Assignment 2

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Importing dataset

```
OnlineRetail<- read.csv("Online_Retail.csv")
```

Importing required libraries

```
#install.packages("tidyverse")

library(tidyverse)
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse
1.3.2 ──
## ✓ ggplot2 3.3.6     ✓ purrr   0.3.4
## ✓ tibble  3.1.8     ✓ dplyr   1.0.9
## ✓ tidyr   1.2.1     ✓ stringr 1.4.1
## ✓ readr   2.1.2     ✓ forcats 0.5.2
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
```

```
library(readr)
library(dplyr)
```

The first 6 columns of the dataset

```
head(OnlineRetail)
```

```
##   InvoiceNo StockCode                         Description Quantity
## 1    536365    85123A  WHITE HANGING HEART T-LIGHT HOLDER        6
## 2    536365     71053                 WHITE METAL LANTERN        6
## 3    536365    84406B      CREAM CUPID HEARTS COAT HANGER        8
## 4    536365    84029G KNITTED UNION FLAG HOT WATER BOTTLE        6
## 5    536365    84029E      RED WOOLLY HOTTIE WHITE HEART.        6
## 6    536365     22752        SET 7 BABUSHKA NESTING BOXES        2
##      InvoiceDate UnitPrice CustomerID        Country
## 1 12/1/2010 8:26      2.55      17850 United Kingdom
## 2 12/1/2010 8:26      3.39      17850 United Kingdom
## 3 12/1/2010 8:26      2.75      17850 United Kingdom
## 4 12/1/2010 8:26      3.39      17850 United Kingdom
```

```
## 5 12/1/2010 8:26      3.39      17850 United Kingdom
## 6 12/1/2010 8:26      7.65      17850 United Kingdom
```

Data Exploration

```
# Getting the descriptive statistics

summary(OnlineRetail)

##   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       Country
##  Length:541909      Min.   :-11062.06   Min.   :12346    Length:541909
##  Class :character   1st Qu.:     1.25   1st Qu.:13953    Class :character
##  Mode  :character   Median :     2.08   Median :15152    Mode  :character
##                     Mean   :     4.61   Mean   :15288
##                     3rd Qu.:     4.13   3rd Qu.:16791
##                     Max.   : 38970.00   Max.   :18287
##                                         NA's   :135080
```

Question 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.

```
# Number of transactions by countries

Transactions<- table(OnlineRetail$Country)
head(Transactions)

##
## Australia   Austria   Bahrain   Belgium    Brazil    Canada
##      1259       401        19      2069        32       151

# Countries accounting for more than 1% of the total transactions.
```

```
Trans_Countries<- OnlineRetail %>% group_by(Country)%>%
summarise(Total_Trans= n(), Total_Perc=
sum(n()/length(OnlineRetail$Country)*100)) %>% filter(Total_Perc >1)

# Dataframe for the Number of countries with more than 1% of the total
transactions
head(Trans_Countries)
```

```
## # A tibble: 4 × 3
##   Country        Total_Trans Total_Perc
##   <chr>                <int>      <dbl>
## 1 EIRE                  8196       1.51
## 2 France                8557       1.58
## 3 Germany               9495       1.75
## 4 United Kingdom      495478      91.4
```

EIRE, FRANCE, GERMANY, and UNITED KINGDOM are the countries with more than 1% of the total transactions.

Question 2:

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

```
# Creation of new variable 'TransactionValue'.

OnlineRetail <- OnlineRetail %>% mutate(TransactionValue= Quantity *
UnitPrice)

# Rows and columns of the dataset

head(OnlineRetail)
```

```
##   InvoiceNo StockCode                          Description Quantity
## 1    536365    85123A  WHITE HANGING HEART T-LIGHT HOLDER        6
## 2    536365     71053                 WHITE METAL LANTERN        6
## 3    536365    84406B      CREAM CUPID HEARTS COAT HANGER        8
## 4    536365    84029G KNITTED UNION FLAG HOT WATER BOTTLE        6
## 5    536365    84029E      RED WOOLLY HOTTIE WHITE HEART.        6
## 6    536365     22752        SET 7 BABUSHKA NESTING BOXES        2
##      InvoiceDate UnitPrice CustomerID        Country TransactionValue
## 1 12/1/2010 8:26      2.55      17850 United Kingdom            15.30
## 2 12/1/2010 8:26      3.39      17850 United Kingdom            20.34
## 3 12/1/2010 8:26      2.75      17850 United Kingdom            22.00
## 4 12/1/2010 8:26      3.39      17850 United Kingdom            20.34
## 5 12/1/2010 8:26      3.39      17850 United Kingdom            20.34
## 6 12/1/2010 8:26      7.65      17850 United Kingdom            15.30
```

Question 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.

```
# Countries with total transaction exceeding 130,000 British Pound

BritishPound <- OnlineRetail %>% select(Country, TransactionValue)%>%
group_by(Country) %>% summarise(Transactions= sum(TransactionValue))%>%
filter(Transactions >130000)

as.data.frame(BritishPound)
```

```
##          Country Transactions
## 1      Australia     137077.3
## 2           EIRE     263276.8
## 3         France     197403.9
## 4        Germany     221698.2
## 5    Netherlands     284661.5
## 6 United Kingdom    8187806.4
```

There are in total 6 countries whose transactions exceed 130,000 British Pound out of which United Kingdom has the highest transaction.

Question 4:

Converting InvoiceDate variable to Date variable

```
# First let's convert 'InvoiceDate' into a POSIXlt object:

Temp=strptime(OnlineRetail$InvoiceDate,format='%m/%d/%Y %H:%M',tz='GMT')

# Checking the variable

head(Temp)
```

```
## [1] "2010-12-01 08:26:00 GMT" "2010-12-01 08:26:00 GMT"
## [3] "2010-12-01 08:26:00 GMT" "2010-12-01 08:26:00 GMT"
## [5] "2010-12-01 08:26:00 GMT" "2010-12-01 08:26:00 GMT"
```

```
#Now, let's separate date, day of the week and hour components
dataframe with names as New_Invoice_Date,Invoice_Day_Week and
New_Invoice_Hour:

OnlineRetail$New_Invoice_Date <- as.Date(Temp)

# Knowing two date values, the object allows you to know the difference
between the two dates in terms of the number days.

OnlineRetail$New_Invoice_Date[20000]-OnlineRetail$New_Invoice_Date[10]
```

```
## Time difference of 8 days

# Converting dates to days of the week. Let's define a new variable for that

OnlineRetail$Invoice_Day_Week= weekdays(OnlineRetail$New_Invoice_Date)

# For the Hour, let's just take the hour (ignore the minute) and
convert into a normal numerical value:

OnlineRetail$New_Invoice_Hour = as.numeric(format(Temp, "%H"))

# Finally, lets define the month as a separate numeric variable too:

OnlineRetail$New_Invoice_Month = as.numeric(format(Temp, "%m"))

# Dataset with new columns

OnlineRetail[1:6,10:13]

##   New_Invoice_Date Invoice_Day_Week New_Invoice_Hour New_Invoice_Month
## 1       2010-12-01        Wednesday                8                 12
## 2       2010-12-01        Wednesday                8                 12
## 3       2010-12-01        Wednesday                8                 12
## 4       2010-12-01        Wednesday                8                 12
## 5       2010-12-01        Wednesday                8                 12
## 6       2010-12-01        Wednesday                8                 12
```

Now answer the following questions.

a) Show the percentage of transactions (by numbers) by days of the week.

```
# Getting the total no.of day transactions and its percentage

Day_Percent <- OnlineRetail %>% group_by(Invoice_Day_Week) %>%
summarise(Trans_Number= n(), Percent=
sum(n()/length(OnlineRetail$Invoice_Day_Week)*100))

#Show the dataframe

as.data.frame(Day_Percent)

##   Invoice_Day_Week Trans_Number  Percent
## 1           Friday        82193 15.16731
## 2           Monday        95111 17.55110
## 3           Sunday        64375 11.87930
## 4         Thursday       103857 19.16503
## 5          Tuesday       101808 18.78692
## 6        Wednesday        94565 17.45035
```

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

```
# Getting the total volume of transactions by week and it's percentage

Totalday_percent <- OnlineRetail%>% group_by(Invoice_Day_Week)%>%
summarise(Total_trans= sum(TransactionValue))%>% mutate(Percent=
Total_trans/sum(Total_trans)*100)

as.data.frame(Totalday_percent)

##   Invoice_Day_Week Total_trans   Percent
## 1           Friday   1540610.8 15.804787
## 2           Monday   1588609.4 16.297194
## 3           Sunday    805678.9  8.265282
## 4         Thursday   2112519.0 21.671867
## 5          Tuesday   1966182.8 20.170636
## 6        Wednesday   1734147.0 17.790232
```

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

```
# Getting total transaction value by months and it's percent

Totalmonth_percent <- OnlineRetail%>% group_by(New_Invoice_Month)%>%
summarise(Total_trans= sum(TransactionValue))%>% mutate(Percent=
Total_trans/sum(Total_trans)*100)

as.data.frame((Totalmonth_percent))

##    New_Invoice_Month Total_trans   Percent
## 1                  1    560000.3  5.744919
## 2                  2    498062.6  5.109515
## 3                  3    683267.1  7.009487
## 4                  4    493207.1  5.059703
## 5                  5    723333.5  7.420519
## 6                  6    691123.1  7.090080
## 7                  7    681300.1  6.989308
## 8                  8    682680.5  7.003469
## 9                  9   1019687.6 10.460751
## 10                10   1070704.7 10.984123
## 11                11   1461756.2 14.995836
## 12                12   1182625.0 12.132290
```

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

```
# Selecting the date with highest number of transactions from Australia

Highest_num<- OnlineRetail%>% filter(OnlineRetail$Country == "Australia")%>%
group_by(New_Invoice_Date)%>% summarise(Aus_TransactionValue= n())%>%
top_n(1, Aus_TransactionValue)

as.data.frame(Highest_num)

##   New_Invoice_Date Aus_TransactionValue
## 1       2011-06-15                  139
```

On 2011-06-15 Australia recorded the highest number of transactions i.e., 139.

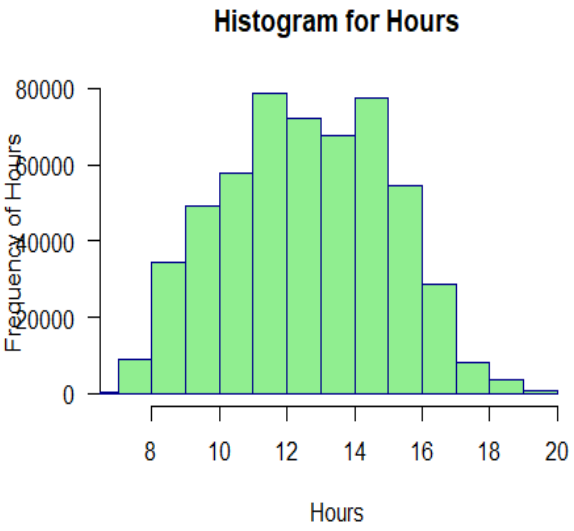
e) The company needs to shut down the website for two consecutive hours for maintenance. What would be the hour of the day to start this so that the distribution is at minimum for the customers? The responsible IT team is available from 7:00 to 20:00 every day.

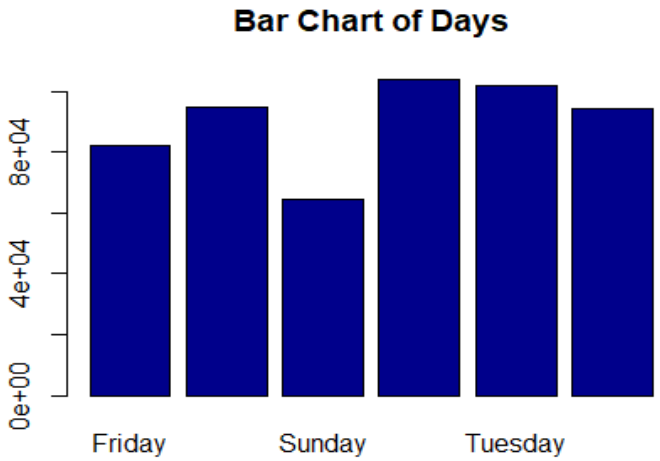
```
# Histogram for hours

hist(OnlineRetail$New_Invoice_Hour, main= "Histogram for Hours",xlab=
"Hours", ylab= "Frequency of Hours",border= "Dark blue",col= "Light green",
las=1, xlim=c(7,20), breaks= 12)

# Bar Chart to identify

barplot(table(OnlineRetail$Invoice_Day_Week), main="Bar Chart of Days",col="
Dark Blue")
```





From the Histogram and the Bar chart we can interpret that the best hours to do the maintenance of the company's website are between 18:00- 20:00. Moreover, Sunday would be the great day to do the maintenance.

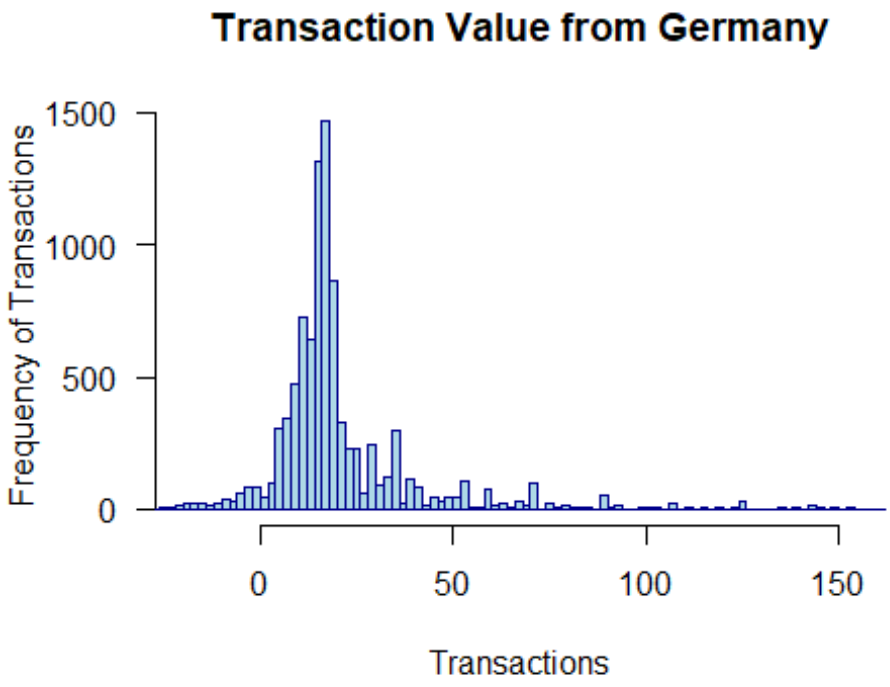
5. Plot the histogram of transaction values from Germany. Use the hist() function to plot.

```
# Getting the transaction values from Germany

Germany <- select(OnlineRetail,TransactionValue, Country)%>%
filter(OnlineRetail$Country == "Germany")
```

```
# Histogram for transaction values from Germany

hist(Germany$TransactionValue,xlab= "Transactions",ylab= "Frequency of
Transactions",xlim=c(-20,155),las=1, breaks= 600,col= "light
blue",border="dark blue", main="Transaction Value from Germany")
```



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

```
# Customer with the highest number of transactions

Valuable_customer <- OnlineRetail %>% na.omit()%>% group_by(CustomerID)%>%
summarise(Num_highest = n())%>% top_n(1,Num_highest)

as.data.frame(Valuable_customer)

##   CustomerID Num_highest
## 1      17841        7983
```

The customer with CustomerID 17841 had the highest number of transactions amongst the others with a total of 7983.

```
# Valuable customer with the highest Volume of transactions

Valuable_customer <- OnlineRetail%>% na.omit()%>% group_by(CustomerID)%>%
summarise(High_transaction= sum(TransactionValue))%>%
top_n(1,High_transaction)
```

```
as.data.frame(Valuable_customer)
```

```
##   CustomerID High_transaction
## 1      14646           279489
```

The customer with CustomerID 14646 is the valuable customer with the highest transaction sum of 279489 British Sterling Pound.

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

```
percent_missing <- colMeans(is.na(OnlineRetail))

as.data.frame(percent_missing)
```

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

Out of all the Variables in the dataset CustomerID is the only attribute with 24.92669% of NAs.

8. **What are the number of transactions with missing CustomerID records by countries?**

```
 # Number of Transactions with missing CustomerID records by countries

ID_missing<- OnlineRetail%>% group_by(Country, CustomerID)%>%
filter(is.na(CustomerID)) %>% summarise(Num_trans= n())
```

```
## `summarise()` has grouped output by 'Country'. You can override using the
## `.groups` argument.
```

```
as.data.frame(ID_missing)
```

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

There are 9 countries with missing CustomerID records, out of which the United Kingdom is the highest with 133600 missing values.

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)**

```
# Days average between consecutive shopping

Days_Avg <- OnlineRetail %>% select(CustomerID, New_Invoice_Date) %>%
group_by(CustomerID) %>% mutate(Days_diff =
as.numeric(c(diff(New_Invoice_Date),0))) %>% summarise(Days_time =
sum(Days_diff),
Days_Avg = sum(Days_diff)/sum(n()))

head(as.data.frame(Days_Avg))
```

```
##   CustomerID Days_time Days_Avg
## 1      12346         0 0.000000
## 2      12347       365 2.005495
## 3      12348       283 9.129032
## 4      12349         0 0.000000
## 5      12350         0 0.000000
## 6      12352       260 2.736842
```

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? Consider the cancelled transactions as those where the 'Quantity' variable has a negative value.**

```
# Return rate for the French customers

numerator <- OnlineRetail %>% select(Quantity, TransactionValue, Country) %>%
filter(Country == "France" & Quantity < 0)
denominator <- OnlineRetail %>% select(Quantity, TransactionValue, Country)
%>% filter(Country == "France")
Ratio <- count(numerator) / count(denominator)
```

```
as.data.frame(Ratio)

##            n
## 1 0.01741264
```

The return rate for the French customers is 1.741264%

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

```
# Highest revenue for the retailer

Rev_Highest <- OnlineRetail %>% group_by(Description) %>%
summarise(Trans_highest = sum(TransactionValue)) %>%
  top_n(1)

## Selecting by Trans_highest

as.data.frame((Rev_Highest))

##      Description Trans_highest
## 1 DOTCOM POSTAGE      206245.5
```

The product generating the highest revenue for the retailer is DOTCOM POSTAGE i.e., 206245.5 British Sterling Pound.

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

```
#Showing the number of unique customers

length(unique(OnlineRetail$CustomerID))

## [1] 4373
```

There are total of 4373 unique customers