Supervised Learning

Beaty

9/02/2021

Analysis on Ads

Data Understanding

1. Define the question:

I am a data scientist working to create a supervised learning model to identify which individuals are most likely to click on my client's ads on her blog.

2. Metric for success:

- Cleaned data.
- Graphical representation of the relationships in the data as well as the distributions f the different variables in the data.
- Create a model using KNN.
- Sound conclusions and recommendations to the client as per the analysis done.

3. Understanding the context:

A Kenyan entrepreneur has created an online cryptography course and would want to advertise it on her blog.

She currently targets audiences originating from various countries.

In the past, she ran ads to advertise a related course on the same blog and collected data in the process. She would now like to employ my services as a Data Science Consultant to help her identify which individuals are most likely to click on her ads.

4. Experimental design:

Steps to be undertaken during this study include: - Loading the data & needed packages. - Exploring the dataset. - Cleaning the data. - Feature engineering. - Exploratory Data Analysis. - Conclusions. - Recommendations. - Implementing the Solution - Challenging the Solution

5. Data appropriateness:

This will be well checked & described in the data cleaning.

Exploring the data

```
# Loading the libraries
#install.packages("corrplot")
library("corrplot")
```

```
## corrplot 0.90 loaded

#install.packages("PerformanceAnalytics")
library("PerformanceAnalytics")

## Loading required package: xts

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

##
## Attaching package: 'PerformanceAnalytics'

## The following object is masked from 'package:graphics':
##
##     legend

#install.packages("ggplot2")
library("ggplot2")
#install.packages("data.table")
library("data.table")

##
## Attaching package: 'data.table'

## The following objects are masked from 'package:xts':
##
##     first, last

#detach("package:dplyr", unload = TRUE)
#install.packages("dplyr", dependencies = TRUE)
library("dplyr")

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:data.table':
##
##     between, first, last

## The following objects are masked from 'package:xts':
##
##     first, last

## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

#install.packages("tidyr")
library("tidyr")

# Packages for modelling
#install.packages("rpart",dependencies = TRUE)
library("rpart")
#install.packages("rpart.plot",dependencies=TRUE)
library("rpart.plot")
#install.packages("mlbench",dependencies = TRUE)
library("mlbench")

# Loading the data
data = read.csv('advertising.csv', header = TRUE, sep = ',')

# Previewing the data
head(data)

##   Daily.Time.Spent.on.Site Age Area.Income Daily.Internet.Usage
## 1                    68.95  35    61833.90               256.09
## 2                    80.23  31    68441.85               193.77
## 3                    69.47  26    59785.94               236.50
## 4                    74.15  29    54806.18               245.89
## 5                    68.37  35    73889.99               225.58
## 6                    59.99  23    59761.56               226.74
##                          Ad.Topic.Line           City Male    Country
## 1    Cloned 5thgeneration orchestration    Wrightburgh    0    Tunisia
## 2    Monitored national standardization      West Jodi    1      Nauru
## 3      Organic bottom-line service-desk       Davidton    0 San Marino
## 4 Triple-buffered reciprocal time-frame West Terrifurt    1      Italy
## 5         Robust logistical utilization   South Manuel    0    Iceland
## 6       Sharable client-driven software      Jamieberg    1     Norway
##             Timestamp Clicked.on.Ad
## 1 2016-03-27 00:53:11             0
## 2 2016-04-04 01:39:02             0
## 3 2016-03-13 20:35:42             0
## 4 2016-01-10 02:31:19             0
## 5 2016-06-03 03:36:18             0
## 6 2016-05-19 14:30:17             0

# Checking the shape of the data
dim(data)

## [1] 1000   10
```

The dataset has 1000 entries and 10 columns.

```
# Checking column names of our data
colnames(data)
```

```
##  [1] "Daily.Time.Spent.on.Site" "Age"
##  [3] "Area.Income"              "Daily.Internet.Usage"
##  [5] "Ad.Topic.Line"            "City"
##  [7] "Male"                     "Country"
##  [9] "Timestamp"                "Clicked.on.Ad"
```

Our column titles are as listed above. We shall rename the "Male" column so that it becomes "Gender" then the 0 will represent males, and 0 for females.

```
# Renaming "Male" column
colnames(data)[7] <- "Gender"

# Checking if column name has changed
colnames(data)
```

```
##  [1] "Daily.Time.Spent.on.Site" "Age"
##  [3] "Area.Income"              "Daily.Internet.Usage"
##  [5] "Ad.Topic.Line"            "City"
##  [7] "Gender"                   "Country"
##  [9] "Timestamp"                "Clicked.on.Ad"
```

Data Cleaning

1. Dealing with missing data

```
# Checking for missing values
null_values = is.na(data)
null_values
```

```
##       Daily.Time.Spent.on.Site   Age Area.Income Daily.Internet.Usage
##  [1,]                    FALSE FALSE       FALSE                 FALSE
##  [2,]                    FALSE FALSE       FALSE                 FALSE
##  [3,]                    FALSE FALSE       FALSE                 FALSE
##  [4,]                    FALSE FALSE       FALSE                 FALSE
##  [5,]                    FALSE FALSE       FALSE                 FALSE
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##  [819,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [820,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [821,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [822,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [823,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [824,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [825,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [826,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [827,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [828,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [829,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [830,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [831,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [832,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [833,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [834,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [835,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [836,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [837,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [838,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [839,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [840,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [841,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [842,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [843,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [844,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [845,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [846,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [847,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [848,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [849,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [850,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [851,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [852,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [853,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [854,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [855,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [856,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [857,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [858,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [859,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [860,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [861,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [862,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [863,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [864,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [865,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [866,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [867,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [868,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
```

```
##  [869,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [870,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [871,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [872,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [873,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [874,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [875,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [876,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [877,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [878,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [879,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [880,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [881,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [882,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [883,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [884,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [885,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [886,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [887,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [888,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [889,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [890,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [891,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [892,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [893,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [894,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [895,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [896,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [897,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [898,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [899,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [900,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [901,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [902,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [903,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [904,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [905,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [906,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [907,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [908,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [909,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [910,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [911,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [912,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [913,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [914,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [915,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [916,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [917,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [918,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
```

```
##  [919,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [920,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [921,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [922,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [923,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [924,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [925,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [926,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [927,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [928,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [929,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [930,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [931,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [932,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [933,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [934,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [935,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [936,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [937,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [938,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [939,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [940,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [941,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [942,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [943,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [944,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [945,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [946,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [947,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [948,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [949,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [950,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [951,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [952,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [953,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [954,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [955,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [956,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [957,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [958,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [959,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [960,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [961,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [962,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [963,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [964,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [965,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [966,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [967,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [968,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
```

```
##  [969,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [970,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [971,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [972,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [973,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [974,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [975,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [976,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [977,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [978,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [979,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [980,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [981,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [982,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [983,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [984,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [985,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [986,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [987,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [988,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [989,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [990,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [991,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [992,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [993,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [994,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [995,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [996,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [997,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [998,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
##  [999,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
## [1000,]         FALSE FALSE  FALSE   FALSE     FALSE         FALSE
```

Our data seems to have no nulls since most of the fields are showing “FALSE” for our code. We shall do a coun to check for the total number of null values.

```
length(which(is.na(data)))
```

```
## [1] 0
```

The data has no missing values

2. Checking for duplicates:

```
duplicates = duplicated(data)
duplicates
```

```
##    [1] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##   [13] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##   [25] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
FALSE
##   [37] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##   [49] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##   [61] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##   [73] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##   [85] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##   [97] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [109] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [121] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [133] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [145] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [157] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [169] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [181] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [193] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [205] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [217] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [229] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [241] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [253] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [265] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [277] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [289] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [301] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [313] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [325] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
FALSE
##  [337] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [349] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [361] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [373] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [385] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [397] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [409] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [421] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [433] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [445] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [457] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [469] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [481] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [493] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [505] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [517] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [529] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [541] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [553] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [565] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [577] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [589] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [601] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [613] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [625] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
FALSE
##  [637] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [649] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [661] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [673] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [685] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [697] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [709] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [721] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [733] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [745] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [757] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [769] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [781] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [793] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [805] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [817] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [829] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [841] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [853] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [865] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [877] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [889] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [901] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [913] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [925] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
FALSE
##  [937] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [949] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [961] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [973] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [985] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE
##  [997] FALSE FALSE FALSE FALSE
```

The data seems to have no duplicates. We shall do a count just to make sure.

```
length(which(duplicated(data)))
```

```
## [1] 0
```

There are no duplicates in our dataset.

3. Checking column data types

```
# Checking the columns datatypes
str(data)
```

```
## 'data.frame':    1000 obs. of  10 variables:
##  $ Daily.Time.Spent.on.Site: num  69 80.2 69.5 74.2 68.4 ...
##  $ Age                     : int  35 31 26 29 35 23 33 48 30 20 ...
##  $ Area.Income             : num  61834 68442 59786 54806 73890 ...
##  $ Daily.Internet.Usage    : num  256 194 236 246 226 ...
##  $ Ad.Topic.Line           : chr  "Cloned 5thgeneration orchestration"
"Monitored national standardization" "Organic bottom-line service-desk"
"Triple-buffered reciprocal time-frame" ...
##  $ City                    : chr  "Wrightburgh" "West Jodi" "Davidton"
"West Terrifurt" ...
##  $ Gender                  : int  0 1 0 1 0 1 0 1 1 1 ...
##  $ Country                 : chr  "Tunisia" "Nauru" "San Marino" "Italy"
...
##  $ Timestamp               : chr  "2016-03-27 00:53:11" "2016-04-04
01:39:02" "2016-03-13 20:35:42" "2016-01-10 02:31:19" ...
##  $ Clicked.on.Ad           : int  0 0 0 0 0 0 0 1 0 0 ...
```

All our columns have the right data type except for the time. We shall convert it to a timestamp for ease of calculation

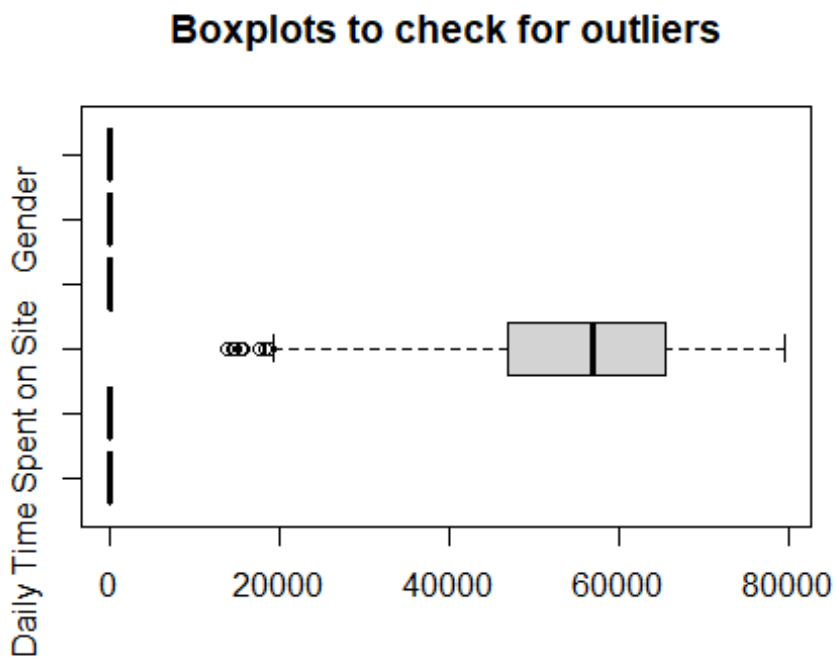
```
# Converting date from character to a timestamp
data$Timestamp <- as.Date(data$Timestamp)

# Checking data type to confirm change
str(data)
```

```
## 'data.frame':    1000 obs. of  10 variables:
##  $ Daily.Time.Spent.on.Site: num  69 80.2 69.5 74.2 68.4 ...
##  $ Age                     : int  35 31 26 29 35 23 33 48 30 20 ...
##  $ Area.Income             : num  61834 68442 59786 54806 73890 ...
##  $ Daily.Internet.Usage    : num  256 194 236 246 226 ...
##  $ Ad.Topic.Line           : chr  "Cloned 5thgeneration orchestration"
"Monitored national standardization" "Organic bottom-line service-desk"
"Triple-buffered reciprocal time-frame" ...
##  $ City                    : chr  "Wrightburgh" "West Jodi" "Davidton"
"West Terrifurt" ...
##  $ Gender                  : int  0 1 0 1 0 1 0 1 1 1 ...
##  $ Country                 : chr  "Tunisia" "Nauru" "San Marino" "Italy"
...
##  $ Timestamp               : Date, format: "2016-03-27" "2016-04-04" ...
##  $ Clicked.on.Ad           : int  0 0 0 0 0 0 0 1 0 0 ...
```

The data types are all okay now.

4. Checking for outliers

```
# Checking for outliers in the numerical columns
Time_spent = data$Daily.Time.Spent.on.Site
Age = data$Age
Income = data$Area.Income
Internet = data$Daily.Internet.Usage
Gender = data$Gender
Clicked = data$Clicked.on.Ad

boxplot(Time_spent, Age, Income, Internet, Gender, Clicked, main = "Boxplots
to check for outliers",   names = c("Daily Time Spent on Site", "Age",
"Income","Daily Internet Usage", "Gender","Clicked on ad"), horizontal =
TRUE)
```



The columns do not have outliers except the income column which has quite a number of outliers, which may be due to the paygaps that exist in the real world. Thus we shall ignore them for this project.

Feature Engineering

We'd like to extract the year, month, & day from the time stamp so we can derive more insights from it.

```
#Separating our Time stamp column into Year, Month and day.
data = separate(data, "Timestamp", c("Year", "Month", "Day"), sep = "-")

head(data)
```

```
##   Daily.Time.Spent.on.Site Age Area.Income Daily.Internet.Usage
## 1                    68.95  35    61833.90               256.09
## 2                    80.23  31    68441.85               193.77
## 3                    69.47  26    59785.94               236.50
## 4                    74.15  29    54806.18               245.89
## 5                    68.37  35    73889.99               225.58
## 6                    59.99  23    59761.56               226.74
##                          Ad.Topic.Line           City Gender    Country
Year
## 1    Cloned 5thgeneration orchestration    Wrightburgh      0    Tunisia
2016
## 2    Monitored national standardization      West Jodi      1      Nauru
2016
```

```
## 3      Organic bottom-line service-desk       Davidton      0 San Marino
2016
## 4 Triple-buffered reciprocal time-frame West Terrifurt      1      Italy
2016
## 5         Robust logistical utilization   South Manuel      0    Iceland
2016
## 6       Sharable client-driven software      Jamieberg      1     Norway
2016
##   Month Day Clicked.on.Ad
## 1    03  27             0
## 2    04  04             0
## 3    03  13             0
## 4    01  10             0
## 5    06  03             0
## 6    05  19             0
```

Exploratory Data Analysis

1. Univariate Analysis

Measures of Dispersion

a) Mean

```
# Creating a dataframe with only the numeric columns
data_num = data[,c("Daily.Time.Spent.on.Site", "Age",
"Area.Income","Daily.Internet.Usage" ,"Gender", "Clicked.on.Ad" )]

# Preview dataset
head(data_num)
```

```
##   Daily.Time.Spent.on.Site Age Area.Income Daily.Internet.Usage Gender
## 1                    68.95  35    61833.90               256.09      0
## 2                    80.23  31    68441.85               193.77      1
## 3                    69.47  26    59785.94               236.50      0
## 4                    74.15  29    54806.18               245.89      1
## 5                    68.37  35    73889.99               225.58      0
## 6                    59.99  23    59761.56               226.74      1
##   Clicked.on.Ad
## 1             0
## 2             0
## 3             0
## 4             0
## 5             0
## 6             0
```

```
# Calculating the mean

colMeans(data_num)
```

```
## Daily.Time.Spent.on.Site                      Age             Area.Income
##                  65.0002                  36.0090               55000.0001
```

```
##     Daily.Internet.Usage                     Gender             Clicked.on.Ad
##                 180.0001                     0.4810                   0.5000
```

The means for the different columns are as shown in the output above.

b) Mode

```
# Create the function.
getmode <- function(v) {
   uniqv <- unique(v)
   uniqv[which.max(tabulate(match(v, uniqv)))]
}

# Get the mode for different columns
getmode(data$Daily.Time.Spent.on.Site)

## [1] 62.26

getmode(data$Age)

## [1] 31

getmode(data$Area.Income)

## [1] 61833.9

getmode(data$Daily.Internet.Usage)

## [1] 167.22

getmode(data$City)

## [1] "Lisamouth"

getmode(data$Gender)

## [1] 0

getmode(data$Country)

## [1] "Czech Republic"

getmode(data$Clicked.on.Ad)

## [1] 0

getmode(data$Month)

## [1] "02"
```

The most common amount of time spent on the site is 62.26, while the most popular age is 31years. Most of the site visits have an income of 61,833.9. The city with most visitors is Lisamouth while Czech Republic had the most site visitors. I would have expected the city with the most number of visitors to belong to the country with the most visitors, however,

Lisamouth had different countries on the dataset provided. Most of the visitors were female, while most didn't click on the ads. The site had most traffic in February.

c) Median

```
# Calculating median
median(data$Daily.Time.Spent.on.Site)

## [1] 68.215

median(data$Age)

## [1] 35

median(data$Area.Income)

## [1] 57012.3

median(data$Daily.Internet.Usage)

## [1] 183.13

median(data$Gender)

## [1] 0

median(data$Clicked.on.Ad)

## [1] 0.5
```

The medians for each column is as shown above

d) Range

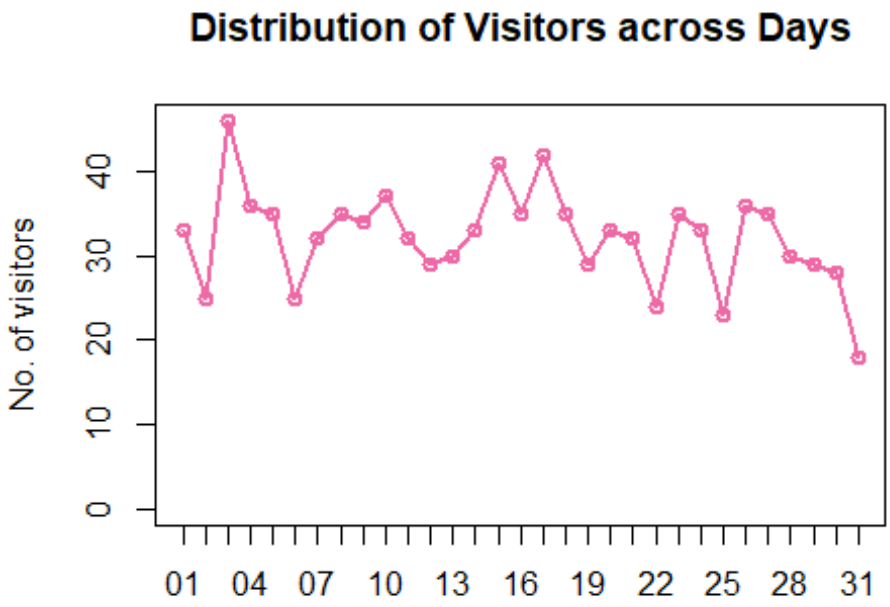
```
# Calculating the ranges
range(data$Daily.Time.Spent.on.Site)

## [1] 32.60 91.43

range(data$Age)

## [1] 19 61

range(data$Area.Income)

## [1] 13996.5 79484.8

range(data$Daily.Internet.Usage)

## [1] 104.78 269.96

range(data$Gender)

## [1] 0 1

range(data$Clicked.on.Ad)
```

```
## [1] 0 1
```

The codes above show the ranges for each of the columns in our dataset

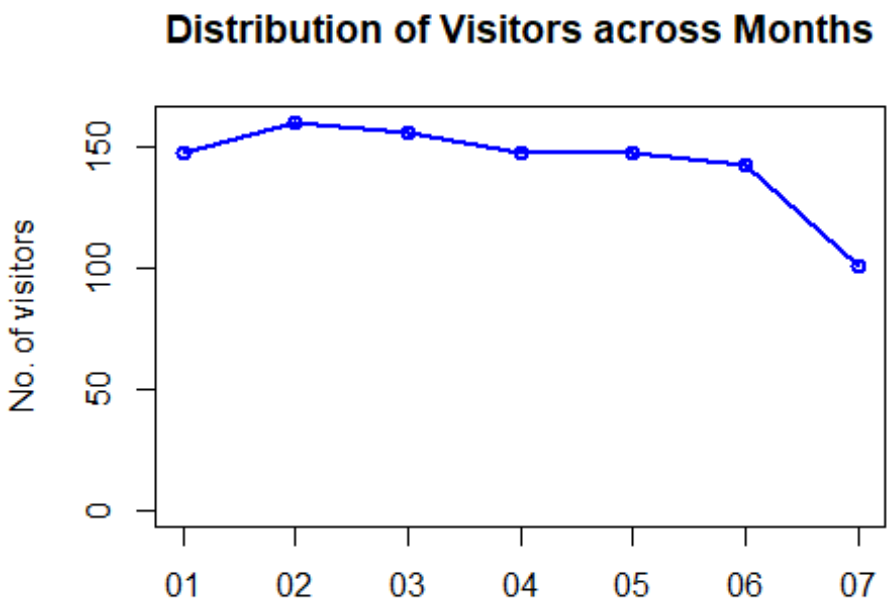
Plots:

```
# A bar plot showing the distribution of visitors accross different days
plot(table(data$Day), type = "o", main = "Distribution of Visitors across
Days", ylab = "No. of visitors", col ="hotpink2")
```



From our plot, we can see that most visitors visited the site on 3rd then 15th. The middle of the month had a high rate of visitors.

```
# A bar plot showing the distribution of visitors accross different months
plot(table(data$Month), type = "o", main = "Distribution of Visitors across
Months", ylab = "No. of visitors", col ="blue")
```

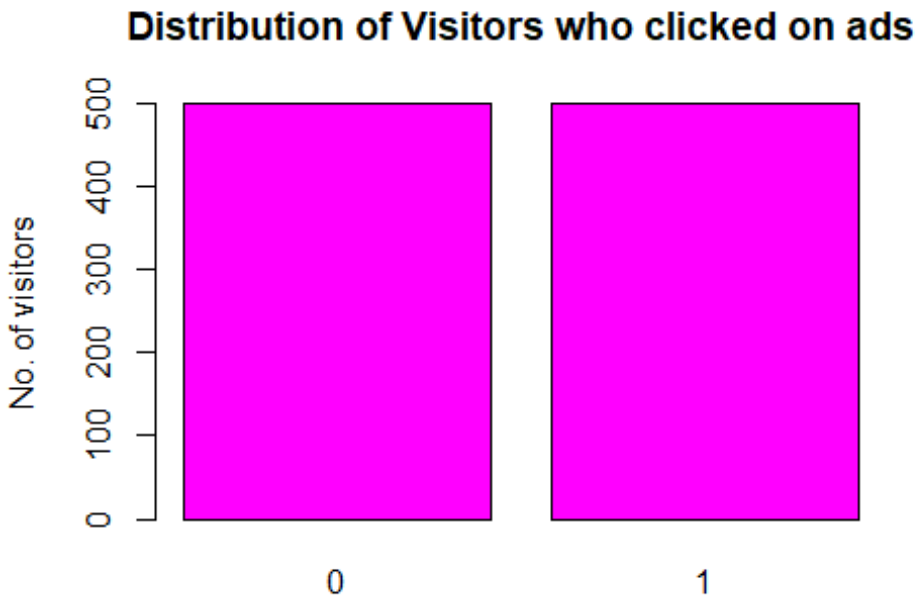


From our plot, we can see that February had the highest site traffic, followed closely by March, then April. July had the least amount of traffic to the site.

```
# A bar plot showing the gender distribution
barplot(table(data$Gender),  col =  c("red" , "green"), ylab = "No. of
visitors", main = "Distribution of Gender")
```

From the plot, we can see that 0, ie females, caused the highest traffic to the site.

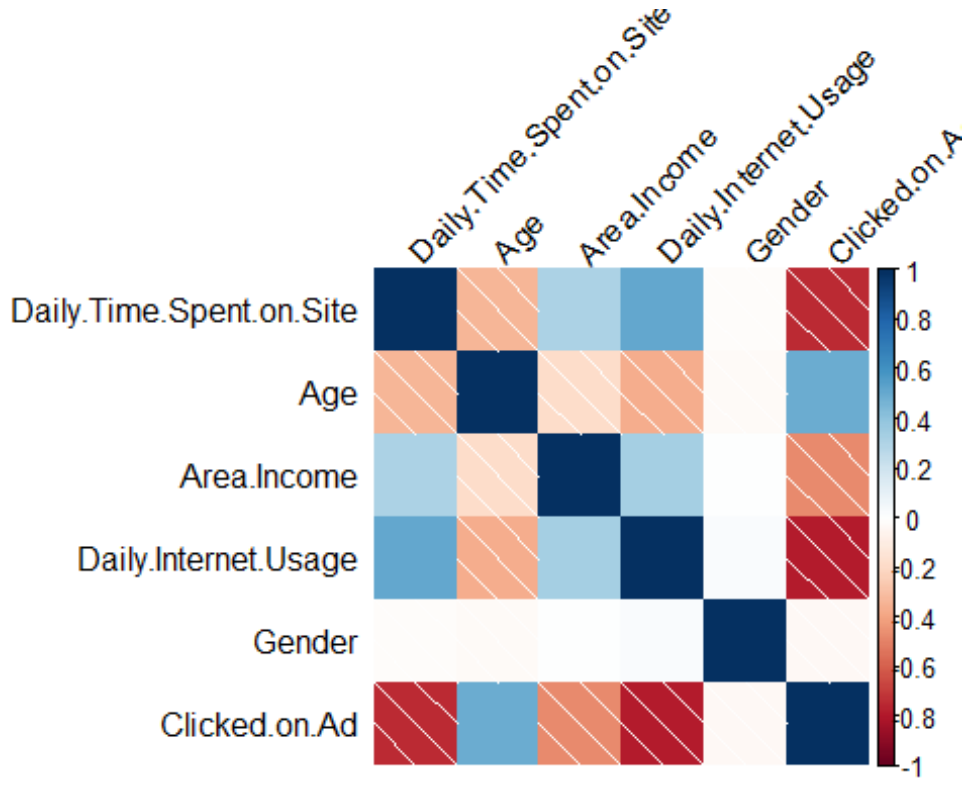
```
# A bar plot showing the distribution of visitors who clicked on the ads
barplot(table(data$Clicked.on.Ad), main = "Distribution of Visitors who
clicked on ads", ylab = "No. of visitors", col ="magenta")
```



From the plot, it seems like there was an equal amount of visitors who clicked on ads as well as those who didn't.

2. Bivariate Analysis

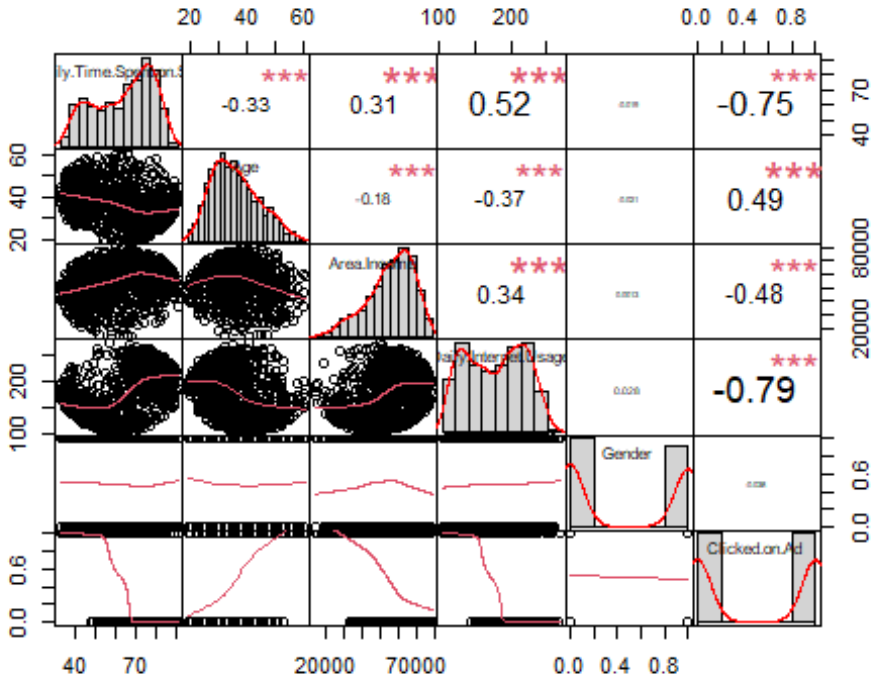
```
#Calculating the correlation between columns

correlation = cor(data_num)

# Creating a correlogram to plot our correlation for better presentation
corrplot(correlation, method="shade", tl.col="black", tl.srt=45)
```



From the correlogram above & using the legend on the right, we can see that:

- Daily time spent on the site has a high negative relationship with whether one clicked on an ad. Thus if one spends alot of time on the site, there is a high chance of them not clicking on an ad.
- There's a low negative relationship between one's age and the daily time spent on the site as well as their daily internet usage. Thus the higher one's age, the less likely they are to spend more time on the site or to have a high internet usage.
- There is a medium negative relationship between one's income and whether they clicked on an ad. Thus, the higher one's income, the less likely they are to click on ad.
- There's a medium positive relationship between one's daily internet usage and the daily time spent on the site. This shows that there's a medium chance that people with a high internet usage would be those spending a lot of time on the site.
- There is also a medium positive relationship between one's age and whether they clicked on ads. Thus the older one's age, the more like they are to click on an ad, however the realtionship is not too strong.

```
# Plotting scatterplots to get the distributions of the columns as well as
the significance value

chart.Correlation(data_num, histogram = TRUE,)
```



From the scatterplot above, we can see the significance levels for the different variables, as well as the scatter plots with the fitted lines. We can also see the different distributions for our datasets.

Conclusion

The most common amount of time spent on the site is 62.26, while the most popular age is 31years. Most of the site visits have an income of 61,833.9. The city with most visitors is Lisamouth while Czech Republic had the most site visitors. Most of the visitors were female, while most didn't click on the ads. The site had most traffic in February. The internet users that are most likely to click on our client's ads are those who spend very little time online. Also the lower ones income is,the higher the chances of them clicking on the ads. The older one is, the more like they are to click on an ad, however the relationship is not too strong.

Recommendations

My recommendation as a data scientist, would be for her to do curate the ads to be mostly on courses that may interest the people most likely to click on the ads as outlined above. She can alsoo include other content so as to pique other users to click more on the ads.

Implementing the Solution using KNN

We will convert our labels on the target variable to be categorical

```
#Converting labels to categorical
data$Clicked.on.Ad <- factor(data$Clicked.on.Ad)
```

We will then check for class imbalance

```
round(prop.table(table(data$Clicked.on.Ad)) * 100, digits = 1)
```

```
##
##  0  1
## 50 50
```

There seems to be no data imbalance in our dataset

We will now select the features we shall use for modelling

```
unique(data[c("City")])
```

```
##                          City
## 1                  Wrightburgh
## 2                    West Jodi
## 3                     Davidton
## 4                West Terrifurt
## 5                  South Manuel
## 6                     Jamieberg
## 7                  Brandonstad
## 8              Port Jefferybury
## 9                    West Colin
## 10                  Ramirezton
## 11              West Brandonton
## 12            East Theresashire
## 13               West Katiefurt
## 14                   North Tara
## 15                 West William
## 16               New Travistown
## 17               West Dylanberg
## 18                  Pruittmouth
## 19                  Jessicastad
## 20                   Millertown
## 21              Port Jacqueline
## 22                  Lake Nicole
## 23                   South John
## 24                  Pamelamouth
## 25               Harperborough
## 26            Port Danielleberg
## 27              West Jeremyside
## 28              South Cathyfurt
## 29                   Palmerside
## 30                West Guybury
## 31               Phelpschester
## 32            Lake Melindamouth
## 33           North Richardburgh
## 34                  Port Cassie
## 35                   New Thomas
## 36                      Johnstad
```

```
## 37            West Aprilport
## 38                 Kellytown
## 39              Charlesport
## 40             Millerchester
## 41            Mackenziemouth
## 42               Zacharystad
## 43              North Joshua
## 44                 Bowenview
## 45                 Jamesberg
## 46        Lake Cassandraport
## 47                New Sharon
## 48                  Johnport
## 49               Hamiltonfort
## 50          West Christopher
## 51               Hollandberg
## 52                 Odomville
## 53        East Samanthashire
## 54             South Lauraton
## 55                Amandahaven
## 56                 Thomasview
## 57                 Garciaside
## 58           Port Sarahshire
## 59              Port Gregory
## 60             Brendachester
## 61                   Lake Amy
## 62             Lake Annashire
## 63                 Smithburgh
## 64           North Leonmouth
## 65                 Robertfurt
## 66                Jasminefort
## 67             Jensenborough
## 68              Bradleyburgh
## 69                New Sheila
## 70              North Regina
## 71                Davidmouth
## 72           New Michaeltown
## 73                East Tammie
## 74                 Wilcoxport
## 75         East Michaelmouth
## 76          East Tiffanyport
## 77              Ramirezhaven
## 78                Cranemouth
## 79               Lake Edward
## 80           Lake Conniefurt
## 81         East Shawnchester
## 82                West Joseph
## 83      Lake Christopherfurt
## 84           East Tylershire
## 85                 Sharpberg
## 86               Lake Dustin
```

```
## 87             North Kristine
## 88                 Grahamberg
## 89                   New Tina
## 90                 Nelsonfurt
## 91              Christopherport
## 92              Port Sarahhaven
## 93              Bradleyborough
## 94                   Whiteport
## 95                 New Theresa
## 96                    Wongland
## 97               Williammouth
## 98              Williamsborough
## 99                North Michael
## 100             Benjaminchester
## 101              Hernandezville
## 102                  Youngburgh
## 103              Wallacechester
## 104               Sanchezmouth
## 105             Bradshawborough
## 106                     Amyhaven
## 107                Marcushaven
## 108                    Erinton
## 109                Hughesport
## 111              New Lucasburgh
## 112               Michelleside
## 113                Andersonton
## 114                 New Rachel
## 115                 Port Susan
## 116             West Angelabury
## 117  Port Christopherborough
## 118                Phillipsbury
## 119                 Millerside
## 120                Lake Jessica
## 121                 Lopezmouth
## 122                  Johnsport
## 123                South Ronald
## 124                South Daniel
## 125                 Suzannetown
## 126                    Lisaberg
## 127                  Brianfurt
## 128                Stewartbury
## 130         North Wesleychester
## 131           East Michelleberg
## 132                   Port Eric
## 133                 Timothyfurt
## 134                Port Jeffrey
## 135                  Guzmanland
## 136                East Michele
## 137                   East John
## 138                 Lesliebury
```

```
## 139            Patriciahaven
## 140            Ashleychester
## 141            Lake Josetown
## 142               Debraburgh
## 143           New Debbiestad
## 144               West Shaun
## 145            Kimberlyhaven
## 146            Port Lawrence
## 147             West Ricardo
## 148                Lake Jose
## 149             Heatherberg
## 150            South George
## 151             Tinachester
## 152               Port Jodi
## 153            Jonathantown
## 154              Sylviaview
## 155         East Timothyport
## 156             West Roytown
## 157                Codyburgh
## 158          Port Erikhaven
## 159         Port Chasemouth
## 160             Ramirezside
## 161         East Michaeltown
## 162            West Courtney
## 163        West Michaelhaven
## 164               Walshhaven
## 165          East Rachelview
## 166               Curtisport
## 167                Frankbury
## 168              Timothytown
## 169            Samanthaland
## 170           South Jennifer
## 171              Kyleborough
## 172              North Randy
## 173       South Daniellefort
## 174              Dianashire
## 175                East Eric
## 176              Hammondport
## 177                Jacobstad
## 178            Hernandezfort
## 179                 Joneston
## 180       New Jeffreychester
## 181              East Stephen
## 182            Turnerchester
## 183                Youngfort
## 184              Ingramberg
## 185         South Denisefurt
## 186         Port Melissaberg
## 187               Bernardton
## 188              Port Mathew
```

```
## 189              Aliciatown
## 190              Josephstad
## 191           West Ericfurt
## 192          New Brendafurt
## 193              Port Julie
## 194        South Tiffanyton
## 195         North Elizabeth
## 196               Kentmouth
## 197              West Casey
## 198              East Henry
## 199               Hollyfurt
## 200              North Anna
## 201            Port Destiny
## 202                Ianmouth
## 203          North Johntown
## 204              Hannahside
## 205             Wilsonburgh
## 206    North Russellborough
## 207             Murphymouth
## 208             Carterburgh
## 209                Penatown
## 210              Joechester
## 211               East Paul
## 212         Hartmanchester
## 213           Mcdonaldfort
## 214          North Mercedes
## 215              Taylorberg
## 216             Hansenmouth
## 217               Bradyfurt
## 218       West Jessicahaven
## 219           Davilachester
## 220       North Ricardotown
## 221             Melissafurt
## 222          East Brianberg
## 223              Millerbury
## 224              Garciaview
## 225            Townsendfurt
## 226             Williamstad
## 227             West Connor
## 228             West Justin
## 229              Robertbury
## 230           New Tinamouth
## 231              Turnerview
## 232            Reneechester
## 233          West Tinashire
## 234               Jamesfurt
## 235               New Nancy
## 236               Lisamouth
## 237              Harveyport
## 238               Ramosstad
```

```
## 239          North Kevinside
## 240                 Haleview
## 241            Christinetown
## 242              New Michael
## 243                Jonesland
## 244            North Shannon
## 245            New Sonialand
## 246               Port Jason
## 247             East Barbara
## 248            Port Erinberg
## 249             Petersonfurt
## 250            New Lindaberg
## 251             West Russell
## 252              South Adam
## 253          North Tracyport
## 254                Brownport
## 255             Port Crystal
## 256              Masonhaven
## 257             Derrickhaven
## 258                Olsonstad
## 259              New Brandy
## 260       South Jasminebury
## 261             East Timothy
## 262           Charlottefort
## 263         Lake Beckyburgh
## 264        West Lindseybury
## 265             West Alyssa
## 266          Lake Craigview
## 267              Lake David
## 268              Bruceburgh
## 269         South Lauratown
## 270              Port Robin
## 271           Jacksonburgh
## 272                Erinmouth
## 273         Port Aliciabury
## 274       Port Whitneyhaven
## 275            Jeffreyshire
## 276                  Tinaton
## 277         North Loriburgh
## 278                 Wendyton
## 279         Lake Jacqueline
## 280       North Christopher
## 281           Alexanderfurt
## 282             West Pamela
## 283             West Amanda
## 284           South Tomside
## 285               Bethburgh
## 286              Jamiefort
## 287            Garciamouth
## 288             West Brenda
```

```
## 289               South Kyle
## 290                Combsstad
## 291          Lake Allenville
## 292            Greenechester
## 293               Jordantown
## 294               Gravesport
## 295               South Troy
## 296             Lake Patrick
## 297               Millerland
## 298        Port Jessicamouth
## 299                 Paulport
## 300               Clineshire
## 301              Cynthiaside
## 302                Port Juan
## 303            Michellefort
## 304         Port Angelamouth
## 305            Jessicahaven
## 306            North Daniel
## 307                New Juan
## 308                 Amyfurt
## 309             Harrishaven
## 310              Roberttown
## 311             Jeremyshire
## 312               Birdshire
## 313              New Amanda
## 314              Curtisview
## 315            Jacksonmouth
## 316              North April
## 317              Hayesmouth
## 318             South Corey
## 319               Juliaport
## 320           Port Paultown
## 321         East Vincentstad
## 322            Kimberlytown
## 323               New Steve
## 324            New Johnberg
## 325                Shawstad
## 326             New Rebecca
## 327            Jeffreyburgh
## 328               Faithview
## 329          Richardsontown
## 330         Port Brookeland
## 331     East Christopherbury
## 332      Port Christinemouth
## 333             South Meghan
## 334                Hessstad
## 335            Rhondaborough
## 336               Lewismouth
## 337                New Paul
## 338              Lake Angela
```

```
## 339           East Graceland
## 340                 Hartport
## 341       East Yvonnechester
## 342              Burgessside
## 343            Hurleyborough
## 344              Garychester
## 345           East Kevinbury
## 346           Contrerasshire
## 347                Erikville
## 348           Robertsonburgh
## 349                 Karenton
## 350        Port Kathleenfort
## 351              Lake Adrian
## 353                Mollyport
## 354              Sandraland
## 355            Charlenetown
## 356              Luischester
## 357        South Johnnymouth
## 358                Hannaport
## 359             East Anthony
## 360         West Daleborough
## 361              Morrismouth
## 362         North Andrewstad
## 364               West Tanya
## 365                Novaktown
## 366            Timothymouth
## 367              Robertmouth
## 368          Stephenborough
## 369           Lake Kurtmouth
## 370               Lauraburgh
## 371               Rogerburgh
## 372                Davidside
## 373              West Thomas
## 374         Andersonchester
## 375        North Ronaldshire
## 376                Greghaven
## 377              Jordanmouth
## 378              Meyersstad
## 380            South Robert
## 381                New Tyler
## 382              Jordanshire
## 383                Reyesland
## 384           New Traceystad
## 385               Port Brian
## 386           Lake Courtney
## 387           Samuelborough
## 388          Christinehaven
## 389               Thomasstad
## 390             Kristintown
## 391                New Wanda
```

```
## 392               Mariebury
## 393        Christopherville
## 394             New Jasmine
## 395               Lopezberg
## 396            Jenniferstad
## 397        West Eduardotown
## 398               Davisfurt
## 399              Bakerhaven
## 400               Paulshire
## 401               West Jane
## 402              Lake Brian
## 403            Alvaradoport
## 404               Lake Kevin
## 405          Richardsonland
## 406         East Sheriville
## 407       Port Michealburgh
## 408              Monicaview
## 409               Katieport
## 410      East Brittanyville
## 411        West Travismouth
## 412             Leonchester
## 413             Ramirezland
## 414                Brownton
## 415         New Jessicaport
## 416          New Denisebury
## 417               Keithtown
## 418        Port Melissastad
## 419              Janiceview
## 420                Mataberg
## 421        West Melaniefurt
## 422              Millerfort
## 423           Alexanderview
## 424              South Jade
## 425              Lake Susan
## 426    South Vincentchester
## 427           Williamsmouth
## 428              Taylorport
## 429           Williamsport
## 430              Emilyfurt
## 432       East Deborahhaven
## 433        Port Katelynview
## 434               Paulhaven
## 435         Elizabethmouth
## 436              Lake Jesus
## 437         North Tylerland
## 438              Munozberg
## 439         North Maryland
## 440           West Barbara
## 441          Andrewborough
## 442            New Gabriel
```

```
## 443          Port Patrickton
## 444               West Julia
## 445           New Keithburgh
## 446             Richardsland
## 447       North Aaronchester
## 448         Lake Matthewland
## 449                Kevinberg
## 450               Morganfort
## 451                Lovemouth
## 452              Taylorhaven
## 453                Jamesville
## 454            East Toddfort
## 455                East Dana
## 456               West Lucas
## 457               Butlerfort
## 458                Lindaside
## 459        West Chloeborough
## 460                 Jayville
## 461             East Lindsey
## 462              Masseyshire
## 463                 Sarahton
## 464               Ryanhaven
## 465        Lake Deborahburgh
## 466         New Williammouth
## 467                Port Blake
## 468             West Richard
## 469              Brandymouth
## 470              Sandraville
## 471             Port Jessica
## 472        Lake Jasonchester
## 473              Pearsonfort
## 474              Sellerstown
## 475                    Yuton
## 476               Smithtown
## 477               Joanntown
## 478              South Peter
## 479            Port Mitchell
## 480              Pottermouth
## 481        Lake Jonathanview
## 482                 Alanview
## 483               Carterport
## 484         New Daniellefort
## 485                Welchshire
## 486             Russellville
## 487                West Lisa
## 488               Greentown
## 489              Timothyport
## 490              Teresahaven
## 491      Lake Stephenborough
## 492                 Silvaton
```

```
## 493         West Michaelstad
## 494               Florestown
## 495                  New Jay
## 496        North Lisachester
## 497               Port Stacy
## 498                Jensenton
## 499          North Alexandra
## 500                Rivasland
## 501             Helenborough
## 502               Garnerberg
## 503            North Anaport
## 504               Pattymouth
## 505      South Alexisborough
## 506            East Jennifer
## 507                 Hallfort
## 508       New Charleschester
## 509         East Breannafurt
## 510           East Susanland
## 511                Estesfurt
## 512             Shirleyfort
## 513             Douglasview
## 514              South Lisa
## 515               Kingshire
## 516            Rebeccamouth
## 517                Brownbury
## 518             South Aaron
## 519             North Andrew
## 520             South Walter
## 521           Catherinefort
## 522              East Donna
## 524          North Kimberly
## 525      South Stephanieport
## 526      North Isabellaville
## 527         North Aaronburgh
## 528               Port James
## 529               Danielview
## 530             Port Stacey
## 531          West Kevinfurt
## 532           Lake Jennifer
## 533               Reyesfurt
## 534         West Carmenfurt
## 535      North Stephanieberg
## 536             East Valerie
## 537            Sherrishire
## 538             Port Daniel
## 539               Brownview
## 540                Greerton
## 541           Hatfieldshire
## 542              Brianabury
## 543               New Maria
```

```
## 544                Colebury
## 545               Calebberg
## 546                Lake Ian
## 547               Gomezport
## 548               Shaneland
## 549              East Aaron
## 550          Dustinborough
## 551        East Michaelland
## 552             East Connie
## 553            West Shannon
## 554         North Lauraland
## 555        Port Christopher
## 556       South Patrickfort
## 557         East Georgeside
## 558             Charlesbury
## 560             South Renee
## 561        South Jackieberg
## 562               Loriville
## 563             Amandaland
## 564         West Robertside
## 565         North Sarashire
## 566              Port Maria
## 567          East Jessefort
## 568            Port Anthony
## 569             Edwardmouth
## 570           Dustinchester
## 571               Rochabury
## 573             Austinland
## 574             Lake Gerald
## 575              Wrightview
## 576              Perryburgh
## 577              Tracyhaven
## 578         South Jaimeview
## 579             Sandersland
## 580     South Meredithmouth
## 581         Richardsonshire
## 582           Kimberlymouth
## 583           Meghanchester
## 584              Tammyshire
## 586      Lake Elizabethside
## 587           Villanuevaton
## 588               Greerport
## 589         North Garyhaven
## 590              East Sharon
## 591           Johnstonmouth
## 592        East Heatherside
## 594         Richardsonmouth
## 595           Jenniferhaven
## 596               Boyerberg
## 597             Port Elijah
```

```
## 598              Knappburgh
## 599            New Dawnland
## 600            Chapmanmouth
## 601              Robertside
## 602       West Raymondmouth
## 603              Costaburgh
## 604            Kristineberg
## 605             Sandrashire
## 606            Andersonfurt
## 607                Tranland
## 608             Michaelland
## 609        East Rachaelfurt
## 610           Lake Johnbury
## 611           Elizabethstad
## 612               West Brad
## 613           Johnstonshire
## 614            Lake Timothy
## 615             Anthonyfurt
## 616           East Brettton
## 617             New Matthew
## 618      Christopherchester
## 619               Westshire
## 620             Alexisland
## 621           Kevinchester
## 622       New Patriciashire
## 623             Port Brenda
## 624          Port Brianfort
## 625             Portermouth
## 626           Hubbardmouth
## 627             South Brian
## 628           Hendrixmouth
## 629              Julietown
## 630               Lukeport
## 631              New Shane
## 632          Lake Jillville
## 633             Johnsonfort
## 634               Adamsbury
## 635           East Maureen
## 636        North Angelastad
## 637             Amandafort
## 638           Michaelmouth
## 639             Ronaldport
## 640          Port Davidland
## 641             Isaacborough
## 642           Lake Michael
## 643       West Michaelshire
## 644         Port Calvintown
## 645             Parkerhaven
## 646              Markhaven
## 647           Estradashire
```

```
## 648               Brianland
## 649           Cassandratown
## 650          West Dannyberg
## 651       East Debraborough
## 652            Frankchester
## 653                Lisafort
## 654            Colemanshire
## 655               Troyville
## 656               Hobbsbury
## 657           Harrisonmouth
## 658         Port Eugeneport
## 659              Karenmouth
## 660             Brendaburgh
## 661       New Christinatown
## 662             Jacksonstad
## 663          South Margaret
## 664         Port Georgebury
## 666              Sanderstown
## 667                Perezland
## 668                 Luisfurt
## 669            New Karenberg
## 670             West Leahton
## 671              West Sharon
## 672                Klineside
## 673             Lake Cynthia
## 674      South Cynthiashire
## 675               Lake Jacob
## 676            West Samantha
## 677               Jeremybury
## 678              Blevinstown
## 679            Meyerchester
## 680              Reginamouth
## 681              Donaldshire
## 682              Salazarbury
## 683         Lake Joshuafurt
## 684              Wintersfort
## 685               Jamesmouth
## 686               Laurieside
## 687              Andrewmouth
## 688              West Angela
## 689              East Carlos
## 690              Kennedyfurt
## 691               Blairville
## 692          East Donnatown
## 693              Matthewtown
## 694              Brandonbury
## 695           New Jamestown
## 696              Mosleyburgh
## 697                 Leahside
## 698          West Wendyland
```

```
## 699          Lawrenceborough
## 700              Kennethview
## 701           West Mariafort
## 702          Port Sherrystad
## 703        West Melissashire
## 705                Lesliefort
## 706                 Shawnside
## 707              Josephmouth
## 708                Garciatown
## 709                Chaseshire
## 710              Destinyfurt
## 711                  Mezaton
## 712                New Kayla
## 713              Carsonshire
## 714          Jacquelineshire
## 715          South Blakestad
## 716               North Mark
## 717              Kingchester
## 718                Evansfurt
## 719          South Adamhaven
## 720          Brittanyborough
## 721              Barbershire
## 722            East Ericport
## 723            Crawfordfurt
## 724              Turnerville
## 725                Kylieview
## 726      West Zacharyborough
## 727                Watsonfort
## 728                    Dayton
## 729             Nicholasport
## 730             Whitneyfort
## 731              Coffeytown
## 732           North Johnside
## 733             Robinsonland
## 735           West Ericaport
## 736                 Haleberg
## 737         West Michaelport
## 738            Ericksonmouth
## 739                 Yangside
## 740              Estradafurt
## 741                Frankport
## 743             Williamsside
## 744              Johnsonview
## 745                East Heidi
## 746            New Angelview
## 747         Lake Brandonview
## 748               Morganport
## 749                Browntown
## 750              Lake Hailey
## 751                Olsonside
```

```
## 752                Coxhaven
## 753              Meaganfort
## 754        North Monicaville
## 755               Mullenside
## 756               Princebury
## 757              Bradleyside
## 758            Elizabethbury
## 759                West Ryan
## 760                New Tammy
## 761              Sanchezland
## 762                Rogerland
## 763              Vanessaview
## 764             Jessicashire
## 765           Melissachester
## 766              Johnsontown
## 767           New Joshuaport
## 768            Hernandezside
## 769         New Williamville
## 770             Gilbertville
## 771               Newmanberg
## 772               West Alice
## 773               Cannonbury
## 774               Shelbyport
## 775                New Henry
## 776              Dustinmouth
## 779            New Hollyberg
## 780       Port Brittanyville
## 781               East Ronald
## 782         South Davidmouth
## 783                Carterton
## 784              Rachelhaven
## 785              New Timothy
## 786       North Jessicaville
## 788                Staceyfort
## 789         South Dianeshire
## 791              Micheletown
## 792      North Brittanyburgh
## 793             Port Jasmine
## 794              New Sabrina
## 795       Lake Charlottestad
## 796         West Rhondamouth
## 797              North Debra
## 798           Villanuevastad
## 799         North Jeremyport
## 801                Lake John
## 802             Courtneyfort
## 803               Tammymouth
## 804             Lake Vanessa
## 805              Lake Amanda
## 806               Mariemouth
```

```
## 807      Port Douglasborough
## 808          Port Aprilville
## 810               Lake Faith
## 811               Wendyville
## 812               Angelhaven
## 813                 New Sean
## 814                Lake Lisa
## 815              Valerieland
## 816               New Travis
## 817           North Samantha
## 818              Holderville
## 819             Patrickmouth
## 820       Lake Deannaborough
## 821             Jeffreymouth
## 822              Davieshaven
## 823        Lake Jessicaville
## 824         Hernandezchester
## 825        North Kennethside
## 827              Williamport
## 828                Smithside
## 829              Vanessastad
## 831         Lake Rhondaburgh
## 832          Cunninghamhaven
## 833              Robertstown
## 834               South Mark
## 835          New Taylorburgh
## 836           Port Karenfurt
## 837                Carterland
## 838                East Shawn
## 839          West Derekmouth
## 840               Brandiland
## 841           Cervantesshire
## 842         North Debrashire
## 843              Deannaville
## 844         East Christopher
## 845               Rickymouth
## 846              Port Dennis
## 847            Lake Michelle
## 848            East Johnport
## 849              Sabrinaview
## 850              Kristinfurt
## 851              Chapmanland
## 852            North Jonathan
## 853            Port Christina
## 854                 Juanport
## 855                East Mike
## 856         North Angelatown
## 857              West Steven
## 858                Riggsstad
## 859                Davidview
```

```
## 860        Port Kevinborough
## 861              Lawsonshire
## 862            Wagnerchester
## 863               Daisymouth
## 865      Port Jacquelinestad
## 866               New Teresa
## 867                Henryfort
## 868              Lake Joseph
## 869            Daviesborough
## 870            North Brandon
## 871                 Adamside
## 872                Wademouth
## 873            North Raymond
## 874             Randolphport
## 875           East Troyhaven
## 876             Clarkborough
## 877               Josephberg
## 878         Lake Jenniferton
## 880              Ashleymouth
## 881                Henryland
## 882            Lake Danielle
## 883             Joshuaburgh
## 884         South Jeanneport
## 885               New Nathan
## 886               Jonesshire
## 887               Mariahview
## 888           New Julianberg
## 889               Randyshire
## 890               Philipberg
## 891              West Dennis
## 892            Richardshire
## 893              Lake James
## 894            Austinborough
## 895            Alexandrafort
## 896              Melissastad
## 897            Gonzalezburgh
## 898            Port Jennifer
## 899               Chrismouth
## 900                Port Beth
## 901              West David
## 902            Fraziershire
## 904            South Pamela
## 905         North Laurenview
## 906            Campbellstad
## 907           Port Derekberg
## 908              West Andrew
## 909               West Randy
## 910        South Christopher
## 911        Lake Michellebury
## 912               Zacharyton
```

```
## 913              West James
## 914              Millerview
## 915             Hawkinsbury
## 916            Elizabethport
## 918                Wadestad
## 919             Mauriceshire
## 920           West Arielstad
## 921                Adamsstad
## 923             Blairborough
## 924           New Marcusbury
## 925                Evansville
## 926           Huffmanchester
## 927              New Cynthia
## 928              Joshuamouth
## 929            West Benjamin
## 930             Williamsfort
## 931            North Tiffany
## 932              Edwardsport
## 933            Lake Evantown
## 934              South Henry
## 935              Harmonhaven
## 936           West Gregburgh
## 937                Hansenland
## 938       Port Michaelmouth
## 939                Tylerport
## 940              West Lacey
## 941      North Jenniferburgh
## 942         South Davidhaven
## 943        North Charlesbury
## 944             Jonathanland
## 945           North Virginia
## 946              West Tanner
## 947               Jonesmouth
## 949            West Annefort
## 950              East Jason
## 951             North Cassie
## 952              Hintonport
## 953                New James
## 954            North Destiny
## 955           Mclaughlinbury
## 956      West Gabriellamouth
## 957              Alvarezland
## 958                New Julie
## 959          North Frankstad
## 960              Claytonside
## 961                Melanieton
## 962         Lake Michaelport
## 963       East Benjaminville
## 964           Garrettborough
## 965         Port Raymondfort
```

```
## 966               Waltertown
## 967              Cameronberg
## 968               Kaylashire
## 969               Fosterside
## 970                Davidstad
## 971               Lake Tracy
## 972              Taylormouth
## 973               Dianaville
## 974              Collinsburgh
## 975               Port Rachel
## 976            South Rebecca
## 977          Port Joshuafort
## 978             Robinsontown
## 979                  Beckton
## 980           New Frankshire
## 981         North Derekville
## 982              West Sydney
## 983             Lake Matthew
## 984         Lake Zacharyfurt
## 985             Lindsaymouth
## 986                Sarahland
## 988             Michaelshire
## 989                 Sarafurt
## 990             South Denise
## 991               North Katie
## 992               Mauricefurt
## 993               New Patrick
## 994             Edwardsmouth
## 995             Nicholasland
## 996                Duffystad
## 997               New Darlene
## 998            South Jessica
## 1000              Ronniemouth
```

```
unique(data[c("Country")])
```

```
##                                                  Country
## 1                                                Tunisia
## 2                                                  Nauru
## 3                                             San Marino
## 4                                                  Italy
## 5                                                Iceland
## 6                                                 Norway
## 7                                                Myanmar
## 8                                              Australia
## 9                                                Grenada
## 10                                                 Ghana
## 11                                                 Qatar
## 12                                               Burundi
## 13                                                 Egypt
```

```
## 14                                 Bosnia and Herzegovina
## 15                                               Barbados
## 16                                                  Spain
## 17                                   Palestinian Territory
## 18                                             Afghanistan
## 19  British Indian Ocean Territory (Chagos Archipelago)
## 20                                     Russian Federation
## 21                                               Cameroon
## 24                                                  Korea
## 25                                                Tokelau
## 26                                                 Monaco
## 27                                                 Tuvalu
## 28                                                 Greece
## 29                                  British Virgin Islands
## 30                               Bouvet Island (Bouvetoya)
## 31                                                   Peru
## 32                                                 Aruba
## 33                                               Maldives
## 34                                                Senegal
## 35                                               Dominica
## 36                                             Luxembourg
## 37                                             Montenegro
## 38                                                Ukraine
## 39                                           Saint Helena
## 40                                                Liberia
## 43                                             Turkmenistan
## 45                                                  Niger
## 48                                              Sri Lanka
## 49                                       Trinidad and Tobago
## 52                                            United Kingdom
## 53                                             Guinea-Bissau
## 54                                                Micronesia
## 55                                                    Turkey
## 56                                                 Croatia
## 57                                                  Israel
## 58                          Svalbard & Jan Mayen Islands
## 59                                              Azerbaijan
## 60                                                    Iran
## 62                       Saint Vincent and the Grenadines
## 64                                                Bulgaria
## 65                                         Christmas Island
## 66                                                  Canada
## 67                                                  Rwanda
## 68                                Turks and Caicos Islands
## 70                                          Norfolk Island
## 73                                            Cook Islands
## 75                                               Guatemala
## 76                                            Cote d'Ivoire
## 77                                            Faroe Islands
## 79                                                  Ireland
```

```
## 81                                          Moldova
## 82                                        Nicaragua
## 83                                       Montserrat
## 84                                      Timor-Leste
## 86                                      Puerto Rico
## 87                          Central African Republic
## 88                                        Venezuela
## 90                                Wallis and Futuna
## 91                                           Jersey
## 93                                            Samoa
## 95  Antarctica (the territory South of 60 deg S)
## 96                                          Albania
## 97                                        Hong Kong
## 98                                        Lithuania
## 100                                      Bangladesh
## 101                                  Western Sahara
## 102                                          Serbia
## 104                                  Czech Republic
## 105                                        Guernsey
## 106                                        Tanzania
## 107                                          Bhutan
## 109                                          Guinea
## 111                                      Madagascar
## 112                                         Lebanon
## 113                                         Eritrea
## 114                                          Guyana
## 117                           United Arab Emirates
## 118                                      Martinique
## 119                                         Somalia
## 122                                           Benin
## 123                               Papua New Guinea
## 124                                      Uzbekistan
## 125                                    South Africa
## 127                                         Hungary
## 128                   Falkland Islands (Malvinas)
## 132                                    Saint Martin
## 133                                            Cuba
## 134          United States Minor Outlying Islands
## 135                                          Belize
## 139                                          Kuwait
## 140                                        Thailand
## 141                                       Gibraltar
## 142                 Holy See (Vatican City State)
## 147                                     Netherlands
## 148                                         Belarus
## 151                                     New Zealand
## 152                                            Togo
## 153                                           Kenya
## 154                                           Palau
## 156                                        Cambodia
```

```
## 159                                  Costa Rica
## 160                                Liechtenstein
## 163                                       Angola
## 165                            Equatorial Guinea
## 166                                     Mongolia
## 169                                       Brazil
## 170                                         Chad
## 171                                     Portugal
## 172                                       Malawi
## 174                                    Singapore
## 176                                   Kazakhstan
## 179                                        China
## 181                                      Vietnam
## 184                                      Mayotte
## 187                                      Jamaica
## 188                                      Bahamas
## 190                                      Algeria
## 191                                         Fiji
## 193                                    Argentina
## 195                                  Philippines
## 197                                     Suriname
## 199                                         Guam
## 201                          Antigua and Barbuda
## 203                                      Georgia
## 204                                       Jordan
## 205                                 Saudi Arabia
## 210                       Sao Tome and Principe
## 212                                       Cyprus
## 213                             Kyrgyz Republic
## 214                                     Pakistan
## 215                                   Seychelles
## 218                                   Mauritania
## 220                                        Chile
## 221                                       Poland
## 222                                      Estonia
## 224                                       Latvia
## 228                                      Bahrain
## 229                                     Colombia
## 230                           Brunei Darussalam
## 231                                       Taiwan
## 233                 Saint Pierre and Miquelon
## 238                                      Finland
## 243               French Southern Territories
## 248                                Sierra Leone
## 249                                  Tajikistan
## 251                                     Ecuador
## 252                                 Switzerland
## 255                                      France
## 265                                    Malaysia
## 266                                   Mauritius
```

```
## 269                                          Japan
## 270                                      Greenland
## 273                                     Guadeloupe
## 274                                        Belgium
## 276                                       Honduras
## 278                                       Paraguay
## 281                                  French Guiana
## 282                        Northern Mariana Islands
## 285                                  American Samoa
## 286                                        Austria
## 287                                          Tonga
## 291                                  New Caledonia
## 293                        United States of America
## 294                                        Morocco
## 296                                      Macedonia
## 299                                          Gabon
## 304                                         Uganda
## 314                                    Saint Lucia
## 315                                           Niue
## 321                                         Zambia
## 322                                          Congo
## 324                               Pitcairn Islands
## 326                                       Anguilla
## 332                                         Sweden
## 339                                      Indonesia
## 342                                         Mexico
## 344                                          Haiti
## 348                                         Gambia
## 352                                    El Salvador
## 353                          Libyan Arab Jamahiriya
## 355                                Saint Barthelemy
## 356                                        Reunion
## 370                                         Panama
## 384                             Dominican Republic
## 385                                       Zimbabwe
## 394                                      Swaziland
## 398                           Saint Kitts and Nevis
## 399                                   Burkina Faso
## 411                 Heard Island and McDonald Islands
## 413                                        Bolivia
## 417                           Netherlands Antilles
## 428                               French Polynesia
## 455                                        Germany
## 461                                          Malta
## 463                                          Sudan
## 464                  Lao People's Democratic Republic
## 495                                    Isle of Man
## 500                                          Macao
## 502                      United States Virgin Islands
## 504                                       Djibouti
```

```
## 506                                                 Mali
## 508                                              Romania
## 509                                       Cayman Islands
## 521                                             Ethiopia
## 535                                              Uruguay
## 558                                              Comoros
## 562                                              Vanuatu
## 566                                                Nepal
## 571                                                Yemen
## 572                                                India
## 621                                           Cape Verde
## 635                                             Slovenia
## 643                                              Denmark
## 651                                 Syrian Arab Republic
## 662                                              Andorra
## 710                                              Namibia
## 718                           Slovakia (Slovak Republic)
## 729                                              Armenia
## 755        South Georgia and the South Sandwich Islands
## 786                                             Kiribati
## 809                                      Marshall Islands
## 931                                              Bermuda
## 935                                           Mozambique
## 946                                              Lesotho
```

```
#Feature selection
data_f <- data[c('Daily.Time.Spent.on.Site', 'Age', 'Area.Income',
'Daily.Internet.Usage', 'Gender', 'Clicked.on.Ad')]
#Previewing dataset
head(data_f)
```

```
##   Daily.Time.Spent.on.Site Age Area.Income Daily.Internet.Usage Gender
## 1                    68.95  35    61833.90               256.09      0
## 2                    80.23  31    68441.85               193.77      1
## 3                    69.47  26    59785.94               236.50      0
## 4                    74.15  29    54806.18               245.89      1
## 5                    68.37  35    73889.99               225.58      0
## 6                    59.99  23    59761.56               226.74      1
##   Clicked.on.Ad
## 1             0
## 2             0
## 3             0
## 4             0
## 5             0
## 6             0
```

```
#Displaying the structure of our dataframe
str(data)
```

```
## 'data.frame':    1000 obs. of  12 variables:
##  $ Daily.Time.Spent.on.Site: num  69 80.2 69.5 74.2 68.4 ...
```

```
##  $ Age                     : int  35 31 26 29 35 23 33 48 30 20 ...
##  $ Area.Income             : num  61834 68442 59786 54806 73890 ...
##  $ Daily.Internet.Usage    : num  256 194 236 246 226 ...
##  $ Ad.Topic.Line           : chr  "Cloned 5thgeneration orchestration"
"Monitored national standardization" "Organic bottom-line service-desk"
"Triple-buffered reciprocal time-frame" ...
##  $ City                    : chr  "Wrightburgh" "West Jodi" "Davidton"
"West Terrifurt" ...
##  $ Gender                  : int  0 1 0 1 0 1 0 1 1 1 ...
##  $ Country                 : chr  "Tunisia" "Nauru" "San Marino" "Italy"
...
##  $ Year                    : chr  "2016" "2016" "2016" "2016" ...
##  $ Month                   : chr  "03" "04" "03" "01" ...
##  $ Day                     : chr  "27" "04" "13" "10" ...
##  $ Clicked.on.Ad           : Factor w/ 2 levels "0","1": 1 1 1 1 1 1 1 2 1
1 ...
```

Normalizing our data

```
#Normalization function
normalize <- function(x) {
return ((x - min(x)) / (max(x) - min(x))) }

#Normalizing the data
data_norm <- as.data.frame(lapply(data_f[,1:5], normalize))
#Previewing the dataset
head(data_norm)

##   Daily.Time.Spent.on.Site       Age Area.Income Daily.Internet.Usage
Gender
## 1                0.6178820 0.3809524   0.7304725            0.9160310
0
## 2                0.8096209 0.2857143   0.8313752            0.5387456
1
## 3                0.6267211 0.1666667   0.6992003            0.7974331
0
## 4                0.7062723 0.2380952   0.6231599            0.8542802
1
## 5                0.6080231 0.3809524   0.9145678            0.7313234
0
## 6                0.4655788 0.0952381   0.6988280            0.7383460
1
```

Splitting our dataset

```
set.seed(1234)
#random selection of 70% data.
ad_data <- sample(1:nrow(data_norm),size=nrow(data_norm)*0.7,replace = FALSE)

train <- data_f[ad_data,]
test <- data_f[-ad_data,]
```

```
train_label <- data_f[ad_data,6]
test_label <-data_f[-ad_data,6]
```

Building the model

```
#Installing class packages required
#install.packages("class", dependencies = TRUE)

#Loading the libraries required
library("class")
library("caret")

## Loading required package: lattice

library("kernlab")

##
## Attaching package: 'kernlab'

## The following object is masked from 'package:ggplot2':
##
##     alpha

library("e1071")

##
## Attaching package: 'e1071'

## The following objects are masked from 'package:PerformanceAnalytics':
##
##     kurtosis, skewness

#Checking the number of observations
NROW(train_label)

## [1] 700

# Instantiating the KNN function
knn <- knn(train=train, test=test, cl=train_label, k=26)

confusionMatrix(table(knn,test_label))

## Confusion Matrix and Statistics
##
##    test_label
## knn   0   1
##   0 110  53
##   1  42  95
##
##                Accuracy : 0.6833
##                  95% CI : (0.6274, 0.7356)
##     No Information Rate : 0.5067
```

```
##     P-Value [Acc > NIR] : 4.241e-10
##
##                   Kappa : 0.3659
##
##  Mcnemar's Test P-Value : 0.3049
##
##             Sensitivity : 0.7237
##             Specificity : 0.6419
##          Pos Pred Value : 0.6748
##          Neg Pred Value : 0.6934
##              Prevalence : 0.5067
##          Detection Rate : 0.3667
##    Detection Prevalence : 0.5433
##       Balanced Accuracy : 0.6828
##
##        'Positive' Class : 0
##
```

Challenging the solution using SVM

```
intrain <- createDataPartition(y = data_f$Clicked.on.Ad, p= 0.7, list =
FALSE)
train <- data_f[intrain,]
test <- data_f[-intrain,]

#Ensuring the variabke to be predicted is categorical
train[["Clicked.on.Ad"]] = factor(train[["Clicked.on.Ad"]])

#Train control to train data on different algorithm
tr_ctl <- trainControl(method = "repeatedcv", number = 10, repeats = 5)

svm_Linear <- train(Clicked.on.Ad ~., data = train, method = "svmLinear",
trControl=tr_ctl, preProcess = c("center", "scale"), tuneLength = 10)

test_pred <- predict(svm_Linear, newdata = test)
confusionMatrix(table(test_pred, test$Clicked.on.Ad))

## Confusion Matrix and Statistics
##
##
## test_pred   0   1
##         0 146   7
##         1   4 143
##
##                Accuracy : 0.9633
##                  95% CI : (0.9353, 0.9816)
##     No Information Rate : 0.5
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.9267
##
```

```
##  Mcnemar's Test P-Value : 0.5465
##
##             Sensitivity : 0.9733
##             Specificity : 0.9533
##          Pos Pred Value : 0.9542
##          Neg Pred Value : 0.9728
##              Prevalence : 0.5000
##          Detection Rate : 0.4867
##    Detection Prevalence : 0.5100
##       Balanced Accuracy : 0.9633
##
##        'Positive' Class : 0
##
```

SVM has a much higher accuracy at 96% as compared to KNN at 68%, thus it is a better model