

Customer Segmentation Analysis

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1. Defining the Question

a) **Specifying the Question** Creating models using K-Means and Hierarchical to create clusters according to customers segmentation

b) **Defining the Metric for Success** The model will be appraised successful if it will be able to cluster the customer segmentation clearly/best.

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) Recording the Experimental Design

The following are the experimental design i took in order to complete this project:

- 1.Importing all the necessary libraries
- 2>Loading the dataset
- 3.Reading, cleaning the dataset
- 4.Performing Exploratory Data Analysis
- 5.Performing data modelling using K-Means and Hierachical clustering
- 6.Giving conclusions and recommendations.

e) Reading the Data

```
library(magrittr)
library(dplyr)

## 
## Attaching package: 'dplyr'

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

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

```

shop <- read.csv("http://bit.ly/EcommerceCustomersDataset")
head(shop)

##   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             0.0000000  0.2000000  0.2000000          0
## 2              2            64.0000000  0.0000000  0.1000000          0
## 3              1            -1.0000000  0.2000000  0.2000000          0
## 4              2             2.6666667  0.0500000  0.1400000          0
## 5             10            627.500000  0.0200000  0.0500000          0
## 6             19            154.2166667 0.01578947 0.0245614          0
##   SpecialDay Month OperatingSystems Browser Region TrafficType
## 1          0    Feb           Mac OS X     Safari       1
## 2          0    Feb           Mac OS X     Safari       2
## 3          0    Feb           Mac OS X     Safari       3
## 4          0    Feb           Mac OS X     Safari       4
## 5          0    Feb           Mac OS X     Safari       4
## 6          0    Feb           Mac OS X     Safari       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

```

f) Checking the Data

```

#previewing tail of dataset
tail(shop)

##   Administrative Administrative_Duration Informational
## 12325          0                  0          1
## 12326          3                 145          0
## 12327          0                  0          0
## 12328          0                  0          0
## 12329          4                  75          0
## 12330          0                  0          0
##   Informational_Duration ProductRelated ProductRelated_Duration BounceRates
## 12325                  0                 16      503.000 0.0000000000
## 12326                  0                 53     1783.792 0.007142857
## 12327                  0                  5      465.750 0.0000000000
## 12328                  0                  6      184.250 0.0833333333
## 12329                  0                 15      346.000 0.0000000000
## 12330                  0                  3      21.250 0.0000000000
##   ExitRates PageValues SpecialDay Month OperatingSystems Browser Region

```

```

## 12325 0.03764706 0.00000 0 Nov 2 2 1
## 12326 0.02903061 12.24172 0 Dec 4 6 1
## 12327 0.02133333 0.00000 0 Nov 3 2 1
## 12328 0.08666667 0.00000 0 Nov 3 2 1
## 12329 0.02105263 0.00000 0 Nov 2 2 3
## 12330 0.06666667 0.00000 0 Nov 3 2 1
## TrafficType VisitorType Weekend Revenue
## 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

```

```
#previewing the shape of the dataset
dim(shop)
```

```
## [1] 12330 18
```

The dataset contains 12330 rows and 18 columns

```
#previewing the descriptive statistics of dataset
summary(shop)
```

```

## Administrative Administrative_Duration Informational
## Min. : 0.000 Min. : -1.00 Min. : 0.000
## 1st Qu.: 0.000 1st Qu.: 0.00 1st Qu.: 0.000
## Median : 1.000 Median : 8.00 Median : 0.000
## Mean : 2.318 Mean : 80.91 Mean : 0.504
## 3rd Qu.: 4.000 3rd Qu.: 93.50 3rd Qu.: 0.000
## Max. : 27.000 Max. : 3398.75 Max. : 24.000
## NA's : 14 NA's : 14 NA's : 14
## Informational_Duration ProductRelated ProductRelated_Duration
## Min. : -1.00 Min. : 0.00 Min. : -1.0
## 1st Qu.: 0.00 1st Qu.: 7.00 1st Qu.: 185.0
## Median : 0.00 Median : 18.00 Median : 599.8
## Mean : 34.51 Mean : 31.76 Mean : 1196.0
## 3rd Qu.: 0.00 3rd Qu.: 38.00 3rd Qu.: 1466.5
## Max. : 2549.38 Max. : 705.00 Max. : 63973.5
## NA's : 14 NA's : 14 NA's : 14
## BounceRates ExitRates PageValues SpecialDay
## Min. : 0.000000 Min. : 0.00000 Min. : 0.000 Min. : 0.000000
## 1st Qu.: 0.000000 1st Qu.: 0.01429 1st Qu.: 0.000 1st Qu.: 0.000000
## Median : 0.003119 Median : 0.02512 Median : 0.000 Median : 0.000000
## Mean : 0.022152 Mean : 0.04300 Mean : 5.889 Mean : 0.06143
## 3rd Qu.: 0.016684 3rd Qu.: 0.05000 3rd Qu.: 0.000 3rd Qu.: 0.000000
## Max. : 0.200000 Max. : 0.20000 Max. : 361.764 Max. : 1.000000
## NA's : 14 NA's : 14 NA's : 14
## Month OperatingSystems Browser Region
## Length:12330 Min. : 1.000 Min. : 1.000 Min. : 1.000
## Class :character 1st Qu.: 2.000 1st Qu.: 2.000 1st Qu.: 1.000
## Mode :character Median : 2.000 Median : 2.000 Median : 3.000
## Mean : 2.124 Mean : 2.357 Mean : 3.147

```

```

##          3rd Qu.:3.000   3rd Qu.: 2.000   3rd Qu.:4.000
##          Max.    :8.000   Max.    :13.000   Max.    :9.000
##
##  TrafficType  VisitorType      Weekend       Revenue
##  Min.    : 1.00  Length:12330      Mode :logical  Mode :logical
##  1st Qu.: 2.00  Class :character  FALSE:9462    FALSE:10422
##  Median  : 2.00  Mode  :character  TRUE :2868    TRUE :1908
##  Mean   : 4.07
##  3rd Qu.: 4.00
##  Max.   :20.00
##

```

#checking the datatypes of the columns

```

sapply(shop, class)

##      Administrative Administrative_Duration      Informational
##      "integer"           "numeric"           "integer"
##  Informational_Duration ProductRelated ProductRelated_Duration
##      "numeric"           "integer"           "numeric"
##      BounceRates        ExitRates        PageValues
##      "numeric"           "numeric"           "numeric"
##      SpecialDay         Month        OperatingSystems
##      "numeric"           "character"        "integer"
##      Browser            Region        TrafficType
##      "integer"           "integer"           "integer"
##      VisitorType        Weekend       Revenue
##      "character"        "logical"           "logical"

```

information about the dataset

```

str(shop)

## '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 ...

```

```
#checking for percentage of any null values
colMeans(is.na(shop)) *100
```

```
##          Administrative Administrative_Duration      Informational
##          0.1135442           0.1135442           0.1135442
##  Informational_Duration      ProductRelated ProductRelated_Duration
##          0.1135442           0.1135442           0.1135442
##          BounceRates          ExitRates          PageValues
##          0.1135442           0.1135442           0.0000000
##          SpecialDay           Month           OperatingSystems
##          0.0000000           0.0000000           0.0000000
##          Browser              Region           TrafficType
##          0.0000000           0.0000000           0.0000000
##          VisitorType          Weekend          Revenue
##          0.0000000           0.0000000           0.0000000
```

There are a number of missing values in some columns which will be solved during data cleaning

```
#checking for duplicate values
anyDuplicated(shop)
```

```
## [1] 159
```

There are 159 duplicates in the dataset

g) Data Cleaning

```
# dropping duplicates
```

```
shop = shop[!duplicated(shop), ]
```

```
anyDuplicated(shop)
```

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

```
#fill the null values with mean
shop = shop %>%
```

```
  mutate(Administrative = replace(Administrative, is.na(Administrative), mean(Administrative, na.rm=TRUE))
  mutate(Administrative_Duration = replace(Administrative_Duration, is.na(Administrative_Duration), mean(Administrative_Duration, na.rm=TRUE))
  mutate(Informational = replace(Informational, is.na(Informational), mean(Informational, na.rm=TRUE))
  mutate(Informational_Duration = replace(Informational_Duration, is.na(Informational_Duration), mean(Informational_Duration, na.rm=TRUE))
  mutate(ProductRelated = replace(ProductRelated, is.na(ProductRelated), mean(ProductRelated, na.rm=TRUE))
  mutate(ProductRelated_Duration = replace(ProductRelated_Duration, is.na(ProductRelated_Duration), mean(ProductRelated_Duration, na.rm=TRUE))
  mutate(BounceRates = replace(BounceRates, is.na(BounceRates), mean(BounceRates, na.rm=TRUE)))%>%
  mutate(ExitRates = replace(ExitRates, is.na(ExitRates), mean(ExitRates, na.rm=TRUE)))
```

```
colSums(is.na(shop))
```

```

##      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

```

```
#checking for percentage of any null values
colMeans(is.na(shop)) *100
```

```

##      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

```

```
#checking numerical cols
num_cols <- unlist(lapply(shop, is.numeric))
num_cols
```

```

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

```

```
#displaying the numerical columns
df_num <- shop[, num_cols]
head(df_num, 5)
```

```

##      Administrative Administrative_Duration Informational Informational_Duration
## 1                  0                      0                      0                      0

```

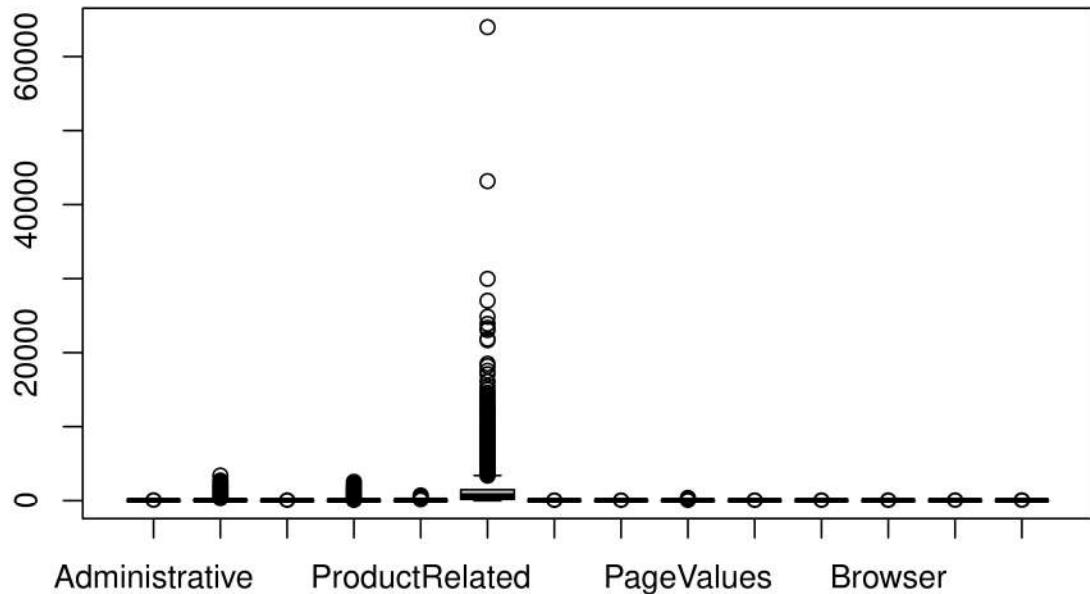
```

## 2          0          0          0          0
## 3          0         -1          0         -1
## 4          0          0          0          0
## 5          0          0          0          0
##   ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1              1             0.000000     0.20      0.20      0
## 2              2            64.000000     0.00      0.10      0
## 3              1            -1.000000     0.20      0.20      0
## 4              2            2.666667     0.05      0.14      0
## 5             10            627.500000     0.02      0.05      0
##   SpecialDay OperatingSystems Browser Region TrafficType
## 1          0                 1       1       1       1
## 2          0                 2       2       1       2
## 3          0                 4       1       9       3
## 4          0                 3       2       2       4
## 5          0                 3       3       1       4

outlier <- function(x){
  out <- boxplot.stats(x)$out
  return((length(out)/ 12330)*100)
}

#visualizing the outliers
boxplot(df_num)

```



there are a number of outliers in the dataset but will not be removed since they are neccesary for our analysis

h) Exploratory Data Analysis Univariate Analysis

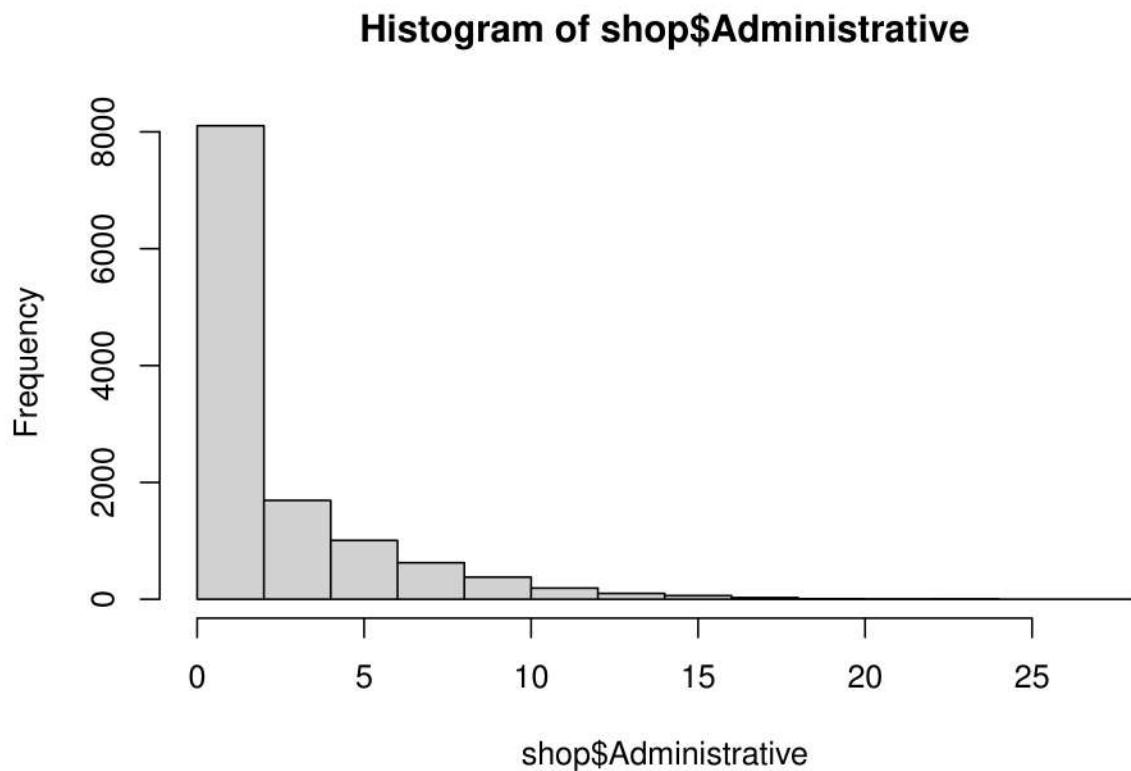
```
# describing our columns

psych::describe(shop)

## Warning in FUN(newX[, i], ...): no non-missing arguments to min; returning Inf
## Warning in FUN(newX[, i], ...): no non-missing arguments to min; returning Inf
## Warning in FUN(newX[, i], ...): no non-missing arguments to max; returning -Inf
## Warning in FUN(newX[, i], ...): no non-missing arguments to max; returning -Inf

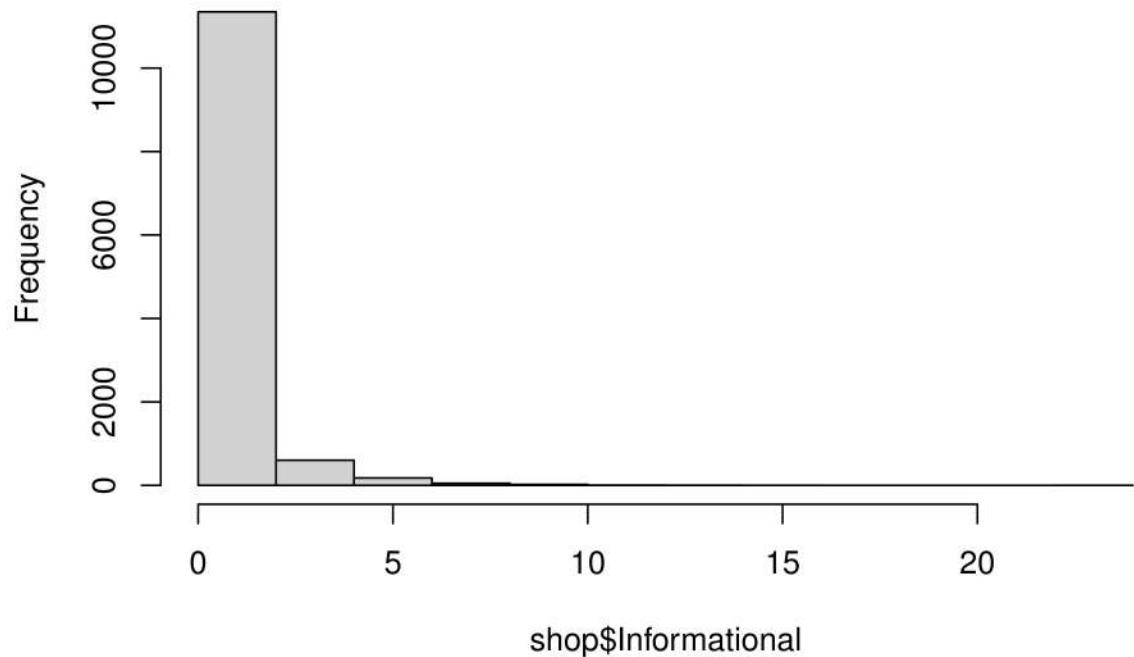
##          vars     n    mean      sd median trimmed    mad min
## Administrative       1 12211    2.34    3.33    1.00    1.66   1.48   0
## Administrative_Duration 2 12211  81.68 177.44    9.00   42.89  13.34  -1
## Informational        3 12211    0.51    1.28    0.00    0.18   0.00   0
## Informational_Duration 4 12211  34.84 141.39    0.00    3.75   0.00  -1
## ProductRelated        5 12211   32.06   44.58   18.00   23.06  19.27   0
## ProductRelated_Duration 6 12211 1207.51 1918.98  611.00  832.56 747.53  -1
## BounceRates           7 12211    0.02    0.05    0.00    0.01   0.00   0
## ExitRates              8 12211    0.04    0.05    0.03    0.03   0.02   0
## PageValues             9 12211    5.95   18.65    0.00    1.33   0.00   0
## SpecialDay            10 12211    0.06    0.20    0.00    0.00   0.00   0
## Month*                 11 12211    6.17    2.37    7.00    6.36   1.48   1
## OperatingSystems       12 12211    2.12    0.91    2.00    2.06   0.00   1
## Browser                13 12211    2.36    1.71    2.00    2.00   0.00   1
## Region                  14 12211    3.15    2.40    3.00    2.79   2.97   1
## TrafficType            15 12211    4.07    4.02    2.00    3.22   1.48   1
## VisitorType*           16 12211    2.72    0.69    3.00    2.90   0.00   1
## Weekend                 17 12211    NaN     NA     NA     NA     NA Inf
## Revenue                 18 12211    NaN     NA     NA     NA     NA Inf
##                      max    range   skew kurtosis     se
## Administrative         27.00  27.00  1.95    4.64  0.03
## Administrative_Duration 3398.75 3399.75  5.59   50.14  1.61
## Informational          24.00  24.00  4.01   26.67  0.01
## Informational_Duration 2549.38 2550.38  7.54   75.53  1.28
## ProductRelated          705.00 705.00  4.33   31.08  0.40
## ProductRelated_Duration 63973.52 63974.52  7.25  136.71 17.37
## BounceRates             0.20   0.20  3.15    9.27  0.00
## ExitRates               0.20   0.20  2.23    4.63  0.00
## PageValues              361.76 361.76  6.35   64.99  0.17
## SpecialDay              1.00   1.00  3.29    9.80  0.00
## Month*                  10.00  9.00 -0.83   -0.37  0.02
## OperatingSystems         8.00   7.00  2.03   10.27  0.01
## Browser                  13.00 12.00  3.22   12.54  0.02
## Region                   9.00   8.00  0.98   -0.16  0.02
## TrafficType              20.00 19.00  1.96    3.46  0.04
## VisitorType*              3.00   2.00 -2.05   2.24  0.01
## Weekend                  -Inf   -Inf   NA     NA     NA
## Revenue                  -Inf   -Inf   NA     NA     NA
```

```
hist(shop$Administrative)
```



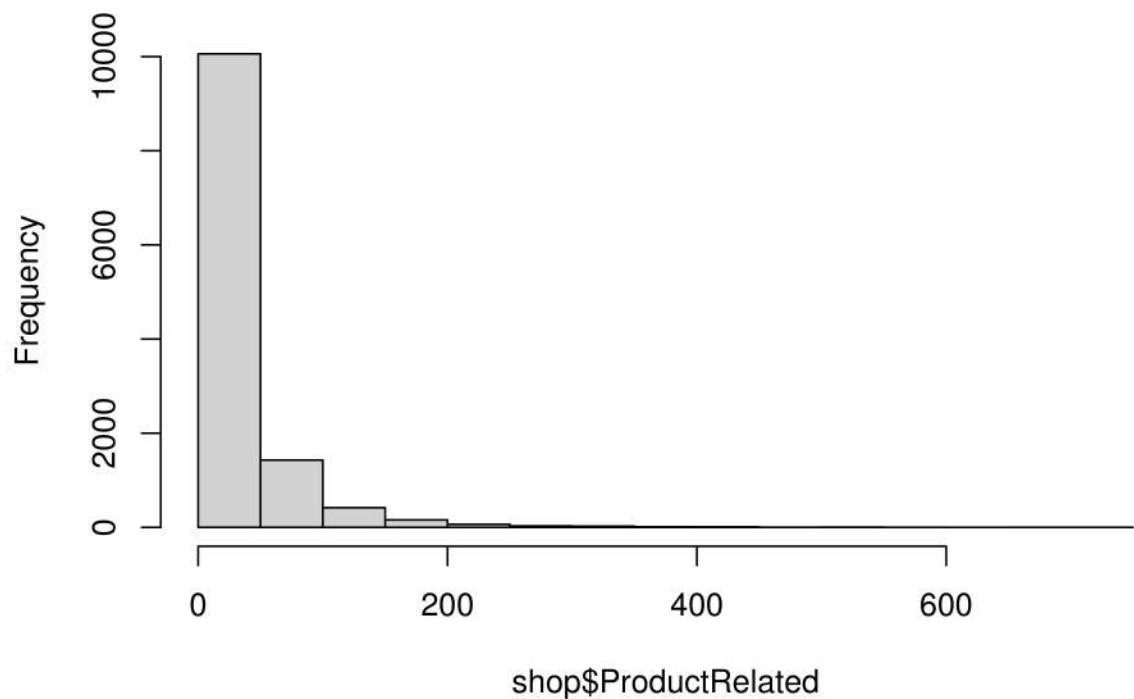
```
hist(shop$Informational)
```

Histogram of shop\$Informational



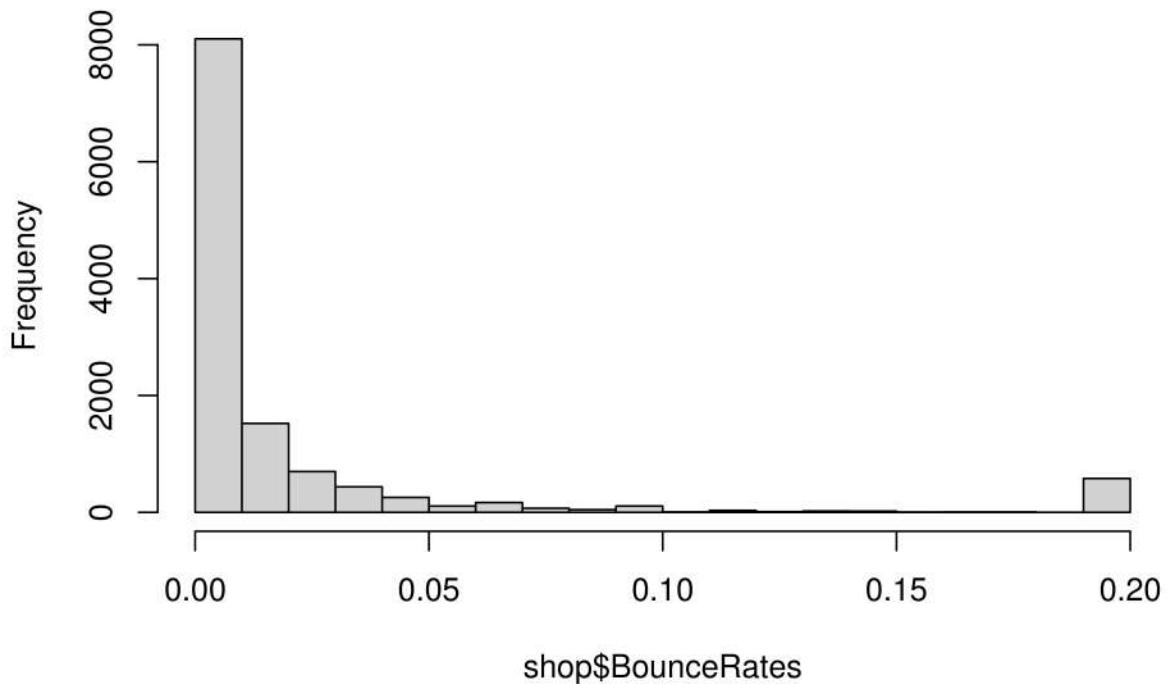
```
hist(shop$ProductRelated)
```

Histogram of shop\$ProductRelated



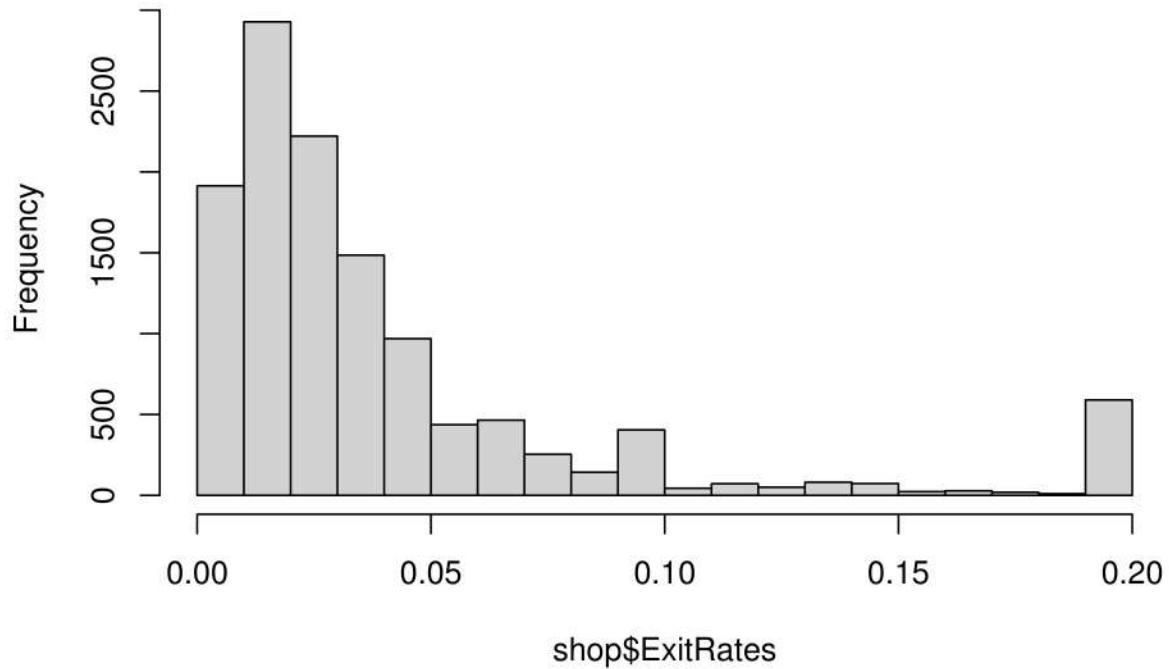
```
hist(shop$BounceRates)
```

Histogram of shop\$BounceRates



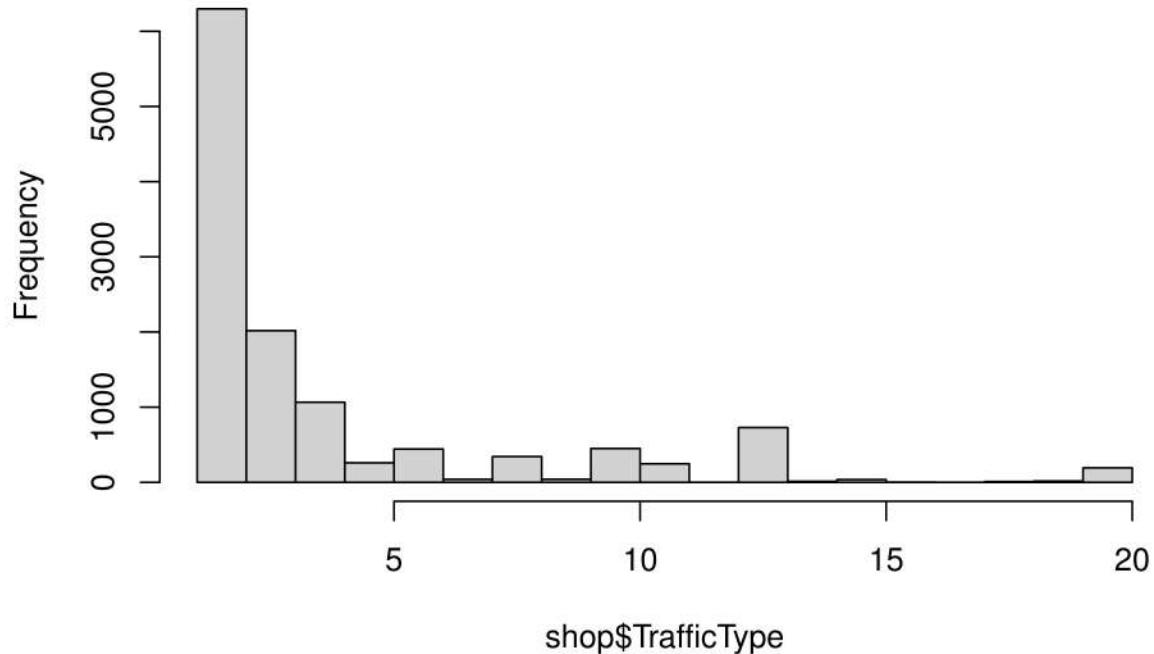
```
hist(shop$ExitRates)
```

Histogram of shop\$ExitRates



```
hist(shop$TrafficType)
```

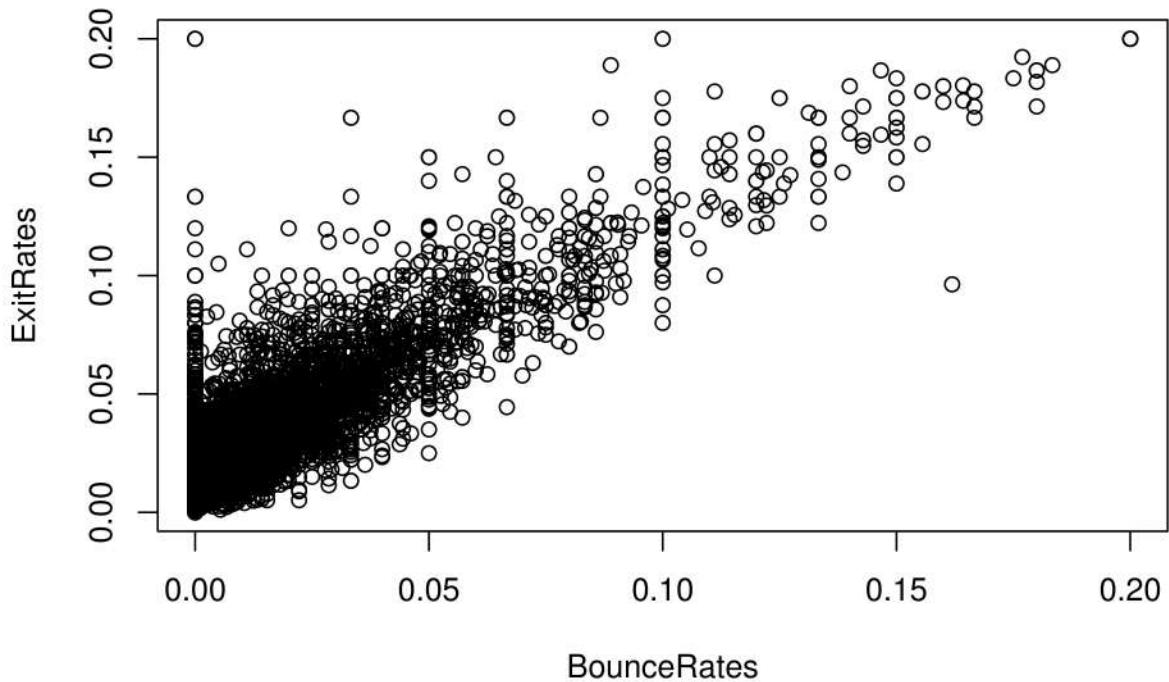
Histogram of shop\$TrafficType



Bivariate analysis

```
# Plotting a scatter plot using the plot() method  
  
plot(ExitRates ~ BounceRates, data = shop,  
     col = "black",  
     main = "Bounce vs Exit Rates")
```

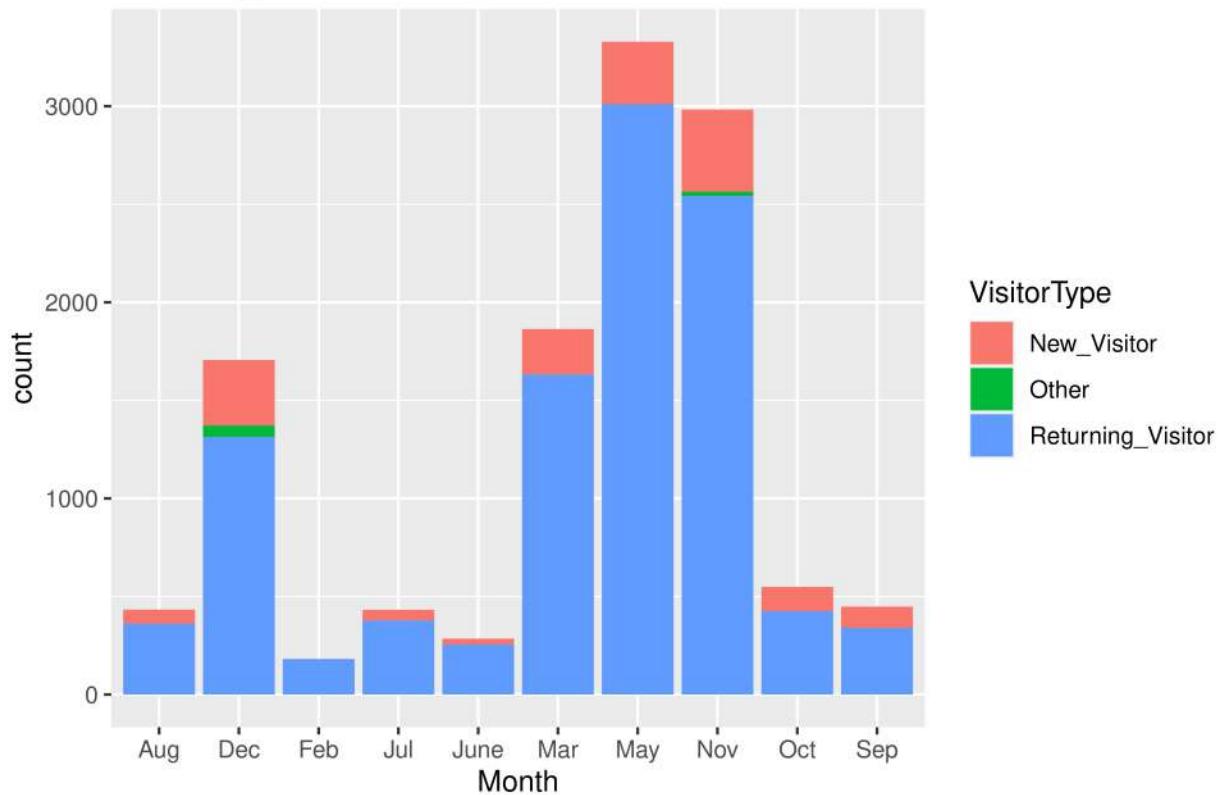
Bounce vs Exit Rates



There is a high correlation between the two variables

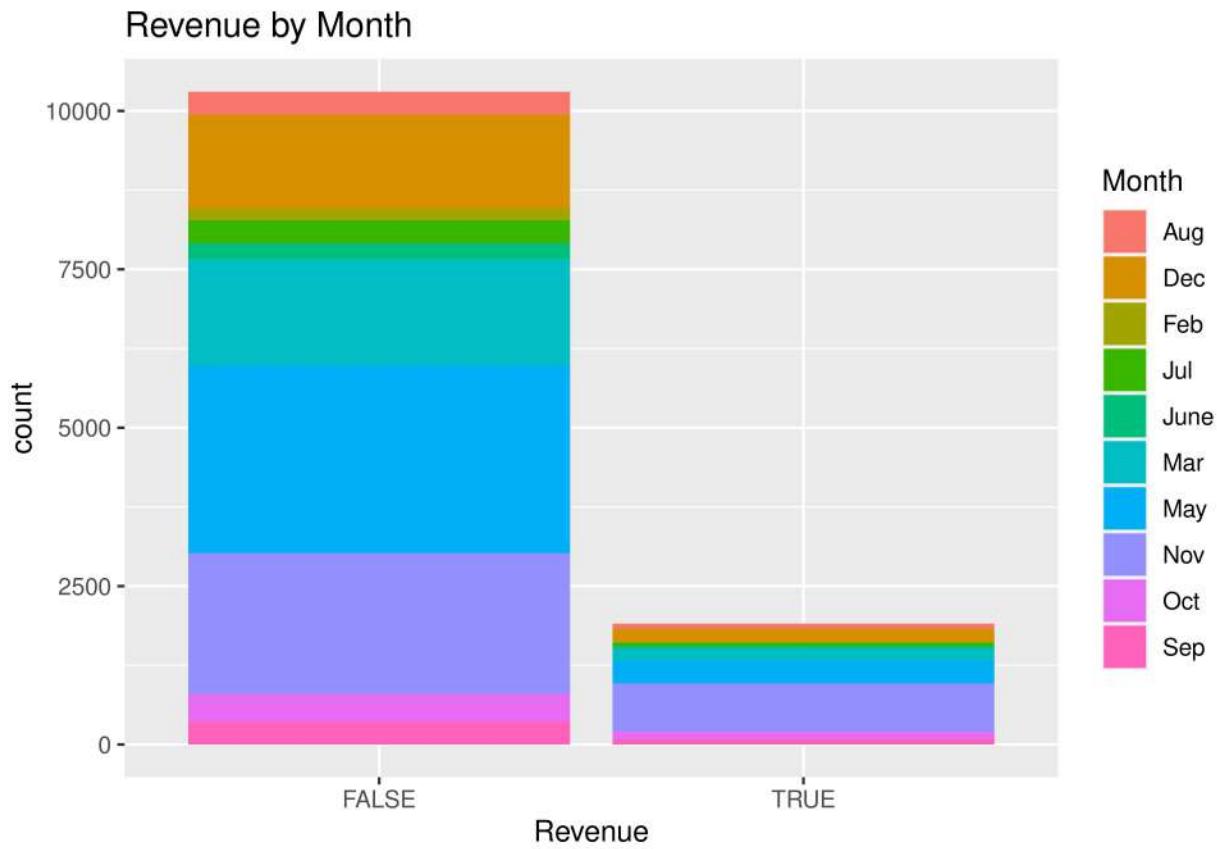
```
library(ggplot2)
shop %>%
  ggplot(aes(Month)) +
  geom_bar(aes(fill = VisitorType))+
  labs(title = "Visitor Type vs Month")
```

Visitor Type vs Month



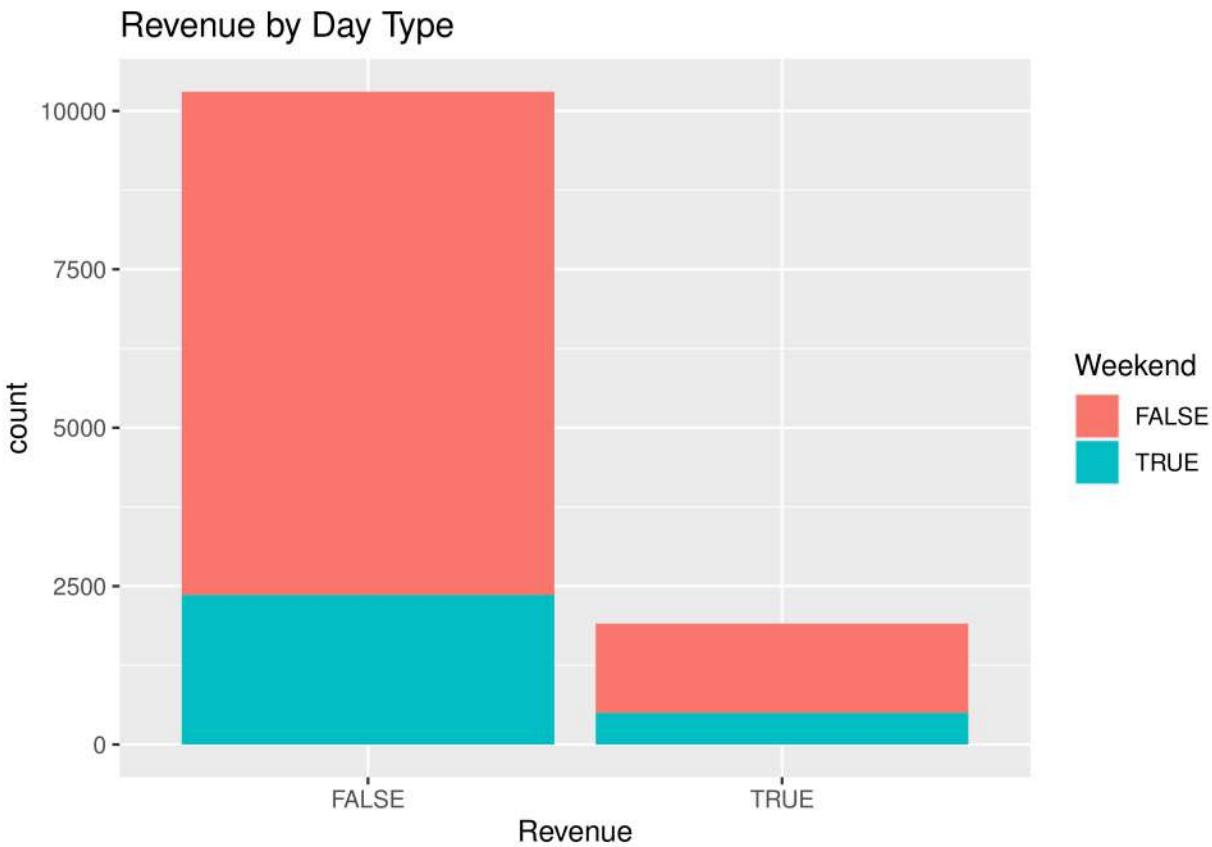
the months of May, November, March, and December have the highest number of visitors especially the new ones. February and June have the least no of visitors

```
#Revenue vs Month
shop %>%
  ggplot(aes(Revenue)) +
  geom_bar(aes(fill = Month))+
  labs(title = "Revenue by Month")
```



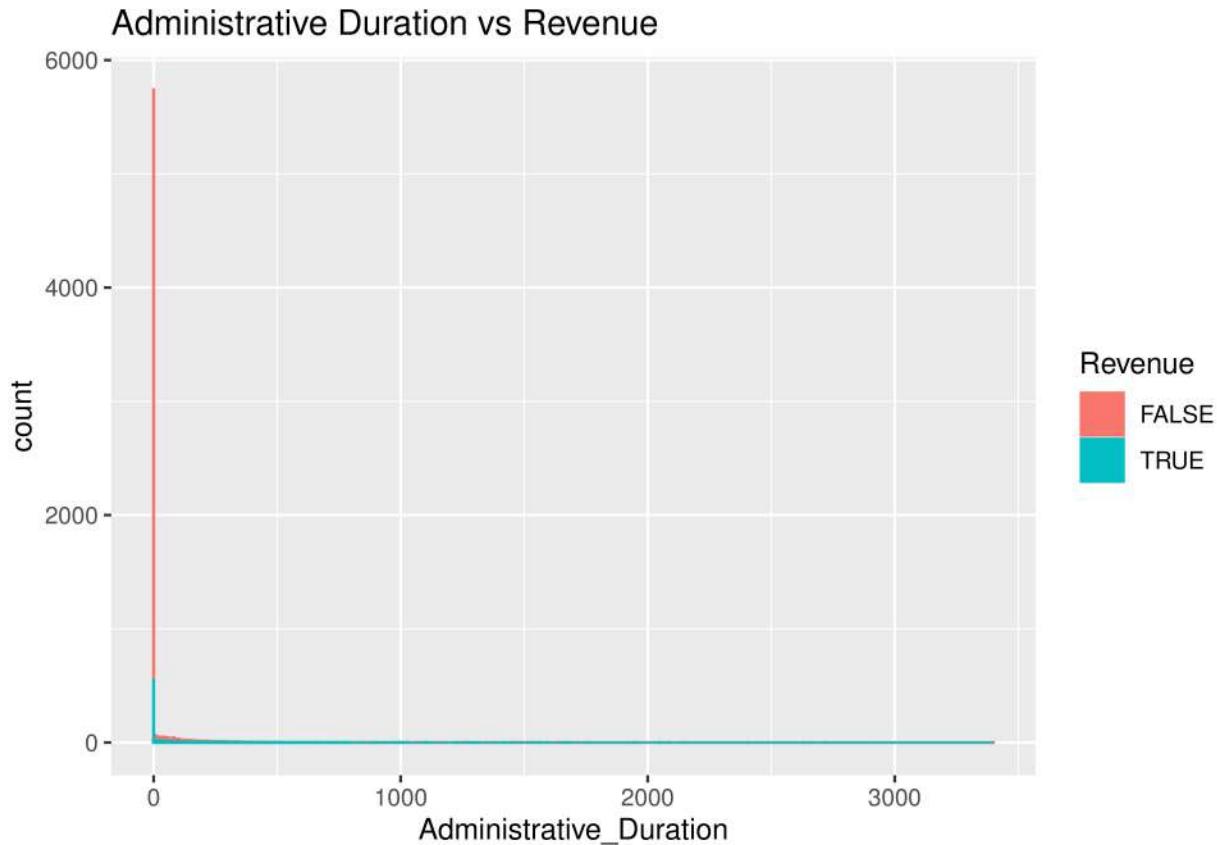
the months of May, November, March have the highest amount of revenue collected

```
#Revenue vs Day Type
shop %>%
  ggplot(aes(Revenue)) +
  geom_bar(aes(fill = Weekend))+
  labs(title = "Revenue by Day Type")
```



From the output, most revenue was collected during weekdays

```
ggplot(shop, aes(x = Administrative_Duration, fill = Revenue, color = Revenue)) +  
  geom_histogram(binwidth = 1) +  
  labs(title = "Administrative Duration vs Revenue")
```



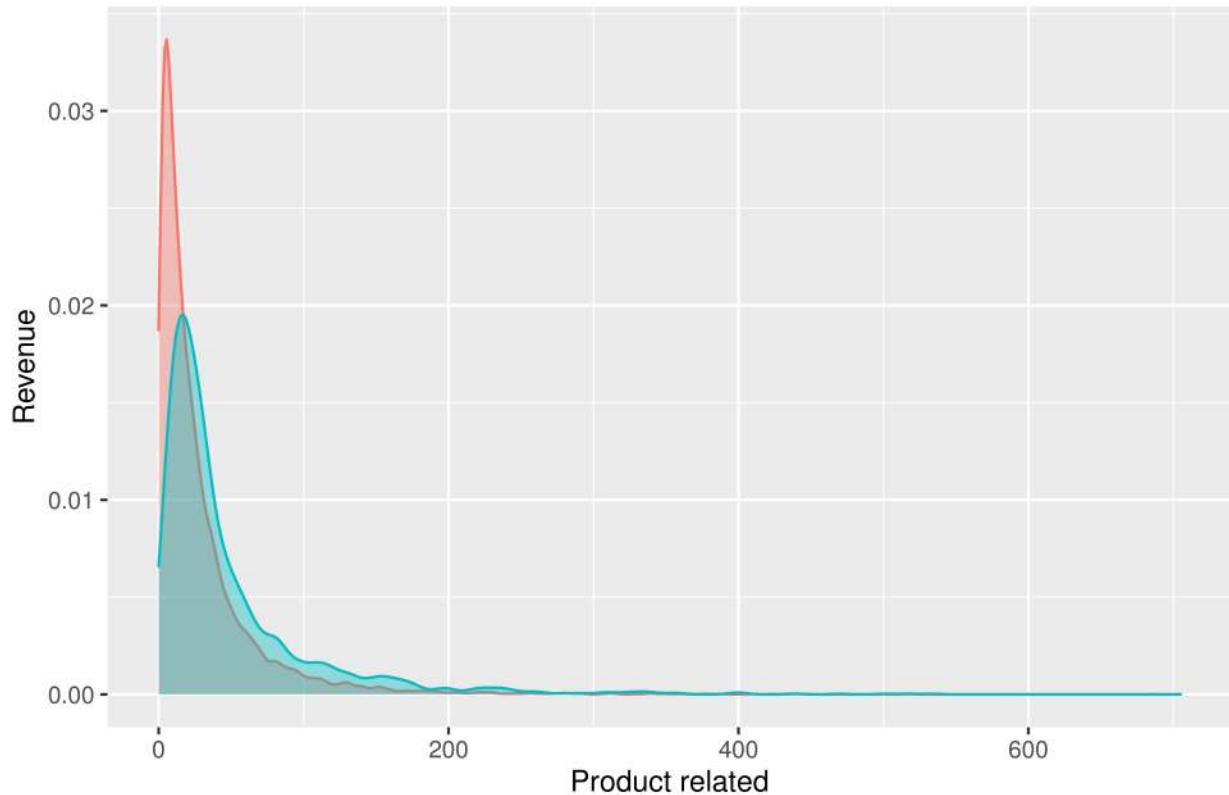
```
head(shop,1)
```

```
##   Administrative Administrative_Duration Informational Informational_Duration
## 1           0                  0           0                  0
##   ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1           1                  0           0.2      0.2       0
##   SpecialDay Month OperatingSystems Browser Region TrafficType
## 1           0     Feb          OperatingSystems  Browser  Region TrafficType
##   VisitorType Weekend Revenue
## 1 Returning_Visitor FALSE  FALSE
```

There is no much relationship between revenue and admin duration

```
ggplot(shop, aes(ProductRelated, col = Revenue)) +
  geom_density(aes(fill = Revenue), alpha = 0.4) +
  labs(x = 'Product related', y = 'Revenue', title = 'Product related vs revenue') +
  theme(legend.position = 'none',
        plot.title = element_text(size = 12))
```

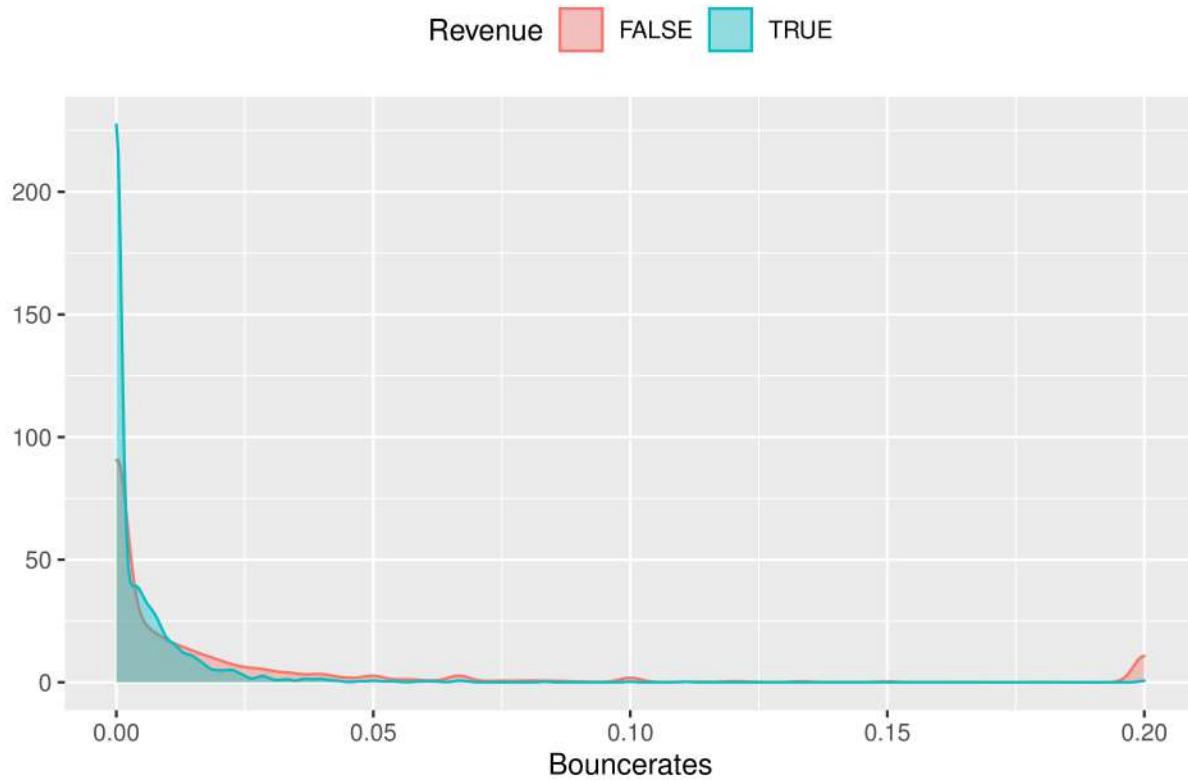
Product related vs revenue



Revenue is still low even when product related increases

```
ggplot(shop, aes(BounceRates, col = Revenue)) +  
  geom_density(aes(fill = Revenue), alpha = 0.4) +  
  labs(x = 'Bouncerates', y = '', title = 'Bounce rate vs Revenue') +  
  theme(legend.position = 'top')
```

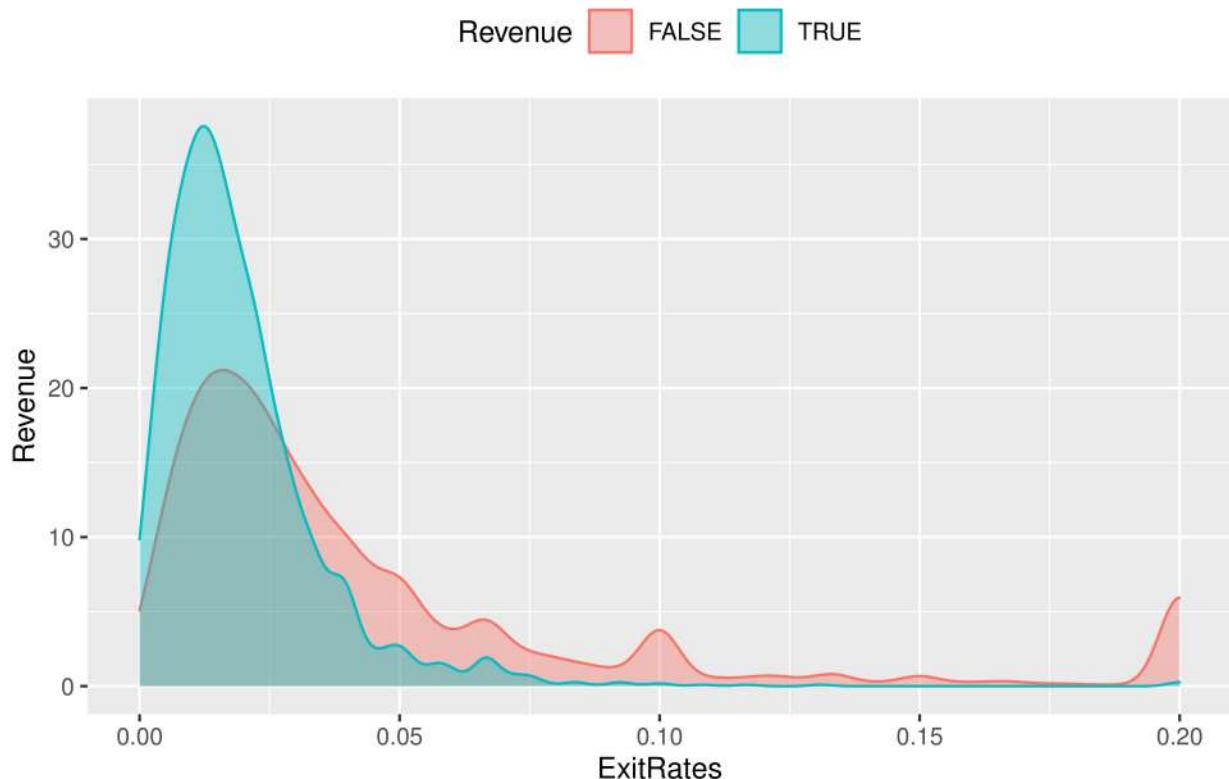
Bounce rate vs Revenue



false revenue is increased by the bounce rates extremely as compared to the true revenue

```
ggplot(shop, aes(ExitRates, col = Revenue)) +  
  geom_density(aes(fill = Revenue), alpha = 0.4) +  
  labs(x = 'ExitRates', y = 'Revenue', title = 'Exit rate vs revenue') +  
  theme(legend.position = 'top',  
        plot.title = element_text(size = 12))
```

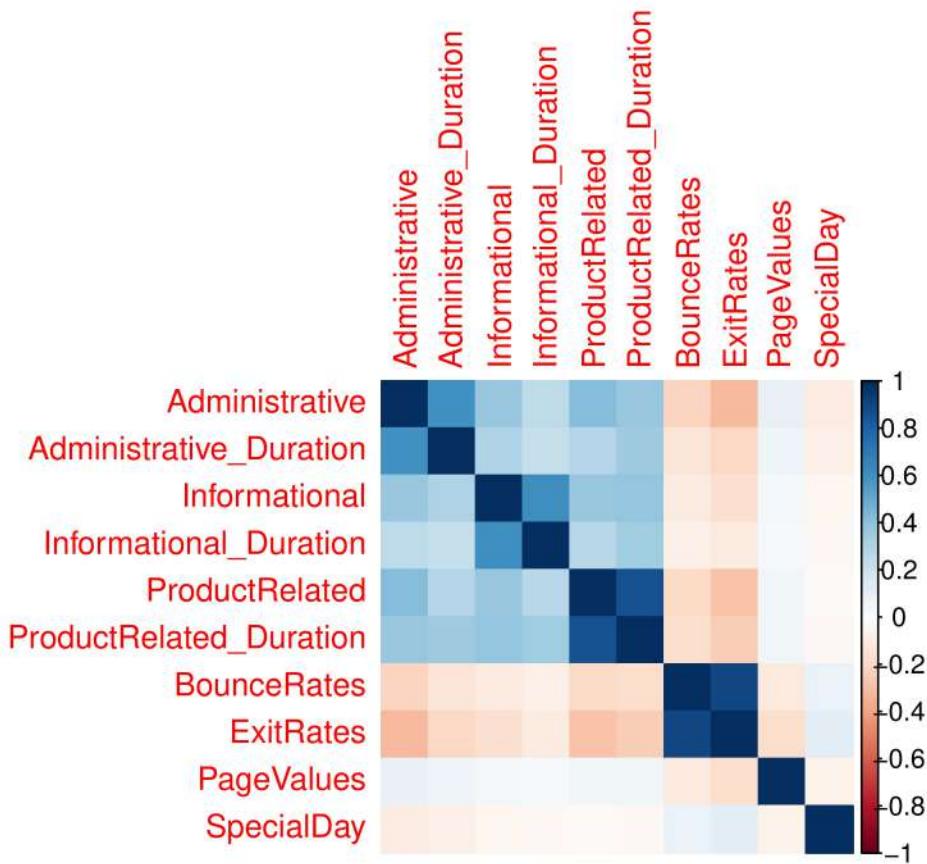
Exit rate vs revenue



true revenue is increased extremely as compared to the false revenue by the exit rate variable

```
#checking for correlation of the data and visualizing data  
library("corrplot")
```

```
## corrplot 0.92 loaded  
  
correlation <- cor(shop[,1:10])  
corrplot(correlation, method="color")
```



There is a high correlation among administrative ,informational, informational duration, product related, product duration, bounce rates and exit rates variables

Implementing the solution kmeans clustering

```
# converting the columns to numerical datatype
facttt = c(gsub('VisitorType', 'Weekend', 'Region', 'TrafficType',"OperatingSystems", "Browser"))

for (i in facttt){
  shop[,i] = as.numeric(shop[,i])
}

factdata<- shop[, c(1,2,3,4,5,6,7,8,9,10,12,13,14,15,17)]
shop.class<- shop[, "Revenue"]
head(factdata)

##   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                  0.0000000  0.2000000  0.2000000      0
## 2            2                  64.0000000 0.00000000 0.1000000      0
```

```

## 3          1           -1.000000  0.2000000  0.2000000      0
## 4          2            2.666667  0.0500000  0.1400000      0
## 5         10           627.500000  0.0200000  0.0500000      0
## 6         19           154.216667  0.01578947 0.0245614      0
##   SpecialDay OperatingSystems Browser Region TrafficType Weekend
## 1          0              1          1          1           1 FALSE
## 2          0              2          2          1           2 FALSE
## 3          0              4          1          9           3 FALSE
## 4          0              3          2          2           4 FALSE
## 5          0              3          3          1           4 TRUE
## 6          0              2          2          1           3 FALSE

# Normalizing the data
normalize <- function(x){
  return ((x-min(x)) / (max(x)-min(x)))
}

num = c(1,2,3,4,5,6,7,8,9,10)
for (i in num){
  factdata[,i] = normalize(factdata[,i])
}

head(factdata)

##   Administrative Administrative_Duration Informational Informational_Duration
## 1          0             0.0002941393          0           0.0003920992
## 2          0             0.0002941393          0           0.0003920992
## 3          0             0.0000000000          0           0.0000000000
## 4          0             0.0002941393          0           0.0003920992
## 5          0             0.0002941393          0           0.0003920992
## 6          0             0.0002941393          0           0.0003920992
##   ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1    0.001418440        1.563122e-05  1.00000000  1.000000      0
## 2    0.002836879        1.016029e-03  0.00000000  0.500000      0
## 3    0.001418440        0.000000e+00  1.00000000  1.000000      0
## 4    0.002836879        5.731448e-05  0.25000000  0.700000      0
## 5    0.014184397        9.824223e-03  0.10000000  0.250000      0
## 6    0.026950355        2.426226e-03  0.07894737  0.122807      0
##   SpecialDay OperatingSystems Browser Region TrafficType Weekend
## 1          0              1          1          1           1 FALSE
## 2          0              2          2          1           2 FALSE
## 3          0              4          1          9           3 FALSE
## 4          0              3          2          2           4 FALSE
## 5          0              3          3          1           4 TRUE
## 6          0              2          2          1           3 FALSE

# Applying the K-means clustering algorithm
# ---
#
res <- kmeans(factdata, 3)

colSums(is.na(factdata))

```

```

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

```

```

# Previewing the no. of records for each cluster
#
res$size

```

```

## [1] 3339 2032 6840

```

cluster 1 has 2362 data point, cluster 2 has 2031 data point and cluster 3 has 7818 data point

```

res$centers

```

```

##      Administrative Administrative_Duration Informational Informational_Duration
## 1      0.08755139                  0.02455495    0.02065896      0.01343261
## 2      0.07787766                  0.02295493    0.01794245      0.01188305
## 3      0.08884763                  0.02461095    0.02243276      0.01499833
##      ProductRelated ProductRelated_Duration BounceRates ExitRates PageValues
## 1      0.04300739                  0.01789998    0.09255068    0.1952630 0.01680666
## 2      0.04218749                  0.01792751    0.14542064    0.2503743 0.01646582
## 3      0.04765261                  0.01966004    0.09413069    0.2007079 0.01624966
##      SpecialDay OperatingSystems      Browser      Region TrafficType      Weekend
## 1 0.05630428                  2.081462    2.351003    6.096137    2.504043 0.2416891
## 2 0.06328740                  2.398130    2.546752    3.145669   12.086614 0.2470472
## 3 0.06423977                  2.063743    2.304825    1.718421    2.460088 0.2266082

```

```

res$cluster

```

```

##   1   2   3   4   5   6   7   8   9   10  11  12  13
##  3   3   1   3   3   3   3   3   3   3   3   3   1   3
## 14  15  16  17  18  19  20  21  22  23  24  25  26
##  3   3   1   1   3   3   1   1   3   3   3   3   1   1
## 27  28  29  30  31  32  33  34  35  36  37  38  39
##  3   3   3   3   1   1   3   3   3   1   3   1   3   3
## 40  41  42  43  44  45  46  47  48  49  50  51  52
##  3   1   3   1   3   3   3   3   3   3   3   3   3   3
## 53  54  55  56  57  58  59  60  61  62  63  64  65
##  1   3   3   3   3   1   1   3   3   3   3   1   1
## 66  67  68  69  70  71  72  73  74  75  76  77  78
##  3   3   1   3   3   3   1   3   3   3   3   3   3
## 79  80  81  82  83  84  85  86  87  88  89  90  91
##  3   3   3   3   3   1   3   3   3   3   3   1   3
## 92  93  94  95  96  97  98  99  100 101 102 103 104
##  3   3   3   3   3   3   3   3   3   3   1   3   1

```

##	105	106	107	108	109	110	111	112	113	114	115	116	117
##	3	1	3	3	3	3	3	3	3	3	3	3	3
##	118	119	120	121	122	123	124	125	126	127	128	129	130
##	3	3	1	1	3	3	3	3	3	3	1	1	3
##	131	132	133	134	135	136	137	138	139	140	141	142	143
##	3	3	3	1	3	1	1	3	3	3	1	1	3
##	144	145	146	147	148	149	150	151	152	153	154	155	156
##	3	3	3	3	3	1	3	3	3	1	3	3	3
##	157	158	160	161	162	163	164	165	166	167	168	169	170
##	3	3	3	1	3	3	3	3	3	3	3	1	1
##	171	172	173	174	175	176	177	178	180	181	182	183	184
##	3	3	3	3	1	3	1	3	1	1	3	3	3
##	185	186	187	188	189	190	191	192	193	194	195	196	197
##	2	3	3	1	1	3	3	3	3	3	1	3	1
##	198	199	200	201	202	203	204	205	206	207	208	209	210
##	3	1	3	1	2	3	2	2	1	3	1	1	3
##	211	212	213	214	215	216	217	218	219	220	221	222	223
##	3	3	2	1	3	1	1	3	3	2	1	3	3
##	224	225	226	227	228	229	230	231	232	233	234	235	236
##	2	1	2	1	3	3	3	2	3	3	3	3	3
##	237	238	239	240	241	242	243	244	245	246	247	248	249
##	2	3	3	1	3	3	1	3	3	3	1	3	3
##	250	251	252	253	254	255	256	257	258	259	260	261	262
##	3	1	3	3	3	1	3	3	1	3	2	1	1
##	263	264	265	266	267	268	269	270	271	272	273	274	275
##	3	3	1	3	1	2	3	3	3	3	2	3	2
##	276	277	278	279	280	281	282	283	284	285	286	287	288
##	1	3	1	3	3	3	2	3	1	1	3	3	3
##	289	290	291	292	293	294	295	296	297	298	299	300	301
##	1	2	1	3	3	3	3	3	3	3	1	3	2
##	302	303	304	305	306	307	308	309	310	311	312	313	314
##	3	3	1	3	3	3	3	2	2	2	3	3	3
##	315	316	317	318	319	320	321	322	323	324	325	326	327
##	1	3	3	2	3	3	1	1	1	3	1	3	3
##	328	329	330	331	332	333	334	335	336	337	338	339	340
##	3	2	1	3	3	3	3	3	3	3	3	3	3
##	341	342	343	344	345	346	347	348	349	350	351	352	353
##	3	1	3	1	1	2	1	3	3	3	3	1	3
##	354	355	356	357	358	359	360	361	362	363	364	365	366
##	1	3	3	1	3	3	3	3	3	3	3	3	1
##	367	368	369	370	371	372	373	374	375	376	377	378	379
##	1	1	3	1	1	1	2	3	3	1	1	3	2
##	380	381	382	383	384	385	386	387	388	389	390	391	392
##	1	1	3	1	3	1	1	3	1	3	3	3	1
##	393	394	395	396	397	398	399	400	401	402	403	404	405
##	3	3	3	1	2	3	3	1	3	3	3	1	3
##	406	407	408	409	410	411	412	413	414	415	416	417	418
##	1	3	3	2	1	1	1	2	2	1	2	3	3
##	420	421	422	423	424	425	426	427	428	429	430	431	432
##	1	3	3	3	1	3	3	3	1	3	2	3	3
##	433	434	435	436	437	438	439	440	441	442	443	444	445
##	3	3	2	3	3	3	3	1	1	1	1	2	2
##	446	447	448	449	450	451	452	453	454	455	456	458	459
##	2	3	1	1	3	3	3	1	3	3	2	3	1

##	460	461	462	463	464	465	466	467	468	469	470	471	472
##	3	2	3	2	3	3	3	1	1	3	3	1	3
##	473	474	475	476	477	478	479	480	481	482	483	485	486
##	1	3	3	3	3	3	3	3	3	3	1	1	1
##	487	488	489	490	491	492	493	494	495	496	497	498	499
##	3	1	1	2	3	2	3	1	3	3	2	3	1
##	500	501	502	503	504	505	506	507	508	509	510	511	512
##	3	1	3	3	3	2	1	2	3	3	3	1	3
##	514	515	516	517	518	519	520	521	522	523	524	525	526
##	3	1	1	3	3	2	3	2	3	3	3	3	2
##	527	528	529	530	531	532	533	534	535	536	537	538	539
##	1	1	1	3	3	3	1	3	1	3	3	2	2
##	540	541	542	543	544	545	546	547	548	549	550	551	552
##	3	3	1	1	3	3	1	3	2	3	3	3	1
##	553	554	556	557	558	559	560	561	562	563	564	565	566
##	3	3	3	1	1	3	3	1	2	1	2	3	3
##	567	568	569	570	571	572	573	574	575	576	577	578	579
##	3	3	2	3	2	1	3	3	3	3	3	1	1
##	580	581	582	583	584	585	586	587	588	589	591	592	593
##	3	1	3	2	3	3	2	2	2	3	1	3	3
##	594	595	596	597	598	599	600	601	602	603	604	605	606
##	1	3	1	3	1	3	1	1	3	3	3	1	3
##	607	608	609	610	611	612	613	614	615	616	617	618	619
##	3	2	3	2	3	3	3	3	3	2	3	1	3
##	620	621	622	623	624	625	626	627	628	629	630	631	632
##	3	3	3	1	3	1	1	1	3	3	1	3	1
##	633	634	635	636	637	638	639	640	641	642	643	644	645
##	1	3	1	1	3	3	3	1	3	3	1	3	1
##	646	647	648	649	650	651	652	653	654	655	656	657	658
##	3	2	3	3	3	2	3	3	3	1	3	3	1
##	659	661	662	663	664	665	666	667	668	669	670	671	672
##	1	3	1	2	1	3	1	3	2	1	3	1	3
##	673	674	675	676	677	678	679	680	681	682	683	684	685
##	3	3	1	3	3	2	3	1	3	1	3	3	1
##	686	687	688	689	690	691	692	693	694	695	696	697	698
##	3	3	2	2	3	3	3	2	3	1	3	3	2
##	699	700	701	702	703	704	705	706	707	708	709	710	711
##	1	2	2	1	2	3	3	3	1	3	3	2	3
##	712	713	714	715	716	717	718	719	720	721	722	723	724
##	2	1	3	2	3	1	3	3	1	3	3	3	1
##	725	726	727	728	729	730	731	732	733	734	735	736	737
##	3	1	2	3	1	3	2	1	3	3	2	3	
##	738	739	740	741	742	743	744	745	746	747	748	749	750
##	3	2	2	1	1	2	3	1	3	3	3	2	1
##	751	752	753	754	755	756	757	758	759	760	761	762	763
##	1	3	3	3	3	3	3	1	3	3	3	3	3
##	764	765	766	767	768	769	770	771	772	773	774	776	777
##	3	3	1	3	3	3	3	3	3	3	1	3	3
##	778	779	780	781	782	783	784	785	786	787	788	789	790
##	2	3	3	1	2	3	2	3	3	3	1	3	3
##	791	792	793	794	795	796	797	798	799	800	801	802	803
##	3	3	2	1	3	1	2	1	2	2	2	2	2
##	804	805	806	807	808	809	810	811	812	813	814	815	816
##	3	3	1	3	3	1	3	3	3	1	3	3	1

##	817	818	819	820	821	822	823	824	825	826	827	828	829
##	1	2	3	3	1	3	3	3	3	3	3	3	3
##	830	831	832	833	834	835	836	837	838	839	840	841	842
##	3	3	3	1	3	2	2	3	3	1	2	2	1
##	843	844	845	846	847	848	849	850	851	852	853	854	855
##	3	3	3	2	3	2	3	3	1	1	3	3	3
##	856	857	858	859	860	861	862	863	864	865	866	867	868
##	1	3	1	2	2	3	3	2	2	3	3	1	2
##	869	870	871	872	874	875	876	877	878	879	880	881	882
##	1	3	3	2	3	1	3	2	3	2	3	1	3
##	883	884	885	886	887	888	889	891	892	893	894	895	896
##	3	3	1	1	1	3	3	3	1	3	1	3	3
##	897	898	899	900	901	902	903	904	905	906	907	908	909
##	1	2	3	1	3	3	3	3	2	3	3	2	1
##	910	911	912	913	914	915	916	917	918	919	920	921	922
##	2	1	1	3	3	3	1	3	1	3	1	3	2
##	924	925	926	927	928	929	930	931	932	933	934	935	936
##	3	3	1	3	1	3	2	2	3	3	2	1	3
##	937	938	939	940	941	942	943	944	945	946	947	949	950
##	3	2	1	2	3	1	1	1	3	2	1	3	2
##	951	952	953	954	955	956	957	958	959	960	961	962	963
##	3	3	3	2	2	1	3	3	3	2	1	3	3
##	964	965	966	967	968	969	970	971	972	973	974	976	977
##	1	3	3	1	3	3	3	2	3	1	1	3	1
##	978	979	980	981	982	983	984	985	986	987	988	989	990
##	3	3	2	1	3	3	3	3	3	3	3	1	3
##	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003
##	3	1	3	2	3	3	3	3	3	3	1	2	3
##	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016
##	2	2	1	3	1	3	3	1	3	1	2	2	2
##	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029
##	3	1	1	2	3	2	3	3	3	2	3	3	1
##	1030	1031	1032	1033	1034	1036	1037	1038	1039	1040	1041	1042	1043
##	2	2	3	3	2	3	3	2	2	1	3	3	3
##	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056
##	1	3	3	3	1	1	3	1	2	3	3	3	2
##	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069
##	3	3	2	3	1	3	1	3	1	3	1	3	3
##	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082
##	2	3	3	3	3	1	1	3	3	3	3	3	2
##	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095
##	3	2	3	3	3	3	2	1	1	3	1	1	3
##	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108
##	2	2	3	1	1	3	1	3	1	3	3	2	3
##	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1121	1122
##	3	3	1	3	3	2	3	1	3	2	1	3	3
##	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135
##	2	3	3	1	3	2	1	2	3	3	3	1	3
##	1136	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149
##	3	1	3	3	1	2	3	3	3	3	2	1	1
##	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162
##	3	1	1	2	3	2	3	3	3	1	2	2	1
##	1163	1164	1165	1166	1167	1168	1169	1170	1172	1173	1174	1175	1176
##	3	3	3	3	3	2	2	3	1	2	3	3	3

##	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190
##	3	3	2	3	3	1	1	3	3	1	3	2	3
##	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203
##	1	3	1	1	3	3	3	3	2	3	2	3	1
##	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1216	1217	1218
##	3	1	3	1	3	3	1	3	3	3	3	3	3
##	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231
##	2	1	1	3	1	3	3	1	3	1	3	1	1
##	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244
##	1	1	2	3	3	3	3	3	3	1	1	3	3
##	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257
##	3	3	1	3	3	1	3	2	3	2	3	2	2
##	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270
##	2	3	3	3	3	3	3	3	3	1	3	2	1
##	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283
##	1	3	3	3	3	3	1	3	1	3	3	1	3
##	1284	1285	1286	1287	1288	1289	1290	1291	1293	1294	1295	1296	1297
##	3	1	3	2	3	1	1	3	1	1	3	3	2
##	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310
##	2	3	1	3	3	1	3	3	3	3	3	1	3
##	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323
##	1	3	3	1	2	3	2	1	3	3	1	3	1
##	1324	1325	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337
##	2	1	3	3	2	3	1	1	3	1	3	2	2
##	1338	1339	1340	1341	1342	1343	1344	1345	1346	1347	1348	1349	1350
##	3	3	3	2	3	2	3	3	3	1	3	3	3
##	1351	1352	1353	1354	1355	1356	1358	1359	1360	1361	1362	1363	1364
##	1	3	1	3	3	1	3	3	2	3	3	2	3
##	1365	1366	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378
##	3	3	3	3	3	3	1	2	1	2	3	1	1
##	1379	1380	1381	1383	1384	1385	1386	1387	1388	1389	1390	1392	1393
##	1	1	3	1	1	1	3	1	1	3	3	3	3
##	1394	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407
##	2	2	1	1	3	3	1	3	3	2	2	3	1
##	1408	1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419	1420
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##	1448	1449	1450	1451	1452	1453	1455	1456	1457	1458	1459	1460	1461
##	1	1	3	3	1	1	1	3	1	3	2	1	3
##	1462	1463	1464	1465	1466	1467	1468	1469	1470	1471	1472	1473	1474
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##	3	3	3	1	2	1	3	1	3	1	2	1	1
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##	1541	1542	1543	1544	1545	1546	1547	1548	1549	1550	1551	1552	1553
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##	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911
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##	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1951	1952	1953
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##	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
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##	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
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##	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
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##	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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##	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
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##	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
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##	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112
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##	4432	4433	4434	4435	4436	4437	4438	4439	4440	4441	4442	4443	4444
##	1	2	1	3	2	1	3	1	3	2	2	3	3
##	4445	4446	4447	4448	4449	4450	4451	4452	4453	4454	4455	4456	4457
##	1	3	3	3	3	1	1	3	1	3	1	3	1
##	4458	4459	4460	4461	4462	4463	4465	4466	4467	4468	4469	4470	4471
##	3	1	2	2	3	3	3	3	3	3	3	1	3
##	4472	4473	4474	4475	4476	4477	4478	4479	4480	4481	4482	4483	4484
##	1	3	3	3	3	3	1	3	2	2	3	1	2
##	4485	4486	4487	4488	4489	4491	4492	4493	4494	4495	4496	4497	4498
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##	4499	4500	4501	4502	4503	4504	4505	4506	4507	4508	4509	4510	4511
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##	4512	4513	4514	4515	4516	4517	4518	4519	4520	4521	4522	4523	4524
##	1	1	1	1	3	2	2	3	2	1	3	3	1
##	4525	4526	4527	4528	4529	4530	4531	4532	4533	4534	4535	4536	4537
##	2	1	3	3	3	3	1	3	1	2	3	1	3
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##	4551	4552	4554	4555	4556	4557	4558	4559	4560	4561	4562	4563	4564
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##	4565	4566	4567	4568	4569	4570	4571	4572	4573	4574	4575	4576	4577
##	3	1	3	3	3	1	1	1	1	1	1	2	1
##	4578	4579	4580	4581	4582	4583	4584	4585	4586	4587	4588	4589	4590
##	3	1	1	3	3	3	1	1	3	2	3	1	2
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##	4604	4605	4606	4607	4608	4609	4610	4611	4612	4613	4614	4615	4616
##	2	1	3	1	3	3	2	3	3	3	2	3	1
##	4617	4618	4619	4620	4621	4622	4623	4624	4625	4626	4627	4628	4629
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##	4630	4631	4632	4633	4634	4635	4636	4637	4638	4639	4640	4641	4642
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##	4643	4644	4645	4646	4647	4648	4649	4650	4651	4652	4653	4654	4655
##	3	2	3	3	3	1	1	3	1	3	2	2	2
##	4656	4657	4658	4659	4660	4661	4662	4663	4664	4665	4666	4667	4668
##	3	3	1	3	1	3	3	3	3	3	3	1	3
##	4669	4670	4671	4672	4673	4674	4675	4676	4677	4678	4679	4680	4681
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##	3	2	3	3	3	3	3	1	1	3	3	1	3
##	4695	4696	4697	4698	4699	4700	4701	4702	4703	4704	4705	4706	4707
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##	4721	4722	4723	4724	4725	4726	4727	4728	4729	4730	4731	4732	4733
##	3	1	1	3	1	3	3	1	1	3	1	3	1

##	4734	4735	4736	4737	4738	4739	4740	4741	4742	4743	4744	4745	4746
##	1	3	1	3	3	3	3	3	3	1	2	3	1
##	4747	4748	4749	4750	4751	4752	4753	4754	4755	4756	4757	4758	4759
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##	4760	4761	4762	4763	4764	4765	4766	4767	4768	4769	4770	4771	4772
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##	4773	4774	4775	4776	4777	4778	4779	4780	4781	4782	4783	4784	4785
##	3	1	1	3	3	3	3	3	3	3	3	3	1
##	4786	4787	4788	4789	4790	4791	4792	4793	4794	4795	4796	4797	4798
##	2	3	3	2	3	1	3	1	3	3	1	1	3
##	4799	4800	4801	4802	4803	4804	4805	4806	4807	4808	4809	4810	4811
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##	4865	4866	4867	4868	4869	4870	4871	4872	4873	4874	4875	4876	4877
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##	4878	4879	4880	4881	4882	4883	4885	4886	4887	4888	4889	4890	4891
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##	4919	4920	4921	4922	4923	4924	4925	4926	4927	4928	4929	4930	4931
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##	3	3	3	3	3	3	3	3	3	3	1	3	3
##	4945	4946	4947	4948	4949	4950	4951	4952	4953	4954	4955	4956	4957
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##	4997	4998	4999	5000	5001	5002	5003	5004	5005	5006	5007	5008	5009
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##	5010	5011	5012	5013	5014	5015	5016	5017	5018	5019	5020	5021	5022
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##	5036	5037	5038	5040	5041	5042	5043	5045	5046	5047	5048	5049	5050
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##	5051	5052	5053	5054	5055	5056	5058	5059	5060	5061	5062	5063	5064
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##	5065	5066	5067	5068	5069	5070	5071	5072	5073	5074	5075	5076	5077
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##	5078	5079	5080	5081	5082	5083	5084	5085	5086	5087	5088	5089	5090
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##	5091	5092	5093	5094	5095	5096	5097	5098	5099	5100	5101	5102	5103
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##	5292	5293	5294	5295	5296	5297	5298	5299	5300	5301	5302	5303	5304
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##	5358	5359	5360	5361	5362	5363	5364	5365	5366	5367	5368	5369	5370
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##	5371	5372	5373	5374	5375	5376	5377	5378	5379	5380	5381	5382	5383
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##	5450	5451	5452	5453	5454	5455	5456	5457	5458	5459	5460	5461	5462
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##	5632	5633	5634	5635	5636	5637	5638	5639	5640	5641	5642	5643	5644
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##	5658	5659	5660	5661	5662	5663	5664	5665	5666	5667	5668	5669	5670
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##	5801	5802	5803	5804	5805	5806	5807	5808	5809	5810	5811	5812	5813
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##	7415	7416	7417	7418	7419	7420	7421	7422	7423	7424	7425	7426	7427
##	1	3	3	3	3	3	3	3	1	1	1	3	3
##	7428	7429	7430	7431	7432	7433	7434	7435	7436	7437	7438	7439	7440
##	3	1	2	3	3	1	3	2	3	3	3	3	3
##	7441	7442	7443	7444	7445	7446	7447	7448	7449	7450	7451	7452	7453
##	3	2	3	3	3	3	3	1	3	1	3	1	3
##	7454	7455	7456	7457	7458	7459	7460	7461	7462	7463	7464	7465	7466
##	1	3	3	1	2	1	1	3	1	3	3	3	3
##	7467	7468	7469	7470	7471	7472	7473	7474	7475	7476	7477	7478	7479
##	3	1	3	1	3	3	3	1	3	1	1	1	2
##	7480	7481	7482	7483	7484	7485	7486	7487	7488	7489	7490	7491	7492
##	3	1	3	1	3	3	1	3	3	2	1	3	1
##	7493	7494	7495	7496	7497	7498	7499	7500	7501	7502	7503	7504	7505
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##	7506	7507	7508	7509	7510	7511	7512	7513	7514	7515	7516	7517	7518
##	1	1	1	3	3	3	1	3	2	3	1	3	3
##	7519	7520	7521	7522	7523	7524	7525	7526	7527	7528	7529	7530	7531
##	1	3	1	3	3	1	1	2	2	2	3	1	3
##	7532	7533	7534	7535	7536	7537	7538	7539	7540	7541	7542	7543	7544
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##	7545	7546	7547	7548	7549	7550	7551	7552	7553	7554	7555	7556	7557
##	1	1	3	3	3	3	2	1	2	1	3	3	1

##	7558	7559	7560	7561	7562	7563	7564	7565	7566	7567	7568	7569	7570
##	1	3	3	2	3	3	1	3	3	1	1	1	1
##	7571	7572	7573	7574	7575	7576	7577	7578	7579	7580	7581	7582	7583
##	3	3	3	3	3	3	3	3	3	1	3	1	3
##	7584	7585	7586	7587	7588	7589	7590	7591	7592	7593	7594	7595	7596
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##	7741	7742	7743	7744	7745	7746	7747	7748	7749	7750	7751	7752	7753
##	3	3	3	1	1	3	3	3	3	1	3	2	3
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##	7793	7794	7795	7796	7797	7798	7799	7800	7801	7802	7803	7804	7805
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##	7845	7846	7847	7848	7849	7850	7851	7852	7853	7854	7855	7856	7857
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##	7910	7911	7912	7913	7914	7915	7916	7917	7918	7919	7920	7921	7922
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##	1	3	1	3	3	1	3	3	3	3	3	2	2
##	7988	7989	7990	7991	7992	7993	7994	7995	7996	7997	7998	7999	8000
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##	8261	8262	8263	8264	8265	8266	8267	8268	8269	8270	8271	8272	8273
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##	8899	8900	8901	8902	8903	8904	8905	8906	8907	8908	8909	8910	8911
##	3	1	3	2	3	2	2	1	2	3	3	3	3
##	8912	8913	8914	8915	8916	8917	8918	8919	8920	8921	8922	8923	8924
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##	8925	8926	8927	8928	8929	8930	8931	8932	8933	8934	8935	8936	8937
##	3	3	1	3	3	3	3	1	2	3	2	3	3
##	8938	8939	8940	8941	8942	8943	8944	8945	8946	8947	8948	8949	8950
##	3	2	2	3	3	1	3	3	1	3	3	3	3
##	8951	8952	8953	8954	8955	8956	8957	8958	8959	8960	8961	8962	8963
##	3	1	3	1	3	1	2	1	3	3	1	1	3

##	8964	8965	8966	8967	8968	8969	8970	8971	8972	8973	8974	8975	8976
##	2	1	1	2	1	3	1	1	2	3	2	1	3
##	8977	8978	8979	8980	8981	8982	8983	8984	8985	8986	8987	8988	8989
##	3	3	3	3	2	3	2	2	1	3	2	1	2
##	8990	8991	8992	8993	8994	8995	8996	8997	8998	8999	9000	9001	9002
##	2	3	2	3	3	2	3	2	3	3	3	2	3
##	9003	9004	9005	9006	9007	9008	9009	9010	9011	9012	9013	9014	9015
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##	3	1	3	3	3	3	3	3	2	1	3	2	2
##	9029	9030	9031	9032	9033	9034	9035	9036	9037	9038	9039	9040	9041
##	1	2	3	3	3	1	2	3	1	2	3	3	3
##	9042	9043	9044	9045	9046	9047	9048	9049	9050	9051	9052	9053	9054
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##	9671	9672	9673	9674	9675	9676	9677	9678	9679	9680	9681	9682	9683
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##	3	1	3	3	1	1	3	3	2	1	1	1	2

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## 10026 10027 10028 10029 10030 10031 10032 10033 10034 10035 10036 10037 10038
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## 3     3     1     3     1     3     3     1     3     1     2     3     3
## 10052 10053 10054 10055 10056 10057 10058 10059 10060 10061 10062 10063 10064
## 2     3     3     1     1     1     1     3     2     3     3     3     3
## 10065 10066 10067 10068 10069 10070 10071 10072 10073 10074 10075 10076 10077
## 1     2     2     2     3     3     2     1     3     2     3     3     3
## 10078 10079 10080 10081 10082 10083 10084 10085 10086 10087 10088 10089 10090
## 1     3     3     3     1     3     2     3     1     1     3     1     1
## 10091 10092 10093 10094 10095 10096 10097 10098 10099 10100 10101 10102 10103
## 3     3     3     1     3     1     2     1     3     2     3     3     2
## 10104 10105 10106 10107 10108 10109 10110 10111 10112 10113 10114 10115 10116
## 2     2     3     3     3     1     1     3     3     3     3     2     3
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## 1     3     2     3     1     2     1     2     3     1     2     1     1
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## 3     3     1     3     3     2     1     3     3     3     3     3     1
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## 3     3     1     3     3     3     2     1     3     3     3     2     1
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## 3     1     1     2     1     3     1     3     3     3     2     1     2
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## 3     3     3     1     3     1     3     3     3     1     3     1     3
## 10249 10250 10251 10252 10253 10254 10255 10256 10257 10258 10259 10260 10261
## 1     3     3     2     2     2     3     1     2     3     3     1     2
## 10262 10263 10264 10265 10266 10267 10268 10269 10271 10272 10273 10274 10275
## 1     2     3     1     3     2     3     2     1     2     2     2     3
## 10276 10277 10278 10279 10280 10281 10282 10283 10284 10285 10286 10287 10288
## 1     2     3     3     2     1     3     1     3     2     2     2     3
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## 3     2     3     3     2     3     3     3     3     2     3     3     3
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## 1     2     3     1     1     2     3     1     3     1     3     3     3
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## 2     3     2     2     2     2     3     2     3     3     3     3     3
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## 2     3     3     3     3     1     3     3     2     2     3     3     3

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## 10380 10381 10382 10383 10384 10385 10386 10387 10388 10389 10390 10391 10392
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## 2 3 3 2 1 3 2 2 3 2 3 3 1
## 10497 10498 10499 10500 10501 10502 10503 10504 10505 10506 10507 10508 10509
## 3 3 3 3 3 3 1 2 1 3 2 3 3
## 10510 10511 10512 10513 10514 10515 10516 10517 10518 10519 10520 10521 10522
## 3 3 3 1 3 3 2 3 2 3 1 2 3
## 10523 10524 10525 10526 10527 10528 10529 10530 10531 10532 10533 10534 10535
## 2 3 1 3 3 3 2 3 3 1 2 3
## 10536 10537 10538 10539 10540 10541 10542 10543 10544 10545 10546 10547 10548
## 3 1 2 2 3 3 3 3 1 1 2 2 1
## 10549 10550 10551 10552 10553 10554 10555 10556 10557 10558 10559 10560 10561
## 1 3 1 3 3 1 1 3 3 2 3 3 3
## 10562 10563 10564 10565 10566 10567 10568 10569 10570 10571 10572 10574 10575
## 3 1 1 1 1 1 3 3 3 2 1 2 3
## 10576 10577 10578 10579 10580 10581 10582 10583 10584 10585 10586 10587 10588
## 3 3 2 1 3 2 1 2 3 3 1 1 1
## 10589 10590 10591 10592 10593 10594 10595 10596 10597 10598 10599 10600 10601
## 3 3 3 3 3 2 3 3 2 1 3 1 3
## 10602 10603 10604 10605 10606 10607 10608 10609 10610 10611 10612 10613 10614
## 1 1 2 3 2 3 3 3 2 2 3 3 2
## 10615 10616 10617 10618 10619 10620 10621 10622 10623 10624 10625 10626 10627
## 3 3 3 2 1 2 3 3 3 2 2 3 3
## 10628 10629 10630 10631 10633 10634 10635 10636 10637 10638 10639 10640 10641
## 1 3 3 3 2 1 3 3 3 3 3 3 3
## 10642 10643 10644 10645 10646 10647 10648 10649 10650 10651 10652 10653 10654
## 1 3 3 2 1 3 1 3 1 1 1 3 3
## 10655 10656 10657 10658 10659 10660 10661 10662 10663 10664 10665 10666 10667
## 1 3 2 3 3 3 1 2 1 3 3 3 3
## 10668 10669 10670 10671 10672 10673 10674 10675 10676 10677 10678 10679 10680
## 2 3 3 3 2 3 3 3 1 1 3 3 2
## 10681 10682 10683 10684 10685 10686 10687 10688 10689 10690 10691 10692 10693
## 3 2 3 1 3 2 3 1 3 3 3 3 3
## 10694 10695 10696 10697 10698 10699 10700 10701 10702 10703 10704 10705 10706
## 2 3 3 1 1 1 2 1 2 3 1 1 3
## 10707 10708 10709 10710 10711 10712 10713 10714 10715 10716 10717 10718 10719
## 1 3 3 1 1 3 2 3 1 3 3 3 3
## 10720 10721 10722 10723 10724 10725 10726 10727 10728 10729 10730 10731 10732
## 3 3 1 1 2 3 3 1 3 3 1 1 3

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## 10733 10734 10735 10736 10737 10738 10739 10740 10741 10742 10743 10744 10745
##   3     1     3     3     3     3     2     3     1     3     2     2     2
## 10746 10747 10748 10749 10750 10751 10753 10754 10755 10756 10757 10758 10759
##   2     3     1     3     2     3     3     3     3     1     2     1     1
## 10760 10761 10762 10763 10764 10765 10766 10767 10768 10769 10770 10771 10772
##   3     1     3     1     2     3     1     3     2     2     1     3     2
## 10773 10774 10775 10776 10777 10778 10779 10780 10781 10782 10783 10784 10785
##   1     3     1     2     3     3     3     1     3     3     1     1     2
## 10786 10787 10788 10789 10790 10791 10792 10793 10794 10795 10797 10798 10799
##   3     3     3     1     2     3     1     1     1     1     3     2     1
## 10800 10801 10802 10803 10804 10805 10806 10807 10808 10809 10810 10811 10812
##   2     1     3     2     2     3     3     3     3     3     2     3     1
## 10813 10814 10815 10816 10817 10818 10819 10820 10821 10822 10823 10824 10825
##   2     3     2     1     3     1     3     3     2     2     3     3     1
## 10826 10827 10828 10829 10830 10831 10832 10833 10834 10835 10836 10837 10838
##   3     3     3     2     3     3     2     1     2     2     3     3     3
## 10839 10840 10841 10843 10844 10845 10846 10847 10848 10849 10850 10851 10852
##   3     1     2     3     1     2     2     3     1     2     2     1     2
## 10853 10854 10855 10856 10857 10858 10859 10860 10861 10862 10863 10864 10865
##   1     3     3     1     2     3     1     3     1     3     1     3     3
## 10866 10867 10868 10869 10870 10871 10872 10873 10874 10875 10876 10877 10878
##   2     3     3     3     3     1     3     3     1     1     2     2     3
## 10879 10880 10881 10882 10883 10884 10885 10886 10887 10888 10889 10890 10891
##   1     3     3     2     2     2     3     3     3     2     3     3     1
## 10892 10893 10894 10895 10896 10897 10898 10899 10900 10901 10902 10903 10904
##   3     3     1     3     3     3     1     1     3     3     3     1     2
## 10905 10906 10907 10908 10909 10910 10911 10912 10913 10914 10915 10916 10917
##   3     1     3     1     3     2     3     3     1     2     3     2     3
## 10918 10919 10920 10921 10922 10923 10924 10925 10926 10927 10928 10929 10930
##   2     3     3     3     1     3     2     3     3     3     1     3     3
## 10931 10932 10933 10934 10935 10936 10937 10938 10939 10940 10941 10942 10943
##   2     3     1     2     2     1     2     2     3     3     3     2     1
## 10944 10945 10946 10947 10948 10949 10950 10951 10952 10953 10954 10955 10956
##   2     3     3     3     2     1     2     2     2     3     3     3     2
## 10957 10958 10959 10960 10961 10962 10963 10964 10965 10966 10967 10968 10969
##   3     3     3     2     1     2     3     3     3     3     2     1     1
## 10970 10971 10972 10973 10974 10975 10976 10977 10978 10979 10980 10981 10982
##   2     1     3     3     3     3     1     1     1     3     3     3     3
## 10983 10984 10985 10986 10987 10988 10990 10991 10992 10993 10994 10995 10996
##   1     3     3     1     1     3     3     3     1     2     3     3     3
## 10997 10998 10999 11000 11001 11002 11003 11004 11005 11006 11007 11008 11009
##   1     3     3     3     1     1     1     1     3     3     2     3
## 11010 11011 11012 11013 11014 11015 11016 11017 11018 11019 11020 11021 11022
##   3     3     3     3     3     3     3     3     3     3     3     3     1
## 11023 11024 11025 11026 11027 11028 11029 11030 11031 11032 11033 11034 11035
##   3     2     1     2     1     3     3     1     1     1     2     1     1
## 11036 11037 11038 11039 11040 11041 11042 11043 11045 11046 11047 11048 11049
##   2     3     2     2     2     3     3     1     3     3     3     3     2
## 11050 11051 11052 11053 11054 11055 11056 11057 11058 11059 11060 11061 11062
##   3     2     3     3     1     1     1     3     2     3     3     2     1
## 11063 11064 11065 11066 11067 11068 11069 11070 11071 11072 11073 11074 11075
##   2     2     1     3     3     3     3     3     3     3     3     3     3
## 11076 11077 11078 11079 11080 11081 11082 11083 11084 11085 11086 11087 11088
##   3     1     3     3     3     1     3     1     3     1     3     3     3

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## 11089 11090 11091 11092 11093 11094 11095 11096 11097 11098 11099 11100 11101
##   3     3     2     3     3     3     2     1     3     3     3     3     3     3     2
## 11102 11103 11104 11105 11106 11107 11108 11109 11110 11111 11112 11113 11114
##   1     2     1     2     3     1     3     2     3     3     3     3     1     3
## 11115 11116 11117 11118 11119 11120 11121 11122 11123 11124 11125 11126 11127
##   3     1     3     2     2     3     1     2     1     2     3     3     3     1
## 11128 11129 11130 11131 11132 11133 11134 11135 11136 11137 11138 11139 11140
##   3     1     2     3     3     1     3     3     2     2     2     2     2     2
## 11141 11142 11143 11144 11145 11146 11147 11148 11149 11150 11151 11152 11153
##   1     2     3     2     3     3     3     2     1     1     3     3     3
## 11154 11155 11156 11157 11158 11159 11160 11161 11162 11163 11164 11165 11166
##   2     2     3     2     3     1     3     1     2     3     3     1     2
## 11167 11168 11169 11170 11171 11172 11173 11174 11175 11176 11177 11178 11179
##   3     3     1     2     3     2     2     2     3     1     3     3     3
## 11180 11181 11182 11183 11184 11185 11186 11187 11188 11189 11190 11191 11192
##   2     2     1     3     3     3     2     3     1     1     3     1     1
## 11193 11194 11195 11196 11197 11198 11199 11200 11201 11202 11203 11204 11205
##   2     2     3     2     3     2     2     1     3     3     1     2     1
## 11207 11208 11209 11210 11211 11212 11213 11214 11215 11216 11217 11218 11219
##   2     2     3     1     3     1     2     1     3     3     3     2     3
## 11220 11221 11222 11223 11224 11225 11226 11227 11228 11229 11230 11231 11232
##   1     2     3     2     1     3     3     1     1     2     1     3     3
## 11233 11234 11235 11236 11237 11238 11239 11240 11241 11242 11243 11244 11245
##   1     3     2     2     3     1     3     2     2     3     3     3     3
## 11246 11247 11248 11249 11250 11251 11252 11253 11254 11255 11256 11257 11258
##   3     2     3     3     3     2     3     1     3     1     2     3     1
## 11259 11260 11261 11262 11263 11264 11265 11266 11267 11268 11269 11270 11271
##   3     1     3     3     3     3     3     2     3     3     3     1     3
## 11272 11273 11274 11275 11276 11277 11278 11279 11280 11281 11282 11283 11284
##   3     2     1     3     1     1     1     2     3     3     2     3     1
## 11285 11286 11287 11288 11289 11290 11291 11292 11293 11294 11295 11296 11297
##   3     1     1     2     3     1     1     3     2     1     2     3     2
## 11298 11299 11300 11301 11302 11303 11304 11305 11306 11307 11308 11309 11310
##   2     3     2     3     3     3     3     1     3     3     2     3     3
## 11311 11312 11313 11314 11315 11316 11317 11318 11319 11320 11321 11322 11323
##   3     3     3     2     3     3     2     1     3     2     1     1     3
## 11324 11325 11326 11327 11328 11329 11330 11331 11332 11333 11334 11335 11336
##   3     3     2     3     1     3     3     3     1     1     3     3     1
## 11337 11338 11339 11340 11341 11342 11343 11344 11345 11346 11347 11348 11349
##   3     1     3     2     3     3     3     3     2     3     3     3     3
## 11350 11351 11352 11353 11354 11355 11356 11357 11358 11359 11360 11361 11362
##   3     3     2     1     3     3     2     2     2     3     3     3     2
## 11363 11364 11365 11366 11367 11368 11369 11370 11371 11372 11373 11374 11375
##   3     3     1     3     2     1     3     2     1     1     3     1     3
## 11376 11377 11378 11379 11380 11381 11382 11383 11384 11385 11386 11387 11388
##   3     3     1     3     1     1     3     3     3     3     2     2     2
## 11389 11390 11391 11392 11393 11394 11395 11396 11397 11398 11399 11400 11401
##   3     1     2     2     3     2     3     3     2     1     1     1     3
## 11402 11403 11404 11406 11407 11408 11409 11410 11411 11412 11413 11414 11415
##   3     3     1     1     3     1     2     1     1     2     1     3     3
## 11416 11417 11418 11419 11420 11421 11422 11423 11424 11425 11426 11427 11428
##   3     3     3     2     3     3     2     3     2     3     3     3     3
## 11429 11430 11431 11432 11433 11434 11435 11436 11437 11438 11439 11440 11441
##   1     1     2     3     3     3     2     1     2     1     3     2     1

```

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## 11442 11443 11444 11445 11446 11447 11448 11449 11450 11451 11452 11453 11454
## 2 3 3 3 3 3 3 3 2 3 1 2 2 3
## 11455 11456 11457 11458 11459 11460 11461 11462 11463 11464 11465 11466 11467
## 2 1 3 1 2 1 3 1 2 3 2 2 3
## 11468 11469 11470 11471 11472 11473 11474 11475 11476 11477 11478 11479 11480
## 3 1 3 3 3 3 3 3 2 3 3 3 3
## 11481 11482 11483 11484 11485 11486 11487 11488 11489 11490 11491 11492 11493
## 2 1 3 2 3 2 1 1 2 2 1 3 3
## 11494 11495 11496 11497 11498 11499 11500 11501 11502 11503 11504 11505 11506
## 2 3 3 3 1 3 3 1 3 1 3 3 1
## 11507 11508 11509 11510 11511 11512 11513 11514 11515 11516 11517 11518 11519
## 2 2 2 3 1 3 3 3 3 3 1 3 1
## 11520 11521 11522 11523 11525 11526 11527 11528 11529 11530 11531 11532 11533
## 3 3 2 3 3 2 3 1 2 1 1 1 3
## 11534 11535 11536 11537 11538 11539 11540 11541 11542 11543 11544 11545 11546
## 1 2 3 3 3 3 2 3 1 2 3 3 2
## 11547 11548 11549 11550 11551 11552 11553 11554 11555 11556 11557 11558 11559
## 2 3 3 3 2 1 1 2 3 3 3 1
## 11560 11561 11562 11563 11564 11565 11566 11567 11568 11569 11570 11571 11572
## 2 2 3 3 1 3 2 3 3 2 1 2 1
## 11573 11574 11575 11576 11577 11578 11579 11580 11581 11583 11584 11585 11586
## 2 3 3 3 3 1 3 3 2 3 1 1 2
## 11587 11588 11589 11590 11591 11592 11593 11594 11595 11596 11597 11598 11599
## 3 3 3 2 3 3 3 2 3 1 3 2 3
## 11600 11601 11602 11603 11604 11605 11606 11607 11608 11609 11610 11611 11612
## 2 3 2 2 3 3 3 3 3 2 3 1 1
## 11613 11614 11615 11616 11617 11618 11619 11620 11621 11622 11623 11624 11626
## 2 1 2 2 2 3 1 3 3 3 3 2 2
## 11627 11628 11629 11630 11631 11632 11633 11634 11635 11636 11637 11638 11639
## 3 3 3 2 2 3 2 3 3 3 3 2 2
## 11640 11641 11642 11643 11644 11645 11646 11647 11648 11649 11650 11651 11652
## 3 1 2 3 2 1 3 3 3 1 1 1 3
## 11653 11654 11655 11656 11657 11658 11660 11661 11662 11663 11664 11665 11666
## 1 1 3 2 3 3 3 3 3 3 3 2 3
## 11667 11668 11669 11670 11671 11672 11673 11674 11675 11676 11677 11678 11679
## 3 3 1 2 2 1 2 2 3 2 2 3 3
## 11680 11681 11682 11683 11684 11685 11686 11687 11688 11689 11690 11691 11692
## 1 3 1 2 3 1 2 3 3 2 3 3 2
## 11693 11694 11695 11696 11697 11698 11699 11700 11701 11702 11703 11704 11705
## 3 1 3 1 3 3 1 3 2 3 3 1 3
## 11706 11707 11708 11709 11710 11711 11712 11713 11714 11715 11716 11717 11718
## 3 1 3 1 3 3 3 3 3 2 3 3 1
## 11719 11720 11721 11722 11723 11724 11725 11726 11727 11728 11729 11730 11731
## 1 2 3 3 3 1 3 1 1 3 3 3 3
## 11732 11733 11735 11736 11737 11738 11739 11740 11741 11742 11743 11744 11745
## 3 3 2 3 3 1 2 3 3 3 2 3 3
## 11746 11747 11749 11750 11751 11752 11753 11754 11755 11756 11757 11758 11759
## 3 3 3 3 3 1 3 3 3 2 2 3
## 11760 11761 11762 11763 11764 11765 11766 11767 11768 11769 11770 11771 11772
## 2 2 3 1 2 3 2 2 2 1 3 3 2
## 11773 11774 11775 11776 11777 11778 11779 11780 11781 11782 11783 11784 11785
## 3 1 3 2 3 1 1 1 3 3 1 3 1
## 11786 11787 11788 11789 11790 11791 11792 11793 11794 11795 11796 11797 11798
## 3 1 3 3 2 3 3 1 2 3 2 3 3

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```

## 11799 11800 11801 11803 11804 11805 11806 11807 11808 11809 11810 11811 11812
##   3     3     3     3     1     3     3     3     1     3     2     2     3     3
## 11813 11815 11816 11817 11818 11819 11820 11821 11822 11823 11824 11825 11826
##   1     2     3     2     2     2     1     2     1     2     3     3     3     1
## 11827 11829 11830 11831 11832 11833 11834 11835 11836 11837 11838 11839 11840
##   3     1     3     3     2     3     1     2     3     3     1     3     2
## 11841 11842 11843 11844 11845 11846 11847 11848 11849 11850 11851 11852 11853
##   3     3     3     3     1     2     2     3     3     3     2     3     1
## 11854 11855 11856 11857 11858 11859 11860 11861 11862 11863 11864 11865 11866
##   3     3     3     1     2     3     3     1     3     3     3     1     1
## 11867 11868 11869 11870 11871 11872 11873 11874 11875 11876 11877 11878 11879
##   1     2     1     3     3     2     1     3     3     3     1     1     1
## 11880 11881 11882 11883 11884 11885 11886 11887 11888 11889 11890 11891 11892
##   1     1     3     3     3     2     1     1     3     3     2     3     3
## 11893 11894 11895 11896 11897 11898 11899 11900 11901 11902 11903 11904 11905
##   1     3     1     3     2     3     3     3     2     3     3     1     2
## 11906 11907 11908 11909 11910 11911 11912 11913 11914 11915 11916 11917 11918
##   2     3     3     2     2     1     3     1     1     3     1     1     2
## 11919 11920 11921 11922 11923 11924 11925 11926 11927 11928 11929 11930 11931
##   1     1     3     1     3     3     1     3     2     2     2     3     3
## 11932 11933 11934 11936 11937 11938 11940 11941 11942 11943 11944 11945 11946
##   2     3     2     3     3     3     2     3     3     3     2     3     3
## 11947 11948 11949 11950 11951 11952 11953 11954 11955 11956 11957 11958 11959
##   1     3     1     3     2     2     2     3     3     1     1     2     3
## 11960 11961 11962 11963 11964 11965 11966 11967 11968 11969 11970 11971 11972
##   1     3     3     2     2     3     3     2     1     2     2     3     1
## 11973 11974 11975 11976 11977 11978 11979 11980 11981 11982 11983 11984 11985
##   3     3     3     1     3     3     1     2     3     2     3     3     3
## 11986 11987 11988 11989 11990 11991 11992 11993 11994 11995 11996 11997 11998
##   2     2     3     1     3     3     3     2     3     3     3     1     3
## 11999 12000 12001 12002 12003 12004 12005 12006 12007 12008 12009 12010 12011
##   2     2     2     1     3     2     3     1     1     1     3     3     1
## 12012 12013 12014 12015 12016 12017 12018 12019 12020 12021 12022 12023 12024
##   3     1     3     3     3     3     3     1     1     1     2     1     3
## 12025 12026 12027 12028 12029 12030 12031 12032 12033 12034 12035 12036 12037
##   2     2     1     1     3     3     1     1     3     3     3     1     3
## 12038 12039 12040 12041 12042 12043 12044 12045 12046 12047 12048 12049 12050
##   3     3     2     2     1     3     3     3     2     2     1     1     3
## 12051 12052 12053 12054 12055 12056 12057 12058 12059 12060 12061 12062 12063
##   3     1     1     3     3     3     2     2     1     3     1     1     1
## 12064 12065 12066 12067 12068 12069 12070 12071 12072 12073 12074 12075 12076
##   1     3     3     3     1     3     3     3     1     3     1     3     2
## 12077 12078 12079 12080 12081 12082 12083 12084 12085 12086 12087 12088 12089
##   2     1     3     3     2     2     3     3     3     3     1     3     2
## 12090 12091 12092 12093 12094 12095 12096 12097 12098 12099 12100 12101 12102
##   3     3     3     1     1     3     3     1     2     3     2     1     1
## 12103 12104 12105 12106 12107 12108 12109 12110 12111 12112 12113 12114 12115
##   1     3     3     2     3     1     2     2     3     2     2     3     3
## 12116 12117 12118 12119 12120 12121 12122 12123 12124 12125 12126 12127 12128
##   3     3     2     1     1     3     3     3     3     3     3     3     3
## 12129 12130 12131 12132 12133 12134 12135 12136 12137 12138 12139 12140 12141
##   3     3     3     3     3     3     3     2     2     3     2     3     1
## 12142 12143 12144 12145 12146 12147 12148 12149 12150 12151 12152 12153 12154
##   3     3     3     3     3     1     3     1     3     3     2     3     2

```

```

## 12155 12156 12157 12158 12159 12161 12162 12163 12164 12165 12166 12167 12168
##   2     3     2     2     1     1     1     1     1     3     1     3     2     3
## 12169 12170 12171 12172 12173 12174 12175 12176 12177 12178 12179 12180 12182
##   2     3     3     2     2     3     1     1     1     2     2     3     3
## 12183 12184 12185 12187 12188 12189 12190 12191 12192 12193 12194 12195 12196
##   3     3     3     3     3     2     1     3     2     3     2     1     3
## 12197 12198 12199 12200 12201 12202 12203 12204 12205 12206 12207 12208 12209
##   1     2     2     3     1     3     3     2     3     3     1     1     3
## 12210 12211 12212 12213 12214 12215 12216 12217 12218 12219 12220 12221 12222
##   2     1     1     3     2     1     3     1     3     2     3     3     2
## 12223 12224 12225 12226 12227 12228 12229 12230 12231 12232 12233 12234 12235
##   3     3     2     3     3     1     3     3     3     1     1     3     2
## 12236 12237 12238 12239 12240 12241 12242 12243 12244 12245 12246 12247 12248
##   3     3     3     2     3     1     1     3     2     3     3     3     2
## 12249 12250 12251 12252 12253 12254 12255 12256 12257 12258 12259 12260 12261
##   3     1     3     1     1     2     2     1     3     2     3     3     3
## 12262 12263 12264 12265 12266 12267 12268 12269 12270 12271 12272 12273 12274
##   1     1     3     3     1     3     3     1     3     3     3     3     3
## 12275 12276 12277 12278 12279 12280 12281 12282 12283 12284 12285 12286 12287
##   2     1     3     3     3     2     1     1     3     1     3     3     1
## 12288 12289 12290 12291 12292 12293 12294 12295 12296 12297 12298 12299 12300
##   1     2     3     3     3     2     3     1     2     3     3     3     3
## 12301 12302 12303 12304 12305 12306 12307 12308 12309 12310 12311 12312 12313
##   1     1     3     2     3     1     1     3     3     3     1     3     3
## 12314 12315 12316 12317 12318 12319 12320 12321 12322 12323 12324 12325 12326
##   3     1     2     3     3     2     3     3     1     1     2     3     3
## 12327 12328 12329 12330
##   2     2     2     3

fact_data <- as.numeric(shop$class)
table(res$cluster, fact_data)

##   fact_data
##       0     1
## 1 2833 506
## 2 1713 319
## 3 5757 1083

fact = c("Region", "TrafficType", "Weekend")
for (i in fact) {
  shop[, i] = as.numeric(shop[, i])
}

sapply(factdata, class)

##          Administrative Administrative_Duration           Informational
##                    "numeric"                  "numeric"                  "numeric"
##  Informational_Duration           ProductRelated ProductRelated_Duration
##                    "numeric"                  "numeric"                  "numeric"
##          BounceRates             ExitRates            PageValues
##                    "numeric"                  "numeric"                  "numeric"
##          SpecialDay        OperatingSystems            Browser

```

```

##           "numeric"          "integer"          "integer"
##           Region            TrafficType        Weekend
##           "numeric"          "integer"          "logical"

library("factoextra")

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

library("cluster")

#visualization of the cluster
fviz_cluster(res, data = factdata)

```



```
mean(factdata == res$cluster)
```

```
## [1] 0.05762564
```

The appropriate number of clusters for this model is 3 for the best results. **Hierarchical clustering**

```

# Before hierarchical clustering, we can compute some descriptive statistics
# ---
#
desc_stats <- data.frame(

```

```

Min = apply(factdata, 2, min),      # minimum
Med = apply(factdata, 2, median),   # median
Mean = apply(factdata, 2, mean),    # mean
SD = apply(factdata, 2, sd),       # Standard deviation
Max = apply(factdata, 2, max)      # Maximum
)
desc_stats <- round(desc_stats, 1)
head(desc_stats)

##                                     Min Med Mean SD Max
## Administrative             0   0  0.1 0.1   1
## Administrative_Duration    0   0  0.0 0.1   1
## Informational              0   0  0.0 0.1   1
## Informational_Duration    0   0  0.0 0.1   1
## ProductRelated              0   0  0.0 0.1   1
## ProductRelated_Duration    0   0  0.0 0.0   1

# Calculating euclidean distances of the independent variables.

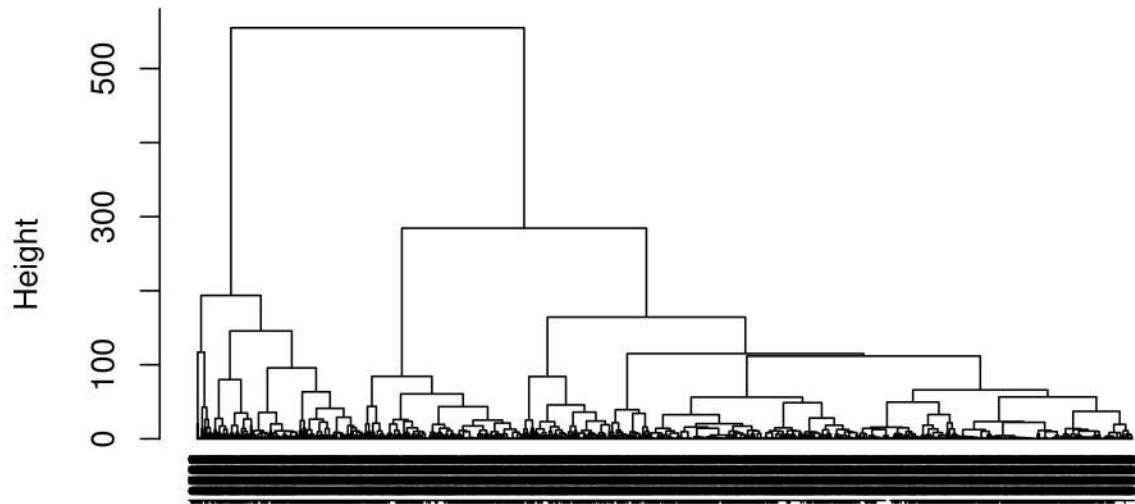
d <- dist(factdata, method = "euclidean")

# using the hclust clustering method.
hie <- hclust(d, method = "ward.D2" )

# plotting the dendrogram
plot(hie, cex = 0.6, hang = -1)

```

Cluster Dendrogram



d
hclust (*, "ward.D2")

```
# Cut tree into 2 groups.  
sub_grp = cutree (hie, k = 2)  
table (sub_grp)
```

```
## sub_grp  
##      1      2  
## 10023  2188
```

```
table (sub_grp, shop.class)
```

```
##          shop.class  
## sub_grp FALSE TRUE  
##      1  8454 1569  
##      2  1849  339
```

```
#checking accuracy  
mean(sub_grp == shop.class)
```

```
## [1] 0.1284907
```

challenging the solution

DBSCAN

```

# Loading the required library
library("dbSCAN")

# Applying our DBSCAN algorithm
# using a minimum of 4 points with in a distance of eps(0.4)
#
l = c('OperatingSystems', 'Browser', 'Region', 'TrafficType')
for (i in l){
  factdata[,i] = as.numeric(factdata[,i])
}
db_model <- dbSCAN(factdata, eps=0.4, MinPts = 4)

## Warning in dbSCAN(factdata, eps = 0.4, MinPts = 4): converting argument MinPts
## (fpc) to minPts (dbSCAN)!

print(db_model)

## DBSCAN clustering for 12211 objects.
## Parameters: eps = 0.4, minPts = 4
## The clustering contains 496 cluster(s) and 2403 noise points.
##
##          0    1    2    3    4    5    6    7    8    9    10   11   12   13   14   15
## 2403  10  571   12  213    4   66   78   40  186   24   50   14   26    5    9
## 16   17   18   19   20   21   22   23   24   25   26   27   28   29   30   31
## 54   13   93   23  310   42   69   17   10    7    9   26    7  212  109    4
## 32   33   34   35   36   37   38   39   40   41   42   43   44   45   46   47
## 10   82  101    5    4  161    6   92   36   19   38   10   28   87   56   36
## 48   49   50   51   52   53   54   55   56   57   58   59   60   61   62   63
## 7    24   11   26   10   11   13   35   14    5    4   38   43    6    8    7
## 64   65   66   67   68   69   70   71   72   73   74   75   76   77   78   79
## 24   9   13   10   21   86    8   19   30   41   20    4  262  119   63    9
## 80   81   82   83   84   85   86   87   88   89   90   91   92   93   94   95
## 101  64   16    7    7   30   49    9   24   15   59    4   13   29   36    8
## 96   97   98   99  100  101  102  103  104  105  106  107  108  109  110  111
## 68   28   12    7   40   97   24   14    5   35   46   43   34   20    8   10
## 112  113  114  115  116  117  118  119  120  121  122  123  124  125  126  127
## 32    6   26   17   21    5    4    8   59   63    4   89   30   16   27   22
## 128  129  130  131  132  133  134  135  136  137  138  139  140  141  142  143
## 18   142    4   10    4   11    6   19   63    8   57   24    7   15   10    9
## 144  145  146  147  148  149  150  151  152  153  154  155  156  157  158  159
## 23   22   26   17   25   16    6   10   12    7   14    8   26   20    4   126
## 160  161  162  163  164  165  166  167  168  169  170  171  172  173  174  175
## 5    40   27   40   27    7    4   13   20    9   16    6   23   11    4    6
## 176  177  178  179  180  181  182  183  184  185  186  187  188  189  190  191
## 15    6   54   27   16    6   19   12   19    8   6   11    8    5    4   12
## 192  193  194  195  196  197  198  199  200  201  202  203  204  205  206  207
## 14   78   22    8   12   33   10   42    5   16    7   47   14    4    7    4
## 208  209  210  211  212  213  214  215  216  217  218  219  220  221  222  223
## 5    11    9    8   19   23   50   16   13   18    5   26    7   12    4    5
## 224  225  226  227  228  229  230  231  232  233  234  235  236  237  238  239
## 25    4    8   13    4   17   10    5    5    4    8   11   14    5    6   11
## 240  241  242  243  244  245  246  247  248  249  250  251  252  253  254  255

```

```

##   30   13    4   20    6   18    6    7    8    5    9   12    4    5   12    4
## 256  257  258  259  260  261  262  263  264  265  266  267  268  269  270  271
##   9   14   12    5    6   22    7    5    5   15    8    4   12    5    6    4
## 272  273  274  275  276  277  278  279  280  281  282  283  284  285  286  287
##   6    4    4   19    5   23    5    7    4    4   6    8    8    6   13   112
## 288  289  290  291  292  293  294  295  296  297  298  299  300  301  302  303
##   5    6    5   13    6    6    4    5    5    4    4    4    4   28    5   11    7
## 304  305  306  307  308  309  310  311  312  313  314  315  316  317  318  319
##   12   4    8   10   13    8    4    7   10    4   10    8   12    4   11    4
## 320  321  322  323  324  325  326  327  328  329  330  331  332  333  334  335
##   4    7   14    9   10    8   12   10   30    7   20   13   134   8   11    5
## 336  337  338  339  340  341  342  343  344  345  346  347  348  349  350  351
##   5    5    9   29    4   15    4   11   52   25   20   39   19    5    7    4
## 352  353  354  355  356  357  358  359  360  361  362  363  364  365  366  367
##   54   24    5   31   13    6    6    8   14    5    4   27    6    5   12    4
## 368  369  370  371  372  373  374  375  376  377  378  379  380  381  382  383
##   6    9   13    5    5    5    4    6    8    6   10    4    5    4   14   13
## 384  385  386  387  388  389  390  391  392  393  394  395  396  397  398  399
##   5   13    6    7    5    7    5    7    4   10    7    5    9    4    4    5
## 400  401  402  403  404  405  406  407  408  409  410  411  412  413  414  415
##   7    4    4   10    7    4    5    7    5    4    5    4    7    4    4    4
## 416  417  418  419  420  421  422  423  424  425  426  427  428  429  430  431
##   4    8    5    4    4    4    7    5    5    4    4    4   13    7    7    6   22
## 432  433  434  435  436  437  438  439  440  441  442  443  444  445  446  447
##   4    7    5    4    4    4    6    4    4    6    8    6    5    4    4    5
## 448  449  450  451  452  453  454  455  456  457  458  459  460  461  462  463
##   7    4    5    4    4    9    4    6   10    4   19    5    5   10    5    4
## 464  465  466  467  468  469  470  471  472  473  474  475  476  477  478  479
##   4    4    4    4    4    4    6    4    4    4    9    4    4    4   43   14    9
## 480  481  482  483  484  485  486  487  488  489  490  491  492  493  494  495
##   6    9   11    4    4    4    8    4    6    4    5    4    3    4    4    4
## 496
##   4
##
## Available fields: cluster, eps, minPts

```

```

library(dbscan)
hullplot(factdata, db_model$cluster)

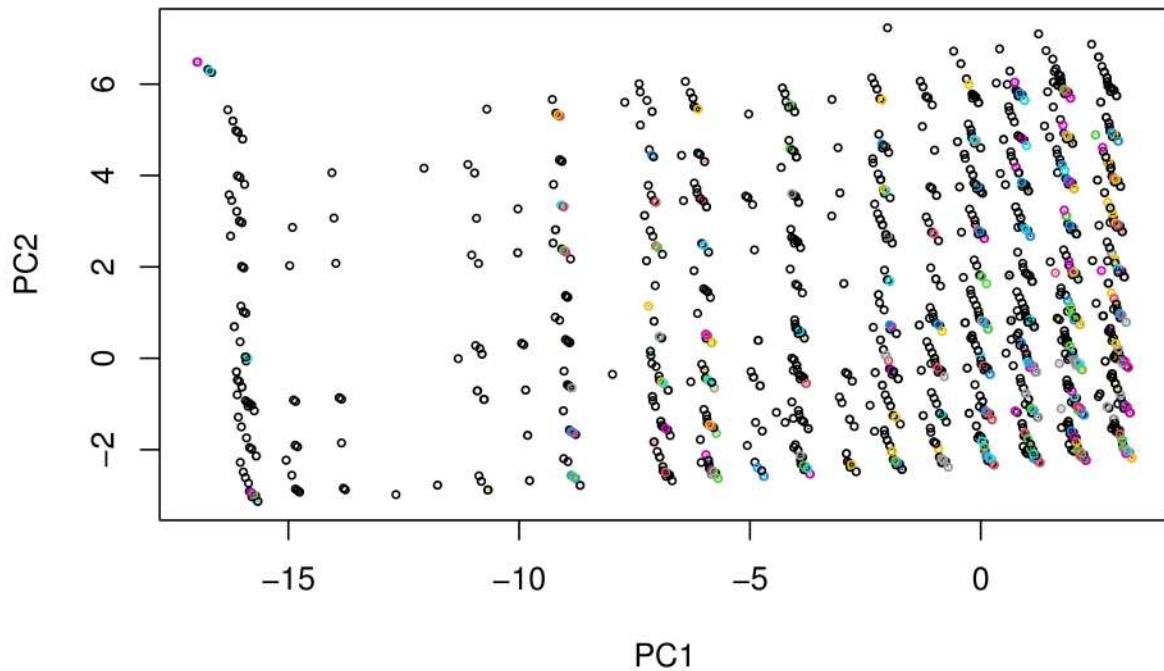
```

```

## Warning in hullplot(factdata, db_model$cluster): Not enough colors. Some colors
## will be reused.

```

Convex Cluster Hulls



Conclusion and Recommendations From the above models performed, K-means has the most clear clusters. I would recommend Kira Plastinina marketers to use K-means for customer segmentation. Also DBSCAN would also be another alternative.