Cardio Good Fitness Model Report

By - Nikhil Rawal

Project Objective

The objective of the report is to explore the cardio data set ("CardioGoodFitness") in R and generate insights about the data set. This exploration report will consists of the following:

- Importing the dataset in R
- Understanding the structure of dataset
- Graphical exploration
- Descriptive statistics
- Insights from the dataset

Assumptions

Given the nature of the data provided in the dataset, it is assumed that the data is related to the customers who have purchased the treadmill products in the last quarter (April – June 2017). The 180 rows of the dataset correspond to 180 unique customers of the treadmill products. The features in the dataset are linked to the demographics and treadmill usage characteristics of the customers.

Also, the following data dictionary is considered for the 9 features in the dataset:

Sl. No.	Feature Name	Feature Code	Feature Description
1	Product	Product	Model of treadmill product (TM195/ TM498/ TM 798)
2	Age	Age	Age of the customer (Years)
3	Gender	Gender	Gender of the customer (Male & Female)
4	Education	Education	Education of the customer (Years)
5	Marital Status	MaritalStatus	Marital status of the customer (Single & Partnered/ Married)
6	Usage	Usage	Weekly average number of times the customer plans to use the treadmill (No. of times/ Week)
7	Fitness Level	Fitness	Weekly average number of miles the customer expects to walk/run on the treadmill (Miles/ Week)
8	Household Income	Income	Annual household income of the customer ($)
9	Total Distance Covered	Miles	Total distance covered on the treadmill (Miles)

Exploratory Data Analysis – Step by step approach

A Typical Data exploration activity consists of the following steps:

1. Environment Set up and Data Import
2. Variable Identification
3. Univariate Analysis
4. Bi-Variate Analysis
5. Missing Value Treatment (Not in scope for our project)
6. Outlier Treatment (Not in scope for our project)
7. Variable Transformation / Feature Creation
8. Feature Exploration

Variable Identification – Inferences

- **No. of Rows and Columns:**

No. of Rows	No. of Columns (Features)
180	9

- The number of rows in the dataset is 180 and
  - The number of columns (Features) is 9.

- **Features and their Types:**
  - Various **Continuous** and **Categorical** Features of the dataset are as follows:

Sr. No.	Feature Name	Type	Continuous / Categorical
1	Product	Factor	Categorical
2	Age	Integer	Continuous
3	Gender	Factor	Categorical
4	Education	Integer	Continuous
5	Marital Status	Factor	Categorical
6	Usage	Integer	Continuous
7	Fitness	Integer	Continuous
8	Income	Integer	Continuous
9	Miles	Integer	Continuous

- **Summary Statistics of the Continuous variables is as follows:**

Feature	Min. Val	1st Q	Median	Mean	3rd Q	Max
Age	18	24	26	28.79	33	50
Education	12	14	16	15.57	16	21
Usage	2	3	3	3.45	4	7
Fitness	1	3	3	3.31	4	5
Income	29,560	44,060	50,600	53,720	58,670	1,04,600
Miles	21	66	94	103.2	114.8	360

Categorical Variables Analysis

table(): List all values of a variable with frequencies

- **Features Summary:**

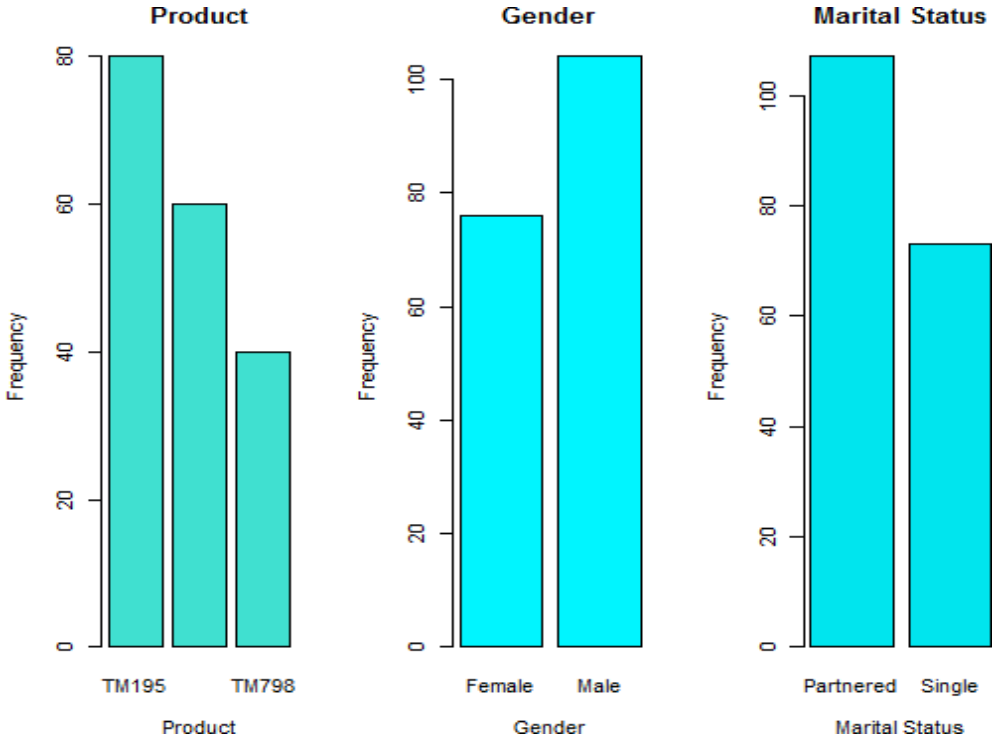
  Population distribution of various Products, Gender and Marital Status is provided in the following tables:

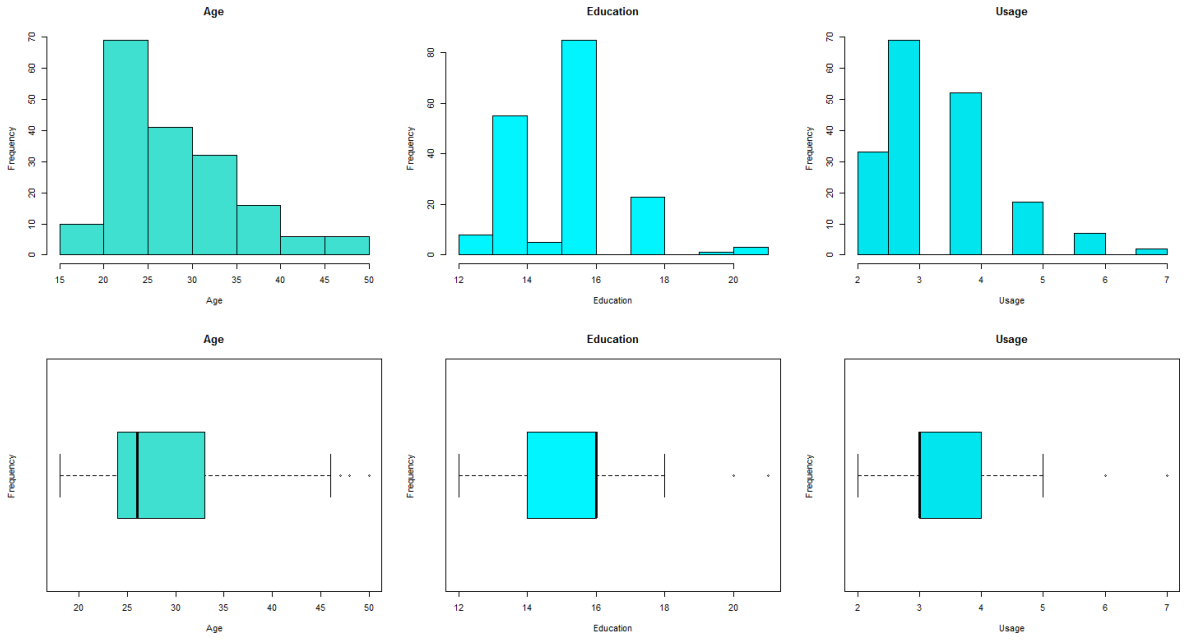
Product	Quantity
TM195	80
TM498	60
TM798	40

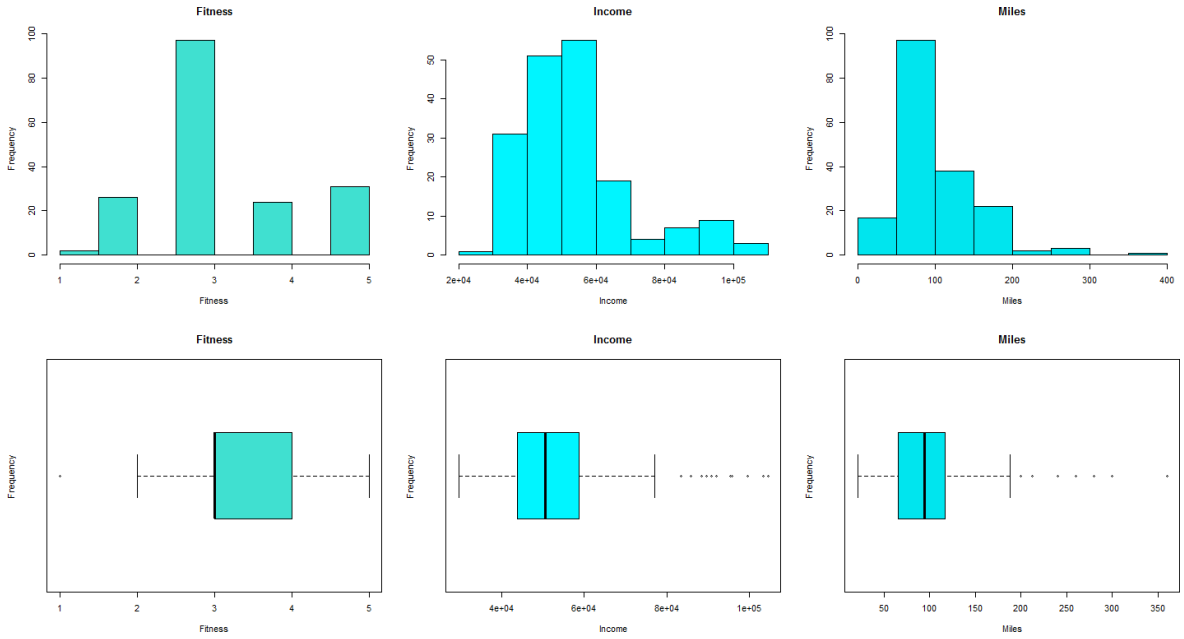
Gender	Count
Female	76
Male	104

Marital Status	Count
Partnered	107
Single	73

Categorical Variables Analysis – Visualization





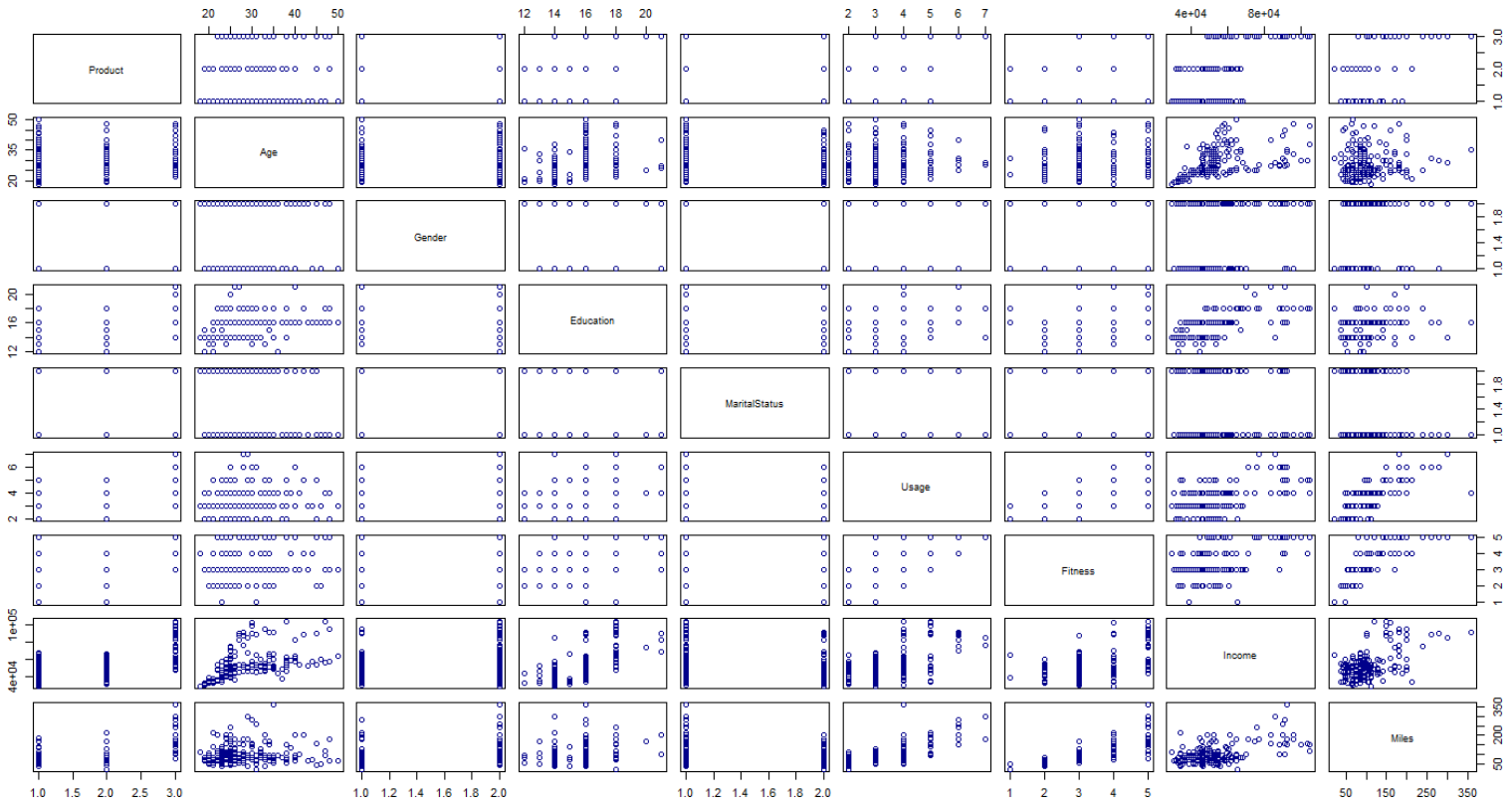


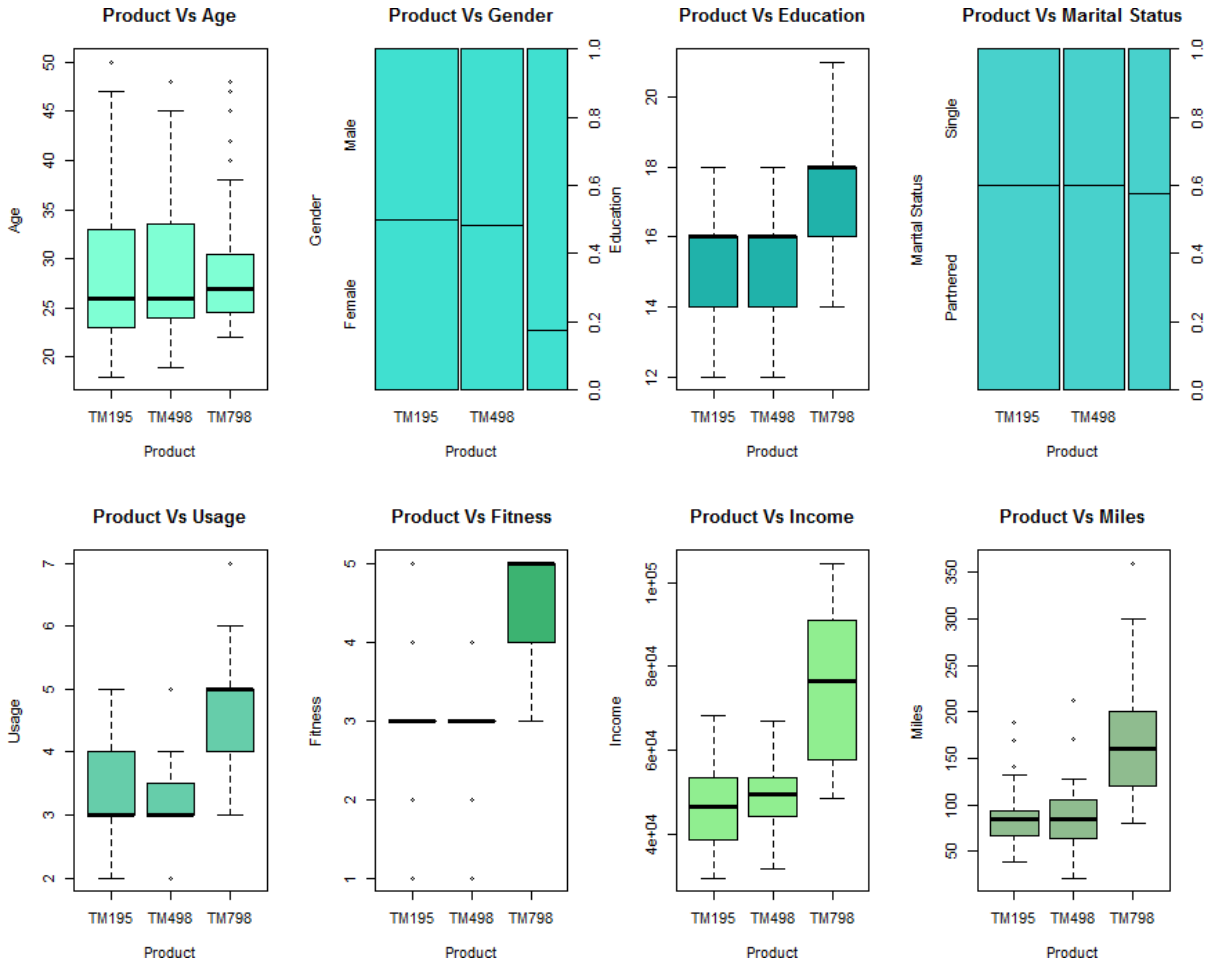
Bi-Variate Analysis

Bi-variate Analysis finds out the relationship between two variables. Here, we look for association and disassociation between variables at a pre- defined significance level. We can perform bi-variate analysis for any combination of categorical and continuous variables. The combination can be: Categorical & Categorical, Categorical & Continuous and Continuous & Continuous. Different methods are used to tackle these combinations during analysis process

Bivariate Analysis – Cardio Good Fitness

Let's analyse the relationship of the 9 features with each other. The visualization can be obtained either by using pairs() function, or plot() function, giving one pair variables at a time. Following graph is created using the pairs() function.


Product
Age
Gender
Education
MaritalStatus
Usage
Fitness
Income
Miles



Interpretation:

- **Product Vs Age:** TM195 is popular among all age groups. TM798 is popular among 22-47 age group.
- **Product Vs Gender:** TM798 is popular among Male.
- **Product Vs Education:** TM798 is more popular in highly educated people.
- **Product Vs Marital Status:** No Correlation found.
- **Product Vs Usage**: TM798 has more usage level.
- **Product Vs Fitness:** TM195 and TM498 is mostly used by people with fitness level of 3, whereas TM798 is popular among 4 and 5 fitness levels.
- **Product Vs Income:** TM195 and TM498 are popular among low and medium income group, whereas TM798 is popular among medium to high income group.
- **Product Vs Miles:** Positive correlation, as the Product range increases from TM195 to TM498 and TM798, there is an increase in Total Distance covered.

- **Age Vs Gender:** No Correlation found.
- **Age Vs Education:** No Correlation found.
- **Age Vs Marital Status:** No Correlation found.
- **Age Vs Usage**: Usage levels 2,3,4 and 5 are popular among all age groups, whereas Usage Levels 6 and 7 are popular among 30-40 age group.
- **Age Vs Fitness:** No Correlation found.
- **Age Vs Income:** Positive Correlation. Income increases along with Age.
- **Age Vs Miles:** Random distribution. Probable candidates for Transformation.
- **Gender Vs Education:** No Correlation found.
- **Gender Vs Marital Status:** No Correlation found.
- **Gender Vs Usage**: Uniform Usage level up to 6. Level 7 is popular among Male.
- **Gender Vs Fitness:** No Correlation found.
- **Gender Vs Income:** Income is slightly more among Male.
- **Gender Vs Miles:** Male tend to burns more Miles than Female.
- **Education Vs Marital Status:** No Correlation found.
- **Education Vs Usage**: No Prominent correlation found.
- **Education Vs Fitness:** No Correlation found.
- **Education Vs Income:** Positive Correlation, Higher income for highly educated person.
- **Education Vs Miles:** Persons at education level 16 tend to burn more miles.
- **Marital Status Vs Usage**: Partnered have a tendency of more usage.
- **Marital Status Vs Fitness:** No Correlation found.
- **Marital Status Vs Income:** Partnered persons have slightly higher income level.
- **Marital Status Vs Miles:** Partnered person's burn more miles.
- **Usage Vs Fitness:** Positive Correlation. More usage with increased fitness.
- **Usage Vs Income:** Higher usage is found at higher income level, however, average usage is found across income groups.
- **Usage Vs Miles:** Positive Correlation found. Miles burned increases with increase in Usage.
- **Fitness Vs Income:** Positive correlation found. High fitness level observed among high income group.
- **Fitness Vs Miles:** Positive Correlation found. Persons with High fitness level tend to burn more miles.
- **Income Vs Miles:** Positive Correlation found.

Categorization of Continuous Variables (Binning):

The following continuous variables are grouped into various slabs:

- ***Age (Variable Name: Age)***
    1. Early Youth: 18 – 25 years
    2. Late Youth: 26-35 years
    3. Middle Aged Adults: 36+ years
- ***Education (Variable Name: Education)***
    1. Higher Secondary: 12 years
    2. Graduation: 13-16 years
    3. Masters/ Post Graduation: 17+ years
- **Usage (Variable Name: Usage)**
    1. Fitness Amateurs: 2-3 times/ week
    2. Fitness Regulars: 4-5 times/ week
    3. Fitness Freaks: 6-7 times/ week
- ***Fitness Level (Variable Name: Fitness)***
    1. Low Intensity: 1-2 miles/ week
    2. Medium Intensity: 3-4 miles/ week
    3. High Intensity: 5 miles/week
- ***Household Income (Variable Name: Income)***
    1. Low Income Household: Upto $ 40,000
    2. Medium Income Household: $ 40,001 - $ 60,000
    3. High Income Household: $ 60,001+
- ***Total Distance Covered (Variable Name: Miles)***
    1. Low Usage: Up to 60 miles
    2. Medium Usage: 61-120 miles
    3. High Usage: 121+ miles

The groupings of continuous variables were done using the command ‘ifelse’. Also, the group slabs were defined by taking into considerations the summary parameters such as minimum value, mean value, quartile value etc. obtained through command ‘summary’.

The R codes for the groupings of continuous variables by groupings of continuous variables are as follows:

Please refer Appendix A for Source Code

After groupings of continuous variables, the data is appended to the dataset ‘cardiodata’ using the command ‘cbind’.

The number of rows in the dataset is 180 and the number of columns is 15. In the new dataset, the number of columns has increased from 9 to 15.

Subset Creation:

Given the business objective is to identify different customer segments available in the market for the product (i.e., treadmill) by understanding whether there are differences across the product lines with respect to customer characteristics.

In such a scenario, the overall database (Variable="cgf_data_1") is divided into three subsets by product types:

- Product 'TM195': Variable="product1"
- Product 'TM498': Variable="product2"
- Product 'TM798': Variable="product3"

The subsets were created using the command 'which' as depicted in Source Code (Appendix A)

Feature Exploration

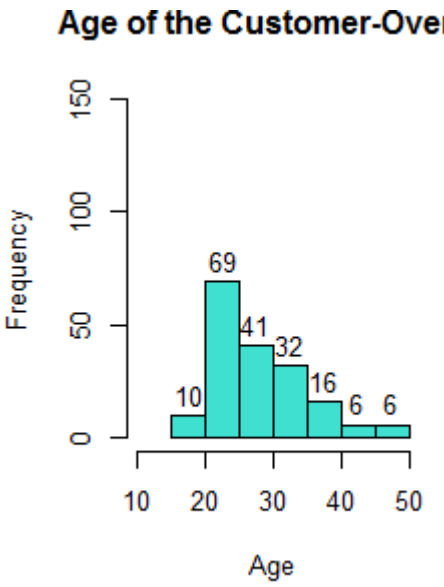
In this section, the features available in the new dataset 'cgf_data_1' will be explored in detail. The goal is to describe or summarize data in ways that are meaningful and useful for insights generation. It provides simple summaries about the sample and the measures. Together with simple graphics analysis, it forms the basis of virtually every quantitative analysis of data.

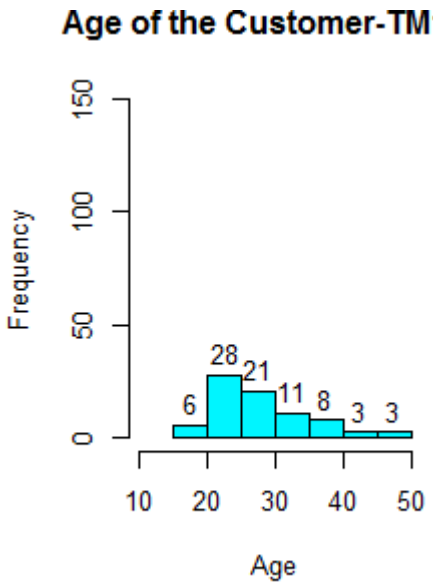
The feature exploration will be done by product types (i.e., treadmill).

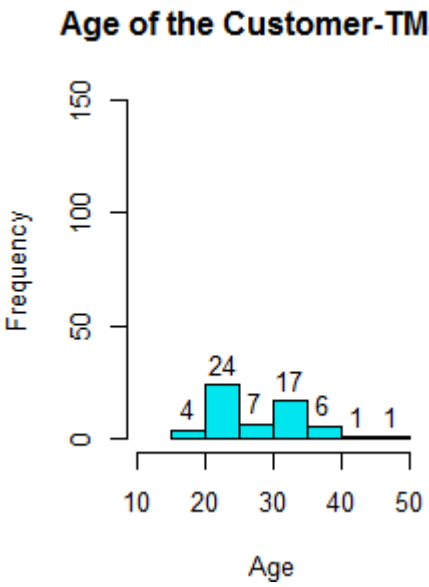
Age

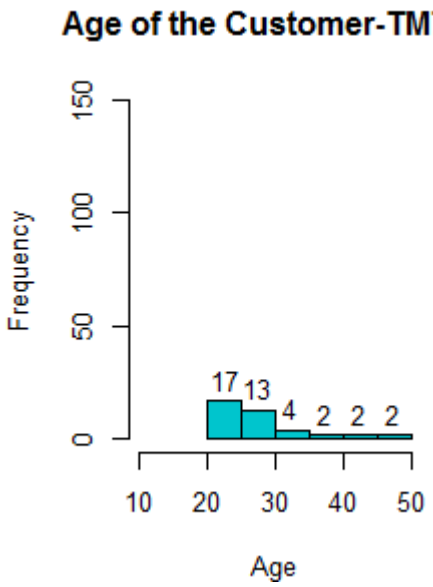
The variable 'Age' is a continuous varaible.

The histogram of Age for different Products is as follows:









Mean, Standard Deviation, and Variance:

Mean	Standard Deviation	Variance	Remark
28.79	6.94	48.21	Age Stats for All Products
28.55	7.22	52.15	Age Stats for TM195
28.9	6.65	44.16	Age Stats for TM498
28.1	6.97	48.61	Age Stats for TM798

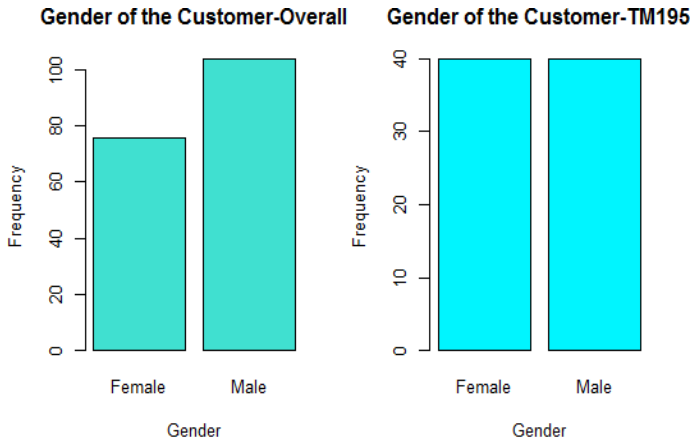
Interpretation:

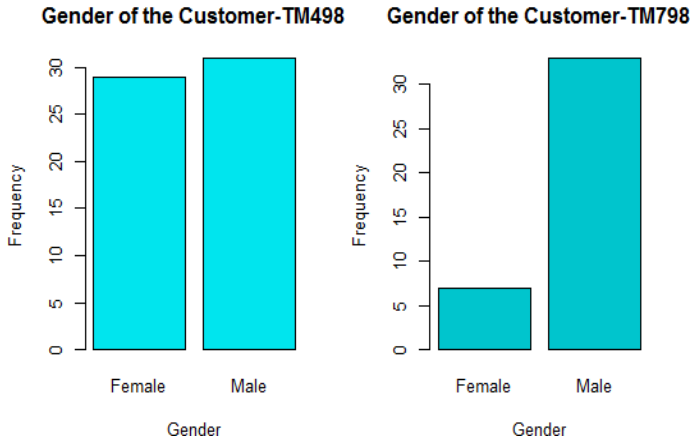
- The majority of the treadmill customers had age between 21-30 years across product types – TM195, TM498 & TM798
- TM498 has relatively higher proportion of customers above 30 years of age as compared to TM195 & TM798
- The average customer age across product types (TM195, TM498 & TM798) is similar, approximately 29 years
- TM195 has relatively higher variation in the data distribution in comparison to TM498 & TM798

Gender

The variable 'Gender' is a categorical varaible.

Lets use barplot and Frequency Table to explore the details.

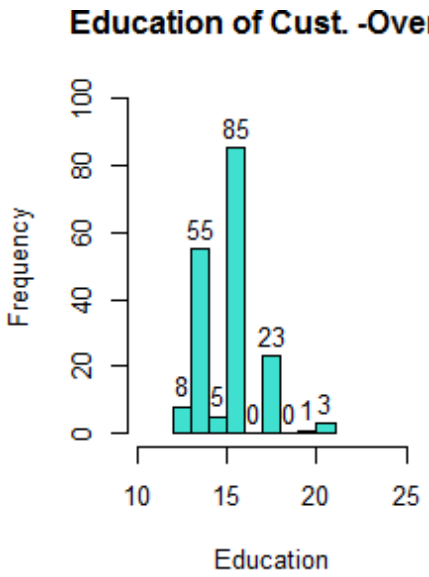


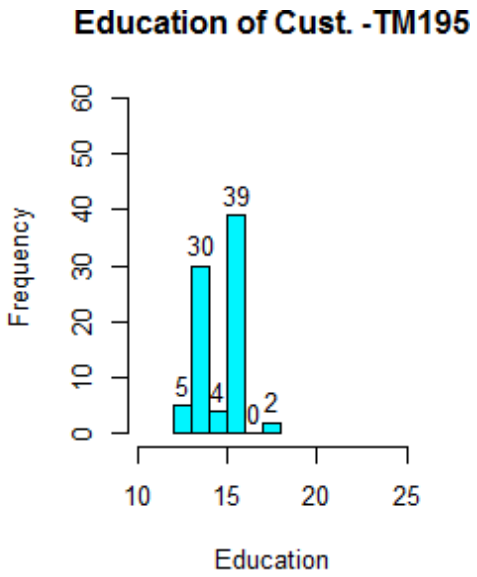


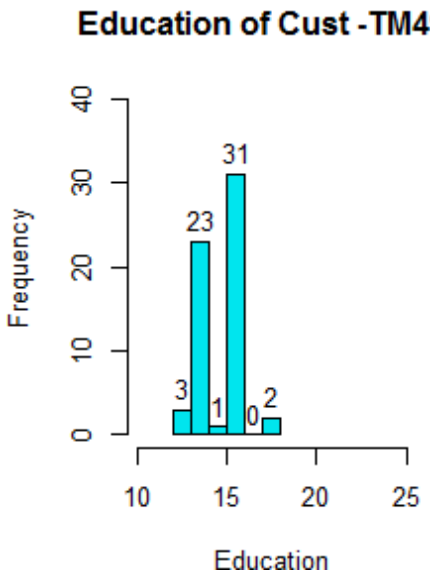
Product	Female	Male
Overall	76	104
TM195	40	40
TM498	29	31
TM798	7	33

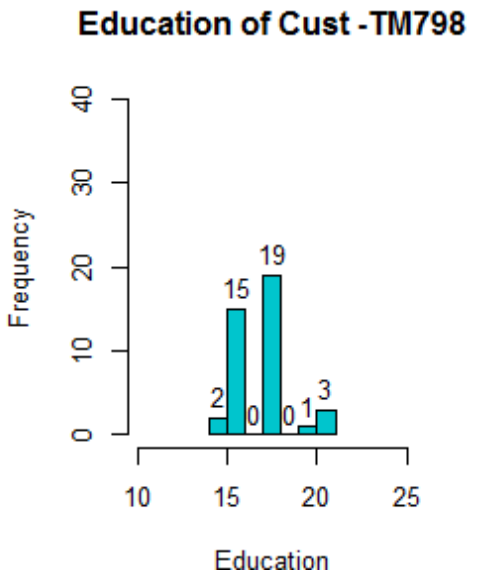
Interpretation:

- The gender profile of products – TM195 & TM498 seems to be almost equally balanced between males and females, i.e. equal proportion of males and females as customers.
- TM798 is dominated by male users.





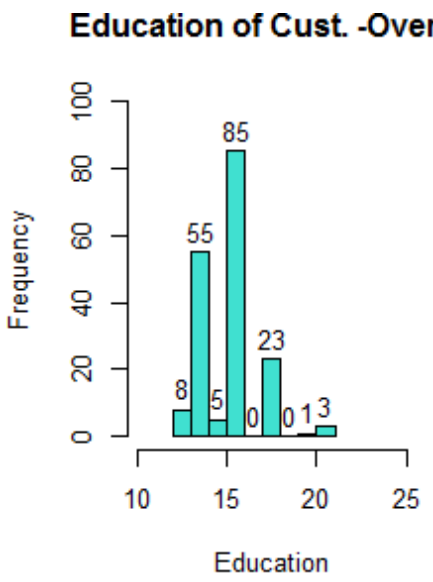


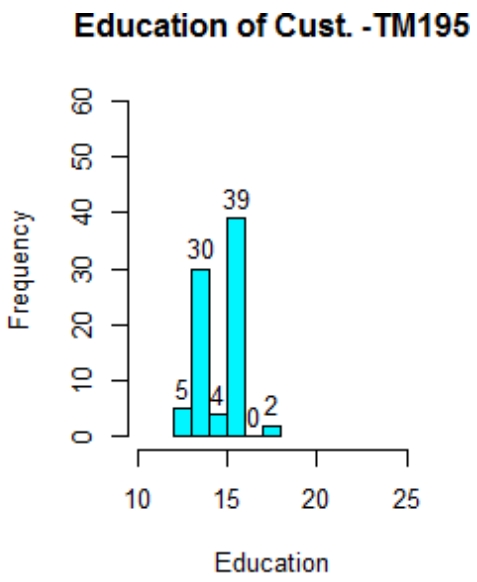


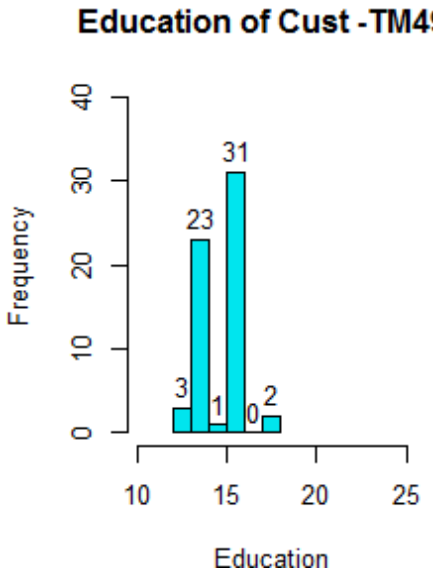
Education

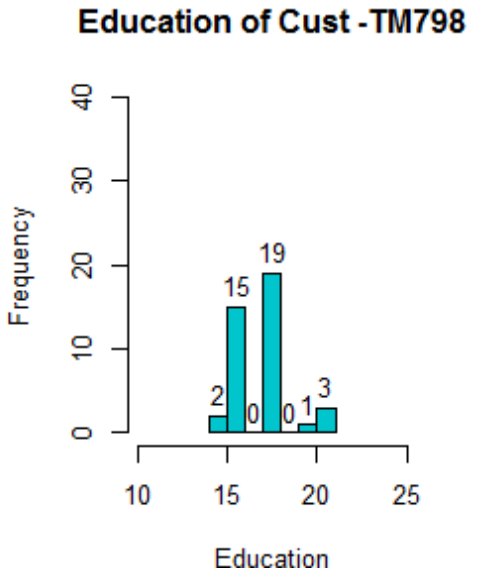
The variable ‘Education’ is a continuous varaible.

Lets use Histogram and the measures of dispersion (Mean, Standard Deviation and Variance) to explore this variable.









Mean	Standard Deviation	Variance	Remark
15.57	1.62	2.61	Education Stats for All Products
15.04	1.22	1.48	Education Stats for TM195
15.12	1.22	1.49	Education Stats for TM498
17.32	1.64	2.69	Education Stats for TM798

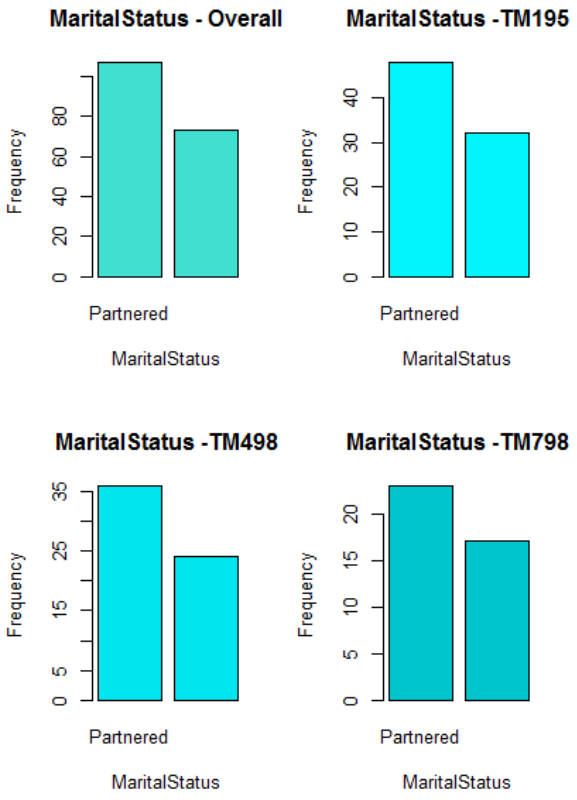
Interpretation:

- The majority of the treadmill customers had education in years above 15 years across product types – TM195, TM498 & TM798.
- TM195 & TM498 had 49% & 45% of their customers with up to 15 years of education respectively.
- TM798 had predominantly customers with more than 15 years of education (95%).
- TM798 had relatively higher average number of years in education by customers in comparison to TM195 & TM498.
    - Also, TM798 had relatively higher variation in the data distribution in comparison to TM195 & TM498.

Marital Status

The variable 'MaritalStatus' is a categorical varaible.

Lets use barplot and Frequency Table to explore the details.



Product	Partnered	Single
Overall	107	73
TM195	48	32
TM498	36	24
TM798	23	17

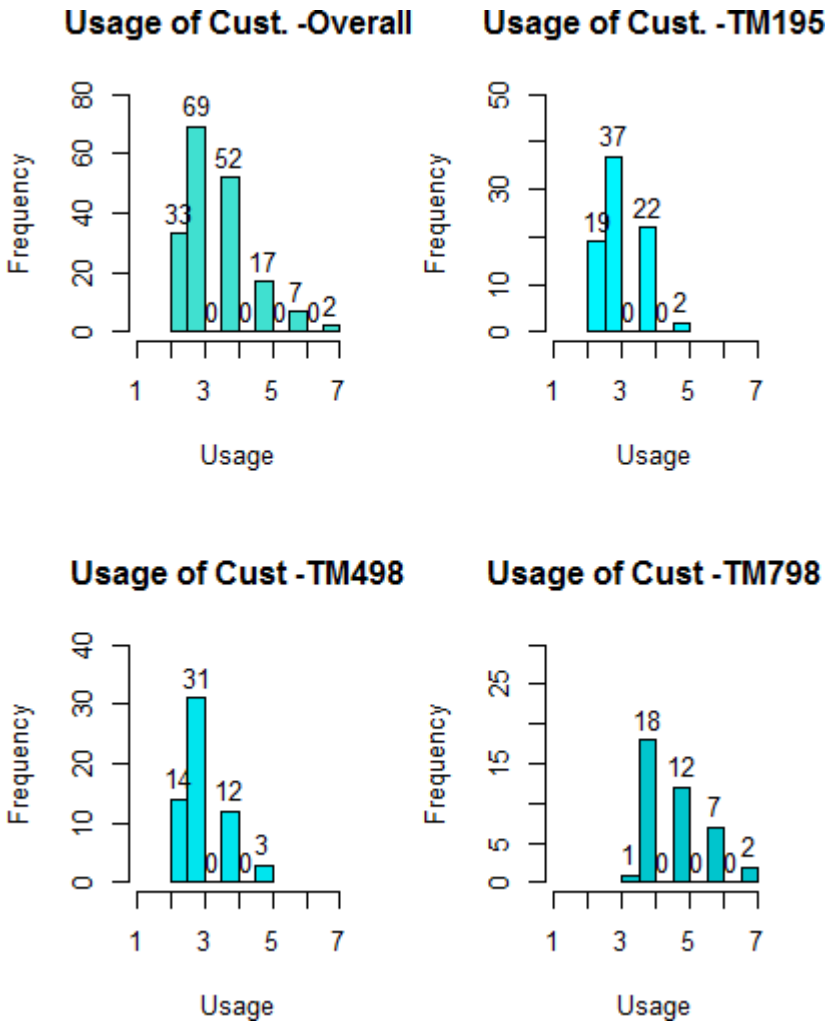
Interpretation:

- Majority of the customers had marital status as 'Partnered' across product types – TM195, TM498 & TM 798.

Usage

The variable 'Usage is a continuous varaible.

Lets use Histogram and the measures of dispersion (Mean, Standard Deviation and Variance) to explore this variable.



Mean	Standard Deviation	Variance	Remark
3.46	1.08	1.18	Usage Stats for All Products
3.09	0.78	0.61	Usage Stats for TM195
3.07	0.8	0.64	Usage Stats for TM498
4.78	0.95	0.9	Usage Stats for TM798

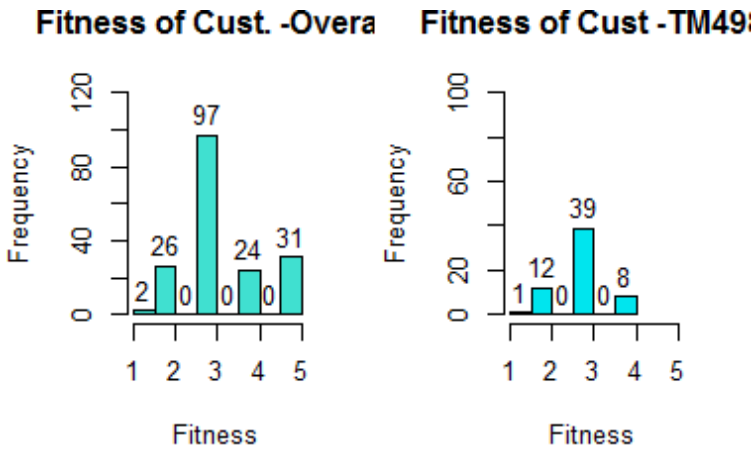
Interpretation:

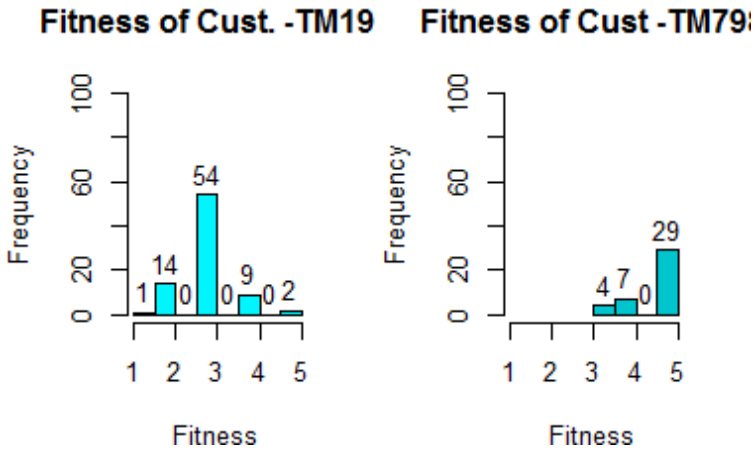
- Majority of TM195 & TM498 customers plan to use the treadmill upto 3 times a week on an average
- Almost cent percent of the TM798 customers plan to use the treadmill 4 times or more a week on an average
- TM798 customers had relatively higher intention to use treadmill (in terms of average number of times using the treadmill per week) in comparison to TM195 & TM498 customers
    - Also, TM798 had relatively higher variation in the data distribution in comparison to TM195 & TM498.

Fitness

The variable 'Fitness' is a continuous varaible.

Lets use Histogram and the measures of dispersion (Mean, Standard Deviation and Variance) to explore this variable.





Mean	Standard Deviation	Variance	Remark
3.31	0.96	0.92	Fitness Stats for All Products
2.96	0.66	0.44	Fitness Stats for TM195
2.9	0.63	0.4	Fitness Stats for TM498
4.62	0.67	0.45	Fitness Stats for TM798

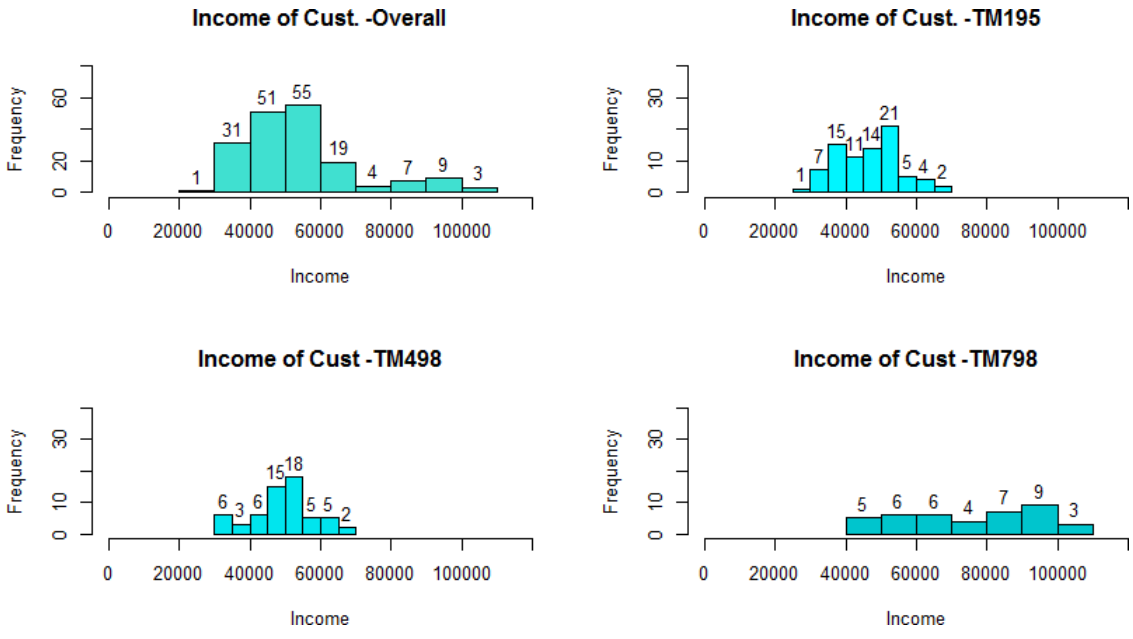
Interpretation:

- Majority of TM195 & TM498 customers plan to cover upto 3 miles on the treadmill per week on an average.
- Majority of TM798 customers plan to cover 4 miles or more on the treadmill per week on an average.
- TM798 customers had relatively higher fitness goals (in terms of average number of miles covered on treadmill per week) in comparison to TM195 & TM498 customers.

Income

The variable 'Income is a continuous varaible.

Lets use Histogram and the measures of dispersion (Mean, Standard Deviation and Variance) to explore this variable.



Mean	Standard Deviation	Variance	Remark
53719.58	16506.68	272470624.1	Income Stats for All Products
46418.03	9075.78	82369840.51	Income Stats for TM195
48973.65	8653.99	74891532.33	Income Stats for TM498
75441.57	18505.84	342465992.7	Income Stats for TM798

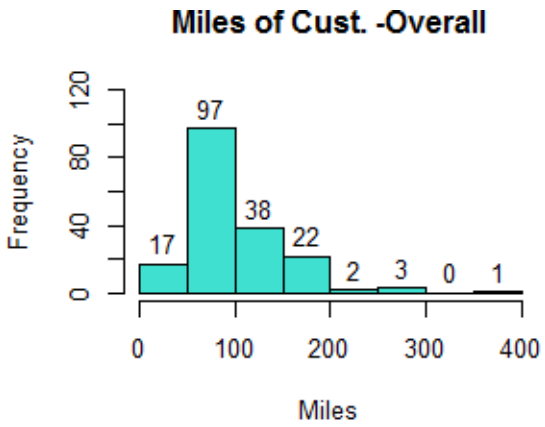
Interpretation:

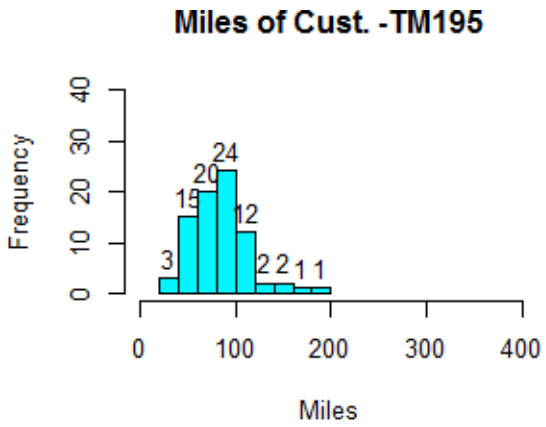
- Almost 3/4th customer of the products (TM195, TM498 & TM798) have annual household income in the following range:
    - 76% of the TM195 customers have annual household income between $35,000 - $55,000
    - 73% of the TM498 customers have annual household income between $40,000 - $60,000
    - 72% of the TM798 customers have annual household income of more than $60,000
- TM798 customers had relatively higher average annual household income in comparison to TM195 & TM498 customers
    - Also, TM798 had relatively higher variation in the data distribution in comparison to TM195 & TM498

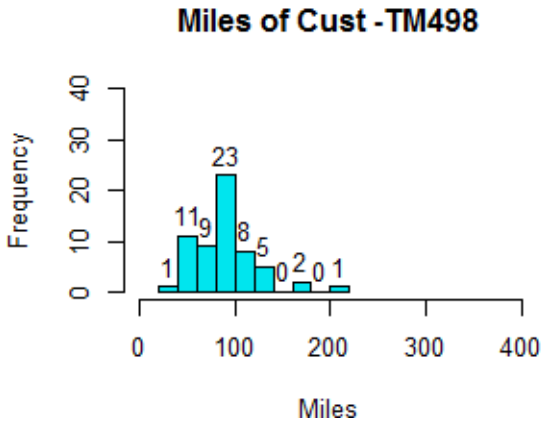
Total Distance Covered – Miles

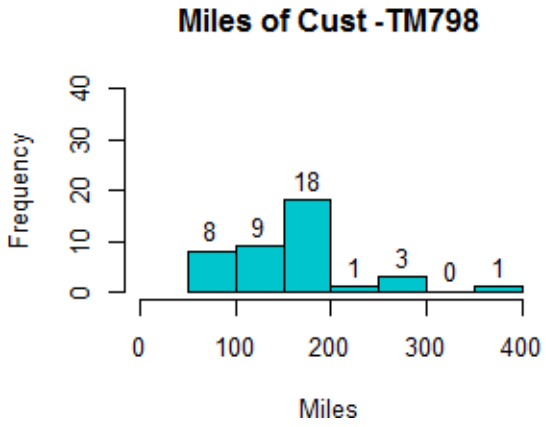
The variable 'Miles' is a continuous varaible.

Lets use Histogram and the measures of dispersion (Mean, Standard Deviation and Variance) to explore this variable.









Mean	Standard Deviation	Variance	Remark
103.19	51.86	2689.83	Miles Stats for All Products
82.79	28.87	833.71	Miles Stats for TM195
87.93	33.26	1106.44	Miles Stats for TM498
166.9	60.07	3607.99	Miles Stats for TM798

Interpretation:

- Almost 3 out of 4 TM195 & TM498 customers have covered upto 100 miles on treadmill.
- Nearly cent percent of TM798 customers have covered 100 miles or more on treadmill.
- TM798 customers had relatively higher average distance covered on treadmill in comparison to TM195 & TM498 customers.
- Also, TM798 had relatively higher variation in the data distribution in comparison to TM195 & TM498.

Conclusion

Outliers in the Data:

- Outliers found in the data for Age, Education, Usage, Income, and Miles.
- Further investigation required as how these outliers should be treated.

Gender:

- The collected data is Male dominated (104 Vs 76). Hence precaution should be taken while interpreting the results for Male Vs. Female.
- Usage of the Product: Level 7 is popular among Male.
- It is observed that Male candidate have slightly higher income than Female.
- Also the Miles burning rate is higher in Male than Female. Looking at the Product Features, we may conclude that Male candidates can be targeted for product M798.

Marital Status:

- The collected data is dominated with Partners (107 Vs 73). Hence precaution should be taken while interpreting the results for Partners Vs. Single.
- Partnered have shown more usage of the Fitness Centre compared to Singles. This is significant insight for target marketing.
- Partnered persons also tend to burn more miles. This suggests that the promotion of products TM498 and TM798 can be penetrated more on them.

Product:

- TM195 is popular among all age groups, whereas TM798 is popular among 22-47 age group. This is useful insight for target marketing of TM798.
- TM195 seems to be an entry level product, as it's been used across various Fitness levels whereas TM798 seems to be a specialized product, as it's being used for higher fitness levels. (3+ Levels)
- TM798 also should be targeted among highly educated people.
- A new comer to the fitness club may safely start using TM195.
- TM195 and TM498 are popular among low and medium income group, whereas TM798 is popular among medium to high income group. Another indicator for Target Marketing.
- If one needs to achieve more miles, then TM798 is the product for him/her.
- Significance of Usage Level need to understand to provide further inputs on this feature.

Education:

- Highly educated people tend to earn more income. This information can be used for cross selling.
- Persons at education level 16 tend to burn more miles. Such are the ideal candidates for product TM798.

Usage:

- Persons with higher fitness level tend to use the fitness centre more.
- Higher Income group has shown more usage. This information can be used for promotional activities / cross selling.
- Persons with increasing income has shown good fitness and inclination towards more usage of the fitness centre.

Appendix A – Source Code

```
#============================================================
=========   #

#   Exploratory Data Analysis – CardioFitness #

#=========================================================================
===

# Environment Set up and Data Import
#=========================================================================

# Install Packages
#============================================================
=========   #

# Install the necessary packages in this section, including libraries.

# Having all packages and libraries at one place makes the code readable. #
For example, if ggplot2 is needed, following is the sample code:
#install.packages("ggplot2")

#library("ggplot2")
#

# Setup Working Directory
setwd("D:/BACP Mini Project")
getwd()


#

# Read Input File
cgf_data=read.csv("CardioGoodFitness.csv")
attach(cgf_data)

#

# Find out Total Number of Rows and Columns

dim(cgf_data)


## [1] 180   9

# Find out Names of the Columns (Features)

names(cgf_data)


## [1] "Product"       "Age"           "Gender"        "Education"
## [5] "MaritalStatus" "Usage"         "Fitness"       "Income"
## [9] "Miles"

# Find out Class of each Feature, along with internal structure

str(cgf_data)


## 'data.frame':    180 obs. of  9 variables:
##  $ Product       : Factor w/ 3 levels "TM195","TM498",..: 1 1 1 1 1 1 1
1 1 1 ...
##  $ Age           : int  18 19 19 19 20 20 21 21 21 21 ...
```

```
##   $ Gender        : Factor w/ 2 levels "Female","Male": 2 2 1 2 2 1 1 2 2
1 ...
##   $ Education     : int  14 15 14 12 13 14 14 13 15 15 ...
##   $ MaritalStatus: Factor w/ 2 levels "Partnered","Single": 2 2 1 2 1 1
1 2 2 1 ...
##   $ Usage         : int  3 2 4 3 4 3 3 3 5 2 ...
##   $ Fitness       : int  4 3 3 3 2 3 3 3 4 3 ...
##   $ Income        : int  29562 31836 30699 32973 35247 32973 35247 32973
```

```
35247 37521 ...
##   $ Miles         : int  112 75 66 85 47 66 75 85 141 85 ...

#
# Check top 6 and bottom 6 Rows of the Dataset
head(cgf_data)
```

```
##     Product Age  Gender Education MaritalStatus Usage Fitness Income Miles
## 1    TM195  18    Male        14         Single     3       4  29562   112
## 2    TM195  19    Male        15         Single     2       3  31836    75
## 3    TM195  19  Female        14      Partnered     4       3  30699    66
## 4    TM195  19    Male        12         Single     3       3  32973    85
## 5    TM195  20    Male        13      Partnered     4       2  35247    47
## 6    TM195  20  Female        14      Partnered     3       3  32973    66
```

```
tail(cgf_data)
```

```
##            Product Age Gender Education MaritalStatus Usage Fitness Income
Miles
## 175          TM798  38   Male        18      Partnered     5       5
 104581
150
## 176          TM798  40   Male        21         Single     6       5
200
## 177          TM798  42   Male        18         Single     5       4
200
## 178          TM798  45   Male        16         Single     5       5
160
## 179          TM798  47   Male        18      Partnered     4       5
 104581
120
## 180          TM798  48   Male        18      Partnered     4       5
180
```

```
# head(cgf_data,10) # To obtain desired number of rows, here 10.

#

#Check for Missing Values

colSums(is.na(cgf_data))
```

```
##        Product            Age         Gender      Education MaritalStatus
##              0              0              0              0              0
##          Usage        Fitness         Income          Miles
##              0              0              0              0
```

```
#

# Provide Summary of a Dataset.

summary(cgf_data)
```

```
##    Product          Age              Gender      Education
MaritalStatus
##  TM195:80    Min.   :18.00    Female: 76    Min.   :12.00    Partnered:107 ##
TM498:60     1st Qu.:24.00    Male   :104     1st Qu.:14.00     Single    : 73 ##
TM798:40    Median :26.00                     Median :16.00
##                Mean   :28.79                     Mean   :15.57
##                3rd Qu.:33.00                     3rd Qu.:16.00
##                Max.   :50.00                     Max.   :21.00
```

```
##       Usage           Fitness         Income          Miles
##   Min    :2.000    Min.   :1.000    Min.   : 29562    Min.   : 21.0
    .
##   1st  Qu.:3.000    1st Qu.:3.000    1st Qu.: 44059    1st Qu.: 66.0
##   Medi an :3.000    Median :3.000    Median : 50597    Median : 94.0
##   Mean    :3.456    Mean   :3.311    Mean   : 53720    Mean    :103.2
##   3rd  Qu.:4.000    3rd Qu.:4.000    3rd Qu.: 58668    3rd Qu.:114.8
##   Max.    :7.000    Max.   :5.000    Max.     104581   Max.    :360.0
```

```
# Check all values of a Feature with it's frequencies.
table(Product)
```

```
## Product
## TM195 TM498 TM798 ##      80
  60       40
table(Gender) ## Gender
## Female       Male
## 76    104
table(MaritalStatus) ##
MaritalStatus
## Partnered    Single ##     107
       73
```

Table (Age)

```
## Age
## 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
42
##  1  4  5  7  7 18 12 25 12  7  9  6  7  6  4  8  6  8  1  2  7  1  5  1
1
## 43 44 45 46 47 48 50
##  1  1  2  1  2  2  1
```

```
table(Education)
```

```
## Education
## 12 13 14 15 16 18 20 21
##  3  5 55  5 85 23  1  3
```

```
table(Usage)
```

```
## Usage
##  2  3  4  5  6  7
## 33 69 52 17  7  2
```

```
table(Fitness)
```

```
##  1  2  3  4  5
##  2 26 97 24 31
```

```
table(Income)
```

```
##  Income
##  29562 30699 31836 32973 34110 35247 36384 37521 38658 39795
##      1     1     2     5     5     5     4     2     5     2
##  40932 42069 43206 44343 45480 46617 47754 48556 48658 48891
##      6     2     5     4    14     8     2     2     1     5
##  49801 50028 51165 52290 52291 52302 53439 53536 54576 54781
##      2     7     7     1     1     9     8     1     8     1
##  55713 56850 57271 57987 58516 59124 60261 61006 61398 62251
##      1     2     1     4     1     3     3     2     2     1
##  62535 64741 64809 65220 67083 68220 69721 70966 74701 75946
##      1     2     3     1     2     1     1     1     1     1
##  77191 83416 85906 88396 89641 90886 92131 95508 95866 99601
##      1     2     1     2     2     3     3     1     1     1
## 103336 104581
##      1      2
```

```
table(Miles)
```

```
## Miles
##  21  38  42  47  53  56  64  66  74  75  80  85  94  95 100 103 106 112
##   1   3   4   9   7   6   6  10   3  10   1  27   8  12   7   3   9   1
## 113 120 127 132 140 141 150 160 169 170 180 188 200 212 240 260 280 300
##   8   3   5   2   1   2   4   5   1   3   6   1   6   1   1   1   1   1
## 360
##   1
```

```
#
#=================================================================
=========

# Variable Transformation / Feature Creation
#=================================================================
=========   #

AgeGroup <- ifelse(Age<26, "Early Youth",
                   ifelse(Age>35, "Middle Aged Adults",
                          "Late Youth"))
EducationLevel <- ifelse(Education<13, "Higher Secondary",
                         ifelse(Education>16, "Masters/ Post Graduation", "Graduation"))
Usagelevel <- ifelse(Usage<4, "Fitness Amateurs",
                     ifelse(Usage>5, "Fitness Freaks",
                            "Fitness Regulars"))
FitnessLevel <- ifelse(Fitness<3, "Low Intensity",
                       ifelse(Fitness>4, "High Intensity", "Medium
                              Intensity"))
HHIncome <- ifelse(Income<40001, "Low Income HH",
                   ifelse(Income>60000, "High Income HH",
                          "Medium Income HH"))
TotalDistance <- ifelse(Miles<61, "Low Usage",
                        ifelse(Miles>120, "High Usage",
                               "Medium Usage"))
#

# Append the newly created features with the original Data

cgf_data_1 <- cbind(cgf_data, AgeGroup, EducationLevel,
                    Usagelevel, FitnessLevel, HHIncome, TotalDistance)

# Check dimensions of the newly created data, # Sample
Records and Summary Statistics

#

dim(cgf_data_1) ## [1] 180

  15

head(cgf_data_1)

tail(cgf_data_1)

str(cgf_data_1)

summary(cgf_data_1)
```

```
#
# Create Product wise three Subsets of the modified dataset
#
product1 <- cgf_data_1[which(cgf_data_1$Product == "TM195"),]
product2 <- cgf_data_1[which(cgf_data_1$Product == "TM498"),]
product3 <- cgf_data_1[which(cgf_data_1$Product == "TM798"),]
#
#=============================================================================

# Feature Exploration
#=============================================================================
#
# Data Visualization using Graphs:

# Generic Plot for Categorical variables
# Histogram for Continuous Variables

# Box Plot to see the Outliers in Continuous Variables


#Create Partitions in the Panel
#
par(mfrow=c(1,3))
plot(Product,main="Product",xlab = "Product",
     ylab = "Frequency",col = "turquoise")
plot(Gender,main="Gender",xlab = "Gender",
     ylab = "Frequency",col = "turquoise1")
plot(MaritalStatus,main="Marital Status",xlab = "Marital Status",
     ylab = "Frequency",col = "turquoise2")
```

```
#
dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,3))

hist(Age,main="Age",xlab = "Age",ylab = "Frequency",col = "turquoise")
hist(Education,main="Education",xlab = "Education",
     ylab = "Frequency",col = "turquoise1")
hist(Usage,main="Usage",xlab = "Usage",
     ylab = "Frequency",col = "turquoise2")
#
boxplot(Age,main="Age",xlab = "Age",
        ylab = "Frequency",col = "turquoise",horizontal = TRUE)
```

```
  boxplot(Education,main='Education',xlab = "Education",
          ylab = "Frequency",col = "turquoise1",horizontal = TRUE)
  boxplot(Usage,main='Usage',xlab = "Usage",
          ylab = "Frequency",col = "turquoise2",horizontal = TRUE)
#

hist(Fitness,main='Fitness',xlab = "Fitness", ylab =
     "Frequency",col = "turquoise")
hist(Income,main='Income',xlab = "Income", ylab
     = "Frequency",col = "turquoise1")
hist(Miles,main='Miles',xlab = "Miles",
     ylab = "Frequency",col = "turquoise2")
#

boxplot(Fitness,main='Fitness',xlab = "Fitness",
        ylab = "Frequency",col = "turquoise",horizontal = TRUE)
boxplot(Income,main='Income',xlab = "Income",
        ylab = "Frequency",col = "turquoise1",horizontal = TRUE)
boxplot(Miles,main='Miles',xlab = "Miles",
        ylab = "Frequency",col = "turquoise2",horizontal = TRUE)
#
#============================================================
=========

# Feature Exploration - Age
#============================================================
=========   #

dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,2))

hist(cgf_data_1$Age, main="Age of the Customer-Overall",
     xlab="Age", ylab="Frequency", labels=TRUE,
     col="turquoise", xlim=c(10,50), ylim=c(0,150))
hist(product1$Age, main="Age of the Customer-TM195",
     xlab="Age", ylab="Frequency", labels=TRUE,
     col="turquoise1", xlim=c(10,50), ylim=c(0,150))
hist(product2$Age, main="Age of the Customer-TM498",
     xlab="Age", ylab="Frequency", labels=TRUE,
     col="turquoise2", xlim=c(10,50), ylim=c(0,150))
hist(product3$Age, main="Age of the Customer-TM798",
     xlab="Age", ylab="Frequency", labels=TRUE,
     col="turquoise3", xlim=c(10,50), ylim=c(0,150))
#
#============================================================
=========

# Mean, Standard Deviation and Variance
#============================================================================

# Normal mean(),sd(),var() Functions are used.

# round() function is used with parameter digits, #
to display the results upto two decimal places
```

```
#=============================================================
=========   #

Col_Head <- c("Mean","Standard Deviation","Variance","Remark")
Prod0_Stats <- c(round(mean(cgf_data_1$Age),digits = 2),
                 round(sd(cgf_data_1$Age),digits = 2),
                 round(var(cgf_data_1$Age),digits = 2), "Age
                 Stats for all Products")
Prod1_Stats <- c(round(mean(product1$Age),digits = 2),
                 round(sd(product1$Age),digits = 2),

                 round(var(product1$Age),digits = 2), "Age Stats for TM195")
Prod2_Stats <- c(round(mean(product2$Age),digits = 2),
                 round(sd(product2$Age),digits = 2),
                 round(var(product2$Age),digits = 2),
                 "Age Stats for TM498")
Prod3_Stats <- c(round(mean(product3$Age),digits = 2),
                 round(sd(product3$Age),digits = 2),
                 round(var(product3$Age),digits = 2),
                 "Age Stats for TM798")
#

Age_Stats <- rbind(Col_Head,Prod0_Stats,Prod1_Stats,
                   Prod2_Stats,Prod3_Stats)
Age_Stats

##              [,1]    [,2]                  [,3]
## Col_Head     "Mean"  "Standard Deviation" "Variance"
## Prod0_Stats "28.79" "6.94"                "48.21"
## Prod1_Stats "28.55" "7.22"                "52.15"
## Prod2_Stats "28.9"    "6.65"              "44.16"
## Prod3_Stats "29.1"    "6.97"              "48.61"
##              [,4]
## Col_Head     "Remark"
## Prod0_Stats "Age Stats for all Products" ##
Prod1_Stats "Age Stats for TM195"
## Prod2_Stats "Age Stats for TM498" ##
Prod3_Stats "Age Stats for TM798"

#
#=============================================================
=========

# Feature Exploration - Gender
#=============================================================
=========   #

dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,2))

plot(cgf_data_1$Gender,main='Gender of the Customer-Overall', xlab =
     "Gender",ylab = "Frequency",col = "turquoise")
plot(product1$Gender, main='Gender of the Customer-TM195',
     xlab="Gender", ylab="Frequency", col="turquoise1")
plot(product2$Gender, main="Gender of the Customer-TM498",
     xlab="Gender", ylab="Frequency", col="turquoise2")
```

```
plot(product3$Gender, main="Gender of the Customer-TM798",
     xlab="Gender", ylab="Frequency", col="turquoise3")



#
#=================================================================
=========

# Frequency Table
#=================================================================
=========   #

table(cgf_data_1$Gender)

table(product1$Gender)

table(product2$Gender)

table(product3$Gender)

#
#=================================================================
=========

# Feature Exploration - Education
#=================================================================
=========   #

dev.off() # To Reset the earlier partition command.

par(mfrow=c(2,2))

hist(cgf_data_1$Education, main="Education of Cust. -Overall",
     xlab="Education", ylab="Frequency", labels=TRUE,
     col="turquoise", xlim=c(10,25), ylim=c(0,100))
hist(product1$Education, main="Education of Cust. -TM195",
     xlab="Education", ylab="Frequency", labels=TRUE,
     col="turquoise1", xlim=c(10,25), ylim=c(0,60))
  hist(product2$Education, main="Education of Cust -TM498",
       xlab="Education", ylab="Frequency", labels=TRUE,
       col="turquoise2", xlim=c(10,25), ylim=c(0,40))
  hist(product3$Education, main="Education of Cust -TM798",
       xlab="Education", ylab="Frequency", labels=TRUE,
       col="turquoise3", xlim=c(10,25), ylim=c(0,40))
#
#=================================================================
=========

# Mean, Standard Deviation and Variance
#=================================================================================

# Normal mean(),sd(),var() Functions are used.

# round() function is used with parameter digits, #
to display the results upto two decimal places
```

```
#============================================================
=========   #

Col_Head <- c("Mean","Standard Deviation","Variance","Remark")
Prod0_Stats <- c(round(mean(cgf_data_1$Education),digits = 2),
                 round(sd(cgf_data_1$Education),digits = 2),
                 round(var(cgf_data_1$Education),digits = 2),
                 "Education Stats for all Products")
Prod1_Stats <- c(round(mean(product1$Education),digits = 2),
                 round(sd(product1$Education),digits = 2),
                 round(var(product1$Education),digits = 2),
                 "Education Stats for TM195")
Prod2_Stats <- c(round(mean(product2$Education),digits = 2),
                 round(sd(product2$Education),digits = 2),
                 round(var(product2$Education),digits = 2),
                 "Education Stats for TM498")
Prod3_Stats <- c(round(mean(product3$Education),digits = 2),
                 round(sd(product3$Education),digits = 2),
                 round(var(product3$Education),digits = 2),
                 "Education Stats for TM798")
# Education_Stats <- rbind(Col_Head,Prod0_Stats,Prod1_Stats,

                         Prod2_Stats,Prod3_Stats)
Education_Stats


#
#============================================================
=========

# Feature Exploration - MaritalStatus
#============================================================
=========   #

dev.off() # To Reset the earlier partition command.

par(mfrow=c(2,2)) plot(cgf_data_1$MaritalStatus,main='MaritalStatus
- Overall',
     xlab = "MaritalStatus",ylab = "Frequency",col = "turquoise")
plot(product1$MaritalStatus, main='MaritalStatus -TM195',
     xlab="MaritalStatus", ylab="Frequency", col="turquoise1")
plot(product2$MaritalStatus, main="MaritalStatus -TM498",
     xlab="MaritalStatus", ylab="Frequency", col="turquoise2")
plot(product3$MaritalStatus, main="MaritalStatus -TM798",
     xlab="MaritalStatus", ylab="Frequency", col="turquoise3")
#
#============================================================
=========

# Frequency Table
#============================================================
=========   #

table(cgf_data_1$MaritalStatus)

table(product1$MaritalStatus)

table(product2$MaritalStatus)
```

```
table(product3$MaritalStatus)

#
#=================================================================
=========

# Feature Exploration - Usage
#=================================================================
=========   #

dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,2))

hist(cgf_data_1$Usage, main="Usage of Cust. -Overall",
     xlab="Usage", ylab="Frequency", labels=TRUE,
     col="turquoise", xlim=c(1,7), ylim=c(0,80))
hist(product1$Usage, main="Usage of Cust. -TM195",
     xlab="Usage", ylab="Frequency", labels=TRUE,
     col="turquoise1", xlim=c(1,7), ylim=c(0,50))
hist(product2$Usage, main="Usage of Cust -TM498", xlab="Usage",
ylab="Frequency", labels=TRUE, col="turquoise2", xlim=c(1,7),
ylim=c(0,40)) hist(product3$Usage, main="Usage of Cust -TM798",
xlab="Usage", ylab="Frequency", labels=TRUE, col="turquoise3",
                                xlim=c(1,7), ylim=c(0,30))
#
#=================================================================
=========

# Mean, Standard Deviation and Variance
#=============================================================================

# Normal mean(),sd(),var() Functions are used.

# round() function is used with parameter digits,

# to display the results upto two decimal places
#=================================================================
=========   #

Col_Head <- c("Mean","Standard Deviation","Variance","Remark")
Prod0_Stats <- c(round(mean(cgf_data_1$Usage),digits = 2),
                 round(sd(cgf_data_1$Usage),digits = 2),
                 round(var(cgf_data_1$Usage),digits = 2),
                 "Usage Stats for all Products")
Prod1_Stats <- c(round(mean(product1$Usage),digits = 2),
                 round(sd(product1$Usage),digits = 2),
                 round(var(product1$Usage),digits = 2),
                 "Usage Stats for TM195")
Prod2_Stats <- c(round(mean(product2$Usage),digits = 2),
                 round(sd(product2$Usage),digits = 2),
                 round(var(product2$Usage),digits = 2),
                 "Usage Stats for TM498")
Prod3_Stats <- c(round(mean(product3$Usage),digits = 2),
                 round(sd(product3$Usage),digits = 2),
                 round(var(product3$Usage),digits = 2),
                 "Usage Stats for TM798")
```

```
#

Usage_Stats <- rbind(Col_Head,Prod0_Stats,Prod1_Stats,
                     Prod2_Stats,Prod3_Stats)
Usage_Stats

#
#================================================================
=========

# Feature Exploration - Fitness
#================================================================
=========   #

dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,2))

hist(cgf_data_1$Fitness, main="Fitness of Cust. -Overall",
     xlab="Fitness", ylab="Frequency", labels=TRUE, col="turquoise",
     xlim=c(1,5), ylim=c(0,120))
hist(product1$Fitness, main="Fitness of Cust. -TM195", xlab="Fitness",
     ylab="Frequency", labels=TRUE, col="turquoise1", xlim=c(1,5),
     ylim=c(0,100))
hist(product2$Fitness, main="Fitness of Cust -TM498", xlab="Fitness",
     ylab="Frequency", labels=TRUE, col="turquoise2", xlim=c(1,5),
     ylim=c(0,100))
hist(product3$Fitness, main="Fitness of Cust -TM798", xlab="Fitness",
     ylab="Frequency", labels=TRUE, col="turquoise3", xlim=c(1,5),
     ylim=c(0,100))
#
#================================================================
=========

# Mean, Standard Deviation and Variance
#================================================================================


# Normal mean(),sd(),var() Functions are used.

# round() function is used with parameter digits, #
to display the results upto two decimal places

#================================================================
=========   #

Col_Head <- c("Mean","Standard Deviation","Variance","Remark")
Prod0_Stats <- c(round(mean(cgf_data_1$Fitness),digits = 2),
                 round(sd(cgf_data_1$Fitness),digits = 2),
                 round(var(cgf_data_1$Fitness),digits = 2), "Fitness
                 Stats for all Products")
Prod1_Stats <- c(round(mean(product1$Fitness),digits = 2),
                 round(sd(product1$Fitness),digits = 2),
                 round(var(product1$Fitness),digits = 2),
                 "Fitness Stats for TM195")
Prod2_Stats <- c(round(mean(product2$Fitness),digits = 2),
                 round(sd(product2$Fitness),digits = 2),
```

```
                  round(var(product2$Fitness),digits = 2),
                  "Fitness Stats for TM498")
Prod3_Stats <- c(round(mean(product3$Fitness),digits = 2),
                  round(sd(product3$Fitness),digits = 2),
                  round(var(product3$Fitness),digits = 2),
                  "Fitness Stats for TM798")
#

Fitness_Stats <- rbind(Col_Head,Prod0_Stats,Prod1_Stats,
                       Prod2_Stats,Prod3_Stats)
Fitness_Stats

#
#================================================================
=========

# Feature Exploration - Annual Household Income
#================================================================
=========   #

dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,2))

hist(cgf_data_1$Income, main="Income of Cust. -Overall",
     xlab="Income", ylab="Frequency", labels=TRUE,
     col="turquoise", xlim=c(0,120000), ylim=c(0,80))
hist(product1$Income, main="Income of Cust. -TM195",
     xlab="Income", ylab="Frequency", labels=TRUE,
     col="turquoise1", xlim=c(0,120000), ylim=c(0,40))
hist(product2$Income, main="Income of Cust -TM498",
     xlab="Income", ylab="Frequency", labels=TRUE,
     col="turquoise2", xlim=c(0,120000), ylim=c(0,40))
hist(product3$Income, main="Income of Cust -TM798",
     xlab="Income", ylab="Frequency", labels=TRUE,
     col="turquoise3", xlim=c(0,120000), ylim=c(0,40))
#
#================================================================
=========

# Mean, Standard Deviation and Variance
#================================================================================

# Normal mean(),sd(),var() Functions are used.

# round() function is used with parameter digits, #
to display the results upto two decimal places

#================================================================
=========   #

Col_Head <- c("Mean","Standard Deviation","Variance","Remark")
Prod0_Stats <- c(round(mean(cgf_data_1$Income),digits = 2),
                  round(sd(cgf_data_1$Income),digits = 2),


                  round(var(cgf_data_1$Income),digits = 2),
                  "Income Stats for all Products")
```

```
Prod1_Stats <- c(round(mean(product1$Income),digits = 2),
                 round(sd(product1$Income),digits = 2),
                 round(var(product1$Income),digits = 2),
                 "Income Stats for TM195")
Prod2_Stats <- c(round(mean(product2$Income),digits = 2),
                 round(sd(product2$Income),digits = 2),
                 round(var(product2$Income),digits = 2),
                 "Income Stats for TM498")
Prod3_Stats <- c(round(mean(product3$Income),digits = 2),
                 round(sd(product3$Income),digits = 2),
                 round(var(product3$Income),digits = 2),
                 "Income Stats for TM798")
#

Income_Stats <- rbind(Col_Head,Prod0_Stats,Prod1_Stats,
                      Prod2_Stats,Prod3_Stats)
Income_Stats

#
#=================================================================
=========

# Feature Exploration - Total Distance Covered - Miles
#=================================================================
=========   #

dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,2))

hist(cgf_data_1$Miles, main="Miles of Cust. -Overall",
     xlab="Miles", ylab="Frequency", labels=TRUE,
     col="turquoise", xlim=c(0,400), ylim=c(0,120))
hist(product1$Miles, main="Miles of Cust. -TM195",
     xlab="Miles", ylab="Frequency", labels=TRUE,
     col="turquoise1", xlim=c(0,400), ylim=c(0,40))
hist(product2$Miles, main="Miles of Cust -TM498",
     xlab="Miles", ylab="Frequency", labels=TRUE,
     col="turquoise2", xlim=c(0,400), ylim=c(0,40))
hist(product3$Miles, main="Miles of Cust -TM798",
     xlab="Miles", ylab="Frequency", labels=TRUE,
     col="turquoise3", xlim=c(0,400), ylim=c(0,40))
#
#=================================================================
=========

# Mean, Standard Deviation and Variance
#=================================================================================

# Normal mean(),sd(),var() Functions are used.

# round() function is used with parameter digits, #
to display the results upto two decimal places

#=================================================================
=========   #

Col_Head <- c("Mean","Standard Deviation","Variance","Remark")
```

```
Prod0_Stats <- c(round(mean(cgf_data_1$Miles),digits = 2),
                 round(sd(cgf_data_1$Miles),digits = 2),
                 round(var(cgf_data_1$Miles),digits = 2),
                 "Miles Stats for all Products")
Prod1_Stats <- c(round(mean(product1$Miles),digits = 2),


                 round(sd(product1$Miles),digits = 2),
                 round(var(product1$Miles),digits = 2),
                 "Miles Stats for TM195")
Prod2_Stats <- c(round(mean(product2$Miles),digits = 2),
                 round(sd(product2$Miles),digits = 2),
                 round(var(product2$Miles),digits = 2),
                 "Miles Stats for TM498")
Prod3_Stats <- c(round(mean(product3$Miles),digits = 2),
                 round(sd(product3$Miles),digits = 2),
                 round(var(product3$Miles),digits = 2),
                 "Miles Stats for TM798")
#

Miles_Stats <- rbind(Col_Head,Prod0_Stats,Prod1_Stats,
                     Prod2_Stats,Prod3_Stats)
Miles_Stats

#
#=================================================================
=========

# Bi-variate Analysis
#=================================================================
=========   #

dev.off() # To Reset the earlier partition command.


par(mfrow=c(2,4))

plot(Product,Age, main="Product Vs Age",xlab = "Product", ylab
     = "Age",col = "Aquamarine")
plot(Product,Gender, main="Product Vs Gender",xlab = "Product", ylab =
     "Gender",col = "Turquoise")
plot(Product,Education, main="Product Vs Education",xlab = "Product", ylab
     = "Education",col = "Light Sea Green")
plot(Product,MaritalStatus, main="Product Vs Marital Status",
     xlab = "Product",ylab = "Marital Status",col = "Medium Turquoise")
plot(Product,Usage, main="Product Vs Usage",xlab = "Product", ylab =
     "Usage",col = "Medium Aquamarine")
plot(Product,Fitness, main="Product Vs Fitness",xlab = "Product", ylab
     = "Fitness",col = "Medium Sea Green")
plot(Product,Income, main="Product Vs Income",xlab = "Product", ylab =
     "Income",col = "Light Green")
plot(Product,Miles, main="Product Vs Miles",xlab = "Product", ylab =
     "Miles",col = "Dark Sea Green")
#

pairs(cgf_data,col = "dark blue")
#
```

```
# Correlation Coefficients Sample example

cor(Age,Education)

## [1] 0.2804957

#=================================================================
=========    #

#                                THE-END

#
#=================================================================
=====
```