Problem Definition :

User should be able to provide a Customer ID and Date, and program should be able to predict quantity

In [1]:

```
import pandas as pd
import numpy as np
```

In [2]:

```
data = pd.read_csv("online_retail.csv")
```

In [3]:

```
data.head()
```

Out[3]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
0	536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	12/1/10 8:26	2.55	17850.0	United Kingdom
1	536365	71053	WHITE METAL LANTERN	6	12/1/10 8:26	3.39	17850.0	United Kingdom
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	12/1/10 8:26	2.75	17850.0	United Kingdom
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	12/1/10 8:26	3.39	17850.0	United Kingdom
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	12/1/10 8:26	3.39	17850.0	United Kingdom

In [4]:

```
data.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 [5]:

```
data.isna().sum()
```

Out[5]:

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

In [6]:

```
# removing rows where description is null , customerid is null , unit price is less than
# all condition needs to be true
to_drop = data[(data['Description'].isnull()) & (data['CustomerID'].isnull()) &
               (data['UnitPrice'] < 1) & (data['Quantity'] < 0)].index

# Remove the filtered rows
data.drop(to_drop, inplace=True)
```

In [7]:

```
data.isna().sum()
```

Out[7]:

```
InvoiceNo           0
StockCode           0
Description       592
Quantity            0
InvoiceDate         0
UnitPrice           0
CustomerID     134218
Country             0
dtype: int64
```

In [8]:

```
# forward filled all null CustomerID because

data['CustomerID'].fillna(method='ffill', inplace=True)
```

In [9]:

```
data.isna().sum()
```

Out[9]:

```
InvoiceNo        0
StockCode        0
Description    592
Quantity         0
InvoiceDate      0
UnitPrice        0
CustomerID       0
Country          0
dtype: int64
```

In [10]:

```
# removing rows where quantity is in negative
# removing rows where quantity is greater than 2000 to remove outliers

data = data[(data['Quantity'] >= 0) & (data['Quantity'] <= 2000)]
```

In [11]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 531259 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype  
---  ------       --------------   -----  
 0   InvoiceNo    531259 non-null  object 
 1   StockCode    531259 non-null  object 
 2   Description  530669 non-null  object 
 3   Quantity     531259 non-null  int64  
 4   InvoiceDate  531259 non-null  object 
 5   UnitPrice    531259 non-null  float64
 6   CustomerID   531259 non-null  float64
 7   Country      531259 non-null  object 
dtypes: float64(2), int64(1), object(5)
memory usage: 36.5+ MB
```

In [12]:

```
neg_rows = data[data['Quantity'] <= 0]
neg_rows
```

Out[12]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country

In [13]:

```
print(data.duplicated().sum())
data.drop_duplicates(inplace=True)
```

```
5231
```

In [14]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 526028 entries, 0 to 541908
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype  
---  ------       --------------   -----  
 0   InvoiceNo    526028 non-null  object 
 1   StockCode    526028 non-null  object 
 2   Description  525438 non-null  object 
 3   Quantity     526028 non-null  int64  
 4   InvoiceDate  526028 non-null  object 
 5   UnitPrice    526028 non-null  float64
 6   CustomerID   526028 non-null  float64
 7   Country      526028 non-null  object 
dtypes: float64(2), int64(1), object(5)
memory usage: 36.1+ MB
```

In [15]:

```
# converted InvoiceDate to date time format and extracted Day, Month and Year.

data['InvoiceDate'] = pd.to_datetime(data['InvoiceDate'])
data['Day'] = data['InvoiceDate'].dt.day
data['Month'] = data['InvoiceDate'].dt.month
data['Year'] = data['InvoiceDate'].dt.year
```

In [16]:

```
# these columns are not required for prediction hence we are removing these columns.

data.drop(columns=['InvoiceNo','StockCode','Description','UnitPrice','Country','InvoiceDa
```

In [17]:

```
data.head(1)
```

Out[17]:

	Quantity	CustomerID	Day	Month	Year
0	6	17850.0	1	12	2010

In [18]:

```
data['CustomerID'] = data['CustomerID'].astype('int64')
data['Quantity'] = data['Quantity'].astype('int64')
```

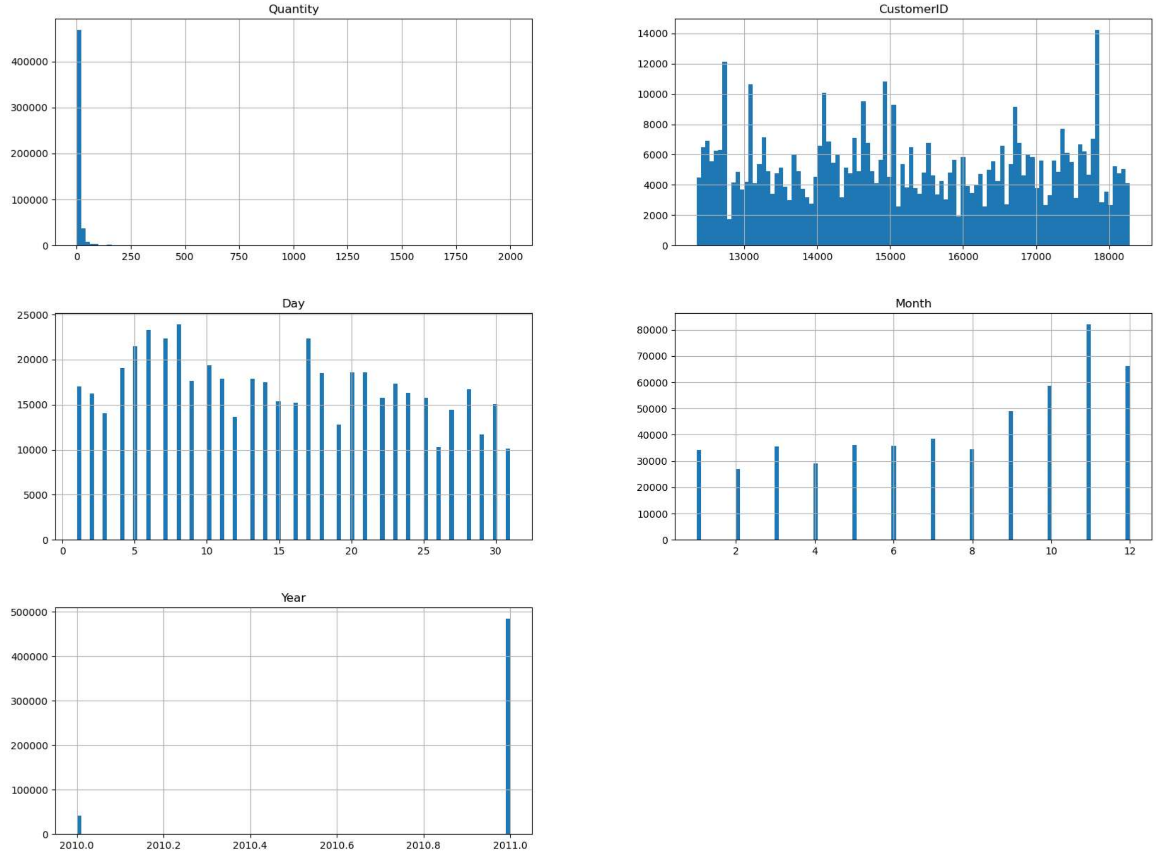
In [19]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 526028 entries, 0 to 541908
Data columns (total 5 columns):
 #   Column      Non-Null Count   Dtype
---  ------      --------------   -----
 0   Quantity    526028 non-null  int64
 1   CustomerID  526028 non-null  int64
 2   Day         526028 non-null  int64
 3   Month       526028 non-null  int64
 4   Year        526028 non-null  int64
dtypes: int64(5)
memory usage: 24.1 MB
```

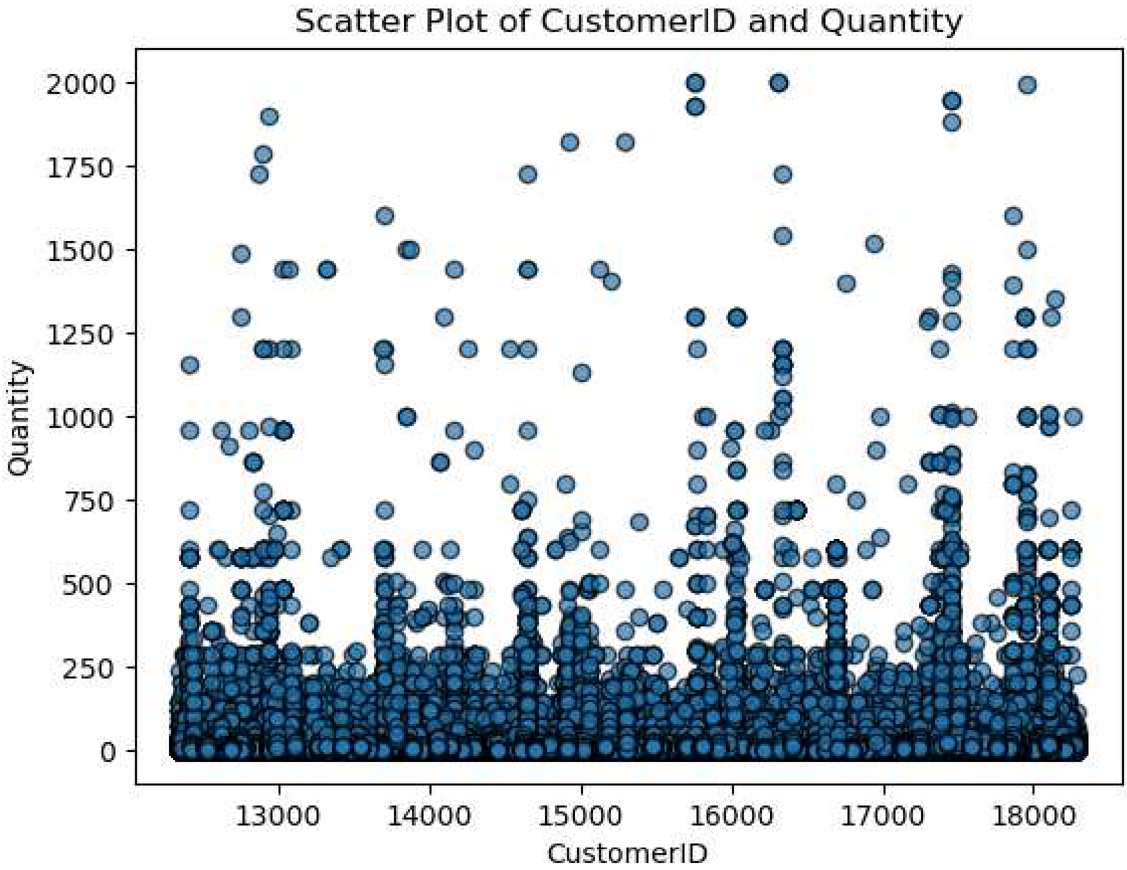
In [20]:

```
import matplotlib.pyplot as plt
data.hist(bins=100, figsize=(20,15))
plt.show()
```



In [21]:

```
plt.scatter(data['CustomerID'], data['Quantity'], edgecolor='black', alpha=0.7)
plt.xlabel('CustomerID')
plt.ylabel('Quantity')
plt.title('Scatter Plot of CustomerID and Quantity')
plt.show()
```



Pivot Tables

In [22]:

```
pivot_table2 = pd.pivot_table(data, index='Day', columns='Year', values='Quantity', aggfu
pivot_table2.sort_values(by='All', ascending=False, inplace=True)
print(pivot_table2)
```

```
Year      2010       2011      All
Day
All   355814.0  5050855.0  5406669
7      25324.0   215160.0   240484
5      16243.0   215497.0   231740
6      21775.0   194258.0   216033
20     15767.0   199456.0   215223
17     16947.0   195722.0   212669
11         NaN   211665.0   211665
14     20738.0   187885.0   208623
4          NaN   206013.0   206013
8      23049.0   175415.0   198464
21     15650.0   180715.0   196365
18         NaN   191519.0   191519
28         NaN   185337.0   185337
10     21031.0   161812.0   182843
9      20698.0   161086.0   181784
1      26906.0   152459.0   179365
15     18453.0   157725.0   176178
13     17701.0   153767.0   171468
24         NaN   168129.0   168129
16     27464.0   135904.0   163368
22      3212.0   157995.0   161207
2      28403.0   130329.0   158732
3      16430.0   138540.0   154970
19      3734.0   150583.0   154317
23      5752.0   146864.0   152616
25         NaN   149989.0   149989
12     10537.0   134570.0   145107
27         NaN   135642.0   135642
30         NaN   127676.0   127676
29         NaN   117130.0   117130
26         NaN   115819.0   115819
31         NaN    96194.0    96194
```

In [23]:

```
pivot_table3 = pd.pivot_table(data, index='Month', columns='Year', values='Quantity', agg
print(pivot_table3)
```

```
Year       2010      2011
Month
1           NaN  311573.0
2           NaN  274776.0
3           NaN  378863.0
4           NaN  308200.0
5           NaN  391686.0
6           NaN  389633.0
7           NaN  399187.0
8           NaN  421386.0
9           NaN  574169.0
10          NaN  619173.0
11          NaN  748788.0
12     355814.0  233421.0
```

In [24]:

```
pivot_table_6 = data.pivot_table(index='CustomerID', columns='Year', values='Quantity', a
# Sorted pivot table high to low
pivot_table_6.sort_values(by='All', ascending=False, inplace=True)

print(pivot_table_6.head(10))
```

```
Year            2010       2011      All
CustomerID
All         355814.0  5050855.0  5406669
14646         7983.0   188462.0   196445
14911         3331.0    81894.0    85225
12415            NaN    77812.0    77812
17450          786.0    70251.0    71037
18102         6695.0    61209.0    67904
13694         3860.0    62975.0    66835
17511         6426.0    59565.0    65991
14156         1606.0    59943.0    61549
14298         4976.0    53367.0    58343
```

Model Implementation

In [25]:

```
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestRegressor
from sklearn.tree import DecisionTreeRegressor
from sklearn.model_selection import train_test_split
```

In [26]:

```
X = data[['CustomerID', 'Year', 'Month', 'Day']]
y = data['Quantity']
```

In [27]:

```
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
x_scaled = scaler.fit_transform(X)
X = pd.DataFrame(x_scaled, columns=X.columns)
```

In [28]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
print(f"rows in train set : {len(X_train)}\nrows in test set : {len(X_test)}\n")
```

```
rows in train set : 420822
rows in test set : 105206
```

In [29]:

```
# regressor = LinearRegression()
# regressor.fit(X_train, y_train)

# regressor = RandomForestRegressor()
# regressor.fit(X_train, y_train)

regressor = DecisionTreeRegressor()
regressor.fit(X_train, y_train)
```

Out[29]:

```
DecisionTreeRegressor()
```

In [30]:

```
y_pred = regressor.predict(X_test)
```

In [31]:

```
print('R-squared score:', regressor.score(X_test, y_test))
```

```
R-squared score: 0.3267892862224361
```

In [32]:

```
from sklearn.metrics import mean_squared_error

# Calculating the MSE for the training data
y_train_pred = regressor.predict(X_train)
train_mse = mean_squared_error(y_train, y_train_pred)
print('Train MSE:', train_mse)
```

```
Train MSE: 489.944470249676
```

In [33]:

```
# Calculating the MSE for the test data
y_test_pred = regressor.predict(X_test)
test_mse = mean_squared_error(y_test, y_test_pred)
print('Test MSE:', test_mse)
```

```
Test MSE: 767.1758034959994
```

In [34]:

```
data = [[17850, 2010, 12, 1]]  # CustomerID, Year, Month and Day

predicted_quantity = regressor.predict(data)

print('Predicted quantity:', predicted_quantity[0])
```

```
Predicted quantity: 2.6153846153846154

C:\Users\kajal\anaconda3\lib\site-packages\sklearn\base.py:450: UserWarnin
g: X does not have valid feature names, but DecisionTreeRegressor was fitt
ed with feature names
  warnings.warn(
```

In [ ]:

In [ ]: