EDA

The datasheet for 2009-10 and sheet containing data for 2010-11 are both same. So we will do EDA on one of the datasheet.

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from datetime import datetime

sns.set_style("whitegrid")
```

```
df1 = pd.read_csv("RetailPulseAssignmentData(2009-10).csv")
df2 = pd.read_csv("RetailPulseAssignmentData(2010-11).csv")
```

```
df1.head(4)
```

```
  Invoice StockCode                          Description  Quantity  \
0  489434     85048  15CM CHRISTMAS GLASS BALL 20 LIGHTS        12
1  489434    79323P                   PINK CHERRY LIGHTS        12
2  489434    79323W                  WHITE CHERRY LIGHTS        12
3  489434     22041         RECORD FRAME 7" SINGLE SIZE         48

        InvoiceDate  Price  Customer ID         Country
0  01-12-2009 07:45   6.95      13085.0  United Kingdom
1  01-12-2009 07:45   6.75      13085.0  United Kingdom
2  01-12-2009 07:45   6.75      13085.0  United Kingdom
3  01-12-2009 07:45   2.10      13085.0  United Kingdom
```

```
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 525461 entries, 0 to 525460
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   Invoice      525461 non-null  object
 1   StockCode    525461 non-null  object
 2   Description  522533 non-null  object
 3   Quantity     525461 non-null  int64
 4   InvoiceDate  525461 non-null  object
 5   Price        525461 non-null  float64
 6   Customer ID  417534 non-null  float64
 7   Country      525461 non-null  object
dtypes: float64(2), int64(1), object(5)
memory usage: 32.1+ MB
```

```
df1.columns
```

```
Index(['Invoice', 'StockCode', 'Description', 'Quantity',
'InvoiceDate',
       'Price', 'Customer ID', 'Country'],
      dtype='object')
```

```
df1[['Price','Customer ID']].apply(pd.to_numeric)
df1['Quantity'].astype('int64')
df1[['Description','Country']].astype(str)
print("The datatypes of columns are changed.")
```

```
The datatypes of columns are changed.
```

```
df1.describe()
```

```
            Quantity          Price    Customer ID
count  525461.000000  525461.000000  417534.000000
mean       10.337667       4.688834   15360.645478
std       107.424110     146.126914    1680.811316
min     -9600.000000  -53594.360000   12346.000000
25%         1.000000       1.250000   13983.000000
50%         3.000000       2.100000   15311.000000
75%        10.000000       4.210000   16799.000000
max     19152.000000   25111.090000   18287.000000
```

```
print("Does quantity have negetive values:", (df1['Quantity'].values <
0).any())
```

```
Does quantity have negetive values: True
```

```
neg_index = df1[df1['Quantity'].values < 0].index
df1.drop(neg_index,inplace = True)
```

The datasheet has **525461 transaction enteries** with records of

- **(Invoice, StockCode, Description, Quality, InvoiceData, Price, CustomerID, Country)**

```
print("Is the datasheet with 2009-10 and 2010-11 are exactly same:
",df1.equals(df2))
```

```
Is the datasheet with 2009-10 and 2010-11 are exactly same:  False
```

```
print("Null values/missing values in the datasheet:-")
df1.isnull().sum()
```

```
Null values/missing values in the datasheet:-

Invoice             0
StockCode           0
Description      1101
Quantity            0
InvoiceDate         0
Price               0
Customer ID    105440
Country             0
dtype: int64
```

```
df1.dropna(inplace=True)  #Description and CustomerID cannot be
replaced, thus those enteries are dropped
df1.isnull().sum()
```

```
Invoice        0
StockCode      0
Description    0
Quantity       0
InvoiceDate    0
Price          0
Customer ID    0
Country        0
dtype: int64
```

```
df1 = df1.drop_duplicates()
```

```
df1['InvoiceDate'] = pd.to_datetime(df1['InvoiceDate'])
df1['Date'] = df1['InvoiceDate'].dt.strftime('%d-%m-%Y')
df1['Date'] = pd.to_datetime(df1['Date'])
df1['Time']= df1['InvoiceDate'].dt.strftime('%H:%M:%S')
```

```
df1['TotalPrice'] = df1['Quantity'] * df1['Price']
```

```
df1.head(4)
```

```
  Invoice StockCode                          Description  Quantity  \
0  489434     85048  15CM CHRISTMAS GLASS BALL 20 LIGHTS        12
1  489434    79323P                   PINK CHERRY LIGHTS        12
2  489434    79323W                  WHITE CHERRY LIGHTS        12
3  489434     22041         RECORD FRAME 7" SINGLE SIZE         48

          InvoiceDate  Price  Customer ID         Country
Date  \
0 2009-01-12 07:45:00   6.95      13085.0  United Kingdom 2009-12-01

1 2009-01-12 07:45:00   6.75      13085.0  United Kingdom 2009-12-01

2 2009-01-12 07:45:00   6.75      13085.0  United Kingdom 2009-12-01

3 2009-01-12 07:45:00   2.10      13085.0  United Kingdom 2009-12-01


       Time  TotalPrice
0  07:45:00        83.4
1  07:45:00        81.0
2  07:45:00        81.0
3  07:45:00       100.8
```

Analysing data

```
print(f"The range of dates of transactions: {df1['Date'].min()} to
{df1['Date'].max()}")
```

```
The range of dates of transactions: 2009-12-01 00:00:00 to 2010-12-09
00:00:00
```

Above shows the range of dates of which the data is available.

Now,These are the **frequency of transactions** done by the same Customer and what amount sums their purchases. The top 5 Customers who have been the most loyal Customers.

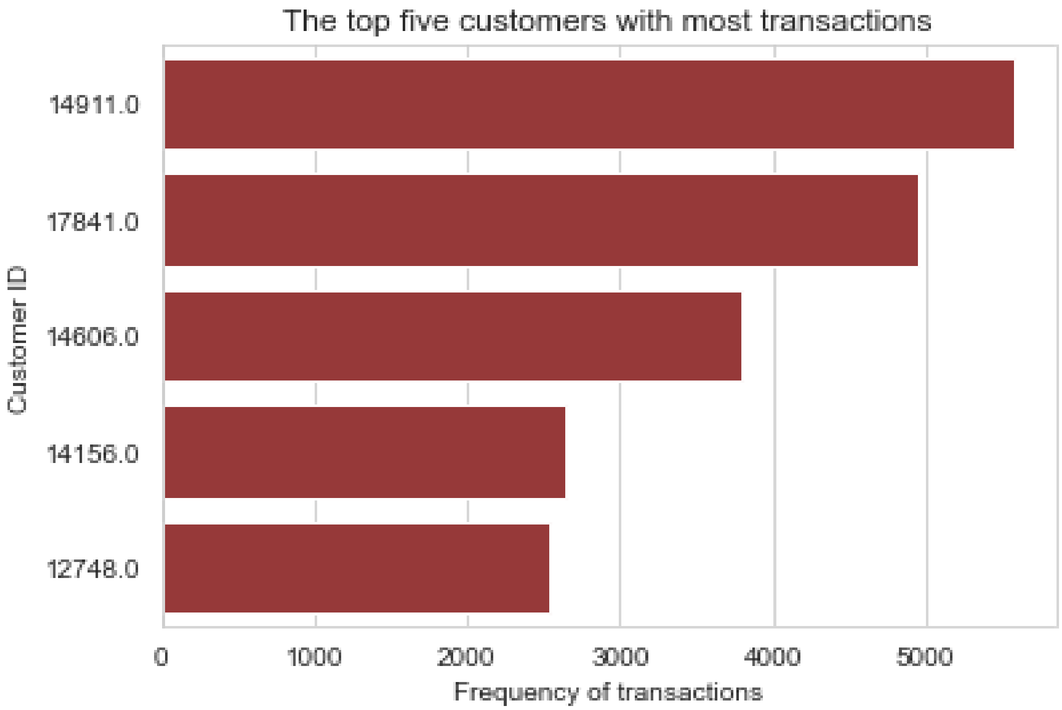
```
Freq_df = df1.groupby('Customer ID').agg({'Customer ID': lambda x:
len(x),
                                         'TotalPrice': lambda x:
x.sum(),
                                          'Date': lambda x: (x.max() -
x.min()).days})

Freq_df.rename(columns = {'Customer ID':'Frequency of transactions'},
inplace= True)

Freq_df.sort_values(by = ['Frequency of
transactions'] ,ascending=False, inplace = True)
Freq_df['Customer ID'] = Freq_df.index
Freq_df['Customer ID'] = Freq_df['Customer ID'].astype(str)
Freq_df.rename(columns = {'Date':'Period of purchases'}, inplace =
True)

print("The top five customer with most transaction: -")
top_five_customer_data = Freq_df.head(5)
top_five_customer_data
```

```
The top five customer with most transaction: -

             Frequency of transactions  TotalPrice  Period of
purchases  \
Customer ID

14911.0                         5568.0   152121.22
373
17841.0                         4944.0    29562.02
372
14606.0                         3802.0    18482.10
370
14156.0                         2646.0   196549.74
367
12748.0                         2532.0    22457.90
370

            Customer ID
Customer ID
14911.0         14911.0
17841.0         17841.0
```

```
14606.0        14606.0
14156.0        14156.0
12748.0        12748.0
```

```
plt.title("The top five customers with most transactions")
sns.barplot(data = top_five_customer_data, x= 'Frequency of
transactions', y = 'Customer ID', color='brown')
```

```
<AxesSubplot:title={'center':'The top five customers with most
transactions'}, xlabel='Frequency of transactions', ylabel='Customer
ID'>
```



The loyal customers or it's value might be evaluated by repeated transactions of valuable products.

We can see the **Customer ID : 14911.0** had most frequent transactions resulting of **5568** purchases. followed by these four customers :-

1. ID :17841.0
2. ID :14606.0
3. ID :14156.0
4. ID :12748.0

```
# Customer Value can be evaluated as: Average Order Value * Purchase
Frequency

Freq_df['avg_order_value'] = Freq_df['TotalPrice'] / Freq_df['Period
of purchases']
```

```
Freq_df['profit_margin'] = Freq_df['TotalPrice'] * 0.05
Freq_df['Customer_value'] = Freq_df['avg_order_value'] *
Freq_df['Frequency of transactions']
Freq_df['Customer_lifetime_value'] = Freq_df['Customer_value'] *
Freq_df['profit_margin']

Freq_df.sort_values(by = 'Customer_value',ascending = False)
Freq_df.head(5)
```

```
             Frequency of transactions  TotalPrice  Period of
purchases  \
Customer ID

14911.0                         5568.0   152121.22
373
17841.0                         4944.0    29562.02
372
14606.0                         3802.0    18482.10
370
14156.0                         2646.0   196549.74
367
12748.0                         2532.0    22457.90
370

            Customer ID  avg_order_value  profit_margin
Customer_value  \
Customer ID

14911.0         14911.0       407.831689       7606.061
2.270807e+06
17841.0         17841.0        79.467796       1478.101
3.928888e+05
14606.0         14606.0        49.951622        924.105
1.899161e+05
14156.0         14156.0       535.557875       9827.487
1.417086e+06
12748.0         12748.0        60.697027       1122.895
1.536849e+05

             Customer_lifetime_value
Customer ID
14911.0                 1.727190e+10
17841.0                 5.807293e+08
14606.0                 1.755024e+08
14156.0                 1.392640e+10
12748.0                 1.725720e+08
```

We can see the similar results where **Customer ID : 14911.0** had still **most valued** along with other 4 people who are in the top five customers.

```
df1['month'] = pd.DatetimeIndex(df1['Date']).month

date_df = df1.groupby('Date').agg({'TotalPrice': lambda x: x.sum(),
                                  'Quantity': lambda x: x.sum()})

date_df['date'] = date_df.index
date_df['date'] = pd.to_datetime(date_df['date'])
date_df['month'] = date_df['date'].dt.month
# The months are added as column


date_price_df = date_df.sort_values(by = ['TotalPrice'], ascending = 
False)
print("The highest transaction amount recorded on a day : ", 
date_price_df['TotalPrice'][0])
date_price_df.head(4)
```

```
The highest transaction amount recorded on a day :  115172.23999999999

            TotalPrice  Quantity       date  month
Date
2010-09-27   115172.24    125369 2010-09-27      9
2010-10-14    86945.13     37130 2010-10-14     10
2010-11-04    83876.12     58902 2010-11-04     11
2010-11-10    73575.93     33426 2010-11-10     11
```

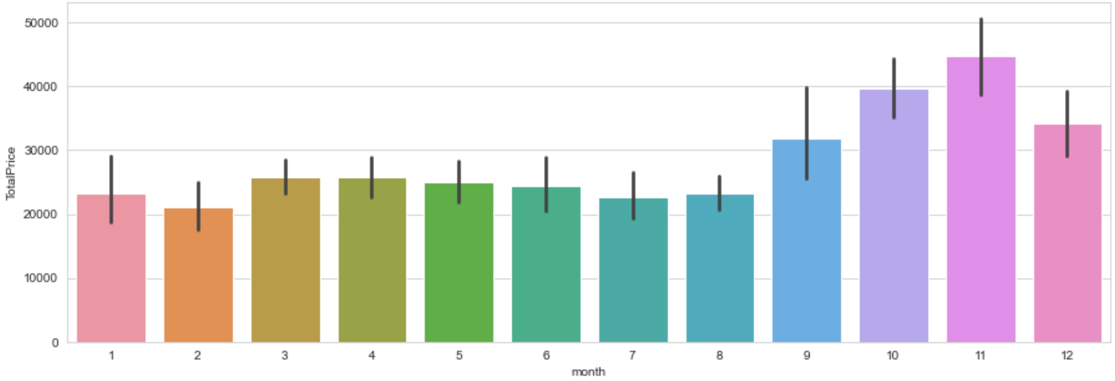
```
date_quantity_df = date_df.sort_values(by = ['Quantity'], ascending = 
False)
print("The highest units purchased on a day : 
",date_price_df['Quantity'][0])
date_quantity_df.head(4)
```

```
The highest units purchased on a day :  125369

            TotalPrice  Quantity       date  month
Date
2010-09-27  115172.240    125369 2010-09-27      9
2010-08-09   31336.590    100084 2010-08-09      8
2010-02-15   42318.211     96358 2010-02-15      2
2010-03-17   29543.780     78565 2010-03-17      3
```

We can see that on **27-09-2010** the highest transaction both in **quantity and amount / price** was recorded globally. The quantity sold was **125369 units**, all of which summed to an inflow of **115172.240 USD** (*currency it was recorded*).

```
plt.figure(figsize = (15,5))

date_df.sort_values(by = 'month', ascending = True, inplace = True)
sns.barplot(data = date_df, x = 'month', y = 'TotalPrice')
```

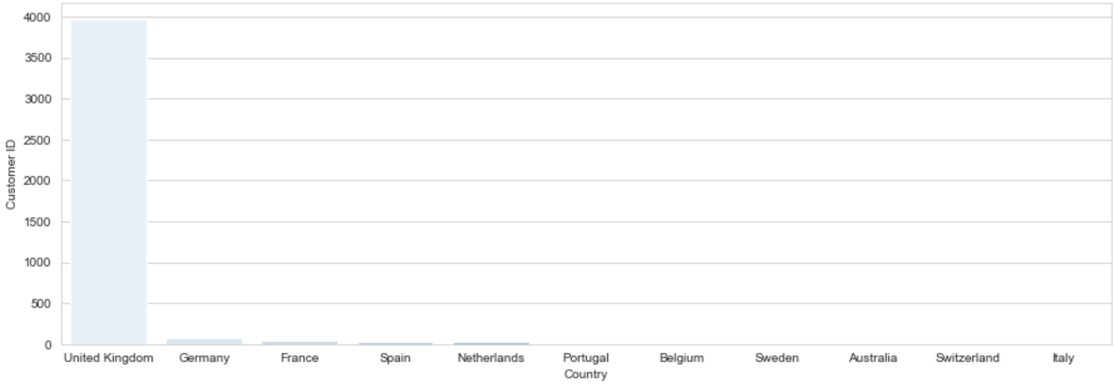
```
<AxesSubplot:xlabel='month', ylabel='TotalPrice'>
```



Most revenue generated with transactions were made in month of **November** followed by Octobe and December. Thus this likely indicates the most inflow occurs in winter season which is the end of the year.

```
plt.figure(figsize = (15,5))
Customer_Country = df1.groupby('Country')['Customer
ID'].nunique().sort_values(ascending=False).reset_index().head(11)
sns.barplot(data=Customer_Country,x='Country',y='Customer
ID',palette='Blues')
```

```
<AxesSubplot:xlabel='Country', ylabel='Customer ID'>
```



Almost all the Customers are residing in *United Kindom*.

```
df1['Description'].unique()
```

```
array(['15CM CHRISTMAS GLASS BALL 20 LIGHTS', 'PINK CHERRY LIGHTS',
       ' WHITE CHERRY LIGHTS', ..., 'BAKING MOULD ROSE MILK
CHOCOLATE',
       'BAKING MOULD CHOCOLATE CUP CAKES',
       'BAKING MOULD EASTER EGG MILK CHOC'], dtype=object)
```

```
len(df1['Description'].unique())
```

```
4444
```

```
Desc_df = df1.groupby('Description').agg({'Customer ID': lambda x:
len(x),
                                          'TotalPrice': lambda x:
x.sum(),
                                          'Quantity': lambda x:
x.sum()})

Desc_df_ID = Desc_df.sort_values(by = 'Customer ID', ascending =
False)
Desc_df_price = Desc_df.sort_values(by = 'TotalPrice', ascending =
False)
Desc_df_Quantity = Desc_df.sort_values(by = 'Quantity',ascending =
False)
```

```
Desc_df_ID.head(5)
```

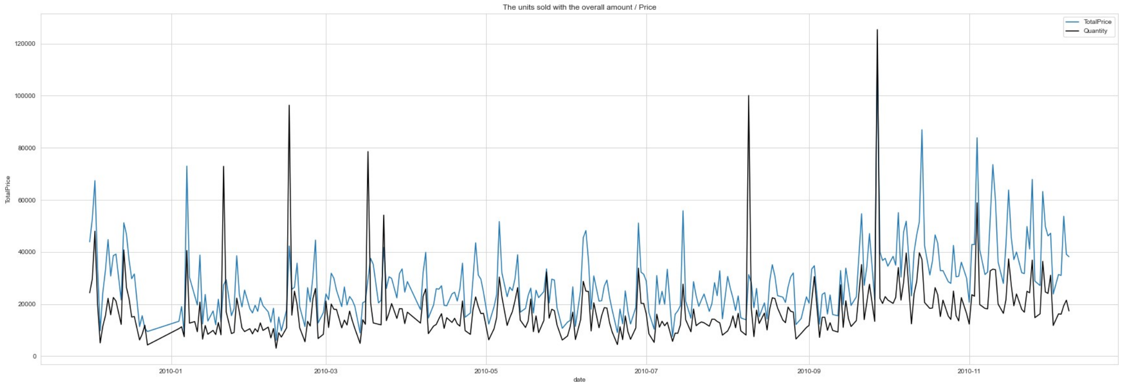
```
                                    Customer ID  TotalPrice  Quantity
Description
WHITE HANGING HEART T-LIGHT HOLDER       3107.0   151339.16     56814
REGENCY CAKESTAND 3 TIER                 1696.0   143727.60     12489
STRAWBERRY CERAMIC TRINKET BOX           1372.0    29694.86     25330
ASSORTED COLOUR BIRD ORNAMENT            1355.0    70291.03     44431
HOME BUILDING BLOCK WORD                 1192.0    28028.30      4784
```

We can see that **"WHITE HANGING HEART T-LIGHT HOLDER"** is the best seller followed by other items in above dataframe.

There were **4444 different items/products** that were purchased. So people prefering to buy same things can be assumed as a category of people prefering that item. The most prefered product was WHITE HANGING HEART T-LIGHT HOLDER with over 56814 units sold contributing in **56814 USD** of inflow.

```
plt.figure(figsize = (30,10))
plt.title("The units sold with the overall amount / Price")


sns.lineplot(x = date_df['date'], y = date_df['TotalPrice'])
sns.lineplot(x = date_df['date'], y = date_df['Quantity'], color =
'black')
plt.legend(['TotalPrice','Quantity'])
```

```
<matplotlib.legend.Legend at 0x22f4475ceb0>
```



Here we can see the most of **units were sold around october and november** and most inflow was around the same time. With more data seasonality could have been detected confirming if there is some periodic pattern of purchase but with this data we can't confirm the same.