Problem Statement:

The transactions made by a UK-based, registered, non-store online retailer between December 1, 2010, and December 9,2011, are all included in the transnational data set known as online retail. The company primarily offer one-of-a-kind gifts for every occasion. The company has a large number of wholesalers as clients.Company Objective Using the global online retail dataset, we will design a clustering model and select the ideal group of clients for the business to target.

In [1]:

```
#import libraries
import pandas as pd
from matplotlib import pyplot as plt
%matplotlib inline
```

In [2]:

```
df=pd.read_csv(r"C:\Users\raja\Downloads\OnlineRetail2.csv")
df
```

Out[2]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	C
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	01-12-2010 08:26	2.55	17850.0	K
1	536365	71053	WHITE METAL LANTERN	6	01-12-2010 08:26	3.39	17850.0	K
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	01-12-2010 08:26	2.75	17850.0	K
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	01-12-2010 08:26	3.39	17850.0	K
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	01-12-2010 08:26	3.39	17850.0	K
...	...	...	...	...	...	...	...	
541904	581587	22613	PACK OF 20 SPACEBOY NAPKINS	12	09-12-2011 12:50	0.85	12680.0	
541905	581587	22899	CHILDREN'S APRON DOLLY GIRL	6	09-12-2011 12:50	2.10	12680.0	
541906	581587	23254	CHILDRENS CUTLERY DOLLY GIRL	4	09-12-2011 12:50	4.15	12680.0	
541907	581587	23255	CHILDRENS CUTLERY CIRCUS PARADE	4	09-12-2011 12:50	4.15	12680.0	
541908	581587	22138	BAKING SET 9 PIECE RETROSPOT	3	09-12-2011 12:50	4.95	12680.0	

541909 rows × 8 columns

In [3]:

```
df.head()
```

Out[3]:

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

In [4]:

```
df.tail()
```

Out[4]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	C
541904	581587	22613	PACK OF 20 SPACEBOY NAPKINS	12	09-12-2011 12:50	0.85	12680.0	
541905	581587	22899	CHILDREN'S APRON DOLLY GIRL	6	09-12-2011 12:50	2.10	12680.0	
541906	581587	23254	CHILDRENS CUTLERY DOLLY GIRL	4	09-12-2011 12:50	4.15	12680.0	
541907	581587	23255	CHILDRENS CUTLERY CIRCUS PARADE	4	09-12-2011 12:50	4.15	12680.0	
541908	581587	22138	BAKING SET 9 PIECE RETROSPOT	3	09-12-2011 12:50	4.95	12680.0	

In [5]:

```
df['CustomerID'].value_counts()
```

Out[5]:

```
CustomerID
17841.0    7983
14911.0    5903
14096.0    5128
12748.0    4642
14606.0    2782
           ...
15070.0       1
15753.0       1
17065.0       1
16881.0       1
16995.0       1
Name: count, Length: 4372, dtype: int64
```

In [6]:

```
df['Quantity'].value_counts()
```

Out[6]:

```
Quantity
 1        148227
 2         81829
 12        61063
 6         40868
 4         38484
           ...
-472           1
-161           1
-1206          1
-272           1
-80995         1
Name: count, Length: 722, dtype: int64
```

In [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
```

In [8]:

```
df.isnull().sum()
```

Out[8]:

```
InvoiceNo          0
StockCode          0
Description     1454
Quantity           0
InvoiceDate        0
UnitPrice          0
CustomerID     135080
Country            0
dtype: int64
```

In [9]:

```
df.fillna(method='ffill',inplace=True)
```

In [10]:

```
df.isnull().sum()
```

Out[10]:

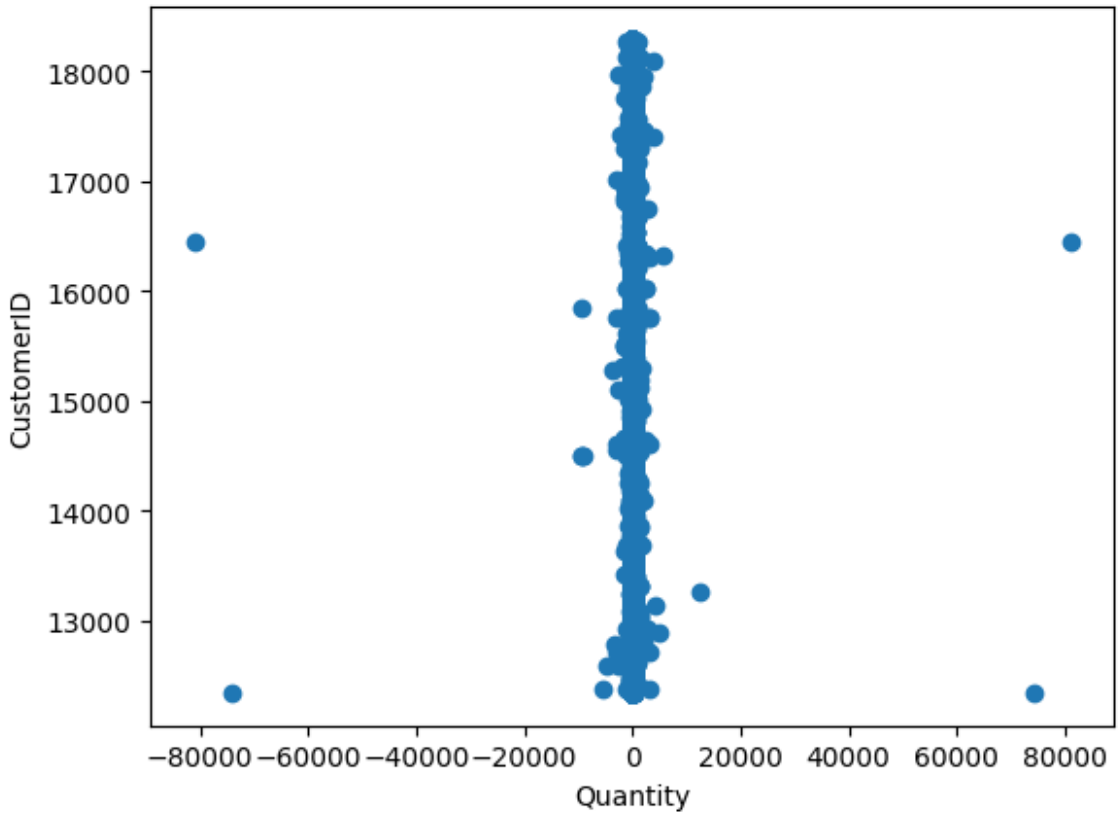
```
InvoiceNo      0
StockCode      0
Description    0
Quantity       0
InvoiceDate    0
UnitPrice      0
CustomerID     0
Country        0
dtype: int64
```

In [16]:

```
plt.scatter(df["Quantity"],df["CustomerID"])
plt.xlabel("Quantity")
plt.ylabel("CustomerID")
```

Out[16]:

```
Text(0, 0.5, 'CustomerID')
```



KMeans Clustering

In [12]:

```
from sklearn.cluster import KMeans
```

In [13]:

```
km=KMeans()
km
```

Out[13]:

```
KMeans()
```

In [14]:

```
y_predicted=km.fit_predict(df[["Quantity","CustomerID"]])
y_predicted
```

```
C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
```

Out[14]:

```
array([4, 4, 4, ..., 7, 7, 7])
```

In [15]:

```
df["Cluster"]=y_predicted
df.head()
```

Out[15]:

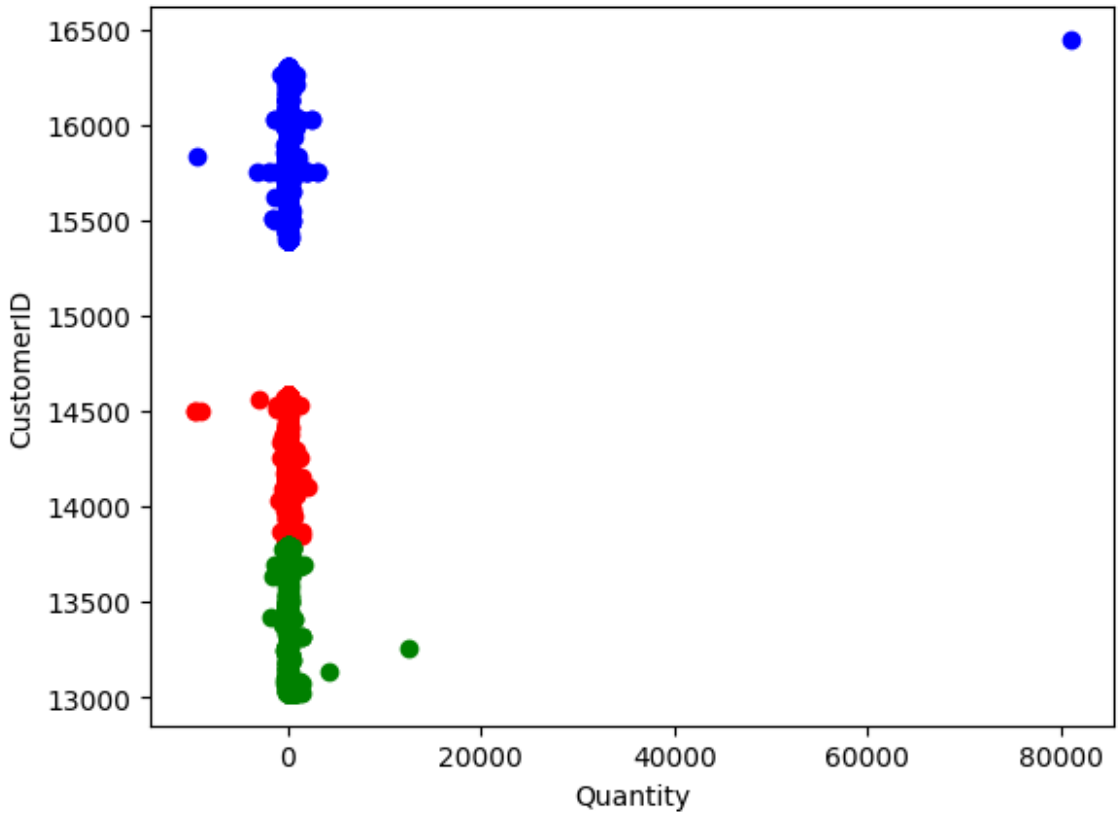
	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	01-12-2010 08:26	2.55	17850.0	United Kingdom
1	536365	71053	WHITE METAL LANTERN	6	01-12-2010 08:26	3.39	17850.0	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT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

In [17]:

```
df1=df[df.Cluster==0]
df2=df[df.Cluster==2]
df3=df[df.Cluster==3]
plt.scatter(df1["Quantity"],df1["CustomerID"],color="red")
plt.scatter(df2["Quantity"],df2["CustomerID"],color="green")
plt.scatter(df3["Quantity"],df3["CustomerID"],color="blue")
plt.xlabel("Quantity")
plt.ylabel("CustomerID")
```

Out[17]:

```
Text(0, 0.5, 'CustomerID')
```



In [18]:

```
from sklearn.preprocessing import MinMaxScaler
```

In [19]:

```
scaler=MinMaxScaler()
```

In [20]:

```
scaler.fit(df[["CustomerID"]])
df["CustomerID"]=scaler.transform(df[["CustomerID"]])
df.head()
```

Out[20]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	01-12-2010 08:26	2.55	0.926443	United Kingdom
1	536365	71053	WHITE METAL LANTERN	6	01-12-2010 08:26	3.39	0.926443	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	01-12-2010 08:26	2.75	0.926443	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	01-12-2010 08:26	3.39	0.926443	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	01-12-2010 08:26	3.39	0.926443	United Kingdom

In [21]:

```
scaler.fit(df[["Quantity"]])
df["Quantity"]=scaler.transform(df[["Quantity"]])
df.head()
```

Out[21]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	0.500037	01-12-2010 08:26	2.55	0.926443	United Kingdom
1	536365	71053	WHITE METAL LANTERN	0.500037	01-12-2010 08:26	3.39	0.926443	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	0.500049	01-12-2010 08:26	2.75	0.926443	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	0.500037	01-12-2010 08:26	3.39	0.926443	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	0.500037	01-12-2010 08:26	3.39	0.926443	United Kingdom

In [22]:

```
km=KMeans()
```

In [23]:

```
y_predicted=km.fit_predict(df[["Quantity","CustomerID"]])
y_predicted
```

```
C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
```

Out[23]:

```
array([7, 7, 7, ..., 3, 3, 3])
```

In [24]:

```
df["New cluster"]=y_predicted
df.head()
```

Out[24]:

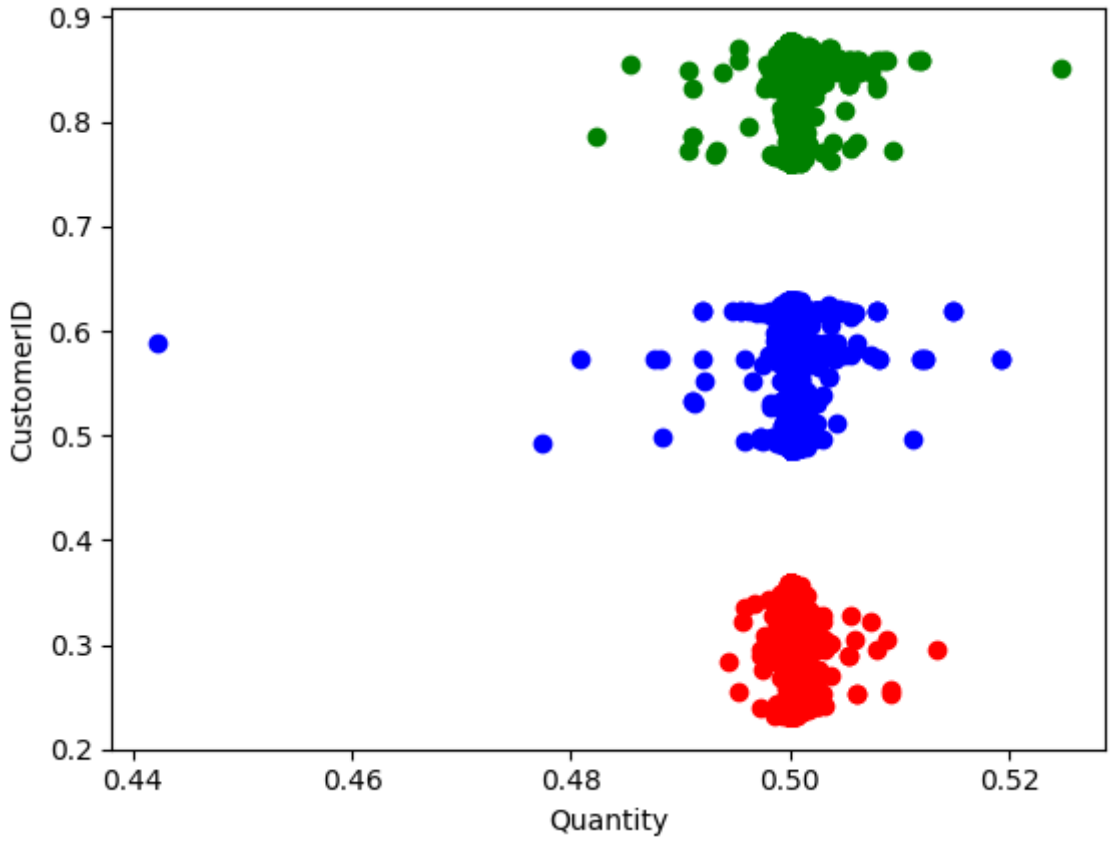
	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	0.500037	01-12-2010 08:26	2.55	0.926443	United Kingdom
1	536365	71053	WHITE METAL LANTERN	0.500037	01-12-2010 08:26	3.39	0.926443	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	0.500049	01-12-2010 08:26	2.75	0.926443	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	0.500037	01-12-2010 08:26	3.39	0.926443	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	0.500037	01-12-2010 08:26	3.39	0.926443	United Kingdom

In [25]:

```
df1=df[df["New cluster"]==0]
df2=df[df["New cluster"]==1]
df3=df[df["New cluster"]==2]
plt.scatter(df1["Quantity"],df1["CustomerID"],color="red")
plt.scatter(df2["Quantity"],df2["CustomerID"],color="green")
plt.scatter(df3["Quantity"],df3["CustomerID"],color="blue")
plt.xlabel("Quantity")
plt.ylabel("CustomerID")
```

Out[25]:

```
Text(0, 0.5, 'CustomerID')
```



In [26]:

```
km.cluster_centers_
```

Out[26]:

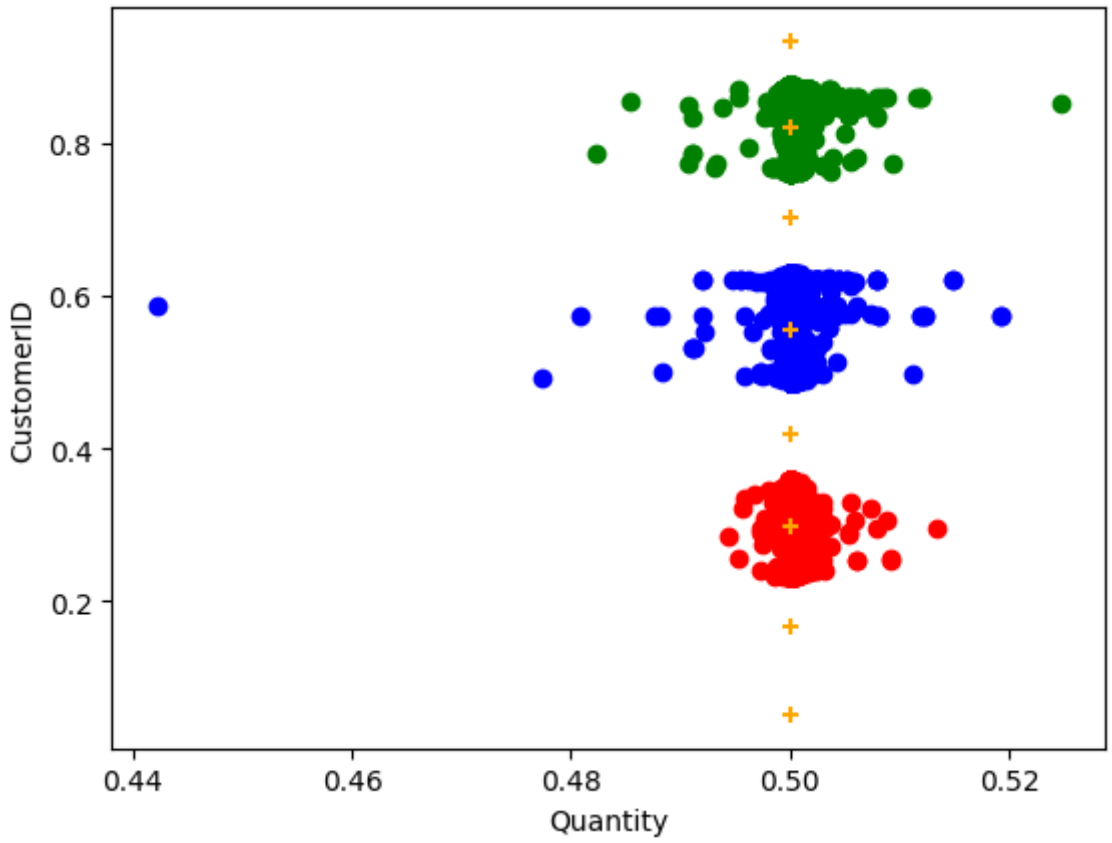
```
array([[0.50006065, 0.29837516],
       [0.50006047, 0.81912277],
       [0.50005342, 0.55551005],
       [0.50006705, 0.05156814],
       [0.50005804, 0.70196132],
       [0.50006106, 0.4185919 ],
       [0.50006062, 0.16561407],
       [0.50005085, 0.93332193]])
```

In [27]:

```
df1=df[df["New cluster"]==0]
df2=df[df["New cluster"]==1]
df3=df[df["New cluster"]==2]
plt.scatter(df1["Quantity"],df1["CustomerID"],color="red")
plt.scatter(df2["Quantity"],df2["CustomerID"],color="green")
plt.scatter(df3["Quantity"],df3["CustomerID"],color="blue")
plt.scatter(km.cluster_centers_[:,0],km.cluster_centers_[:,1],color="orange",marker="+")
plt.xlabel("Quantity")
plt.ylabel("CustomerID")
```

Out[27]:

```
Text(0, 0.5, 'CustomerID')
```



In [28]:

```
k_rng=range(1,10)
sse=[]
```

In [29]:

```
for k in k_rng:
    km=KMeans(n_clusters=k)
    km.fit(df[["Quantity","CustomerID"]])
    sse.append(km.inertia_)
#km.inertia_ will give you the value of sum of square errorprint(sse)
plt.plot(k_rng,sse)
plt.xlabel("K")
plt.ylabel("Sum of Squared Error")
```

```
C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
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to suppress the warning
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C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
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  warnings.warn(
C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
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C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
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C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
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learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
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learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
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C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
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C:\Users\raja\AppData\Local\Programs\Python\Python310\lib\site-packages\sk
learn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init`
will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly
to suppress the warning
  warnings.warn(
```
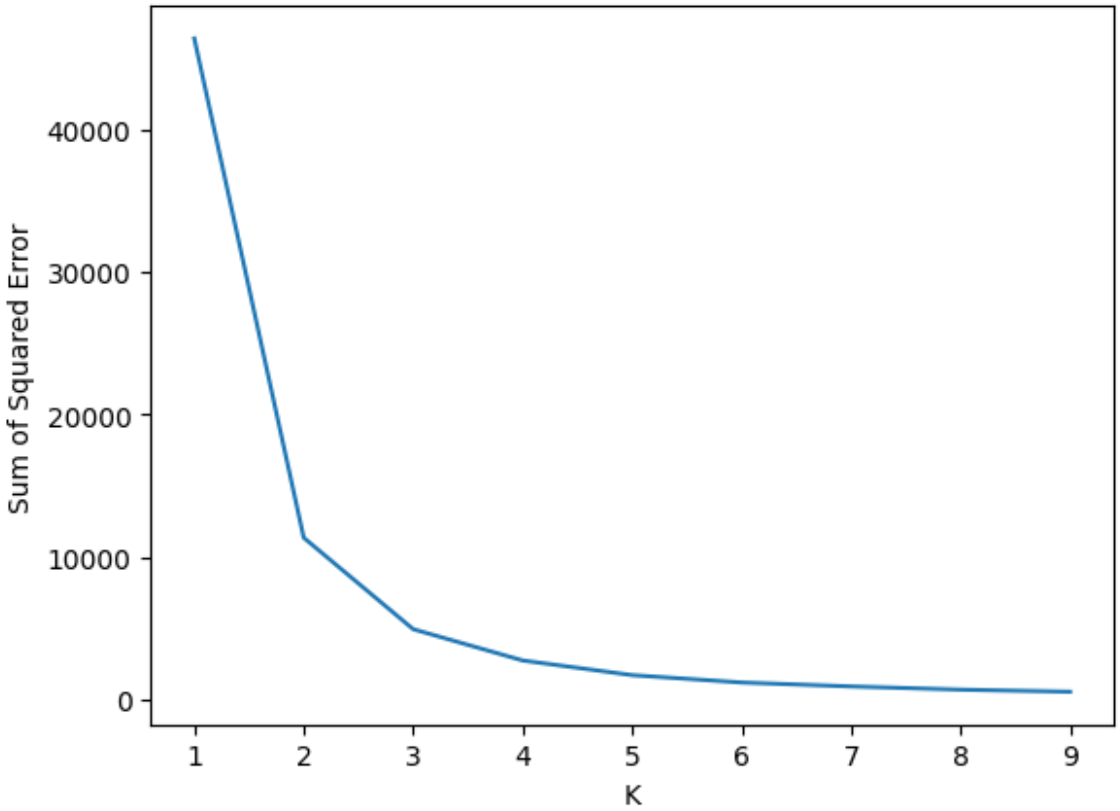

Out[29]:

```
Text(0, 0.5, 'Sum of Squared Error')
```


Sum of Squared Error
40000
30000
20000
10000
0
1
2
3
4
5
6
7
8
9
K