Assignment 2

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```
#Import the dataset "Online Retail"
ORetail <- read.csv("C:/Users/keert/Downloads/Online_Retail.csv")
```

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.

```
#Showing the total number of transactions by country
Country_totalnumber <- table(ORetail$Country)
Country_totalnumber
```

```
##
##           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
```

```r
# Calculate the percentage of transactions for each country
transaction_percent <- round(100*prop.table(Country_totalnumber),digits = 2)

# Combine the total number and percentage of transactions into a table
total <- data.frame(Country=names(Country_totalnumber),
                    TotalNumber=Country_totalnumber,
                    Percentage=transaction_percent)

# Subset the table to show only countries accounting for more than 1% of the total transactions
total <- subset(total,transaction_percent>1)
total
```

```
##           Country TotalNumber.Var1 TotalNumber.Freq Percentage.Var1
## 11           EIRE             EIRE             8196            EIRE
## 14         France           France             8557          France
## 15        Germany          Germany             9495         Germany
## 36 United Kingdom   United Kingdom           495478  United Kingdom
##    Percentage.Freq
## 11            1.51
## 14            1.58
## 15            1.75
## 36           91.43
```

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

```r
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
```

```r
#Creating a new variable 'TransactionValue'
ORetail <- ORetail %>% mutate(TransactionValue= Quantity * UnitPrice)
summary(ORetail$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.

```
data <- summarise(group_by(ORetail,Country),sum_1= sum(TransactionValue))
Transaction <- filter(data,sum_1 >130000)
Transaction
```

```
## # A tibble: 6 x 2
##   Country           sum_1
##   <chr>             <dbl>
## 1 Australia       137077.
## 2 EIRE            263277.
## 3 France          197404.
## 4 Germany         221698.
## 5 Netherlands     284662.
## 6 United Kingdom 8187806.
```

4.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(ORetail$InvoiceDate,format='%m/%d/%Y %H:%M',tz='GMT')
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:

```
#Converting InvoiceDate to datetime format
ORetail$InvoiceDate <- as.POSIXct(ORetail$InvoiceDate, format = "%Y-%m-%d %H:%M:%S")

# Creating new columns for date, day of week, and hour
ORetail$New_Invoice_Date <- as.Date(ORetail$InvoiceDate)
ORetail$Invoice_Day_Week <- weekdays(ORetail$InvoiceDate)
ORetail$New_Invoice_Hour <- format(ORetail$InvoiceDate, format = "%H:%M:%S")

# View the first few rows of the updated dataset
head(ORetail)
```

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

```
## 5      3.39      17850 United Kingdom            20.34             <NA>
## 6      7.65      17850 United Kingdom            15.30             <NA>
##   Invoice_Day_Week New_Invoice_Hour
## 1             <NA>             <NA>
## 2             <NA>             <NA>
## 3             <NA>             <NA>
## 4             <NA>             <NA>
## 5             <NA>             <NA>
## 6             <NA>             <NA>
```

Date objects have a lot of flexible functions. For example, knowing two date values, the object allows you to know the difference between the two dates in terms of the number days.

```
#Create two example date values
date1 <- as.Date("2023-08-15")
date2 <- as.Date("2023-09-15")

# Determine the number of days between the two dates
Days_between <- as.numeric(date2 - date1)
Days_between
```

```
## [1] 31
```

we can convert dates to days of the week also.So for that,let's create a new variable.

```
ORetail$Invoice_Day_Week= weekdays(ORetail$New_Invoice_Date)
```

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

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

Lets define the month as a separate numeric variable too:

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

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

```
# calculate the total number of transactions for each day of the week
day_counts <- table(ORetail$Invoice_Day_Week)

# calculate the percentage of transactions for each day of the week
day_percents <- round(100 * prop.table(day_counts), digits = 2)

# combine the day counts and percents into a data frame
day_summary <- data.frame(Day = names(day_counts),
                          TotalNumber = day_counts,
                          Percentage = day_percents)

# display the resulting data frame
day_summary
```

```
## [1] Freq       Percentage
## <0 rows> (or 0-length row.names)
```

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

```
d1<-summarise(group_by(ORetail,Invoice_Day_Week),Transaction_Volume=sum(TransactionValue))
d2<-mutate(d1,percentage=(Transaction_Volume/sum(Transaction_Volume))*100)
d2
```

```
## # A tibble: 1 x 3
##   Invoice_Day_Week Transaction_Volume percentage
##   <chr>                        <dbl>      <dbl>
## 1 <NA>                       9747748.        100
```

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

```
m1<-summarise(group_by(ORetail,New_Invoice_Month),Transaction_Volume=sum(TransactionValue))
m2<-mutate(m1,percentage=(Transaction_Volume/sum(Transaction_Volume))*100)
m2
```

```
## # A tibble: 12 x 3
##    New_Invoice_Month Transaction_Volume percentage
##                <dbl>              <dbl>      <dbl>
##  1                 1             560000.       5.74
##  2                 2             498063.       5.11
##  3                 3             683267.       7.01
##  4                 4             493207.       5.06
##  5                 5             723334.       7.42
##  6                 6             691123.       7.09
##  7                 7             681300.       6.99
##  8                 8             682681.       7.00
##  9                 9            1019688.      10.5
## 10                10            1070705.      11.0
## 11                11            1461756.      15.0
## 12                12            1182625.      12.1
```

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

```
ORetail <- ORetail %>% mutate(TransactionValue = Quantity * UnitPrice)
ORetail %>%filter(Country == 'Australia') %>%group_by(New_Invoice_Date) %>%
summarise(total_transactions = sum(TransactionValue)) %>%
arrange(desc(total_transactions)) %>% slice(1)
```

```
## # A tibble: 1 x 2
##   New_Invoice_Date total_transactions
##   <date>                        <dbl>
## 1 NA                          137077.
```

4.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.

```
library(zoo)
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

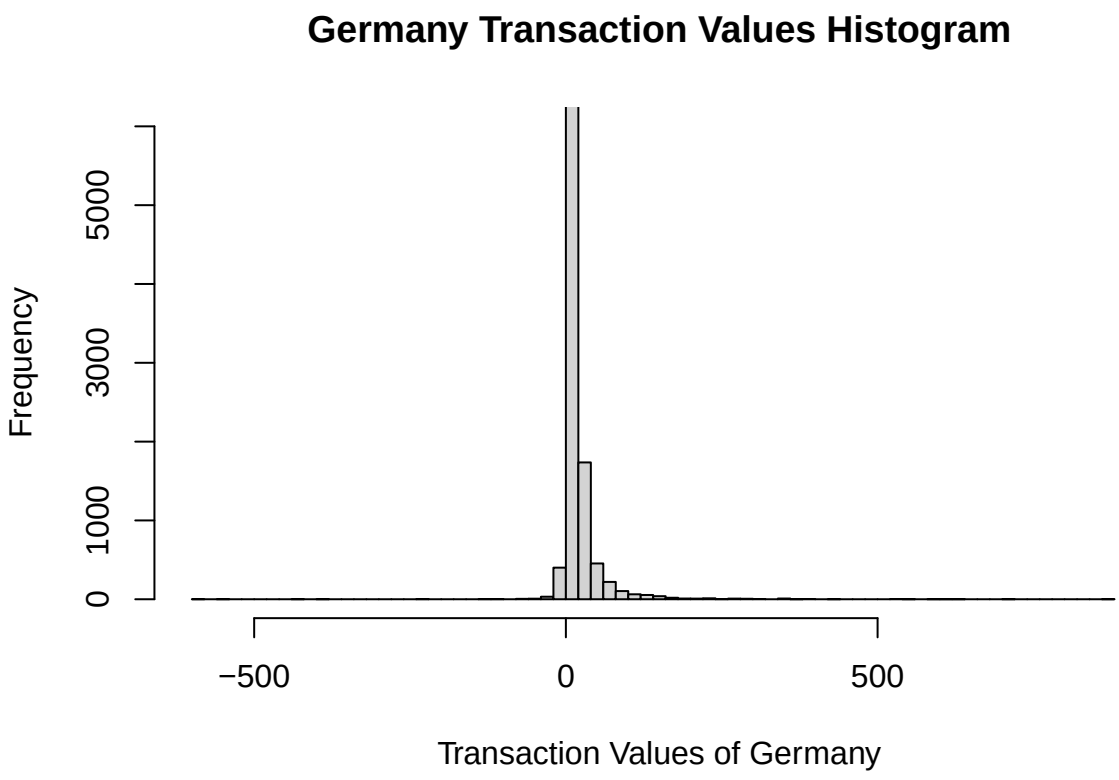
```
e1<-summarise(group_by(ORetail,New_Invoice_Hour),Transaction_min=n_distinct(InvoiceNo))
e1<-filter(e1,New_Invoice_Hour>=7&New_Invoice_Hour<=20)
e12<-rollmax(e1$Transaction_min,3,sum)
e123<-which.min(e12)
e123
```

```
## [1] 12
```

Starting the work at 12 noon is suitable for maintenance.

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

```
Germany_data <- subset(ORetail,Country == "Germany")
hist(Germany_data$TransactionValue,xlim = c(-600,900),breaks=100,xlab = "Transaction Values of Germany"
```



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

```
ORetail1 <- na.omit(ORetail)
result1 <- summarise(group_by(ORetail1,CustomerID), sum2= sum(TransactionValue))
result1[which.max(result1$sum2),]
```

```
## # A tibble: 0 x 2
## # i 2 variables: CustomerID <int>, sum2 <dbl>
```

```
data2 <- table(ORetail$CustomerID)
data2 <- as.data.frame(data2)
result2 <- data2[which.max(data2$Freq),]
result2
```

```
##       Var1 Freq
## 4043 17841 7983
```

7. Calculate the percentage of missing values for each variable in the dataset.

```
missing_values <- colMeans(is.na(ORetail) * 100)
missing_values
```

```
##         InvoiceNo         StockCode       Description          Quantity
##           0.00000           0.00000           0.00000           0.00000
##       InvoiceDate         UnitPrice        CustomerID           Country
##         100.00000           0.00000          24.92669           0.00000
##  TransactionValue  New_Invoice_Date  Invoice_Day_Week  New_Invoice_Hour
##           0.00000         100.00000         100.00000           0.00000
## New_Invoice_Month
##           0.00000
```

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

```
ORetail2 <- ORetail %>% filter(is.na(CustomerID)) %>% group_by(Country)
summary(ORetail2$Country)
```

```
##    Length     Class      Mode
##    135080 character character
```

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).

```
library(dplyr)

#convert InvoiceDate to proper format
ORetail$InvoiceDate <- as.POSIXct(ORetail$InvoiceDate, format="%Y-%m-%d %H:%M:%S")

# subset the data to include only CustomerID and InvoiceDate
custo_dates <- select(ORetail, CustomerID, InvoiceDate)
```

```r
# sort the data by CustomerID and InvoiceDate
custo_dates <- arrange(custo_dates, CustomerID, InvoiceDate)

# calculate time difference between consecutive shopping trips for each customer
custo_times <- group_by(custo_dates, CustomerID) %>%
mutate(diff_days = as.numeric(difftime(InvoiceDate, lag(InvoiceDate), units = "days")))

# calculate the average time difference across all customers
avg_days_between_shopping <- mean(na.omit(custo_times$diff_days))
avg_days_between_shopping
```

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

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.

```r
ORetail_table <- filter(ORetail, Country == "France")
totalrow <- nrow(ORetail_table)
total_transactions <- nrow(ORetail_table)
cancelled_transactions <- nrow(filter(ORetail_table, TransactionValue < 0))
return_rate <- cancelled_transactions / total_transactions
return_rate
```

```
## [1] 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').

```r
product_revenue <- tapply(ORetail$TransactionValue, ORetail$StockCode, sum)
product_with_highest_revenue <- names(product_revenue)[which.max(product_revenue)]
product_with_highest_revenue
```

```
## [1] "DOT"
```

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

```r
uniq_custo <- unique(ORetail$CustomerID)
number_of_uniq_custo <- length(uniq_custo)
number_of_uniq_custo
```

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