Market Segmentation with R -Unsupervised Machine learning

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9/3/2021

setwd("C://Users//Revolve//Documents//Basics Practice")

Project Overview

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. 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.

Defining the Research Question Our main aim of the project is to learn the characteristics of customer groups.

Defining our metric for Success We should be able to draw meaningful insights from our analysis and visualizations that enable us to characterize customer groups.

Data Relevance The dataset provided is relevant as it contains data with variables that are useful to draw our conclusions.

Experimental Design . Business Understanding . Data Preparation . Data Exploration and Cleaning . Data Analysis . Conclusions . Recommendations

Data Glossary The dataset consists of 10 numerical and 8 categorical attributes. The 'Revenue' attribute can be used as the class label. "Administrative", "Administrative Duration", "Informational", "Informational Duration", "Product Related" and "Product Related Duration" represents the number of different types of pages visited by the visitor in that session and total time spent in each of these page categories. The values of these features are derived from the URL information of the pages visited by the user and updated in real-time when a user takes an action, e.g. moving from one page to another. The "Bounce Rate", "Exit Rate" and "Page Value" features represent the metrics measured by "Google Analytics" for each page in the e-commerce site. The value of the "Bounce Rate" feature for a web page refers to the percentage of visitors who enter the site from that page and then leave ("bounce") without triggering any other requests to the analytics server during that session. The value of the "Exit Rate" feature for a specific web page is calculated as for all pageviews to the page, the percentage that was the last in the session. The "Page Value" feature represents the average value for a web page that a user visited before completing an e-commerce transaction. The "Special Day" feature indicates 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. The value of this attribute is determined by considering the dynamics of e-commerce such as the duration between the order date and delivery date. For example, for Valentina's day, this value takes a nonzero value between February 2 and February 12, zero before and after this date unless it is close to another special day, and its maximum value of 1 on February 8. The dataset also includes the operating system, browser, region, traffic type, visitor type as returning or new visitor, a Boolean value indicating whether the date of the visit is weekend, and month of the year.

a) Data Understanding

Loading our dataset

```
data <- read.csv('online_shoppers_intention.csv')
df<-data.frame(data)
```

Previewing the first ten rows

```
head(data, 10)
```

```
##    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
## 7               0                      -1             0                     -1
## 8               1                      -1             0                     -1
## 9               0                       0             0                      0
## 10              0                       0             0                      0
##    ProductRelated ProductRelated_Duration BounceRates  ExitRates PageValues
## 1               1                0.000000  0.20000000 0.20000000          0
## 2               2               64.000000  0.00000000 0.10000000          0
## 3               1               -1.000000  0.20000000 0.20000000          0
## 4               2                2.666667  0.05000000 0.14000000          0
## 5              10              627.500000  0.02000000 0.05000000          0
## 6              19              154.216667  0.01578947 0.02456140          0
## 7               1               -1.000000  0.20000000 0.20000000          0
## 8               1               -1.000000  0.20000000 0.20000000          0
## 9               2               37.000000  0.00000000 0.10000000          0
## 10              3              738.000000  0.00000000 0.02222222          0
##    SpecialDay Month OperatingSystems Browser Region TrafficType
## 1         0.0   Feb                1       1      1           1
## 2         0.0   Feb                2       2      1           2
## 3         0.0   Feb                4       1      9           3
## 4         0.0   Feb                3       2      2           4
## 5         0.0   Feb                3       3      1           4
## 6         0.0   Feb                2       2      1           3
## 7         0.4   Feb                2       4      3           3
## 8         0.0   Feb                1       2      1           5
## 9         0.8   Feb                2       2      2           3
## 10        0.4   Feb                2       4      1           2
##          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
## 7  Returning_Visitor   FALSE   FALSE
## 8  Returning_Visitor    TRUE   FALSE
```

```
## 9  Returning_Visitor   FALSE   FALSE
## 10 Returning_Visitor   FALSE   FALSE
```

Previewing the last ten records

```
tail(data, 10)
```

```
##       Administrative Administrative_Duration Informational
## 12321              0                    0.00            0
## 12322              0                    0.00            0
## 12323              6                   76.25            0
## 12324              2                   64.75            0
## 12325              0                    0.00            1
## 12326              3                  145.00            0
## 12327              0                    0.00            0
## 12328              0                    0.00            0
## 12329              4                   75.00            0
## 12330              0                    0.00            0
##       Informational_Duration ProductRelated ProductRelated_Duration BounceRates
## 12321                      0              8                143.5833 0.014285714
## 12322                      0              6                  0.0000 0.200000000
## 12323                      0             22               1075.2500 0.000000000
## 12324                      0             44               1157.9762 0.000000000
## 12325                      0             16                503.0000 0.000000000
## 12326                      0             53               1783.7917 0.007142857
## 12327                      0              5                465.7500 0.000000000
## 12328                      0              6                184.2500 0.083333333
## 12329                      0             15                346.0000 0.000000000
## 12330                      0              3                 21.2500 0.000000000
##         ExitRates PageValues SpecialDay Month OperatingSystems Browser Region
## 12321 0.050000000    0.00000          0   Nov                2       2      3
## 12322 0.200000000    0.00000          0   Nov                1       8      4
## 12323 0.004166667    0.00000          0   Dec                2       2      4
## 12324 0.013953488    0.00000          0   Nov                2       2      1
## 12325 0.037647059    0.00000          0   Nov                2       2      1
## 12326 0.029030612   12.24172          0   Dec                4       6      1
## 12327 0.021333333    0.00000          0   Nov                3       2      1
## 12328 0.086666667    0.00000          0   Nov                3       2      1
## 12329 0.021052632    0.00000          0   Nov                2       2      3
## 12330 0.066666667    0.00000          0   Nov                3       2      1
##       TrafficType       VisitorType Weekend Revenue
## 12321           1 Returning_Visitor   FALSE   FALSE
## 12322           1 Returning_Visitor   FALSE   FALSE
## 12323           2 Returning_Visitor   FALSE   FALSE
## 12324          10 Returning_Visitor   FALSE   FALSE
## 12325           1 Returning_Visitor   FALSE   FALSE
## 12326           1 Returning_Visitor    TRUE   FALSE
## 12327           8 Returning_Visitor    TRUE   FALSE
## 12328          13 Returning_Visitor    TRUE   FALSE
## 12329          11 Returning_Visitor   FALSE   FALSE
## 12330           2       New_Visitor    TRUE   FALSE
```

Accessing Basic information about our dataset

```r
print(str(data))#Returns column names with data types and factors
```

```
## '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" "Return
##  $ Weekend                : logi  FALSE FALSE FALSE FALSE TRUE FALSE ...
##  $ Revenue                : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
## NULL
```

```r
print(colnames(data))#shows column names
```

```
##  [1] "Administrative"          "Administrative_Duration"
##  [3] "Informational"           "Informational_Duration"
##  [5] "ProductRelated"          "ProductRelated_Duration"
##  [7] "BounceRates"             "ExitRates"
##  [9] "PageValues"              "SpecialDay"
## [11] "Month"                   "OperatingSystems"
## [13] "Browser"                 "Region"
## [15] "TrafficType"             "VisitorType"
## [17] "Weekend"                 "Revenue"
```

```r
sapply(data, function(x) length(unique(x)))#checking for number of unique values in our dataset
```

```
##          Administrative Administrative_Duration           Informational
##                      28                    3337                      18
##  Informational_Duration          ProductRelated ProductRelated_Duration
##                    1260                     312                    9553
##             BounceRates               ExitRates              PageValues
##                    1873                    4778                    2704
##              SpecialDay                   Month        OperatingSystems
##                       6                      10                       8
##                 Browser                  Region             TrafficType
##                      13                       9                      20
##             VisitorType                 Weekend                 Revenue
##                       3                       2                       2
```

Our dataset has 18 columns and 12330 rows/ observations.Datatypes range from numerical , character to logical in our class labels.

b)Data Preparation and Cleaning

We will now go through some basic data preparation operations such as identifying anomalies, missing data, duplicated data.

We will import some packages that will be useful in the process.

```
library(funModeling)
```

```
## Loading required package: Hmisc

## Loading required package: lattice

## Loading required package: survival

## Loading required package: Formula

## Loading required package: ggplot2

##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:base':
##
##     format.pval, units

## funModeling v.1.9.4 :)
## Examples and tutorials at livebook.datascienceheroes.com
##  / Now in Spanish: librovivodecienciadedatos.ai
```

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:Hmisc':
##
##     src, summarize

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

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

```
library(tidyr)
library(tidyr)
library(ggplot2)
library(pander)
library(forcats)
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v tibble  3.1.3     v purrr   0.3.4
## v readr   2.0.1     v stringr 1.4.0

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter()    masks stats::filter()
## x dplyr::lag()       masks stats::lag()
## x dplyr::src()       masks Hmisc::src()
## x dplyr::summarize() masks Hmisc::summarize()
```

We will profile our data set to find missing values, zeros, unique values and filter or remove where appropriate

```
df_status(data)#function can help us by showing these numbers in relative and percentage values. It als
```

```
##                   variable q_zeros p_zeros q_na p_na q_inf p_inf      type
## 1           Administrative    5754   46.67   14 0.11     0     0   integer
## 2  Administrative_Duration    5857   47.50   14 0.11     0     0   numeric
## 3            Informational    9686   78.56   14 0.11     0     0   integer
## 4   Informational_Duration    9879   80.12   14 0.11     0     0   numeric
## 5           ProductRelated      35    0.28   14 0.11     0     0   integer
## 6  ProductRelated_Duration     719    5.83   14 0.11     0     0   numeric
## 7              BounceRates    5510   44.69   14 0.11     0     0   numeric
## 8                ExitRates      76    0.62   14 0.11     0     0   numeric
## 9               PageValues    9600   77.86    0 0.00     0     0   numeric
## 10              SpecialDay   11079   89.85    0 0.00     0     0   numeric
## 11                   Month       0    0.00    0 0.00     0     0 character
## 12        OperatingSystems       0    0.00    0 0.00     0     0   integer
## 13                 Browser       0    0.00    0 0.00     0     0   integer
## 14                  Region       0    0.00    0 0.00     0     0   integer
## 15             TrafficType       0    0.00    0 0.00     0     0   integer
## 16             VisitorType       0    0.00    0 0.00     0     0 character
## 17                 Weekend    9462   76.74    0 0.00     0     0   logical
## 18                 Revenue   10422   84.53    0 0.00     0     0   logical
##    unique
## 1      27
## 2    3336
## 3      17
## 4    1259
## 5     311
## 6    9552
## 7    1872
## 8    4777
## 9    2704
## 10      6
## 11     10
## 12      8
## 13     13
## 14      9
## 15     20
## 16      3
## 17      2
## 18      2
```

From the above we see that our data has quite a number of missing values denoted by q-na and p-na.We will now write a code to sum out the total number of missing values

```
sum(is.na(data))
```

```
## [1] 112
```

There are 112 nan values in our dataset.We will drop the null values.We will use the na.omit function

```
data <- na.omit(data)
```

Confirming we no longer have null values

```
sum(is.na(data))
```

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

Let's then proceed to Identify duplicated records

```
duplicated(data)
```

```
##     [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  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [169] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE 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  TRUE 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]  TRUE 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  TRUE 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  TRUE 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  TRUE 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  TRUE 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  TRUE
##   [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  TRUE 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  TRUE FALSE FALSE FALSE
##   [877] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [889] FALSE  TRUE 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  TRUE 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  TRUE
##   [949] 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
##   [973] FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [985] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##   [997] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
##  [1009] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1021] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1033] FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1045] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1057] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1069] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1081] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1093] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1105] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1117] FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1129] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1141] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1153] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1165]  TRUE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE
##  [1177] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1189] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1201] FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE FALSE FALSE FALSE
##  [1213] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1225] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1237] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1249] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1261] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1273] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1285] FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1297] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1309] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE
##  [1321] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1333] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1345] FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE
##  [1357] FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1369] FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE
##  [1381] FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE
##  [1393] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1405] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1417] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1429] FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1441] FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE
##  [1453] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1465] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1477] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1489] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1501] FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1513] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1525] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1537] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1549] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1561] FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1573] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1585] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1597] FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1609] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1621] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1633] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1645] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
##  [1657] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1669] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1681] FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE
##  [1693] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1705] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1717] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1729] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1741] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1753] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1765] FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1777] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1789] FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE
##  [1801] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1813] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1825] FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1837] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1849] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE
##  [1861] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1873] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1885] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1897] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1909] FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE
##  [1921] FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1933] FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE
##  [1945] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1957] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1969] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1981] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [1993] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2005] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2017] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2029] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2041] FALSE FALSE FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2053] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2065] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2077] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2089] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2101] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2113] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2125] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2137] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2149] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2161] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2173] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2185] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [2197] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
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## [12217] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12229] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12241] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12253] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12265] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12277] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12289] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12301] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [12313] FALSE FALSE FALSE FALSE
```

```
#We can already spot that there are some duplicated records in our dataset
```

```
data<- data %>% distinct()
#omitting the duplicated data
```

Confirming to see that we have omitted the duplicated records

```
colSums(data[duplicated(data),])
```

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

Since we made some transformations with our data, we will now see the new dimensions and summary of our data

```
print(dim(data))
```

```
## [1] 12199    18
```

Our new dataset has 12199 observations and 18 columns.

*Changing the dtypes to categorical and numeric

```
#install.packages("dplyr") #We will install the magrittr and dplyr package to help us apply the followi
library(dplyr)
library(magrittr)
```

```
##
## Attaching package: 'magrittr'

## The following object is masked from 'package:purrr':
##
##     set_names

## The following object is masked from 'package:tidyr':
##
##     extract
```

```
cat_v = c('Month', 'OperatingSystems',   'Browser',  'Region',   'TrafficType', 'VisitorType')

data[,cat_v] %<>% lapply(function(x) as.factor(as.character(x)))
```

```
str(data)
```

```
## 'data.frame':    12199 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                  : Factor w/ 10 levels "Aug","Dec","Feb",..: 3 3 3 3 3 3 3 3 3 3 ...
##  $ OperatingSystems       : Factor w/ 8 levels "1","2","3","4",..: 1 2 4 3 3 2 2 1 2 2 ...
##  $ Browser                : Factor w/ 13 levels "1","10","11",..: 1 6 1 6 7 6 8 6 6 8 ...
##  $ Region                 : Factor w/ 9 levels "1","2","3","4",..: 1 1 9 2 1 1 3 1 2 1 ...
##  $ TrafficType            : Factor w/ 20 levels "1","10","11",..: 1 12 14 15 15 14 14 16 14 12 ...
##  $ VisitorType            : Factor w/ 3 levels "New_Visitor",..: 3 3 3 3 3 3 3 3 3 3 ...
##  $ Weekend                : logi  FALSE FALSE FALSE FALSE TRUE FALSE ...
##  $ Revenue                : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
```

Identifying Outliers

Outliers are data points that differ significantly from other data points in the datasets.We will proceed to check whether our data has any outstanding outliers by applying a function to our data subset

```r
numeric_v <- data %>%
  select_if(is.numeric)
```

```r
FindOutliers <- function(data) {
  lowerq = quantile(data)[2]
  upperq = quantile(data)[4]
  iqr = upperq - lowerq #Or use IQR(data)
  # we identify extreme outliers
  extreme.threshold.upper = (iqr * 3) + upperq
  extreme.threshold.lower = lowerq - (iqr * 3)
  result <- which(data > extreme.threshold.upper | data < extreme.threshold.lower)
  length(result)
}
apply(numeric_v, 2, FindOutliers)
```

```
##          Administrative Administrative_Duration           Informational
##                      51                     540                    2630
##  Informational_Duration          ProductRelated ProductRelated_Duration
##                    2437                     446                     398
##             BounceRates               ExitRates              PageValues
##                     928                     670                    2730
##              SpecialDay
##                    1249
```

Our dataset appears to have too many outliers. We will not drop them and use them for analysis as removing them may cause too large a variation.

#Exploratory Data Analysis

Descriptive Analysis

```r
summary(data)#Displays the statistical summaries of our dataset including the min.max, median, mean and
```

```
##  Administrative  Administrative_Duration Informational
##  Min.   : 0.00   Min.   :  -1.00         Min.   : 0.0000
##  1st Qu.: 0.00   1st Qu.:   0.00         1st Qu.: 0.0000
##  Median : 1.00   Median :   9.00         Median : 0.0000
##  Mean   : 2.34   Mean   :  81.68         Mean   : 0.5088
##  3rd Qu.: 4.00   3rd Qu.:  94.75         3rd Qu.: 0.0000
##  Max.   :27.00   Max.   :3398.75         Max.   :24.0000
##
##  Informational_Duration ProductRelated   ProductRelated_Duration
##  Min.   :  -1.00        Min.   :  0.00   Min.   :   -1.0
##  1st Qu.:   0.00        1st Qu.:  8.00   1st Qu.:  193.6
##  Median :   0.00        Median : 18.00   Median :  609.5
##  Mean   :  34.84        Mean   : 32.06   Mean   : 1207.5
##  3rd Qu.:   0.00        3rd Qu.: 38.00   3rd Qu.: 1477.6
##  Max.   :2549.38        Max.   :705.00   Max.   :63973.5
##
##   BounceRates        ExitRates         PageValues        SpecialDay
##  Min.   :0.00000   Min.   :0.00000   Min.   :  0.000   Min.   :0.00000
##  1st Qu.:0.00000   1st Qu.:0.01422   1st Qu.:  0.000   1st Qu.:0.00000
##  Median :0.00293   Median :0.02500   Median :  0.000   Median :0.00000
```

```
##  Mean   :0.02045   Mean   :0.04150   Mean   :  5.952   Mean   :0.06197
##  3rd Qu.:0.01667   3rd Qu.:0.04848   3rd Qu.:  0.000   3rd Qu.:0.00000
##  Max.   :0.20000   Max.   :0.20000   Max.   :361.764   Max.   :1.00000
##
##      Month      OperatingSystems    Browser         Region      TrafficType
##  May    :3328   2      :6536     2      :7878   1      :4711   2      :3907
##  Nov    :2983   1      :2548     1      :2426   3      :2382   1      :2383
##  Mar    :1853   3      :2530     4      : 730   4      :1168   3      :2017
##  Dec    :1706   4      : 478     5      : 466   2      :1127   4      :1066
##  Oct    : 549   8      :  75     6      : 174   6      : 800   13     : 728
##  Sep    : 448   6      :  19     10     : 163   7      : 758   10     : 450
##  (Other):1332   (Other):  13     (Other): 362   (Other):1253   (Other):1648
##             VisitorType     Weekend         Revenue
##  New_Visitor      : 1693   Mode :logical   Mode :logical
##  Other            :   81   FALSE:9343      FALSE:10291
##  Returning_Visitor:10425   TRUE :2856      TRUE :1908
##
##
##
##
```

Measures of Dispersion

```
library(moments)

#Skewness

skewness(numeric_v)#On our numerical variables
```

```
##          Administrative Administrative_Duration           Informational
##                1.946248                5.590210                4.013451
##  Informational_Duration          ProductRelated ProductRelated_Duration
##                7.537435                4.332134                7.251403
##             BounceRates               ExitRates              PageValues
##                3.152874                2.233125                6.348663
##              SpecialDay
##                3.284481
```

```
kurtosis(numeric_v)
```

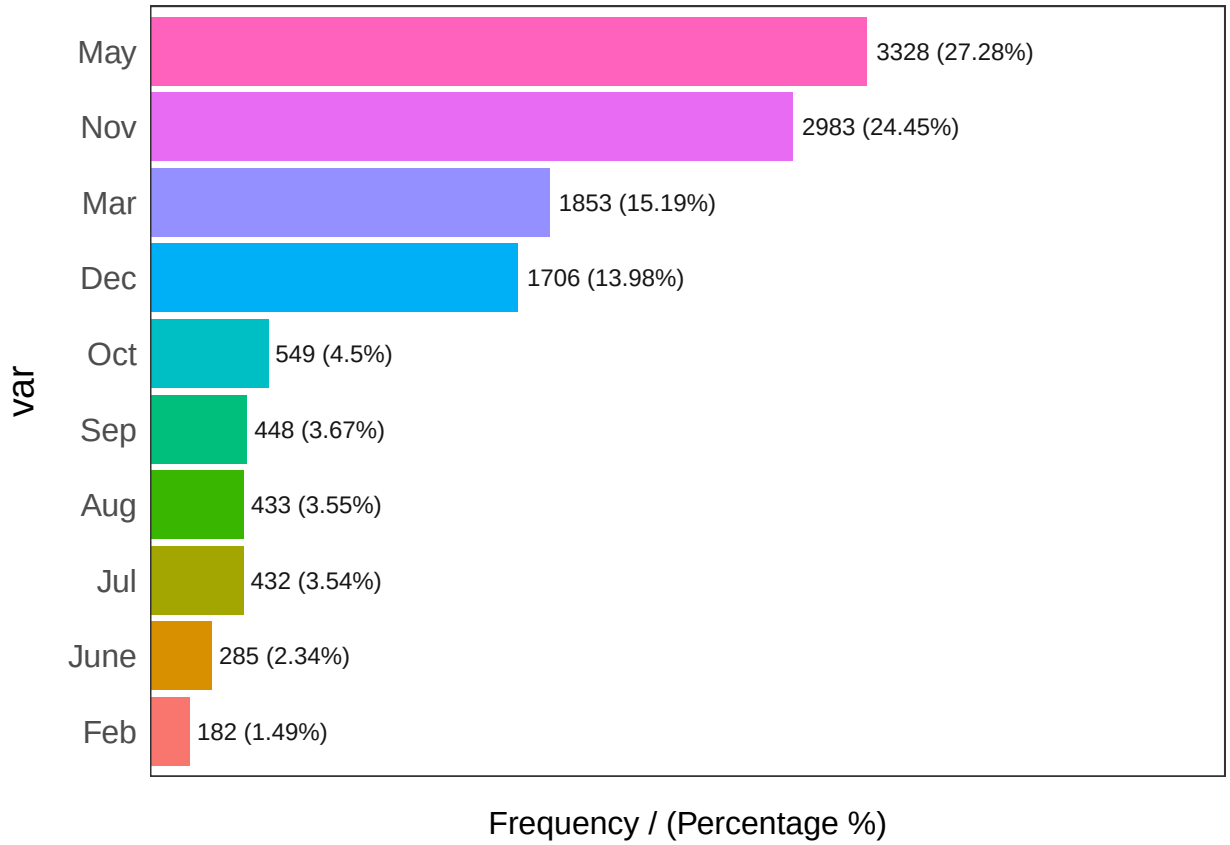
```
##          Administrative Administrative_Duration           Informational
##                7.636106               53.093885               29.642540
##  Informational_Duration          ProductRelated ProductRelated_Duration
##               78.464088               34.049027              139.590792
##             BounceRates               ExitRates              PageValues
##               12.255064                7.624252               67.940307
##              SpecialDay
##               12.786054
```

The distribution of the variables is positively skewed meaning the tail is on the right side. The kurtosis of the variables implies that they have thick tails.

Univariate Analysis Profiling our categorical variables

```r
freq(data=data$Month)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

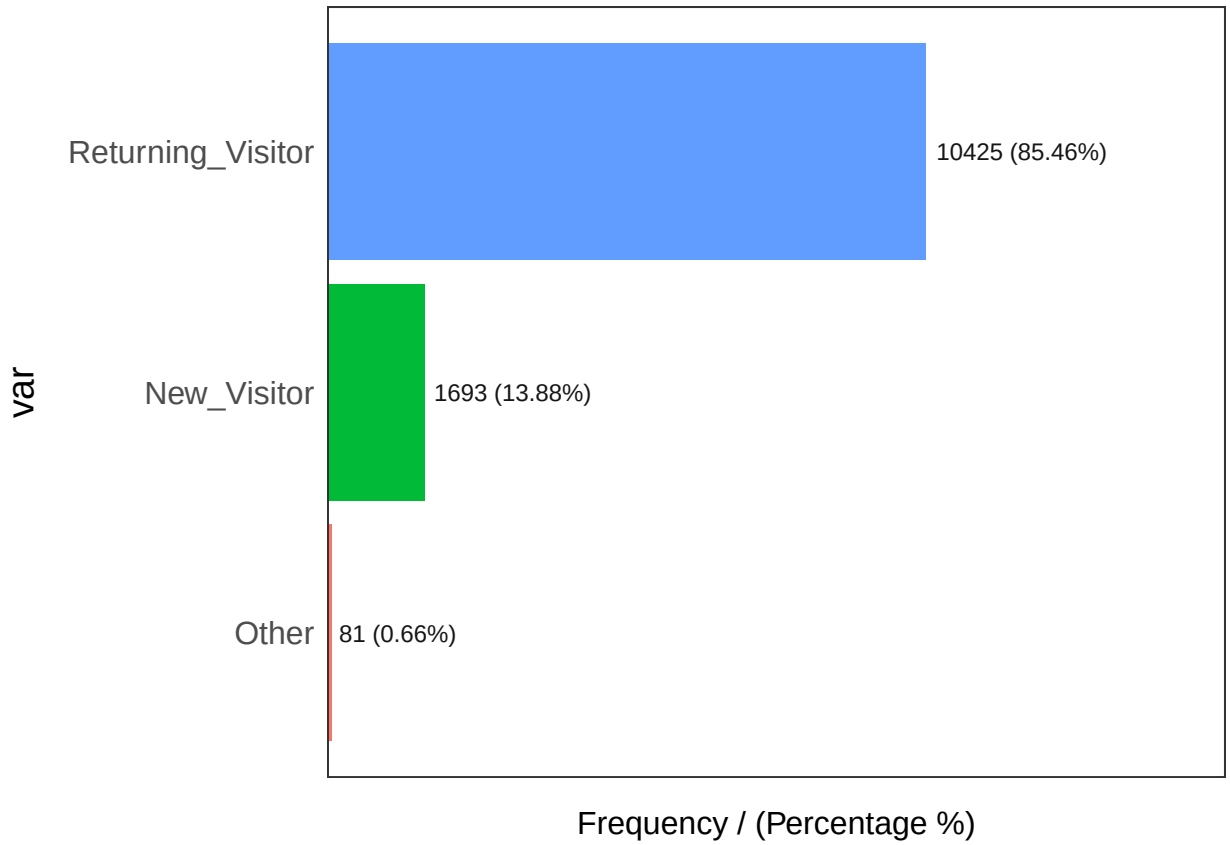



```
##     var frequency percentage cumulative_perc
## 1   May      3328      27.28           27.28
## 2   Nov      2983      24.45           51.73
## 3   Mar      1853      15.19           66.92
## 4   Dec      1706      13.98           80.90
## 5   Oct       549       4.50           85.40
## 6   Sep       448       3.67           89.07
## 7   Aug       433       3.55           92.62
## 8   Jul       432       3.54           96.16
## 9  June       285       2.34           98.50
## 10  Feb       182       1.49          100.00
```

The site was highly frequented in the Month of May with 27.28% followed closely by November with 24.45%. The month with the least visits was in February which has 1.49% of visitors.

```r
freq(data=data$VisitorType)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

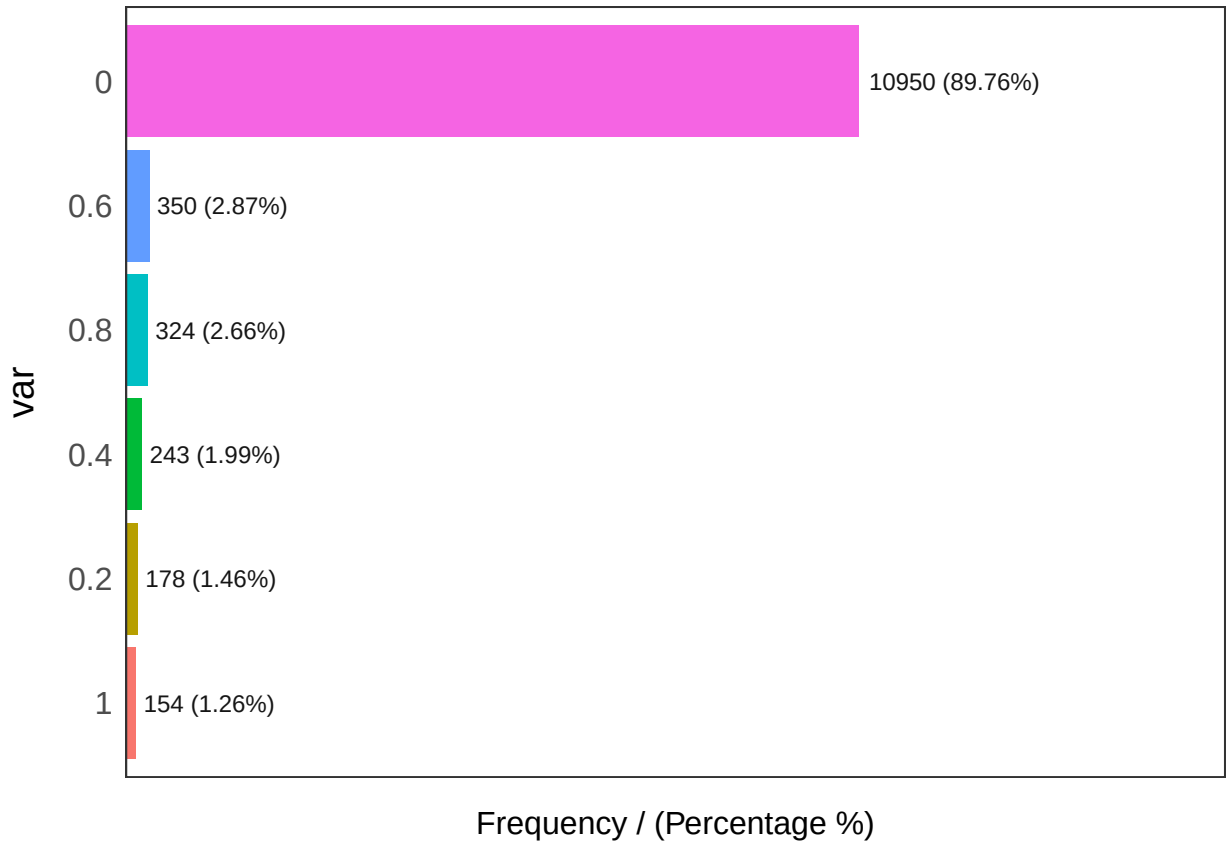



```
##                 var frequency percentage cumulative_perc
## 1 Returning_Visitor     10425      85.46           85.46
## 2       New_Visitor      1693      13.88           99.34
## 3             Other        81       0.66          100.00
```

85.46% of the visits are the from Returning Visitors with 13% being new visitors and 0.66%others.

```
freq(data=data$SpecialDay)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

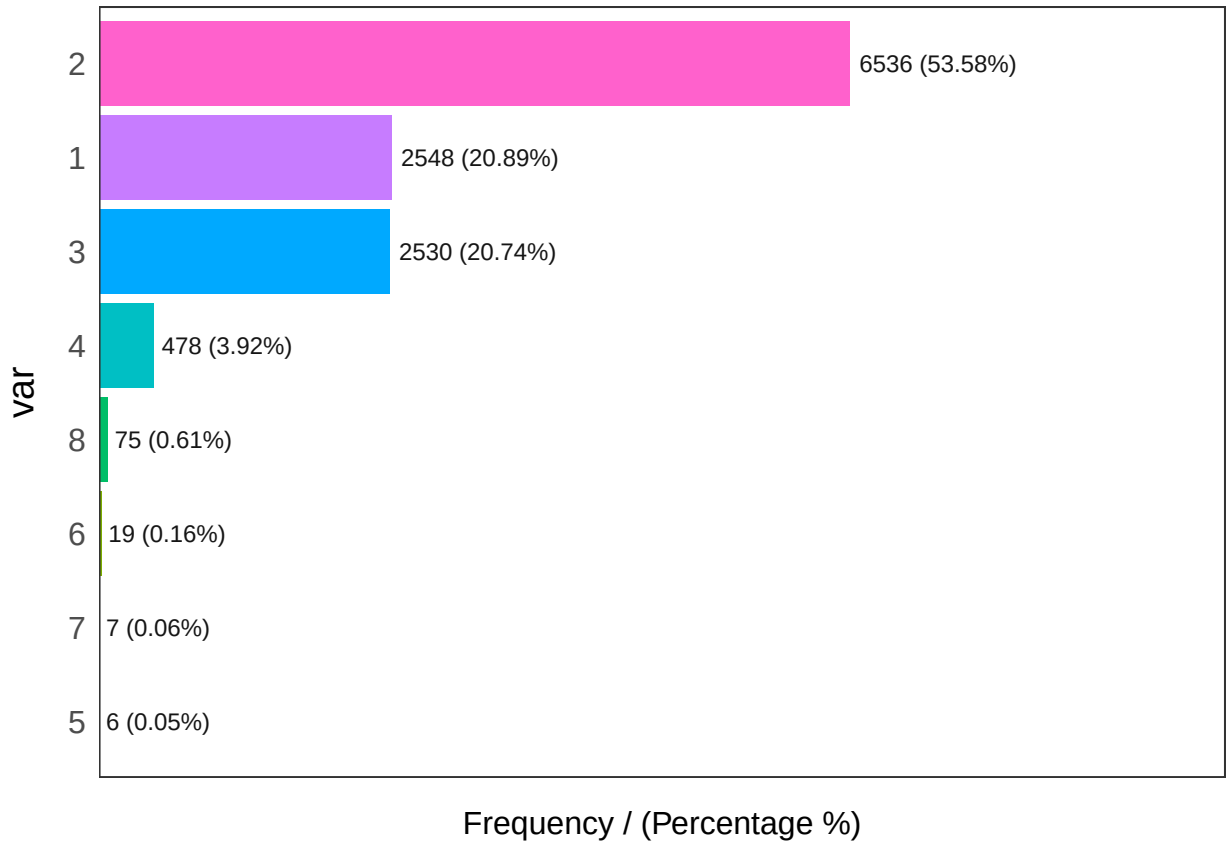



```
##   var frequency percentage cumulative_perc
## 1   0     10950      89.76           89.76
## 2 0.6       350       2.87           92.63
## 3 0.8       324       2.66           95.29
## 4 0.4       243       1.99           97.28
## 5 0.2       178       1.46           98.74
## 6   1       154       1.26          100.00
```

The "Special Day" feature indicates the closeness of the site visiting time to a specific special day.The value of this attribute is determined by considering the dynamics of e-commerce such as the duration between the order date and delivery date. For example, for Valentina's day, this value takes a nonzero value between February 2 and February 12, zero before and after this date unless it is close to another special day, and its maximum value of 1 on February 8.The most activity is at 89.76%

```
freq(data=data$OperatingSystems)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

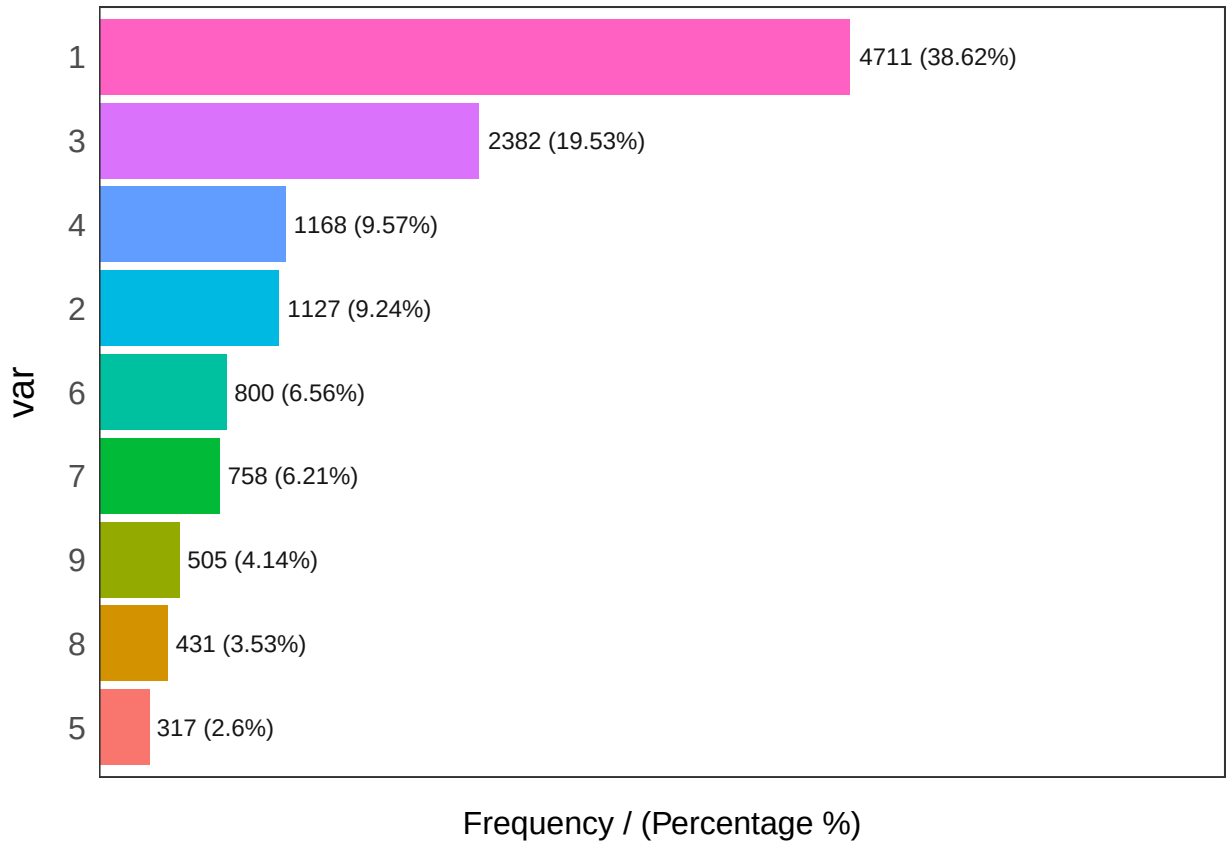



```
##   var frequency percentage cumulative_perc
## 1   2      6536      53.58           53.58
## 2   1      2548      20.89           74.47
## 3   3      2530      20.74           95.21
## 4   4       478       3.92           99.13
## 5   8        75       0.61           99.74
## 6   6        19       0.16           99.90
## 7   7         7       0.06           99.96
## 8   5         6       0.05          100.00
```

53.58% of users use the Operating system denoted by 2

```
freq(data=data$Region)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

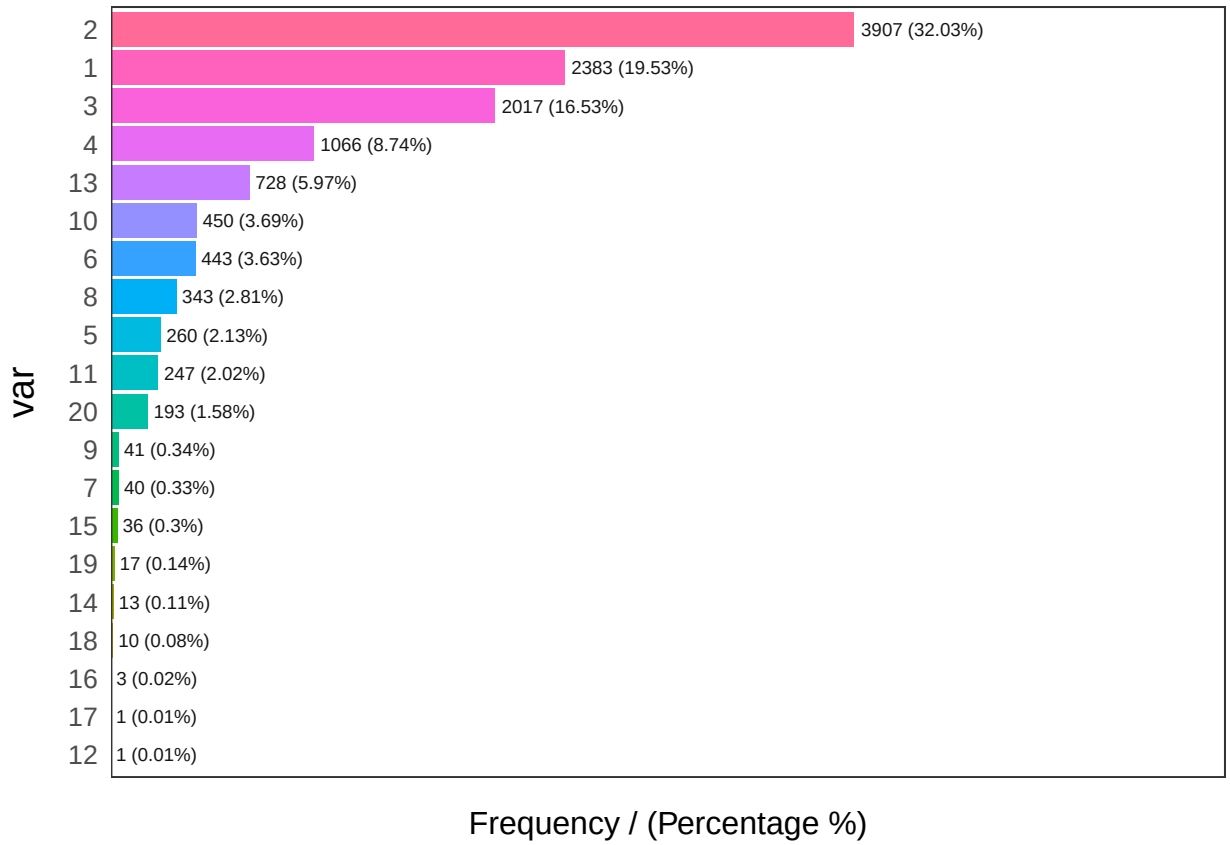



```
##   var frequency percentage cumulative_perc
## 1   1      4711      38.62           38.62
## 2   3      2382      19.53           58.15
## 3   4      1168       9.57           67.72
## 4   2      1127       9.24           76.96
## 5   6       800       6.56           83.52
## 6   7       758       6.21           89.73
## 7   9       505       4.14           93.87
## 8   8       431       3.53           97.40
## 9   5       317       2.60          100.00
```

38.62% of users are from region 2 and the least from region 5 at 2.6%

```
freq(data=data$TrafficType)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

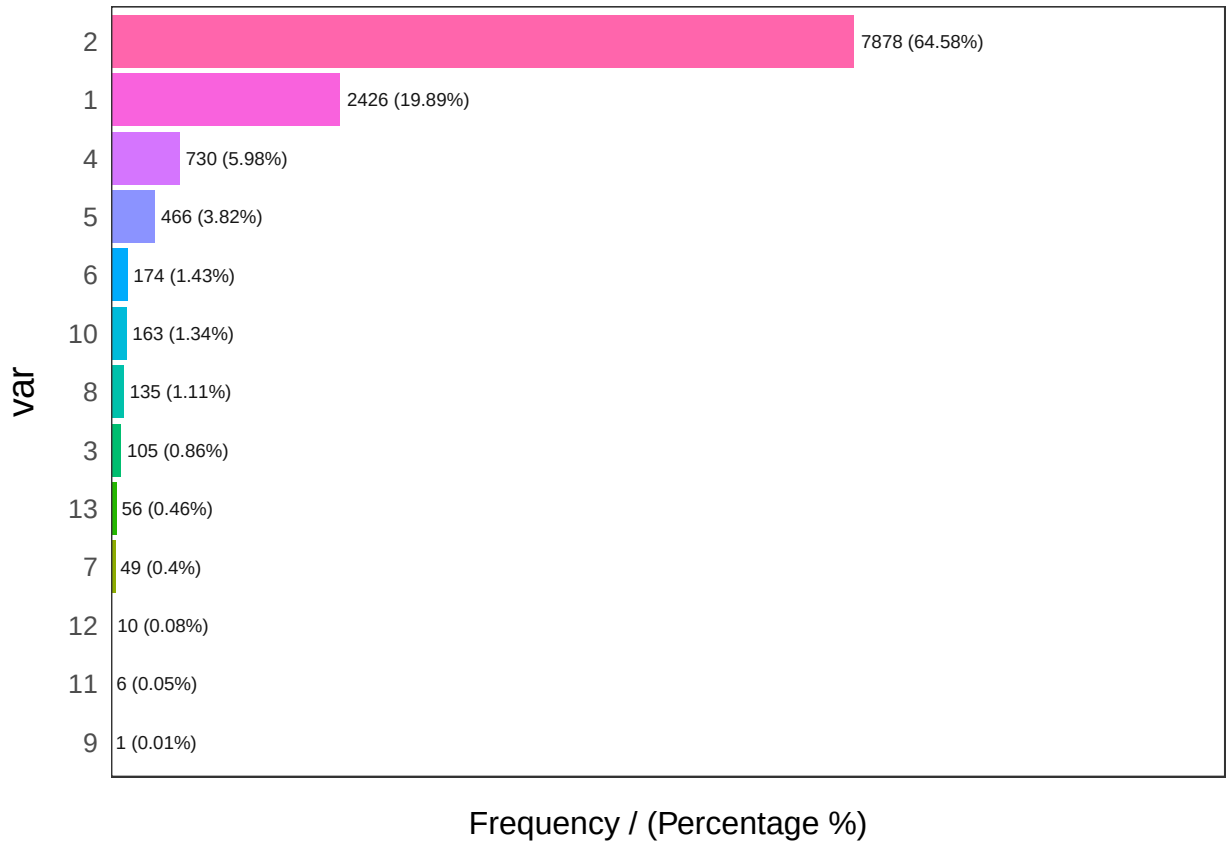



```
##    var frequency percentage cumulative_perc
## 1    2      3907      32.03           32.03
## 2    1      2383      19.53           51.56
## 3    3      2017      16.53           68.09
## 4    4      1066       8.74           76.83
## 5   13       728       5.97           82.80
## 6   10       450       3.69           86.49
## 7    6       443       3.63           90.12
## 8    8       343       2.81           92.93
## 9    5       260       2.13           95.06
## 10  11       247       2.02           97.08
## 11  20       193       1.58           98.66
## 12   9        41       0.34           99.00
## 13   7        40       0.33           99.33
## 14  15        36       0.30           99.63
## 15  19        17       0.14           99.77
## 16  14        13       0.11           99.88
## 17  18        10       0.08           99.96
## 18  16         3       0.02           99.98
## 19  12         1       0.01           99.99
## 20  17         1       0.01          100.00
```

The most recurring traffic type is 2 with 32.03% followed by 1 with 19.53% and 3with 16.53%

```r
freq(data=data$Browser)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```



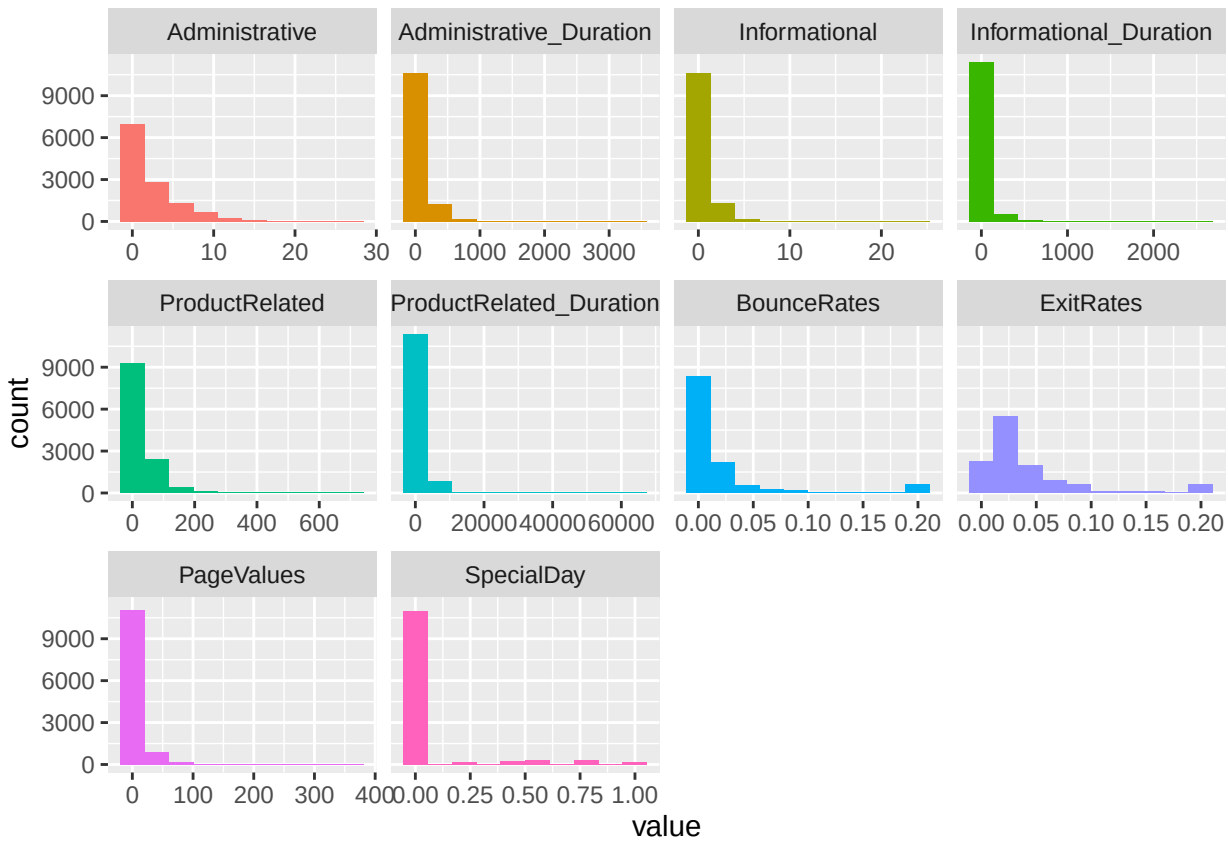

```
##    var frequency percentage cumulative_perc
## 1    2      7878      64.58           64.58
## 2    1      2426      19.89           84.47
## 3    4       730       5.98           90.45
## 4    5       466       3.82           94.27
## 5    6       174       1.43           95.70
## 6   10       163       1.34           97.04
## 7    8       135       1.11           98.15
## 8    3       105       0.86           99.01
## 9   13        56       0.46           99.47
## 10   7        49       0.40           99.87
## 11  12        10       0.08           99.95
## 12  11         6       0.05          100.00
## 13   9         1       0.01          100.00
```

65.58% of users prefer browser 2 followed by activity from browsers 1,4,6,10,8,3. The least preferred browser is browser 9 with 0.01% of users.

Profiling the numerical variables

```
plot_num(data)#This function  plots the distribution of every numerical variable while automatically ex
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```



As we can see from the plots above most of our data distribution is right skewed meaning that the mode is the highest peak of most of our histograms and most values fall to the right side

Correlation and Bivariate Analysis

We will now explore the relationships between our different variables to deduce more insights about our ecommere data

```
#Loading packages we might need
#install.packages("corrplot")
library(corrplot)
```

```
## corrplot 0.90 loaded
```

```
library(ggplot2)
library(dplyr)
library(lessR)
```

```
##
## lessR 4.0.2  feedback: gerbing@pdx.edu  web: lessRstats.com/new
```

```
## ----------------------------------------------------------------
## > d <- Read("")   Read text, Excel, SPSS, SAS, or R data file
##   d is default data frame, data= in analysis routines optional
##
## Learn about reading, writing, and manipulating data, graphics,
## testing means and proportions, regression, factor analysis,
## customization, and descriptive statistics from pivot tables.
##   Enter:  browseVignettes("lessR")
##
## View changes in this new version of lessR.
##   Enter: help(package=lessR)  Click: Package NEWS

##
## Attaching package: 'lessR'

## The following object is masked from 'package:moments':
##
##     kurtosis

## The following object is masked from 'package:dplyr':
##
##     recode

## The following objects are masked from 'package:Hmisc':
##
##     label, Merge
```

```
library(reshape2)
```

```
##
## Attaching package: 'reshape2'

## The following object is masked from 'package:tidyr':
##
##     smiths
```

```
library(gridExtra) # allow us to plot two plots in a row
```

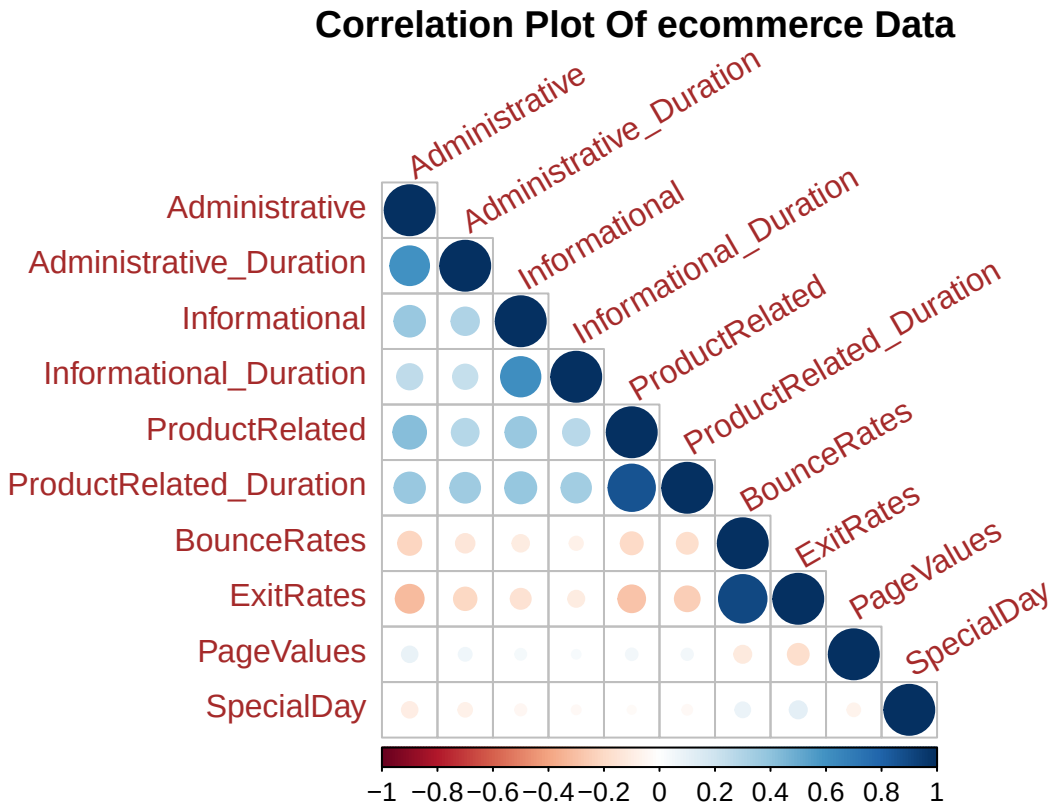
```
##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##     combine
```

```
options(scipen=999) # disable scientific notation
```

```
corr_tab<-cor(numeric_v)
```

Displaying the correlation in a matrix

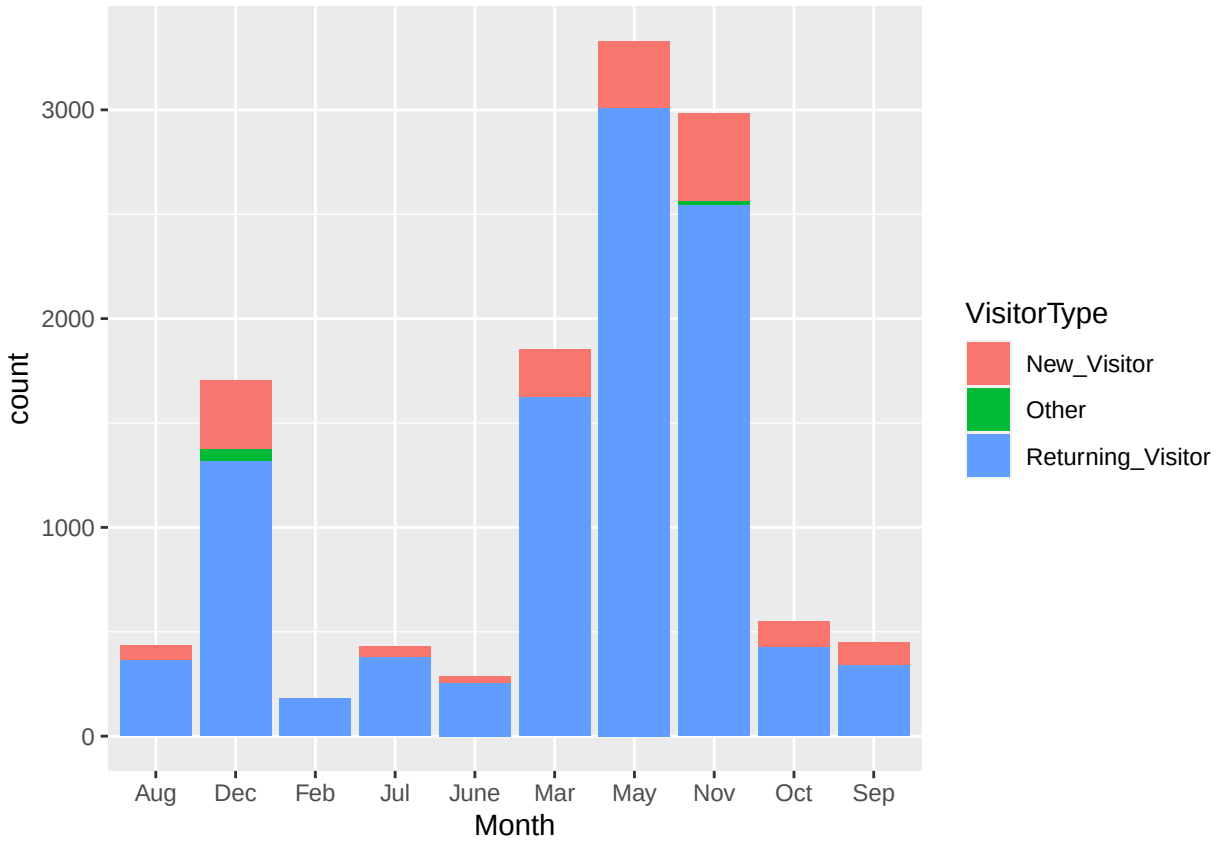
```
corrplot(corr_tab, tl.col = "brown", tl.srt = 30, bg = "White",
         title = "\n\n Correlation Plot Of ecommerce Data",
         type = "lower")
```



visualizing bivariate relationships

Visitor type by Month

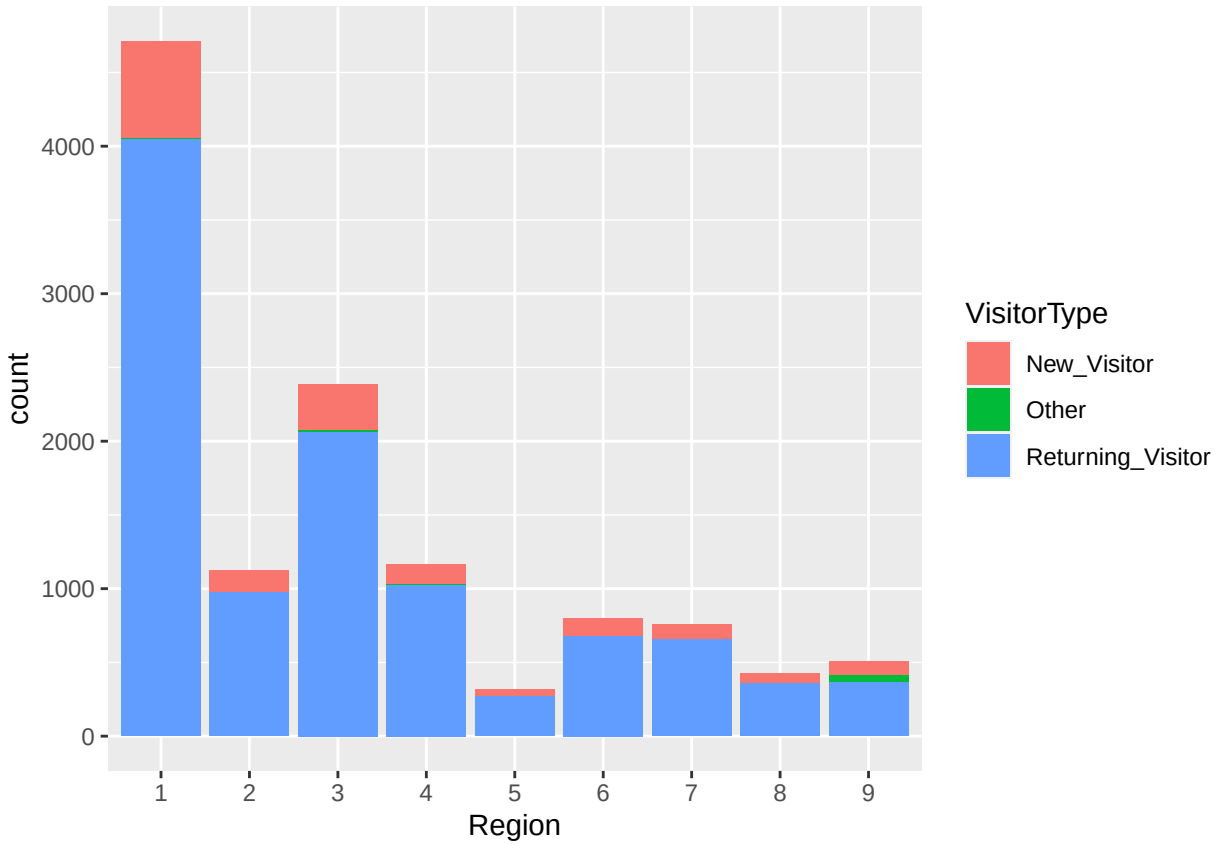
```
 # stacked bar chart
ggplot(data,
       aes(x = Month,
           fill = VisitorType)) +
  geom_bar(position = "stack")
```



The activity was highest in May with majority of the visitors being returning visitors.December and November saw a lot of visits by new and other users. February had the lowest visits.

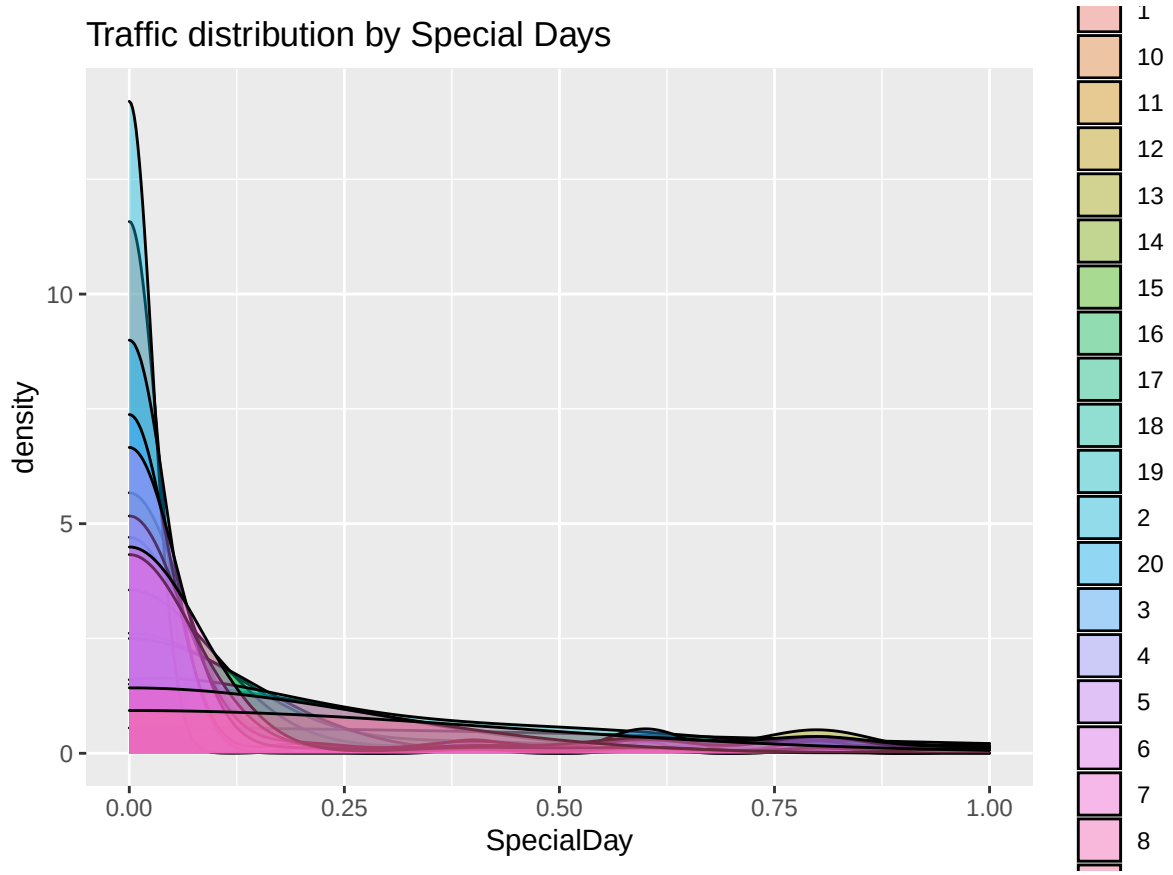
Visitor Type by Region

```
# stacked bar chart
ggplot(data,
       aes(x = Region,
           fill = VisitorType)) +
  geom_bar(position = "stack")
```



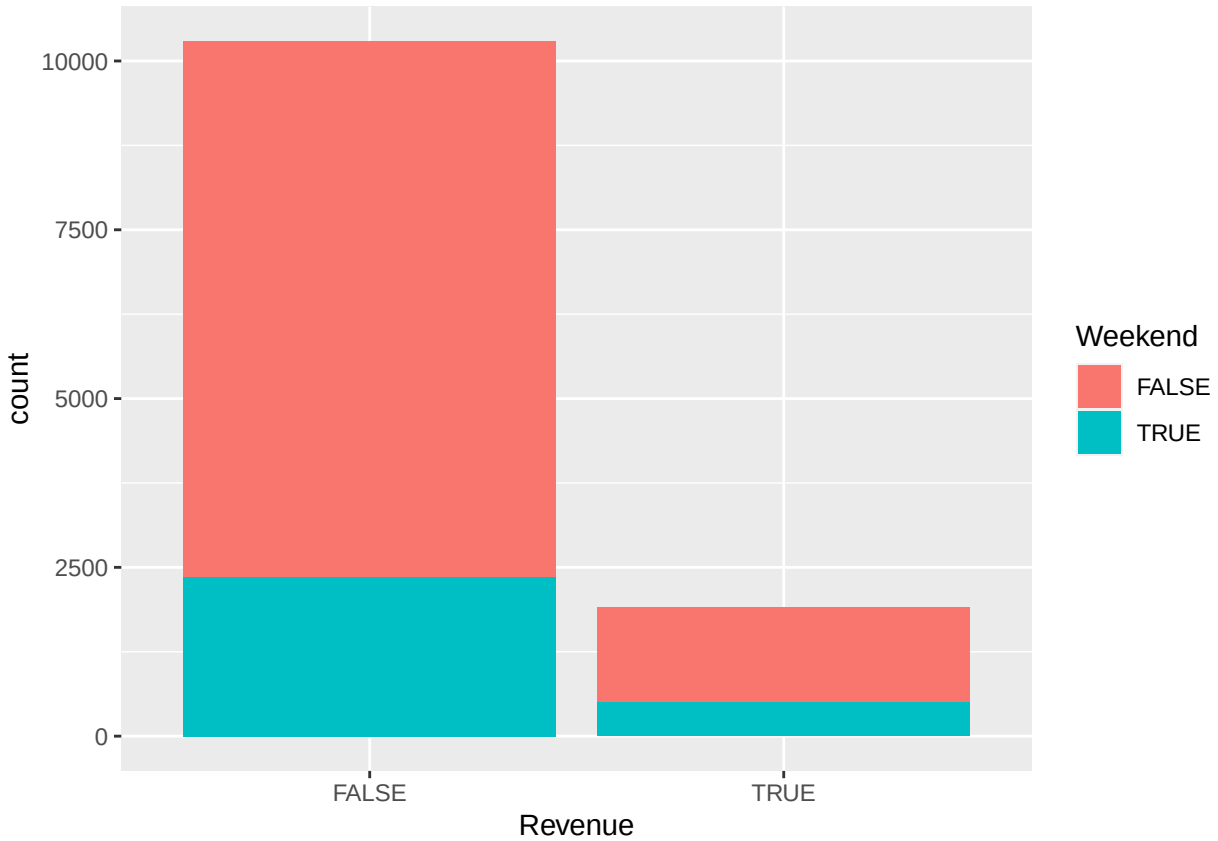
Region 1 saw most visits by Returning visitors as well as new visitors followed by region 3

```
# stacked bar chart
ggplot(data,
       aes(x = SpecialDay,
           fill = TrafficType)) +
  geom_density(alpha= 0.4) +
  labs(title = "Traffic distribution by Special Days")
```



Revenue by weekday type

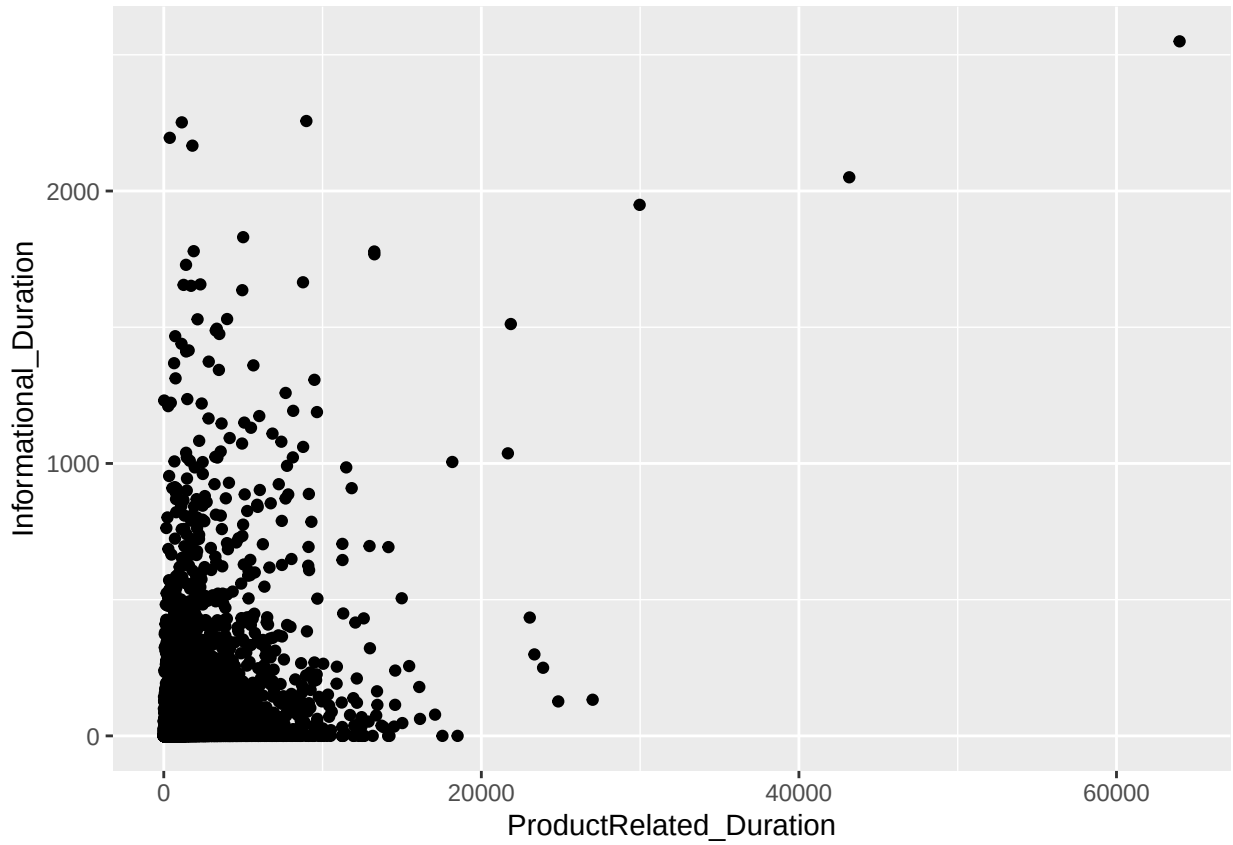
```
#Stacked bar chart
ggplot(data,
       aes(x = Revenue,
           fill = Weekend)) +
  geom_bar(position = "stack")
```



The revenue stack on weekdays mean that those are the days that generate more revenue compared to weekends.

Numerical - Numerical visualizations using scatterplots

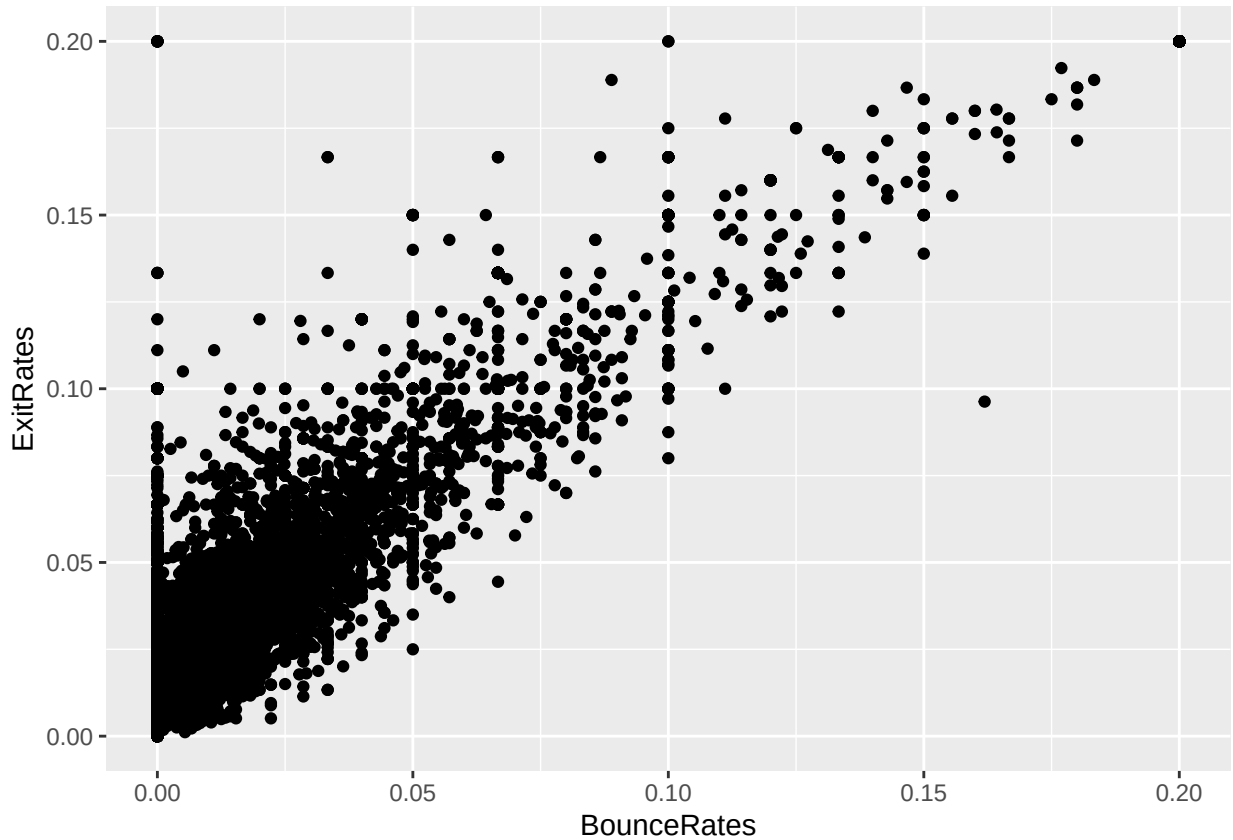
```
# simple scatterplot visualization of product related and Informational Duration
ggplot(data,
       aes(x = ProductRelated_Duration,
           y = Informational_Duration)) +
  geom_point()
```




```
cor(data$Informational_Duration, data$ProductRelated_Duration, method="pearson")#The two variable have
```

```
## [1] 0.3465807
```

```
# simple scatterplot visualization of Bounce and Exit Rates
ggplot(data,
       aes(x = BounceRates,
           y = ExitRates)) +
  geom_point()
```

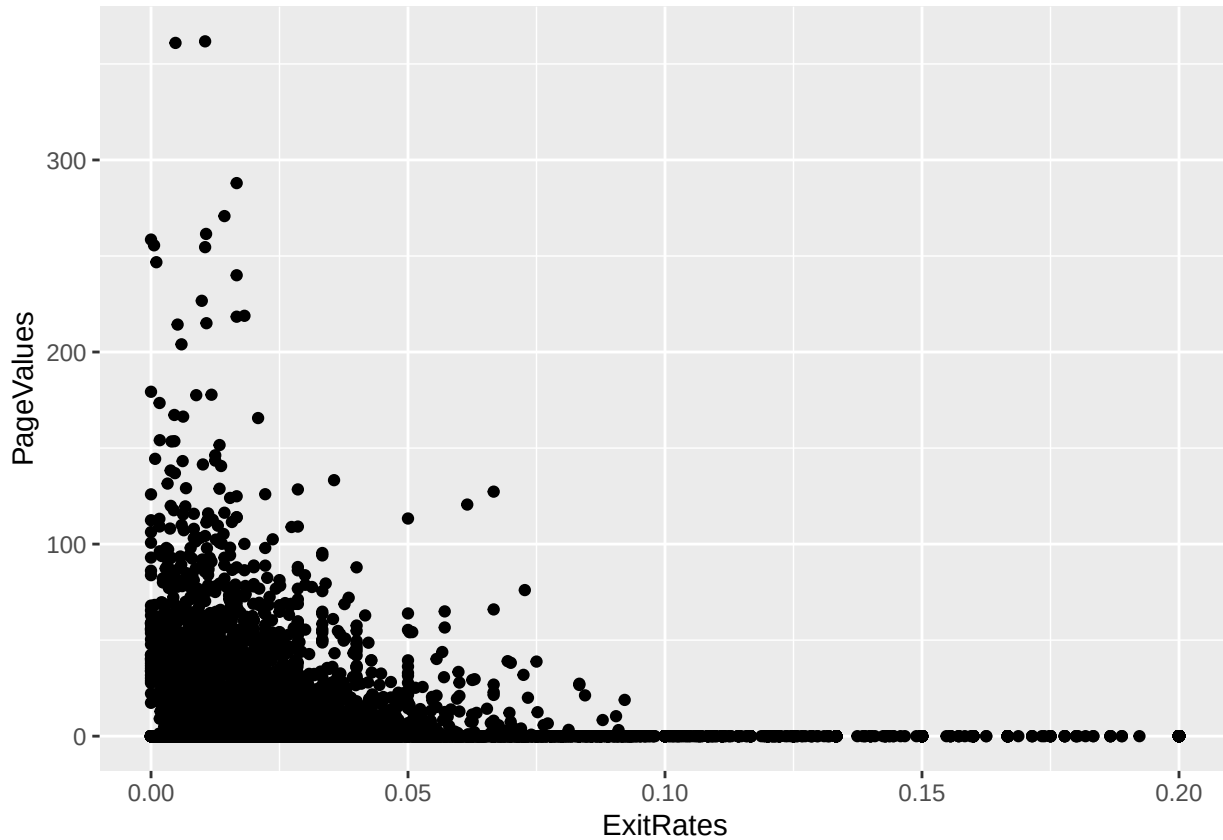



```
cor(data$BounceRates,data$ExitRates, method="pearson")
```

```
## [1] 0.9033582
```

Bounce and Exit rates are highly correlated.

```
# simple scatterplot visualization of Bounce and Exit Rates
ggplot(data,
       aes(x = ExitRates,
           y = PageValues)) +
  geom_point()
```



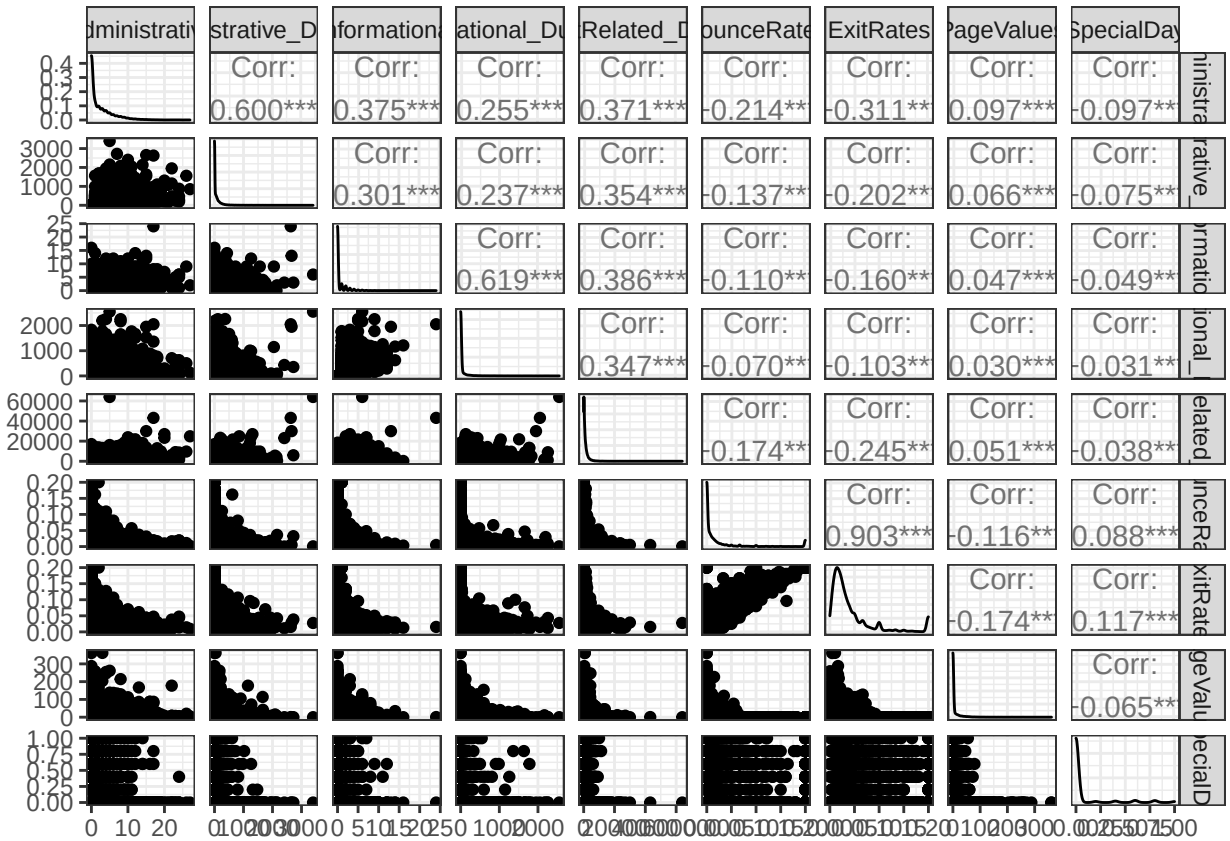
Their is no relationship between page values and exit rates

mUltivariate visualizations

```
library(GGally)
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2

##
## Attaching package: 'GGally'

## The following object is masked from 'package:pander':
##
##     wrap

## The following object is masked from 'package:funModeling':
##
##     range01
```

```
library(ggplot2)

ggpairs(numeric_v[,-5])+ theme_bw()
```



#d) Implementing the solution

Requirements: - Perform clustering stating insights drawn from your analysis and visualizations. - Upon implementation, provide comparisons between the approaches learned this week i.e. K-Means clustering vs Hierarchical clustering highlighting the strengths and limitations of each approach in the context of your analysis.

Data Preprocessing

We will remove the class label; Revenue since unsupervised algorithms do not require class labels and store in a separate variable

```
data.new<- data[, c(1:17)]
data.class<- data[, "Revenue"]
colnames(data.new)
```

```
##  [1] "Administrative"          "Administrative_Duration"
##  [3] "Informational"           "Informational_Duration"
##  [5] "ProductRelated"          "ProductRelated_Duration"
##  [7] "BounceRates"             "ExitRates"
##  [9] "PageValues"              "SpecialDay"
## [11] "Month"                   "OperatingSystems"
## [13] "Browser"                 "Region"
## [15] "TrafficType"             "VisitorType"
## [17] "Weekend"
```

```r
str(data.new)
```

```
## 'data.frame':    12199 obs. of  17 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                  : Factor w/ 10 levels "Aug","Dec","Feb",..: 3 3 3 3 3 3 3 3 3 3 ...
##  $ OperatingSystems       : Factor w/ 8 levels "1","2","3","4",..: 1 2 4 3 3 2 2 1 2 2 ...
##  $ Browser                : Factor w/ 13 levels "1","10","11",..: 1 6 1 6 7 6 8 6 6 8 ...
##  $ Region                 : Factor w/ 9 levels "1","2","3","4",..: 1 1 9 2 1 1 3 1 2 1 ...
##  $ TrafficType            : Factor w/ 20 levels "1","10","11",..: 1 12 14 15 15 14 14 16 14 12 ...
##  $ VisitorType            : Factor w/ 3 levels "New_Visitor",..: 3 3 3 3 3 3 3 3 3 3 ...
##  $ Weekend                : logi  FALSE FALSE FALSE FALSE TRUE FALSE ...
```

We will need to change our dtypes and encode our categorical dtypes

```r
#data.new$Weekend <- lapply(data.new$Weekend, as.factor)

#install.packages("CatEncoders")
library(CatEncoders)
```

```
##
## Attaching package: 'CatEncoders'

## The following object is masked from 'package:base':
##
##     transform
```

```r
#factor_cols =  names(which(sapply(data.new, is.factor)))
#for(i in factor_cols){
#    encode <- LabelEncoder.fit(data.new[,i])
#    data.new[,i]<- transform(encode,data.new[,i])
#}

#data.new$Weekend <- lapply(data.new$Weekend, as.integer)
```

```r
xx <- sapply(data.new,is.logical)
data.new[xx] <- lapply(data.new[xx], function(x) as.numeric(as.factor(x)))


## converting the factor variables into numerical data type using label encoder
## Label encoding
factor_cols =  names(which(sapply(data.new, is.factor)))
for(i in factor_cols){
    encode <- LabelEncoder.fit(data.new[,i])
    data.new[,i]<- transform(encode,data.new[,i])}
```

```r
glimpse(data.new)
```

```
## Rows: 12,199
## Columns: 17
## $ Administrative          <int> 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 2~
## $ Administrative_Duration <dbl> 0, 0, -1, 0, 0, 0, -1, -1, 0, 0, 0, 0, 0, 0, 0~
## $ Informational           <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0~
## $ Informational_Duration  <dbl> 0, 0, -1, 0, 0, 0, -1, -1, 0, 0, 0, 0, 0, 0, 0~
## $ ProductRelated          <int> 1, 2, 1, 2, 10, 19, 1, 1, 2, 3, 3, 16, 7, 6, 2~
## $ ProductRelated_Duration <dbl> 0.000000, 64.000000, -1.000000, 2.666667, 627.~
## $ BounceRates             <dbl> 0.200000000, 0.000000000, 0.200000000, 0.05000~
## $ ExitRates               <dbl> 0.200000000, 0.100000000, 0.200000000, 0.14000~
## $ PageValues              <dbl> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0~
## $ SpecialDay              <dbl> 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.4, 0.0, 0.8, 0~
## $ Month                   <int> 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3~
## $ OperatingSystems        <int> 1, 2, 4, 3, 3, 2, 2, 1, 2, 2, 1, 1, 1, 2, 3, 1~
## $ Browser                 <int> 1, 6, 1, 6, 7, 6, 8, 6, 6, 8, 1, 1, 1, 9, 6, 1~
## $ Region                  <int> 1, 1, 9, 2, 1, 1, 3, 1, 2, 1, 3, 4, 1, 1, 3, 9~
## $ TrafficType             <int> 1, 12, 14, 15, 15, 14, 14, 16, 14, 12, 14, 14,~
## $ VisitorType             <int> 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3~
## $ Weekend                 <dbl> 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 1~
```

```r
#Normalizing the dataset so that no particular attribute
# has more impact on clustering algorithm than others.
# ---
normalize <- function(x){
  return ((x-min(x)) / (max(x)-min(x))) }
```

```r
#Scaling our dataset so that no particular attribute
# has more impact on clustering algorithm than others.
data_nor <-as.data.frame(scale(data.new))

#head(data_scaled)

#we're storing our normalized data in the data.norm variable
data_scaled <- as.data.frame(lapply(data_nor[,1:17], normalize))


#Previewing our normalized data
head(data_scaled)
```

```
##   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           0.00001563122  1.00000000  1.000000          0
## 2    0.002836879           0.00101602947  0.00000000  0.500000          0
## 3    0.001418440           0.00000000000  1.00000000  1.000000          0
```

```
## 4    0.002836879           0.00005731448  0.25000000  0.700000          0
## 5    0.014184397           0.00982422343  0.10000000  0.250000          0
## 6    0.026950355           0.00242622627  0.07894737  0.122807          0
##   SpecialDay     Month OperatingSystems   Browser Region TrafficType
## 1          0 0.2222222        0.0000000 0.0000000  0.000   0.0000000
## 2          0 0.2222222        0.1428571 0.4166667  0.000   0.5789474
## 3          0 0.2222222        0.4285714 0.0000000  1.000   0.6842105
## 4          0 0.2222222        0.2857143 0.4166667  0.125   0.7368421
## 5          0 0.2222222        0.2857143 0.5000000  0.000   0.7368421
## 6          0 0.2222222        0.1428571 0.4166667  0.000   0.6842105
##   VisitorType Weekend
## 1           1       0
## 2           1       0
## 3           1       0
## 4           1       0
## 5           1       1
## 6           1       0
```

##K-Means Clustering

K-Means clustering is unsupervised machine learning because there is not a target variable. Clustering can be used to create a target variable, or simply group data by certain characteristics.

```
#our algorithm is sensitive to missing values hence we will confirm that there are indeed none

sum(is.na(data_scaled))
```

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

Applying K-Means clustering

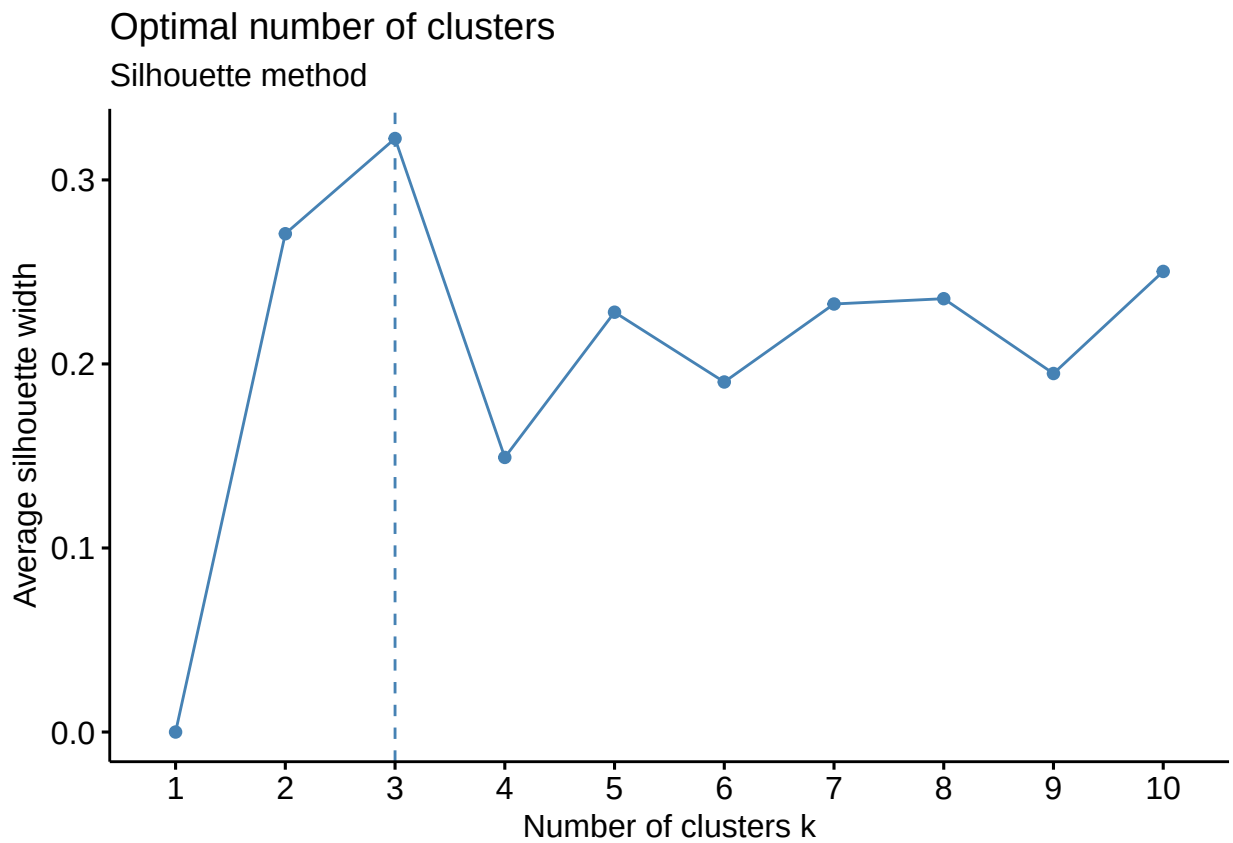
```
#libraries
library(tidyverse)  # data manipulation
library(cluster)    # clustering algorithms
#install.packages("factoextra")
library(factoextra) # clustering algorithms & visualization
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
#install.packages("NbClust")
library(NbClust)
```

Finding the optimal number of k

```
# Silhouette method
fviz_nbclust(data_scaled, kmeans, method = "silhouette")+
  labs(subtitle = "Silhouette method")
```




```r
#using k=4 for our algorithm
set.seed(123)

k_model <- kmeans(data_scaled, centers = 3, nstart = 25)
print(k_model)
```

```
## K-means clustering with 3 clusters of sizes 2378, 8080, 1741
##
## Cluster means:
##   Administrative Administrative_Duration Informational Informational_Duration
## 1     0.09144005              0.02515692    0.02656294            0.018088068
## 2     0.08363128              0.02342200    0.02121493            0.014212104
## 3     0.09424128              0.02734497    0.01380911            0.007794699
##   ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1     0.05137460              0.02103679  0.10103667 0.2027581 0.01584685
## 2     0.04800312              0.02015531  0.11930452 0.2314727 0.01341712
## 3     0.02566960              0.01008868  0.02464266 0.1026066 0.03137828
##   SpecialDay     Month OperatingSystems   Browser    Region TrafficType
## 1 0.06341463 0.5901785        0.1619008 0.3397813 0.2641400   0.4551591
## 2 0.07066832 0.5740374        0.1585396 0.3690800 0.2632735   0.4437402
## 3 0.01964388 0.5532580        0.1685402 0.3521922 0.3033458   0.6287977
##   VisitorType   Weekend
## 1  0.99810765 1.0000000
## 2  0.99845297 0.0000000
## 3  0.01407237 0.2745549
##
```

```
## Clustering vector:
##     [1] 2 2 2 2 1 2 2 1 2 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 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 3 2 2 2 2 2 2 2 1 2 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 2 2
##   [145] 2 2 2 2 2 2 2 2 2 2 2 1 1 1 2 2 1 1 2 2 2 2 2 2 1 1 2 2 1 1 2 2 2 2 1 2
##   [181] 2 1 2 2 2 1 2 2 2 2 2 2 1 2 3 2 3 3 1 1 3 2 2 3 3 3 3 2 2 2 2 1 2 2 2 2
##   [217] 2 2 2 2 2 3 2 1 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 2 2
##   [253] 1 2 2 2 2 3 1 2 1 2 2 1 2 2 2 1 1 2 3 2 1 2 1 2 2 2 1 1 2 2 2 2 2 2 2 2
##   [289] 2 2 2 1 2 2 2 2 2 2 1 1 2 2 2 2 1 2 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 3 2 2
##   [325] 3 1 2 3 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 3 1 3 2 1 2 2 2 2 2 2 2 2 1
##   [361] 2 2 1 3 1 2 2 1 2 2 3 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 1 2 3 2
##   [397] 2 2 2 2 3 2 3 2 3 2 1 2 2 1 3 1 1 2 1 1 2 1 2 2 1 2 1 1 2 2 2 2 1 2 3 1
##   [433] 3 2 2 2 2 1 2 2 3 2 1 2 3 2 1 2 3 2 1 3 1 3 2 2 3 2 1 2 2 1 2 2 2 1 2 2
##   [469] 2 1 2 3 3 2 2 2 2 2 2 3 2 2 2 1 2 1 1 2 2 3 1 1 1 1 2 2 2 2 2 2 3 2 2 2
##   [505] 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 2 2 3 1 2 3
##   [541] 1 3 3 2 2 2 2 2 2 3 1 2 2 2 2 2 2 2 1 1 2 2 1 1 2 2 1 2 1 2 1 1 3 2 1 3
##   [577] 2 2 2 2 2 2 2 2 2 3 2 2 2 2 2 2 2 1 2 2 1 2 2 1 2 1 3 1 2 2 2 1 2 2 2 2 2
##   [613] 2 2 2 2 2 1 2 3 2 2 2 2 2 1 2 2 2 2 2 2 1 2 2 2 2 2 2 1 3 2 1 2 3 1 2 2
##   [649] 2 2 2 1 2 3 2 1 2 2 2 3 2 2 2 2 1 2 2 2 1 3 2 2 2 1 2 2 1 2 1 2 2 2 2 1
##   [685] 2 2 1 1 1 2 3 2 2 2 2 2 2 1 2 3 2 2 2 2 2 2 2 2 2 2 3 2 2 1 1 2 2 2 2 1
##   [721] 2 1 2 1 2 1 2 2 2 3 1 2 1 2 2 2 2 2 2 2 2 1 2 2 1 3 3 2 2 3 2 2 2 2 2 2
##   [757] 1 2 2 2 2 1 1 2 3 2 2 1 1 2 2 3 3 2 2 2 2 1 1 2 2 2 1 3 2 1 2 2 2 3 3 3
##   [793] 1 2 2 2 2 2 3 3 1 1 1 2 2 3 3 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2 3 1 3 1 2
##   [829] 1 2 1 2 1 2 2 3 2 1 2 2 2 2 1 2 3 2 2 1 3 1 3 2 2 3 2 2 3 2 2 3 1 2 1 1
##   [865] 2 1 2 3 2 2 2 2 3 2 2 2 3 2 2 2 2 2 1 2 1 2 2 2 2 2 2 3 3 1 2 1 1 2 3 1
##   [901] 2 2 1 1 2 1 2 2 2 2 3 2 2 2 2 2 2 2 2 3 2 3 1 2 3 2 2 2 2 1 2 3 1 3 2 3
##   [937] 2 2 2 2 2 2 2 1 2 2 1 3 1 2 2 2 2 1 1 2 3 2 2 2 2 1 2 2 2 2 2 2 2 3 2 3
##   [973] 1 2 2 1 1 2 1 2 2 2 2 2 2 2 2 3 3 2 2 1 2 2 3 1 3 2 2 2 3 2 2 2 3 2 2 1
##  [1009] 2 2 2 2 2 2 3 2 2 1 1 2 2 1 2 2 1 1 3 2 2 2 2 2 2 1 1 2 2 1 1 2 2 2 1 2
##  [1045] 2 2 1 1 2 2 2 2 2 2 2 3 2 2 2 1 2 2 2 2 2 1 2 2 2 1 2 1 2 2 2 2 2 2 3 3
##  [1081] 2 2 2 1 2 1 1 2 3 1 1 2 2 2 3 2 2 2 1 2 2 2 2 1 3 2 2 3 2 2 2 2 2 2 2 2
##  [1117] 2 1 3 2 2 2 2 2 2 2 2 1 2 1 1 1 2 2 2 1 2 1 2 2 2 2 2 3 2 2 2 2 2 3 2 3
##  [1153] 3 2 2 2 2 3 1 1 2 3 2 2 1 2 2 3 2 2 3 2 1 2 2 2 2 1 2 2 2 2 2 3 2 1 3 2
##  [1189] 2 2 3 3 1 2 1 1 2 3 2 2 2 2 2 2 2 1 1 1 1 2 2 1 2 2 2 2 2 1 2 2 2 2 2 2
##  [1225] 3 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 3 3 1 2 2 2 3 2 2 2 2 1 1 3 2 2 1 3 2 2
##  [1261] 1 2 2 2 2 2 1 2 2 2 1 2 2 1 1 3 2 2 2 2 2 2 1 3 1 2 2 2 2 2 3 1 2 1 1 2
##  [1297] 1 2 1 3 2 3 2 1 2 2 3 2 2 1 1 1 2 2 1 1 1 2 2 2 2 2 1 2 1 3 2 3 2 2 2 2
##  [1333] 2 2 2 2 2 2 1 2 2 1 2 2 2 1 1 2 1 2 2 2 2 2 1 3 2 1 2 2 3 1 3 2 3 2 2 3
##  [1369] 2 3 3 3 3 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 1 1 2 2 2 2 3 3 2 3 2 2
##  [1405] 2 2 2 2 2 2 3 2 2 2 2 2 2 2 2 1 2 2 2 1 2 2 1 2 3 3 2 2 2 2 2 3 1 2 2 2
##  [1441] 1 2 2 2 2 2 2 2 2 2 2 3 2 2 2 1 2 3 1 2 2 2 2 2 2 2 2 2 2 2 1 3 2 1 2 2
##  [1477] 2 2 2 2 1 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 3 2 1 2 1 2 2 1 3 2 3 2 2 2 2 2
##  [1513] 1 1 2 1 2 1 2 2 2 2 3 3 2 3 1 2 2 2 2 2 1 1 2 3 2 3 2 1 2 2 3 2 2 2 2 2
##  [1549] 2 2 3 2 2 2 1 2 2 2 1 2 2 2 3 2 2 2 1 2 2 1 1 2 2 2 2 2 2 3 1 2 2 1 2 1
##  [1585] 2 2 2 2 1 2 2 2 2 1 1 2 1 1 2 2 2 2 2 2 3 2 2 2 2 1 2 2 2 2 1 2 1 2 2 2
##  [1621] 1 3 1 1 2 2 3 2 1 3 2 2 1 2 3 1 2 2 3 2 2 3 3 2 2 1 2 1 1 2 1 2 2 2 1 1
##  [1657] 2 2 2 3 2 3 2 2 2 2 3 1 1 1 2 2 2 2 2 2 2 2 3 2 3 2 2 2 2 2 2 1 2 2 3 2
##  [1693] 1 1 2 2 2 2 2 2 1 1 2 1 2 2 2 2 1 3 1 3 2 1 2 1 2 2 2 2 2 1 1 2 2 2 2 3
##  [1729] 2 2 1 2 1 2 2 1 1 1 1 2 2 1 2 2 1 2 3 2 2 2 2 2 1 3 2 3 2 2 2 2 2 2 2 3
##  [1765] 2 2 3 1 1 2 2 1 2 2 2 2 3 1 1 2 2 3 2 2 2 2 2 2 1 2 1 2 2 3 2 2 2 2 3 2
##  [1801] 2 2 2 1 2 3 2 2 2 2 1 1 2 3 2 2 1 3 2 2 3 2 3 2 2 2 2 2 2 2 1 2 2 2 2 2
##  [1837] 2 3 2 3 2 1 3 1 1 2 3 3 2 2 2 1 2 1 2 3 3 2 2 2 1 2 2 1 3 3 2 2 1 2 1 3
##  [1873] 2 3 2 2 2 2 2 1 3 2 2 2 2 1 1 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2 1 2 3 3 1
```

```
## [1909] 2 3 1 2 1 2 2 2 2 2 2 1 2 3 1 2 2 2 1 2 2 2 1 2 3 2 2 2 2 2 2 3 2 3 1 2
## [1945] 2 2 3 2 2 1 1 1 2 2 2 2 2 2 1 3 2 2 2 2 2 2 2 1 1 2 2 1 1 2 2 1 2 2 2 2
## [1981] 2 2 2 2 2 2 2 2 2 2 3 1 2 2 2 2 2 2 2 2 2 2 3 2 2 2 3 2 2 3 2 2 2 2 2 2
## [2017] 1 2 2 2 2 2 2 2 3 2 2 2 1 3 3 1 2 1 1 2 2 2 2 2 2 2 3 2 2 2 1 2 2 3 2 2
## [2053] 2 2 2 2 1 2 3 2 2 2 2 1 2 2 2 1 2 3 3 2 2 2 2 3 1 1 2 2 2 2 2 2 1 2 1 2
## [2089] 2 2 3 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 1 2 3 1 2 1 1 3 2 2 2 2 1 2 2 2 2 2
## [2125] 2 2 2 2 2 1 2 1 2 1 2 2 2 2 2 2 2 2 2 1 2 3 2 2 1 2 2 2 2 1 2 2 1 1 2 3
## [2161] 1 2 2 2 2 1 2 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 1 1 1 1 2 2 2 2
## [2197] 3 2 1 2 1 2 1 2 2 1 2 1 2 2 1 2 1 2 2 2 1 2 2 2 2 3 2 2 3 2 2 2 2 2 2 1
## [2233] 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 3 1 2 3 2 2 2 2 1 1 2 1 1 2 2 3 1 2 1 2 2
## [2269] 2 2 2 2 1 3 2 2 1 2 2 3 3 1 2 2 2 2 2 3 1 3 2 2 3 2 2 2 2 2 2 2 2 1 2 2
## [2305] 2 2 2 2 2 2 3 2 2 2 2 1 3 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2
## [2341] 2 1 1 2 2 2 2 2 3 1 1 2 2 2 2 3 2 2 1 1 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2
## [2377] 3 2 2 2 2 2 2 2 2 2 3 2 3 2 1 2 1 2 2 2 1 2 1 3 2 2 1 2 1 2 2 1 2 3 3 2
## [2413] 2 2 2 2 1 2 2 2 2 2 2 1 2 3 3 1 1 1 2 3 2 2 2 2 2 2 2 2 1 2 2 1 3 1 2 2
## [2449] 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 1 2 1 2 2 2 2 2 2
## [2485] 2 2 1 2 2 1 2 2 2 2 1 2 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 1 2 1 2 1 1 2 2 2
## [2521] 2 3 3 2 2 2 2 2 2 1 2 2 3 2 3 2 2 2 2 2 2 1 1 2 2 1 1 1 2 2 2 2 1 1 2 1
## [2557] 2 2 2 1 1 2 2 3 2 2 2 2 2 2 2 1 1 2 2 2 3 3 1 2 2 1 1 2 2 2 1 2 2 2 2 2
## [2593] 2 2 3 1 2 2 2 1 3 2 1 3 2 2 2 3 1 2 2 1 1 2 2 2 1 2 2 2 1 2 2 2 2 1 2 2
## [2629] 2 3 1 1 2 2 3 3 2 2 2 2 2 2 2 2 2 2 3 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1
## [2665] 2 2 2 2 1 2 3 2 2 1 2 2 2 2 2 2 2 1 2 2 1 2 1 2 2 1 2 3 3 2 2 1 2 2 2 2
## [2701] 2 2 2 1 2 2 1 1 1 3 1 3 2 1 2 2 2 2 2 3 2 2 3 1 2 2 2 2 2 2 2 2 2 2 2 2
## [2737] 2 2 2 2 2 3 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 2 2 2 2 2 3 3 2 2
## [2773] 2 2 3 2 1 2 1 2 2 2 2 2 2 1 2 3 2 2 1 2 1 2 2 2 3 2 2 2 2 2 1 2 2 2 3 2
## [2809] 2 2 2 1 2 3 2 1 1 1 2 1 2 3 2 2 3 2 2 3 2 2 2 3 1 2 1 2 2 2 2 2 2 2 1 2
## [2845] 2 1 2 1 2 1 1 2 1 2 2 2 2 2 3 2 2 2 2 2 1 1 2 3 2 1 3 1 2 3 1 3 2 2 1 2
## [2881] 2 1 3 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 1 2 1 1 1 3 3 1 1 2 2 1 2 2
## [2917] 1 2 2 1 2 2 1 1 1 1 2 2 2 2 2 2 2 1 3 2 2 2 2 1 2 2 1 2 2 2 3 2 2 2 2 1
## [2953] 2 2 2 2 3 3 1 2 2 1 2 2 3 2 2 2 3 2 2 2 2 2 2 3 2 2 2 2 2 2 2 2 1 3 2 2
## [2989] 1 1 2 3 1 2 2 2 2 2 2 2 2 2 2 1 3 2 3 1 2 2 3 2 2 2 3 2 2 2 2 2 2 3 2 2
## [3025] 2 1 2 2 1 1 2 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 1 2 1 1 2 3 1 2 2
## [3061] 2 2 2 3 2 2 2 1 2 1 1 1 2 2 2 2 2 2 1 1 1 2 2 2 3 2 2 2 3 1 1 2 2 2 1 3
## [3097] 2 1 2 1 3 2 3 1 2 2 1 2 3 2 2 3 3 2 2 2 2 3 2 2 2 2 2 2 2 2 2 2 2 1 2 2
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## [12169] 2 2 2 1 2 1 2 2 2 1 2 2 2 1 2 1 1 2 3 1 2 2 2 2 2 2 1 1 1 2 3
##
## Within cluster sum of squares by cluster:
## [1] 1195.699 3951.143 1034.910
##  (between_SS / total_SS =  35.4 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```
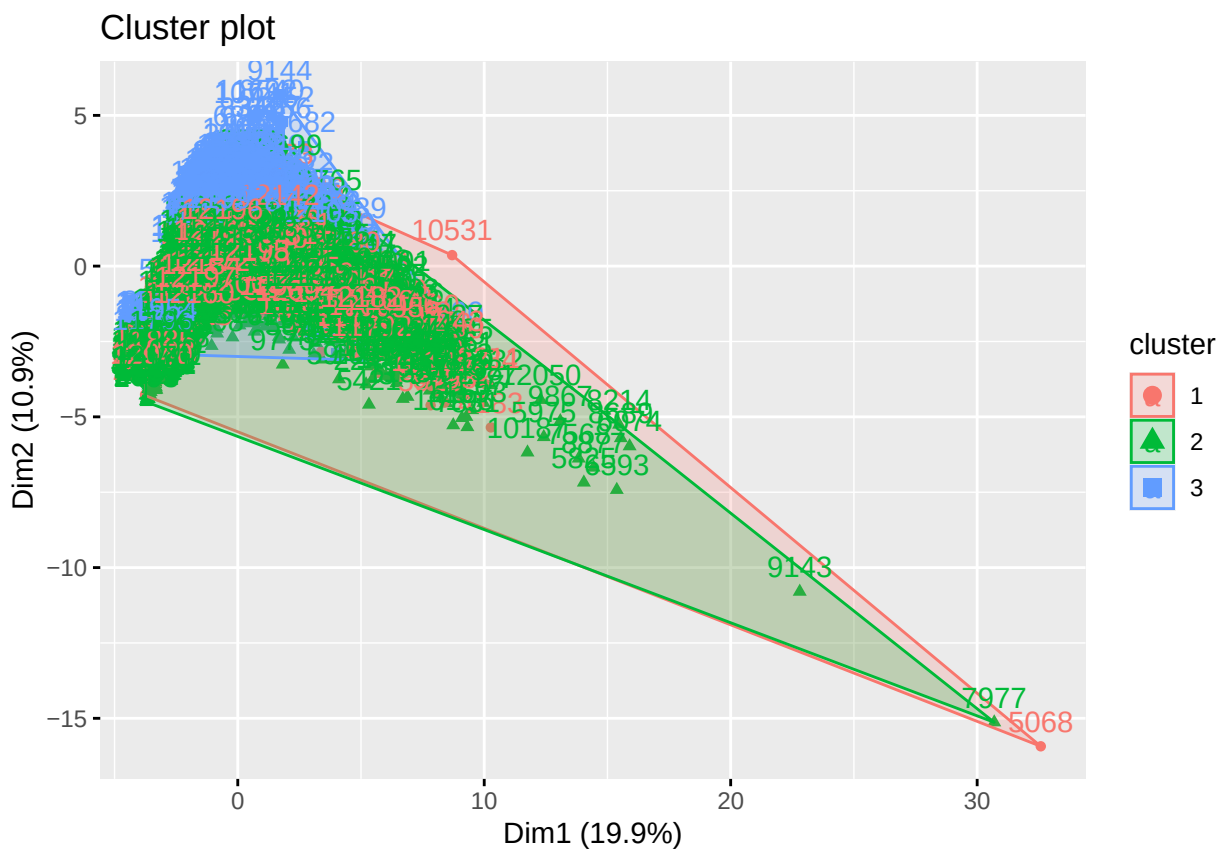

Our K grouping resulted in clusters of 3 clusters of sizes 2378, 8080, 1741

Visualizing our groupings

```
fviz_cluster(k_model, data = data_scaled)
```




```
# Cluster centers
k_model$centers
```

```
##   Administrative Administrative_Duration Informational Informational_Duration
## 1     0.09144005              0.02515692    0.02656294            0.018088068
## 2     0.08363128              0.02342200    0.02121493            0.014212104
## 3     0.09424128              0.02734497    0.01380911            0.007794699
##   ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1     0.05137460              0.02103679  0.10103667 0.2027581 0.01584685
## 2     0.04800312              0.02015531  0.11930452 0.2314727 0.01341712
## 3     0.02566960              0.01008868  0.02464266 0.1026066 0.03137828
##   SpecialDay     Month OperatingSystems   Browser    Region TrafficType
## 1 0.06341463 0.5901785        0.1619008 0.3397813 0.2641400   0.4551591
## 2 0.07066832 0.5740374        0.1585396 0.3690800 0.2632735   0.4437402
## 3 0.01964388 0.5532580        0.1685402 0.3521922 0.3033458   0.6287977
##   VisitorType   Weekend
## 1  0.99810765 1.0000000
## 2  0.99845297 0.0000000
## 3  0.01407237 0.2745549
```

Lets try to use another method of K-means

```
# Elbow method
#fviz_nbclust(data_scaled, kmeans, method = "wss") +
#  labs(subtitle = "Elbow method")
```

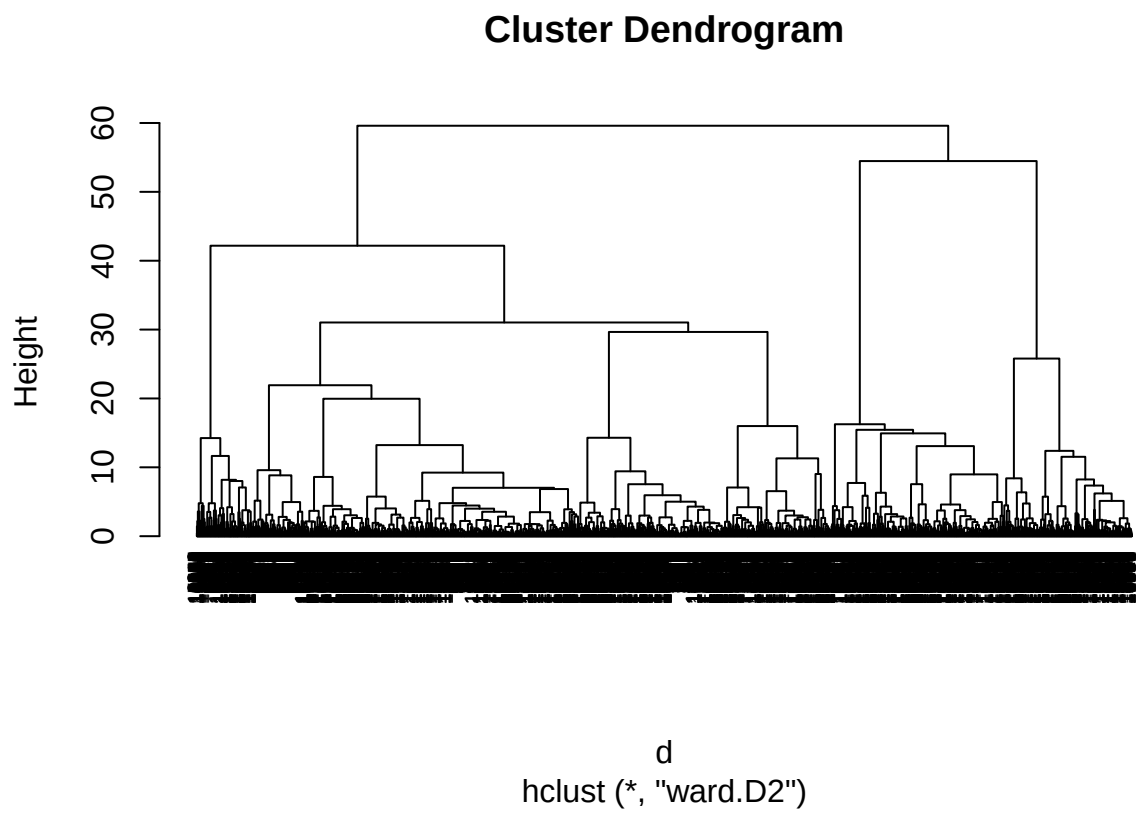
##**Hierachical Clustering**

Since have already processed our data, we will use it for this model as well

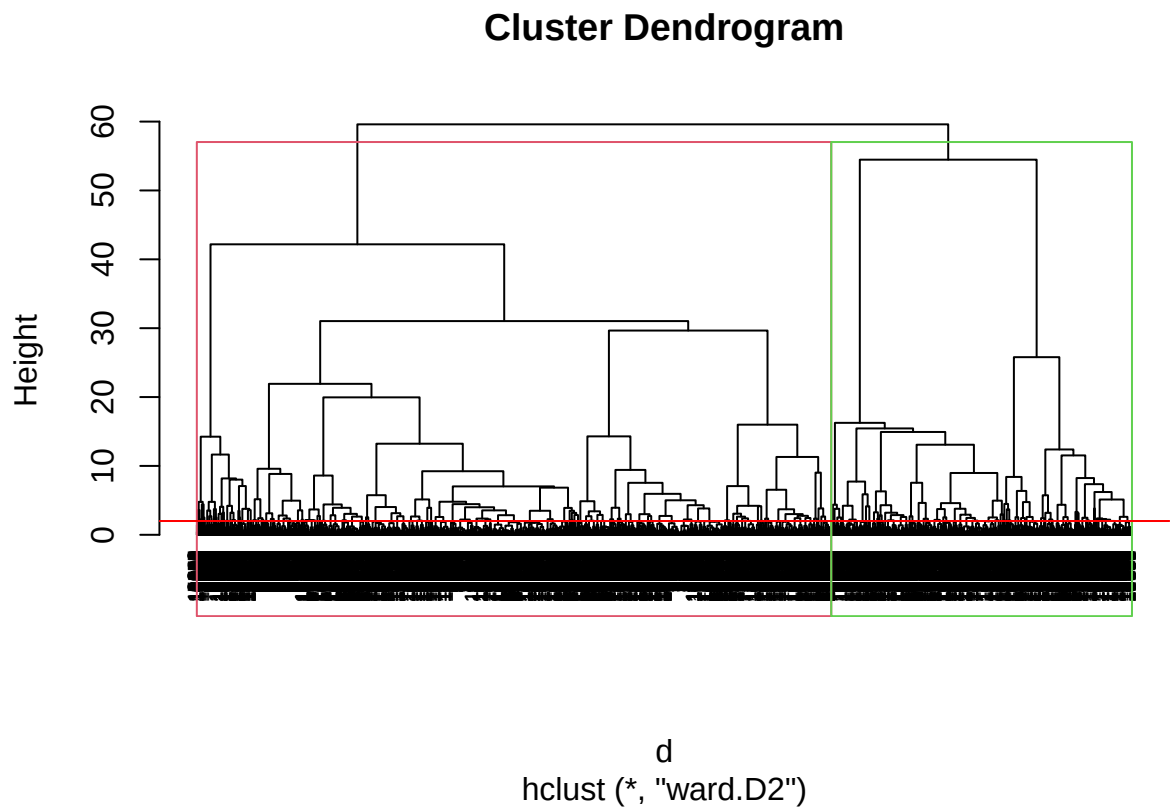
```
# First we use the dist() function to compute the Euclidean distance between observations,
# d will be the first argument in the hclust() function dissimilarity matrix
# ---
#
d <- dist(data_scaled, method = "euclidean")
```

```
# We then hierarchical clustering using the Ward's method
# ---
#
res.hc <- hclust(d, method = "ward.D2" )
```

```
# Lastly we then plot the obtained dendrogram
# ---
plot(res.hc, cex = 0.6, hang = -1)
```




```
#
plot(res.hc, cex = 0.6, hang = -1)
rect.hclust(res.hc , k = 2, border = 2:6)
abline(h = 2, col = 'red')
```



#Conclusions

We have made various insights as stated through our analysis above. Some of these insights that might be helpful to the retail are:

- The site was highly frequented in the Month of May with 27.28% followed closely by November with 24.45%. The month with the least visits was in February which has 1.49% of visitors.
- 85.46% of the visits are the from Returning Visitors with 13% being new visitors and 0.66%others.
- 53.58% of users use the Operating system denoted by 2
- 38.62% of users are from region 2 and the least from region 5 at 2.6%
- The most recurring traffic type is 2 with 32.03% followed by 1 with 19.53% and 3with 16.53%
- 65.58% of users prefer browser 2 followed by activity from browsers 1,4,6,10,8,3. The least preferred browser is browser 9 with 0.01% of users.
- 38.62% of users are from region 2 and the least from region 5 at 2.6%
- The platform activity was highest in May with majority of the visitors being returning visitors.December and November saw a lot of visits by new and other users. February had the lowest visits.
- Region 1 saw most visits by Returning visitors as well as new visitors followed by region 3
- Weekdays are the days that generate more revenue compared to weekends.

Recommendations The store should target its marketing efforts into Region 2 as that is where most of its users are based, as well as Region 1 as most Returning visitors are from the region. There are new visits to the sight especially in the months of May, December and November. This could be due to the proximity of the holidays. They should tap into the loyalty of their existing customers since they are the ones that return to the site more and maybe have some offers.

Model Differences

- Hierarchical clustering can handle any distance metric while k-means rely on euclidean distances.
- K-means requires a random step at its initialization that may yield different results if the process is re-run. That wouldn't be the case in hierarchical clustering.
- K-means is less computationally slow compared to hierarchical clustering.