Week 13

Siiren

4/4/2021

# Week 12 Independent Project

## Defining The Question

### a) Specifying the Question.

* 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.

### b) Defining the Metrics for Success.

For this study, we will perform conclusive Exploratory Data Analysis to enable answer the questions

### c) Understanding the context.

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. More specifically, they would like to learn the characteristics of customer groups.

### d) Experimental Design.

The project was undertaken using the following design Datasets(<http://bit.ly/EcommerceCustomersDataset>)

* Load dataset.
* Data Cleaning.
* Performing Exploratory Analysis.
* Modelling.
  + K-Means
  + Hierarchical
* Conclusion.

### e) Data Relevance

## Data Preparation

### Importing the Libraries

# load libraries  
library(tidyverse)

## -- Attaching packages --------------------------------------- tidyverse 1.3.0 --

## v ggplot2 3.3.3 v purrr 0.3.4  
## v tibble 3.1.0 v dplyr 1.0.5  
## v tidyr 1.1.3 v stringr 1.4.0  
## v readr 1.4.0 v forcats 0.5.1

## -- Conflicts ------------------------------------------ tidyverse\_conflicts() --  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()

library(data.table)

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

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

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

options(warn = -1)

### Loading the data

#load data  
df <- fread('http://bit.ly/EcommerceCustomersDataset')  
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

#priview the first 6 rows  
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

# Checking the class of our dataset  
class(df)

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

# Find the number of column and rows  
class(df); ncol(df); nrow(df)

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

## [1] 18

## [1] 12330

We have 18 columns and 12330 rows

#checking the first 10 rows in our dataset  
(print(head(df, n=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

## 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

#checking the bottom 10 rows in our dataset  
(print(tail(df, n=10)))

## Administrative Administrative\_Duration Informational Informational\_Duration  
## 1: 0 0.00 0 0  
## 2: 0 0.00 0 0  
## 3: 6 76.25 0 0  
## 4: 2 64.75 0 0  
## 5: 0 0.00 1 0  
## 6: 3 145.00 0 0  
## 7: 0 0.00 0 0  
## 8: 0 0.00 0 0  
## 9: 4 75.00 0 0  
## 10: 0 0.00 0 0  
## ProductRelated ProductRelated\_Duration BounceRates ExitRates PageValues  
## 1: 8 143.5833 0.014285714 0.050000000 0.00000  
## 2: 6 0.0000 0.200000000 0.200000000 0.00000  
## 3: 22 1075.2500 0.000000000 0.004166667 0.00000  
## 4: 44 1157.9762 0.000000000 0.013953488 0.00000  
## 5: 16 503.0000 0.000000000 0.037647059 0.00000  
## 6: 53 1783.7917 0.007142857 0.029030612 12.24172  
## 7: 5 465.7500 0.000000000 0.021333333 0.00000  
## 8: 6 184.2500 0.083333333 0.086666667 0.00000  
## 9: 15 346.0000 0.000000000 0.021052632 0.00000  
## 10: 3 21.2500 0.000000000 0.066666667 0.00000  
## SpecialDay Month OperatingSystems Browser Region TrafficType  
## 1: 0 Nov 2 2 3 1  
## 2: 0 Nov 1 8 4 1  
## 3: 0 Dec 2 2 4 2  
## 4: 0 Nov 2 2 1 10  
## 5: 0 Nov 2 2 1 1  
## 6: 0 Dec 4 6 1 1  
## 7: 0 Nov 3 2 1 8  
## 8: 0 Nov 3 2 1 13  
## 9: 0 Nov 2 2 3 11  
## 10: 0 Nov 3 2 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 FALSE FALSE  
## 6: Returning\_Visitor TRUE FALSE  
## 7: Returning\_Visitor TRUE FALSE  
## 8: Returning\_Visitor TRUE FALSE  
## 9: Returning\_Visitor FALSE FALSE  
## 10: New\_Visitor TRUE FALSE

## Administrative Administrative\_Duration Informational Informational\_Duration  
## 1: 0 0.00 0 0  
## 2: 0 0.00 0 0  
## 3: 6 76.25 0 0  
## 4: 2 64.75 0 0  
## 5: 0 0.00 1 0  
## 6: 3 145.00 0 0  
## 7: 0 0.00 0 0  
## 8: 0 0.00 0 0  
## 9: 4 75.00 0 0  
## 10: 0 0.00 0 0  
## ProductRelated ProductRelated\_Duration BounceRates ExitRates PageValues  
## 1: 8 143.5833 0.014285714 0.050000000 0.00000  
## 2: 6 0.0000 0.200000000 0.200000000 0.00000  
## 3: 22 1075.2500 0.000000000 0.004166667 0.00000  
## 4: 44 1157.9762 0.000000000 0.013953488 0.00000  
## 5: 16 503.0000 0.000000000 0.037647059 0.00000  
## 6: 53 1783.7917 0.007142857 0.029030612 12.24172  
## 7: 5 465.7500 0.000000000 0.021333333 0.00000  
## 8: 6 184.2500 0.083333333 0.086666667 0.00000  
## 9: 15 346.0000 0.000000000 0.021052632 0.00000  
## 10: 3 21.2500 0.000000000 0.066666667 0.00000  
## SpecialDay Month OperatingSystems Browser Region TrafficType  
## 1: 0 Nov 2 2 3 1  
## 2: 0 Nov 1 8 4 1  
## 3: 0 Dec 2 2 4 2  
## 4: 0 Nov 2 2 1 10  
## 5: 0 Nov 2 2 1 1  
## 6: 0 Dec 4 6 1 1  
## 7: 0 Nov 3 2 1 8  
## 8: 0 Nov 3 2 1 13  
## 9: 0 Nov 2 2 3 11  
## 10: 0 Nov 3 2 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 FALSE FALSE  
## 6: Returning\_Visitor TRUE FALSE  
## 7: Returning\_Visitor TRUE FALSE  
## 8: Returning\_Visitor TRUE FALSE  
## 9: Returning\_Visitor FALSE FALSE  
## 10: New\_Visitor TRUE FALSE

# Check the structure of the data   
print(str(df))

## 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>   
## NULL

The dataset is a dataframe/datatable containing 12330 observations and 18 variables. The variables has discrete and countinous values and also it has character values.

## Perform Data Cleaning

### Renaming of columns

# Changing column names to lower and replacing spaces with an underscore for readability  
colnames(df) = tolower(str\_replace\_all(colnames(df), c(' ' = '\_')))  
  
# Checking whether the column names have been renames appriopriately  
print(colnames(df))

## [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"

### Finding missing values

#   
#check missing values in each column  
colSums(is.na(df))

## administrative administrative\_duration informational   
## 14 14 14   
## informational\_duration productrelated productrelated\_duration   
## 14 14 14   
## bouncerates exitrates pagevalues   
## 14 14 0   
## specialday month operatingsystems   
## 0 0 0   
## browser region traffictype   
## 0 0 0   
## visitortype weekend revenue   
## 0 0 0

# Dropping the missing columns  
  
data<-na.omit(df)  
#check missing values in each column  
colSums(is.na(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

### Finding Duplicates values

# find the duplicated rows   
#   
anyDuplicated(df)

## [1] 159

# Now lets find the duplicated rows in the dataset data  
# ---  
#   
duplicated\_rows <- data[duplicated(data),]  
duplicated\_rows

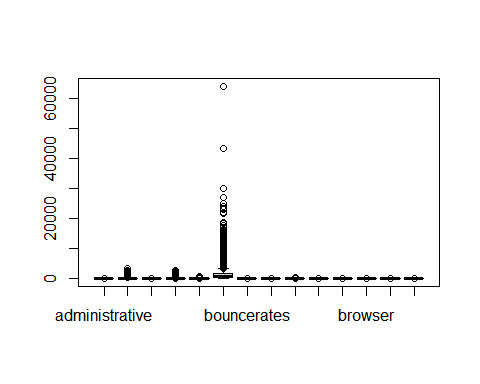
## administrative administrative\_duration informational  
## 1: 0 0 0  
## 2: 0 0 0  
## 3: 0 0 0  
## 4: 0 0 0  
## 5: 0 0 0  
## ---   
## 113: 0 0 0  
## 114: 0 0 0  
## 115: 0 0 0  
## 116: 0 0 0  
## 117: 0 0 0  
## informational\_duration productrelated productrelated\_duration bouncerates  
## 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

Will not drop duplicate they because they are not duplicate at all they have different values accros the dataset ### Finding Outliers

### Finding Outliers  
# get numerical columnns  
num <- data %>% select\_if(is.numeric)  
num

## 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 operatingsystems browser  
## 1: 0.200000000 0.20000000 0.00000 0 1 1  
## 2: 0.000000000 0.10000000 0.00000 0 2 2  
## 3: 0.200000000 0.20000000 0.00000 0 4 1  
## 4: 0.050000000 0.14000000 0.00000 0 3 2  
## 5: 0.020000000 0.05000000 0.00000 0 3 3  
## ---   
## 12312: 0.007142857 0.02903061 12.24172 0 4 6  
## 12313: 0.000000000 0.02133333 0.00000 0 3 2  
## 12314: 0.083333333 0.08666667 0.00000 0 3 2  
## 12315: 0.000000000 0.02105263 0.00000 0 2 2  
## 12316: 0.000000000 0.06666667 0.00000 0 3 2  
## region traffictype  
## 1: 1 1  
## 2: 1 2  
## 3: 9 3  
## 4: 2 4  
## 5: 1 4  
## ---   
## 12312: 1 1  
## 12313: 1 8  
## 12314: 1 13  
## 12315: 3 11  
## 12316: 1 2

#check for outliers in the numerical columns  
boxplot(num)



## Perform Exploratory Data Analysis (Univariate, Bivariate & Multivariate)

### Univariate Analysis

# checking for the dataset statistical summary  
(summary(num))

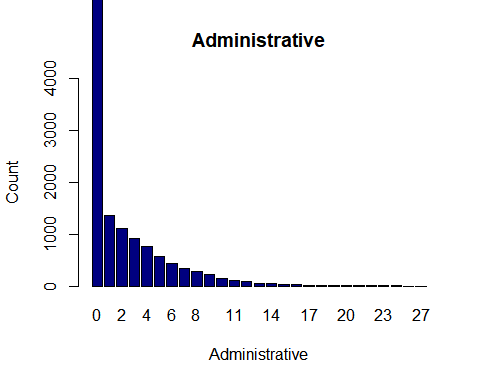
## administrative administrative\_duration informational   
## Min. : 0.000 Min. : -1.00 Min. : 0.000   
## 1st Qu.: 0.000 1st Qu.: 0.00 1st Qu.: 0.000   
## Median : 1.000 Median : 8.00 Median : 0.000   
## Mean : 2.318 Mean : 80.91 Mean : 0.504   
## 3rd Qu.: 4.000 3rd Qu.: 93.50 3rd Qu.: 0.000   
## Max. :27.000 Max. :3398.75 Max. :24.000   
## 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   
## bouncerates exitrates pagevalues specialday   
## Min. :0.000000 Min. :0.00000 Min. : 0.000 Min. :0.0000   
## 1st Qu.:0.000000 1st Qu.:0.01429 1st Qu.: 0.000 1st Qu.:0.0000   
## Median :0.003119 Median :0.02512 Median : 0.000 Median :0.0000   
## Mean :0.022152 Mean :0.04300 Mean : 5.896 Mean :0.0615   
## 3rd Qu.:0.016684 3rd Qu.:0.05000 3rd Qu.: 0.000 3rd Qu.:0.0000   
## Max. :0.200000 Max. :0.20000 Max. :361.764 Max. :1.0000   
## operatingsystems browser region traffictype   
## Min. :1.000 Min. : 1.000 Min. :1.000 Min. : 1.00   
## 1st Qu.:2.000 1st Qu.: 2.000 1st Qu.:1.000 1st Qu.: 2.00   
## Median :2.000 Median : 2.000 Median :3.000 Median : 2.00   
## Mean :2.124 Mean : 2.358 Mean :3.148 Mean : 4.07   
## 3rd Qu.:3.000 3rd Qu.: 2.000 3rd Qu.:4.000 3rd Qu.: 4.00   
## Max. :8.000 Max. :13.000 Max. :9.000 Max. :20.00

### Histogram

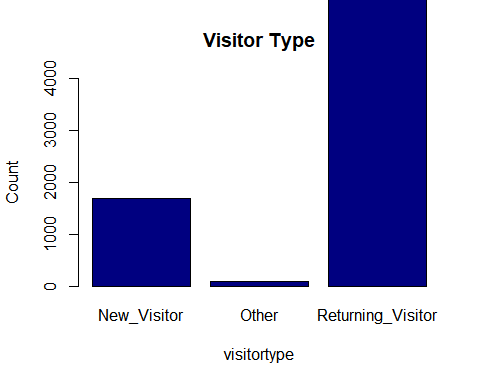
head(data)

## 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

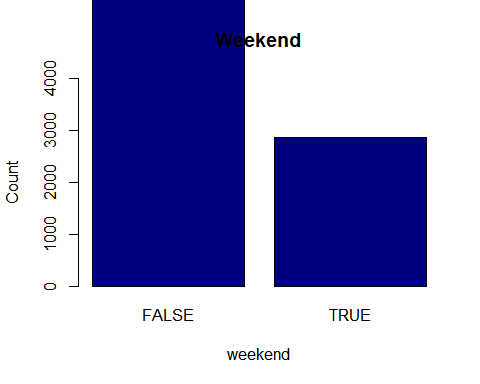
#BarChart for adminstrative col  
# x-axis values  
admin <- table(data$administrative)  
#plot the barchart  
barplot(admin, col = "navyblue", xlab='Administrative' , ylab ='Count' ,  
ylim=c(0, 4000), main = 'Administrative' )



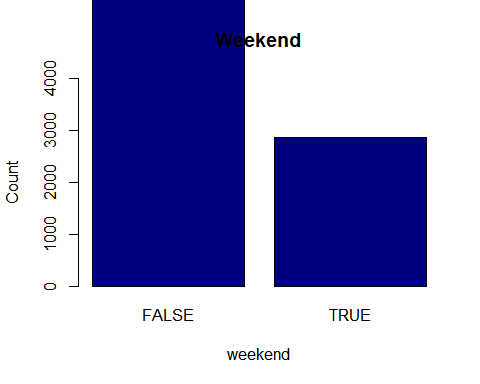
#BarChart for adminstrative col  
# x-axis values  
admin <- table(data$visitortype)  
#plot the barchart  
barplot(admin, col = "navyblue", xlab='visitortype' , ylab ='Count' ,  
ylim=c(0, 4000), main = 'Visitor Type' )



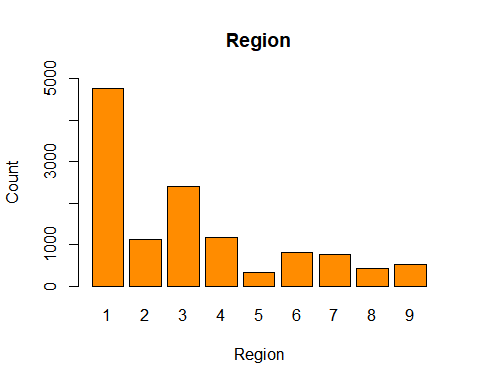
#BarChart for adminstrative col  
# x-axis values  
admin <- table(data$weekend)  
#plot the barchart  
barplot(admin, col = "navyblue", xlab='weekend' , ylab ='Count' ,  
ylim=c(0, 4000), main = 'Weekend' )



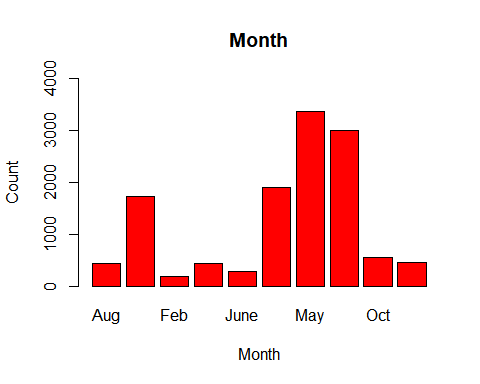
#BarChart for adminstrative col  
# x-axis values  
admin <- table(data$weekend)  
#plot the barchart  
barplot(admin, col = "navyblue", xlab='weekend' , ylab ='Count' ,  
ylim=c(0, 4000), main = 'Weekend' )



#BarChart for product browser col  
# x-axis values  
region <- table(data$region)  
#plot  
barplot(region, col = "darkorange", xlab='Region' , ylab ='Count' , ylim=c(0, 5000),  
main = 'Region' )



#BarChart for month col  
# x-axis values  
month <- table(data$month)  
#plot  
barplot(month, col = "red", xlab='Month' , ylab ='Count' , ylim=c(0, 4000), main  
= 'Month' )



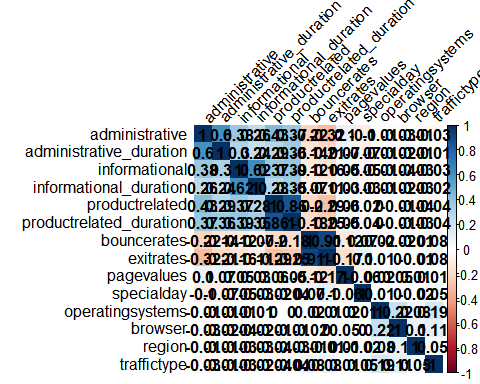
## Bivariate and Multivariate Analysis.

### Correlation

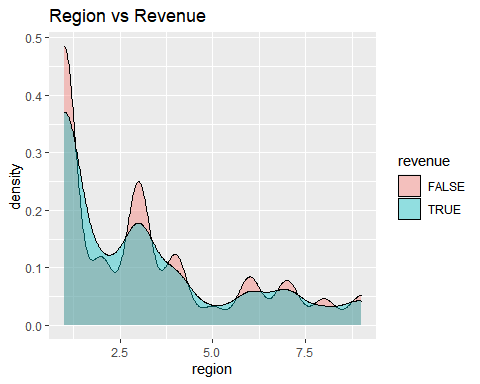
library(corrplot)

## corrplot 0.84 loaded

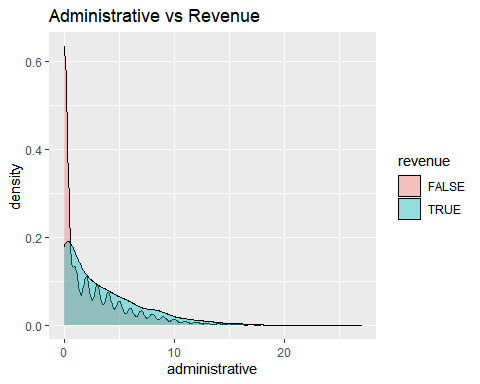
#Get the correlation matrix  
res = cor(num)  
#Plotting a correlation plot  
  
corrplot(res, method="color",addCoef.col = "black",   
 tl.col="black", tl.srt=45)



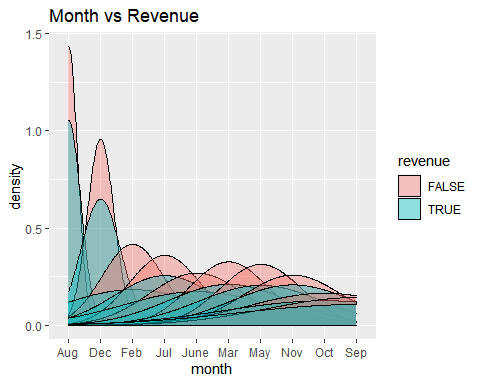
#Income class and it's relationship to clicking an ad  
ggplot(data,   
 aes(x = region,   
 fill = revenue)) +  
 geom\_density(alpha = 0.4) +  
 labs(title = "Region vs Revenue")



#Income class and it's relationship to clicking an ad  
ggplot(data,   
 aes(x = administrative,   
 fill = revenue)) +  
 geom\_density(alpha = 0.4) +  
 labs(title = "Administrative vs Revenue")



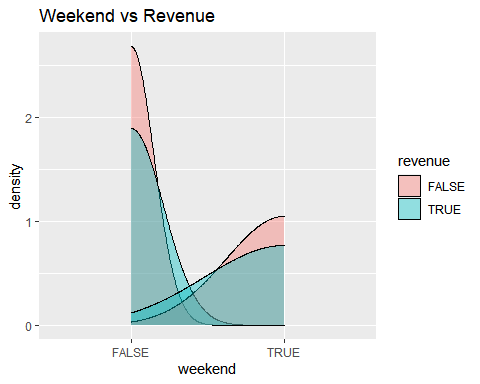
#Income class and it's relationship to clicking an ad  
ggplot(data,   
 aes(x = month,   
 fill = revenue)) +  
 geom\_density(alpha = 0.4) +  
 labs(title = "Month vs Revenue")



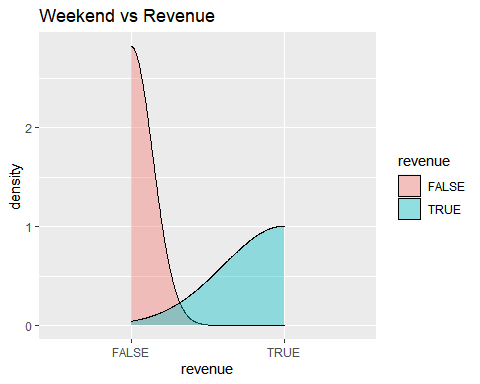
print(colnames(df))

## [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"

#Income class and it's relationship to clicking an ad  
ggplot(data,   
 aes(x = weekend,   
 fill = revenue)) +  
 geom\_density(alpha = 0.4) +  
 labs(title = "Weekend vs Revenue")



#Income class and it's relationship to clicking an ad  
ggplot(data,   
 aes(x = revenue,   
 fill = revenue)) +  
 geom\_density(alpha = 0.4) +  
 labs(title = "Weekend vs Revenue")



## Implement the Solution

### K-Means Clustering

#revenue encoding  
#data$revenue <- ifelse(data$revenue == "TRUE",1,0)  
  
#table(data$revenue)

# Creating the cluster dataframe and the class dataframe  
df\_cluster<-data[, c(1:17)]  
df\_class<- data[, "revenue"]  
data.class<- data[, "revenue"]  
# Previewing the cluster dataframe  
head(df\_cluster)

## 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  
## 1: Returning\_Visitor FALSE  
## 2: Returning\_Visitor FALSE  
## 3: Returning\_Visitor FALSE  
## 4: Returning\_Visitor FALSE  
## 5: Returning\_Visitor TRUE  
## 6: Returning\_Visitor FALSE

head(data.class)

## revenue  
## 1: FALSE  
## 2: FALSE  
## 3: FALSE  
## 4: FALSE  
## 5: FALSE  
## 6: FALSE

#revenue encoding  
df\_cluster$month <- ifelse(df\_cluster$month == "TRUE",1,0)  
  
df\_cluster$visitortype <- ifelse(df\_cluster$visitortype == "TRUE",1,0)  
  
df\_cluster$weekend <- ifelse(df\_cluster$weekend == "TRUE",1,0)  
  
df\_cluster

## 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 0 1  
## 2: 0.000000000 0.10000000 0.00000 0 0 2  
## 3: 0.200000000 0.20000000 0.00000 0 0 4  
## 4: 0.050000000 0.14000000 0.00000 0 0 3  
## 5: 0.020000000 0.05000000 0.00000 0 0 3  
## ---   
## 12312: 0.007142857 0.02903061 12.24172 0 0 4  
## 12313: 0.000000000 0.02133333 0.00000 0 0 3  
## 12314: 0.083333333 0.08666667 0.00000 0 0 3  
## 12315: 0.000000000 0.02105263 0.00000 0 0 2  
## 12316: 0.000000000 0.06666667 0.00000 0 0 3  
## browser region traffictype visitortype weekend  
## 1: 1 1 1 0 0  
## 2: 2 1 2 0 0  
## 3: 1 9 3 0 0  
## 4: 2 2 4 0 0  
## 5: 3 1 4 0 1  
## ---   
## 12312: 6 1 1 0 1  
## 12313: 2 1 8 0 1  
## 12314: 2 1 13 0 1  
## 12315: 2 3 11 0 0  
## 12316: 2 1 2 0 1

# Encoding with onehotencoding  
#library(caret)  
  
#dmy <- dummyVars(" ~ .", data = df\_cluster, fullRank = T)  
#dat\_transformed <- data.frame(predict(dmy, newdata = df\_cluster))  
  
#glimpse(dat\_transformed)

#Scaling the data  
my\_data\_Norm <- as.data.frame(scale(num))  
head(my\_data\_Norm)

## administrative administrative\_duration informational informational\_duration  
## 1 -0.6975533 -0.4574578 -0.3966145 -0.2450294  
## 2 -0.6975533 -0.4574578 -0.3966145 -0.2450294  
## 3 -0.6975533 -0.4631119 -0.3966145 -0.2521304  
## 4 -0.6975533 -0.4574578 -0.3966145 -0.2450294  
## 5 -0.6975533 -0.4574578 -0.3966145 -0.2450294  
## 6 -0.6975533 -0.4574578 -0.3966145 -0.2450294  
## productrelated productrelated\_duration bouncerates exitrates pagevalues  
## 1 -0.6914734 -0.6247671 3.67247746 3.2352400 -0.3173633  
## 2 -0.6689966 -0.5913358 -0.45743910 1.1745443 -0.3173633  
## 3 -0.6914734 -0.6252895 3.67247746 3.2352400 -0.3173633  
## 4 -0.6689966 -0.6233742 0.57504004 1.9988226 -0.3173633  
## 5 -0.4891823 -0.2969835 -0.04444744 0.1441964 -0.3173633  
## 6 -0.2868911 -0.5442099 -0.13139305 -0.3800157 -0.3173633  
## specialday operatingsystems browser region traffictype  
## 1 -0.309001 -1.2332048 -0.7901988 -0.8941841 -0.76292777  
## 2 -0.309001 -0.1361914 -0.2081361 -0.8941841 -0.51445574  
## 3 -0.309001 2.0578354 -0.7901988 2.4360812 -0.26598370  
## 4 -0.309001 0.9608220 -0.2081361 -0.4779009 -0.01751167  
## 5 -0.309001 0.9608220 0.3739266 -0.8941841 -0.01751167  
## 6 -0.309001 -0.1361914 -0.2081361 -0.8941841 -0.26598370

# Applying the K-means clustering algorithm with no. of centroids(k)=2  
# ---  
#   
result<- kmeans(my\_data\_Norm,2)   
  
# Previewing the no. of records in each cluster  
#   
result$size

## [1] 1872 10444

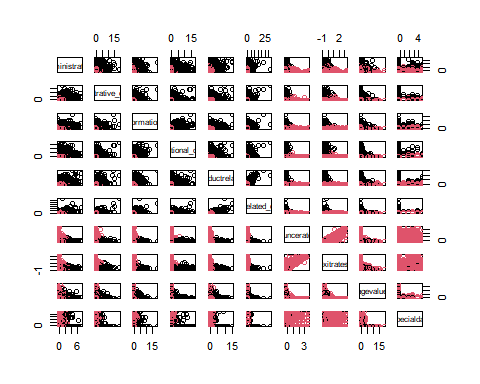
# Getting the value of cluster center datapoint value(3 centers for k=3)  
# ---  
#   
result$centers

## administrative administrative\_duration informational informational\_duration  
## 1 1.473279 1.2104337 1.4203040 1.0989109  
## 2 -0.264073 -0.2169602 -0.2545777 -0.1969706  
## productrelated productrelated\_duration bouncerates exitrates pagevalues  
## 1 1.3490517 1.2575001 -0.33005478 -0.49111411 0.21292357  
## 2 -0.2418063 -0.2253964 0.05915957 0.08802811 -0.03816478  
## specialday operatingsystems browser region traffictype  
## 1 -0.1629861 -0.017817108 -0.08096534 -0.06940082 -0.11480334  
## 2 0.0292139 0.003193568 0.01451236 0.01243952 0.02057754

# Getting the cluster vector that shows the cluster where each record falls  
# ---  
#   
result$cluster

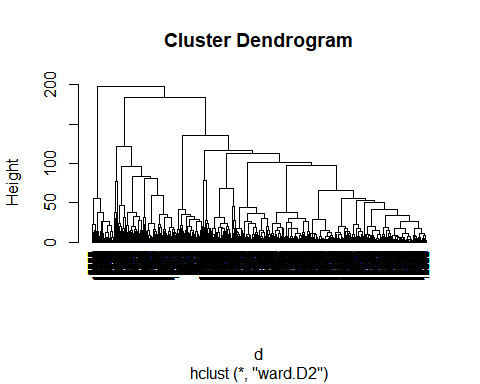
## [1] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [37] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 1 2 2 2 2 2  
## [73] 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [109] 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [145] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [181] 2 2 2 2 1 2 2 1 1 2 2 1 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [217] 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 2 1 2 1 2 2 2 2 2 2 2 1 2 2 2 2 1 2 2 2  
## [253] 2 2 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 2 2 2 1 2 2 2 2 2  
## [289] 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2  
## [325] 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2  
## [361] 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2  
## [397] 2 2 2 1 2 2 1 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2  
## [433] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [469] 2 2 2 2 2 2 2 2 2 1 1 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  
## [505] 2 2 2 2 2 2 1 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2  
## [541] 2 2 2 2 1 2 2 2 2 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 1  
## [577] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1  
## [613] 1 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 2 2 2 2 2  
## [649] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [685] 2 2 2 2 2 1 2 2 2 2 1 2 1 2 1 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [721] 2 2 1 2 2 2 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 2  
## [757] 2 2 2 2 1 2 2 2 2 2 2 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  
## [793] 2 2 2 2 1 2 2 1 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 2 2 2  
## [829] 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 1 2 2 2 2 1 2 1 2 2 2 2 2 2 2 2  
## [865] 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2  
## [901] 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2 2 1 2 1 2 2 2 2 2 1 1 2 2 2 2 2 1 1 2 2 2  
## [937] 2 2 2 2 2 2 2 2 1 2 2 2 1 2 2 2 1 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2  
## [973] 2 2 2 2 2 2 2 1 2 2 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  
## [1009] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 1 1 2 2 2 1 2 2  
## [1045] 2 2 2 2 2 2 2 1 2 2 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  
## [1081] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 2 1 2 2 2 2 2 2 2 2 2 2 2  
## [1117] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2  
## [1153] 2 2 2 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 2  
## [1189] 2 2 2 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2  
## [1225] 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [1261] 2 2 2 2 2 2 1 1 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [1297] 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [1333] 2 1 2 2 1 2 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 2 2 2 2  
## [1369] 2 2 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 2 2 2 2 2 2 2 2 2  
## [1405] 2 2 2 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 2 2 2 2  
## [1441] 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 2 2 2 2  
## [1477] 2 2 2 2 2 2 1 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 2 2 1 2 2  
## [1513] 2 2 2 2 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 2 2 2 1 2 1 2  
## [1549] 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 2 2 2 2 2 2 2 2  
## [1585] 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 2 2 2 2 2 2 2 2 2 1  
## [1621] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 1 2 2 2 2 2 1 2 1 2 2 2 2 2 2 2 2 2 1 2  
## [1657] 1 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [1693] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2  
## [1729] 2 2 2 2 2 1 2 2 2 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 1  
## [1765] 2 2 2 2 2 2 2 2 1 2 2 2 1 2 2 1 2 2 2 1 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 1  
## [1801] 2 2 2 2 2 1 2 2 2 2 2 2 1 1 2 2 1 2 2 2 2 2 2 1 2 2 2 1 2 2 2 2 2 2 2 2  
## [1837] 1 2 2 2 2 1 2 2 2 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [1873] 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 2 1 2 2 2 2 2 2 2 2 1 2 2 2 2  
## [1909] 2 1 2 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 2 2 2 2  
## [1945] 2 2 2 1 2 2 2 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 1 1  
## [1981] 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 1 2 1 1 1 2 2 1 1 2 2 2 2 2 2 2 2 2  
## [2017] 2 2 2 2 1 2 2 2 2 2 2 1 1 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1  
## [2053] 2 2 2 2 2 1 1 2 1 2 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 2  
## [2089] 2 2 1 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2  
## [2125] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [2161] 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2  
## [2197] 2 2 2 2 1 1 2 1 2 2 1 2 2 2 2 2 2 2 1 2 2 1 2 2 2 1 2 2 2 1 2 2 2 2 2 2  
## [2233] 2 2 1 2 1 2 2 2 2 1 1 1 2 2 1 2 2 1 2 2 2 2 2 2 2 2 2 2 1 2 1 2 1 2 2 2  
## [2269] 2 2 2 1 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2  
## [2305] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [2341] 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [2377] 1 2 2 2 2 2 2 2 1 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2 2  
## [2413] 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 1 1 2 2 2 2 1 2 2 2 2 2 1 2 2 2  
## [2449] 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 1 2 1 2 2 2 2 2 1 2 1 2 2 2 2 2 2 2 2 2 2  
## [2485] 2 2 2 2 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  
## [2521] 2 2 2 2 2 1 1 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 1 2 2 1 2 2 2 1  
## [2557] 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 1 2 2 2 2 2  
## [2593] 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 2 1 2 2 2 2 2 2 1 2 2 2 1 2 2 2  
## [2629] 2 2 2 2 1 2 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2  
## [2665] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1 2 2  
## [2701] 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 1 2 2  
## [2737] 2 2 2 2 2 2 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 1 2 2 2  
## [2773] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1  
## [2809] 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 1 2  
## [2845] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2  
## [2881] 2 2 2 2 2 2 2 2 1 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [2917] 2 2 2 2 2 2 2 2 2 1 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  
## [2953] 2 1 1 1 1 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 2 2 2  
## [2989] 2 2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 2 1 2 1 2 1 2 2 2 2 2 1 2 2 2 2 2 2 2 2  
## [3025] 2 1 2 2 2 2 2 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  
## [3061] 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 1 1 2 1 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2  
## [3097] 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2  
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# Visualizing the clustering results  
# ---  
#   
par(mfrow = c(1,2), mar = c(5,4,2,2))  
  
# Plotting to see how Ozone and Solar.R data points have been distributed in clusters  
# ---  
#  
plot(my\_data\_Norm[,1:10], col = result$cluster)

 ### Hierarchical Clustering

# We now use the R function hclust() for hierarchical clustering  
# ---  
#   
  
# 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(my\_data\_Norm, method = "euclidean")  
  
# We then hierarchical clustering using the Ward's method  
# ---  
#   
res.hc <- hclust(d, method = "ward.D2" )

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



## Conclusion

In conclusion, we were able to come up with the characteristics of customers who generated revenue and those who didn’t for the brand. Additionally using K-means we were able to segment those both groups into 2 base on the charesteristics.