188  0.2294624014 -0.2707866821
-0.1279543  0.13421689
## WartyClaim    0.08831231  0.0518981915  0.7971679258
0.1404083  0.01079207
## OrdBilling    0.10430307  0.1561473316  0.0801018246
0.7568686  0.18423559
## DelSpeed      0.02771800  0.1916360683  0.0254406935
0.8650917  0.27586308
## Satisfaction  0.48632500  0.2827450147  0.1125971788
0.6032626  0.30466947
##                 ProdLine SalesFImage  ComPricing  Wa
rtyClaim  OrdBilling
```

```
## ProdQual      0.47749341 -0.15181287 -0.40128188  0.
08831231  0.10430307

## Ecom         -0.05268784  0.79154371  0.22946240  0.
05189819  0.15614733

## TechSup       0.19262546  0.01699054 -0.27078668  0.
79716793  0.08010182

## CompRes       0.56141695  0.22975176 -0.12795425  0.
14040830  0.75686859

## Advertising  -0.01155082  0.54220366  0.13421689  0.
01079207  0.18423559

## ProdLine      1.00000000 -0.06131553 -0.49494840  0.
27307753  0.42440825

## SalesFImage  -0.06131553  1.00000000  0.26459655  0.
10745534  0.19512741

## ComPricing   -0.49494840  0.26459655  1.00000000 -0.
24498605 -0.11456703

## WartyClaim    0.27307753  0.10745534 -0.24498605  1.
00000000  0.19706512

## OrdBilling    0.42440825  0.19512741 -0.11456703  0.
19706512  1.00000000

## DelSpeed      0.60185021  0.27155126 -0.07287173  0.
10939460  0.75100307

## Satisfaction  0.55054594  0.50020531 -0.20829569  0.
17754482  0.52173191

##                DelSpeed Satisfaction

## ProdQual      0.02771800    0.4863250

## Ecom          0.19163607    0.2827450

## TechSup       0.02544069    0.1125972

## CompRes       0.86509170    0.6032626

## Advertising   0.27586308    0.3046695

## ProdLine      0.60185021    0.5505459
```

```
## SalesFImage   0.27155126    0.5002053
## ComPricing   -0.07287173   -0.2082957
## WartyClaim    0.10939460    0.1775448
## OrdBilling    0.75100307    0.5217319
## DelSpeed      1.00000000    0.5770423
## Satisfaction  0.57704227    1.0000000
```

```
c$P
```

```
##                  ProdQual          Ecom     TechSup
CompRes  Advertising
## ProdQual               NA 1.735678e-01 0.344069774 2
.921951e-01 5.972310e-01
## Ecom         1.735678e-01           NA 0.993171061 1
.642110e-01 8.057831e-06
## TechSup      3.440698e-01 9.931711e-01          NA 3
.387408e-01 5.343289e-01
## CompRes      2.921951e-01 1.642110e-01 0.338740849
NA 4.956684e-02
## Advertising  5.972310e-01 8.057831e-06 0.534328881 4
.956684e-02           NA
## ProdLine     5.079855e-07 6.026343e-01 0.054850413 1
.230039e-09 9.091904e-01
## SalesFImage  1.316067e-01 0.000000e+00 0.866755288 2
.147747e-02 5.663263e-09
## ComPricing   3.508603e-05 2.164685e-02 0.006431524 2
.045561e-01 1.830814e-01
## WartyClaim   3.822660e-01 6.080893e-01 0.000000000 1
.635161e-01 9.151325e-01
## OrdBilling   3.017269e-01 1.208120e-01 0.428231475 0
.000000e+00 6.651550e-02
## DelSpeed     7.842785e-01 5.613196e-02 0.801621550 0
.000000e+00 5.468280e-03
```

```
## Satisfaction 2.900993e-07 4.367712e-03 0.264693293 3
.085354e-11 2.056065e-03

##                  ProdLine  SalesFImage   ComPricing
WartyClaim   OrdBilling

## ProdQual     5.079855e-07 1.316067e-01 3.508603e-05
0.382265961 3.017269e-01

## Ecom         6.026343e-01 0.000000e+00 2.164685e-02
0.608089260 1.208120e-01

## TechSup      5.485041e-02 8.667553e-01 6.431524e-03
0.000000000 4.282315e-01

## CompRes      1.230039e-09 2.147747e-02 2.045561e-01
0.163516085 0.000000e+00

## Advertising  9.091904e-01 5.663263e-09 1.830814e-01
0.915132498 6.651550e-02

## ProdLine               NA 5.445035e-01 1.653082e-07
0.005979643 1.079444e-05

## SalesFImage  5.445035e-01           NA 7.807337e-03
0.287270577 5.171654e-02

## ComPricing   1.653082e-07 7.807337e-03           NA
0.014025148 2.563719e-01

## WartyClaim   5.979643e-03 2.872706e-01 1.402515e-02
NA 4.939207e-02

## OrdBilling   1.079444e-05 5.171654e-02 2.563719e-01
0.049392074           NA

## DelSpeed     3.524825e-11 6.277454e-03 4.712084e-01
0.278609678 0.000000e+00

## Satisfaction 2.953080e-09 1.164314e-07 3.755877e-02
0.077195604 2.601982e-08

##                  DelSpeed Satisfaction

## ProdQual     7.842785e-01 2.900993e-07

## Ecom         5.613196e-02 4.367712e-03

## TechSup      8.016216e-01 2.646933e-01
```

```
## CompRes      0.000000e+00 3.085354e-11
## Advertising  5.468280e-03 2.056065e-03
## ProdLine     3.524825e-11 2.953080e-09
## SalesFImage  6.277454e-03 1.164314e-07
## ComPricing   4.712084e-01 3.755877e-02
## WartyClaim   2.786097e-01 7.719560e-02
## OrdBilling   0.000000e+00 2.601982e-08
## DelSpeed               NA 3.300471e-10
## Satisfaction 3.300471e-10           NA
```

```
#### VARIABLE INFLATION FACTOR ####
vif(mymodel)####IF VIF VALUES ARE > 4,THEN MULTICOLLINE
ARITY EXISTS BETWEEN THE REGRESSORS
```

```
##    ProdQual        Ecom     TechSup     CompRes Adve
rtising    ProdLine
##    1.635797    2.756694    2.976796    4.730448    1
.508933    3.488185
## SalesFImage  ComPricing  WartyClaim  OrdBilling    D
elSpeed
##    3.439420    1.635000    3.198337    2.902999    6
.516014
```

```
mean(vif(mymodel))
```

```
## [1] 3.162602
```

```
#########################################################
# SIMPLE LINEAR REGRESSION #
#########################################################
MODEL1=lm(Satisfaction~ProdQual,data = Mydata)
summary(MODEL1)
```

```
##
## Call:
## lm(formula = Satisfaction ~ ProdQual, data = Mydata)
##
## 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
```

```
plot(ProdQual,Satisfaction,col="maroon",abline(lm(Satisfaction~ProdQual),col="dark blue"))
MODEL2=lm(Satisfaction~Ecom)
summary(MODEL2)
```

```
##
## 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
```

```
plot(Ecom,Satisfaction,col="blue",abline(lm(Satisfaction~Ecom),col="red"))
MODEL3=lm(Satisfaction~TechSup)
summary(MODEL3)
```

```
##
## 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
```

```
plot(TechSup,Satisfaction,col="black",abline(lm(Satisfaction~TechSup),col="red"))
MODEL4=lm(Satisfaction~CompRes)
summary(MODEL4)
```

```
##
## 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
```

```
plot(CompRes,Satisfaction,col="red",abline(lm(Satisfaction~CompRes),col="black"))
MODEL5=lm(Satisfaction~Advertising)
summary(MODEL5)
```

```
##
## 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
```

```
plot(Advertising,Satisfaction,col="black",abline(lm(Satisfaction~Advertising),col="red"))
MODEL6=lm(Satisfaction~ProdLine)
summary(MODEL6)
```

```
##
## 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
```

```
plot(ProdLine,Satisfaction,col="blue",abline(lm(Satisfaction~ProdLine),col="red"))
MODEL7=lm(Satisfaction~SalesFImage)
summary(MODEL7)
```

```
##
## 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
```

```
plot(SalesFImage,Satisfaction,col="blue",abline(lm(Sati
sfaction~SalesFImage),col="red"))
```

```
MODEL8=lm(Satisfaction~ComPricing)
```

```
summary(MODEL8)
```

```
##
## 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 free
dom
## Multiple R-squared:  0.04339,    Adjusted R-squared:
0.03363
## F-statistic: 4.445 on 1 and 98 DF,  p-value: 0.03756
```

```
plot(ComPricing,Satisfaction,col="blue",abline(lm(Satis
faction~ComPricing),col="red"))
```

```
MODEL9=lm(Satisfaction~WartyClaim)
summary(MODEL9)
```

```
##
## 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
```

```
plot(WartyClaim,Satisfaction,col="blue",abline(lm(Satisfaction~WartyClaim),col="red"))
MODEL10=lm(Satisfaction~OrdBilling)
summary(MODEL10)
```

```
##
## 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
```

```
plot(OrdBilling,Satisfaction,col="blue",abline(lm(Satisfaction~OrdBilling),col="red"))
MODEL11=lm(Satisfaction~DelSpeed)
summary(MODEL11)
```

```
##
## 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
```

```
plot(DelSpeed,Satisfaction,col="blue",abline(lm(Satisfaction~DelSpeed),col="red"))
```

```
#####################################################
# PRINCIPAL COMPONENT ANALYSIS AND FACTOR ANALYSIS #
#####################################################
MOD_DATA<-Mydata[,-12]
View(MOD_DATA)


dim(MOD_DATA)
```

```
## [1] 100  11
```

```
class(MOD_DATA)
```

```
## [1] "data.frame"
```

```
M<-eigen(cor((MOD_DATA)))
EIGENVALUES<-M$values
FACTORS=c(1:11)
kappa(cor(MOD_DATA),exact = TRUE)
## [1] 34.81738
SCREE<-data.frame(FACTORS,EIGENVALUES)
SCREE
##    FACTORS EIGENVALUES
## 1        1  3.42697133
## 2        2  2.55089671
## 3        3  1.69097648
## 4        4  1.08655606
## 5        5  0.60942409
## 6        6  0.55188378
## 7        7  0.40151815
## 8        8  0.24695154
## 9        9  0.20355327
## 10      10  0.13284158
## 11      11  0.09842702

#### SCREE PLOT USING BASE PLOT ####
plot(SCREE,main="SCREE PLOT",col="Blue",ylim=c(0,4))
lines(SCREE,col="Red")
abline(h=1,col="Green")

#### SCREE PLOT USING GGPLOT2 ####
```

```
ggplot(data=SCREE,mapping = aes(x=FACTORS,y=EIGENVALUES
))+geom_point()+geom_line()+scale_y_continuous(name = "
EIGEN VALUES",limits = c(0,5))+theme(panel.background =
element_blank())+theme(plot.background = element_blank(
))+theme(panel.grid.major.y = element_line(colour = "CO
RAL"))+ggtitle("SCREE PLOT")


max(eigen(cor(MOD_DATA))$values)/min(eigen(cor(MOD_DATA
))$values)
```

```
## [1] 34.81738
```

```
kappa(cor(MOD_DATA),exact = TRUE)
```

```
## [1] 34.81738
```

```
corr1<-cor(MOD_DATA)
#### HYPOTHESIS TESTING ####
# H0 = DIMENSIONAL REDUCTION IS POSSIBLE
# H1 = DIMENSIONAL REDUCTION IS NOT POSSIBLE
library(psych)
KMO(corr1)####IF MSA VALUE IS > 0.5,FACTOR ANALYSIS CAN
BE DONE FOR THE INDEPENDENT VARIABLES
```

```
## Kaiser-Meyer-Olkin factor adequacy
## Call: KMO(r = corr1)
## Overall MSA =  0.65
## MSA for each item =
##    ProdQual        Ecom     TechSup     CompRes Adve
rtising    ProdLine
##        0.51        0.63        0.52        0.79
0.78        0.62
```

```
## SalesFImage  ComPricing  WartyClaim  OrdBilling    D
elSpeed
##         0.62         0.75         0.51         0.76
0.67
```

```
#### BARLETT's TEST FOR SPHERICITY ####
print(cortest.bartlett(corr1,nrow(MOD_DATA)))
```

```
## $chisq
## [1] 619.2726
##
## $p.value
## [1] 1.79337e-96
##
## $df
## [1] 55
```

```
##### USING FACTANAL COMMAND #####
nfactors<-4
fit<-factanal(MOD_DATA,nfactors,scores = c("regression"
),rotation = "none")
print(fit)
```

```
##
## Call:
## factanal(x = MOD_DATA, factors = nfactors, scores =
c("regression"),     rotation = "none")
##
## Uniquenesses:
##    ProdQual        Ecom     TechSup     CompRes Adve
rtising    ProdLine
```

```
##       0.682       0.360       0.228       0.178
0.679       0.005
## SalesFImage  ComPricing  WartyClaim  OrdBilling    D
elSpeed
##       0.017       0.636       0.163       0.347
0.076
##
## Loadings:
##             Factor1 Factor2 Factor3 Factor4
## ProdQual     0.467  -0.148  -0.229  -0.159
## Ecom                 0.791
## TechSup      0.198          -0.482   0.707
## CompRes      0.589   0.316   0.535   0.300
## Advertising          0.556   0.110
## ProdLine     0.997
## SalesFImage          0.987
## ComPricing  -0.491   0.252   0.238
## WartyClaim   0.279   0.124  -0.487   0.712
## OrdBilling   0.452   0.275   0.493   0.360
## DelSpeed     0.629   0.364   0.582   0.241
##
##                Factor1 Factor2 Factor3 Factor4
## SS loadings      2.522   2.316   1.469   1.322
## Proportion Var   0.229   0.211   0.134   0.120
## Cumulative Var   0.229   0.440   0.573   0.694
##
## Test of the hypothesis that 4 factors are sufficient
.
```

```
## The chi square statistic is 24.26 on 17 degrees of f
reedom.
## The p-value is 0.113
```

```
##### USING VARIMAX ROTATION #####
fit1<-factanal(MOD_DATA,nfactors,scores = c("regression
"),rotation = "varimax")
print(fit1)
```

```
##
## Call:
## factanal(x = MOD_DATA, factors = nfactors, scores =
c("regression"),     rotation = "varimax")
##
## Uniquenesses:
##    ProdQual        Ecom     TechSup     CompRes Adve
rtising    ProdLine
##       0.682       0.360       0.228       0.178
0.679       0.005
## SalesFImage  ComPricing  WartyClaim  OrdBilling    D
elSpeed
##       0.017       0.636       0.163       0.347
0.076
##
## Loadings:
##             Factor1 Factor2 Factor3 Factor4
## ProdQual                            0.557
## Ecom                 0.793
## TechSup                      0.872   0.102
## CompRes      0.884   0.142           0.135
```

```
## Advertising  0.190   0.521          -0.110
## ProdLine     0.502          0.104   0.856
## SalesFImage  0.119   0.974          -0.130
## ComPricing           0.225  -0.216  -0.514
## WartyClaim                  0.894   0.158
## OrdBilling   0.794   0.101   0.105
## DelSpeed     0.928   0.189          0.164
##
##                Factor1 Factor2 Factor3 Factor4
## SS loadings      2.592   1.977   1.638   1.423
## Proportion Var   0.236   0.180   0.149   0.129
## Cumulative Var   0.236   0.415   0.564   0.694
##
## Test of the hypothesis that 4 factors are sufficient
.
## The chi square statistic is 24.26 on 17 degrees of f
reedom.
## The p-value is 0.113
```

```
#### PRINCIPAL AXIS METHOD ####
fa_unrot<-fa(r=MOD_DATA,nfactors = 4,rotate = "none",fm
="pa")
print(fa_unrot)
```

```
## Factor Analysis using method =  pa
## Call: fa(r = MOD_DATA, nfactors = 4, rotate = "none"
, fm = "pa")
## Standardized loadings (pattern matrix) based upon co
rrelation matrix
##               PA1   PA2   PA3   PA4   h2    u2 com
```

```
## ProdQual     0.20 -0.41 -0.06  0.46 0.42 0.576 2.4
## Ecom         0.29  0.66  0.27  0.22 0.64 0.362 2.0
## TechSup      0.28 -0.38  0.74 -0.17 0.79 0.205 1.9
## CompRes      0.86  0.01 -0.26 -0.18 0.84 0.157 1.3
## Advertising  0.29  0.46  0.08  0.13 0.31 0.686 1.9
## ProdLine     0.69 -0.45 -0.14  0.31 0.80 0.200 2.3
## SalesFImage  0.39  0.80  0.35  0.25 0.98 0.021 2.1
## ComPricing  -0.23  0.55 -0.04 -0.29 0.44 0.557 1.9
## WartyClaim   0.38 -0.32  0.74 -0.15 0.81 0.186 2.0
## OrdBilling   0.75  0.02 -0.18 -0.18 0.62 0.378 1.2
## DelSpeed     0.90  0.10 -0.30 -0.20 0.94 0.058 1.4
##
##                        PA1  PA2  PA3  PA4
## SS loadings           3.21 2.22 1.50 0.68
## Proportion Var        0.29 0.20 0.14 0.06
## Cumulative Var        0.29 0.49 0.63 0.69
## Proportion Explained  0.42 0.29 0.20 0.09
## Cumulative Proportion 0.42 0.71 0.91 1.00
##
## Mean item complexity =  1.9
## Test of the hypothesis that 4 factors are sufficient
.
##
## The degrees of freedom for the null model are  55  a
nd the objective function was  6.55 with Chi Square of
619.27
## The degrees of freedom for the model are 17  and the
objective function was  0.33
##
```

```
## The root mean square of the residuals (RMSR) is  0.0
2

## The df corrected root mean square of the residuals i
s  0.03

##

## The harmonic number of observations is  100 with the
empirical chi square  3.19  with prob <  1

## The total number of observations was  100  with Like
lihood Chi Square =  30.27  with prob <  0.024

##

## Tucker Lewis Index of factoring reliability =  0.921

## RMSEA index =  0.088  and the 90 % confidence interv
als are  0.032 0.139

## BIC =  -48.01

## Fit based upon off diagonal values = 1

## Measures of factor score adequacy

##                                                    P
A1  PA2  PA3  PA4

## Correlation of (regression) scores with factors   0.
98 0.97 0.95 0.88

## Multiple R square of scores with factors          0.
96 0.95 0.91 0.78

## Minimum correlation of possible factor scores     0.
92 0.90 0.82 0.56
```

```
fa.diagram(fa_unrot)

fa_unrot$loadings
```

```
##

## Loadings:

##             PA1    PA2    PA3    PA4

## ProdQual     0.201 -0.408         0.463
```

```
## Ecom          0.290  0.659  0.270  0.216
## TechSup       0.278 -0.381  0.738 -0.166
## CompRes       0.862        -0.255 -0.184
## Advertising   0.286  0.457         0.129
## ProdLine      0.689 -0.453 -0.142  0.315
## SalesFImage   0.395  0.801  0.346  0.251
## ComPricing   -0.232  0.553        -0.286
## WartyClaim    0.379 -0.324  0.735 -0.153
## OrdBilling    0.747        -0.175 -0.181
## DelSpeed      0.895        -0.303 -0.198
##
##                  PA1   PA2   PA3   PA4
## SS loadings    3.215 2.223 1.499 0.678
## Proportion Var 0.292 0.202 0.136 0.062
## Cumulative Var 0.292 0.494 0.631 0.692
```

```
fa_rot<-fa(r=MOD_DATA,nfactors = 4,rotate = "varimax",fm="pa")
print(fa_rot)
```

```
## Factor Analysis using method =  pa
## Call: fa(r = MOD_DATA, nfactors = 4, rotate = "varimax", fm = "pa")
## Standardized loadings (pattern matrix) based upon correlation matrix
##                PA1   PA2   PA3   PA4   h2    u2 com
## ProdQual      0.02 -0.07  0.02  0.65 0.42 0.576 1.0
## Ecom          0.07  0.79  0.03 -0.11 0.64 0.362 1.1
## TechSup       0.02 -0.03  0.88  0.12 0.79 0.205 1.0
## CompRes       0.90  0.13  0.05  0.13 0.84 0.157 1.1
```

```
## Advertising  0.17  0.53 -0.04 -0.06 0.31 0.686 1.2
## ProdLine     0.53 -0.04  0.13  0.71 0.80 0.200 1.9
## SalesFImage  0.12  0.97  0.06 -0.13 0.98 0.021 1.1
## ComPricing  -0.08  0.21 -0.21 -0.59 0.44 0.557 1.6
## WartyClaim   0.10  0.06  0.89  0.13 0.81 0.186 1.1
## OrdBilling   0.77  0.13  0.09  0.09 0.62 0.378 1.1
## DelSpeed     0.95  0.19  0.00  0.09 0.94 0.058 1.1
##
##                        PA1  PA2  PA3  PA4
## SS loadings           2.63 1.97 1.64 1.37
## Proportion Var        0.24 0.18 0.15 0.12
## Cumulative Var        0.24 0.42 0.57 0.69
## Proportion Explained  0.35 0.26 0.22 0.18
## Cumulative Proportion 0.35 0.60 0.82 1.00
##
## Mean item complexity =  1.2
## Test of the hypothesis that 4 factors are sufficient
.
##
## The degrees of freedom for the null model are  55  a
nd the objective function was  6.55 with Chi Square of
619.27
## The degrees of freedom for the model are 17  and the
objective function was  0.33
##
## The root mean square of the residuals (RMSR) is  0.0
2
## The df corrected root mean square of the residuals i
s  0.03
```

```
##
## The harmonic number of observations is  100 with the
empirical chi square  3.19  with prob <  1
## The total number of observations was  100  with Like
lihood Chi Square =  30.27  with prob <  0.024
##
## Tucker Lewis Index of factoring reliability =  0.921
## RMSEA index =  0.088  and the 90 % confidence interv
als are  0.032 0.139
## BIC =  -48.01
## Fit based upon off diagonal values = 1
## Measures of factor score adequacy
##                                                    P
A1  PA2  PA3  PA4
## Correlation of (regression) scores with factors   0.
98 0.99 0.94 0.88
## Multiple R square of scores with factors          0.
96 0.97 0.88 0.78
## Minimum correlation of possible factor scores     0.
93 0.94 0.77 0.55
```

```
fa.diagram(fa_rot)
fa_rot$loadings
```

```
##
## Loadings:
##             PA1    PA2    PA3    PA4
## ProdQual                          0.647
## Ecom                0.787        -0.113
## TechSup                     0.883  0.116
## CompRes      0.898  0.130         0.132
```

```
## Advertising  0.166  0.530
## ProdLine     0.525         0.127  0.712
## SalesFImage  0.115  0.971        -0.135
## ComPricing           0.213 -0.209 -0.590
## WartyClaim   0.103         0.885  0.128
## OrdBilling   0.768  0.127
## DelSpeed     0.949  0.185
##
##                  PA1   PA2   PA3   PA4
## SS loadings    2.635 1.967 1.641 1.371
## Proportion Var 0.240 0.179 0.149 0.125
## Cumulative Var 0.240 0.418 0.568 0.692
```

```
fa_rot$scores
```

```
##                PA1         PA2          PA3
PA4
##   [1,] -0.13388710  0.91751661 -1.719604873  0.09135
411
##   [2,]  1.62976040 -2.00900531 -0.596361722  0.65808
192
##   [3,]  0.36376581  0.83617362  0.002979966  1.37548
765
##   [4,] -1.22252302 -0.54913358  1.245473305 -0.64421
384
##   [5,] -0.48542093 -0.42762231 -0.026980304  0.47360
747
##   [6,] -0.59509240 -1.30353334 -1.183019401 -0.95913
571
##   [7,] -2.52885363  0.38836877 -0.603275803 -1.29659
025
```

```
##   [8,] -0.11315168 -0.13097631 -0.699238481 -1.36606
005
##   [9,]  0.95751096  0.34755882 -0.142256076 -0.93477
420
##  [10,]  0.58135807  0.43427719 -0.481549064 -0.66519
579
##  [11,] -0.04744554 -0.34677999 -0.477931226  0.62086
386
##  [12,] -1.22969845  1.22373499  0.307420873 -1.06601
488
##  [13,]  0.70120038  1.40162126 -0.077278204  0.61198
552
##  [14,]  0.18944710 -0.12001589  0.341391428  1.43748
733
##  [15,]  1.59586476  0.51484865 -0.307216912 -0.62265
003
##  [16,]  1.11215548 -1.25985548 -0.535588676  0.99091
689
##  [17,]  0.90477581 -0.30392244  0.909413294 -1.04926
552
##  [18,]  1.35863182  0.09820639  0.147598367 -0.63536
585
##  [19,]  0.76821232  0.25113902 -0.444327163 -0.84712
501
##  [20,]  0.61161128  1.74911250 -0.747772366 -0.37770
002
##  [21,] -0.49662748 -0.40513549  1.413398115 -1.42620
085
##  [22,] -0.24583333  2.83259042  0.458183224  2.15737
479
##  [23,] -0.08593028 -0.20647990  0.954813784  1.29099
542
```

```
##  [24,]  1.30419410 -0.65840510 -0.735880788  0.79535
237
##  [25,]  0.02837015  0.11289267  0.352466288 -0.83695
432
##  [26,]  0.37516895 -0.08949421  0.586591370 -1.33839
027
##  [27,]  0.69040218 -1.27676215  0.980470048  0.97700
863
##  [28,]  0.19330562 -1.09019060  0.410744110 -1.15018
948
##  [29,]  0.74807174 -1.20388888 -0.169444094  1.11442
401
##  [30,] -0.53645976 -0.31470400 -1.389463973 -0.62508
147
##  [31,] -0.98478652 -0.32465411  2.054616799  0.57213
335
##  [32,] -0.89540824 -1.30592549  1.145669622 -0.17981
750
##  [33,] -0.61006900 -0.25385457  0.201747129 -0.51103
804
##  [34,]  0.58139098 -0.57102185  0.160508882 -1.09267
691
##  [35,] -1.08254233  1.61817367  0.121735970 -0.32924
397
##  [36,] -1.51860194 -1.82264781  0.280394795  1.08323
735
##  [37,] -0.54298600 -0.45867623  0.359185746  0.44557
509
##  [38,]  1.35035690  0.28270522  0.116158567  0.69743
150
##  [39,]  0.98244317 -0.26293227 -1.015054009 -0.98172
621
```

```
##  [40,] -0.92383910  1.28059000 -1.167921851 -0.79331
056
##  [41,]  0.09932064  0.09827305 -1.837451060 -0.63276
007
##  [42,]  0.10869713 -0.04357923 -1.050920110  0.49209
145
##  [43,]  0.44811474  1.20846081 -0.968824054  0.72015
394
##  [44,]  0.70660340  2.17850627  1.233358555 -0.84868
686
##  [45,]  1.38263370 -2.03732511 -0.954180731  0.77953
010
##  [46,]  0.94936859  0.24232567  0.291172997 -0.56344
261
##  [47,]  0.08771633 -0.60985289  0.976205747  0.45795
642
##  [48,]  1.81030056  0.43834059  0.814478797 -1.17962
559
##  [49,] -0.19224074  1.62888205 -0.733730711  1.33934
942
##  [50,]  0.22531882  0.78430768 -0.957752366  0.92784
955
##  [51,] -1.41135829 -0.16930613  0.091870699 -0.12631
052
##  [52,]  1.75365232 -1.99153570 -1.147542434  0.70646
283
##  [53,]  0.93209854 -0.51397965 -0.162358377  0.70759
613
##  [54,] -0.94184081 -0.25288506  0.358406630  0.67268
912
##  [55,]  0.72242047 -0.54924734 -0.909388995 -1.09941
166
```

```
##  [56,] -0.63244099  0.41450294  0.914064214  0.81720
176
##  [57,]  1.99193341  1.41977208 -0.077384854 -0.41266
731
##  [58,]  0.08548402  0.30077469  0.319615332  0.74357
193
##  [59,] -0.57061091 -0.34885418  0.365475898  0.45601
852
##  [60,]  0.83067496 -1.65626897  0.641678078  0.23244
952
##  [61,]  0.86635294 -1.24543164  1.546930711  0.94382
806
##  [62,] -0.60680134  0.74525730 -0.146586558 -0.25509
333
##  [63,] -1.00306329 -0.09710517 -1.081705300  0.42111
790
##  [64,] -1.28310920 -1.59838664  0.403626668 -0.02388
625
##  [65,] -1.39461685 -0.23395772  0.557826636 -0.26460
336
##  [66,]  1.60952000  0.55610373 -0.999093684 -1.16665
258
##  [67,]  1.07257520 -0.39772241  1.815878900 -1.14631
126
##  [68,]  0.50884788 -0.29395183 -0.416389316 -0.75909
753
##  [69,] -0.70601563 -0.44707894 -0.973611521 -0.83304
582
##  [70,]  0.23899120  0.05018369 -1.219545924 -1.27828
253
##  [71,]  0.48631145  1.74069413  0.854795068 -0.43411
595
```

```
##  [72,] -1.37477720 -0.22770098 -1.265787815  1.00015
839
##  [73,]  0.76539809  0.81612817 -1.748046205 -0.13852
761
##  [74,] -0.64249465  1.66245576  1.253902625  1.20305
576
##  [75,] -0.26909538  0.83656999 -0.210138132 -0.11412
392
##  [76,] -0.12296694 -0.33391431  1.172210398  0.39677
906
##  [77,]  0.10371878 -0.33487753  2.082854211 -1.18017
022
##  [78,]  0.46301479 -0.33956677  1.214737442  0.10357
998
##  [79,]  0.98918468  0.65624508  0.485336460  1.22733
204
##  [80,] -1.74919939  0.82890385  0.003384046  0.09231
225
##  [81,] -0.32137992 -0.20110631  0.470666208  0.60888
606
##  [82,] -0.03471489 -0.38974940  0.412648407  0.57771
035
##  [83,] -1.17790878 -0.90045717  0.198122454  0.40011
473
##  [84,] -2.55956258 -0.25686675  1.554283149 -1.14101
556
##  [85,]  0.73971919 -0.90696938  0.655846983  0.51129
012
##  [86,] -0.50161741 -0.56408382 -1.009145207 -0.86106
988
##  [87,] -1.33057806 -0.01745886 -2.201996451 -0.92403
144
```

```
##  [88,]  0.70358137 -0.91236060  1.299031585  0.56968
494
##  [89,]  0.10912530 -0.46505791  0.266161987  0.17120
142
##  [90,]  1.02813129  2.57446865  1.640665437 -0.80151
398
##  [91,] -1.04672561  0.44260491  1.394021786  0.75011
393
##  [92,] -1.90712581 -0.46993540 -0.522475751 -1.31422
452
##  [93,]  0.07279015 -0.02235421 -0.352359525  1.61044
504
##  [94,]  1.08706436  0.61924340  0.089460676  1.16081
123
##  [95,] -0.95457978  0.66256003 -0.981787816  1.06717
592
##  [96,] -0.41931326  0.70755398 -0.077703201  0.52522
023
##  [97,] -0.12315824 -0.25275815 -1.762967608 -0.63424
275
##  [98,] -1.79270636 -1.59315365 -1.309147686  1.28219
570
##  [99,] -0.33991434  1.89138931  0.122487640 -0.17511
674
## [100,] -0.31758889 -0.42356050 -0.453981729 -1.03250
054
```

```
##################################################

# NEW DATA FRAME WITH DEPENDENT VARIABLE AND FACTOR SCO
RES #

##################################################

newdata=cbind(Mydata$Satisfaction,fa_rot$scores)

newdata
```

```
##                     PA1         PA2           PA3
PA4
##   [1,] 8.2 -0.13388710  0.91751661 -1.719604873  0.0
9135411
##   [2,] 5.7  1.62976040 -2.00900531 -0.596361722  0.6
5808192
##   [3,] 8.9  0.36376581  0.83617362  0.002979966  1.3
7548765
##   [4,] 4.8 -1.22252302 -0.54913358  1.245473305 -0.6
4421384
##   [5,] 7.1 -0.48542093 -0.42762231 -0.026980304  0.4
7360747
##   [6,] 4.7 -0.59509240 -1.30353334 -1.183019401 -0.9
5913571
##   [7,] 5.7 -2.52885363  0.38836877 -0.603275803 -1.2
9659025
##   [8,] 6.3 -0.11315168 -0.13097631 -0.699238481 -1.3
6606005
##   [9,] 7.0  0.95751096  0.34755882 -0.142256076 -0.9
3477420
##  [10,] 5.5  0.58135807  0.43427719 -0.481549064 -0.6
6519579
##  [11,] 7.4 -0.04744554 -0.34677999 -0.477931226  0.6
2086386
##  [12,] 6.0 -1.22969845  1.22373499  0.307420873 -1.0
6601488
##  [13,] 8.4  0.70120038  1.40162126 -0.077278204  0.6
1198552
##  [14,] 7.6  0.18944710 -0.12001589  0.341391428  1.4
3748733
##  [15,] 8.0  1.59586476  0.51484865 -0.307216912 -0.6
2265003
```

```
##  [16,] 6.6  1.11215548 -1.25985548 -0.535588676  0.9
9091689
##  [17,] 6.4  0.90477581 -0.30392244  0.909413294 -1.0
4926552
##  [18,] 7.4  1.35863182  0.09820639  0.147598367 -0.6
3536585
##  [19,] 6.8  0.76821232  0.25113902 -0.444327163 -0.8
4712501
##  [20,] 7.6  0.61161128  1.74911250 -0.747772366 -0.3
7770002
##  [21,] 5.4 -0.49662748 -0.40513549  1.413398115 -1.4
2620085
##  [22,] 9.9 -0.24583333  2.83259042  0.458183224  2.1
5737479
##  [23,] 7.0 -0.08593028 -0.20647990  0.954813784  1.2
9099542
##  [24,] 8.6  1.30419410 -0.65840510 -0.735880788  0.7
9535237
##  [25,] 4.8  0.02837015  0.11289267  0.352466288 -0.8
3695432
##  [26,] 6.6  0.37516895 -0.08949421  0.586591370 -1.3
3839027
##  [27,] 6.3  0.69040218 -1.27676215  0.980470048  0.9
7700863
##  [28,] 5.4  0.19330562 -1.09019060  0.410744110 -1.1
5018948
##  [29,] 6.3  0.74807174 -1.20388888 -0.169444094  1.1
1442401
##  [30,] 5.4 -0.53645976 -0.31470400 -1.389463973 -0.6
2508147
##  [31,] 6.1 -0.98478652 -0.32465411  2.054616799  0.5
7213335
```

```
##  [32,] 6.4 -0.89540824 -1.30592549  1.145669622 -0.1
7981750
##  [33,] 5.4 -0.61006900 -0.25385457  0.201747129 -0.5
1103804
##  [34,] 7.3  0.58139098 -0.57102185  0.160508882 -1.0
9267691
##  [35,] 6.3 -1.08254233  1.61817367  0.121735970 -0.3
2924397
##  [36,] 5.4 -1.51860194 -1.82264781  0.280394795  1.0
8323735
##  [37,] 7.1 -0.54298600 -0.45867623  0.359185746  0.4
4557509
##  [38,] 8.7  1.35035690  0.28270522  0.116158567  0.6
9743150
##  [39,] 7.6  0.98244317 -0.26293227 -1.015054009 -0.9
8172621
##  [40,] 6.0 -0.92383910  1.28059000 -1.167921851 -0.7
9331056
##  [41,] 7.0  0.09932064  0.09827305 -1.837451060 -0.6
3276007
##  [42,] 7.6  0.10869713 -0.04357923 -1.050920110  0.4
9209145
##  [43,] 8.9  0.44811474  1.20846081 -0.968824054  0.7
2015394
##  [44,] 7.6  0.70660340  2.17850627  1.233358555 -0.8
4868686
##  [45,] 5.5  1.38263370 -2.03732511 -0.954180731  0.7
7953010
##  [46,] 7.4  0.94936859  0.24232567  0.291172997 -0.5
6344261
##  [47,] 7.1  0.08771633 -0.60985289  0.976205747  0.4
5795642
```

```
##  [48,] 7.6  1.81030056  0.43834059  0.814478797 -1.1
7962559
##  [49,] 8.7 -0.19224074  1.62888205 -0.733730711  1.3
3934942
##  [50,] 8.6  0.22531882  0.78430768 -0.957752366  0.9
2784955
##  [51,] 5.4 -1.41135829 -0.16930613  0.091870699 -0.1
2631052
##  [52,] 5.7  1.75365232 -1.99153570 -1.147542434  0.7
0646283
##  [53,] 8.7  0.93209854 -0.51397965 -0.162358377  0.7
0759613
##  [54,] 6.1 -0.94184081 -0.25288506  0.358406630  0.6
7268912
##  [55,] 7.3  0.72242047 -0.54924734 -0.909388995 -1.0
9941166
##  [56,] 7.7 -0.63244099  0.41450294  0.914064214  0.8
1720176
##  [57,] 9.0  1.99193341  1.41977208 -0.077384854 -0.4
1266731
##  [58,] 8.2  0.08548402  0.30077469  0.319615332  0.7
4357193
##  [59,] 7.1 -0.57061091 -0.34885418  0.365475898  0.4
5601852
##  [60,] 7.9  0.83067496 -1.65626897  0.641678078  0.2
3244952
##  [61,] 6.6  0.86635294 -1.24543164  1.546930711  0.9
4382806
##  [62,] 8.0 -0.60680134  0.74525730 -0.146586558 -0.2
5509333
##  [63,] 6.3 -1.00306329 -0.09710517 -1.081705300  0.4
2111790
```

```
##  [64,] 6.0 -1.28310920 -1.59838664  0.403626668 -0.0
2388625
##  [65,] 5.4 -1.39461685 -0.23395772  0.557826636 -0.2
6460336
##  [66,] 7.6  1.60952000  0.55610373 -0.999093684 -1.1
6665258
##  [67,] 6.4  1.07257520 -0.39772241  1.815878900 -1.1
4631126
##  [68,] 6.1  0.50884788 -0.29395183 -0.416389316 -0.7
5909753
##  [69,] 5.2 -0.70601563 -0.44707894 -0.973611521 -0.8
3304582
##  [70,] 6.6  0.23899120  0.05018369 -1.219545924 -1.2
7828253
##  [71,] 7.6  0.48631145  1.74069413  0.854795068 -0.4
3411595
##  [72,] 5.8 -1.37477720 -0.22770098 -1.265787815  1.0
0015839
##  [73,] 7.9  0.76539809  0.81612817 -1.748046205 -0.1
3852761
##  [74,] 8.6 -0.64249465  1.66245576  1.253902625  1.2
0305576
##  [75,] 8.2 -0.26909538  0.83656999 -0.210138132 -0.1
1412392
##  [76,] 7.1 -0.12296694 -0.33391431  1.172210398  0.3
9677906
##  [77,] 6.4  0.10371878 -0.33487753  2.082854211 -1.1
8017022
##  [78,] 7.6  0.46301479 -0.33956677  1.214737442  0.1
0357998
##  [79,] 8.9  0.98918468  0.65624508  0.485336460  1.2
2733204
```

```
##  [80,] 5.7 -1.74919939  0.82890385  0.003384046  0.0
9231225
##  [81,] 7.1 -0.32137992 -0.20110631  0.470666208  0.6
0888606
##  [82,] 7.4 -0.03471489 -0.38974940  0.412648407  0.5
7771035
##  [83,] 6.6 -1.17790878 -0.90045717  0.198122454  0.4
0011473
##  [84,] 5.0 -2.55956258 -0.25686675  1.554283149 -1.1
4101556
##  [85,] 8.2  0.73971919 -0.90696938  0.655846983  0.5
1129012
##  [86,] 5.2 -0.50161741 -0.56408382 -1.009145207 -0.8
6106988
##  [87,] 5.2 -1.33057806 -0.01745886 -2.201996451 -0.9
2403144
##  [88,] 8.2  0.70358137 -0.91236060  1.299031585  0.5
6968494
##  [89,] 7.3  0.10912530 -0.46505791  0.266161987  0.1
7120142
##  [90,] 8.2  1.02813129  2.57446865  1.640665437 -0.8
0151398
##  [91,] 7.4 -1.04672561  0.44260491  1.394021786  0.7
5011393
##  [92,] 4.8 -1.90712581 -0.46993540 -0.522475751 -1.3
1422452
##  [93,] 7.6  0.07279015 -0.02235421 -0.352359525  1.6
1044504
##  [94,] 8.9  1.08706436  0.61924340  0.089460676  1.1
6081123
##  [95,] 7.7 -0.95457978  0.66256003 -0.981787816  1.0
6717592
```

```
##  [96,] 7.3 -0.41931326  0.70755398 -0.077703201  0.5
2522023
##  [97,] 6.3 -0.12315824 -0.25275815 -1.762967608 -0.6
3424275
##  [98,] 5.4 -1.79270636 -1.59315365 -1.309147686  1.2
8219570
##  [99,] 6.4 -0.33991434  1.89138931  0.122487640 -0.1
7511674
## [100,] 6.4 -0.31758889 -0.42356050 -0.453981729 -1.0
3250054
```

```
dim(newdata)
```

```
## [1] 100   5
```

```
view(newdata)
```

```
class(newdata)
```

```
## [1] "matrix"
```

```
newdata=data.frame(newdata)
attach(newdata)
names(newdata)<-c("CUSTOMER_SATISFACTION","PRODUCT_PURC
HASE","MARKETING","POST_PROCUREMENT","BRAND_POSITIONING
")
names(newdata)
```

```
## [1] "CUSTOMER_SATISFACTION" "PRODUCT_PURCHASE"
"MARKETING"
## [4] "POST_PROCUREMENT"      "BRAND_POSITIONING"
```

```
head(newdata)
```

```
##   CUSTOMER_SATISFACTION PRODUCT_PURCHASE  MARKETING
POST_PROCUREMENT
```

```
## 1                   8.2       -0.1338871  0.9175166
-1.719604873
## 2                   5.7        1.6297604 -2.0090053
-0.596361722
## 3                   8.9        0.3637658  0.8361736
0.002979966
## 4                   4.8       -1.2225230 -0.5491336
1.245473305
## 5                   7.1       -0.4854209 -0.4276223
-0.026980304
## 6                   4.7       -0.5950924 -1.3035333
-1.183019401
##   BRAND_POSITIONING
## 1        0.09135411
## 2        0.65808192
## 3        1.37548765
## 4       -0.64421384
## 5        0.47360747
## 6       -0.95913571
```

```
mean(newdata$CUSTOMER_SATISFACTION)
```

```
## [1] 6.918
```

```
#########################################################
# MULTIPLE LINEAR REGRESSION #
#########################################################
MRM=lm(CUSTOMER_SATISFACTION~.,data = newdata)
summary(MRM)
```

```
##
## Call:
```

```
## lm(formula = CUSTOMER_SATISFACTION ~ ., data = newda
ta)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.7125 -0.4708  0.1024  0.4158  1.3483
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t
|)
## (Intercept)        6.91800    0.06696 103.317  < 2e-
16 ***
## PRODUCT_PURCHASE   0.57963    0.06857   8.453 3.32e-
13 ***
## MARKETING          0.61978    0.06834   9.070 1.61e-
14 ***
## POST_PROCUREMENT   0.05692    0.07173   0.794    0.4
29
## BRAND_POSITIONING  0.61168    0.07656   7.990 3.16e-
12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.'
0.1 ' ' 1
##
## Residual standard error: 0.6696 on 95 degrees of fre
edom
## Multiple R-squared:  0.6971, Adjusted R-squared:  0.
6844
## F-statistic: 54.66 on 4 and 95 DF,  p-value: < 2.2e-
16
```

```
anova(MRM)
```

```
## Analysis of Variance Table
##
## Response: CUSTOMER_SATISFACTION
##                   Df Sum Sq Mean Sq F value    Pr(>F
)
## PRODUCT_PURCHASE   1 34.712  34.712 77.4219 6.084e-1
4 ***
## MARKETING          1 34.037  34.037 75.9160 9.277e-1
4 ***
## POST_PROCUREMENT   1  0.663   0.663  1.4784     0.22
7
## BRAND_POSITIONING  1 28.622  28.622 63.8381 3.162e-1
2 ***
## Residuals         95 42.593   0.448
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.'
0.1 ' ' 1
```

```
predict(MRM)->PREDICTED_SATISFACTION
COMPARE_VALUES=data.frame(newdata$CUSTOMER_SATISFACTION
,PREDICTED_SATISFACTION)
COMPARE_VALUES
```

```
##     newdata.CUSTOMER_SATISFACTION PREDICTED_SATISFAC
TION
## 1                             8.2              7.36
7049
## 2                             5.7              6.98
6102
## 3                             8.9              8.48
8620
## 4                             4.8              5.54
5893
```

```
## 5                    7.1                  6.65
9765
## 6                    4.7                  5.11
1139
## 7                    5.7                  4.86
5471
## 8                    6.3                  5.89
5844
## 9                    7.0                  7.10
8530
## 10                   5.5                  7.08
9830
## 11                   7.4                  7.02
8136
## 12                   6.0                  6.32
9119
## 13                   8.4                  8.56
3073
## 14                   7.6                  7.85
2140
## 15                   8.0                  7.76
3751
## 16                   6.6                  7.35
7439
## 17                   6.4                  6.66
4020
## 18                   7.4                  7.38
6129
## 19                   6.8                  6.97
5467
## 20                   7.6                  8.08
2976
```

```
## 21                    5.4                   5.58
7122
## 22                    9.9                   9.87
6795
## 23                    7.0                   7.58
4247
## 24                    8.6                   7.71
0493
## 25                    4.8                   6.51
2528
## 26                    6.6                   6.29
4716
## 27                    6.3                   7.18
0292
## 28                    5.4                   5.67
4200
## 29                    6.3                   7.27
7482
## 30                    5.4                   5.95
0564
## 31                    6.1                   6.61
2893
## 32                    6.4                   5.54
4834
## 33                    5.4                   6.10
5945
## 34                    7.3                   6.24
1851
## 35                    6.3                   7.09
8978
## 36                    5.4                   5.58
6690
```

```
## 37                    7.1                   6.61
1987
## 38                    8.7                   8.30
9137
## 39                    7.6                   6.66
6209
## 40                    6.0                   6.62
4468
## 41                    7.0                   6.54
4837
## 42                    7.6                   7.19
5175
## 43                    8.9                   8.31
2075
## 44                    7.6                   8.22
8844
## 45                    5.5                   6.87
9227
## 46                    7.4                   7.29
0397
## 47                    7.1                   6.92
6559
## 48                    7.6                   7.56
3785
## 49                    8.7                   8.59
3608
## 50                    8.6                   8.04
7728
## 51                    5.4                   5.92
2973
## 52                    5.7                   7.06
6959
```

```
## 53                    8.7                   7.56
3296
## 54                    6.1                   6.64
7221
## 55                    7.3                   6.27
2070
## 56                    7.7                   7.36
0217
## 57                    9.0                   8.69
5702
## 58                    8.2                   7.62
6984
## 59                    7.1                   6.67
0786
## 60                    7.9                   6.55
1670
## 61                    6.6                   7.31
3645
## 62                    8.0                   6.86
3797
## 63                    6.3                   6.47
2428
## 64                    6.0                   5.19
1990
## 65                    5.4                   5.83
4539
## 66                    7.6                   7.42
5096
## 67                    6.4                   6.69
5384
## 68                    6.1                   6.54
2730
```

```
## 69                    5.2                   5.66
6705
## 70                    6.6                   6.23
6309
## 71                    7.6                   8.06
1845
## 72                    5.8                   6.51
9740
## 73                    7.9                   7.68
3228
## 74                    8.6                   8.38
3210
## 75                    8.2                   7.19
8745
## 76                    7.1                   6.94
9199
## 77                    6.4                   6.16
7244
## 78                    7.6                   7.10
8424
## 79                    8.9                   8.67
6448
## 80                    5.7                   6.47
4512
## 81                    7.1                   7.00
6312
## 82                    7.4                   7.03
3182
## 83                    6.6                   5.93
3185
## 84                    5.0                   4.66
5743
```

```
## 85                    8.2                   7.13
4719
## 86                    5.2                   5.69
3498
## 87                    5.2                   5.44
5384
## 88                    8.2                   7.18
2762
## 89                    7.3                   6.81
2889
## 90                    8.2                   8.71
2660
## 91                    7.4                   7.12
3788
## 92                    4.8                   4.68
7695
## 93                    7.6                   7.91
1356
## 94                    8.9                   8.64
7025
## 95                    7.7                   7.37
2224
## 96                    7.3                   7.43
0326
## 97                    6.3                   6.20
1653
## 98                    5.4                   5.60
1265
## 99                    6.4                   7.79
3079
## 100                   6.4                   5.81
4001
```

```
plot(newdata$CUSTOMER_SATISFACTION,col="red")
lines(newdata$CUSTOMER_SATISFACTION,col="red")
plot(PREDICTED_SATISFACTION,col="blue")
lines(PREDICTED_SATISFACTION,col="blue")
vif(MRM)
```

```
##  PRODUCT_PURCHASE          MARKETING  POST_PROCUREMEN
T BRAND_POSITIONING
##          1.001021           1.002683          1.00298
1          1.005848
```

```
mean(newdata$CUSTOMER_SATISFACTION)
```

```
## [1] 6.918
```