Part 2 Kira Plastinina Project

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Introduction

Kira Plastinina is a Russian brand that is sold through a defunct chain of retail stores in Russia, Ukraine, Kazakhstan, Belarus, China, Philippines, and Armenia.

Problem Statement

The brand's Sales and Marketing team would like to understand their customer's behavior from data that they have collected over the past year. More specifically, they would like to learn the characteristics of customer groups.

Metrics of Success

- Find and deal with outliers, anomalies, and missing data within the data set.
- Perform uni variate and bivariate analysis.
- Perform clustering stating insights drawn from your analysis and visualizations.
- Provide comparisons between different approaches i.e. K-Means clustering vs Hierarchical clustering highlighting the strengths and limitations of each approach in the context of your analysis.

Data Understanding

Will load the data from the following source http://bit.ly/EcommerceCustomersDataset

```
library(data.table)

## Warning: package 'data.table' was built under R version 4.1.2

data <- fread('http://bit.ly/EcommerceCustomersDataset')
```

Will review the first six rows

```
head(data)

##    Administrative Administrative_Duration Informational
Informational_Duration
## 1:              0                       0             0
0
## 2:              0                       0             0
0
```

```
## 3:              0                       -1             0
-1
## 4:              0                        0             0
0
## 5:              0                        0             0
0
## 6:              0                        0             0
0
##    ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1:              1                0.000000  0.20000000 0.2000000          0
## 2:              2               64.000000  0.00000000 0.1000000          0
## 3:              1               -1.000000  0.20000000 0.2000000          0
## 4:              2                2.666667  0.05000000 0.1400000          0
## 5:             10              627.500000  0.02000000 0.0500000          0
## 6:             19              154.216667  0.01578947 0.0245614          0
##    SpecialDay Month OperatingSystems Browser Region TrafficType
## 1:          0   Feb                1       1      1           1
## 2:          0   Feb                2       2      1           2
## 3:          0   Feb                4       1      9           3
## 4:          0   Feb                3       2      2           4
## 5:          0   Feb                3       3      1           4
## 6:          0   Feb                2       2      1           3
##          VisitorType Weekend Revenue
## 1: Returning_Visitor   FALSE   FALSE
## 2: Returning_Visitor   FALSE   FALSE
## 3: Returning_Visitor   FALSE   FALSE
## 4: Returning_Visitor   FALSE   FALSE
## 5: Returning_Visitor    TRUE   FALSE
## 6: Returning_Visitor   FALSE   FALSE
```

Number of records

```
dim(data)

## [1] 12330    18
```

Attributes

```
str(data)

## Classes 'data.table' and 'data.frame':   12330 obs. of  18 variables:
##  $ Administrative         : int  0 0 0 0 0 0 0 1 0 0 ...
##  $ Administrative_Duration: num  0 0 -1 0 0 0 -1 -1 0 0 ...
##  $ Informational          : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ Informational_Duration : num  0 0 -1 0 0 0 -1 -1 0 0 ...
##  $ ProductRelated         : int  1 2 1 2 10 19 1 1 2 3 ...
##  $ ProductRelated_Duration: num  0 64 -1 2.67 627.5 ...
##  $ BounceRates            : num  0.2 0 0.2 0.05 0.02 ...
##  $ ExitRates              : num  0.2 0.1 0.2 0.14 0.05 ...
##  $ PageValues             : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ SpecialDay             : num  0 0 0 0 0 0 0.4 0 0.8 0.4 ...
```

```
##  $ Month                  : chr  "Feb" "Feb" "Feb" "Feb" ...
##  $ OperatingSystems       : int  1 2 4 3 3 2 2 1 2 2 ...
##  $ Browser                : int  1 2 1 2 3 2 4 2 2 4 ...
##  $ Region                 : int  1 1 9 2 1 1 3 1 2 1 ...
##  $ TrafficType            : int  1 2 3 4 4 3 3 5 3 2 ...
##  $ VisitorType            : chr  "Returning_Visitor" "Returning_Visitor"
"Returning_Visitor" "Returning_Visitor" ...
##  $ Weekend                : logi  FALSE FALSE FALSE FALSE TRUE FALSE ...
##  $ Revenue                : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
##  - attr(*, ".internal.selfref")=<externalptr>
```

Summary Statistics

```
summary(data)

##  Administrative   Administrative_Duration Informational
##  Min.   : 0.000   Min.   :  -1.00         Min.   : 0.000
##  1st Qu.: 0.000   1st Qu.:   0.00         1st Qu.: 0.000
##  Median : 1.000   Median :   8.00         Median : 0.000
##  Mean   : 2.318   Mean   :  80.91         Mean   : 0.504
##  3rd Qu.: 4.000   3rd Qu.:  93.50         3rd Qu.: 0.000
##  Max.   :27.000   Max.   :3398.75         Max.   :24.000
##  NA's   :14       NA's   :14              NA's   :14
##  Informational_Duration ProductRelated   ProductRelated_Duration
##  Min.   :  -1.00        Min.   :  0.00   Min.   :   -1.0
##  1st Qu.:   0.00        1st Qu.:  7.00   1st Qu.:  185.0
##  Median :   0.00        Median : 18.00   Median :  599.8
##  Mean   :  34.51        Mean   : 31.76   Mean   : 1196.0
##  3rd Qu.:   0.00        3rd Qu.: 38.00   3rd Qu.: 1466.5
##  Max.   :2549.38        Max.   :705.00   Max.   :63973.5
##  NA's   :14             NA's   :14       NA's   :14
##   BounceRates         ExitRates         PageValues        SpecialDay
##  Min.   :0.000000   Min.   :0.00000   Min.   :  0.000   Min.   :0.00000
##  1st Qu.:0.000000   1st Qu.:0.01429   1st Qu.:  0.000   1st Qu.:0.00000
##  Median :0.003119   Median :0.02512   Median :  0.000   Median :0.00000
##  Mean   :0.022152   Mean   :0.04300   Mean   :  5.889   Mean   :0.06143
##  3rd Qu.:0.016684   3rd Qu.:0.05000   3rd Qu.:  0.000   3rd Qu.:0.00000
##  Max.   :0.200000   Max.   :0.20000   Max.   :361.764   Max.   :1.00000
##  NA's   :14         NA's   :14
##     Month           OperatingSystems    Browser           Region
##  Length:12330       Min.   :1.000    Min.   : 1.000   Min.   :1.000
##  Class :character   1st Qu.:2.000    1st Qu.: 2.000   1st Qu.:1.000
##  Mode  :character   Median :2.000    Median : 2.000   Median :3.000
##                     Mean   :2.124    Mean   : 2.357   Mean   :3.147
##                     3rd Qu.:3.000    3rd Qu.: 2.000   3rd Qu.:4.000
##                     Max.   :8.000    Max.   :13.000   Max.   :9.000
##
##   TrafficType    VisitorType         Weekend         Revenue
##  Min.   : 1.00   Length:12330       Mode :logical   Mode :logical
##  1st Qu.: 2.00   Class :character   FALSE:9462      FALSE:10422
```

```
##  Median : 2.00   Mode  :character   TRUE :2868      TRUE :1908
##  Mean   : 4.07
##  3rd Qu.: 4.00
##  Max.   :20.00
##
```

Data Cleaning and Data Preparation

a. Checking for missing values

```
library(tidyverse)

## -- Attaching packages --------------------------------------- tidyverse
1.3.2 --
## v ggplot2 3.3.6     v purrr   0.3.4
## v tibble  3.1.7     v dplyr   1.0.9
## v tidyr   1.2.0     v stringr 1.4.0
## v readr   2.1.2     v forcats 0.5.1

## Warning: package 'ggplot2' was built under R version 4.1.3

## Warning: package 'tibble' was built under R version 4.1.3

## Warning: package 'tidyr' was built under R version 4.1.3

## Warning: package 'readr' was built under R version 4.1.2

## Warning: package 'purrr' was built under R version 4.1.2

## Warning: package 'dplyr' was built under R version 4.1.3

## Warning: package 'stringr' was built under R version 4.1.1

## Warning: package 'forcats' was built under R version 4.1.2

## -- Conflicts ------------------------------------------
tidyverse_conflicts() --
## x dplyr::between()   masks data.table::between()
## x dplyr::filter()    masks stats::filter()
## x dplyr::first()     masks data.table::first()
## x dplyr::lag()       masks stats::lag()
## x dplyr::last()      masks data.table::last()
## x purrr::transpose() masks data.table::transpose()

cbind(lapply(lapply(data, is.na), sum))

##                          [,1]
## Administrative           14
## Administrative_Duration  14
## Informational            14
## Informational_Duration   14
## ProductRelated           14
## ProductRelated_Duration  14
## BounceRates              14
```

```
## ExitRates               14
## PageValues              0
## SpecialDay              0
## Month                   0
## OperatingSystems        0
## Browser                 0
## Region                  0
## TrafficType             0
## VisitorType             0
## Weekend                 0
## Revenue                 0
```

Out of the 12330 rows we only have 14 that have missing values meaning they won't have a great significance so will drop them

```
df <- data%>% drop_na()
df
```

```
##        Administrative Administrative_Duration Informational
##     1:              0                       0             0
##     2:              0                       0             0
##     3:              0                      -1             0
##     4:              0                       0             0
##     5:              0                       0             0
##    ---
## 12312:              3                     145             0
## 12313:              0                       0             0
## 12314:              0                       0             0
## 12315:              4                      75             0
## 12316:              0                       0             0
##        Informational_Duration ProductRelated ProductRelated_Duration
##     1:                      0              1                0.000000
##     2:                      0              2               64.000000
##     3:                     -1              1               -1.000000
##     4:                      0              2                2.666667
##     5:                      0             10              627.500000
##    ---
## 12312:                      0             53             1783.791667
## 12313:                      0              5              465.750000
## 12314:                      0              6              184.250000
## 12315:                      0             15              346.000000
## 12316:                      0              3               21.250000
##        BounceRates  ExitRates PageValues SpecialDay Month OperatingSystems
##     1: 0.200000000 0.20000000    0.00000          0   Feb                1
##     2: 0.000000000 0.10000000    0.00000          0   Feb                2
##     3: 0.200000000 0.20000000    0.00000          0   Feb                4
##     4: 0.050000000 0.14000000    0.00000          0   Feb                3
##     5: 0.020000000 0.05000000    0.00000          0   Feb                3
##    ---
## 12312: 0.007142857 0.02903061   12.24172          0   Dec                4
```

```
## 12313: 0.000000000 0.02133333    0.00000          0   Nov                3
## 12314: 0.083333333 0.08666667    0.00000          0   Nov                3
## 12315: 0.000000000 0.02105263    0.00000          0   Nov                2
## 12316: 0.000000000 0.06666667    0.00000          0   Nov                3
##        Browser Region TrafficType       VisitorType Weekend Revenue
##     1:       1      1           1 Returning_Visitor   FALSE   FALSE
##     2:       2      1           2 Returning_Visitor   FALSE   FALSE
##     3:       1      9           3 Returning_Visitor   FALSE   FALSE
##     4:       2      2           4 Returning_Visitor   FALSE   FALSE
##     5:       3      1           4 Returning_Visitor    TRUE   FALSE
##    ---
## 12312:       6      1           1 Returning_Visitor    TRUE   FALSE
## 12313:       2      1           8 Returning_Visitor    TRUE   FALSE
## 12314:       2      1          13 Returning_Visitor    TRUE   FALSE
## 12315:       2      3          11 Returning_Visitor   FALSE   FALSE
## 12316:       2      1           2       New_Visitor    TRUE   FALSE
```

```
cbind(lapply(lapply(df, is.na), sum))
```

```
##                          [,1]
## Administrative           0
## Administrative_Duration  0
## Informational            0
## Informational_Duration   0
## ProductRelated           0
## ProductRelated_Duration  0
## BounceRates              0
## ExitRates                0
## PageValues               0
## SpecialDay               0
## Month                    0
## OperatingSystems         0
## Browser                  0
## Region                   0
## TrafficType              0
## VisitorType              0
## Weekend                  0
## Revenue                  0
```

we now have no null values.

b. Will check for duplicates

```
data_duplicated <- df[duplicated(df),]
data_duplicated
```

```
##      Administrative Administrative_Duration Informational
##   1:              0                       0             0
##   2:              0                       0             0
##   3:              0                       0             0
##   4:              0                       0             0
##   5:              0                       0             0
```

```
##  ---
## 113:              0                       0             0
## 114:              0                       0             0
## 115:              0                       0             0
## 116:              0                       0             0
## 117:              0                       0             0
##      Informational_Duration ProductRelated ProductRelated_Duration
BounceRates
##   1:                      0              1                        0
0.2
##   2:                      0              1                        0
0.2
##   3:                      0              1                        0
0.2
##   4:                      0              1                        0
0.2
##   5:                      0              1                        0
0.2
##  ---
## 113:                      0              1                        0
0.2
## 114:                      0              1                        0
0.2
## 115:                      0              1                        0
0.2
## 116:                      0              1                        0
0.2
## 117:                      0              1                        0
0.2
##      ExitRates PageValues SpecialDay Month OperatingSystems Browser Region
##   1:       0.2          0          0   Feb                 1       1      1
##   2:       0.2          0          0   Feb                 3       2      3
##   3:       0.2          0          0   Mar                 1       1      1
##   4:       0.2          0          0   Mar                 2       2      4
##   5:       0.2          0          0   Mar                 3       2      3
##  ---
## 113:       0.2          0          0   Dec                 1       1      1
## 114:       0.2          0          0   Dec                 1       1      4
## 115:       0.2          0          0   Dec                 1       1      1
## 116:       0.2          0          0   Dec                 1      13      9
## 117:       0.2          0          0   Dec                 8      13      9
##      TrafficType       VisitorType Weekend Revenue
##   1:           3 Returning_Visitor   FALSE   FALSE
##   2:           3 Returning_Visitor   FALSE   FALSE
##   3:           1 Returning_Visitor    TRUE   FALSE
##   4:           1 Returning_Visitor   FALSE   FALSE
##   5:           1 Returning_Visitor   FALSE   FALSE
##  ---
## 113:           2       New_Visitor   FALSE   FALSE
## 114:           1 Returning_Visitor    TRUE   FALSE
```

```
## 115:           3 Returning_Visitor   FALSE   FALSE
## 116:          20 Returning_Visitor   FALSE   FALSE
## 117:          20              Other   FALSE   FALSE
```

we have 119 rows duplicate rows, we are going to drop them

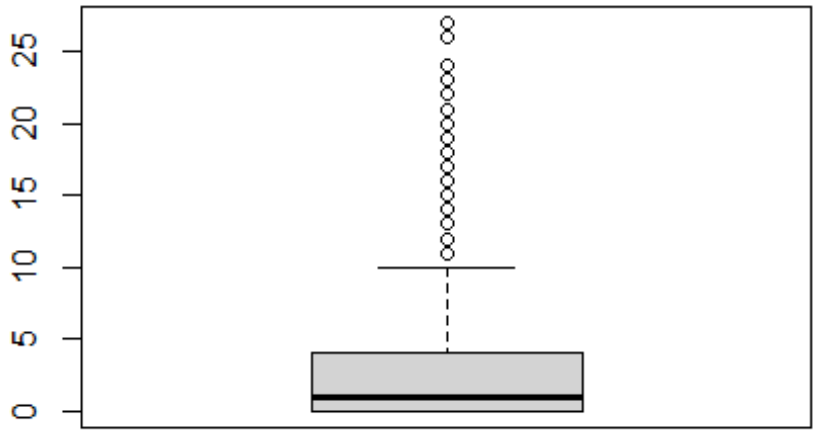
```
unique(df)
```

```
##        Administrative Administrative_Duration Informational
##     1:              0                       0             0
##     2:              0                       0             0
##     3:              0                      -1             0
##     4:              0                       0             0
##     5:              0                       0             0
##    ---
## 12195:              3                     145             0
## 12196:              0                       0             0
## 12197:              0                       0             0
## 12198:              4                      75             0
## 12199:              0                       0             0
##        Informational_Duration ProductRelated ProductRelated_Duration
##     1:                      0              1                0.000000
##     2:                      0              2               64.000000
##     3:                     -1              1               -1.000000
##     4:                      0              2                2.666667
##     5:                      0             10              627.500000
##    ---
## 12195:                      0             53             1783.791667
## 12196:                      0              5              465.750000
## 12197:                      0              6              184.250000
## 12198:                      0             15              346.000000
## 12199:                      0              3               21.250000
##        BounceRates  ExitRates PageValues SpecialDay Month OperatingSystems
##     1: 0.200000000 0.20000000    0.00000          0   Feb                 1
##     2: 0.000000000 0.10000000    0.00000          0   Feb                 2
##     3: 0.200000000 0.20000000    0.00000          0   Feb                 4
##     4: 0.050000000 0.14000000    0.00000          0   Feb                 3
##     5: 0.020000000 0.05000000    0.00000          0   Feb                 3
##    ---
## 12195: 0.007142857 0.02903061   12.24172          0   Dec                 4
## 12196: 0.000000000 0.02133333    0.00000          0   Nov                 3
## 12197: 0.083333333 0.08666667    0.00000          0   Nov                 3
## 12198: 0.000000000 0.02105263    0.00000          0   Nov                 2
## 12199: 0.000000000 0.06666667    0.00000          0   Nov                 3
##        Browser Region TrafficType       VisitorType Weekend Revenue
##     1:       1      1           1 Returning_Visitor   FALSE   FALSE
##     2:       2      1           2 Returning_Visitor   FALSE   FALSE
##     3:       1      9           3 Returning_Visitor   FALSE   FALSE
##     4:       2      2           4 Returning_Visitor   FALSE   FALSE
##     5:       3      1           4 Returning_Visitor    TRUE   FALSE
```

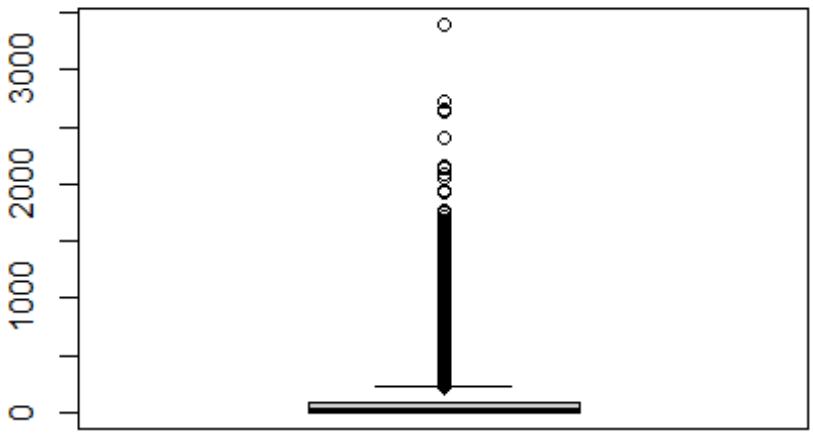
```
##     ---
## 12195:       6      1           1 Returning_Visitor    TRUE   FALSE
## 12196:       2      1           8 Returning_Visitor    TRUE   FALSE
## 12197:       2      1          13 Returning_Visitor    TRUE   FALSE
## 12198:       2      3          11 Returning_Visitor   FALSE   FALSE
## 12199:       2      1           2       New_Visitor    TRUE   FALSE
```

c. Will check for outliers

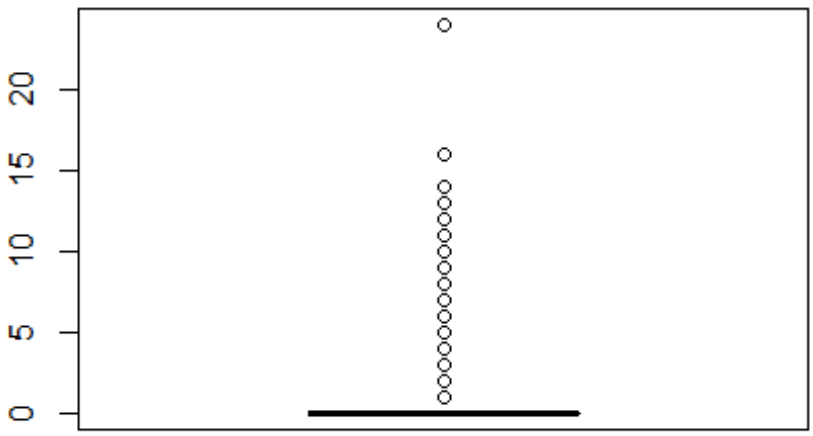
```
boxplot(df$Administrative)
```



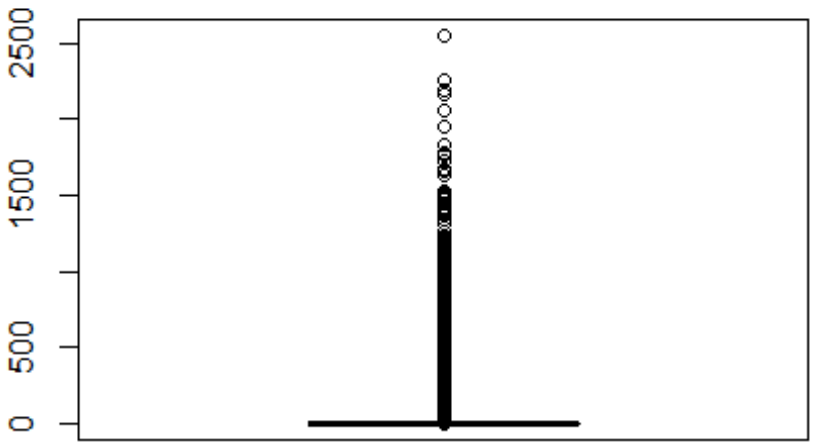

```
boxplot(df$Administrative_Duration)
```



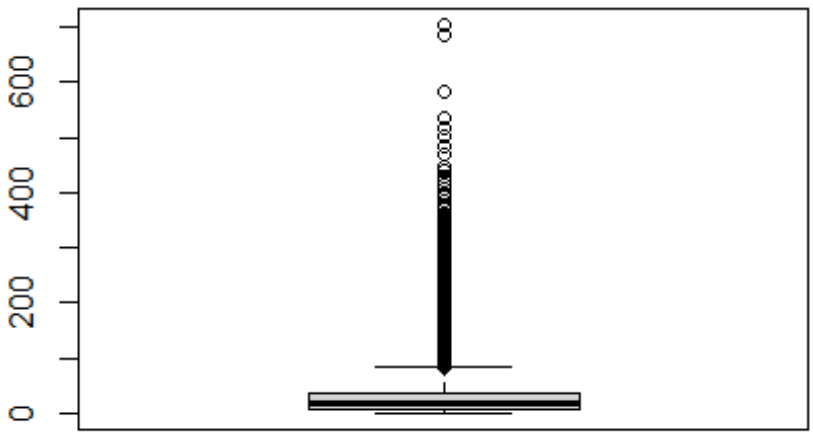

```
boxplot(df$Informational)
```



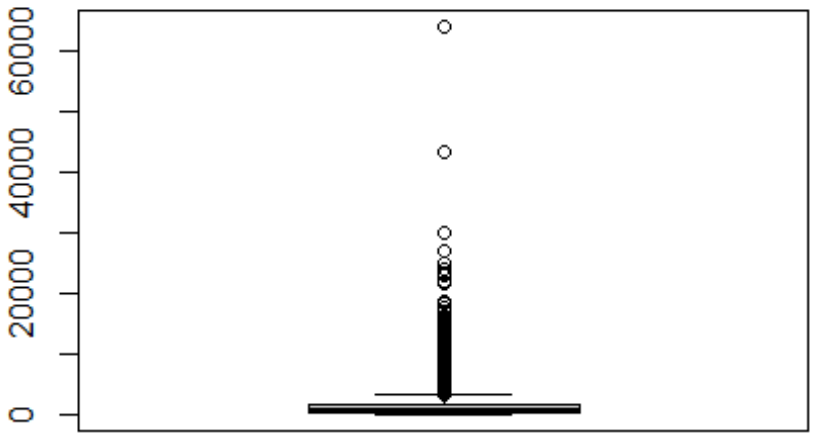

```
boxplot(df$Informational_Duration)
```



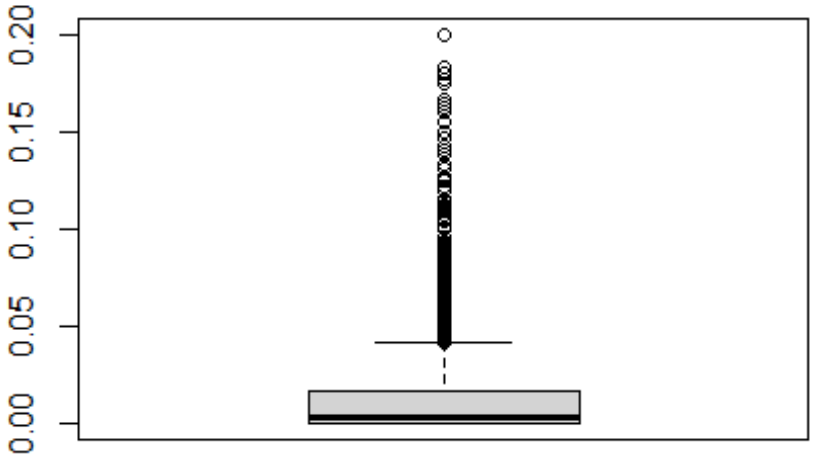

```
boxplot(df$ProductRelated)
```



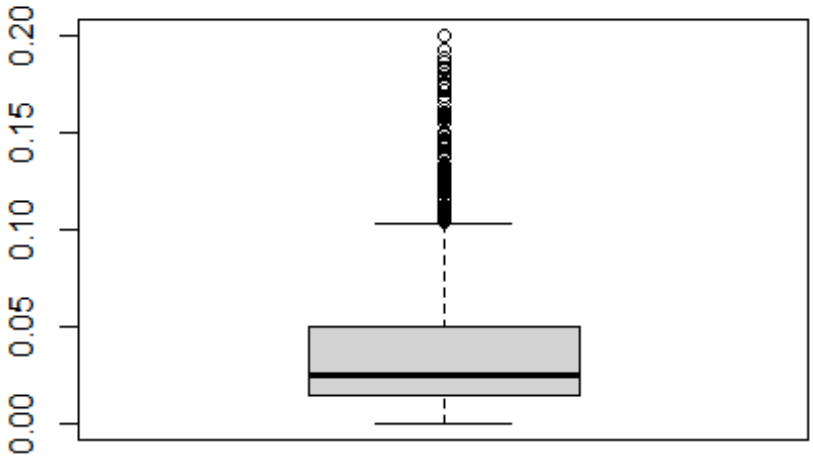

```
boxplot(df$ProductRelated_Duration)
```



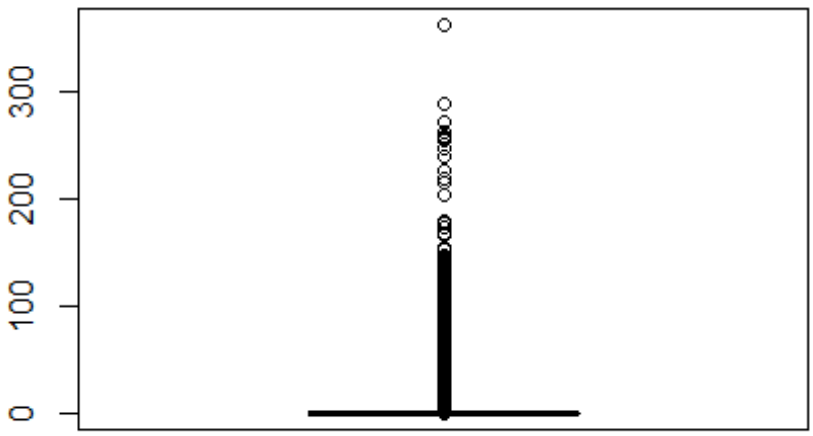

```
boxplot(df$BounceRates)
```




```
boxplot(df$ExitRates)
```




```
boxplot(df$PageValues)
```

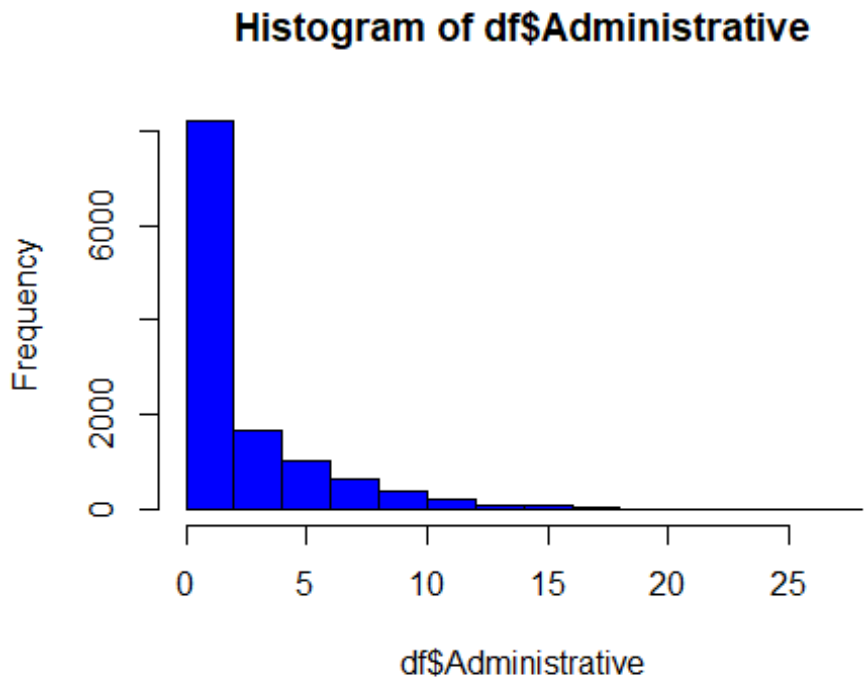


From the above box plot we have quite a number of outliers in the data set, however due to the details entailed in every attribute of the data these outliers are important for the project and will therefore not drop them.

EXPLORATORY DATA ANALYSIS

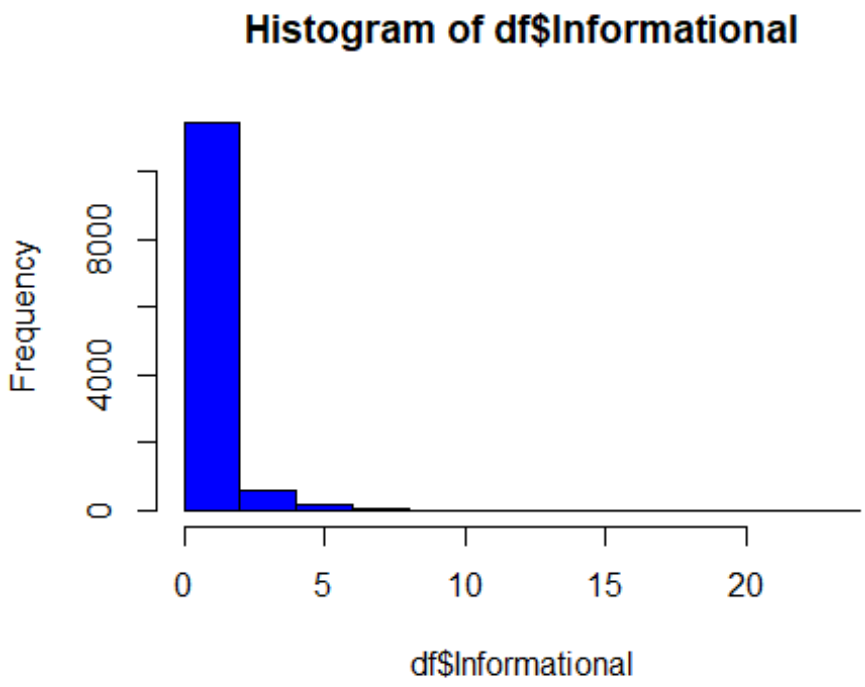
1. Univariate Analysis

```
hist(df$Administrative, col="blue")
```



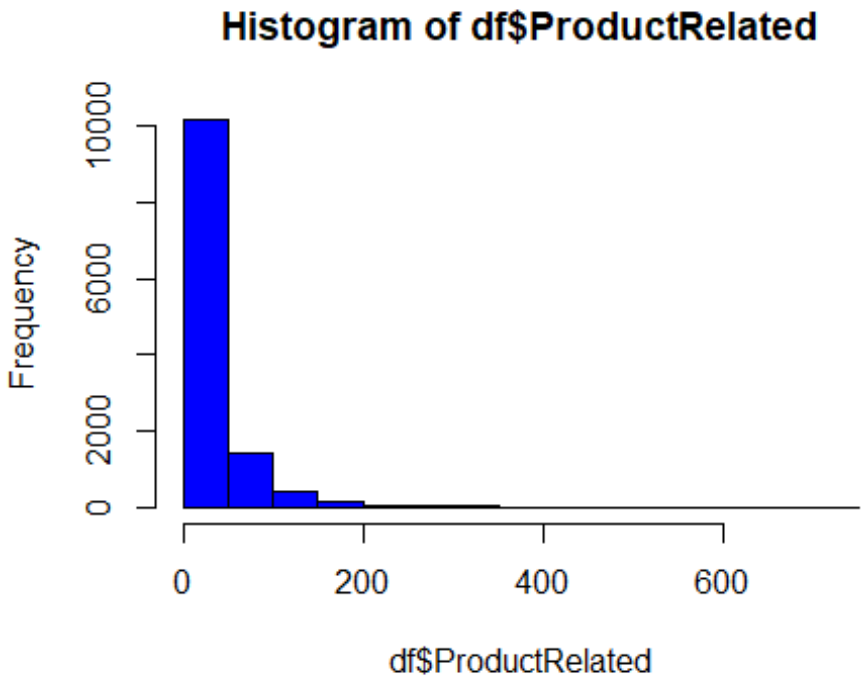
The histogram above shows the distribution of visitor in the administrative page and total time spent. We can see that most of the visitors in this page spent around 5 minutes with a sparse of the visitor spending up to 25 minutes

```
hist(df$Informational, col="blue")
```



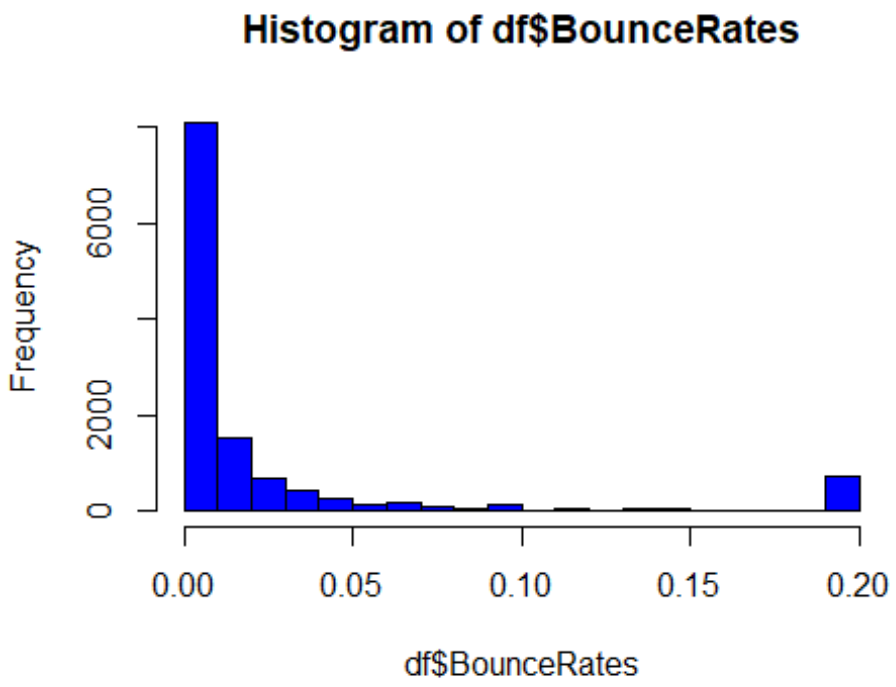
The histogram above shows the distribution of visitor in the Informational page and total time spent. We can see that most of the visitors in this page spent around 5 minutes with a sparse of the visitor spending up to 10 minutes

```
hist(df$ProductRelated, col="blue")
```



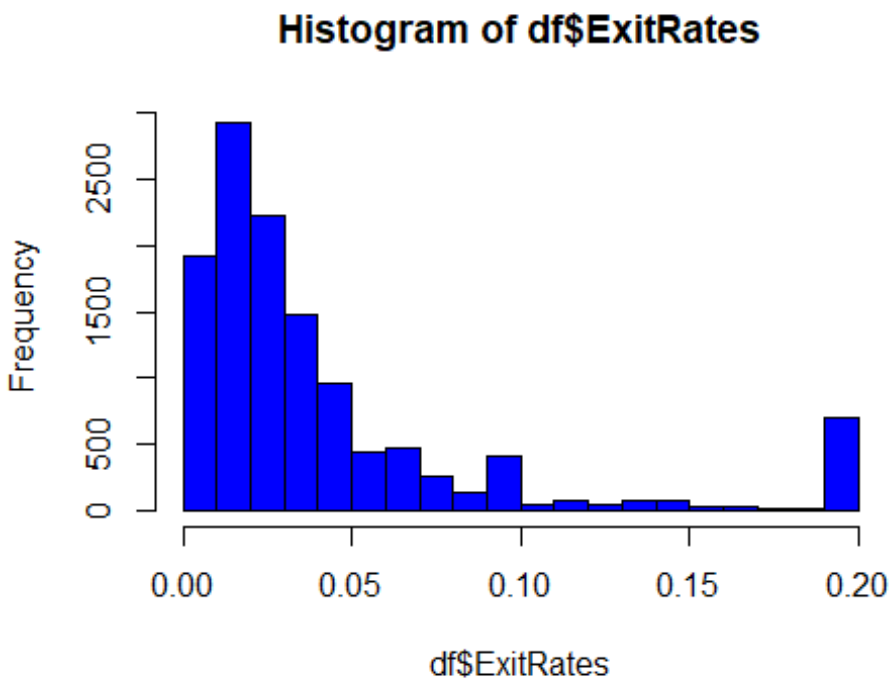
The histogram above shows the distribution of visitor in the Product Related page and total time spent. We can see that most of the visitors in this page spent around 200 minutes with a sparse of the visitor spending up to 400 minutes

```
hist(df$BounceRates, col="blue")
```



The histogram shows the percentage of visitors who enter the site from that page and then leave without triggering any other requests to the analytics server during that session

```
hist(df$ExitRates, col = "blue")
```

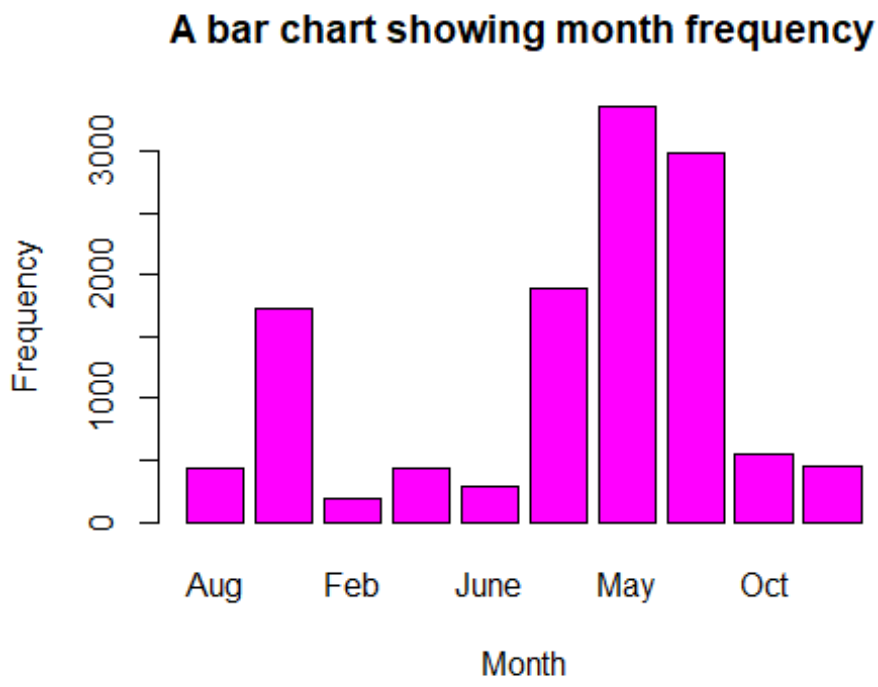


Let's Visualize visitor's distribution through out the year

```
month <- (df$Month)
month.frequency <- table(month)
month.frequency

## month
##  Aug  Dec  Feb  Jul June  Mar  May  Nov  Oct  Sep
##  433 1727  184  432  288 1894 3363 2998  549  448

barplot(month.frequency,
  main="A bar chart showing month frequency",
  xlab="Month",
  ylab = "Frequency",
  col=c("magenta")
  )
```



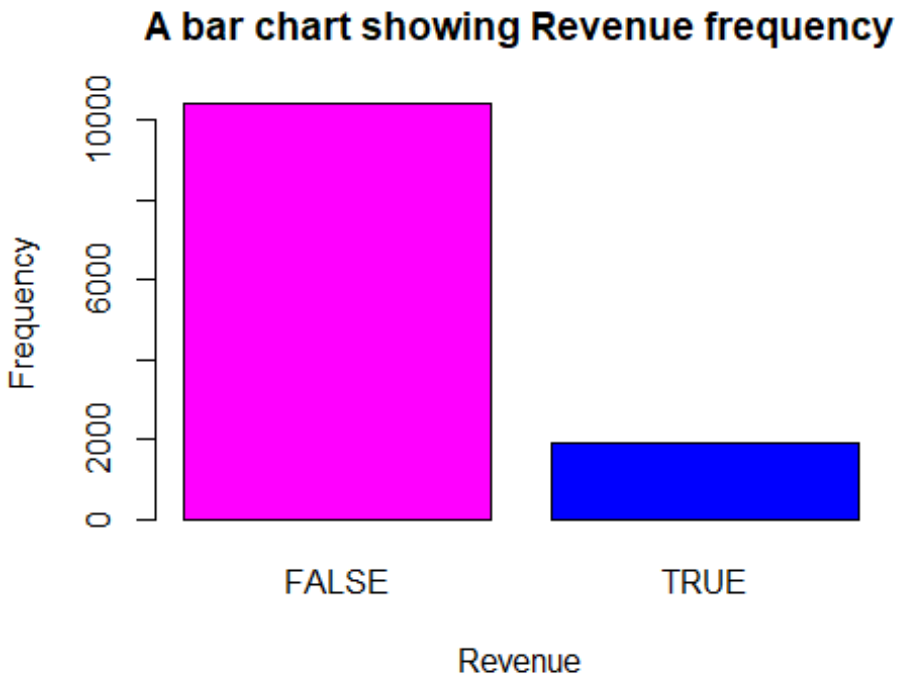
We can see the month with most visitors was may and the least with February.

Revenue Frequency

```
revenue <- (df$Revenue)
revenue.frequency <- table(revenue)
revenue.frequency

## revenue
## FALSE  TRUE
## 10408  1908

barplot(revenue.frequency,
  main="A bar chart showing Revenue frequency",
  xlab="Revenue",
  ylab = "Frequency",
  col=c("magenta", "blue")
  )
```



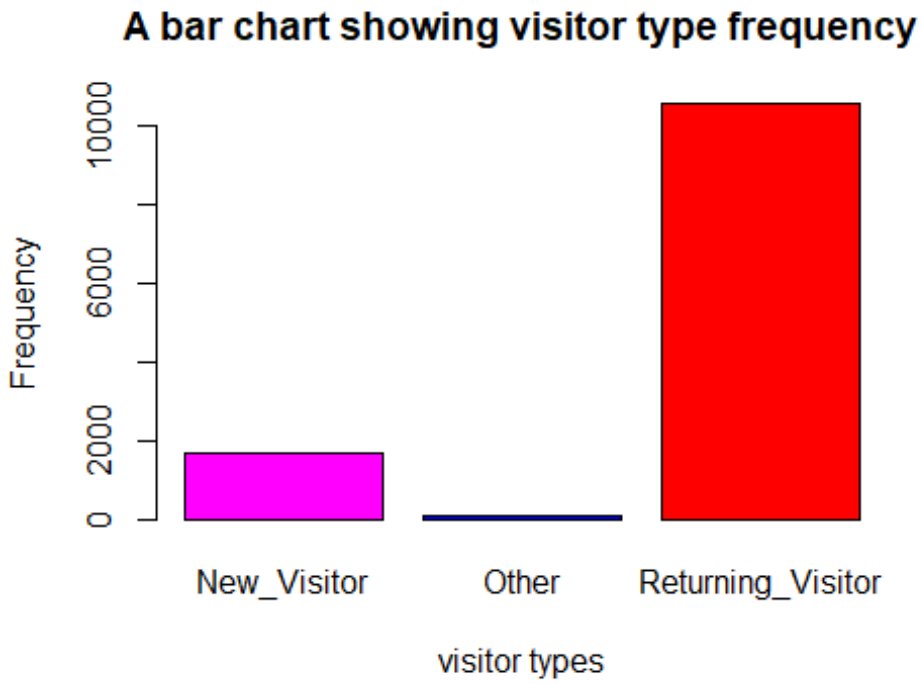
We can see that most of the visit were not revenue generating compared to those generating revenue

Visitor type distribution

```
visitor <- (df$VisitorType)
visitor.frequency <- table(visitor)
visitor.frequency
```

```
## visitor
##       New_Visitor             Other Returning_Visitor
##              1694                85             10537
```

```
barplot(visitor.frequency,
  main="A bar chart showing visitor type frequency",
  xlab="visitor types",
  ylab = "Frequency",
  col=c("magenta", "blue", "red")
  )
```



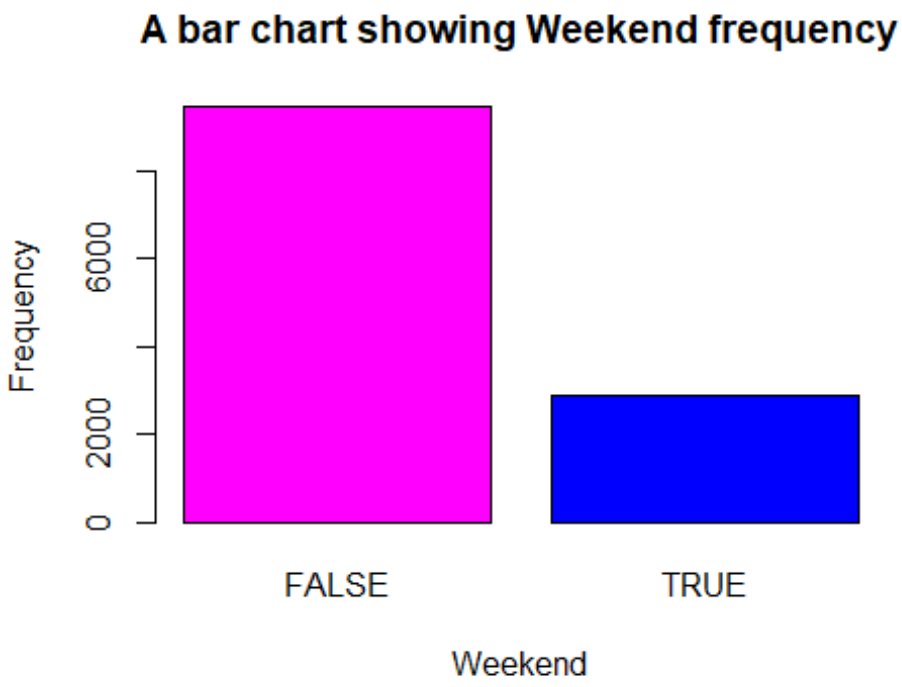
Returning visitors were more compared to new visitors and other being the least.

Week day Distribution

```
weekend <- (df$Weekend)
weekend.frequency <- table(weekend)
weekend.frequency

## weekend
## FALSE  TRUE
##  9451  2865

barplot(weekend.frequency,
  main="A bar chart showing Weekend frequency",
  xlab="Weekend",
  ylab = "Frequency",
  col=c("magenta", "blue")
  )
```



Visits on the weekend were less compared to other days.

Region visitors distribution

```
library(janitor)

## Warning: package 'janitor' was built under R version 4.1.3

##
## Attaching package: 'janitor'

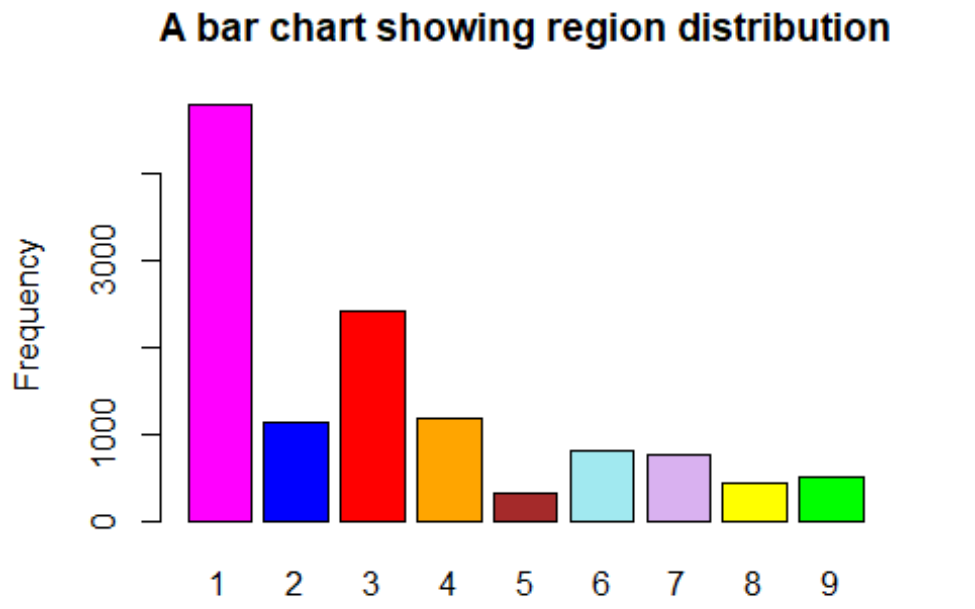
## The following objects are masked from 'package:stats':
##
##     chisq.test, fisher.test

region <- (df$Region)
region.frequency <- table(region)
region.frequency

## region
##    1    2    3    4    5    6    7    8    9
## 4774 1134 2402 1179  317  804  761  434  511

barplot(region.frequency,
  main="A bar chart showing region distribution",
  xlab="Region(1 = Russian, 2 = Ukraine, 3 = Kazakhstan, 4 = Belarus, 5 =
China, 6 = Phillipines, 7 = Armenia, 8 = Rest os asia, 9 = Rest of globe)",
  ylab = "Frequency",
```

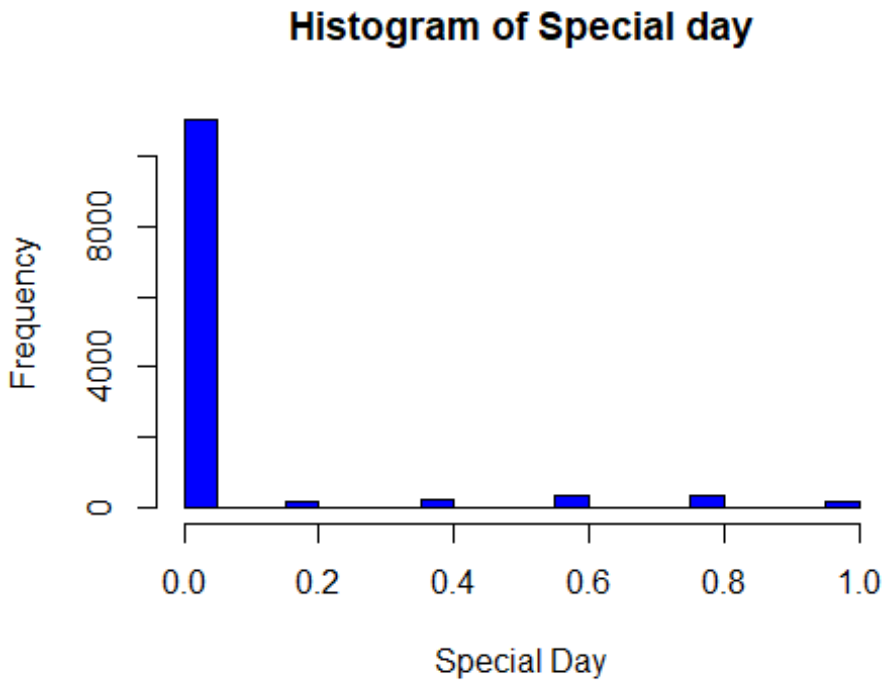
```
  col=c("magenta", "blue", "red", "orange", "brown", "#a1e9f0", "#d9b1f0",
"yellow", "green")
  )
```



e, 3 = Kazakhstan, 4 = Belarus, 5 = China, 6 = Phillipines, 7 = Armenia

Clearly shows most of the visitors come from Russia and the least from China.

```
hist((df$SpecialDay),
main = "Histogram of Special day",
     xlab = 'Special Day',
     ylab = 'Frequency',
     col = "blue")
```



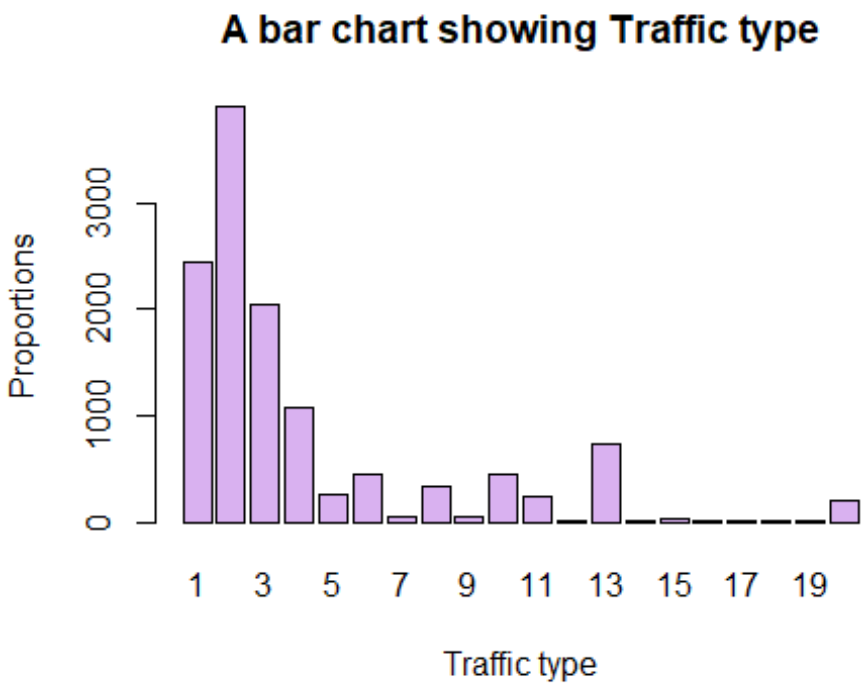
The above graph shows the closeness of the site visiting time to a specific special day (e.g. Mother's Day, Valentine's Day) in which the sessions are more likely to be finalized with the transaction. when close to a special day this value takes a nonzero value meaning most of the transaction happened when there was no special day close since the highest count is around zero.

Traffic Type Proportions

```
traffic <- (df$TrafficType)
traffic.frequency <- table(traffic)
traffic.frequency

## traffic
##    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15
16
## 2444 3909 2051 1069  260  444   40  343   42  450  247    1  737   13   37
3
##   17   18   19   20
##    1   10   17  198

barplot(traffic.frequency,
  main="A bar chart showing Traffic type",
  xlab="Traffic type",
  ylab = "Proportions",
  col=c("#d9b1f0")
  )
```



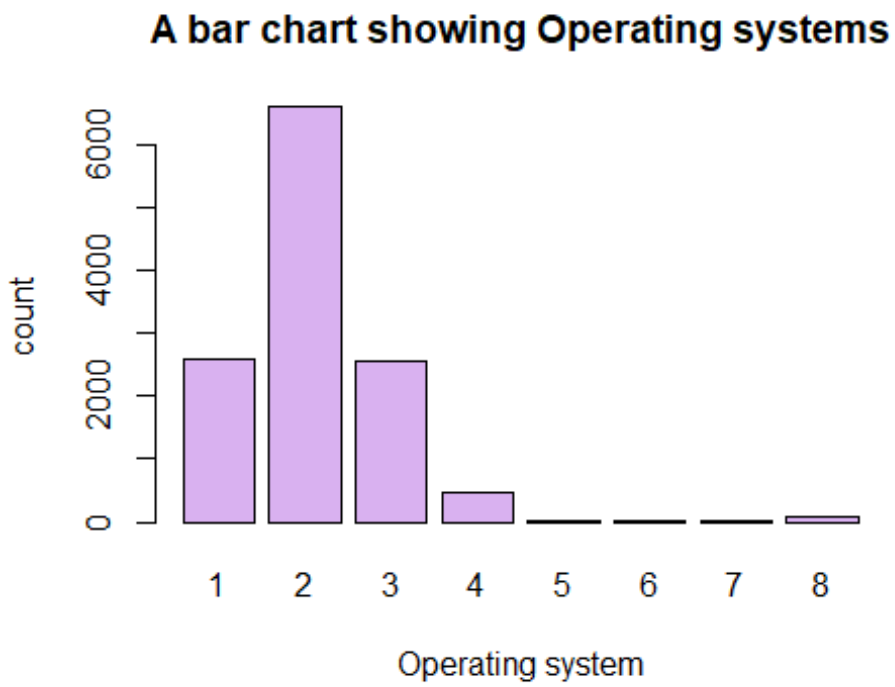
Traffic type 2 had the highest proportion.

Operating Systems Proportion

```
os <- (df$OperatingSystems)
os.frequency <- table(os)
os.frequency

## os
##    1    2    3    4    5    6    7    8
## 2582 6593 2552  478    6   19    7   79

barplot(os.frequency,
  main="A bar chart showing Operating systems",
  xlab="Operating system",
  ylab = "count",
  col=c("#d9b1f0")
  )
```



2. Bivariate Analysis

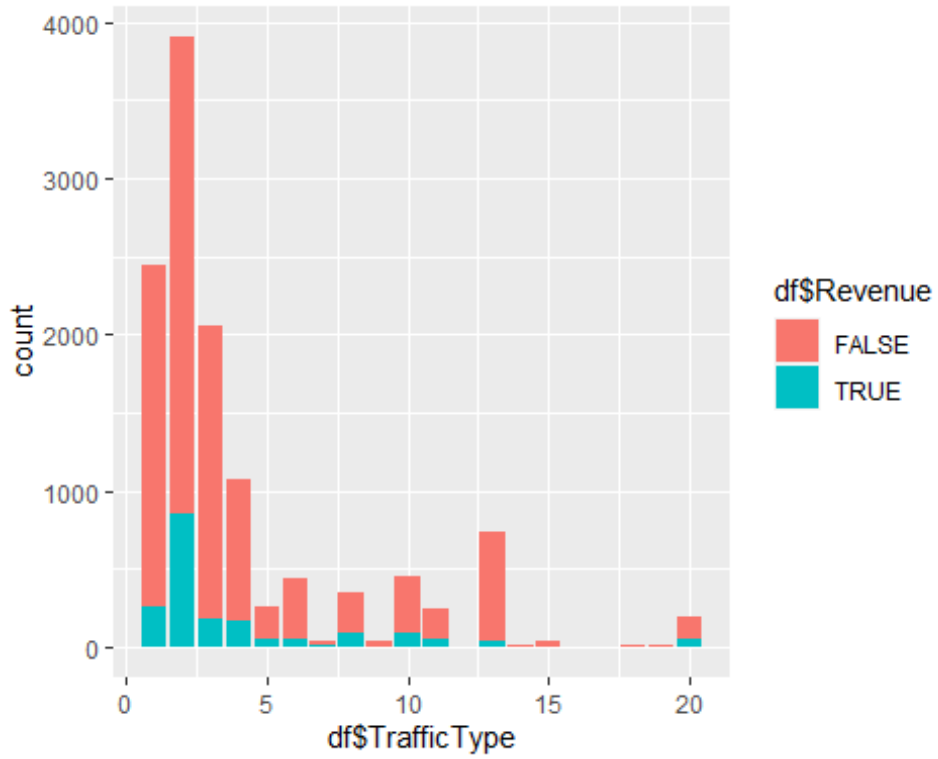
Bounce rate Vs Exit Rates in respect to Revenue

```
ggplot(df,aes(x=df$BounceRates,y=df$ExitRates,col=df$Revenue))+geom_point(aes
(color=df$Revenue))
```

The graph shows revenue generation in respect to Bounce and Exit rates. There is revenue generation when the rates are low but this decreases with increase in the rates.

Traffic Types vs Revenue

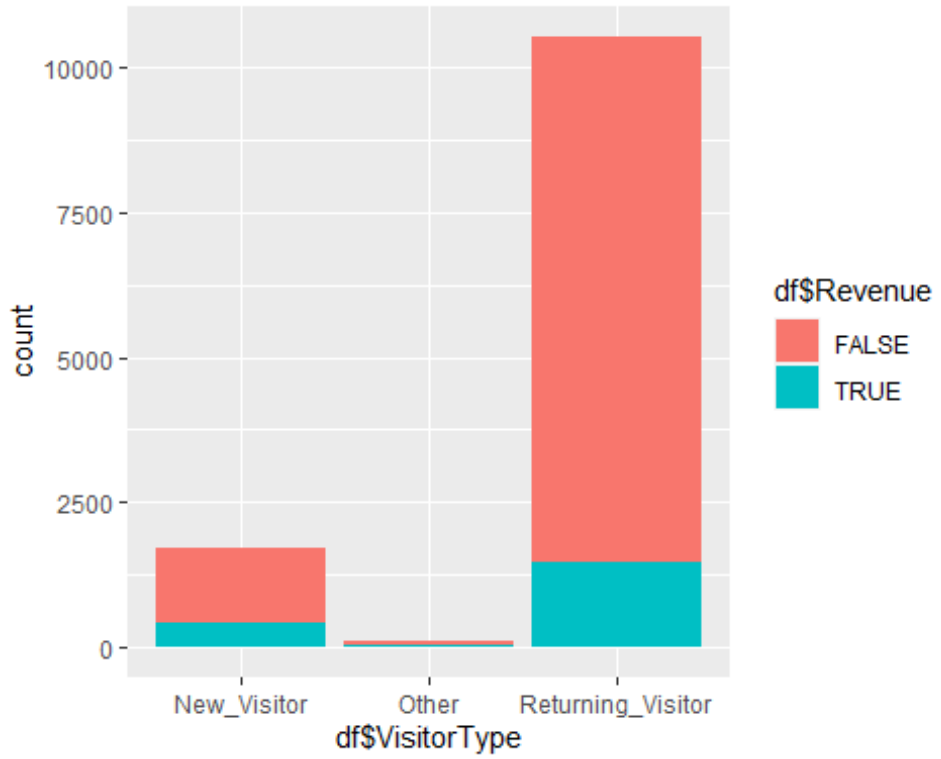
```
ggplot(df, aes(x = df$TrafficType, fill = df$Revenue)) +
  geom_bar()
```



The graph above shows most of the traffic wasn't generating revenue.

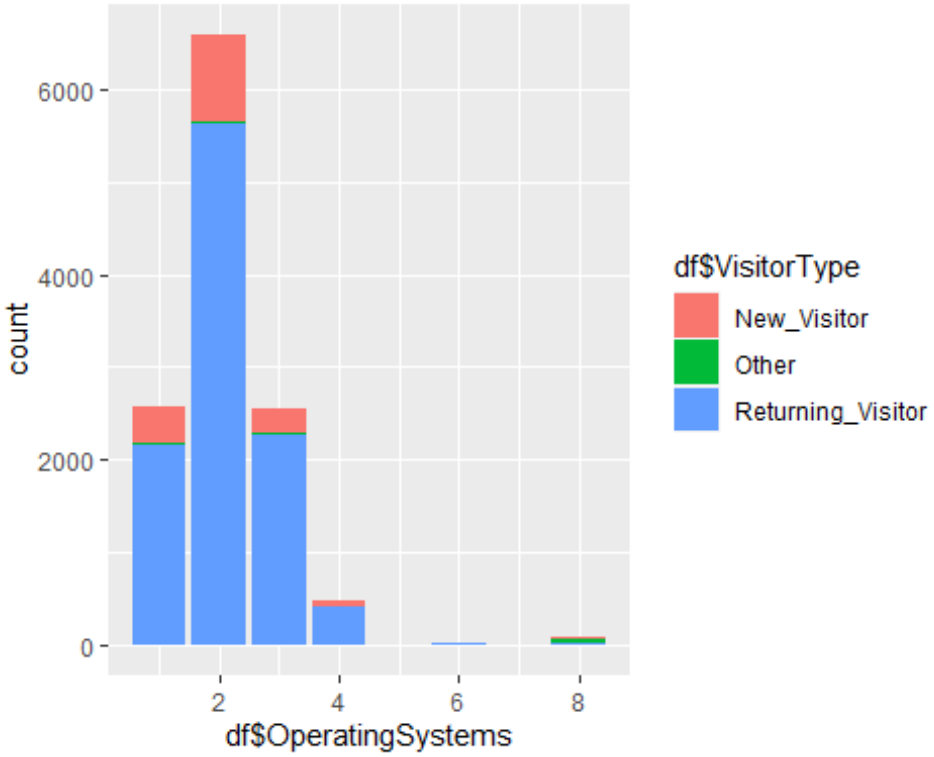
Visitor Type vs Revenue

```
ggplot(df, aes(x = df$VisitorType, fill = df$Revenue)) +
  geom_bar()
```



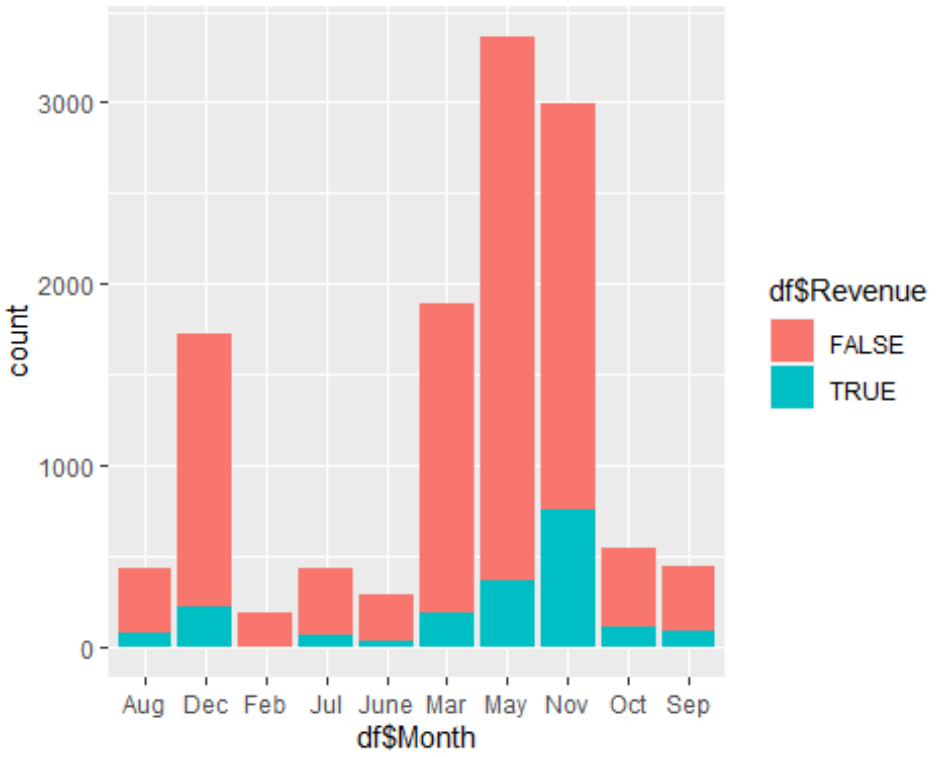
The number of visitor generating revenue were more on returning visitor compared to new visitors and other visitor types.

```
ggplot(df, aes(x = df$OperatingSystems, fill = df$VisitorType)) +
  geom_bar()
```

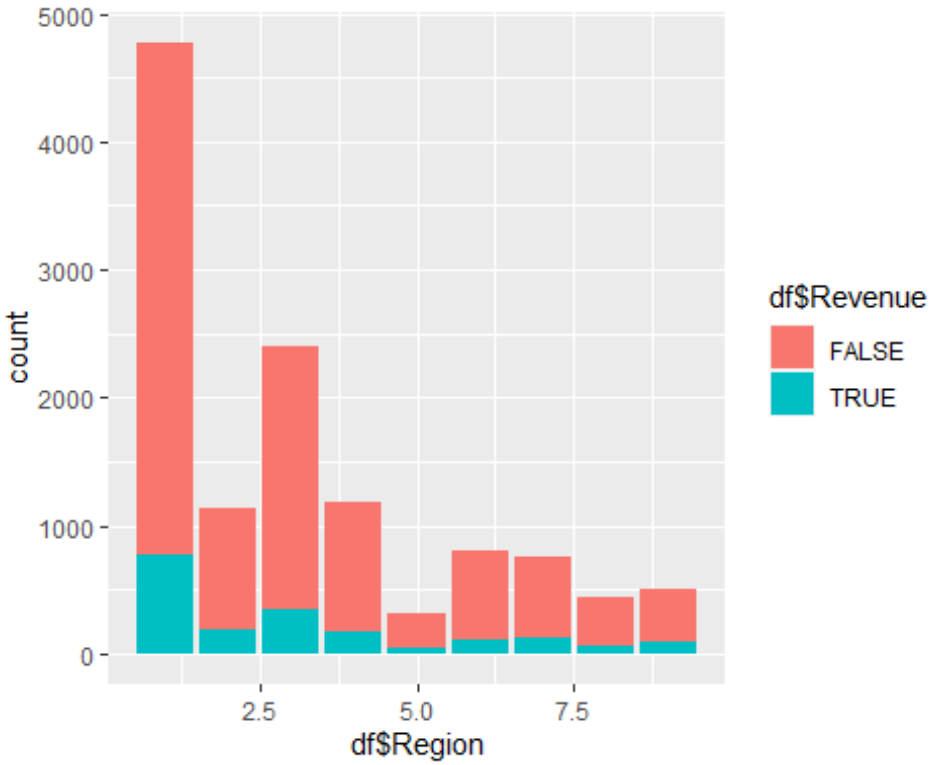


Most of the visitors were using operating system 2 with an outlier of other visitor using operating system 8.

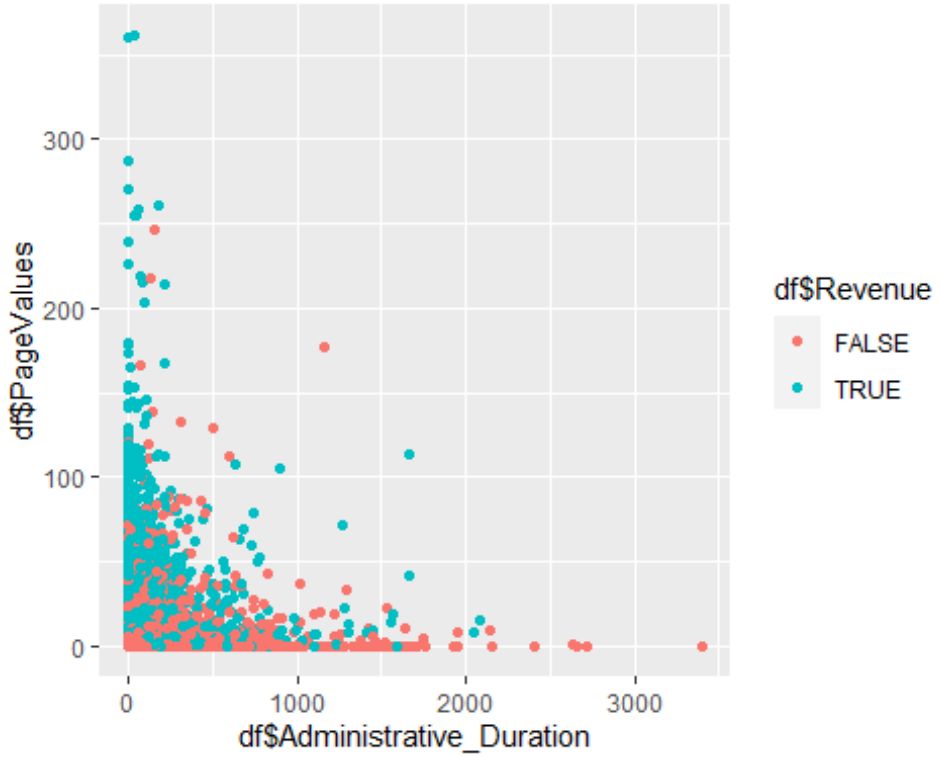
```
ggplot(df, aes(x = df$Month, fill = df$Revenue)) +
  geom_bar()
```




```
ggplot(df, aes(x = df$Region, fill = df$Revenue)) +
  geom_bar()
```



```
ggplot(df,aes(x=df$Administrative_Duration,y=df$PageValues,col=df$Revenue))+g
eom_point(aes(color=df$Revenue))
```



The higher the page value the less the administrative duration

3. Multivariate Analysis

```
head(df)

##    Administrative Administrative_Duration Informational
Informational_Duration
## 1:              0                       0             0
0
## 2:              0                       0             0
0
## 3:              0                      -1             0
-1
## 4:              0                       0             0
0
## 5:              0                       0             0
0
## 6:              0                       0             0
0
##    ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1:              1                0.000000  0.20000000 0.2000000          0
## 2:              2               64.000000  0.00000000 0.1000000          0
## 3:              1               -1.000000  0.20000000 0.2000000          0
## 4:              2                2.666667  0.05000000 0.1400000          0
```

```
## 5:             10              627.500000  0.02000000 0.0500000          0
## 6:             19              154.216667  0.01578947 0.0245614          0
##    SpecialDay Month OperatingSystems Browser Region TrafficType
## 1:          0   Feb                1       1      1           1
## 2:          0   Feb                2       2      1           2
## 3:          0   Feb                4       1      9           3
## 4:          0   Feb                3       2      2           4
## 5:          0   Feb                3       3      1           4
## 6:          0   Feb                2       2      1           3
##          VisitorType Weekend Revenue
## 1: Returning_Visitor   FALSE   FALSE
## 2: Returning_Visitor   FALSE   FALSE
## 3: Returning_Visitor   FALSE   FALSE
## 4: Returning_Visitor   FALSE   FALSE
## 5: Returning_Visitor    TRUE   FALSE
## 6: Returning_Visitor   FALSE   FALSE
```

Will check for correlation among numerical attributes

```
Monthly_statistics <- df %>% select(Month, Administrative_Duration,
                                    Informational_Duration,
                                    ProductRelated_Duration, PageValues,
                                    ExitRates, BounceRates) %>%
  group_by(Month)%>%summarise_all(mean)
Monthly_statistics
```

```
## # A tibble: 10 x 7
##    Month Administrative_Duration Informational~1 Produ~2 PageV~3 ExitR~4
Bounc~5
##    <chr>                   <dbl>           <dbl>   <dbl>   <dbl>   <dbl>
<dbl>
##  1 Aug                     107.            35.5    1273.   5.94   0.0377
0.0182
##  2 Dec                      78.6           38.1    1111.   6.83   0.0413
0.0201
##  3 Feb                      16.8            2.32    471.   0.890  0.0741
0.0470
##  4 Jul                      78.9           45.5    1218.   4.10   0.0453
0.0247
##  5 June                     59.1           20.5    1213.   3.39   0.0582
0.0351
##  6 Mar                      71.7           30.9     817.   3.99   0.0442
0.0215
##  7 May                      69.5           27.2     982.   5.43   0.0488
0.0268
##  8 Nov                      90.9           43.6    1758.   7.13   0.0382
0.0193
##  9 Oct                     126.            38.7    1117.   8.65   0.0290
0.0118
## 10 Sep                     109.            35.7    1253.   7.56   0.0303
```

```
0.0122
## # ... with abbreviated variable names 1: Informational_Duration,
## #   2: ProductRelated_Duration, 3: PageValues, 4: ExitRates, 5:
BounceRates
```

- Month with highest administrative duration was October while February had the least.
- Month with highest Informational duration was July while February had the least.
- Month with highest Product related duration was November while February had the least.
- Month with highest Page value was October while February had the least.
- Month with highest Exit rates was February while October had the least.
- Month with highest Bounce rates was February while October had the least.

```
Region_statistics <- df %>% select(Region, Administrative_Duration,
                                   Informational_Duration,
                                   ProductRelated_Duration, PageValues,
                                   ExitRates, BounceRates) %>%
  group_by(Region)%>%summarise_all(mean)
Region_statistics
```

```
## # A tibble: 9 x 7
##   Region Administrative_Duration Informational~1 Produ~2 PageV~3 ExitR~4
Bounc~5
##    <int>                   <dbl>           <dbl>   <dbl>   <dbl>   <dbl>
<dbl>
## 1      1                    79.7            37.3   1278.    5.91  0.0431
0.0221
## 2      2                    87.0            36.1   1184.    5.92  0.0430
0.0229
## 3      3                    83.1            35.2   1189.    5.35  0.0438
0.0224
## 4      4                    83.3            36.4   1116.    5.82  0.0439
0.0231
## 5      5                    88.5            31.4   1151.    9.28  0.0402
0.0201
## 6      6                    68.7            29.9   1036.    4.81  0.0440
0.0237
## 7      7                    78.8            26.6   1142.    6.26  0.0398
0.0204
## 8      8                    89.6            32.8   1096.    4.26  0.0400
0.0192
## 9      9                    73.0            19.4   1121.    8.94  0.0438
0.0217
## # ... with abbreviated variable names 1: Informational_Duration,
## #   2: ProductRelated_Duration, 3: PageValues, 4: ExitRates, 5:
BounceRates
```

Modeling

```
head(df)
```

```
##    Administrative Administrative_Duration Informational
Informational_Duration
## 1:              0                       0             0
0
## 2:              0                       0             0
0
## 3:              0                      -1             0
-1
## 4:              0                       0             0
0
## 5:              0                       0             0
0
## 6:              0                       0             0
0
##    ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1:              1                0.000000  0.20000000 0.2000000          0
## 2:              2               64.000000  0.00000000 0.1000000          0
## 3:              1               -1.000000  0.20000000 0.2000000          0
## 4:              2                2.666667  0.05000000 0.1400000          0
## 5:             10              627.500000  0.02000000 0.0500000          0
## 6:             19              154.216667  0.01578947 0.0245614          0
##    SpecialDay Month OperatingSystems Browser Region TrafficType
## 1:          0   Feb                1       1      1           1
## 2:          0   Feb                2       2      1           2
## 3:          0   Feb                4       1      9           3
## 4:          0   Feb                3       2      2           4
## 5:          0   Feb                3       3      1           4
## 6:          0   Feb                2       2      1           3
##          VisitorType Weekend Revenue
## 1: Returning_Visitor   FALSE   FALSE
## 2: Returning_Visitor   FALSE   FALSE
## 3: Returning_Visitor   FALSE   FALSE
## 4: Returning_Visitor   FALSE   FALSE
## 5: Returning_Visitor    TRUE   FALSE
## 6: Returning_Visitor   FALSE   FALSE
```

K-MEAN Clustering

Will start by labeling our categorical attribute from categorical to numerical labels and also remove the class label (Revenue)

```
df1 <- df[, 1:17]

# Change the 'weekend' column's data type to 'factor'
df1$Weekend <- as.factor(df$Weekend)
```

```
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.1.3
```

```
## Loading required package: lattice
```

```
## Warning: package 'lattice' was built under R version 4.1.3
```

```
##
## Attaching package: 'caret'
```

```
## The following object is masked from 'package:purrr':
##
##     lift
```

```
dummy <- dummyVars("~ .", "Month + OperatingSystems + Browser + Region +
                   TrafficType + VisitorType + Weekend", data=df1)
encoded <- data.frame(predict(dummy, newdata = df1))
df1 <- cbind(df1[ , 1:10], encoded)

# Normalize the values
normal <-function(x) { (x -min(x))/(max(x)-min(x))}
df_norm <- as.data.frame(lapply(df1, normal))

# Preview the top six records
head(df_norm)
```

```
##   Administrative Administrative_Duration Informational
Informational_Duration
## 1              0           0.0002941393             0
0.0003920992
## 2              0           0.0002941393             0
0.0003920992
## 3              0           0.0000000000             0
0.0000000000
## 4              0           0.0002941393             0
0.0003920992
## 5              0           0.0002941393             0
0.0003920992
## 6              0           0.0002941393             0
0.0003920992
##   ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1    0.001418440            1.563122e-05  1.00000000  1.000000          0
## 2    0.002836879            1.016029e-03  0.00000000  0.500000          0
## 3    0.001418440            0.000000e+00  1.00000000  1.000000          0
## 4    0.002836879            5.731448e-05  0.25000000  0.700000          0
## 5    0.014184397            9.824223e-03  0.10000000  0.250000          0
## 6    0.026950355            2.426226e-03  0.07894737  0.122807          0
##   SpecialDay Administrative.1 Administrative_Duration.1 Informational.1
## 1          0                0              0.0002941393               0
```

```
## 2          0                 0              0.0002941393                0
## 3          0                 0              0.0000000000                0
## 4          0                 0              0.0002941393                0
## 5          0                 0              0.0002941393                0
## 6          0                 0              0.0002941393                0
##   Informational_Duration.1 ProductRelated.1 ProductRelated_Duration.1
## 1             0.0003920992      0.001418440              1.563122e-05
## 2             0.0003920992      0.002836879              1.016029e-03
## 3             0.0000000000      0.001418440              0.000000e+00
## 4             0.0003920992      0.002836879              5.731448e-05
## 5             0.0003920992      0.014184397              9.824223e-03
## 6             0.0003920992      0.026950355              2.426226e-03
##   BounceRates.1 ExitRates.1 PageValues.1 SpecialDay.1 MonthAug MonthDec
## 1    1.00000000    1.000000            0            0        0        0
## 2    0.00000000    0.500000            0            0        0        0
## 3    1.00000000    1.000000            0            0        0        0
## 4    0.25000000    0.700000            0            0        0        0
## 5    0.10000000    0.250000            0            0        0        0
## 6    0.07894737    0.122807            0            0        0        0
##   MonthFeb MonthJul MonthJune MonthMar MonthMay MonthNov MonthOct MonthSep
## 1        1        0         0        0        0        0        0        0
## 2        1        0         0        0        0        0        0        0
## 3        1        0         0        0        0        0        0        0
## 4        1        0         0        0        0        0        0        0
## 5        1        0         0        0        0        0        0        0
## 6        1        0         0        0        0        0        0        0
##   OperatingSystems    Browser Region TrafficType VisitorTypeNew_Visitor
## 1        0.0000000 0.00000000  0.000  0.00000000                       0
## 2        0.1428571 0.08333333  0.000  0.05263158                       0
## 3        0.4285714 0.00000000  1.000  0.10526316                       0
## 4        0.2857143 0.08333333  0.125  0.15789474                       0
## 5        0.2857143 0.16666667  0.000  0.15789474                       0
## 6        0.1428571 0.08333333  0.000  0.10526316                       0
##   VisitorTypeOther VisitorTypeReturning_Visitor
## 1                0                           1
## 2                0                           1
## 3                0                           1
## 4                0                           1
## 5                0                           1
## 6                0                           1
##
WeekendMonth...OperatingSystems...Browser...Region.....................Traf
ficType...VisitorType...WeekendFALSE
## 1
1
## 2
1
## 3
1
## 4
```

```
1
## 5
0
## 6
1
##
WeekendMonth...OperatingSystems...Browser...Region.....................Traf
ficType...VisitorType...WeekendTRUE
## 1
0
## 2
0
## 3
0
## 4
0
## 5
1
## 6
0

library(dplyr)
```

Applying the K-means clustering algorithm with no. of centroids (k)= 4

```
Result<- kmeans(df_norm, 2, nstart = 25)

# check the number of records in each cluster
Result$size

## [1] 2865 9451

Result$cluster

##     [1] 2 2 2 2 1 2 2 1 2 2 2 2 2 2 2 2 1 2 2 1 2 2 2 1 2 2 2 2 2 2 1 2
2 2 2
##    [37] 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2
2 2 2
##    [73] 2 2 2 2 2 2 1 2 1 2 2 2 1 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 1 2 2 2
2 2 2
##   [109] 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2
2 2 2
##   [145] 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 2 2 2 1 1 2 2 2 2 2 2 1 1 2 2 1 1 2 2
2 2 2
##   [181] 1 2 2 1 2 2 2 1 2 2 2 2 2 2 2 1 2 2 2 2 2 1 1 1 2 2 2 2 2 1 2 2 2 2 2
1 2 2
##   [217] 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 1 1 1 2 1 1 1 2 2 2 2 1 2 2 2 2 2
1 1 2
##   [253] 2 2 1 2 2 2 2 2 2 1 2 1 2 2 1 2 2 2 2 1 1 2 2 2 1 2 1 2 2 2 1 1 2 2 2
2 2 2
##   [289] 2 2 2 2 2 2 1 2 2 2 2 2 2 1 1 2 2 2 2 2 1 2 2 1 2 1 2 2 2 2 2 2 2 2 2
```

```
2 2 2
##   [325] 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 2 2 2
2 2 2
##   [361] 2 1 2 2 1 2 1 2 2 1 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1
2 1 2
##   [397] 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 1 1 1 2 1 1 1 2 1 2 2 1 2 1 1 2 2
2 2 1
##   [433] 2 1 1 1 2 2 2 2 1 2 2 2 2 1 2 2 2 1 2 2 2 1 1 1 2 1 2 2 1 2 1 2 2
1 2 2
##   [469] 2 1 2 2 2 1 2 1 1 2 2 2 2 2 2 2 2 2 2 2 1 2 1 1 2 2 1 1 1 1 1 2 2
2 2 2
##   [505] 2 1 2 2 2 2 2 2 2 1 2 2 2 1 2 1 2 2 1 1 2 2 1 2 2 2 2 2 2 1 1 2 2
2 2 2
##   [541] 2 2 2 1 2 1 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 1 1 2 2 1 1 2 2
1 2 1
##   [577] 2 1 1 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 2 1 2 1
2 1 2
##   [613] 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 2 2 2 2
2 2 1
##   [649] 2 2 1 2 2 1 2 2 2 2 2 2 1 2 1 2 1 2 2 2 1 2 2 2 2 1 2 2 2 1 1 2 2
2 1 2
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##     FALSE TRUE
##   1  2366  499
##   2  8042 1409
```

Hierarchical Clustering

Scaling

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df <- scale(df_norm)
head(df)

##      Administrative Administrative_Duration Informational
## [1,]     -0.6975533              -0.4574578    -0.3966145
## [2,]     -0.6975533              -0.4574578    -0.3966145
## [3,]     -0.6975533              -0.4631119    -0.3966145
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## [6,]     -0.6975533              -0.4574578    -0.3966145
##      Informational_Duration ProductRelated ProductRelated_Duration
BounceRates
## [1,]             -0.2450294     -0.6914734              -0.6247671
3.67247746
## [2,]             -0.2450294     -0.6689966              -0.5913358 -
0.45743910
## [3,]             -0.2521304     -0.6914734              -0.6252895
3.67247746
## [4,]             -0.2450294     -0.6689966              -0.6233742
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0.04444744
## [6,]             -0.2450294     -0.2868911              -0.5442099 -
0.13139305
##       ExitRates PageValues SpecialDay Administrative.1
## [1,]  3.2352400 -0.3173633  -0.309001       -0.6975533
## [2,]  1.1745443 -0.3173633  -0.309001       -0.6975533
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## [6,] -0.3800157 -0.3173633  -0.309001       -0.6975533
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## [1,]       -0.6914734                -0.6247671    3.67247746   3.2352400
## [2,]       -0.6689966                -0.5913358   -0.45743910   1.1745443
## [3,]       -0.6914734                -0.6252895    3.67247746   3.2352400
## [4,]       -0.6689966                -0.6233742    0.57504004   1.9988226
## [5,]       -0.4891823                -0.2969835   -0.04444744   0.1441964
## [6,]       -0.2868911                -0.5442099   -0.13139305  -0.3800157
##      PageValues.1 SpecialDay.1   MonthAug   MonthDec MonthFeb   MonthJul
## [1,]   -0.3173633    -0.309001 -0.1908812 -0.4038323 8.119694 -0.1906527
## [2,]   -0.3173633    -0.309001 -0.1908812 -0.4038323 8.119694 -0.1906527
## [3,]   -0.3173633    -0.309001 -0.1908812 -0.4038323 8.119694 -0.1906527
## [4,]   -0.3173633    -0.309001 -0.1908812 -0.4038323 8.119694 -0.1906527
## [5,]   -0.3173633    -0.309001 -0.1908812 -0.4038323 8.119694 -0.1906527
## [6,]   -0.3173633    -0.309001 -0.1908812 -0.4038323 8.119694 -0.1906527
##       MonthJune   MonthMar   MonthMay   MonthNov  MonthOct  MonthSep
## [1,] -0.1547326 -0.4262818 -0.6128603 -0.5672008 -0.215991 -0.194282
## [2,] -0.1547326 -0.4262818 -0.6128603 -0.5672008 -0.215991 -0.194282
## [3,] -0.1547326 -0.4262818 -0.6128603 -0.5672008 -0.215991 -0.194282
## [4,] -0.1547326 -0.4262818 -0.6128603 -0.5672008 -0.215991 -0.194282
## [5,] -0.1547326 -0.4262818 -0.6128603 -0.5672008 -0.215991 -0.194282
## [6,] -0.1547326 -0.4262818 -0.6128603 -0.5672008 -0.215991 -0.194282
##      OperatingSystems    Browser     Region TrafficType
VisitorTypeNew_Visitor
## [1,]       -1.2332048 -0.7901988 -0.8941841 -0.76292777             -
0.3993337
## [2,]       -0.1361914 -0.2081361 -0.8941841 -0.51445574             -
0.3993337
## [3,]        2.0578354 -0.7901988  2.4360812 -0.26598370             -
0.3993337
## [4,]        0.9608220 -0.2081361 -0.4779009 -0.01751167             -
0.3993337
## [5,]        0.9608220  0.3739266 -0.8941841 -0.01751167             -
0.3993337
```

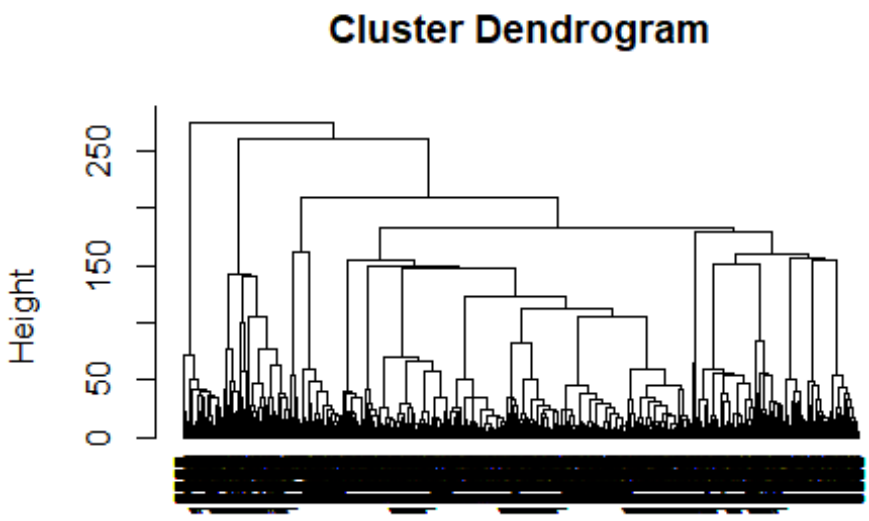
```
## [6,]       -0.1361914 -0.2081361 -0.8941841 -0.26598370             -
0.3993337
##      VisitorTypeOther VisitorTypeReturning_Visitor
## [1,]       -0.0833606                    0.410877
## [2,]       -0.0833606                    0.410877
## [3,]       -0.0833606                    0.410877
## [4,]       -0.0833606                    0.410877
## [5,]       -0.0833606                    0.410877
## [6,]       -0.0833606                    0.410877
##
WeekendMonth...OperatingSystems...Browser...Region.....................Traf
ficType...VisitorType...WeekendFALSE
## [1,]
0.5505615
## [2,]
0.5505615
## [3,]
0.5505615
## [4,]
0.5505615
## [5,]
-1.8161802
## [6,]
0.5505615
##
WeekendMonth...OperatingSystems...Browser...Region.....................Traf
ficType...VisitorType...WeekendTRUE
## [1,]
-0.5505615
## [2,]
-0.5505615
## [3,]
-0.5505615
## [4,]
-0.5505615
## [5,]
1.8161802
## [6,]
-0.5505615
```

computing the Euclidean distance between observations,

```
d <- dist(df, method = "euclidean")
```

We then hierarchical clustering using the Ward's method

```
res.hc <- hclust(d, method = "ward.D2" )
plot(res.hc, cex = 0.6, hang = -1)
```




```
cut <- cutree(res.hc, k = 2)
cut
```

```
##     [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##    [37] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##    [73] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [109] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [145] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [181] 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [217] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [253] 2 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1
##   [289] 1 1 1 1 1 2 1 1 1 1 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##   [325] 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 2 1 1 2 1 1 1 1 1 1 1 1 1 1 2 1 1 2 1
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1 1 1
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1 1 1
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1 1 1
##   [685] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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1 1 1
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1 1 1
##   [793] 1 1 1 1 1 1 1 1 1 1 1 1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 1
1 1 1
##   [829] 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1
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2 1 1
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2 1 1
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1 1 1
##   [973] 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 2
1 1 1
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1 1 1
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1 1 1
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1 1 1
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```

```
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1 1 2
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##  [2737] 1 1 2 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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##  [2989] 1 1 2 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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1 1 1
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##  [4897] 1 1 1 2 1 2 1 1 1 1 1 1 1 1 2 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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1 1 1
## [11773] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 1
1 1 2
## [11809] 1 1 1 1 1 2 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1
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1 1 1
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1 1 1
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1 1 1
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1 1 1
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1 1 1
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1 1 1
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1 1 1
## [12097] 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1
```

```
## [12133] 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 2 2 1 1 1
1 2 1
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1 1 1
## [12205] 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1
## [12241] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1
## [12277] 2 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1
1 1 1
## [12313] 1 1 1 1

table(cut)

## cut
##     1     2
## 11563   753
```

Conclusion Both K-mean and Hierarchical Clustering were unable to predict correctly if Revenue will be true or false. DBSCAN is not stable for this data since it has high dimensional.

Recommendation: Dimensional reduction is the best option to get better results