BA Assignment 2

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R Markdown

##Read the Csv and create a data frame

```
library(caret)
```

```
## Loading required package: ggplot2
```

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

```
library(e1071)
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
```

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

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

```
library(ISLR)
library(caret)
getwd()
```

```
## [1] "C:/Users/haris/Documents/Fall 2022/BA/Assignment 2"
```

```
Online_Retaildf <- read.csv("Online_Retail.csv")
Online_Retaildf$Country   = as.factor(Online_Retaildf$Country)
Online_Retaildf$Quantity = as.numeric(Online_Retaildf$Quantity)
summary(Online_Retaildf)
```

```
##   InvoiceNo          StockCode         Description          Quantity
##  Length:541909      Length:541909      Length:541909      Min.   :-80995.00
##  Class :character   Class :character   Class :character   1st Qu.:     1.00
##  Mode  :character   Mode  :character   Mode  :character   Median :     3.00
##                                                           Mean   :     9.55
##                                                           3rd Qu.:    10.00
##                                                           Max.   : 80995.00
##
##  InvoiceDate          UnitPrice           CustomerID
##  Length:541909      Min.   :-11062.06   Min.   :12346
##  Class :character   1st Qu.:     1.25   1st Qu.:13953
##  Mode  :character   Median :     2.08   Median :15152
##                     Mean   :     4.61   Mean   :15288
##                     3rd Qu.:     4.13   3rd Qu.:16791
##                     Max.   : 38970.00   Max.   :18287
##                                         NA's   :135080
##           Country
##  United Kingdom:495478
##  Germany       :  9495
##  France        :  8557
##  EIRE          :  8196
##  Spain         :  2533
##  Netherlands   :  2371
##  (Other)       : 15279
```

1. Show the breakdown of the number of transactions by countries i.e. how many transactions are in the dataset for each country (consider all records including cancelled transactions). Show this in total number and also in percentage. Show only countries accounting for more than 1% of the total transactions.

```
summary(Online_Retaildf$Country)
```

```
##            Australia              Austria              Bahrain
##                 1259                  401                   19
##              Belgium               Brazil               Canada
##                 2069                   32                  151
##      Channel Islands               Cyprus       Czech Republic
##                  758                  622                   30
##              Denmark                 EIRE   European Community
##                  389                 8196                   61
##              Finland               France              Germany
##                  695                 8557                 9495
##               Greece            Hong Kong              Iceland
##                  146                  288                  182
##               Israel                Italy                Japan
##                  297                  803                  358
##              Lebanon            Lithuania                Malta
```

```
##                  45                  35                 127
##          Netherlands              Norway              Poland
##                2371                1086                 341
##            Portugal                 RSA        Saudi Arabia
##                1519                  58                  10
##           Singapore               Spain              Sweden
##                 229                2533                 462
##         Switzerland United Arab Emirates      United Kingdom
##                2002                  68              495478
##         Unspecified                 USA
##                 446                 291
```

```
Countries_Count <- table(Online_Retaildf$Country)
prop.table(Countries_Count) # We need to know the country values as a whole of countries
```

```
##
##           Australia             Austria             Bahrain
##        2.323268e-03        7.399766e-04        3.506124e-05
##             Belgium              Brazil              Canada
##        3.817984e-03        5.905050e-05        2.786446e-04
##     Channel Islands              Cyprus      Czech Republic
##        1.398759e-03        1.147794e-03        5.535985e-05
##             Denmark                EIRE   European Community
##        7.178327e-04        1.512431e-02        1.125650e-04
##             Finland              France             Germany
##        1.282503e-03        1.579047e-02        1.752139e-02
##              Greece           Hong Kong             Iceland
##        2.694179e-04        5.314545e-04        3.358497e-04
##              Israel               Italy               Japan
##        5.480625e-04        1.481799e-03        6.606275e-04
##             Lebanon           Lithuania               Malta
##        8.303977e-05        6.458649e-05        2.343567e-04
##          Netherlands              Norway              Poland
##        4.375273e-03        2.004027e-03        6.292569e-04
##             Portugal                RSA        Saudi Arabia
##        2.803054e-03        1.070290e-04        1.845328e-05
##            Singapore               Spain              Sweden
##        4.225802e-04        4.674217e-03        8.525417e-04
##          Switzerland United Arab Emirates      United Kingdom
##        3.694347e-03        1.254823e-04        9.143196e-01
##          Unspecified                 USA
##        8.230164e-04        5.369905e-04
```

```
Percentage_Transaction <- round(100*prop.table(Countries_Count),digits = 3) #prop.table is used to roun
Percent_Table <- cbind(Countries_Count,Percentage_Transaction) # We get the transaction value of each c
Value <- subset(Percent_Table,Percentage_Transaction>1)
```

2. Create a new variable 'TransactionValue' that is the product of the exising 'Quantity' and 'UnitPrice' variables. Add this variable to the dataframe.

```
#TransactionValue <- Quantity * UnitPrice
#creating new variable. Variable here refers to the column
```

```
library(dplyr)
TransactionValue = Online_Retaildf$Quantity * Online_Retaildf$UnitPrice
Online_Retaildf$TransactionValue <- TransactionValue #Assigning it to the dataframe as Transactionvalue
summary(TransactionValue)
```

```
##       Min.    1st Qu.     Median       Mean    3rd Qu.       Max.
## -168469.60       3.40       9.75      17.99      17.40  168469.60
```

3. Using the newly created variable, TransactionValue, show the breakdown of transaction values by countries i.e. how much money in total has been spent each country. Show this in total sum of transaction values. Show only countries with total transaction exceeding 130,000 British Pound.

```
EachCountryTransaction <-
  group_by(Online_Retaildf,Country)%>%summarize(transactionvalue=sum(TransactionValue))
EachCountryTransaction
```

```
## # A tibble: 38 x 2
##    Country         transactionvalue
##    <fct>                      <dbl>
##  1 Australia                137077.
##  2 Austria                   10154.
##  3 Bahrain                     548.
##  4 Belgium                   40911.
##  5 Brazil                     1144.
##  6 Canada                     3666.
##  7 Channel Islands           20086.
##  8 Cyprus                    12946.
##  9 Czech Republic              708.
## 10 Denmark                   18768.
## # ... with 28 more rows
```

```
TransactionAbove130 <- filter(EachCountryTransaction,transactionvalue >130000)
TransactionAbove130
```

```
## # A tibble: 6 x 2
##   Country        transactionvalue
##   <fct>                     <dbl>
## 1 Australia               137077.
## 2 EIRE                    263277.
## 3 France                  197404.
## 4 Germany                 221698.
## 5 Netherlands             284662.
## 6 United Kingdom         8187806.
```

4. This is an optional question which carries additional marks (golden questions). In this question, we are dealing with the InvoiceDate variable. The variable is read as a categorical when you read data from the file. Now we need to explicitly instruct R to interpret this as a Date variable. "POSIXlt" and "POSIXct" are two powerful object classes in R to deal with date and time. Click here for more information. First let's convert 'InvoiceDate' into a POSIXlt object:

```
Temp=strptime(Online_Retaildf$InvoiceDate,format='%m/%d/%Y %H:%M',tz='GMT')
Online_Retaildf$New_Invoice_Date <- as.Date(Temp)
Online_Retaildf$New_Invoice_Date[20000]- Online_Retaildf$New_Invoice_Date[10]
```

```
## Time difference of 8 days
```

```
Online_Retaildf$Invoice_Day_Week= weekdays(Online_Retaildf$New_Invoice_Date)
Online_Retaildf$New_Invoice_Hour = as.numeric(format(Temp, "%H"))
Online_Retaildf$New_Invoice_Month = as.numeric(format(Temp, "%m"))
Online_Retaildf$New_Invoice_Year = as.numeric(format(Temp,"%y"))
```

a) Show the percentage of transactions (by numbers) by days of the week (extra 2 marks)

```
# For transactions of days of the weeks, frequencyof the days is calculated and divide by Quantity. Per
TotalTransaction = length(Online_Retaildf$TransactionValue)
TotalTransaction # Total of 541909 Transaction
```

```
## [1] 541909
```

```
Days <- table(Online_Retaildf$Invoice_Day_Week)
Days
```

```
##
##    Friday    Monday    Sunday  Thursday   Tuesday Wednesday
##     82193     95111     64375    103857    101808     94565
```

```
sum(Days)
```

```
## [1] 541909
```

```
#Sunday=64375
Sunday = 64375
Sunday_Percent= Sunday / TotalTransaction

#Monday=95111
Monday = 95111
Monday_Percent = Monday / TotalTransaction

#Tuesday=101808
Tuesday = 101808
Tuesday_Percent = Tuesday / TotalTransaction

#Wednesday=94565
Wednesday = 94565
Wednesday_Percent = Wednesday / TotalTransaction
#Thursday = 103857
Thursday = 103857
Thursday_Percent = Thursday / TotalTransaction
```

```r
#Friday = 82193
Friday = 82193
Friday_Percent = Friday / TotalTransaction
Days_Percent <- data.frame(Sunday_Percent,Monday_Percent,Tuesday_Percent,Wednesday_Percent,Thursday_Per
Days_Percent
```

```
##   Sunday_Percent Monday_Percent Tuesday_Percent Wednesday_Percent
## 1       0.118793       0.175511       0.1878692         0.1745035
##   Thursday_Percent Friday_Percent
## 1        0.1916503      0.1516731
```

b) Show the percentage of transactions (by transaction volume) by days of the week

```r
# The Transaction volume ( Products per order ) is calculated individually for every day.
Trans_Vol <- Online_Retaildf %>% select(Invoice_Day_Week,Quantity) %>% filter(Invoice_Day_Week == "Sunda
Sunday_sum <- sum(Trans_Vol$Quantity)
Trans_Vol <- Online_Retaildf %>% select(Invoice_Day_Week,Quantity) %>% filter(Invoice_Day_Week == "Monda
Monday_sum <- sum(Trans_Vol$Quantity)
Trans_Vol <- Online_Retaildf %>% select(Invoice_Day_Week,Quantity) %>% filter(Invoice_Day_Week == "Tuesd
Tuesday_sum <- sum(Trans_Vol$Quantity)
Trans_Vol <- Online_Retaildf %>% select(Invoice_Day_Week,Quantity) %>% filter(Invoice_Day_Week == "Wedne
Wednesday_sum <- sum(Trans_Vol$Quantity)
Trans_Vol <- Online_Retaildf %>% select(Invoice_Day_Week,Quantity) %>% filter(Invoice_Day_Week == "Thurs
Thursday_sum <- sum(Trans_Vol$Quantity)
Trans_Vol <- Online_Retaildf %>% select(Invoice_Day_Week,Quantity) %>% filter(Invoice_Day_Week == "Frida
Friday_sum <- sum(Trans_Vol$Quantity)
data.frame(Sunday_sum,Monday_sum,Tuesday_sum,Wednesday_sum,Thursday_sum,Friday_sum)  # we can get a com
```

```
##   Sunday_sum Monday_sum Tuesday_sum Wednesday_sum Thursday_sum Friday_sum
## 1     467732     815354      961543        969558      1167823     794440
```

```r
# Percentage of transaction, dividing the day sum by the total transaction per week, we get individual
Transaction_percent_week = sum(Online_Retaildf$Quantity)
Sunday_Vol = Sunday_sum / Transaction_percent_week
Monday_Vol = Monday_sum / Transaction_percent_week
Tuesday_Vol = Tuesday_sum / Transaction_percent_week
Wednesday_Vol = Wednesday_sum / Transaction_percent_week
Thursday_Vol = Thursday_sum / Transaction_percent_week
Friday_Vol = Friday_sum / Transaction_percent_week
data.frame(Transaction_percent_week,Sunday_Vol,Monday_Vol,Tuesday_Vol,Wednesday_Vol,Thursday_Vol,Friday_
```

```
##   Transaction_percent_week Sunday_Vol Monday_Vol Tuesday_Vol Wednesday_Vol
## 1                  5176450 0.09035768  0.1575122   0.1857534     0.1873017
##   Thursday_Vol Friday_Vol
## 1    0.2256031   0.153472
```

c) Show the percentage of transactions (by transaction volume) by month of the year

```r
#Monthly transactions can be achieved by taking Invoice month, Year and also Quantity
Transaction_Month <- Online_Retaildf %>% select(New_Invoice_Month,Quantity,New_Invoice_Year) %>% filter
count(New_Invoice_Month)
data.frame(Transaction_Month)
```

```
##    New_Invoice_Month     n
## 1                  1 35147
## 2                  2 27707
## 3                  3 36748
## 4                  4 29916
## 5                  5 37030
## 6                  6 36874
## 7                  7 39518
## 8                  8 35284
## 9                  9 50226
## 10                10 60742
## 11                11 84711
## 12                12 68006
```

d) What was the date with the highest number of transactions from Australia?

```
# by using the pipeline function we can select the required coulumn which are invoice date as date is r
Australia = Online_Retaildf%>%select(Quantity,Country,TransactionValue,InvoiceDate)%>% filter(Country ==
Australia
```

```
##         InvoiceDate   n
## 1    1/10/2011 9:58   1
## 2    1/11/2011 9:47  19
## 3   1/14/2011 11:36   3
## 4   1/17/2011 11:12  19
## 5    1/19/2011 9:13  13
## 6   1/20/2011 12:11   4
## 7   1/28/2011 14:37  20
## 8    1/6/2011 11:12  46
## 9    1/6/2011 12:37   2
## 10  10/5/2011 12:35   1
## 11  10/5/2011 12:44  81
## 12   10/6/2011 9:31  27
## 13   10/6/2011 9:32   5
## 14 11/15/2011 10:32  26
## 15 11/15/2011 14:22   1
## 16  11/2/2011 12:03   1
## 17  11/2/2011 12:05   1
## 18 11/24/2011 12:30   8
## 19  11/3/2011 11:26   5
## 20  11/4/2011 10:18   1
## 21  11/4/2011 11:55   2
## 22  12/1/2010 10:03  14
## 23 12/14/2010 11:12   3
## 24 12/17/2010 14:10  10
## 25   12/8/2010 9:53   8
## 26   2/15/2011 9:52  69
## 27  2/27/2011 14:43  10
## 28   2/7/2011 13:59   6
## 29   2/7/2011 15:01   2
## 30   2/7/2011 15:09   2
## 31   2/7/2011 15:10   2
## 32  3/24/2011 13:05  16
```

```
## 33   3/3/2011 10:59  82
## 34   3/3/2011 13:11   2
## 35   3/9/2011 15:47  10
## 36   4/1/2011 14:28   1
## 37   4/28/2011 9:49   1
## 38    4/4/2011 9:57   1
## 39    4/8/2011 9:45  17
## 40  5/12/2011 12:34  23
## 41  5/17/2011 15:42  73
## 42  5/20/2011 14:13   4
## 43   5/23/2011 9:14  17
## 44  5/31/2011 11:29   1
## 45  6/15/2011 13:37 139
## 46    6/2/2011 9:57   2
## 47  6/30/2011 12:06  30
## 48  7/13/2011 15:30  22
## 49  7/13/2011 15:31   1
## 50  7/14/2011 13:28  35
## 51  7/19/2011 10:42  23
## 52  7/19/2011 10:51  57
## 53  7/19/2011 12:26  57
## 54  7/24/2011 12:05  20
## 55  7/26/2011 10:15   1
## 56  7/26/2011 10:16   1
## 57  8/12/2011 14:19  10
## 58   8/18/2011 8:51  97
## 59   9/1/2011 13:50   8
## 60   9/1/2011 13:51   1
## 61  9/16/2011 12:38  34
## 62  9/25/2011 11:30  22
## 63  9/28/2011 14:26   2
## 64  9/28/2011 14:55   4
## 65  9/28/2011 15:41  25
## 66    9/5/2011 9:48   8
```

```
max(Australia$n) #139 is the highest
```

```
## [1] 139
```

```
which.max(Australia$n)
```

```
## [1] 45
```

```
Final_Value<- Australia[45,] # The location of 139 is 45 from the list below, by using the index value
data.frame(Final_Value)
```

```
##        InvoiceDate   n
## 45 6/15/2011 13:37 139
```

e) The company needs to shut down the website for two consecutive hours for maintenance. What would be the hour of the day to start this so that the distribution is at minimum for the customers? The responsible IT team is available from 7:00 to 20:00 every day.

```
Maintainence_Time <-Online_Retaildf %>% select(Quantity,New_Invoice_Hour,New_Invoice_Date) %>% filter(N
which.min(Maintainence_Time$Quantity)
```

```
## [1] 131
```

```
which.min(Maintainence_Time$n)
```

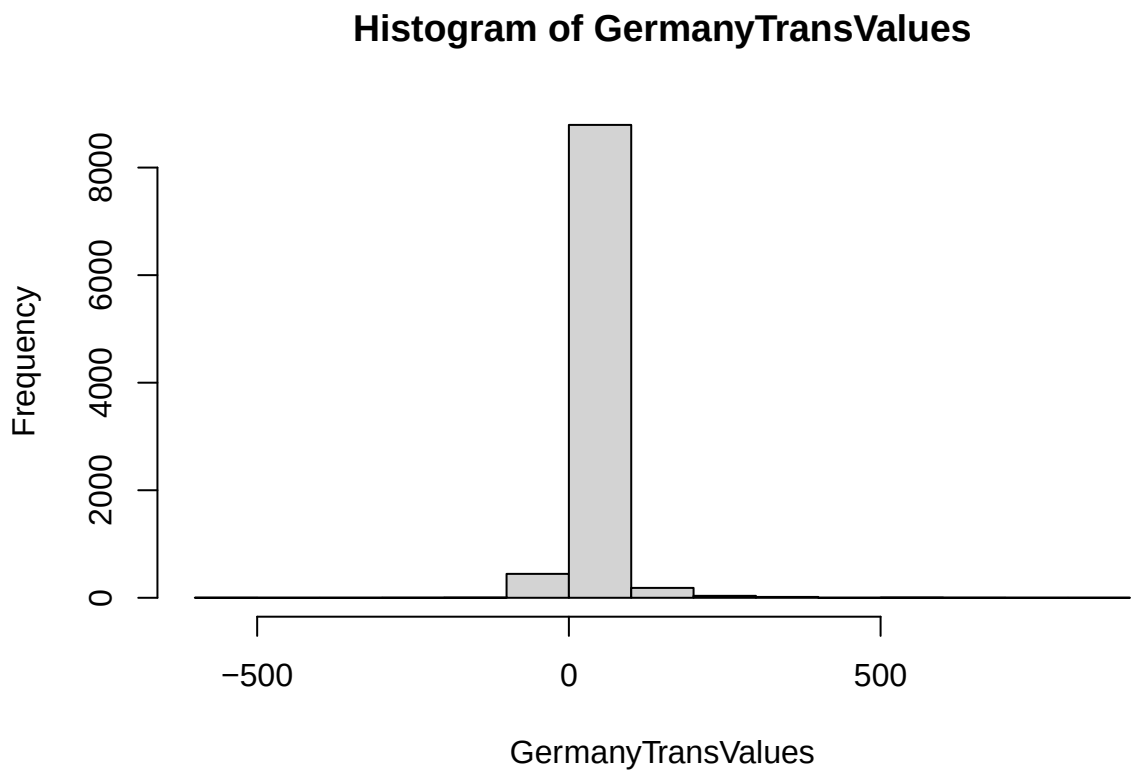
```
## [1] 1
```

```
Minimum_Quantity<- Maintainence_Time["131",]
Minimum_Ret<-Maintainence_Time["1",]
data.frame(Minimum_Quantity,Minimum_Ret)
```

```
##     New_Invoice_Hour Quantity n New_Invoice_Hour.1 Quantity.1 n.1
## 131                9   -80995 1                 7         -4   1
```

5. Plot the histogram of transaction values from Germany. Use the hist() function to plot.

```
GermanyTransValues <- subset(TransactionValue,Online_Retaildf$Country == 'Germany')
#GermanyTransValues
hist(GermanyTransValues)
```



6. Which customer had the highest number of transactions? Which customer is most valuable (i.e. highest total sum of transactions)? (10 marks)

```
Cust_Transaction <-  Online_Retaildf %>% select(CustomerID,Quantity,TransactionValue) %>% count(Customer
which.max(Cust_Transaction$n)
```

```
## [1] 4373
```

```
Cust_Transaction["4373",] #Here we are getting a value which is NA. So it is a missing value
```

```
##      CustomerID      n
## 4373         NA 135080
```

```
#Valuable customer in this case is as follows:
Most_Valuable_CustomerNA <- group_by(Online_Retaildf,CustomerID) %>% summarize(CustomerValNA = sum(Trans
which.max(Most_Valuable_CustomerNA$CustomerValNA)
```

```
## [1] 4373
```

```
Most_Valuable_CustomerNA["4373",]
```

```
## # A tibble: 1 x 2
##   CustomerID CustomerValNA
##        <int>         <dbl>
## 1         NA      1447682.
```

```
Missing_Value_Removal <- na.omit(Online_Retaildf %>% select(CustomerID, Quantity, TransactionValue)%>% c
which.max(Missing_Value_Removal$n)
```

```
## [1] 4043
```

```
Missing_Value_Removal["4043",]
```

```
##      CustomerID    n
## 4043      17841 7983
```

```
#Valuable customer in this case wheere we have removed the missing cases is as follows:
Most_Val_Customer <- na.omit(group_by(Online_Retaildf,CustomerID) %>% summarize(Customer_Value = sum(Tra
which.max(Most_Val_Customer$Customer_Value)
```

```
## [1] 1704
```

```
Most_Val_Customer["1704",]
```

```
## # A tibble: 1 x 2
##   CustomerID Customer_Value
##        <int>          <dbl>
## 1      14646        279489.
```

7. Calculate the percentage of missing values for each variable in the dataset . Hint colMeans():

```
# For the missing values, is.na is used here
colMeans(is.na(Online_Retaildf))
```

```
##         InvoiceNo         StockCode       Description          Quantity
##         0.0000000         0.0000000         0.0000000         0.0000000
##       InvoiceDate         UnitPrice        CustomerID           Country
##         0.0000000         0.0000000         0.2492669         0.0000000
##  TransactionValue  New_Invoice_Date  Invoice_Day_Week  New_Invoice_Hour
##         0.0000000         0.0000000         0.0000000         0.0000000
## New_Invoice_Month  New_Invoice_Year
##         0.0000000         0.0000000
```

8. What are the number of transactions with missing CustomerID records by countries? (10 marks)

```
#   is.na funtion is used here to find missing customer ID records by countries
Online_Retaildf %>%select(Country,CustomerID) %>% filter(is.na(Online_Retaildf$CustomerID)) %>% count (
```

```
##          Country      n
## 1        Bahrain      2
## 2           EIRE    711
## 3         France     66
## 4      Hong Kong    288
## 5         Israel     47
## 6       Portugal     39
## 7    Switzerland    125
## 8 United Kingdom 133600
## 9    Unspecified    202
```

9. On average, how often the costumers comeback to the website for their next shopping? (i.e. what is the average number of days between consecutive shopping) (Optional/Golden question: 18 additional marks!) Hint: 1. A close approximation is also acceptable and you may find diff() function useful.

```
Comeback_df <- table (Online_Retaildf$Invoice_Day_Week,Online_Retaildf$New_Invoice_Date)
Updated_Comeback_df<- diff(Comeback_df)
mean(Updated_Comeback_df)
```

```
## [1] 8.112787
```

10. In the retail sector, it is very important to understand the return rate of the goods purchased by customers. In this example, we can define this quantity, simply, as the ratio of the number of transactions cancelled (regardless of the transaction value) over the total number of transactions. With this definition, what is the return rate for the French customers? (10 marks). Consider the cancelled transactions as those where the 'Quantity' variable has a negative value.

```
 #We need to calculate the percentage of cancelled order with reference to the total orders in france.
France_Transaction <- Online_Retaildf%>% select(Quantity,Country) %>% filter (Country == "France") # Fr
Length_French_Orders <- length(France_Transaction$Quantity)
 #If the quantity value is less than 0, then we can consider it as a cancelled transaction
Cancelled_Transactions <- Online_Retaildf%>% select(Quantity,Country) %>% filter (Country == "France",Q
French_Cancelled <-length(Cancelled_Transactions$Quantity)
#We perform cancelled order divided by total orders for France
Percentage_France <-  French_Cancelled / Length_French_Orders
Percentage_France
```

```
## [1] 0.01741264
```

```
data.frame(Length_French_Orders,French_Cancelled,Percentage_France)
```

```
##   Length_French_Orders French_Cancelled Percentage_France
## 1                 8557              149        0.01741264
```

11. What is the product that has generated the highest revenue for the retailer? (i.e. item with the highest total sum of 'TransactionValue').

```
HighestRevenue <- group_by(Online_Retaildf,Description) %>% summarize(Item = sum(TransactionValue))
which.max(HighestRevenue$Item)
```

```
## [1] 1144
```

```
# Index is 1140
HighestRevenue["1140",]
```

```
## # A tibble: 1 x 2
##   Description               Item
##   <chr>                    <dbl>
## 1 DOORSTOP RETROSPOT HEART 6462.
```

12. How many unique customers are represented in the dataset? You can use unique() and length() functions.

```
# ssapply() function in R Language takes list, vector or data frame as Online_Retaildf and gives output
Unique_Customer <- sapply(Online_Retaildf, function(Online_Retaildf) length(unique(Online_Retaildf)))
Unique_Customer
```

```
##         InvoiceNo         StockCode       Description          Quantity
##             25900              4070              4224               722
##       InvoiceDate         UnitPrice        CustomerID           Country
##             23260              1630              4373                38
##  TransactionValue  New_Invoice_Date  Invoice_Day_Week  New_Invoice_Hour
##              6204               305                 6                15
## New_Invoice_Month  New_Invoice_Year
##                12                 2
```

```
Unique_ID <- length(unique(Online_Retaildf$CustomerID))
Unique_ID
```

```
## [1] 4373
```