#Problem statement: The transactions made by a UK-based,we will design a clustering model and select the ideal groupof clients for the business to target

In [1]:

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

In [3]:

```
df=pd.read_csv(r"C:\Users\jas_m\Downloads\212U5A3305\OnlineRetail.csv")
df
```

Out[3]:

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

```
df.head()
```

Out[4]:

	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 [5]:

```
df.tail()
```

Out[5]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID
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 [6]:

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

Out[6]:

```
573585     1114
581219      749
581492      731
580729      721
558475      705
           ... 
554023        1
554022        1
554021        1
554020        1
C558901       1
Name: InvoiceNo, Length: 25900, dtype: int64
```

In [7]:

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

Out[7]:

```
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: CustomerID, Length: 4372, dtype: int64
```

In [8]:

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

Out[8]:

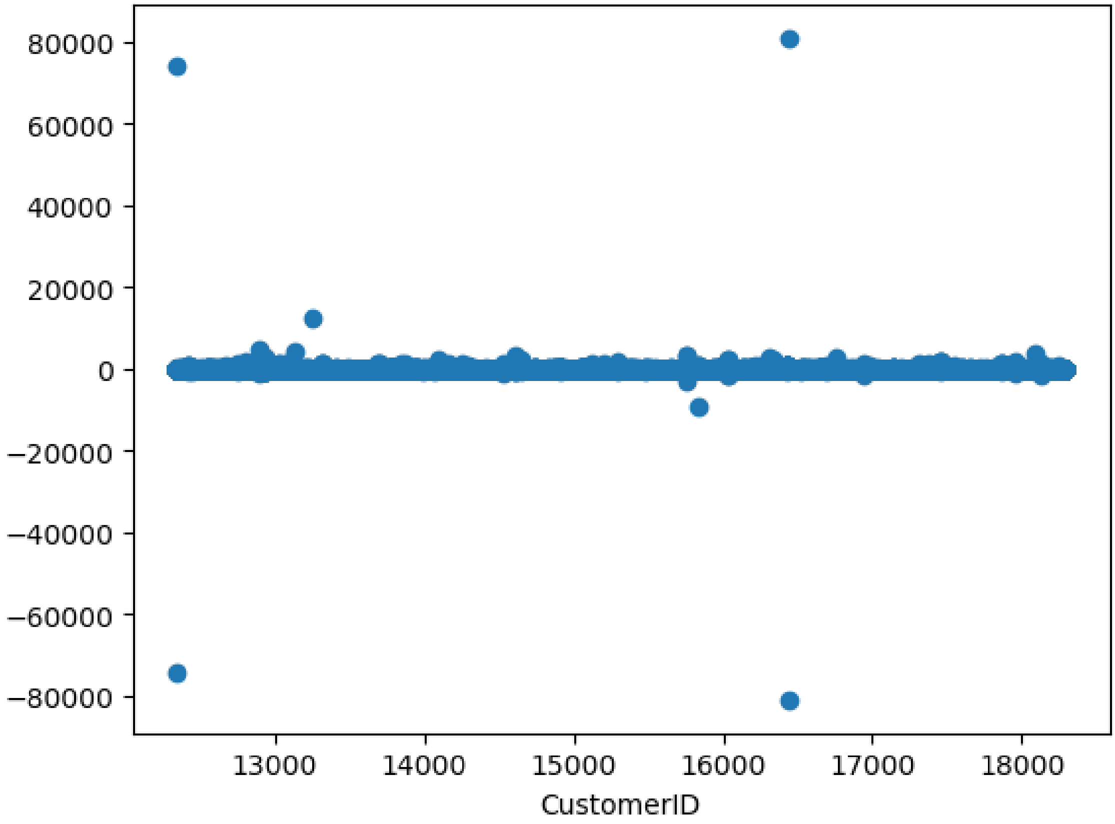
```
 1        148227
 2         81829
 12        61063
 6         40868
 4         38484
           ...  
-472           1
-161           1
-1206          1
-272           1
-80995         1
Name: Quantity, Length: 722, dtype: int64
```

In [9]:

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

Out[9]:

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



In [10]:

```
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 [11]:

```
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 [12]:

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

Out[12]:

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

In [13]:

```
from sklearn.cluster import KMeans
km=KMeans()
km
```

Out[13]:

```
▾ KMeans
KMeans()
```

In [14]:

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

```
C:\Users\jas_m\anaconda3\lib\site-packages\sklearn\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([0, 0, 0, ..., 2, 2, 2])
```

In [15]:

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

Out[15]:

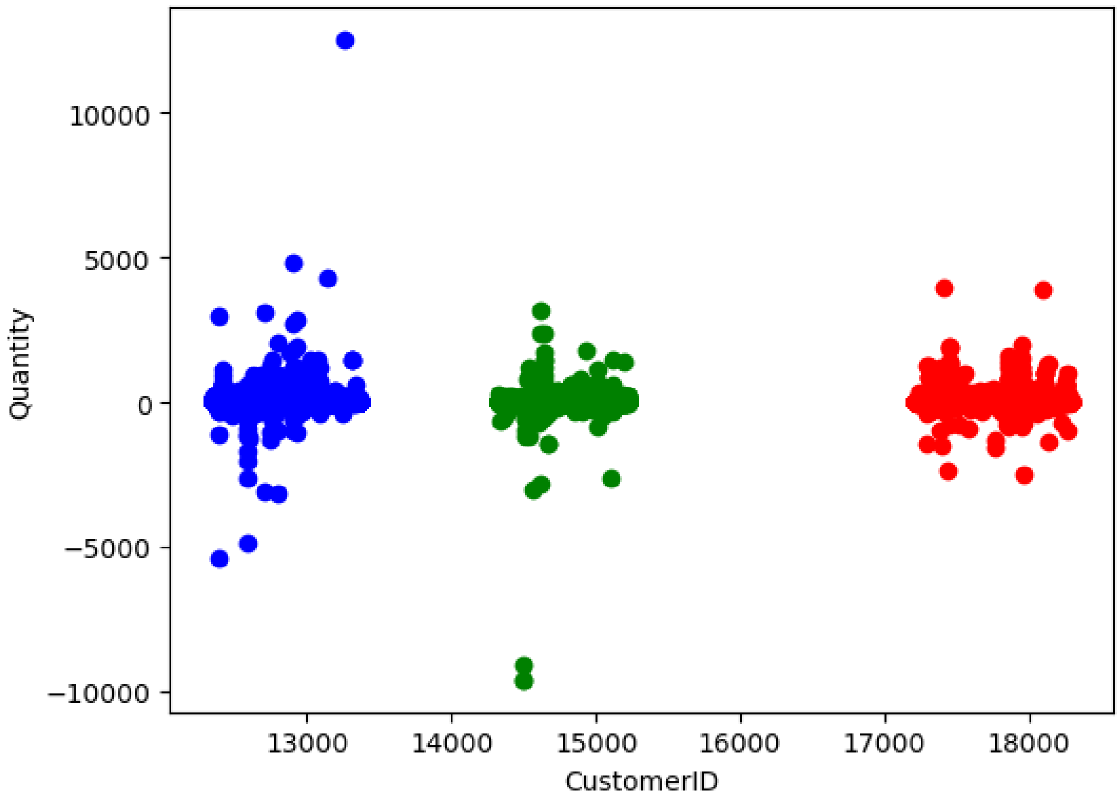
	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	01-12-2010 08:26	2.55	17850.0	Unitec Kingdom
1	536365	71053	WHITE METAL LANTERN	6	01-12-2010 08:26	3.39	17850.0	Unitec Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT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

In [16]:

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

Out[16]:

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



In [17]:

```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler()
scaler.fit(df[["Quantity"]])
df["Quantity"]=scaler.transform(df[["Quantity"]])
df.head()
```

Out[17]:

	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	17850.0	United Kingdom
1	536365	71053	WHITE METAL LANTERN	0.500037	01-12-2010 08:26	3.39	17850.0	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	0.500049	01-12-2010 08:26	2.75	17850.0	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	0.500037	01-12-2010 08:26	3.39	17850.0	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	0.500037	01-12-2010 08:26	3.39	17850.0	United Kingdom

In [18]:

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

Out[18]:

	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	Unitec Kingdon
1	536365	71053	WHITE METAL LANTERN	0.500037	01-12-2010 08:26	3.39	0.926443	Unitec Kingdon
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	0.500049	01-12-2010 08:26	2.75	0.926443	Unitec Kingdon
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	0.500037	01-12-2010 08:26	3.39	0.926443	Unitec Kingdon
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	0.500037	01-12-2010 08:26	3.39	0.926443	Unitec Kingdon

In [19]:

```
km=KMeans()
```

In [20]:

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

```
C:\Users\jas_m\anaconda3\lib\site-packages\sklearn\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[20]:

```
array([6, 6, 6, ..., 5, 5, 5])
```

In [21]:

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

Out[21]:

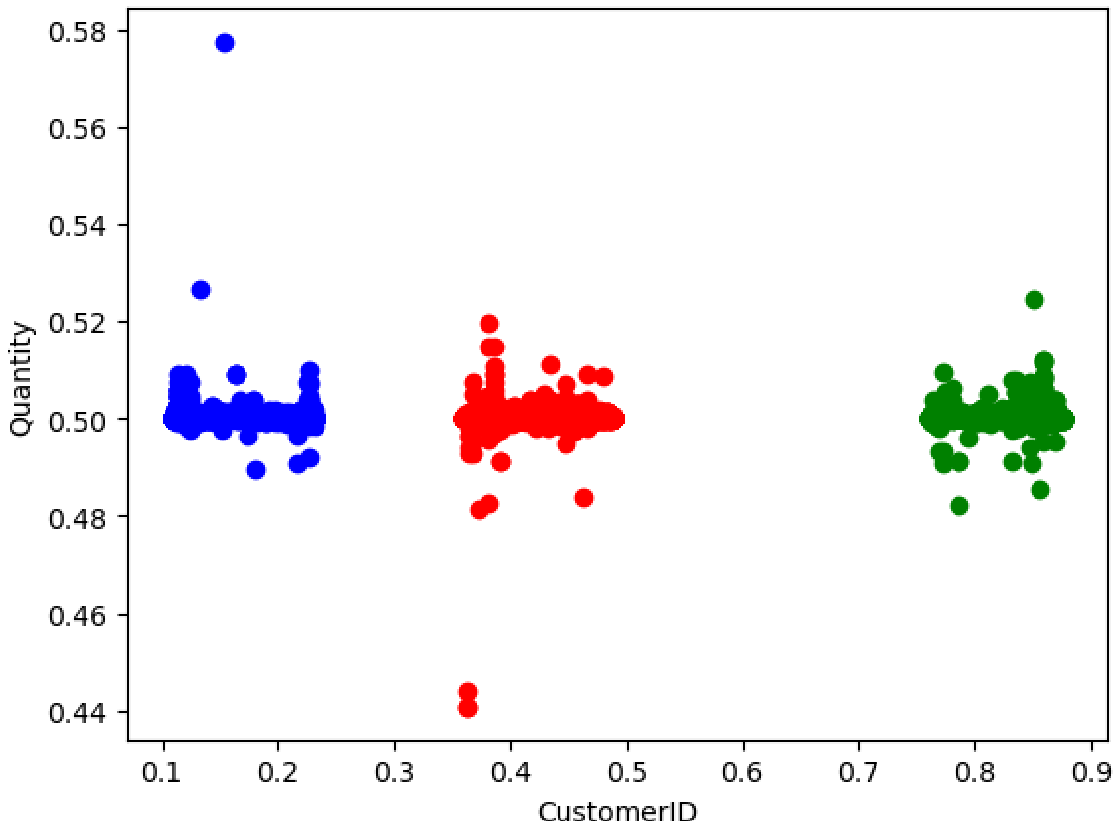
	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	0.500037	01-12-2010 08:26	2.55	0.926443	United Kingdom
1	536365	71053	WHITE METAL LANTERN	0.500037	01-12-2010 08:26	3.39	0.926443	United Kingdom
2	536365	84406B	CREAM CUPID 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]:

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

Out[22]:

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



In [23]:

```
km.cluster_centers_
```

Out[23]:

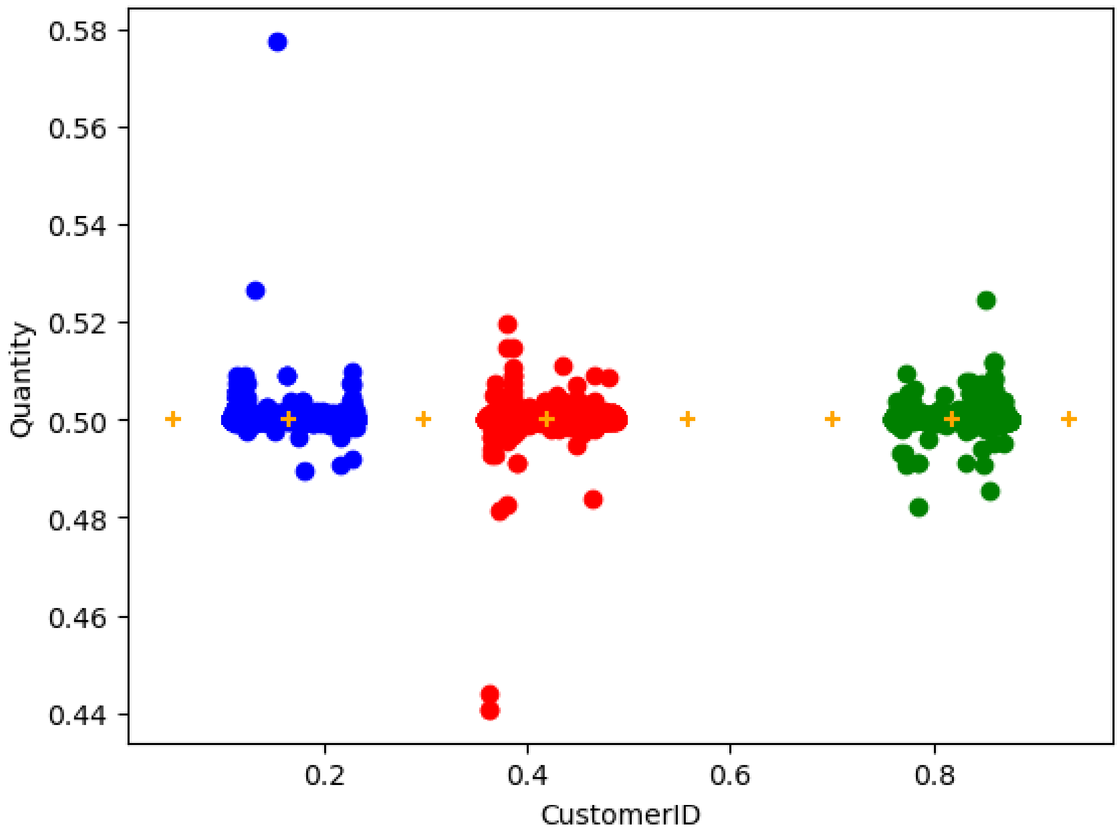
```
array([[0.42034012, 0.50006104],
       [0.81846395, 0.50006031],
       [0.165866  , 0.50006058],
       [0.29887766, 0.50006072],
       [0.70173498, 0.50005811],
       [0.05156814, 0.50006705],
       [0.93301334, 0.50005098],
       [0.55740616, 0.50005319]])
```

In [24]:

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

Out[24]:

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



In [25]:

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

In [27]:

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

```
C:\Users\jas_m\anaconda3\lib\site-packages\sklearn\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(
C:\Users\jas_m\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:870:
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C:\Users\jas_m\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:870:
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in 1.4. Set the value of `n_init` explicitly to suppress the warning
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C:\Users\jas_m\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:870:
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  warnings.warn(
C:\Users\jas_m\anaconda3\lib\site-packages\sklearn\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(

[46374.84553398474, 11336.0653054853, 4915.900467978989, 2723.51910518953,
1695.07109745742, 1178.4495409566046, 903.555546770782, 688.4704309720291,
528.5500057548226]
```
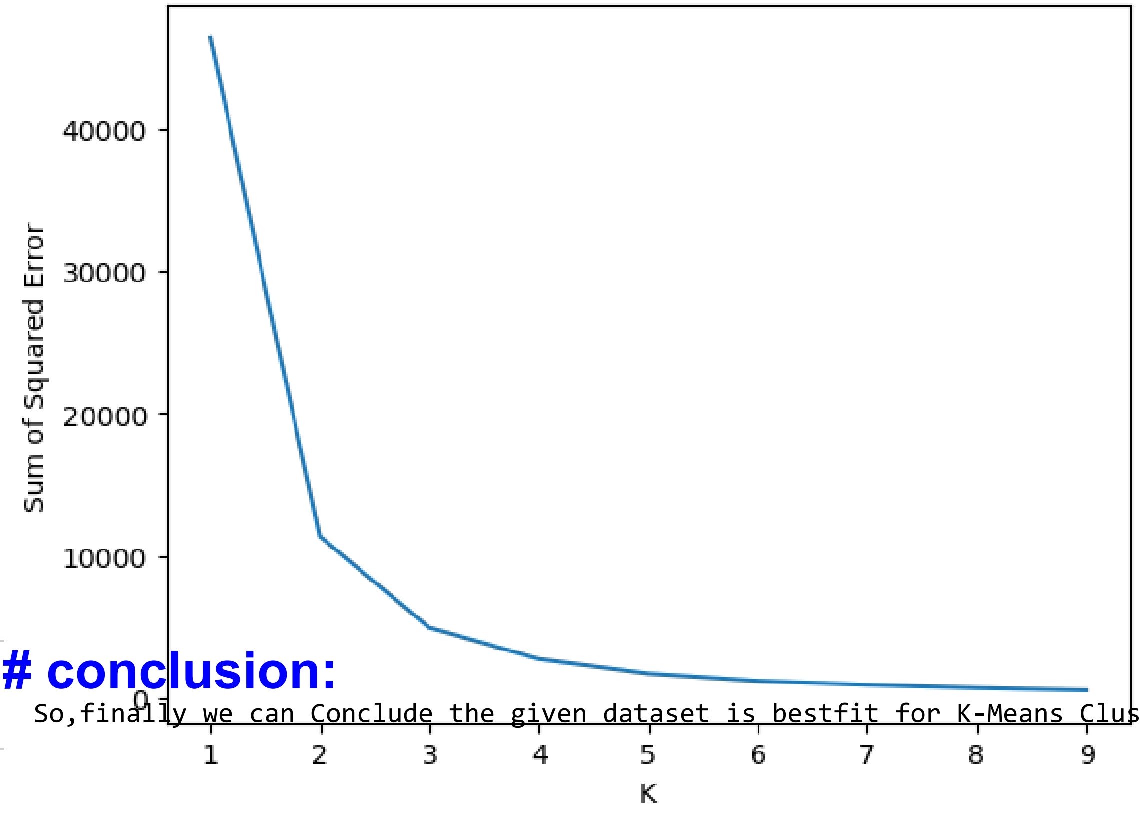

Out[27]:

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



# conclusion:

```
So,finally we can Conclude the given dataset is bestfit for K-Means Clustering
```