Online Sales Analysis

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

0.0.1 Data Loading and Initial Inspection

[2]:
```
df = pd.read_csv("Online Sales Dataset.csv")
```

Importing the Dataset

[3]:
```
df.head()
```

[3]:
```
   Row ID        Order ID  Order Date   Ship Date       Ship Mode Customer ID  \
0       1  CA-2017-152156  08/11/2017  11/11/2017    Second Class    CG-12520
1       2  CA-2017-152156  08/11/2017  11/11/2017    Second Class    CG-12520
2       3  CA-2017-138688  12/06/2017  16/06/2017    Second Class    DV-13045
3       4  US-2016-108966  11/10/2016  18/10/2016  Standard Class    SO-20335
4       5  US-2016-108966  11/10/2016  18/10/2016  Standard Class    SO-20335

     Customer Name    Segment        Country             City       State  \
0      Claire Gute   Consumer  United States        Henderson    Kentucky
1      Claire Gute   Consumer  United States        Henderson    Kentucky
2  Darrin Van Huff  Corporate  United States      Los Angeles  California
3   Sean O'Donnell   Consumer  United States  Fort Lauderdale     Florida
4   Sean O'Donnell   Consumer  United States  Fort Lauderdale     Florida

   Postal Code Region       Product ID         Category Sub-Category  \
0      42420.0  South  FUR-BO-10001798        Furniture    Bookcases
1      42420.0  South  FUR-CH-10000454        Furniture       Chairs
2      90036.0   West  OFF-LA-10000240  Office Supplies       Labels
3      33311.0  South  FUR-TA-10000577        Furniture       Tables
4      33311.0  South  OFF-ST-10000760  Office Supplies      Storage

                                        Product Name     Sales
0                  Bush Somerset Collection Bookcase  261.9600
1  Hon Deluxe Fabric Upholstered Stacking Chairs,…  731.9400
2  Self-Adhesive Address Labels for Typewriters b…   14.6200
```

```
3      Bretford CR4500 Series Slim Rectangular Table  957.5775
4                     Eldon Fold 'N Roll Cart System   22.3680
```

Taking overview of the data.

[4]:

```
df.shape
```

[4]:

```
(9800, 18)
```

Dataset(df) have 9800 rows and 18 columns.

[5]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9800 entries, 0 to 9799
Data columns (total 18 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Row ID         9800 non-null   int64
 1   Order ID       9800 non-null   object
 2   Order Date     9800 non-null   object
 3   Ship Date      9800 non-null   object
 4   Ship Mode      9800 non-null   object
 5   Customer ID    9800 non-null   object
 6   Customer Name  9800 non-null   object
 7   Segment        9800 non-null   object
 8   Country        9800 non-null   object
 9   City           9800 non-null   object
 10  State          9800 non-null   object
 11  Postal Code    9789 non-null   float64
 12  Region         9800 non-null   object
 13  Product ID     9800 non-null   object
 14  Category       9800 non-null   object
 15  Sub-Category   9800 non-null   object
 16  Product Name   9800 non-null   object
 17  Sales          9800 non-null   float64
dtypes: float64(2), int64(1), object(15)
memory usage: 1.3+ MB
```

Checking the data type of columns.

[6]:

```
df.describe()
```

[6]:

```
            Row ID   Postal Code         Sales
count  9800.000000   9789.000000   9800.000000
mean   4900.500000  55273.322403    230.769059
std    2829.160653  32041.223413    626.651875
min       1.000000   1040.000000      0.444000
25%    2450.750000  23223.000000     17.248000
```

```
50%    4900.500000  58103.000000     54.490000
75%    7350.250000  90008.000000    210.605000
max    9800.000000  99301.000000  22638.480000
```

Minimum purchased is $0.44 and maximum purchased is $22638.48. Average order per customer is $230.76.

0.1 Data Cleaning

[7]:

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

[7]:

```
Row ID            0
Order ID          0
Order Date        0
Ship Date         0
Ship Mode         0
Customer ID       0
Customer Name     0
Segment           0
Country           0
City              0
State             0
Postal Code      11
Region            0
Product ID        0
Category          0
Sub-Category      0
Product Name      0
Sales             0
dtype: int64
```

Column “Postal Code” have 11 null values.

[8]:

```
df["Order Date"] = pd.to_datetime(df["Order Date"], format='%d/%m/%Y')
df["Ship Date"] = pd.to_datetime(df["Ship Date"], format= '%d/%m/%Y')
df["Postal Code"] = df["Postal Code"].astype(str)
df["Postal Code"] = df["Postal Code"].replace("","05907")
```

-Change the data type of order date and ship day to datetime format to calculate how many day did take to deliver order. -Changing the data type of Postal Code column to str to handle the missing values. -Postal Code have 11 null values that’s state(Vermont). Vermont have Postal Code(05907). Replacing all the null values with state(Vermont’s) Postal Code.

Changing the data type of Postal Code column to str to handle the missing values.

Postal Code have 11 null values that’s state(Vermont). Vermont have Postal Code(05907). Replacing all the null values with state(Vermont’s) Postal Code.

[9]:

```
df.duplicated().sum()
```

```
[9]: np.int64(0)
```

DataFrame have no duplicate data.

```
[10]: df= df.sort_values(by="Order Date", ascending=True)
```

0.1.1 Feature Engineering

```
[11]: df["Order Month"] = df["Order Date"].dt.to_period('M')
      df["Order Year"] = df["Order Date"].dt.to_period('Y')
      df["Order Weekday"] = df["Order Date"].dt.day_name()
      df["Order Quarter"] = df["Order Date"].dt.to_period('Q')
```

```
[12]: df["Shipping Days"] = (df["Ship Date"] - df["Order Date"]).dt.days
```

Create a new column name “Shipping Days”. It means that how many days delivered the order.

```
[13]: def format_dollars(value):
          if value >=1_000_000:
              return f"{value/1_000_000:.2f}M"
          elif value >= 1_000:
              return f"{value/1_000:.2f}K"
          else:
              return value
```

0.1.2 KPI’s

```
[14]: total_sales = df["Sales"].sum()
      total_sales
```

```
[14]: np.float64(2261536.7827000003)
```

Total Sales from 2015 to 2018

```
[15]: total_orders = df["Order ID"].nunique()
      total_orders
```

```
[15]: 4922
```

```
[16]: total_customer = df["Customer ID"].nunique()
      total_customer
```

```
[16]: 793
```

```
[17]: avg_sale_per_order = total_sales/total_orders
      avg_sale_per_order
```

```
[17]: np.float64(459.4751691791955)
```

```
[18]: avg_sale_per_person = total_sales/total_customer
      avg_sale_per_person
```

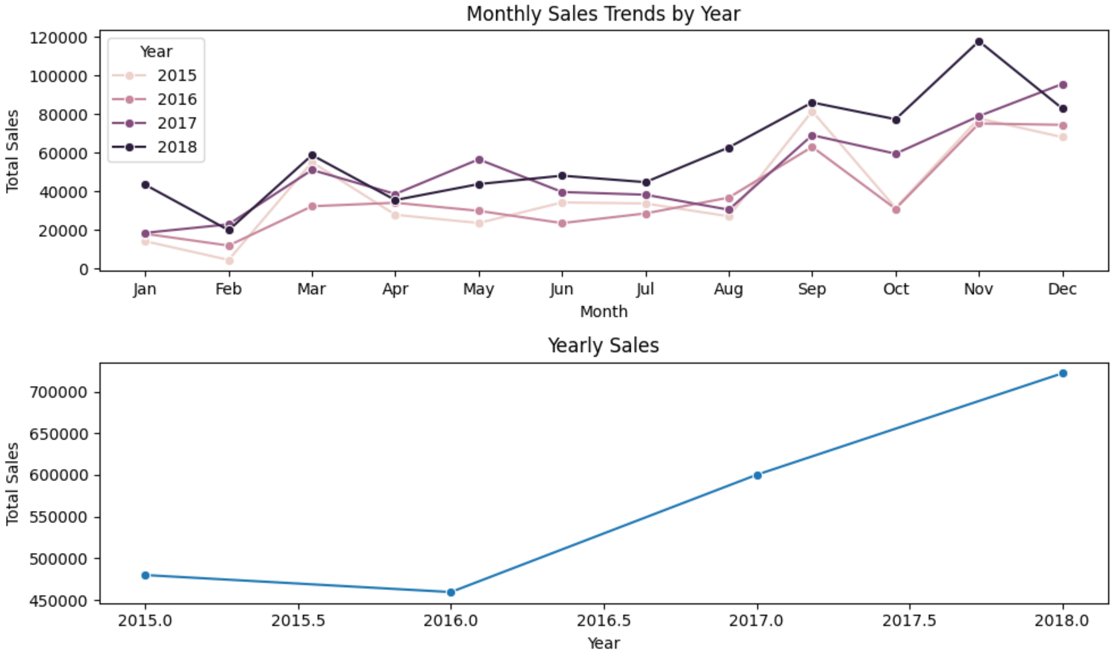
```
[18]: np.float64(2851.874883606558)
```

```
[27]: yearly_sales = df.groupby(["Order Year"])["Sales"].sum().reset_index()
      yearly_sales
```

```
[27]:    Order Year        Sales
      0        2015  479856.2081
      1        2016  459436.0054
      2        2017  600192.5500
      3        2018  722052.0192
```

0.1.3 Exploratory Data Analysis (EDA)

```
[19]: df["Order Month"] = df["Order Date"].dt.month
      df["Order Year"] = df["Order Date"].dt.year

      monthly_sales = df.groupby(["Order Year", "Order Month"])["Sales"].sum().
        ↪reset_index()
      yearly_sales = df.groupby(["Order Year"])["Sales"].sum().reset_index()

      plt.figure(figsize=(10,6))
      plt.subplot(2,1,1)
      sns.lineplot(data=monthly_sales, x="Order Month", y ="Sales", hue="Order Year",␣
        ↪marker="o")

      plt.xlabel("Month")
      plt.ylabel("Total Sales")
      plt.title("Monthly Sales Trends by Year")
      plt.legend(title="Year")
      plt.
        ↪xticks(range(1,13),['Jan','Feb','Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','Dec'

      plt.subplot(2,1,2)
      ax = sns.lineplot(data=yearly_sales, x="Order Year", y ="Sales", marker="o")

      plt.xlabel("Year")
      plt.ylabel("Total Sales")
      plt.title("Yearly Sales")
      plt.xticks()

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

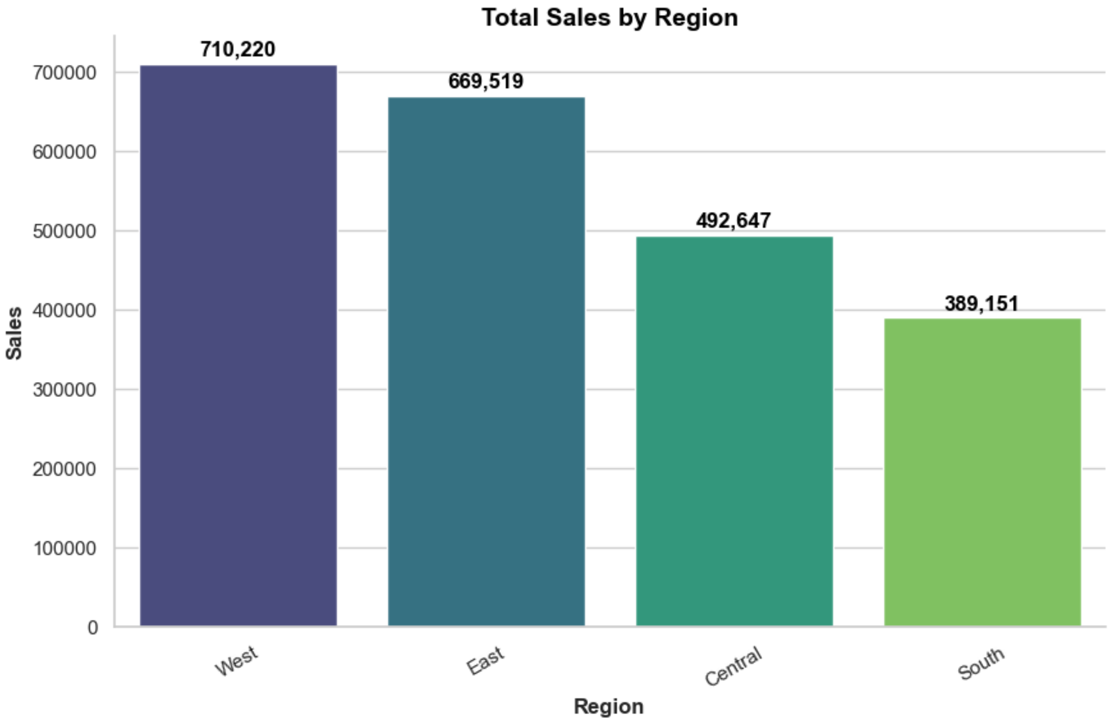

Monthly Sales Trends by Year

Yearly Sales

[20]:

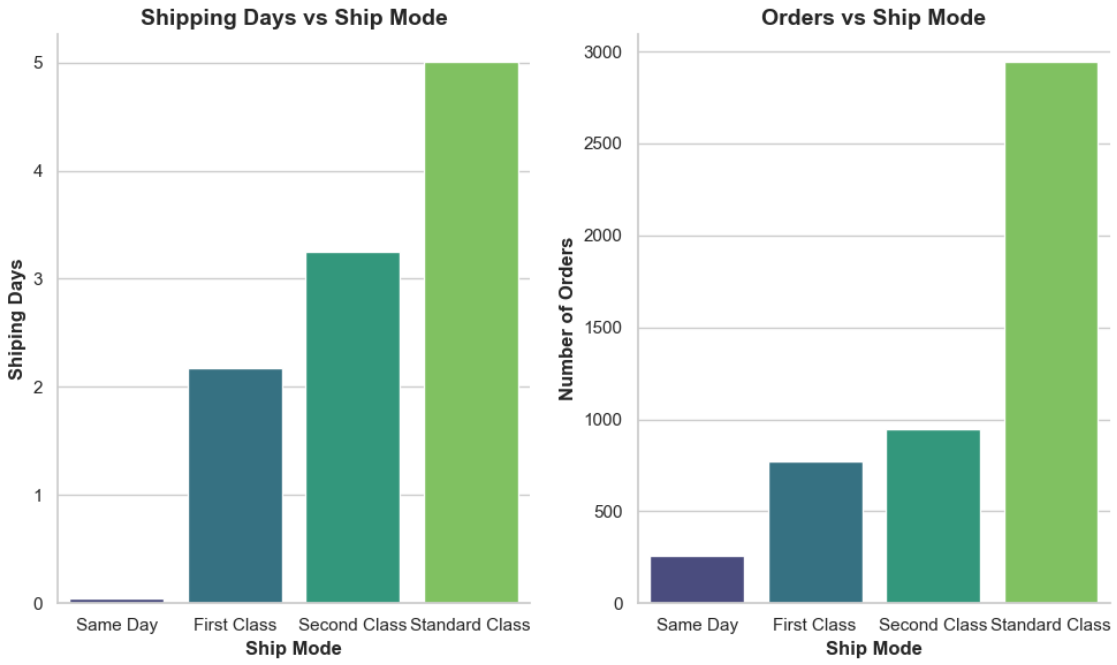
```
region_sales = df.groupby("Region")["Sales"].sum().reset_index()

sns.set_theme(style="whitegrid")

plt.figure(figsize=(10,6))


ax=sns.barplot(
    data=region_sales.sort_values("Sales", ascending=False),
    x="Region",
    y="Sales",
    hue="Region",
    palette="viridis",
    legend=False
)

for i, row in region_sales.sort_values("Sales", ascending=False).reset_index().
 ↪iterrows():
    ax.text(
        i, row["Sales"] + 0.01 * region_sales["Sales"].max(),  # Adjust the␣
 ↪vertical positioning
        f'{row["Sales"]:,.0f}',  # Formatting: thousands separator, no decimals
        ha='center', va='bottom', fontweight='semibold', color='black'
    )
```

```
plt.xlabel("Region", fontsize=12, fontweight="bold")
plt.ylabel("Sales", fontsize=12, fontweight="bold")
plt.title("Total Sales by Region", fontsize=14, fontweight="bold",␣
 ↪color='black')

plt.xticks(rotation=30,ha='center', fontsize=11)

sns.despine()

plt.show()
```



[21]:

```
avg_ship_day = df.groupby("Ship Mode").agg({
    'Shipping Days':'mean',
    'Order ID':"nunique"
})

plt.figure(figsize=(10,6))

plt.subplot(1,2,1)
sns.barplot(
    data=avg_ship_day.sort_values("Shipping Days", ascending=True),
    x="Ship Mode",
    y="Shipping Days",
    hue="Ship Mode",
    legend=False,
    palette="viridis"
)

plt.xlabel("Ship Mode",fontsize=12, fontweight="bold")
plt.ylabel("Shiping Days", fontsize=12, fontweight="bold")
plt.title("Shipping Days vs Ship Mode", fontsize=14, fontweight="bold")

sns.despine()

plt.subplot(1,2,2)
sns.barplot(
    data=avg_ship_day.sort_values("Shipping Days", ascending=True),
    x="Ship Mode",
    y="Order ID",
    hue="Ship Mode",
    legend=False,
    palette="viridis"
)

plt.xlabel("Ship Mode",fontsize=12, fontweight="bold")
plt.ylabel("Number of Orders", fontsize=12, fontweight="bold")
plt.title("Orders vs Ship Mode", fontsize=14, fontweight="bold")

sns.despine()
plt.tight_layout()
plt.show()
```

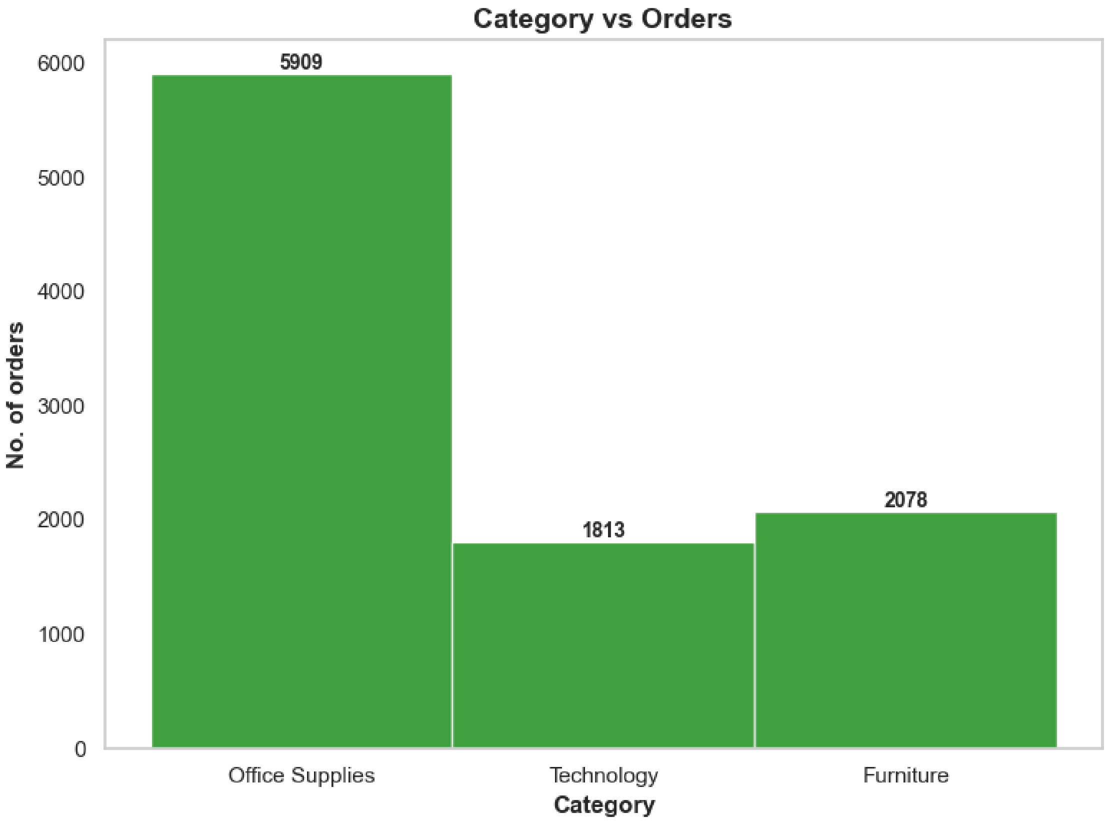


[22]:

```
plt.figure(figsize=(8,6))

plt.grid(False)

ax = sns.histplot(data=df["Category"].reset_index(), x="Category",color="green")

for p in ax.patches:
    height = p.get_height()
    if height > 0:
        ax.text(
            p.get_x() + p.get_width() / 2,
            height,
            int(height),
            ha = "center", va ='bottom',
            fontsize = 10, fontweight = 'bold'
        )



plt.xlabel("Category",fontsize=12, fontweight="bold")
plt.ylabel("No. of orders", fontsize=12, fontweight="bold")
plt.title("Category vs Orders", fontsize=14, fontweight="bold")



plt.tight_layout()
plt.show
```

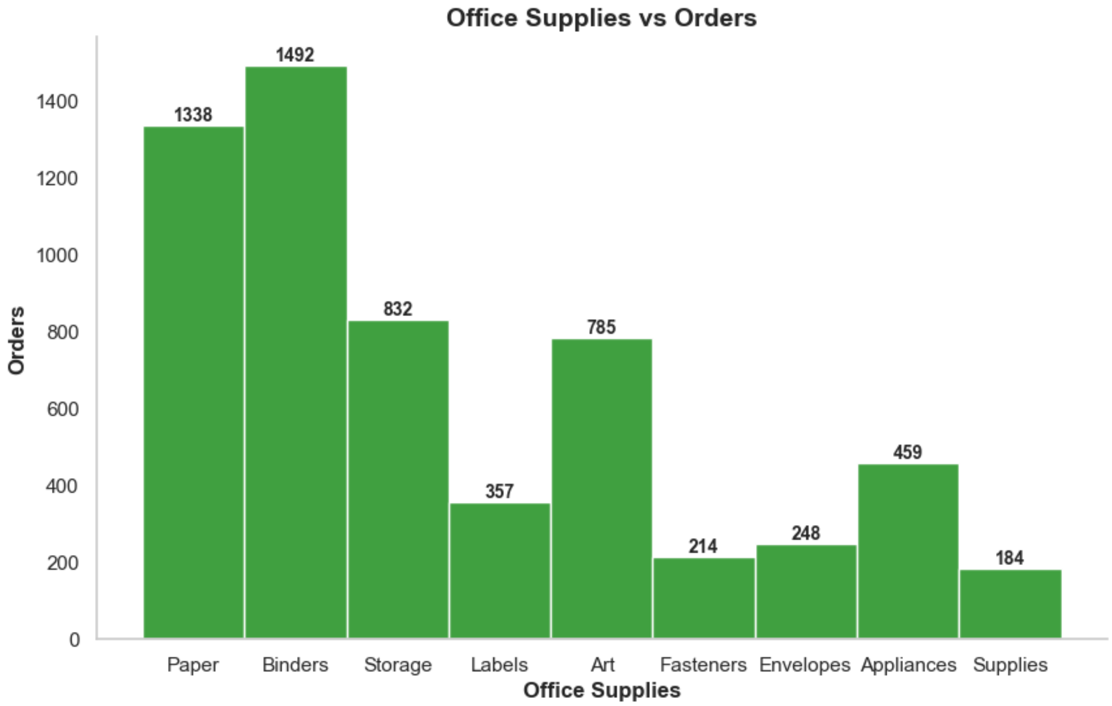
[22]:

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



[23]:

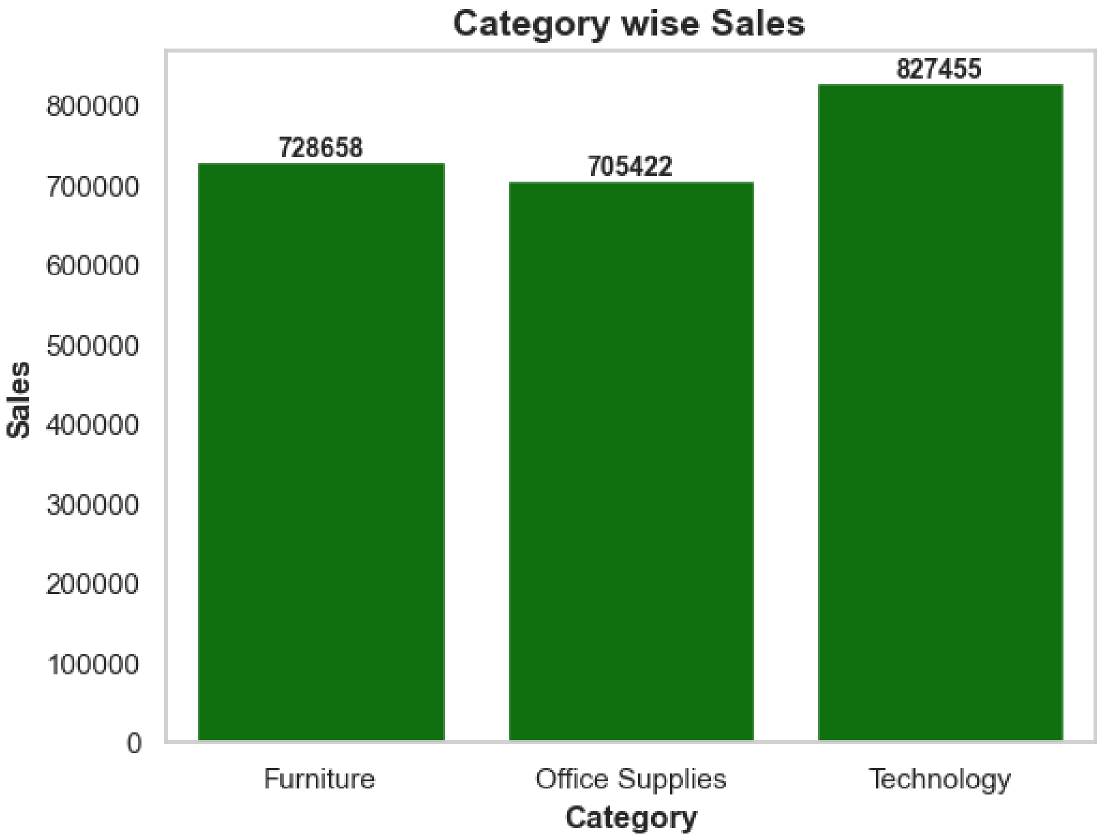
```
office_supplies=df[df["Category"]=="Office Supplies"]

plt.figure(figsize=(10,6))
plt.grid(False)
ax1 = sns.histplot(
    data=office_supplies,
    x="Sub-Category",
    color="green"
)

for p in ax1.patches:
    height = p.get_height()
    ax1.text(
        p.get_x() +p.get_width() / 2,
        height,
        int(height),
        ha = 'center', va = 'bottom',
        fontsize = 10, fontweight = 'bold'
    )

plt.xlabel("Office Supplies",fontsize=12, fontweight="bold")
plt.ylabel("Orders", fontsize=12, fontweight="bold")
plt.title("Office Supplies vs Orders", fontsize=14, fontweight="bold")

sns.despine()

plt.show()
```



[24]:

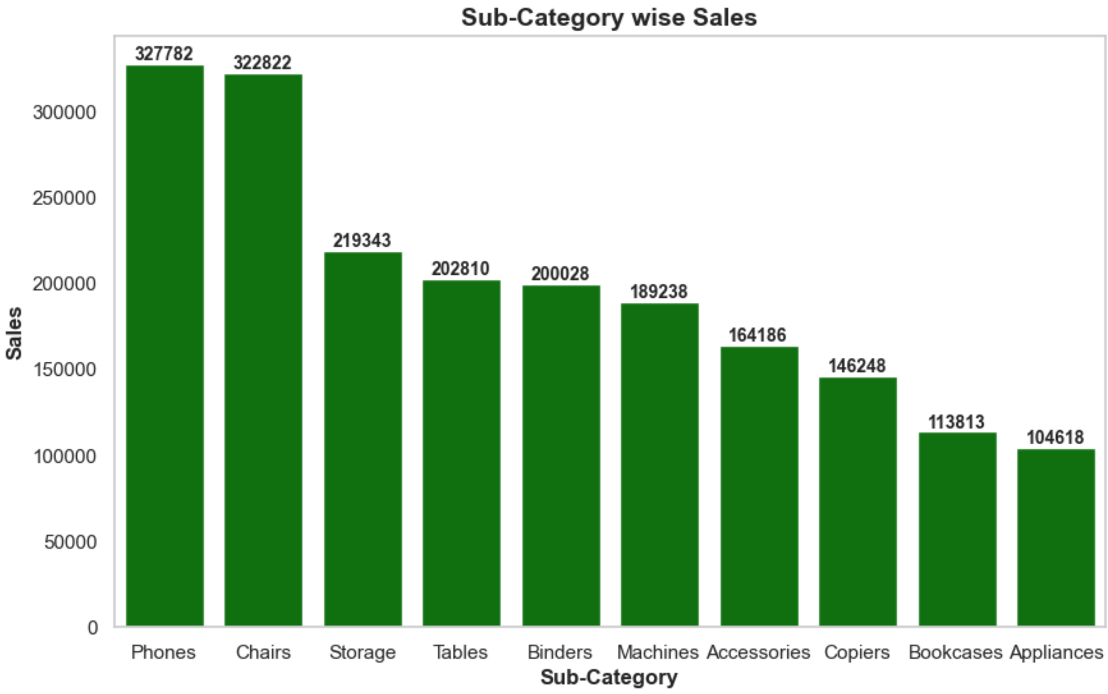
```
category_sales=df.groupby("Category")["Sales"].sum().reset_index()

plt.grid(False)

ax2 = sns.barplot(data=category_sales, x="Category", y="Sales", color="green")

for p in ax2.patches:
    height = p.get_height()
    ax2.text(
        p.get_x() +p.get_width() / 2,
        height,
        int(height),
        ha = 'center', va = 'bottom',
        fontsize = 10, fontweight = 'bold'
    )

plt.xlabel("Category",fontsize=12, fontweight="bold")
plt.ylabel("Sales", fontsize=12, fontweight="bold")
plt.title("Category wise Sales", fontsize=14, fontweight="bold")

plt.show
```

```
[24]: <function matplotlib.pyplot.show(close=None, block=None)>
```



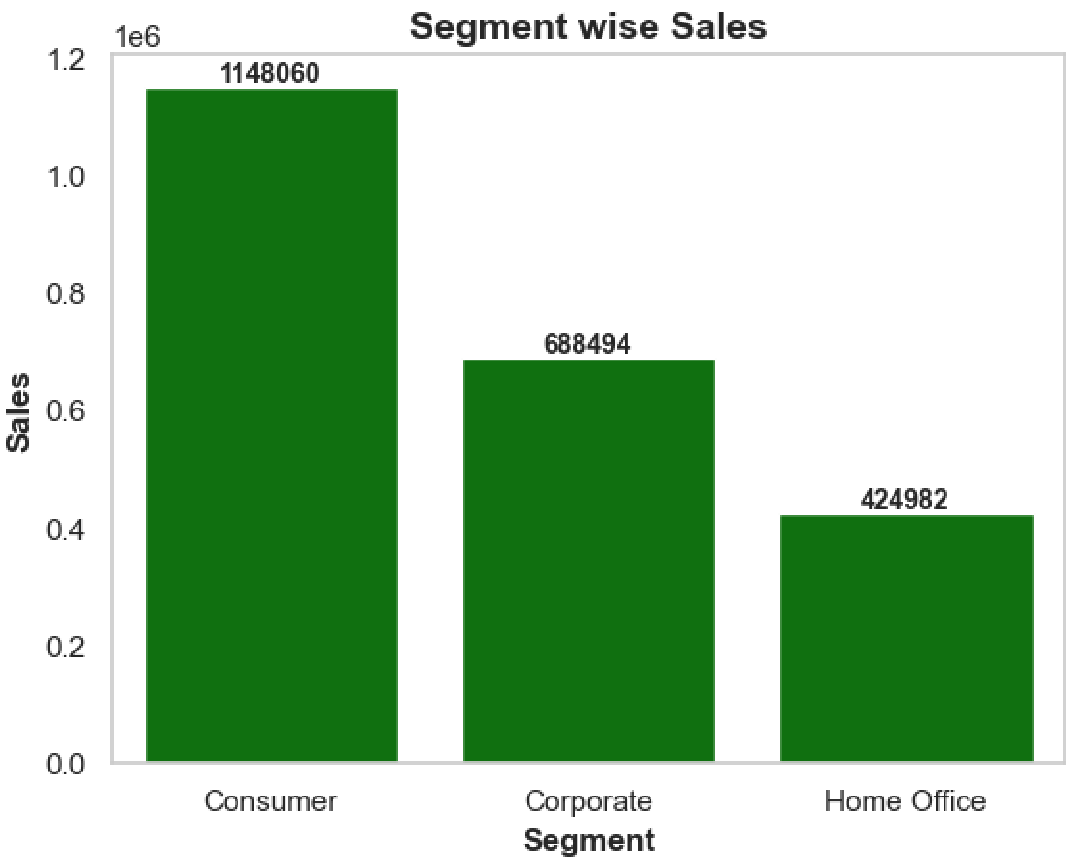
```
[25]: sub_category_sales=df.groupby("Sub-Category")["Sales"].sum().reset_index()
      sub_category_sales=(sub_category_sales.nlargest(10,'Sales')).reset_index()

      plt.figure(figsize=(10,6))
      plt.grid(False)

      ax4 = sns.barplot(data=sub_category_sales, x="Sub-Category", y="Sales",␣
       ↪color="green")

      for p in ax4.patches:
          height = p.get_height()
          ax4.text(
              p.get_x() +p.get_width() / 2,
            height,
            int(height),
            ha = 'center', va = 'bottom',
            fontsize = 10, fontweight = 'bold'
        )

plt.xlabel("Sub-Category",fontsize=12, fontweight="bold")
plt.ylabel("Sales", fontsize=12, fontweight="bold")
plt.title("Sub-Category wise Sales", fontsize=14, fontweight="bold")

plt.show
```

```
[25]: <function matplotlib.pyplot.show(close=None, block=None)>
```



```
[26]: segment_sales=df.groupby("Segment")["Sales"].sum().reset_index()
segment_sales["Sales_formatted"] = segment_sales["Sales"].apply(lambda x:
  ↪format_dollars(x))
print(segment_sales)
plt.grid(False)

ax5 = sns.barplot(data=segment_sales, x="Segment", y="Sales", color="green")

for p in ax5.patches:
    height = p.get_height()
    ax5.text(
        p.get_x() +p.get_width() / 2,
        height,
        int(height),
        ha = 'center', va = 'bottom',
        fontsize = 10, fontweight = 'bold'
    )

plt.xlabel("Segment",fontsize=12, fontweight="bold")
plt.ylabel("Sales", fontsize=12, fontweight="bold")
plt.title("Segment wise Sales", fontsize=14, fontweight="bold")

plt.show()
```

```
       Segment         Sales Sales_formatted
0     Consumer  1.148061e+06           1.15M
1    Corporate  6.884941e+05         688.49K
2  Home Office  4.249822e+05         424.98K
```



1 Key Insights

1.0.1 Sales Performance Trends:

Sales saw a decline from 2015 (479.8K) to 2016 (459.4K), followed by a sharp upturn in 2017 (600.1K) and 2018 (722.0K), indicating a period of recovery and growth in recent years.

1.0.2 Monthly Sales Peaks:

March, September, and November consistently recorded the highest sales volumes, revealing clear seasonal demand cycles.

1.0.3 Regional Sales Distribution:

The West region generated the highest sales (710.2K), trailed by the East (669.5K), Central (492.6K), and South (389.1K). The South region remains underpenetrated with significant growth potential.

1.0.4 Shipping Performance:

Standard Class shipments averaged five days for delivery. The extended delivery time may be offset by cost benefits, such as free shipping, which drives customer selection of this mode.

1.0.5 Category Sales Analysis:

While Office Supplies account for the highest number of units sold (5909), the Technology category delivers greater overall sales revenue (875.5K), underscoring its profit potential.

1.0.6 Sub-Category Sales Insights:

Binders (1492) are the top-selling sub-category by unit count within Office Supplies. However, Phones in the Technology category generate the highest sales revenue (327.7K), followed by Chairs (322.8K). Binders (200.0K) rank fifth in overall sales value across sub-categories.

1.0.7 Customer Segment Opportunities:

The Consumer segment leads in overall market sales (1.15M), highlighting its importance for revenue generation.

2 Strategic Recommendations

2.0.1 Targeted Regional Marketing:

Invest in targeted marketing and promotional activities within the South region to stimulate demand and realize untapped sales opportunities.

2.0.2 Optimized Inventory Management:

Prioritize inventory planning for Office Supplies, with focused stocking of high-velocity items such as Binders and Paper to avoid stockouts and capture peak demand.

2.0.3 Segment-Specific Incentives:

Implement discounts and tailored promotional campaigns for Corporate and Home Office segments to boost engagement and drive incremental sales in these customer groups.

[ ]:

[ ]:

[ ]: