Predicting Customer Lifetime Value and Dynamic Pricing Optimization in Retail

[ ]:

```
# 1. LOADING THE DATASET
```

[1]:

```
#importing Libraraies
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

[2]:

```
# Initializing and Retriving the Data set...
data = pd.read_csv('/kaggle/input/marketing-insights-for-e-commerce-company/
 □Online_Sales.csv')
data
```

[2]:

```
       CustomerID  Transaction_ID Transaction_Date     Product_SKU  \
0           17850           16679         1/1/2019 GGOENEBJ079499
1           17850           16680         1/1/2019 GGOENEBJ079499
2           17850           16681         1/1/2019 GGOEGFKQ020399
3           17850           16682         1/1/2019 GGOEGAAB010516
4           17850           16682         1/1/2019 GGOEGBJL013999
…             …             …              …             …
52919       14410           48493       12/31/2019 GGOENEBB078899
52920       14410           48494       12/31/2019 GGOEGAEB091117
52921       14410           48495       12/31/2019 GGOENEBQ084699
52922       14600           48496       12/31/2019 GGOENEBQ079199
52923       14600           48497       12/31/2019 GGOENEBQ079099
                                   Product_Description Product_Category  \
0      Nest Learning Thermostat 3rd Gen-USA - Stainle…        Nest-USA
1      Nest Learning Thermostat 3rd Gen-USA - Stainle…        Nest-USA
2                 Google Laptop and Cell Phone Stickers          Office
3      Google Men's 100% Cotton Short Sleeve Hero Tee…        Apparel
4                        Google Canvas Tote Natural/Navy           Bags
…                                                  …               …
52919             Nest Cam Indoor Security Camera - USA        Nest-USA
52920                              Google Zip Hoodie Black        Apparel
52921      Nest Learning Thermostat 3rd Gen-USA - White Nest-USA
52922      Nest Protect Smoke + CO White Wired Alarm-USA Nest-USA
52923Nest Protect Smoke + CO White Battery Alarm-USA     Nest-USA

       Quantity Avg_Price Delivery_Charges Coupon_Status
0             1    153.71             6.50          Used
1             1    153.71             6.50          Used
2             1      2.05             6.50          Used
```

```
3            5     17.53           6.50     Not Used
4            1     16.50           6.50         Used
…        …       …           …          …
52919        1    121.30           6.50      Clicked
52920        1     48.92           6.50         Used
52921        1    151.88           6.50         Used
52922        5     80.52           6.50      Clicked
52923        4     80.52          19.99      Clicked
[52924 rows x 10 columns]
```

2. EXPLORING THE DATA SET

Exploring no. of Rows, Column, Datatype & Range etc…

```
[3]: data.columns
```

```
[3]: Index(['CustomerID', 'Transaction_ID', 'Transaction_Date',
'Product_SKU',
  'Product_Description', 'Product_Category', 'Quantity', 'Avg_Price',
           'Delivery_Charges', 'Coupon_Status'],
          dtype='object')
```

```
[4]: # Retriving the overall BASIC information of the Dataset..
     data.info()
```

```
<class
'pandas.core.frame.DataFrame'>
RangeIndex: 52924 entries, 0 to
52923 Data columns (total 10
columns):
#   Column               Non-Null Count
                         Dtype
--- ------               -------------- ----
                         -
0   CustomerID           52924 non-null
                         int64
1   Transaction_ID       52924 non-null
                         int64
2   Transaction_Date     52924       non-null
                         object
3   Product_SKU          52924       non-null
                         object
 4 Product_Description   52924 non-null object
 5  Product_Category     52924 non-null
                         object
 6  Quantity             52924 non-null
                         int64
 7  Avg_Price          52924        non-null
                       float64
 8  Delivery_Charges   52924        non-null
                       float64
 9  Coupon_Status      52924        non-null
                       object
dtypes: float64(2), int64(3), object(5)
memory usage: 4.0+ MB
```

[5]:
```
data.head()
```

[5]:
```
 CustomerID Transaction_ID Transaction_Date  Product_SKU \
0      17850          16679     1/1/2019 GGOENEBJ079499
1      17850          16680     1/1/2019 GGOENEBJ079499
2      17850          16681     1/1/2019 GGOEGFKQ020399
3      17850          16682     1/1/2019 GGOEGAAB010516
4      17850          16682     1/1/2019 GGOEGBJL013999
                           Product_Description Product_Category \
0                 Nest Learning Thermostat 3rd Gen-USA - Stainle…
                       Nest-USA
1                 Nest Learning Thermostat 3rd Gen-USA - Stainle…
                       Nest-USA
2                 Google Laptop and Cell Phone Stickers     Office
3                 Google Men's 100% Cotton Short Sleeve Hero Tee…
                       Apparel
4                 Google Canvas Tote Natural/NavyBags

   Quantity Avg_Price Delivery_Charges Coupon_Status
0         1  153.71     6.5   Used
1         1  153.71     6.5   Used
2         1  2.05  6.5   Used
3         5  17.53 6.5   Not Used
4         1  16.50 6.5   Used
```

[6]:
```
data.tail()
```

[6]:
```
      CustomerID Transaction_ID Transaction_Date  Product_SKU \
52919     14410          48493   12/31/2019 GGOENEBB078899
52920     14410          48494   12/31/2019 GGOEGAEB091117
52921     14410          48495   12/31/2019 GGOENEBQ084699
52922     14600          48496   12/31/2019 GGOENEBQ079199
52923     14600          48497   12/31/2019 GGOENEBQ079099
                              Product_Description Product_Category \
52919       Nest Cam Indoor Security Camera - USA     Nest-
                                                      USA
52920                       Google Zip Hoodie Black      Apparel
52921 Nest Learning Thermostat 3rd Gen-USA - White     Nest-
                                                      USA
```

```
52922Nest Protect Smoke + CO White Wired Alarm-USA    Nest-
                                                      USA
52923 Nest Protect Smoke + CO White Battery Alarm-USA Nest-
                                                      USA
      Quantity Avg_Price Delivery_Charges
      Coupon_Status
52919 1 121.30 6.50 Clicked 52920 1 48.92 6.50 Used
52921        1    151.88      6.50  Used
52922        5    80.52 6.50  Clicked
52923        4    80.52 19.99 Clicked
```

```
[7]: data.shape
```

```
[7]: (52924, 10)
```

```
[8]: data.describe()
```

```
[8]:       CustomerID Transaction_ID    Quantity    Avg_Price \
     count 52924.00000            52924.000000 52924.000000
     52924.000000
     mean  15346.70981  32409.825675    4.497638    52.237646
     std   1766.55602    8648.668977   20.104711    64.006882
     min   12346.00000  16679.000000    1.000000     0.390000
     25%   13869.00000  25384.000000    1.000000     5.700000
     50%   15311.00000  32625.500000    1.000000    16.990000
     75%   16996.25000  39126.250000    2.000000   102.130000
     max   18283.00000  48497.000000  900.000000   355.740000

           Delivery_Charges
     count     52924.000000
     mean         10.517630
     std          19.475613
     min           0.000000
     25%           6.000000
     50%           6.000000
     75%           6.500000
     max         521.360000
```

1 3. DATA CLEANING AND PREPARATION

```
[9]: data.isnull().sum()           # checking for the NULL values in
                                   columns
```

```
[9]: CustomerID           0
     Transaction_ID       0
     Transaction_Date     0
     Product_SKU          0
    Product_Description   0
     Product_Category     0
```

```
Quantity            0
Avg_Price           0
Delivery_Charges    0
Coupon_Status       0
dtype: int64
```

Handling Missing,
incorrect and invalid
data

From above

**** REMOVING DUPLICATES****

```
[10]: # Checking for Duplicates in the dataset by few columns as
      subset data.
  □duplicated(subset=['CustomerID','Transaction_ID','Transaction_Date','Product_Category
                                                                              ,'Qua
        □sum()
```

```
[10]: 13029
```

```
[11]: #Removing the duplicated values as per the subset
      mentioned data.
  □drop_duplicates(subset=['CustomerID','Transaction_ID','Transaction_Date','Product_Cat
                                                                              egory'
        □= 'first',inplace= True)
```

Reducing the Memory Size of the dataset

```
[12]: #Converting the datatype to category datatype
      data['Product_SKU'] = data['Product_SKU'].astype('category')
```

```
[13]: #Checking the datatype is reflected as category in the original dataset for □
        □[Coupon_Status & Product_SKU]

      data.info()

      #Now, check all the Datatypes regarding column so that the invalid data's are □
        □avoided
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 39895 entries, 0 to
52923 Data columns (total 10
columns):
#   Column            Non-Null Count  Dtype
--- ------            --------------  -----
0   CustomerID        39895 non-null  int64
1   Transaction_ID    39895 non-null  int64
2   Transaction_Date  39895 non-null
                      object
```

```
3   Product_SKU         39895        non-null
                        category
 4 Product_Description  39895 non-null object
 5  Product_Category    39895 non-null
                        object
 6   Quantity           39895 non-null
                        int64
 7   Avg_Price          39895        non-null
                        float64
 8  Delivery_Charges    39895        non-null
                        float64
 9  Coupon_Status       39895        non-null
                        object
dtypes: category(1), float64(2), int64(3),
object(4) memory usage: 3.2+ MB
```

[14]:

```
#Creating new Column and assigning values to the dataset

Websites =['Amazon','Meesho','Ajio','Myntra','Alibaba','Flipkart','Urbanic']
data['Purchased_Website'] = data.apply(lambda row: np.random.
  choice(Websites),axis =1)
```

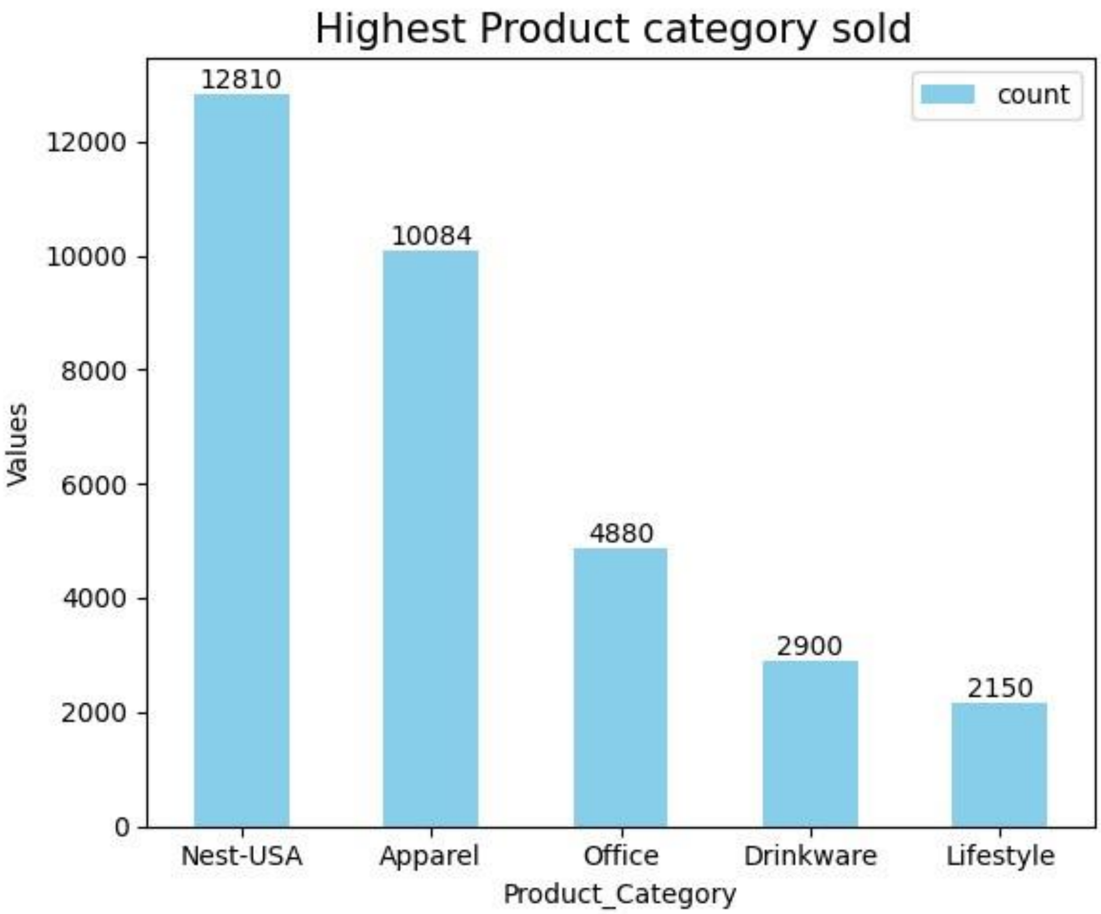
****4. Exploratory Analysis and visualization Matplotlib****

1.What are the top 5 sold product category?

[15]:

```
category_counts = data['Product_Category'].value_counts()                    □
  □#Finding the total values of product categories sold
top_categories = category_counts.head(5)                                      □
  □# printing the top 5 categories

#lets,give the bar-graph figure size
plt.figure(figsize=(6,5))
bar_width =0.5
#plotting the columns in bargraph/chart
top_categories.plot(kind='bar',color='skyblue', width=bar_width)

# Labelling the plot
plt.title('Highest Product category sold  ',fontsize=15)
plt.ylabel('Values', fontsize=10)
plt.xlabel('Product_Category',fontsize=10)

# Retriving the total counts on bargraph- bars for easy understanding
count=0
space=0.5
for i in range(len(top_categories)):
    plt.text(i,top_categories[i]+space,str(top_categories[i]),□
  □ha="center",va="bottom")

plt.xticks(rotation= 360)        # xticks text declaration
plt.legend()                     # Shows the count label with colour int the graph
plt.tight_layout()               #Ensure tight layout to prevent clipping of □
  □labels

# Saving the bar-plot
plt.savefig('highest_product_categories.png')
plt.show()
```

```
/tmp/ipykernel_33/711794304.py:19: FutureWarning: Series.__getitem__
treating keys as positions is deprecated. In a future version,
integer keys will always be treated as labels (consistent with
DataFrame behavior). To access a value by position, use
`ser.iloc[pos]`
  plt.text(i,top_categories[i]+space,str(top_categories[i]),
ha="center",va="bottom")
```



```
[16]: data.head(3)
```

```
[16]: CustomerID Transaction_ID Transaction_Date  Product_SKU \
      0      17850          16679     1/1/2019 GGOENEBJ079499
      1      17850          16680     1/1/2019 GGOENEBJ079499
      2      17850          16681     1/1/2019 GGOEGFKQ020399
                                   Product_Description Product_Category \
      0           Nest Learning Thermostat 3rd Gen-USA - Stainle…Nest-USA
      1           Nest Learning Thermostat 3rd Gen-USA - Stainle…Nest-USA
      2           Google Laptop and Cell Phone Stickers     Office

 Quantity Avg_Price Delivery_Charges Coupon_Status Purchased_Website
      0        1  153.71     6.5   Used  Myntra
      1        1  153.71     6.5   Used  Amazon
      2        1  2.05  6.5   Used  Ajio
```

2. What is the impact of coupons? (show in percentages(%))

[17]:

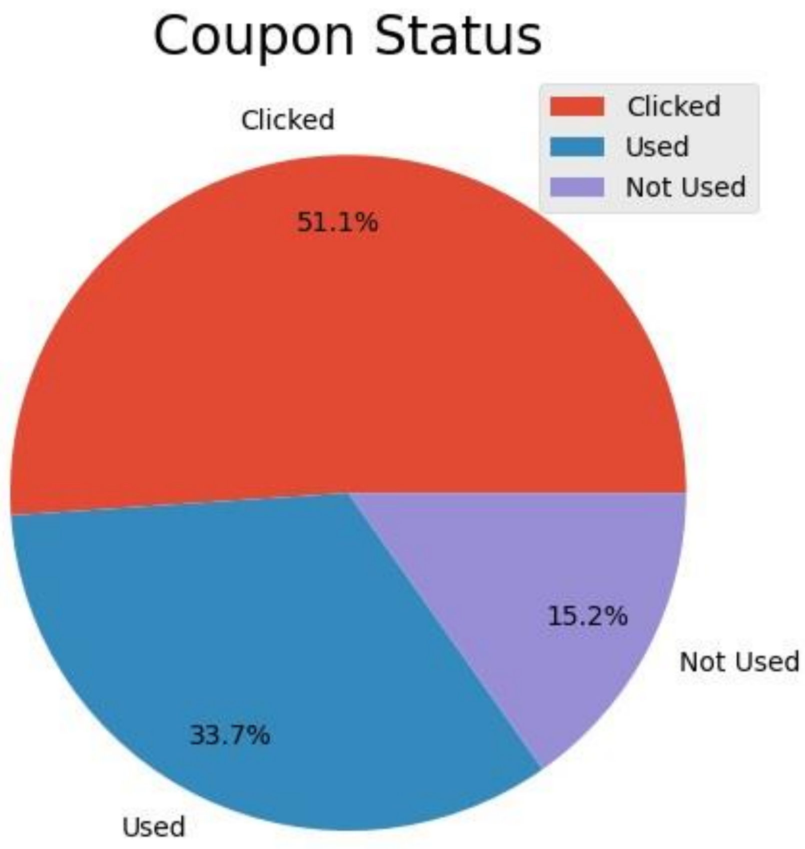
```python
coupon = data['Coupon_Status'].value_counts()
coupon
```

[17]:

```
 Coupon_Status
Clicked    20369
 Used 13448 Not
 Used 6078
 Name: count, dtype: int64
```

[18]:

```python
# Retrieving the counts of coupon status
coupon = data['Coupon_Status'].value_counts()

# Plotting the pie chart
plt.figure(figsize=(5, 5))  # Adjusting the figure size
plt.style.use('ggplot')

# Plotting the pie chart with percentages and labels
plt.pie(coupon, labels=coupon.index, autopct='%1.1f%%', pctdistance=0.8)

# Adding a title with custom font and size
plt.title('Coupon Status', fontdict={'fontname': 'Arial', 'fontsize': 20})

# Setting font size for the labels
plt.setp(plt.gca().get_xticklabels(), fontsize=18)

# Ensure tight layout to prevent clipping of labels
plt.tight_layout()

# Adding a legend with custom location
plt.legend(loc='upper right', bbox_to_anchor=(0.5, 0, 0.5, 1))

# Saving the ba-plot
plt.savefig('coupon_status.png')

# Displaying the plot
plt.show()
```

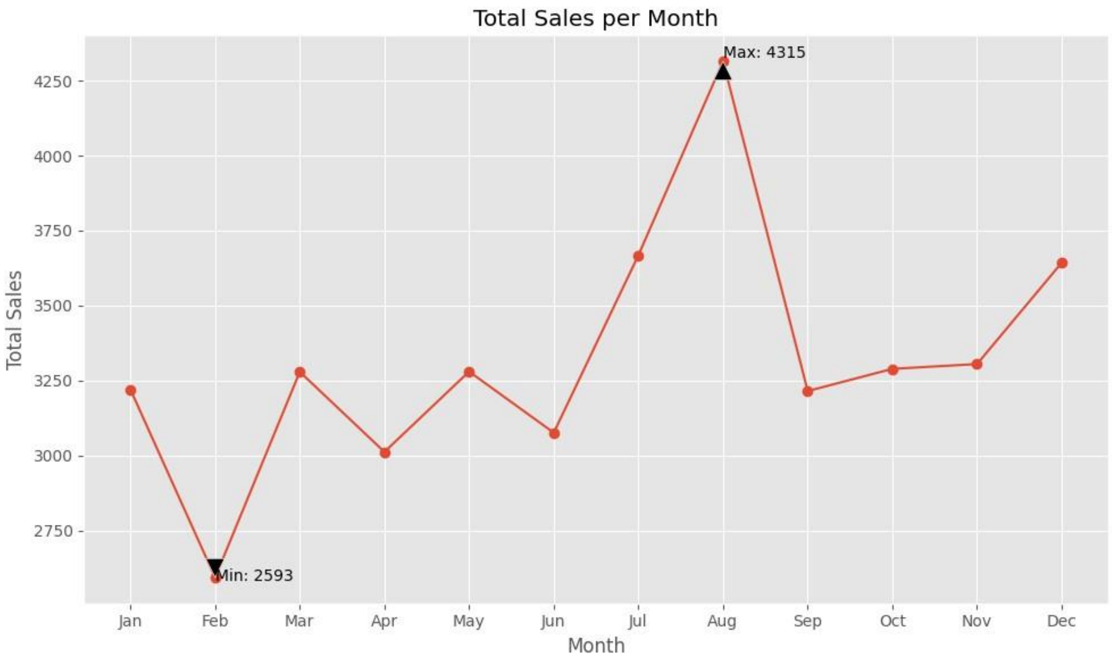


3. **What are total sales/transactions per month(show max and min)?**

```
[19]: data['Transaction_Date'].value_counts()
```

```
[19]: Transaction_Date
     11/27/2019  279
     12/18/2019  219
     8/16/2019   208
     7/13/2019   203
     8/2/2019    201
                 …
     2/5/2019     34
     9/10/2019    33
     12/24/2019   26
     7/1/2019     24
     8/20/2019    23
     Name: count, Length: 365, dtype: int64
```

```
[20]: # Convert 'Transaction_Date' to datetime format
      data['Transaction_Date'] =
      pd.to_datetime(data['Transaction_Date'])

      # Extract year and month
      data['Year'] = data['Transaction_Date'].dt.year
      data['Month'] = data['Transaction_Date'].dt.month

      # Group sales data by month and year, then calculate total sales for each month
      monthly_sales = data.groupby(['Year', 'Month']).size()
      total_sales_per_month = monthly_sales.groupby('Month').sum()

      # Plot total sales per month using a line graph
      plt.figure(figsize=(10, 6)) plt.plot(total_sales_per_month.index,
      total_sales_per_month.values, marker='o',□
       □linestyle='-')
      plt.xlabel('Month')
      plt.ylabel('Total Sales')
      plt.title('Total Sales per
      Month')
      plt.xticks(range(1, 13), ['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul',□
       □'Aug', 'Sep', 'Oct', 'Nov', 'Dec']) # Set x-axis ticks to month names
      plt.grid(True) # Add grid lines for better readability

      # Retrieve and annotate the maximum value on the graph
      max_value = total_sales_per_month.max() max_month =
      total_sales_per_month.idxmax() plt.annotate(f'Max: {max_value}',
      xy=(max_month, max_value), xytext=(max_month,□
       □max_value + 10),
              arrowprops=dict(facecolor='black', shrink=0.05),)

      # Retrieve and annotate the minimum value on the graph
      min_value = total_sales_per_month.min() min_month =
      total_sales_per_month.idxmin() plt.annotate(f'Min: {min_value}',
      xy=(min_month, min_value), xytext=(min_month,□
       □min_value - 10),
              arrowprops=dict(facecolor='black', shrink=0.05))

      # Saving the line-plot
      plt.savefig('transactions.png')

      plt.tight_layout()
      plt.show()
```

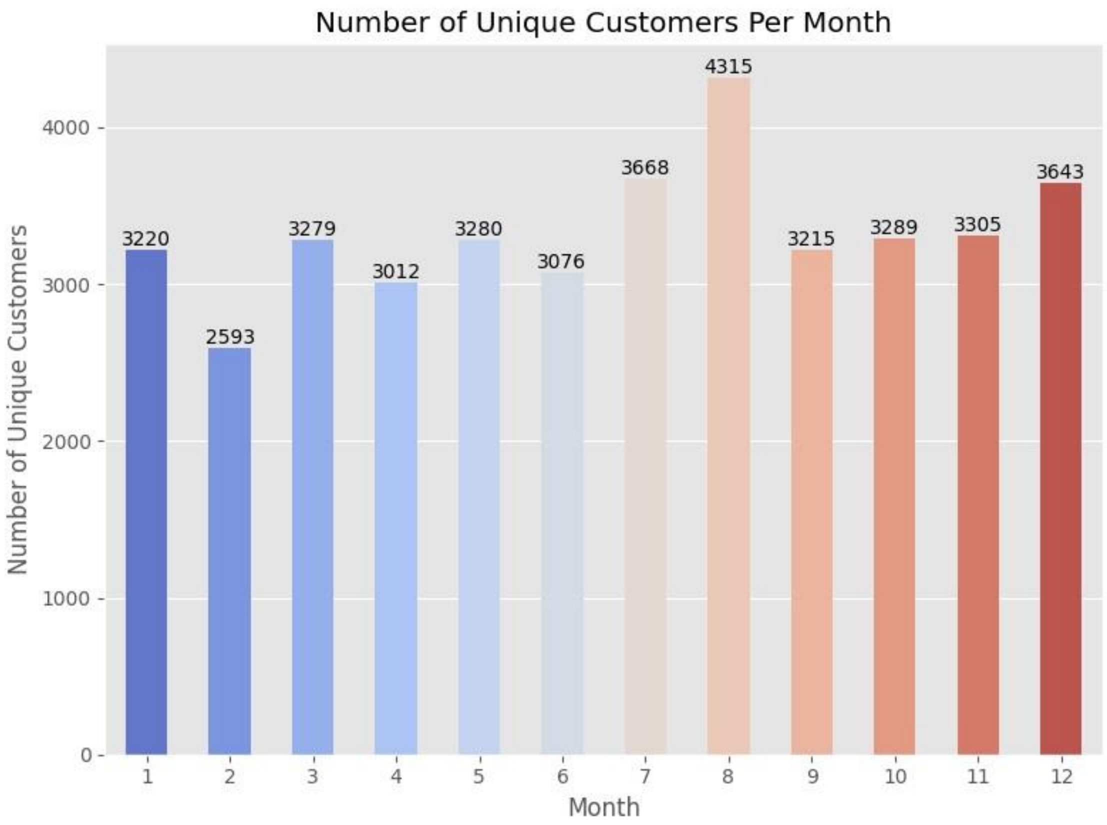


4. how many unique customers made a transactions per month?

```
[21]: data['CustomerID'].nunique()
```

```
[21]: 1468
```

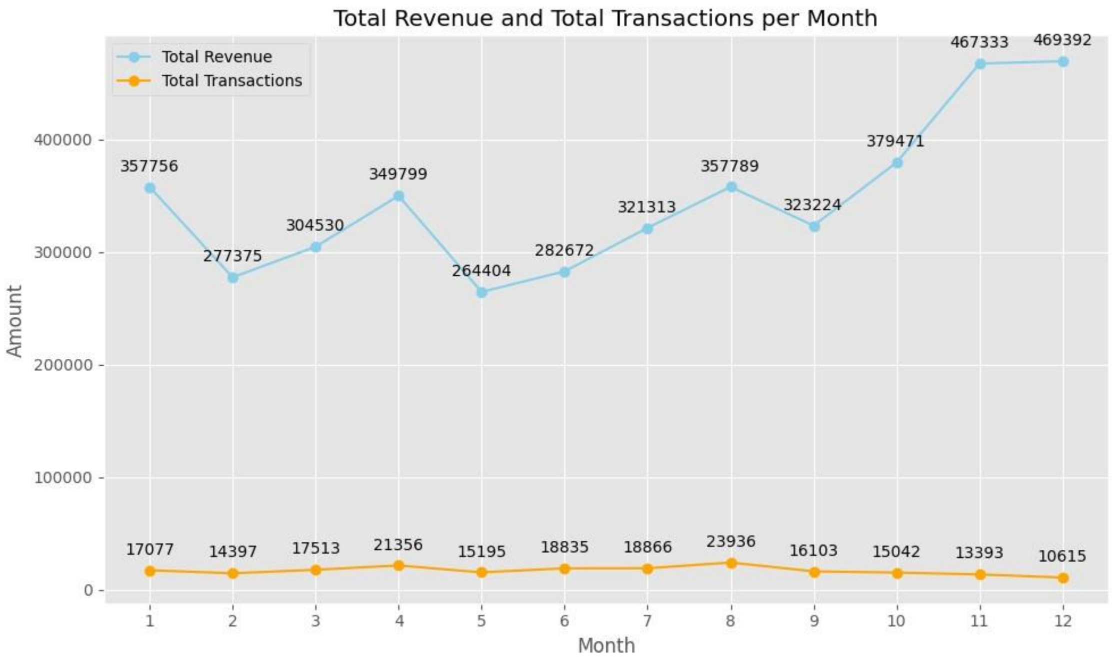
```
[22]: # Convert 'Transaction_Date' to datetime format
      data['Transaction_Date'] =
      pd.to_datetime(data['Transaction_Date'])

      # Convert 'Transaction_Date' to datetime format
      data['Transaction_Date'] = pd.to_datetime(data['Transaction_Date'])

      # Extract month from 'Transaction_Date'
      data['Month'] =
      data['Transaction_Date'].dt.month

      # Calculate the number of unique customers per month
      unique_customers_per_month =
      data.groupby('Month')['CustomerID'].nunique(). reset_index()


      # Create a count plot using Seaborn plt.figure(figsize=(8, 6))
      bar_width=0.5 ax = sns.countplot(x='Month', data=data,
      palette='coolwarm',width=bar_width) plt.xlabel('Month')
      plt.ylabel('Number of Unique Customers')
plt.title('Number of Unique Customers Per Month ')

# Add numbers above the bars
for i in ax.patches:
    ax.text(i.get_x() + i.get_width()/2,  .get_height(), str(int(i.
  □get_height())), ha='center', va='bottom')
# Saving the count-plot
plt.savefig('unique_customers.png')

plt.tight_layout()
plt.show()
```



5. What is the total revenue and total transaction on each month?

```
[23]:  # Convert 'Transaction_Date' to datetime format
data['Transaction_Date'] =
pd.to_datetime(data['Transaction_Date'])

# Calculate total revenue for each transaction
data['Total_Revenue'] = data['Quantity'] * data['Avg_Price']
```

```
# Extract month from 'Transaction_Date'
data['Month'] = data['Transaction_Date'].dt.month

# Group data by month and calculate total revenue and total transactions for␣
 ↪each month
monthly_summary = data.groupby('Month').agg({'Total_Revenue': 'sum', 'Quantity':
 ↪ 'sum'}).reset_index()

# Plot total revenue and total transactions
plt.figure(figsize=(10, 6))

# Plot total revenue
plt.plot(monthly_summary['Month'], monthly_summary['Total_Revenue'],␣
 ↪color='skyblue', marker='o', label='Total Revenue')

# Plot total transactions
plt.plot(monthly_summary['Month'], monthly_summary['Quantity'], color='orange',␣
 ↪marker='o', label='Total Transactions')

# Annotate each dot with its corresponding count
for x, y in zip(monthly_summary['Month'], monthly_summary['Total_Revenue']):
    plt.annotate(f'{int(y)}', (x, y), textcoords="offset points",␣
 ↪xytext=(0,10), ha='center')

for x, y in zip(monthly_summary['Month'], monthly_summary['Quantity']):
    plt.annotate(f'{int(y)}', (x, y), textcoords="offset points",␣
 ↪xytext=(0,10), ha='center')


plt.xlabel('Month')
plt.ylabel('Amount')
plt.title('Total Revenue and Total Transactions per Month')
plt.xticks(range(1, 13))  # Assuming the month numbers are from 1 to 12
plt.legend()
plt.grid(True)
plt.tight_layout()

# Saving the lines-plot
plt.savefig('total_revenue_&_transactions.png')

plt.show()
```



2 5. CONCLUSION

A comprehensive analysis of these data columns can offer valuable insights into customer behavior, product performance, sales trends, and the effectiveness of marketing strategies, enabling businesses to make data-driven decisions to optimize their operations and maximize revenue. ****