online_retail

March 9, 2024

1 Portfolio Project: Online Retail Exploratory Data Analysis with Python

[64]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
%matplotlib inline
```

1.0.1 First Let's Load The Data

[3]:
```
df = pd.read_csv("Online Retail.csv")
```

[4]:
```
df.head()
```

[4]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850.0	United Kingdom
1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17850.0	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00	3.39	17850.0	United Kingdom

1.0.2 Checking the Types

[5]:
```
df.dtypes
```

[5]:
```
InvoiceNo       object
StockCode       object
Description     object
Quantity         int64
InvoiceDate     object
UnitPrice      float64
CustomerID     float64
Country         object
dtype: object
```

2 Cleaning The Data

2.0.1 First Let's Check For Null Values

[6]:
```
df.shape
```

[6]:
```
(541909, 8)
```

We Can Notice That The Total Value for each column is 541909

[7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 541909 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype
---  ------       --------------   -----
 0   InvoiceNo    541909 non-null  object
 1   StockCode    541909 non-null  object
 2   Description  540455 non-null  object
 3   Quantity     541909 non-null  int64
 4   InvoiceDate  541909 non-null  object
 5   UnitPrice    541909 non-null  float64
 6   CustomerID   406829 non-null  float64
 7   Country      541909 non-null  object
dtypes: float64(2), int64(1), object(5)
memory usage: 33.1+ MB
```

While Description and CustomerID Has Some Of their Values are Null Values Let's Clean Them

[8]:
```
df[df['CustomerID'].isnull()]
```

[8]:

	InvoiceNo	StockCode	Description	Quantity	\
622	536414	22139	NaN	56	
1443	536544	21773	DECORATIVE ROSE BATHROOM BOTTLE	1	
1444	536544	21774	DECORATIVE CATS BATHROOM BOTTLE	2	
1445	536544	21786	POLKADOT RAIN HAT	4	

```
1446      536544     21787            RAIN PONCHO RETROSPOT         2
…          …       …                                …       …
541536    581498    85099B          JUMBO BAG RED RETROSPOT         5
541537    581498    85099C   JUMBO  BAG BAROQUE BLACK WHITE         4
541538    581498     85150    LADIES & GENTLEMEN METAL SIGN         1
541539    581498     85174                S/4 CACTI CANDLES         1
541540    581498       DOT                   DOTCOM POSTAGE         1

                InvoiceDate  UnitPrice  CustomerID         Country
622     2010-12-01 11:52:00       0.00         NaN  United Kingdom
1443    2010-12-01 14:32:00       2.51         NaN  United Kingdom
1444    2010-12-01 14:32:00       2.51         NaN  United Kingdom
1445    2010-12-01 14:32:00       0.85         NaN  United Kingdom
1446    2010-12-01 14:32:00       1.66         NaN  United Kingdom
…                       …         …           …              …
541536  2011-12-09 10:26:00       4.13         NaN  United Kingdom
541537  2011-12-09 10:26:00       4.13         NaN  United Kingdom
541538  2011-12-09 10:26:00       4.96         NaN  United Kingdom
541539  2011-12-09 10:26:00      10.79         NaN  United Kingdom
541540  2011-12-09 10:26:00    1714.17         NaN  United Kingdom

[135080 rows x 8 columns]
```

[9]:
```
df.dropna(subset=['CustomerID'],inplace=True)
```

[10]:
```
df[df['CustomerID'].isnull()]
```

[10]:
```
Empty DataFrame
Columns: [InvoiceNo, StockCode, Description, Quantity, InvoiceDate, UnitPrice,
CustomerID, Country]
Index: []
```

Now The CustomerID Column Is Cleaned Let's Check For the Description

[11]:
```
df[df['Description'].isnull()]
```

[11]:
```
Empty DataFrame
Columns: [InvoiceNo, StockCode, Description, Quantity, InvoiceDate, UnitPrice,
CustomerID, Country]
Index: []
```

Both Cleaned

2.0.2 Double Checking For The Null Values

[12]:
```
df.shape
```

[12]:
```
(406829, 8)
```

[13]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 406829 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype  
---  ------       --------------   -----  
 0   InvoiceNo    406829 non-null  object 
 1   StockCode    406829 non-null  object 
 2   Description  406829 non-null  object 
 3   Quantity     406829 non-null  int64  
 4   InvoiceDate  406829 non-null  object 
 5   UnitPrice    406829 non-null  float64
 6   CustomerID   406829 non-null  float64
 7   Country      406829 non-null  object 
dtypes: float64(2), int64(1), object(5)
memory usage: 27.9+ MB
```

All Null Vlues Have Been Removed

2.1 Let's Check For Duplicates

[14]:
```
df[df.duplicated()]
```

[14]:

	InvoiceNo	StockCode	Description	Quantity	\
517	536409	21866	UNION JACK FLAG LUGGAGE TAG	1	
527	536409	22866	HAND WARMER SCOTTY DOG DESIGN	1	
537	536409	22900	SET 2 TEA TOWELS I LOVE LONDON	1	
539	536409	22111	SCOTTIE DOG HOT WATER BOTTLE	1	
555	536412	22327	ROUND SNACK BOXES SET OF 4 SKULLS	1	
…	…	…	…	…	
541675	581538	22068	BLACK PIRATE TREASURE CHEST	1	
541689	581538	23318	BOX OF 6 MINI VINTAGE CRACKERS	1	
541692	581538	22992	REVOLVER WOODEN RULER	1	
541699	581538	22694	WICKER STAR	1	
541701	581538	23343	JUMBO BAG VINTAGE CHRISTMAS	1	

	InvoiceDate	UnitPrice	CustomerID	Country
517	2010-12-01 11:45:00	1.25	17908.0	United Kingdom
527	2010-12-01 11:45:00	2.10	17908.0	United Kingdom
537	2010-12-01 11:45:00	2.95	17908.0	United Kingdom

```
539     2010-12-01 11:45:00       4.95     17908.0  United Kingdom
555     2010-12-01 11:49:00       2.95     17920.0  United Kingdom
…                       …          …          …              …
541675  2011-12-09 11:34:00       0.39     14446.0  United Kingdom
541689  2011-12-09 11:34:00       2.49     14446.0  United Kingdom
541692  2011-12-09 11:34:00       1.95     14446.0  United Kingdom
541699  2011-12-09 11:34:00       2.10     14446.0  United Kingdom
541701  2011-12-09 11:34:00       2.08     14446.0  United Kingdom

[5225 rows x 8 columns]
```

[15]:
```
df.drop_duplicates(inplace=True)
```

[16]:
```
df[df.duplicated()]
```

[16]:
```
Empty DataFrame
Columns: [InvoiceNo, StockCode, Description, Quantity, InvoiceDate, UnitPrice,
CustomerID, Country]
Index: []
```

2.1.1 After Removing Duplicate Data And Null Values The Data is Finally Clean

2.1.2 Create Seperate Year, Month and Day Columns

[17]:
```
df['InvoiceDate'] = pd.to_datetime(df['InvoiceDate'])
```

[18]:
```
df['Year'] = df['InvoiceDate'].dt.strftime('%Y').astype(int)
df['Month'] = df['InvoiceDate'].dt.strftime('%m')
df['Day'] = df['InvoiceDate'].dt.strftime('%d')
```

2.2 Now Let's Check The Outliers of Data

2.2.1 A Quick Look At The Data Statistics

[19]:
```
df.describe()
```

[19]:

	Quantity	UnitPrice	CustomerID	Year
count	401604.000000	401604.000000	401604.000000	401604.000000
mean	12.183273	3.474064	15281.160818	2010.934378
std	250.283037	69.764035	1714.006089	0.247620
min	-80995.000000	0.000000	12346.000000	2010.000000
25%	2.000000	1.250000	13939.000000	2011.000000
50%	5.000000	1.950000	15145.000000	2011.000000
75%	12.000000	3.750000	16784.000000	2011.000000

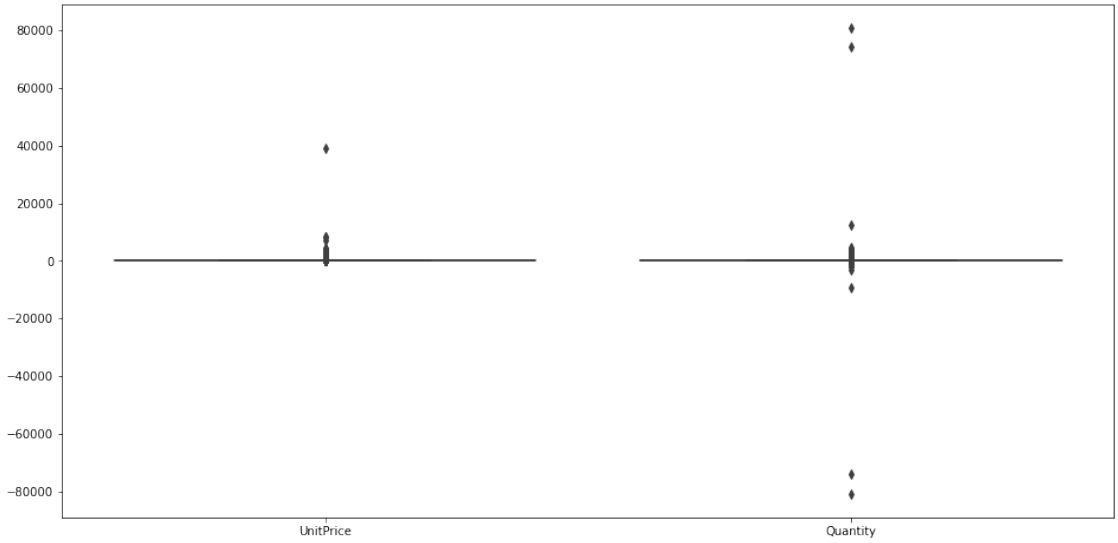
```
max      80995.000000    38970.000000    18287.000000     2011.000000
```

if we look close enough, it's noticeable that the Quantity Has Outliers in min and max values as UnitPrice Max Value

2.3 let's Check The Outliers In the UnitPrice And Quantity

[20]:
```
plt.figure(figsize=(16,8))

sns.boxplot(data=df[['UnitPrice','Quantity']])
```

[20]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f202810a450>
```



The Data Obviously Has Huge Amount Of outliers that needs to be removed or corrected

2.4 Cleaning The Outliers

[21]:
```
def find_outliers_IQR(df):

   q1=df.quantile(0.25)

   q3=df.quantile(0.75)

   IQR=q3-q1

   outliers = df[((df<(q1-1.5*IQR)) | (df>(q3+1.5*IQR)))]
```

```
    return outliers
```

2.4.1 first the Quantity

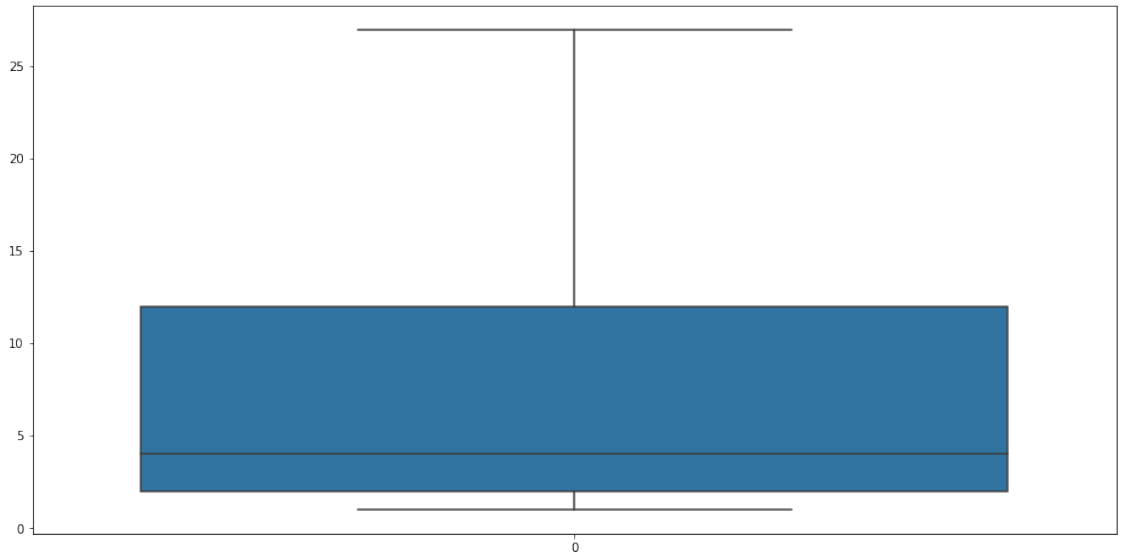
[22]:
```
quantity = df[df['Quantity'] >0]['Quantity']
min(find_outliers_IQR(quantity))
```

[22]:
```
28
```

the first outlier above 0 is 28

[23]:
```
clean = df[df['Quantity']< 28]
clean = clean[df['Quantity']> 0]
plt.figure(figsize=(16,8))
sns.boxplot(data=clean['Quantity'])
```

[23]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f1fb38debd0>
```



2.4.2 second the UnitPrice

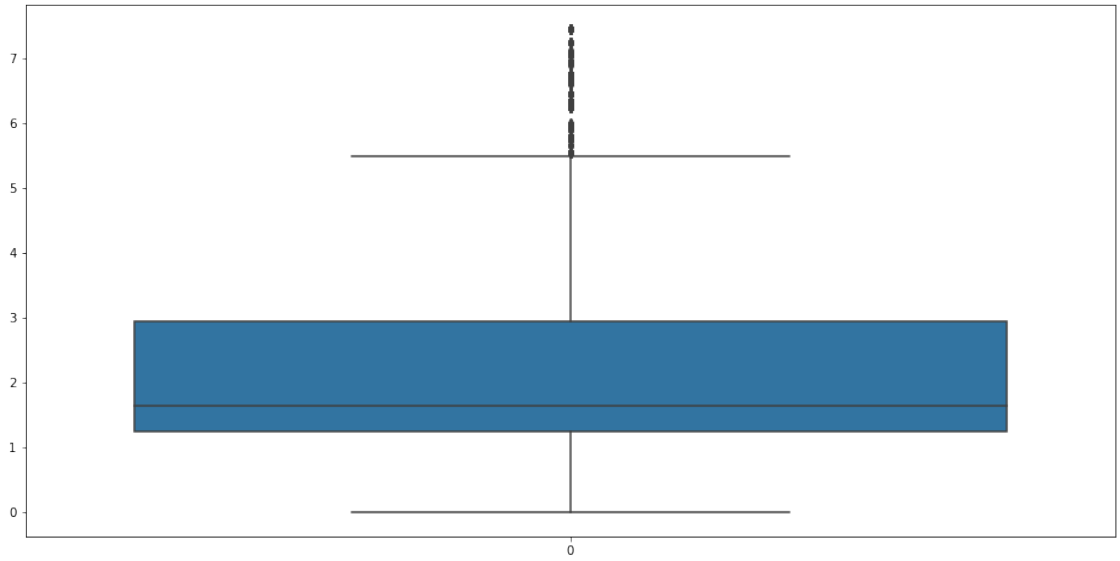
[24]:
```
min(find_outliers_IQR(df['UnitPrice']))
```

[24]:
```
7.6
```

the first outlier for UnitPrice is 7.6

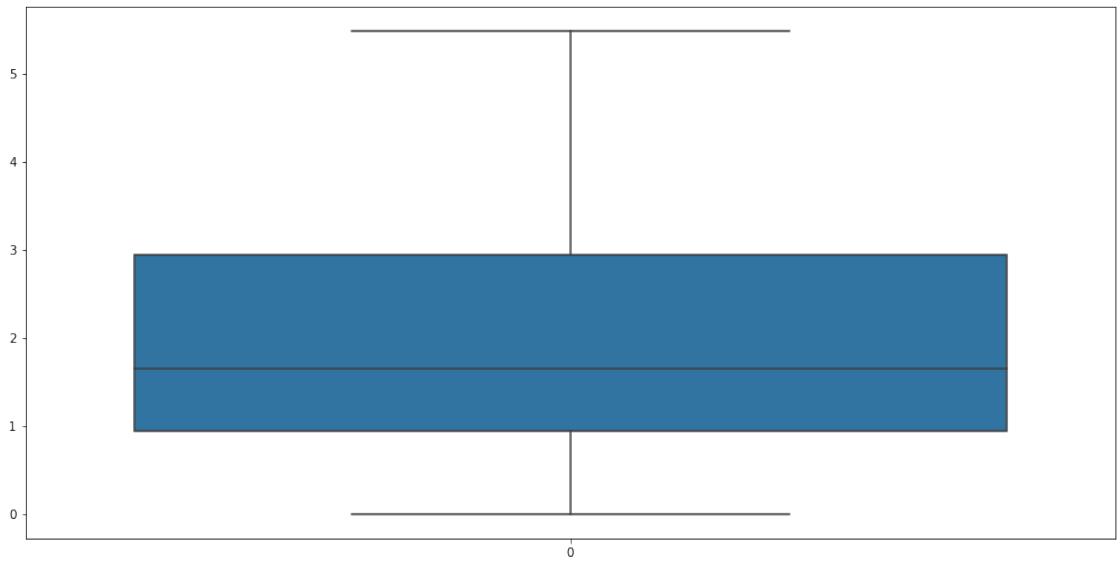
[25]:
```
clean = clean[df['UnitPrice']< 7.5]
plt.figure(figsize=(16,8))
sns.boxplot(data=clean['UnitPrice'])
```

[25]: <matplotlib.axes._subplots.AxesSubplot at 0x7f1fb9037fd0>



[26]:
```
clean = clean[df['UnitPrice']< 5.5]
plt.figure(figsize=(16,8))
sns.boxplot(data=clean['UnitPrice'])
```

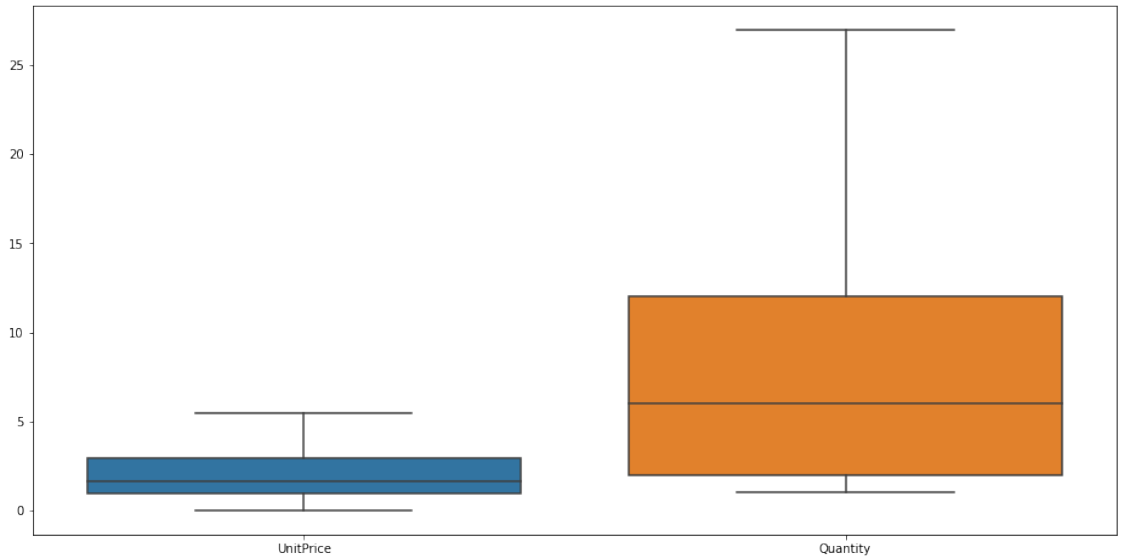
[26]: <matplotlib.axes._subplots.AxesSubplot at 0x7f1fb37c5a50>



2.4.3 Double Checking Both

[27]:
```
plt.figure(figsize=(16,8))

sns.boxplot(data=clean[['UnitPrice','Quantity']])
```

[27]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f1fb3827890>
```



now the data has no outliers

[28]:
```
clean.describe()
```

[28]:

	Quantity	UnitPrice	CustomerID	Year
count	318025.000000	318025.000000	318025.000000	318025.000000
mean	7.728804	1.997575	15321.410609	2010.935103
std	6.834203	1.284375	1713.715621	0.246345
min	1.000000	0.000000	12347.000000	2010.000000
25%	2.000000	0.950000	13985.000000	2011.000000
50%	6.000000	1.650000	15241.000000	2011.000000
75%	12.000000	2.950000	16818.000000	2011.000000
max	27.000000	5.490000	18287.000000	2011.000000

3 Data Analysis

3.1 Cheking Total Items Sold By Month

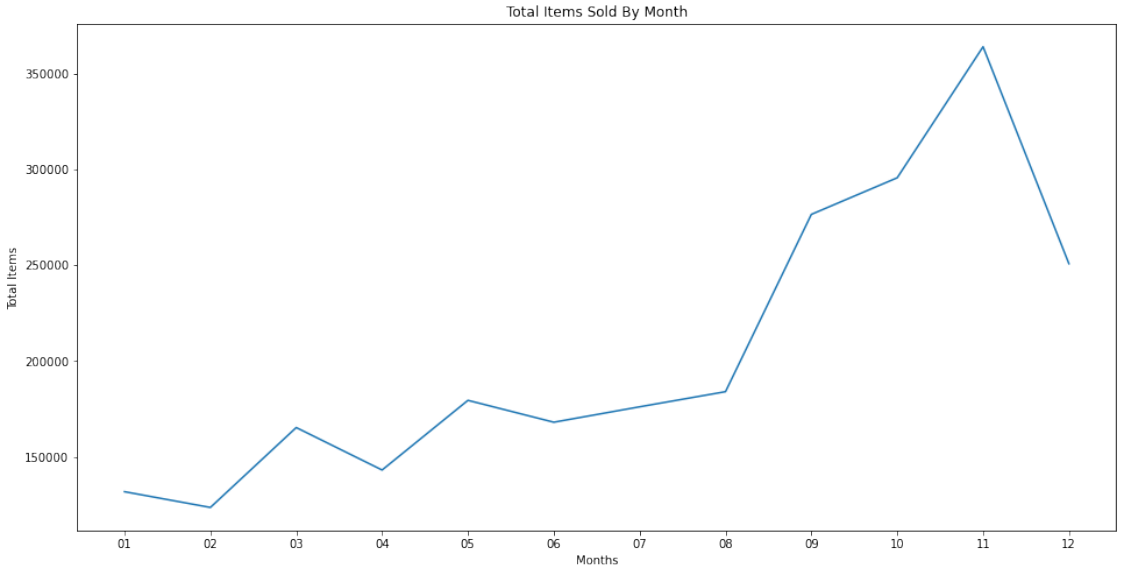
3.1.1 First Creating Grouped Data Relatable to our target

[29]:
```
total_items_monthly = clean.groupby("Month")['Quantity'].sum().reset_index()
```

3.1.2 now visualizing it using line plot

[30]:
```
plt.figure(figsize=(16,8))
sns.lineplot(data=total_items_monthly,x='Month',y='Quantity')

plt.xlabel('Months')
plt.ylabel('Total Items')
plt.title('Total Items Sold By Month')
```

[30]:
```
Text(0.5, 1.0, 'Total Items Sold By Month')
```



we can cleary identify the peak on november total sales and february has the lowest sales

3.2 Let's See How Much Money Spent on the items By Month

3.2.1 first let's calculate the required data

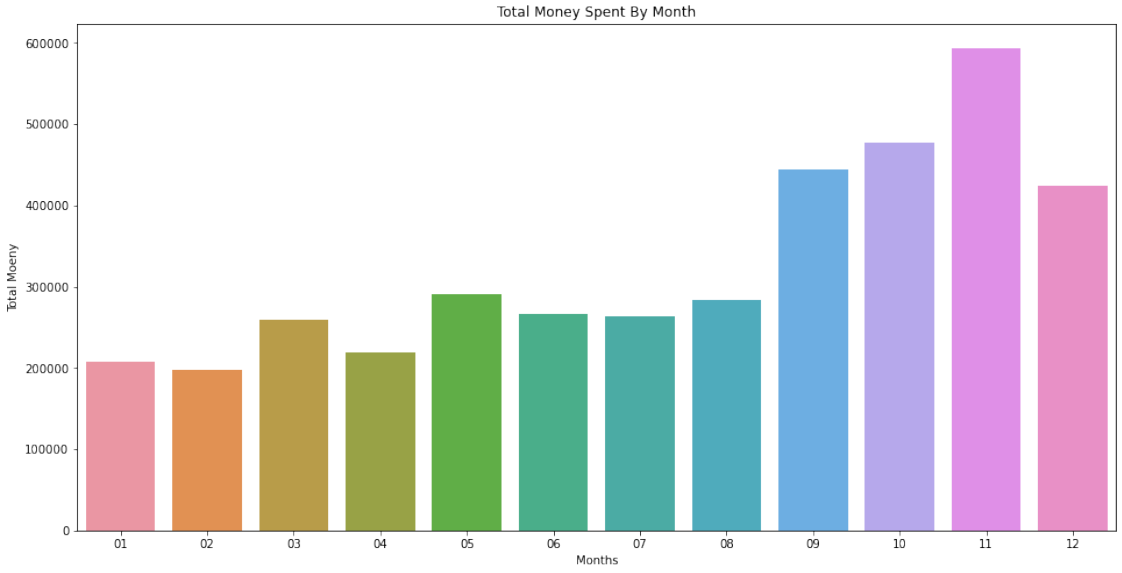
[31]:
```
clean['Total_Price'] = clean['Quantity'] * clean['UnitPrice']
```

3.2.2 let's group the targeted data

[32]:
```
total_price_monthly = clean.groupby("Month")['Total_Price'].sum().reset_index()
```

[33]:
```
plt.figure(figsize=(16,8))

sns.barplot(data=total_price_monthly,x='Month',y='Total_Price')

plt.xlabel('Months')
plt.ylabel('Total Moeny')
plt.title('Total Money Spent By Month')
```

[33]:
```
Text(0.5, 1.0, 'Total Money Spent By Month')
```



this chart confirms that november was the highest active month while february was the least

3.2.3 Creating Bins For The Unit Price

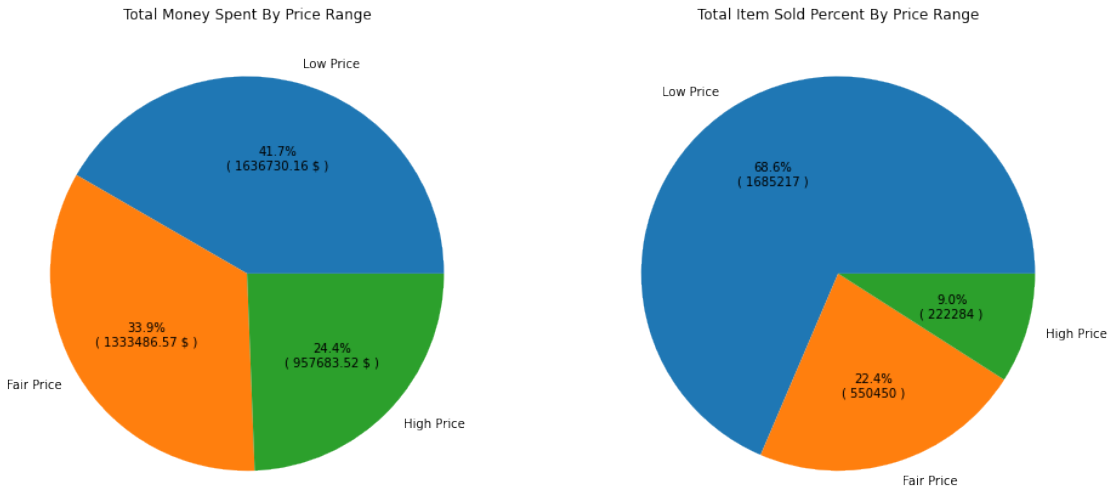
[34]:
```
bins= np.linspace(min(clean['UnitPrice']),max(clean['UnitPrice']),4)
group_names=['Low Price','Fair Price','High Price']
clean['Binned_Unit_Price']= pd.cut(clean['UnitPrice'],bins,labels=group_names,␣
 ↪include_lowest= True)
clean.head()
```

[34]:
```
  InvoiceNo StockCode                          Description  Quantity  \
0    536365    85123A   WHITE HANGING HEART T-LIGHT HOLDER         6
1    536365     71053                  WHITE METAL LANTERN         6
2    536365    84406B       CREAM CUPID HEARTS COAT HANGER         8
3    536365    84029G  KNITTED UNION FLAG HOT WATER BOTTLE         6
4    536365    84029E       RED WOOLLY HOTTIE WHITE HEART.         6

          InvoiceDate  UnitPrice  CustomerID         Country  Year Month Day  \
0 2010-12-01 08:26:00       2.55     17850.0  United Kingdom  2010    12  01
1 2010-12-01 08:26:00       3.39     17850.0  United Kingdom  2010    12  01
2 2010-12-01 08:26:00       2.75     17850.0  United Kingdom  2010    12  01
3 2010-12-01 08:26:00       3.39     17850.0  United Kingdom  2010    12  01
4 2010-12-01 08:26:00       3.39     17850.0  United Kingdom  2010    12  01

   Total_Price Binned_Unit_Price
0        15.30        Fair Price
1        20.34        Fair Price
2        22.00        Fair Price
3        20.34        Fair Price
4        20.34        Fair Price
```

[35]:
```
total_items = clean.groupby('Binned_Unit_Price')['Quantity'].sum().reset_index()
total_price = clean.groupby('Binned_Unit_Price')['Total_Price'].sum().
 ↪reset_index()

def func_price(pct, allvalues):
    absolute = float(pct / 100.*np.sum(allvalues))
    return "{:.1f}%\n( {:.2f} $ )".format(pct, absolute)

plt.figure(figsize=(16,9))

plt.subplot(1,2,1)

plt.pie(total_price['Total_Price'],
        labels= group_names,
        autopct=lambda pct: func_price(pct, total_price['Total_Price']))

plt.title("Total Money Spent By Price Range")
```

```
def func_items(pct, allvalues):
    absolute = int(pct / 100.*np.sum(allvalues))
    return "{:.1f}%\n( {:d} )".format(pct, absolute)

plt.subplot(1,2,2)

plt.pie(total_items['Quantity']
        ,labels= group_names,
        autopct=lambda pct: func_items(pct, total_items['Quantity']))
plt.title("Total Item Sold Percent By Price Range")
```

[35]: Text(0.5, 1.0, 'Total Item Sold Percent By Price Range')



from the both charts it's identifiable that the great majorty of sales and items sold are in the low price range

3.3 let's identify the highest Paying Customer

[36]:
```
customer = clean.groupby('CustomerID')['Total_Price'].sum().reset_index()
customer.sort_values(by='Total_Price',inplace=True, ascending=False)
customer.head(20)
```

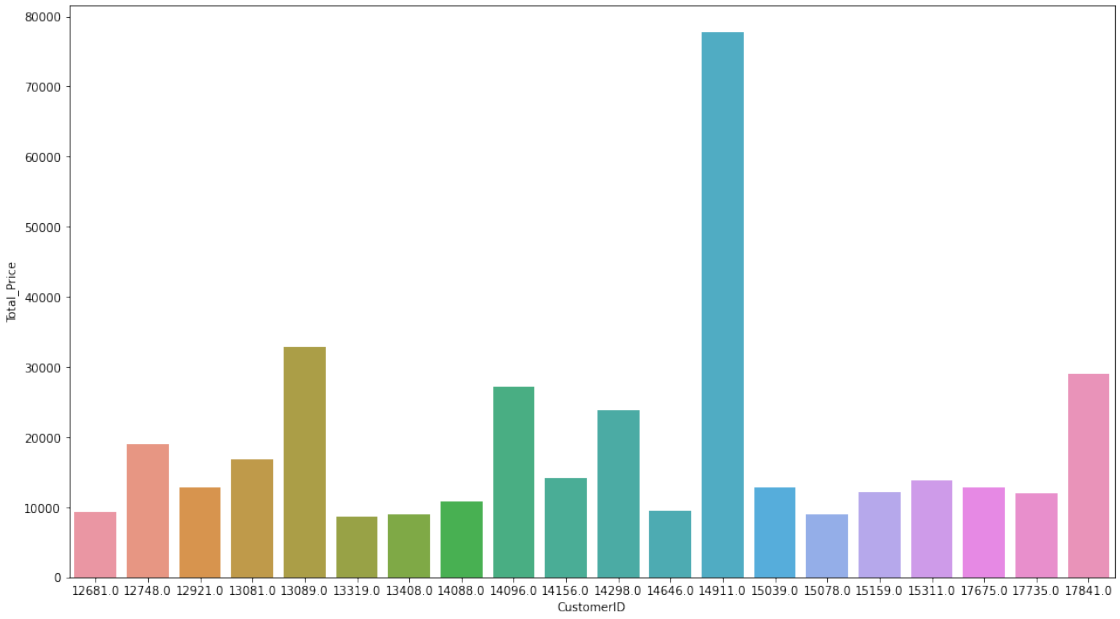
[36]:

	CustomerID	Total_Price
1821	14911.0	77777.89
542	13089.0	32918.58
3873	17841.0	28928.89
1245	14096.0	27211.04

```
1386      14298.0     23848.93
324       12748.0     18994.88
538       13081.0     16778.48
1287      14156.0     14123.81
2106      15311.0     13818.26
1904      15039.0     12792.67
3760      17675.0     12751.55
430       12921.0     12746.37
1998      15159.0     12153.11
3807      17735.0     11990.88
1241      14088.0     10780.04
1635      14646.0      9456.87
270       12681.0      9352.75
766       13408.0      8997.80
1935      15078.0      8940.97
705       13319.0      8673.04
```

[37]:
```
plt.figure(figsize=(16,9))
sns.barplot(data= customer.head(20),x='CustomerID',y='Total_Price')
```

[37]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f1fb9037cd0>
```



we can use the chart above and the list to make specific offers for these customers or identify how to target these users who are well likely to spend more money on shopping

3.4 Identifying The top-selling Products

[49]:
```
items =clean.groupby('Description')[['Total_Price','Quantity']].sum().
 ↪reset_index()
by_quantity= items.sort_values(by='Quantity',ascending=False)
by_quantity.head(5)
```

[49]:

	Description	Total_Price	Quantity
2010	PACK OF 72 RETROSPOT CAKE CASES	8277.68	14986
185	ASSORTED COLOUR BIRD ORNAMENT	22940.06	13574
1554	JUMBO BAG RED RETROSPOT	24923.50	12167
3246	WHITE HANGING HEART T-LIGHT HOLDER	31682.70	10770
1712	LUNCH BAG RED RETROSPOT	16194.80	9776

[50]:
```
by_price= items.sort_values(by='Total_Price',ascending=False)
by_price.head(5)
```

[50]:

	Description	Total_Price	Quantity
2073	PARTY BUNTING	34952.85	7089
3246	WHITE HANGING HEART T-LIGHT HOLDER	31682.70	10770
1554	JUMBO BAG RED RETROSPOT	24923.50	12167
2946	SPOTTY BUNTING	23513.05	4755
185	ASSORTED COLOUR BIRD ORNAMENT	22940.06	13574

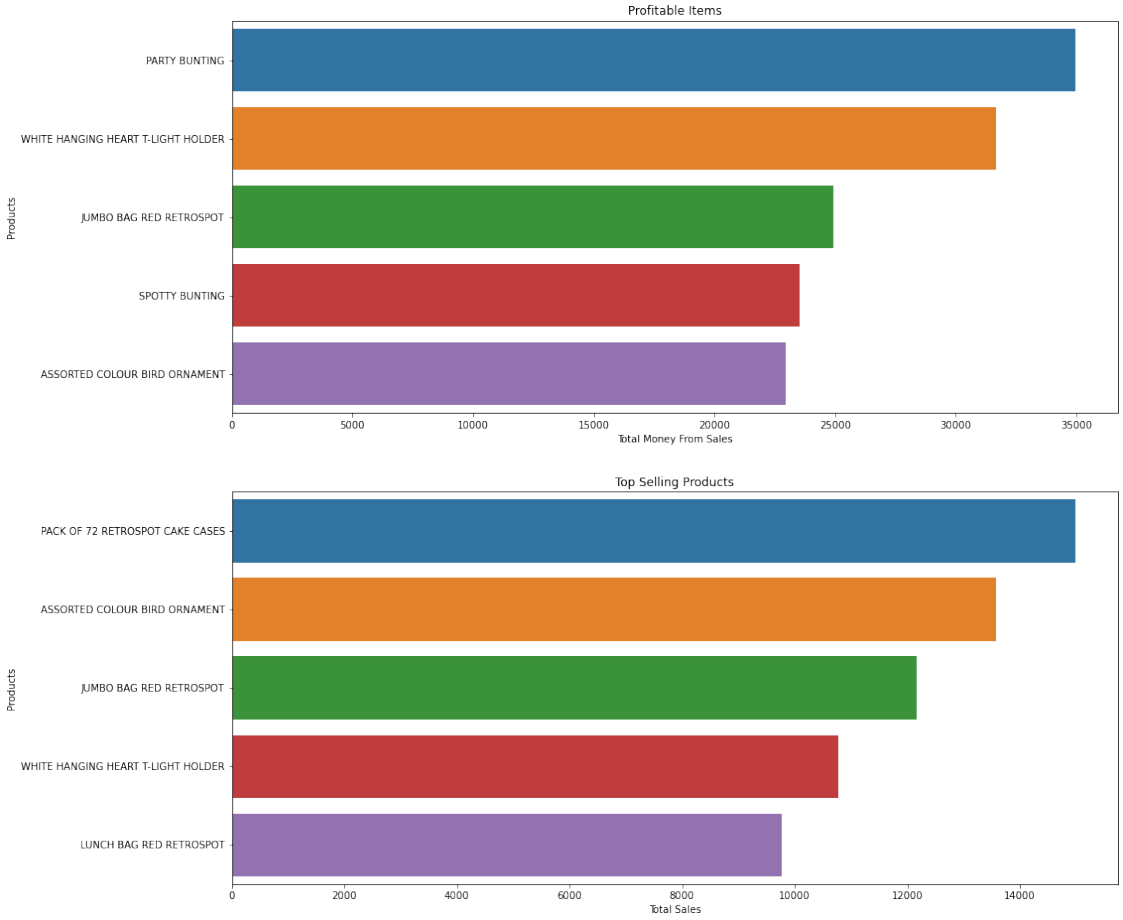
from the two lists above we can identify that the most selling products are [PACK OF 72 RETROSPOT CAKE CASES, ASSORTED COLOUR BIRD ORNAMENT, JUMBO BAG RED RETROSPOT, WHITE HANGING HEART T-LIGHT HOLDER and LUNCH BAG RED RETROSPOT].

while the most profitable products are [PARTY BUNTING, WHITE HANGING HEART T-LIGHT HOLDER, JUMBO BAG RED RETROSPOT, SPOTTY BUNTING and ASSORTED COLOUR BIRD ORNAMENT]

[73]:
```
plt.figure(figsize=(16,16))
plt.subplot(2,1,1)
sns.barplot(data=by_price.head(5),
            y= 'Description',
            x='Total_Price',
            orient = 'h')
plt.title('Profitable Items')
plt.xlabel('Total Money From Sales')
plt.ylabel('Products')

plt.subplot(2,1,2)
sns.barplot(data=by_quantity.head(5),
            y= 'Description',
            x='Quantity',
            orient = 'h')
```

```
plt.title('Top Selling Products')
plt.xlabel('Total Sales')
plt.ylabel('Products')
```

[73]: Text(0, 0.5, 'Products')



4 Conclusion

Initiated Data Cleaning, Analyzing and Visualization using proper tools and analytical skills.

4.0.1 Deployed Improved Data Analysis which led to the next findings

- November Has The highest Sales While February Has the least.
- Coming Closer the new year sales was expected to rise but On the contrary the sales dropped ond december.
- Products In the fair price range was the most sold and the highest total money spent on.

- Identified the top selling products as well as the most profitable
- there are specific customers are willing to pay alot of money on shopping.

4.0.2 .Thank You

4.1 .Author

5 Ahmed A. Elatwy