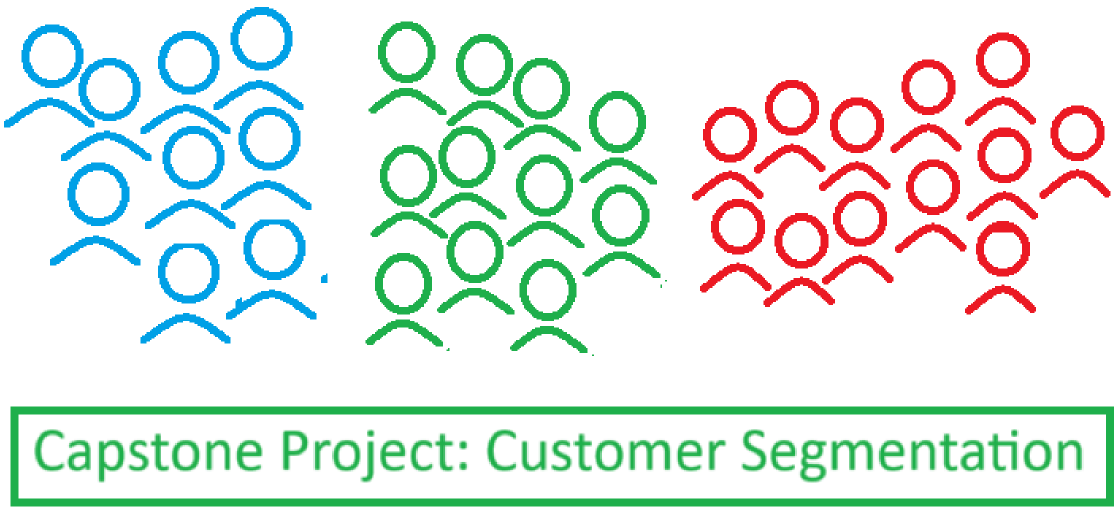

Capstone Project: Customer Segmentation

🗂️ Customer Segmentation 🗂️

Table of Contents

[💠 Problem Statement 💠]

✳️ An online retail store is trying to understand the various customer purchase patterns for theirfirm, you are required to give enough evidence based insights to provide the same.

[💠 Project Objective 💠]

✳️ Segment the customers based on their purchasing behavior.

✳️ find useful insights about the customer purchasing historythat

can be an added advantage for the online retailer..

[💠 Data Description 💠]

✳️ The online_retail.csv contains 387961 rows and 8 columns.

Feature Name Description

```
►Invoice         Invoice number
►StockCode      Product ID
►Description    Product Description
►Quantity       Quantity of the product
►InvoiceDate    Date of the invoice
►Price          Price of the product per unit
►CustomerID     Customer ID
►Country        Region of Purchase
```

[💠 Data Pre-processing Steps 💠]

▶Checking Shape and rows of Data Frame

▶Checking Dtype of columns

▶Checking for NULL values

▶Checking for Duplicate records

▶Correcting Dtype of columns and creating necessary columns

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
```

In [2]:
```
Data=pd.read_csv('OnlineRetail (3).csv',encoding='unicode_escape')
Data.head()
```

Out[2]:

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

In [3]:
```
print(Data.isnull().sum())
print('# Shape of data',Data.shape)
print('____________________________________________')
Data=Data.dropna()
print(Data.isnull().sum())
print('# Shape of data',Data.shape)
```

```
InvoiceNo           0
StockCode           0
Description      1454
Quantity            0
InvoiceDate         0
UnitPrice           0
CustomerID     135080
Country             0
dtype: int64
# Shape of data (541909, 8)
____________________________________________
InvoiceNo      0
StockCode      0
Description    0
Quantity       0
InvoiceDate    0
UnitPrice      0
CustomerID     0
Country        0
dtype: int64
# Shape of data (406829, 8)
```

In [4]:
```
print('# Number of duplicate rows ', Data.duplicated().sum())
print('# Shape of data',Data.shape)
print('____________________________________________')
Data=Data.drop_duplicates()
print('# Number of duplicate rows ', Data.duplicated().sum())
print('# Shape of data',Data.shape)
```

```
# Number of duplicate rows  5225
# Shape of data (406829, 8)
____________________________________________
# Number of duplicate rows  0
# Shape of data (401604, 8)
```

In [5]:
```
Data.describe()
#Here we can observe a problem that some quantities are negative,hence elem
```

Out[5]:

	Quantity	UnitPrice	CustomerID
count	401604.000000	401604.000000	401604.000000
mean	12.183273	3.474064	15281.160818
std	250.283037	69.764035	1714.006089
min	-80995.000000	0.000000	12346.000000
25%	2.000000	1.250000	13939.000000
50%	5.000000	1.950000	15145.000000
75%	12.000000	3.750000	16784.000000
max	80995.000000	38970.000000	18287.000000

In [6]:
```
Data['Sales']=Data['Quantity']*Data['UnitPrice']
Data.head()
```

Out[6]:

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

In [7]:
```
Data=Data[Data['Sales']>0]
Data.shape
```

Out[7]: (392692, 9)

In [8]:
```
Data['InvoiceDate']=pd.to_datetime(Data['InvoiceDate'])
Data['CustomerID']=Data['CustomerID'].astype(str)
```

[💠 Analysing the DataFrame 💠][EDA]

▶Customer Distribution

▶Top Selling Products

▶Outliers detection and treatment

▶Function : product_quantity_analysis

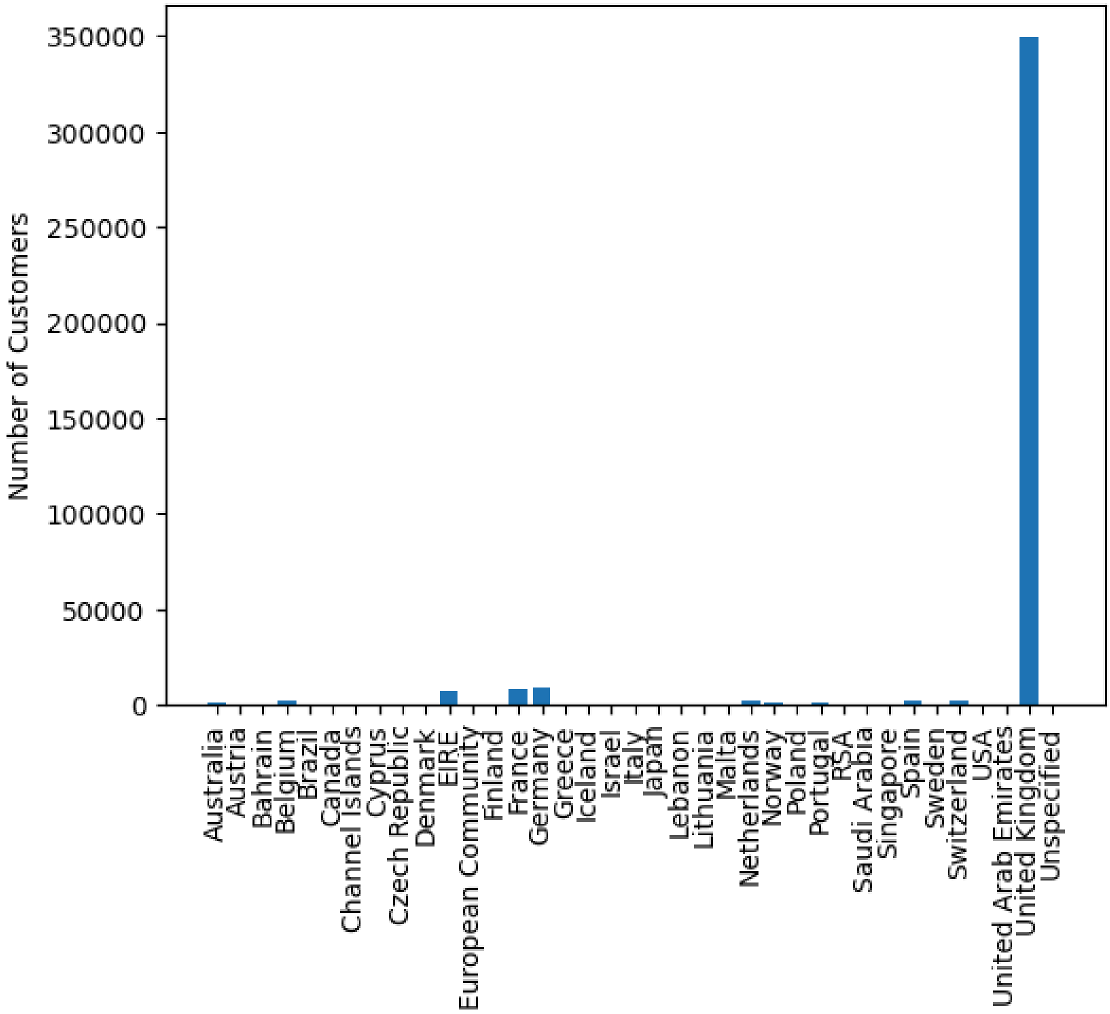
▶Sales distribution per month

💠 Customer Distribution

▶it is clear that majority customers are from United Kingdom 88.92%

In [9]:
```
Custom_distribution=Data.groupby('Country')['CustomerID'].count()
Custom_distribution=pd.DataFrame(Custom_distribution)

plt.bar(Custom_distribution.index,Custom_distribution['CustomerID'])
plt.xticks(rotation=90)
plt.ylabel('Number of Customers')

Percentage=(Data['Country'].value_counts()[0]/Data['Country'].value_counts
print('**** From the below graph it is clear that majority customers are fr

plt.show()
```

```
**** From the below graph it is clear that majority customers are from Un
ited Kingdom  88.92541737544947 ****
```

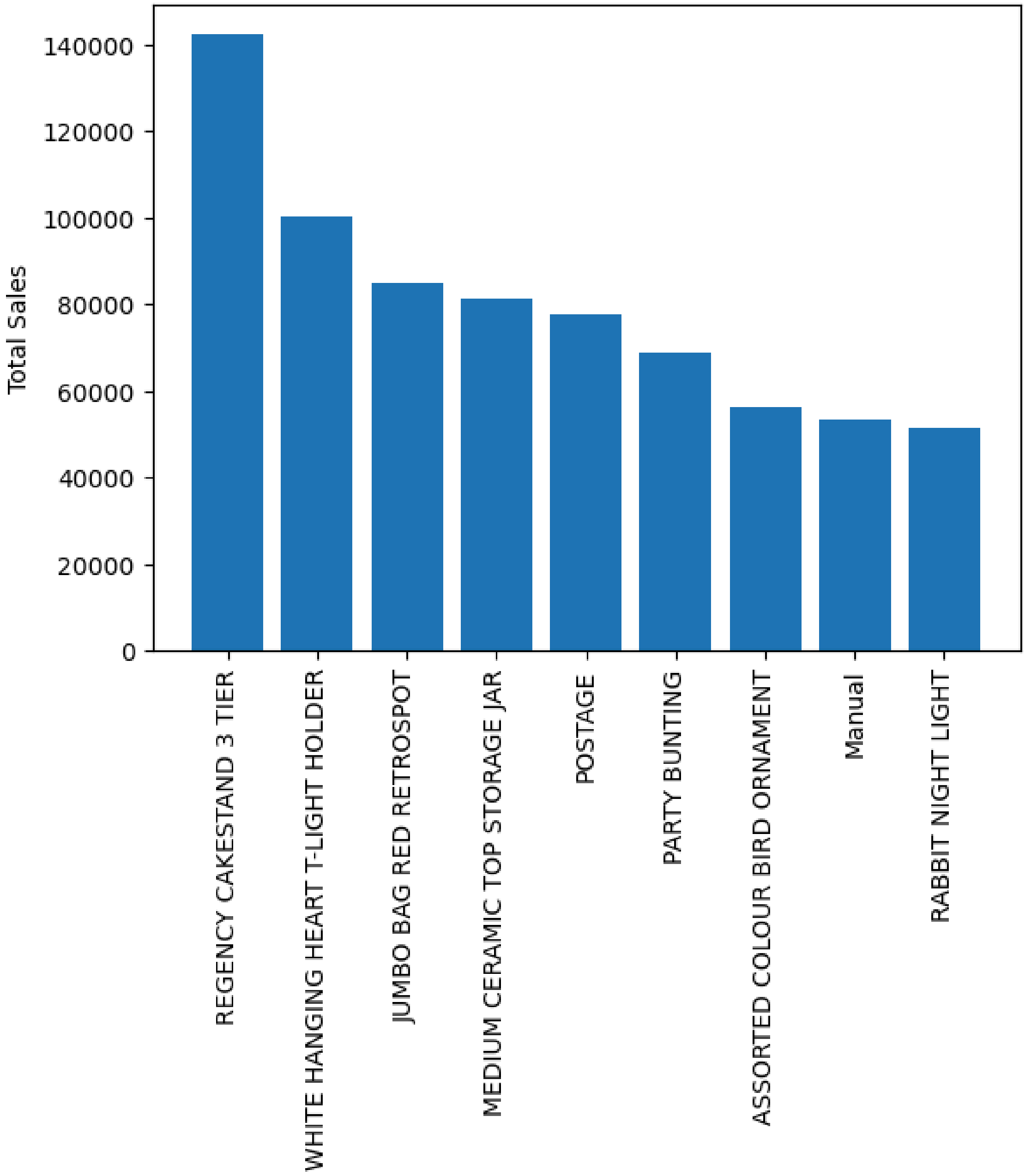

Number of Customers
350000
300000
250000
200000
150000
100000
50000
0
Australia
Austria
Bahrain
Belgium
Brazil
Canada
Channel Islands
Cyprus
Czech Republic
Denmark
EIRE
European Community
Finland
France
Germany
Greece
Iceland
Israel
Italy
Japan
Lebanon
Lithuania
Malta
Netherlands
Norway
Poland
Portugal
RSA
Saudi Arabia
Singapore
Spain
Sweden
Switzerland
USA
United Arab Emirates
United Kingdom
Unspecified

Top Selling Products

'Top_Sales_product' this function will retrive the top performing product based on sales.

In [10]:
```
def Top_Sales_product (y=5,x=0,table=False):
    print('For tabular output give table=True in params' )
    if(y<x):
        x,y=y,x
    Sales=Data.groupby('Description')['Sales'].sum()
    Sales=pd.DataFrame(Sales).sort_values('Sales',ascending=False)
    Sales=Sales[x:y]
    print(f'***********  Top ({x} to {y}) product based on sales  *********
    plt.bar(Sales.index,Sales['Sales'])
    plt.xticks(rotation=90)
    plt.ylabel('Total Sales')
    plt.show()
    if(table==True):
        return(Sales)


Top_Sales_product(1,10,True)
```

```
For tabular output give table=True in params
***********  Top (1 to 10) product based on sales  ***********
```



Out[10]:

	Sales
Description	
REGENCY CAKESTAND 3 TIER	142264.75
WHITE HANGING HEART T-LIGHT HOLDER	100392.10
JUMBO BAG RED RETROSPOT	85040.54
MEDIUM CERAMIC TOP STORAGE JAR	81416.73
POSTAGE	77803.96
PARTY BUNTING	68785.23
ASSORTED COLOUR BIRD ORNAMENT	56413.03
Manual	53419.93
RABBIT NIGHT LIGHT	51251.24

🔷 Outliers detection and treatment

▶Outliers treatment for function 'product_quantity_analysis'

▶Creating necessary columns for the function

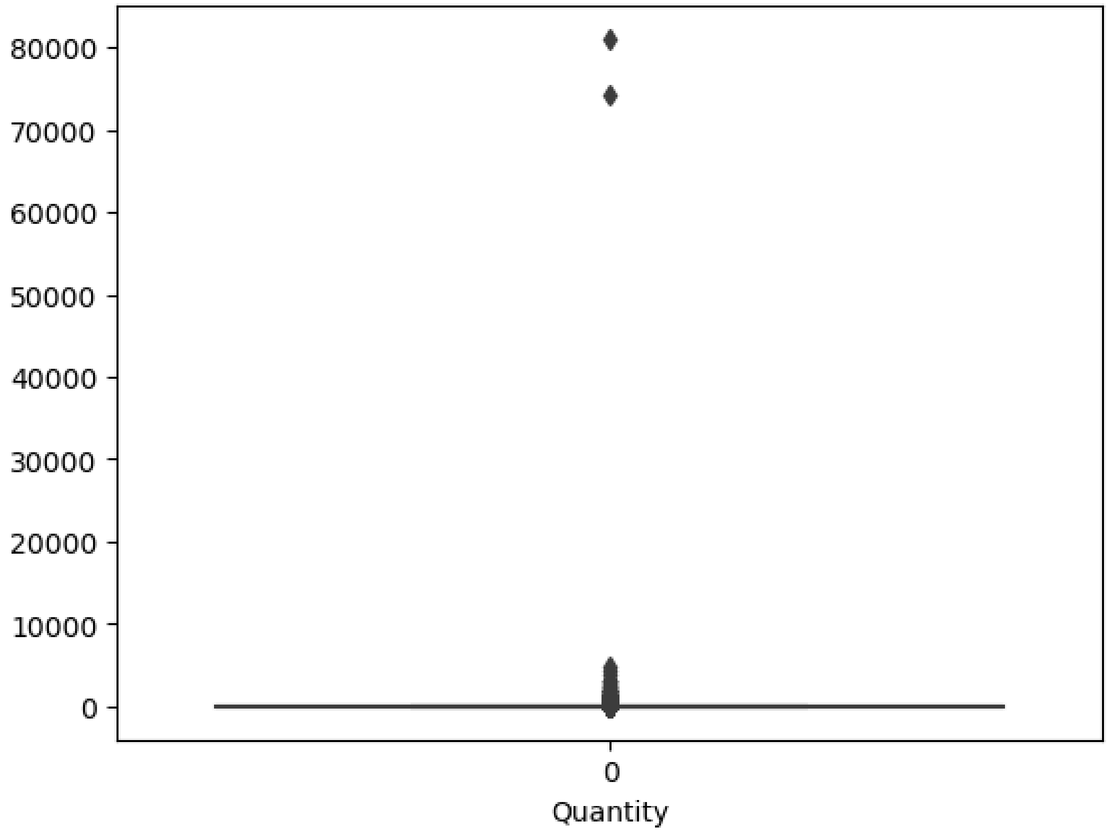
In [11]:

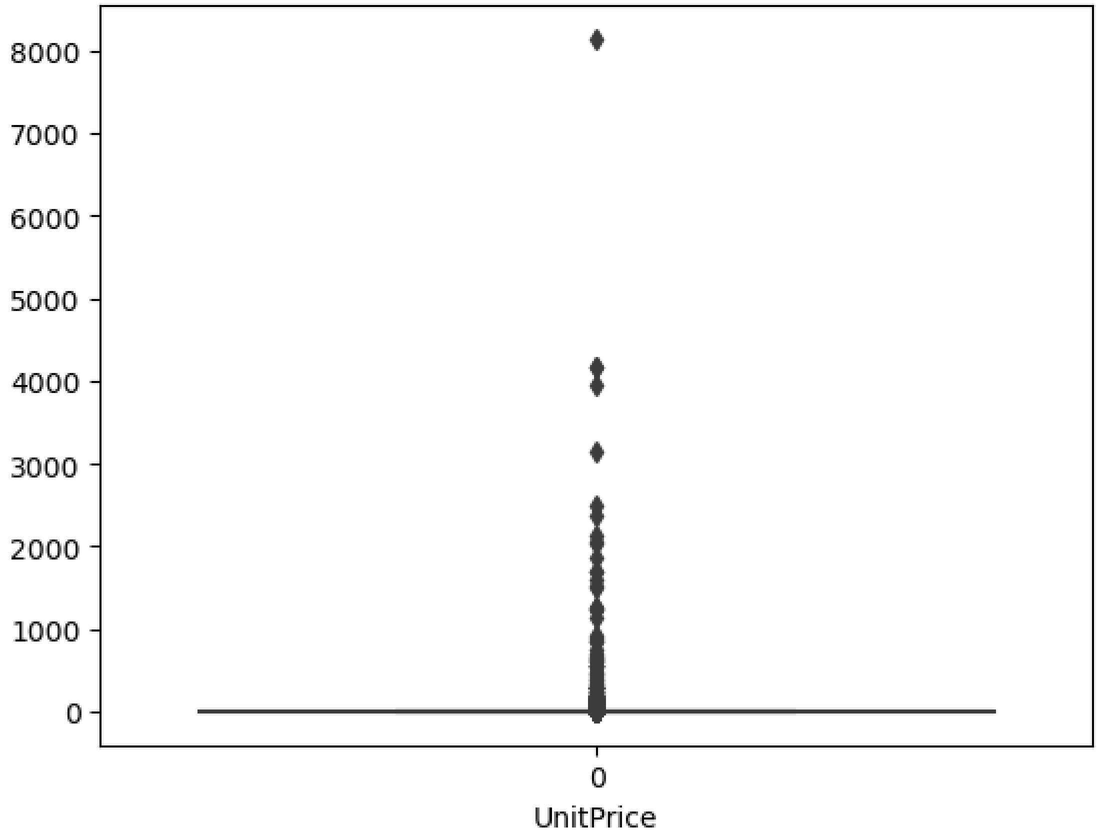
```
data=Data
data['Month']=Data['InvoiceDate'].dt.month
data['Year']=Data['InvoiceDate'].dt.year
data=data.drop(['Sales'],axis=1)
data=data.sort_values(by='InvoiceDate')
data=data.set_index('InvoiceDate')
data.head()
```

Out[11]:

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

In [12]:
```
col=['Quantity','UnitPrice']

for i in col:
    sns.boxplot(data[i])
    plt.xlabel(i)
    plt.show()
```





In [13]:
```
Q1=data.quantile(0.25)
Q3=data.quantile(0.75)
IQR=Q3-Q1
```

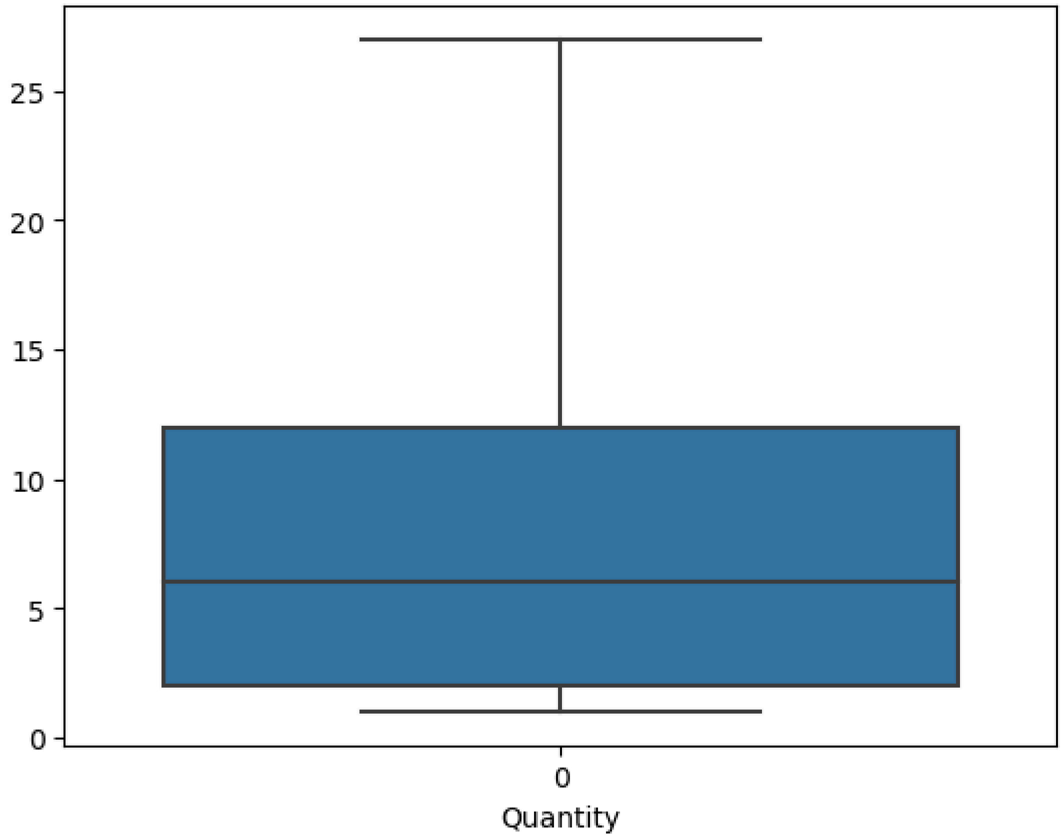
```
C:\Users\MAYUR\AppData\Local\Temp\ipykernel_25444\2242722683.py:1: Future
Warning: The default value of numeric_only in DataFrame.quantile is depre
cated. In a future version, it will default to False. Select only valid c
olumns or specify the value of numeric_only to silence this warning.
  Q1=data.quantile(0.25)
C:\Users\MAYUR\AppData\Local\Temp\ipykernel_25444\2242722683.py:2: Future
Warning: The default value of numeric_only in DataFrame.quantile is depre
cated. In a future version, it will default to False. Select only valid c
olumns or specify the value of numeric_only to silence this warning.
  Q3=data.quantile(0.75)
```

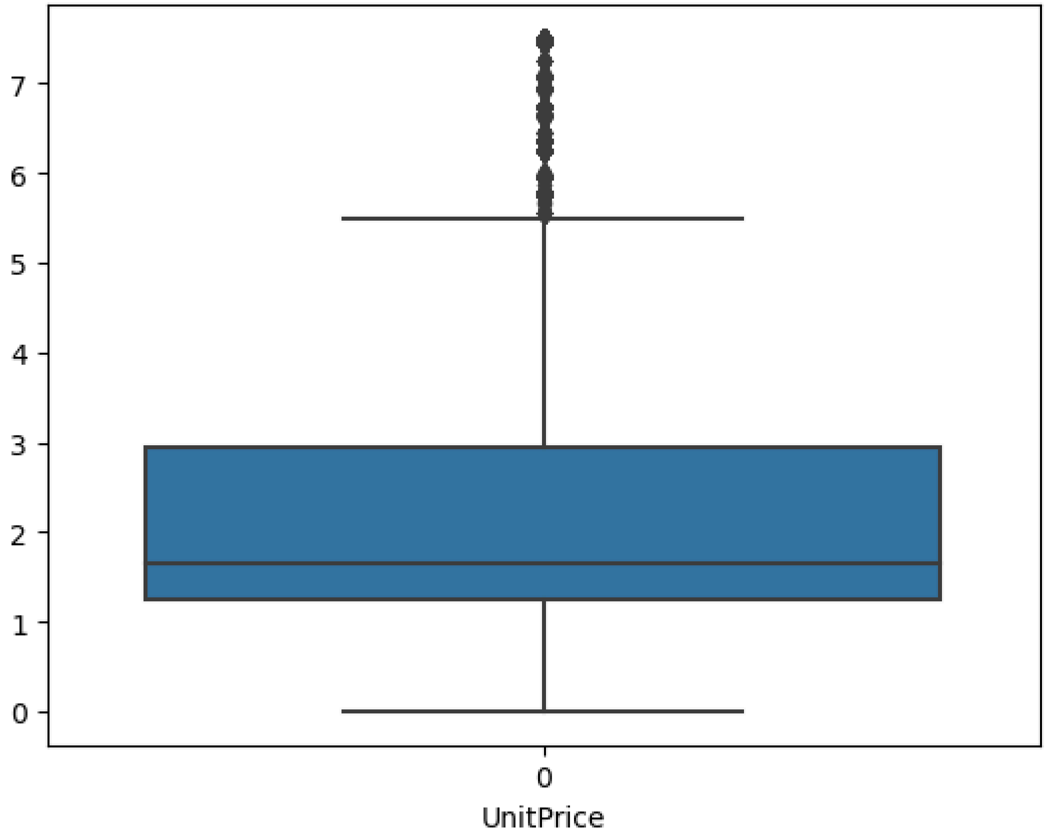
In [14]:
```
data = data[~((data < (Q1 - 1.5 * IQR)) | (data > (Q3 + 1.5 * IQR))).any(a
```

```
C:\Users\MAYUR\AppData\Local\Temp\ipykernel_25444\2520746827.py:1: Future
Warning: Automatic reindexing on DataFrame vs Series comparisons is depre
cated and will raise ValueError in a future version. Do `left, right = le
ft.align(right, axis=1, copy=False)` before e.g. `left == right`
  data = data[~((data < (Q1 - 1.5 * IQR)) | (data > (Q3 + 1.5 * IQR))).an
y(axis=1)]
```

In [15]:

```
col=['Quantity','UnitPrice']

for i in col:
    sns.boxplot(data[i])
    plt.xlabel(i)
    plt.show()
```





In [16]:
```
data['Sales']=data['Quantity']*data['UnitPrice']
data.head(10)
```

Out[16]:

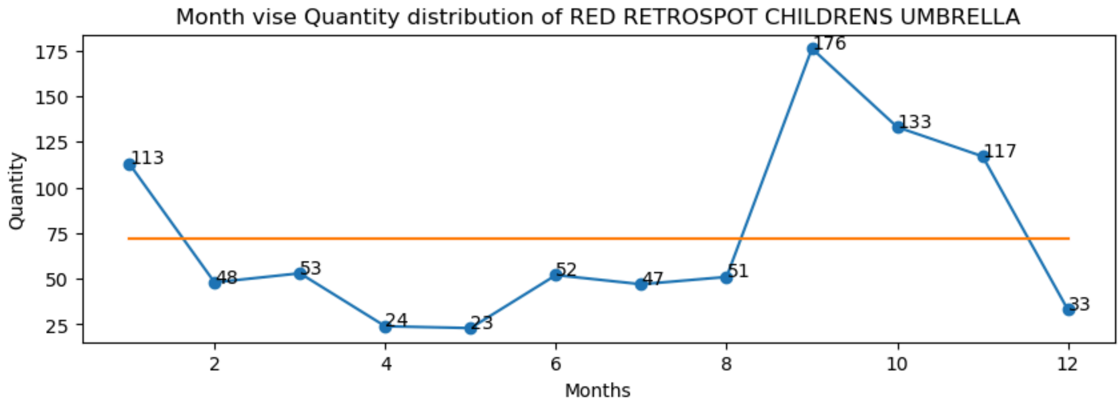
	InvoiceNo	StockCode	Description	Quantity	UnitPrice	CustomerID	Country
InvoiceDate							
2011-01-04 10:00:00	539993	22862	LOVE HEART NAPKIN BOX	4	4.25	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22458	CAST IRON HOOK GARDEN FORK	8	2.55	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22808	SET OF 6 T-LIGHTS EASTER CHICKS	12	2.95	13313.0	United Kingdom
2011-01-04 10:00:00	539993	85123A	WHITE HANGING HEART T-LIGHT HOLDER	12	2.95	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22302	COFFEE MUG PEARS DESIGN	6	2.55	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22303	COFFEE MUG APPLES DESIGN	6	2.55	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22896	PEG BAG APPLES DESIGN	6	2.55	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22898	CHILDRENS APRON APPLES DESIGN	8	1.95	13313.0	United Kingdom
2011-01-04 10:00:00	539993	20682	RED RETROSPOT CHILDRENS UMBRELLA	6	3.25	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22961	JAM MAKING SET PRINTED	12	1.45	13313.0	United Kingdom

💠 Function : product_quantity_analysis

▶The function will underline the order quantity analysis based on order month.

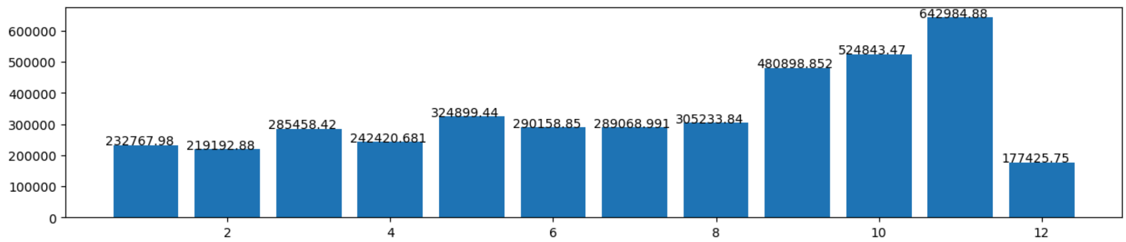
In [17]:
```
def product_quantity_analysis(prod):
    entries=l=[0 for i in range(12)]
    months=[i for i in range(1,13)]

    MQ=data[data['Description']==prod].groupby('Month')['Quantity'].sum()

    for i in MQ.index:
        if(MQ[i]>0):
            entries[i-1]=MQ[i]

    MQ=pd.DataFrame({'Months':months,'Quantity':entries})
    MQ=MQ.set_index('Months')
    MQ['Avg_Quantity']=int(MQ.mean()['Quantity'])

    print(f'***** Has to give more attention on stock of {prod} for below r
    print(MQ[MQ['Quantity']>1.25*MQ.mean()['Quantity']])

    print('________________________________________________________________

    print(f'***** These are months of very low sales of {prod} *****')
    print(MQ[MQ['Quantity']<0.5*MQ.mean()['Quantity']])

    print('________________________________________________________________

    plt.figure(figsize=(10,3))
    plt.plot(MQ['Quantity'])
    plt.plot(MQ['Avg_Quantity'])
    plt.scatter(x=months,y=MQ['Quantity'])

    for i,text in enumerate(MQ['Quantity']):
        plt.annotate(text,(months[i],MQ['Quantity'].iloc[i]))

    plt.xlabel('Months')
    plt.ylabel('Quantity')
    plt.title(f'Month vise Quantity distribution of {prod}')
    plt.show()


product_quantity_analysis('RED RETROSPOT CHILDRENS UMBRELLA')
```

```
***** Has to give more attention on stock of RED RETROSPOT CHILDRENS UMBR
ELLA for below months *****
          Quantity  Avg_Quantity
Months
1              113            72
9              176            72
10             133            72
11             117            72
_____________________________________________________________________________
_________________
***** These are months of very low sales of RED RETROSPOT CHILDRENS UMBRE
LLA *****
          Quantity  Avg_Quantity
Months
4               24            72
5               23            72
12              33            72
_____________________________________________________________________________
_________________
```



💠 Sales distribution per month

In [18]:
```python
Sales=data.groupby('Month')['Sales'].sum()

plt.figure(figsize=(15,3))
plt.bar(height=Sales,x=Sales.index)

for i,t in enumerate(Sales):
    plt.annotate(t,(Sales.index[i]-0.5,Sales.iloc[i]))

plt.show()
```



[💠 Choosing the Algorithm For the Project 💠]

✳️ K-Means clustering is an efficient machine learning algorithm to solve data clustering problems. It’s an unsupervised algorithm that’s quite suitable for solving customer segmentation problems because,

```
▶Easy to use: The k-means algorithm is simple to understand and i
mplement
▶Fast and efficient: It's computationally efficient and can handl
e large datasets
▶No assumptions: It can be used without any assumptions about the
data engineering process. </font>
```

💠 Model building & Segmentation

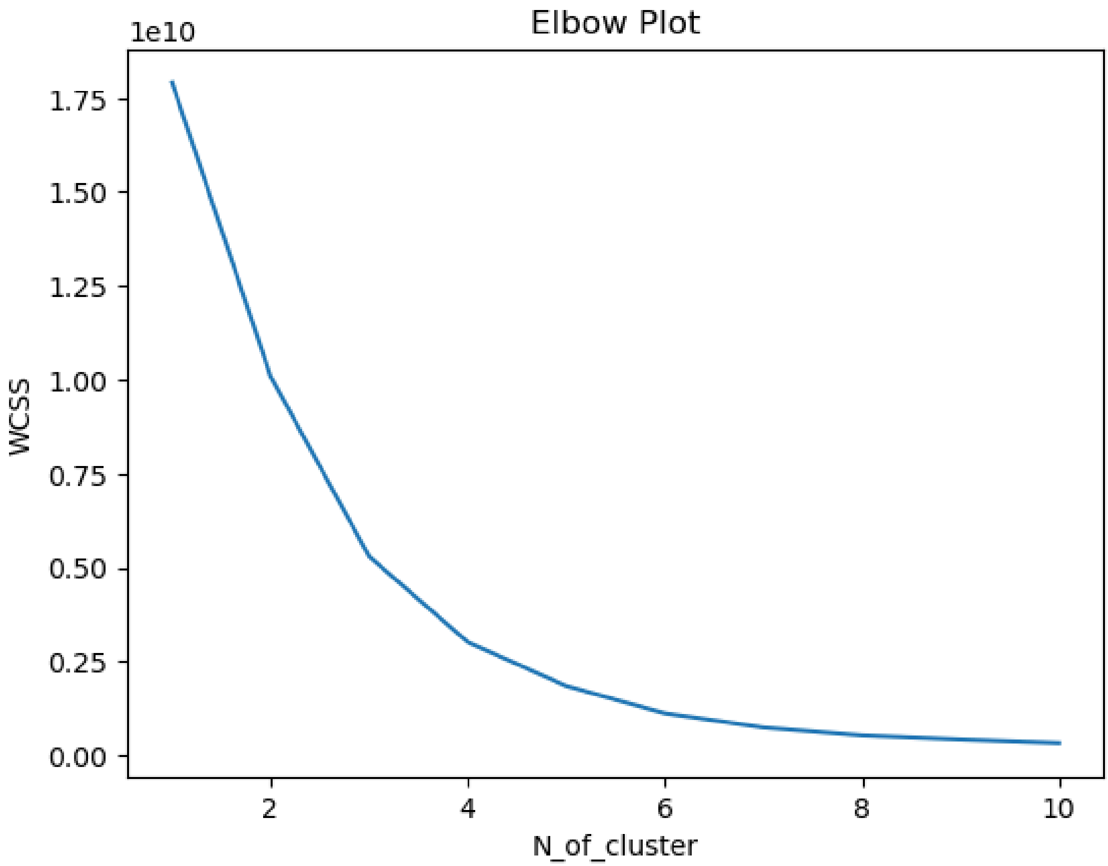
In [19]:
```
Customer=pd.DataFrame(data.groupby('CustomerID')['Sales'].sum())         #(
Customer['No_orders']= data.groupby('CustomerID')['Sales'].count()
Customer.head()
```

Out[19]:

	Sales	No_orders
CustomerID		
12347.0	2663.84	137
12348.0	37.40	2
12349.0	999.15	58
12350.0	294.40	16
12352.0	1130.94	66

In [20]:
```
from sklearn.cluster import KMeans

N_of_cluster=list(range(1,11))
wcss=[]

for n in N_of_cluster:
    model_kmeans=KMeans(n_clusters=n,max_iter=100,random_state=100)
    model_kmeans.fit(Customer)
    wcss.append( model_kmeans.inertia_)

plt.plot(N_of_cluster,wcss)
plt.xlabel('N_of_cluster')
plt.ylabel('WCSS')
plt.title('Elbow Plot')
plt.show()
```

```
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```



In [21]:
```
model_kmeans=KMeans(n_clusters=5,max_iter=100,random_state=100)
model_kmeans.fit(Customer)
```

```
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```

Out[21]:
```
KMeans(max_iter=100, n_clusters=5, random_state=100)
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [22]:
```
Customer['Cluster_ID']=model_kmeans.labels_
Customer.head()
```

Out[22]:

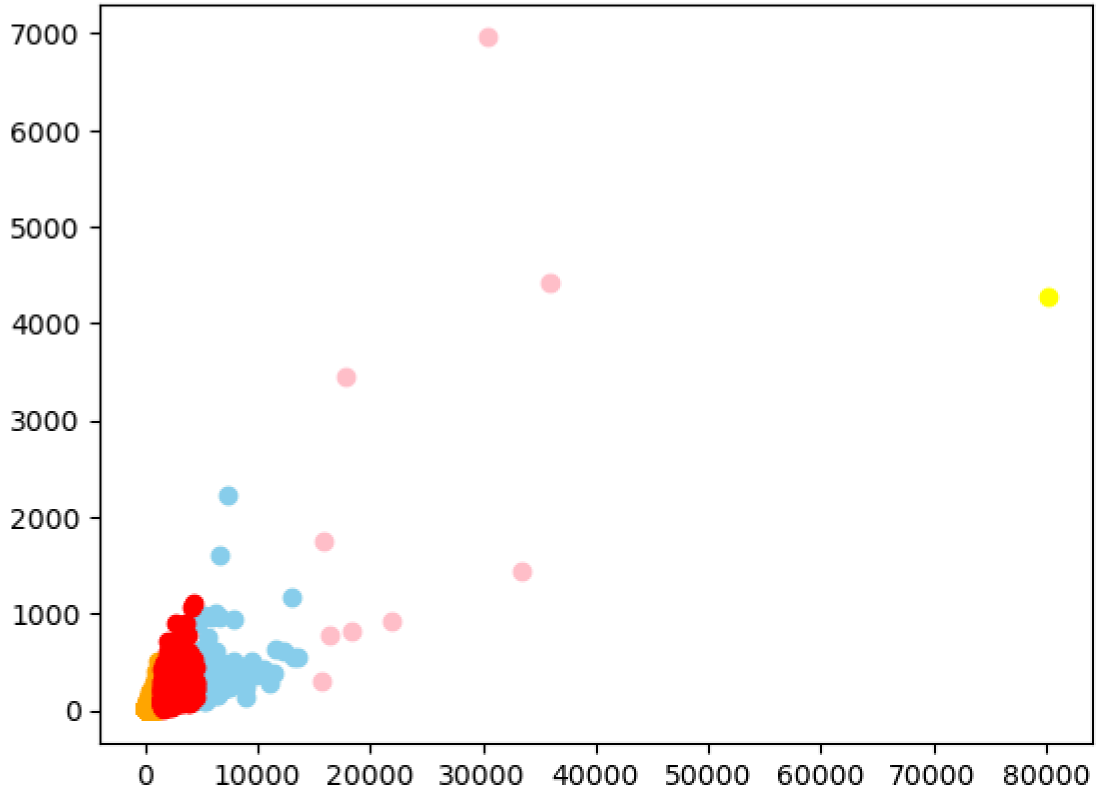
CustomerID	Sales	No_orders	Cluster_ID
12347.0	2663.84	137	4
12348.0	37.40	2	0
12349.0	999.15	58	0
12350.0	294.40	16	0
12352.0	1130.94	66	0

In [23]:
```
x=Customer.drop(columns='Cluster_ID',axis=1)
x=np.array(x)

yk=model_kmeans.fit_predict(x)
yk
```

```
C:\Users\MAYUR\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:87
0: FutureWarning: The default value of `n_init` will change from 10 to 'a
uto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```

Out[23]:
```
array([4, 0, 0, ..., 0, 4, 0])
```

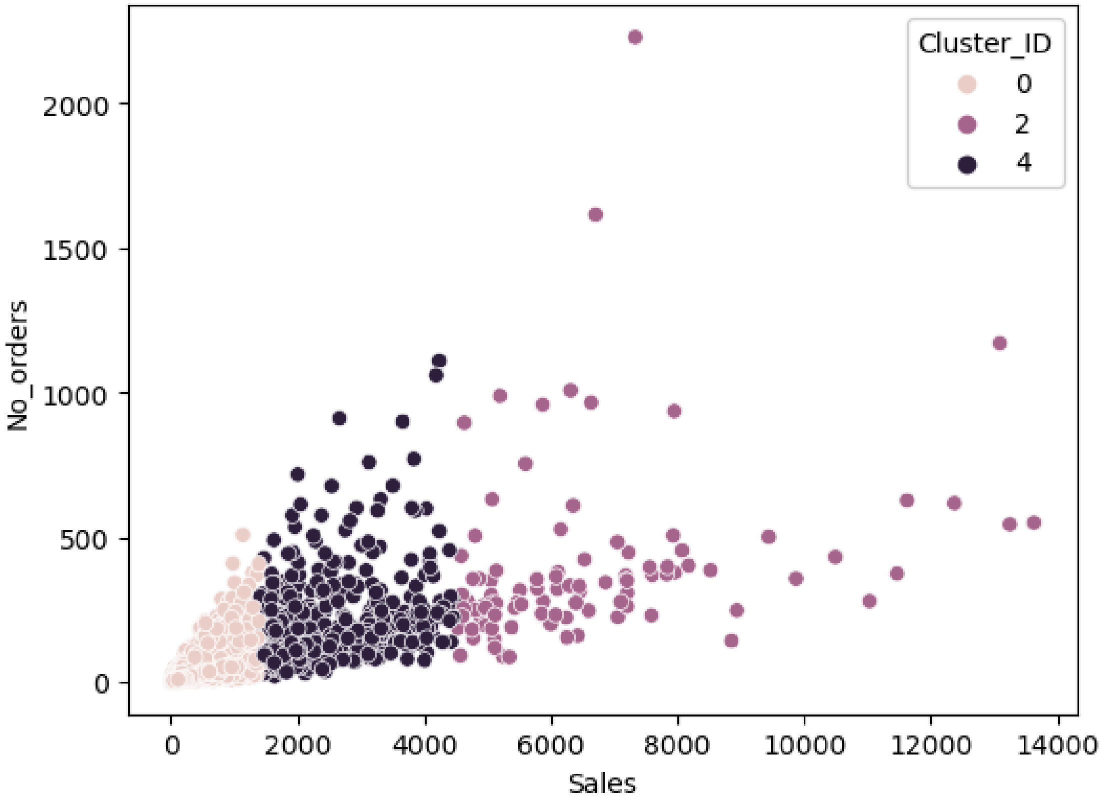
In [24]:
```
plt.scatter(x[yk==0,0],x[yk==0,1],color='orange')
plt.scatter(x[yk==1,0],x[yk==1,1],color='yellow')
plt.scatter(x[yk==2,0],x[yk==2,1],color='skyblue')
plt.scatter(x[yk==3,0],x[yk==3,1],color='pink')
plt.scatter(x[yk==4,0],x[yk==4,1],color='red')
plt.show()
```



In [25]:
```
print(Customer['Cluster_ID'].value_counts())
print('_____________________________________________________________________')
Customer=Customer[Customer['Cluster_ID'].isin([0,4,2])]
print(Customer['Cluster_ID'].value_counts())
```

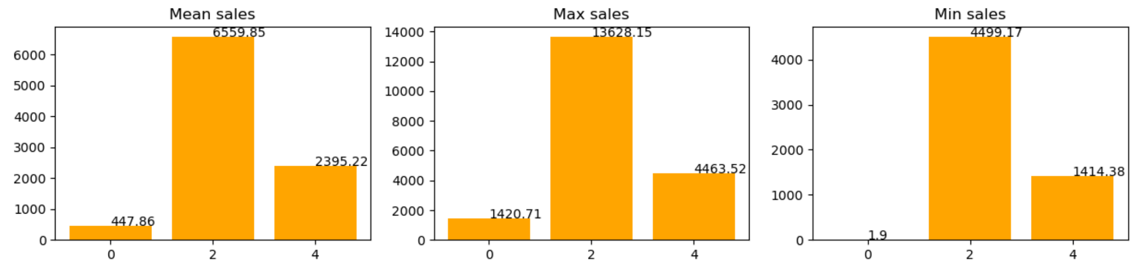
```
0    3302
4     663
2     101
3       9
1       1
Name: Cluster_ID, dtype: int64
_____________________________________________________________________
0    3302
4     663
2     101
Name: Cluster_ID, dtype: int64
```

In [26]:
```
sns.scatterplot(data=Customer,x='Sales',y='No_orders',hue='Cluster_ID')
plt.show()
```



[💠 Analysing Clusters of Customers from Model 💠]

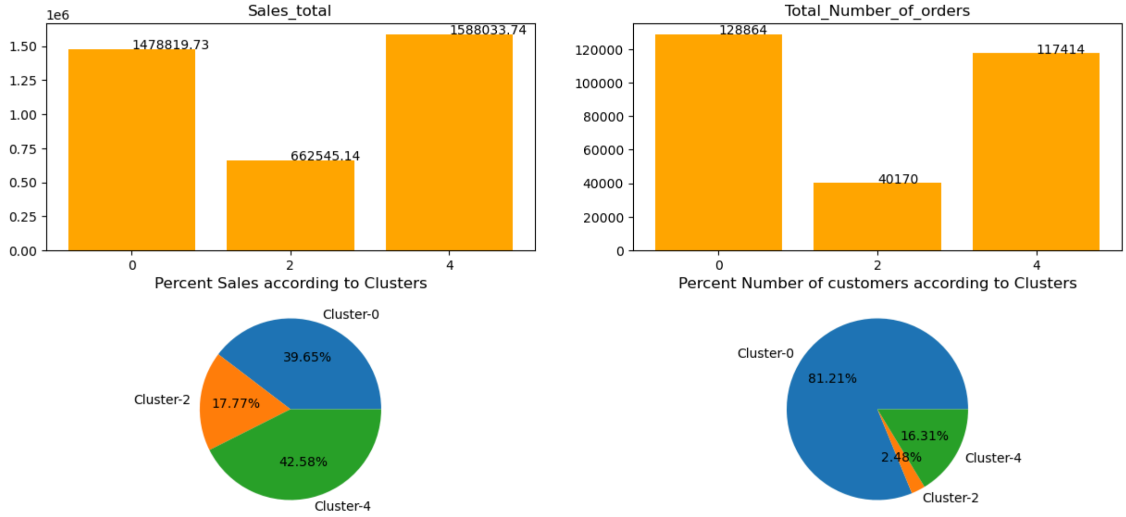
In [27]:
```
cl=list(Customer['Cluster_ID'].unique())
cl.sort()
Mean=[Customer[Customer['Cluster_ID']==i]['Sales'].mean() for i in cl]
Max=[Customer[Customer['Cluster_ID']==i]['Sales'].max() for i in cl]
Min=[Customer[Customer['Cluster_ID']==i]['Sales'].min() for i in cl]
cl=[str(i) for i in cl]
param=[Mean,Max,Min]

plt.figure(figsize=(15,3))
for i,t in enumerate(param):
    title=['Mean','Max','Min']
    plt.subplot(1,3,i+1)
    plt.bar(x=cl,height=t,color='orange')
    plt.title(f'{title[i]} sales')
    for j,tx in enumerate(t):
        plt.annotate(round(tx,2),(cl[j],t[j]))

plt.show()
```



In [28]:
```
cl=list(Customer['Cluster_ID'].unique())
cl.sort()
Mean=[Customer[Customer['Cluster_ID']==i]['No_orders'].mean() for i in cl]
Max=[Customer[Customer['Cluster_ID']==i]['No_orders'].max() for i in cl]
Min=[Customer[Customer['Cluster_ID']==i]['No_orders'].min() for i in cl]
cl=[str(i) for i in cl]
param=[Mean,Max,Min]

plt.figure(figsize=(15,3))
for i,t in enumerate(param):
    title=['Mean','Max','Min']
    plt.subplot(1,3,i+1)
    plt.bar(x=cl,height=t,color='orange')
    plt.title(f'{title[i]} No_orders')
    for j,tx in enumerate(t):
        plt.annotate(round(tx,2),(cl[j],t[j]))

plt.show()
```

In [29]:
```
Total=Customer['Sales'].sum()
print(f'Total sales = {Total}')
print('****** Sales according to Clusters ******')
print(Customer.groupby('Cluster_ID')['Sales'].sum())
print("____________________________________________________________")


cl=list(Customer['Cluster_ID'].unique())
cl.sort()
Sales_total=[Customer[Customer['Cluster_ID']==i]['Sales'].sum() for i in cl
Total_orders=[Customer[Customer['Cluster_ID']==i]['No_orders'].sum() for i

cl=[str(i) for i in cl]
param=[Sales_total,Total_orders]

plt.figure(figsize=(15,7))
for i,t in enumerate(param):
    title=['Sales_total','Total_Number_of_orders']
    plt.subplot(2,2,i+1)
    plt.bar(x=cl,height=t,color='orange')
    plt.title(f'{title[i]}')
    for j,tx in enumerate(t):
        plt.annotate(round(tx,2),(cl[j],t[j]))



plt.subplot(2,2,3)
plt.pie(Customer.groupby('Cluster_ID')['Sales'].sum(),autopct='%.2f%%',labe
plt.title('Percent Sales according to Clusters')

plt.subplot(2,2,4)
plt.pie(Customer.groupby('Cluster_ID')['Cluster_ID'].count(),autopct='%.2f
plt.title('Percent Number of customers according to Clusters')

plt.show()
```

```
Total sales = 3729398.614
****** Sales according to Clusters ******
Cluster_ID
0    1478819.733
2     662545.140
4    1588033.741
Name: Sales, dtype: float64
____________________________________________________________
```



Cluster-0

▶These are the customers who orders very seldomly and are majority in numbers their mean sales is also the least but contributes to 39.65% of total sales.

Cluster-4

▶These are regular customers who have moderate mean sales and responsible for 42.58% of total sales,hence becomes the largest contributers.

Cluster-2

▶These are the customers who are frequent buyers and has about double mean sales as that of Cluster-4 customers. Though they are only 2.48% there contribution to total sales is 17.77%

[💠 Frequently Brought Together 💠]

▶Identifying frequently brought combinations using fpgrowth
▶The function 'possiple_combo' will get the possible combos with respect to a product mentioned.

In [30]:
```
data.head()
```

Out[30]:

InvoiceDate	InvoiceNo	StockCode	Description	Quantity	UnitPrice	CustomerID	Country
2011-01-04 10:00:00	539993	22862	LOVE HEART NAPKIN BOX	4	4.25	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22458	CAST IRON HOOK GARDEN FORK	8	2.55	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22808	SET OF 6 T-LIGHTS EASTER CHICKS	12	2.95	13313.0	United Kingdom
2011-01-04 10:00:00	539993	85123A	WHITE HANGING HEART T-LIGHT HOLDER	12	2.95	13313.0	United Kingdom
2011-01-04 10:00:00	539993	22302	COFFEE MUG PEARS DESIGN	6	2.55	13313.0	United Kingdom

In [31]:
```
product =data['Description'].value_counts()                    #consider
product=list(product[:200].index)
```

In [32]:
```
prod_data=data[data['Description'].isin(product)]
invoice_list=list(data['InvoiceNo'].unique())
```

In [33]:
```
fpgrowth_data=[]
for i in invoice_list:
    List=list(prod_data[prod_data['InvoiceNo']==i]['Description'])
    fpgrowth_data.append(List)

fpgrowth_data
```

Out[33]:
```
[['WHITE HANGING HEART T-LIGHT HOLDER',
  'JAM MAKING SET PRINTED',
  'JUMBO BAG RED RETROSPOT',
  'RED RETROSPOT SHOPPER BAG',
  'RECYCLING BAG RETROSPOT ',
  'JUMBO BAG PINK POLKADOT',
  'RECIPE BOX RETROSPOT '],
 [],
 [],
 ['SET OF 3 HEART COOKIE CUTTERS',
  'HANGING HEART JAR T-LIGHT HOLDER',
  'NATURAL SLATE HEART CHALKBOARD ',
  'HOMEMADE JAM SCENTED CANDLES',
  'JAM MAKING SET PRINTED',
  'SET OF 3 CAKE TINS PANTRY DESIGN ',
  'PACK OF 20 NAPKINS PANTRY DESIGN',
  'HANGING HEART ZINC T-LIGHT HOLDER',
  'ENAMEL FLOWER JUG CREAM'],
 ['REX CASH+CARRY JUMBO SHOPPER',
```

In [34]:
```
Fpgrowth_data=[]
for i in fpgrowth_data:
    if(len(i)!=0):
        Fpgrowth_data.append(i)

len(Fpgrowth_data)
```

Out[34]: 13552

In [35]:
```
from mlxtend.preprocessing import TransactionEncoder

TE=TransactionEncoder()
FD_array=TE.fit(Fpgrowth_data).transform(Fpgrowth_data)
FD=pd.DataFrame(FD_array,columns=TE.columns_)
FD.head(3)
```

Out[35]:

	3 STRIPEY MICE FELTCRAFT	4 TRADITIONAL SPINNING TOPS	6 RIBBONS RUSTIC CHARM	60 CAKE CASES DOLLY GIRL DESIGN	60 CAKE CASES VINTAGE CHRISTMAS	60 TEATIME FAIRY CAKE CASES	72 SWEETHEART FAIRY CAKE CASES	E
0	False	False	False	False	False	False	False	
1	False	False	False	False	False	False	False	
2	False	False	False	False	False	False	False	

3 rows × 200 columns

In [36]:
```
from mlxtend.frequent_patterns import fpgrowth

d=fpgrowth(FD, min_support=0.01,use_colnames=True)
d=pd.DataFrame(d)
```

In [37]:
```
def possiple_combo(prod):
    l=[i for i in d['itemsets'] if (prod in i) ]
    return(d[d['itemsets'].isin(l)])

possiple_combo('JUMBO BAG VINTAGE LEAF')
```

Out[37]:

	support	itemsets
171	0.052981	(JUMBO BAG VINTAGE LEAF)
309	0.014094	(JUMBO BAG VINTAGE LEAF, JUMBO SHOPPER VINTAGE...
343	0.010331	(JUMBO BAG VINTAGE LEAF, JUMBO BAG STRAWBERRY)
384	0.013799	(JUMBO BAG VINTAGE LEAF, JUMBO STORAGE BAG SUKI)
426	0.010626	(JUMBO BAG VINTAGE LEAF, JUMBO BAG BAROQUE BL...
448	0.010626	(JUMBO BAG VINTAGE LEAF, JUMBO BAG PINK VINTAG...
580	0.017636	(JUMBO BAG VINTAGE LEAF, JUMBO BAG ALPHABET)
593	0.018964	(JUMBO BAG VINTAGE LEAF, JUMBO BAG APPLES)
594	0.010257	(JUMBO BAG VINTAGE LEAF, JUMBO BAG APPLES, JUM...
629	0.013872	(JUMBO BAG VINTAGE LEAF, LUNCH BAG VINTAGE LEA...
648	0.016012	(JUMBO BAG VINTAGE LEAF, JUMBO BAG PEARS)
651	0.012249	(JUMBO BAG VINTAGE LEAF, JUMBO BAG APPLES, JUM...
653	0.012987	(JUMBO BAG VINTAGE LEAF, JUMBO BAG DOILEY PATT...
655	0.011880	(JUMBO BAG VINTAGE LEAF, LUNCH BAG APPLE DESIGN)
656	0.022432	(JUMBO BAG VINTAGE LEAF, JUMBO BAG RED RETROSPOT)
657	0.012987	(JUMBO BAG VINTAGE LEAF, JUMBO BAG PINK POLKADOT)
658	0.012397	(JUMBO BAG VINTAGE LEAF, LUNCH BAG RED RETROSPOT)
659	0.010257	(JUMBO BAG VINTAGE LEAF, LUNCH BAG SUKI DESIGN)
660	0.010257	(JUMBO BAG VINTAGE LEAF, LUNCH BAG PINK POLKADOT)
661	0.010921	(JUMBO BAG VINTAGE LEAF, LUNCH BAG BLACK SKULL.)
662	0.010035	(JUMBO BAG VINTAGE LEAF, JUMBO BAG RED RETROSP...
680	0.014610	(JUMBO BAG VINTAGE DOILY , JUMBO BAG VINTAGE L...

[💠 Inferences from Analysis 💠]

▶The majority customers are from United Kingdom (88.92%)

▶Cluster-0 : These are customers with highest numbers(81.21%) with sales of (39.65%) of total sales.

▶Cluster-4 : These are customers with second highest numbers(16.31%) with sales of (42.58%) of total sales.

▶Cluster-2 : These are customers with least numbers(2.48%) with sales of (17.77%) of total sales.

[💠 Conclusion 💠]

▶Customers of Cluster-0 are buying products rarely.

▶Customers of Cluster-4 are buying products on regular basis and are loyal customers.

▶Customers of Cluster-2 are buying products most frequently.

--

[💠 Future Possibilities of the Project 💠]

▶Intigrating more data of different countries will help the company to understand needs and behaviour of customers of different countries.

--

[💠 References 💠]

▶Scikit-learn Documentation.(2024):KMeans [https://scikit-learn.org/stable/modules/generated/sklearn.cluster.KMeans.html (https://scikit-learn.org/stable/modules/generated/sklearn.cluster.KMeans.html)](https://scikit-learn.org/stable/modules/generated/sklearn.cluster.KMeans.html)

▶TKMeans: Intellipaat NLP lectures

▶Kaggle :FP-Growth Algorithm: Frequent Itemset Pattern : [https://www.kaggle.com/code/rjmanoj/fp-growth-algorithm-frequent-itemset-pattern (https://www.kaggle.com/code/rjmanoj/fp-growth-algorithm-frequent-itemset-pattern)](https://www.kaggle.com/code/rjmanoj/fp-growth-algorithm-frequent-itemset-pattern)

▶Matplotlib. (2024). Matplotlib Documentation. [https://matplotlib.org/stable/api/pyplot_summary.html (https://matplotlib.org/stable/api/pyplot_summary.html)](https://matplotlib.org/stable/api/pyplot_summary.html)

--