datascience-project-ayakobtan

September 29, 2025

1 Project Kick-off: Global Superstore Sales & Profit Analysis

1.1 Project Overview

This project focuses on analyzing the **Global Superstore** dataset, a retail dataset containing customer orders across different product categories, customer segments, and global regions. The dataset includes details such as sales, profit, discounts, shipping methods, and order dates, making it suitable for business performance analysis.

1.2 Objective

The main goal of this project is to explore sales and profit patterns to answer key business questions: - Which product categories and sub-categories drive the most revenue and profit? - How do sales and profits change over time (monthly or seasonal trends)? - Which regions and customer segments are most profitable? - Are there categories with high sales but low profitability?

1.3 Tools & Approach

- **Pandas**: Data loading, cleaning, and exploratory analysis
- **Matplotlib & Seaborn**: Static visualizations for trends and comparisons
- **Plotly**: Interactive charts for deeper insights
- **Jupyter/Colab Notebook**: Organized workflow with explanations and charts

1.4 Deliverables

The outcome will be a structured notebook presented as a dashboard-style report with the following sections: 1. Dataset preparation and cleaning
2. Exploratory data analysis (EDA) with summary statistics
3. Visualizations: bar charts, line charts, pie charts, heatmaps, and histograms
4. Key insights and conclusions supported by visual evidence

By the end of this project, I aim to highlight performance trends and provide actionable insights into product, regional, and temporal sales behaviors within the Global Superstore dataset.

1.5 DataSet Preparation

```
[ ]: # Import libraries and load dataset
     from google.colab import files
     import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     import seaborn as sns

     uploaded = files.upload()
     df = pd.read_csv("Global_Superstore2.csv", encoding="latin1")
     df.head()
```

```
<IPython.core.display.HTML object>

Saving Global_Superstore2.csv to Global_Superstore2 (1).csv
```

```
[ ]:   Row ID         Order ID  Order Date   Ship Date     Ship Mode Customer ID  \
     0  32298   CA-2012-124891  31-07-2012  31-07-2012      Same Day    RH-19495
     1  26341    IN-2013-77878  05-02-2013  07-02-2013  Second Class    JR-16210
     2  25330    IN-2013-71249  17-10-2013  18-10-2013   First Class    CR-12730
     3  13524  ES-2013-1579342  28-01-2013  30-01-2013   First Class    KM-16375
     4  47221     SG-2013-4320  05-11-2013  06-11-2013      Same Day     RH-9495

          Customer Name      Segment           City            State  …  \
     0       Rick Hansen     Consumer  New York City         New York  …
     1     Justin Ritter    Corporate     Wollongong  New South Wales  …
     2      Craig Reiter     Consumer       Brisbane       Queensland  …
     3  Katherine Murray  Home Office         Berlin           Berlin  …
     4       Rick Hansen     Consumer          Dakar            Dakar  …

             Product ID    Category Sub-Category  \
     0  TEC-AC-10003033  Technology  Accessories
     1  FUR-CH-10003950   Furniture       Chairs
     2  TEC-PH-10004664  Technology       Phones
     3  TEC-PH-10004583  Technology       Phones
     4 TEC-SHA-10000501  Technology      Copiers

                                          Product Name     Sales Quantity  \
     0  Plantronics CS510 - Over-the-Head monaural Wir…  2309.650        7
     1          Novimex Executive Leather Armchair, Black  3709.395        9
     2                 Nokia Smart Phone, with Caller ID  5175.171        9
     3                    Motorola Smart Phone, Cordless  2892.510        5
     4                    Sharp Wireless Fax, High-Speed  2832.960        8

       Discount    Profit  Shipping Cost Order Priority
     0      0.0  762.1845         933.57       Critical
     1      0.1 -288.7650         923.63       Critical
```

```
2      0.1  919.9710         915.49         Medium
3      0.1  -96.5400         910.16         Medium
4      0.0  311.5200         903.04       Critical

[5 rows x 24 columns]
```

```
[ ]: # Basic dataset overview
     print("Shape:", df.shape)
     print("Columns:", df.columns.tolist())
     df.info()
     df.describe(include="all").transpose()
```

```
Shape: (51290, 25)
Columns: ['row_id', 'order_id', 'order_date', 'ship_date', 'ship_mode',
'customer_id', 'customer_name', 'segment', 'city', 'state', 'country',
'postal_code', 'market', 'region', 'product_id', 'category', 'sub-category',
'product_name', 'sales', 'quantity', 'discount', 'profit', 'shipping_cost',
'order_priority', 'month']
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 51290 entries, 0 to 51289
Data columns (total 25 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   row_id          51290 non-null  int64
 1   order_id        51290 non-null  object
 2   order_date      51290 non-null  datetime64[ns]
 3   ship_date       51290 non-null  datetime64[ns]
 4   ship_mode       51290 non-null  object
 5   customer_id     51290 non-null  object
 6   customer_name   51290 non-null  object
 7   segment         51290 non-null  object
 8   city            51290 non-null  object
 9   state           51290 non-null  object
 10  country         51290 non-null  object
 11  postal_code     9994 non-null   float64
 12  market          51290 non-null  object
 13  region          51290 non-null  object
 14  product_id      51290 non-null  object
 15  category        51290 non-null  object
 16  sub-category    51290 non-null  object
 17  product_name    51290 non-null  object
 18  sales           51290 non-null  float64
 19  quantity        51290 non-null  int64
 20  discount        51290 non-null  float64
 21  profit          51290 non-null  float64
 22  shipping_cost   51290 non-null  float64
 23  order_priority  51290 non-null  object
 24  month           51290 non-null  period[M]
dtypes: datetime64[ns](2), float64(5), int64(2), object(15), period[M](1)
memory usage: 9.8+ MB
```

[ ]:
```
                 count unique             top   freq  \
row_id         51290.0    NaN             NaN    NaN
order_id         51290  25035   CA-2014-100111     14
order_date       51290    NaN             NaN    NaN
ship_date        51290    NaN             NaN    NaN
ship_mode        51290      4  Standard Class  30775
customer_id      51290   1590        PO-18850     97
customer_name    51290    795 Muhammed Yedwab    108
segment          51290      3        Consumer  26518
city             51290   3636   New York City    915
state            51290   1094      California   2001
country          51290    147   United States   9994
postal_code     9994.0    NaN             NaN    NaN
market           51290      7            APAC  11002
region           51290     13         Central  11117
product_id       51290  10292 OFF-AR-10003651     35
category         51290      3 Office Supplies  31273
sub-category     51290     17         Binders   6152
product_name     51290   3788         Staples    227
sales          51290.0    NaN             NaN    NaN
quantity       51290.0    NaN             NaN    NaN
discount       51290.0    NaN             NaN    NaN
profit         51290.0    NaN             NaN    NaN
shipping_cost  51290.0    NaN             NaN    NaN
order_priority   51290      4          Medium  29433
month            51290     48         2014-12   2153

                                        mean                  min  \
row_id                               25645.5                  1.0
order_id                                 NaN                  NaN
order_date     2013-05-11 21:26:49.155781120  2011-01-01 00:00:00
ship_date      2013-05-15 20:42:42.745174528  2011-01-03 00:00:00
ship_mode                                NaN                  NaN
customer_id                              NaN                  NaN
customer_name                            NaN                  NaN
segment                                  NaN                  NaN
city                                     NaN                  NaN
state                                    NaN                  NaN
country                                  NaN                  NaN
postal_code                     55190.379428               1040.0
market                                   NaN                  NaN
region                                   NaN                  NaN
product_id                               NaN                  NaN
```

```
category                          NaN                   NaN
sub-category                      NaN                   NaN
product_name                      NaN                   NaN
sales                      246.490581                 0.444
quantity                     3.476545                   1.0
discount                     0.142908                   0.0
profit                      28.610982             -6599.978
shipping_cost               26.375915                   0.0
order_priority                    NaN                   NaN
month                             NaN                   NaN

                               25%                    50%                    75%  \
row_id                    12823.25                25645.5               38467.75
order_id                       NaN                    NaN                    NaN
order_date     2012-06-19 00:00:00    2013-07-08 00:00:00    2014-05-22 00:00:00
ship_date      2012-06-23 00:00:00    2013-07-12 00:00:00    2014-05-26 00:00:00
ship_mode                      NaN                    NaN                    NaN
customer_id                    NaN                    NaN                    NaN
customer_name                  NaN                    NaN                    NaN
segment                        NaN                    NaN                    NaN
city                           NaN                    NaN                    NaN
state                          NaN                    NaN                    NaN
country                        NaN                    NaN                    NaN
postal_code                23223.0                56430.5                90008.0
market                         NaN                    NaN                    NaN
region                         NaN                    NaN                    NaN
product_id                     NaN                    NaN                    NaN
category                       NaN                    NaN                    NaN
sub-category                   NaN                    NaN                    NaN
product_name                   NaN                    NaN                    NaN
sales                    30.758625                 85.053               251.0532
quantity                       2.0                    3.0                    5.0
discount                       0.0                    0.0                    0.2
profit                         0.0                   9.24                  36.81
shipping_cost                 2.61                   7.79                  24.45
order_priority                 NaN                    NaN                    NaN
month                          NaN                    NaN                    NaN

                               max          std
row_id                     51290.0  14806.29199
order_id                       NaN          NaN
order_date     2014-12-31 00:00:00          NaN
ship_date      2015-01-07 00:00:00          NaN
ship_mode                      NaN          NaN
customer_id                    NaN          NaN
customer_name                  NaN          NaN
segment                        NaN          NaN
```

```
city                          NaN          NaN
state                         NaN          NaN
country                       NaN          NaN
postal_code               99301.0  32063.69335
market                        NaN          NaN
region                        NaN          NaN
product_id                    NaN          NaN
category                      NaN          NaN
sub-category                  NaN          NaN
product_name                  NaN          NaN
sales                    22638.48   487.565361
quantity                     14.0     2.278766
discount                     0.85      0.21228
profit                   8399.976   174.340972
shipping_cost              933.57    57.296804
order_priority                NaN          NaN
month                         NaN          NaN
```

[47]:
```
# Clean dataset
df = df.drop_duplicates()
df = df.dropna(how="all")
df = df.fillna({"sales": 0, "profit": 0, "discount": 0})
df.columns = df.columns.str.strip().str.lower().str.replace(" ", "_")

df['order_date'] = pd.to_datetime(df['order_date'], dayfirst=True,␣
  ↪errors="coerce")
df['ship_date'] = pd.to_datetime(df['ship_date'], dayfirst=True,␣
  ↪errors="coerce")

df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 51290 entries, 0 to 51289
Data columns (total 25 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   row_id          51290 non-null  int64
 1   order_id        51290 non-null  object
 2   order_date      51290 non-null  datetime64[ns]
 3   ship_date       51290 non-null  datetime64[ns]
 4   ship_mode       51290 non-null  object
 5   customer_id     51290 non-null  object
 6   customer_name   51290 non-null  object
 7   segment         51290 non-null  object
 8   city            51290 non-null  object
 9   state           51290 non-null  object
 10  country         51290 non-null  object
 11  postal_code     9994 non-null   float64
 12  market          51290 non-null  object
 13  region          51290 non-null  object
 14  product_id      51290 non-null  object
 15  category        51290 non-null  object
 16  sub-category    51290 non-null  object
 17  product_name    51290 non-null  object
 18  sales           51290 non-null  float64
 19  quantity        51290 non-null  int64
 20  discount        51290 non-null  float64
 21  profit          51290 non-null  float64
 22  shipping_cost   51290 non-null  float64
 23  order_priority  51290 non-null  object
 24  month           51290 non-null  object
dtypes: datetime64[ns](2), float64(5), int64(2), object(16)
memory usage: 9.8+ MB
```

1.6 EDA (Exploratory Data Analysis)

[ ]:
```python
# Step 3: Exploratory Data Analysis

# Summary statistics and missing values
df.describe().transpose()
df.isnull().sum()

# Check unique values for key categorical columns
categorical_cols = ['ship_mode','segment','city','state',
    'country','market','region','category','sub-category','order_priority']
for col in categorical_cols:
    print(col, ":", df[col].nunique())

# Correlation between numerical columns
df[['sales','profit','quantity','discount','shipping_cost']].corr()

# Top 10 products by sales
print("Top 10 products by sales:")
print(df.groupby('product_name')['sales']
      .sum().sort_values(ascending=False).head(10))

# Top 10 products by profit
print("\nTop 10 products by profit:")
print(df.groupby('product_name')['profit']
      .sum().sort_values(ascending=False).head(10))

# Sales and profit by category
df.groupby('category')[['sales','profit']].sum()
```

```python
# Monthly sales and profit trends
df['month'] = df['order_date'].dt.to_period('M')
df.groupby('month')[['sales','profit']].sum().head(12)
```

```
ship_mode : 4
segment : 3
city : 3636
state : 1094
country : 147
market : 7
region : 13
category : 3
sub-category : 17
order_priority : 4
Top 10 products by sales:
product_name
Apple Smart Phone, Full Size                              86935.7786
Cisco Smart Phone, Full Size                              76441.5306
Motorola Smart Phone, Full Size                           73156.3030
Nokia Smart Phone, Full Size                              71904.5555
Canon imageCLASS 2200 Advanced Copier                     61599.8240
Hon Executive Leather Armchair, Adjustable                58193.4841
Office Star Executive Leather Armchair, Adjustable        50661.6840
Harbour Creations Executive Leather Armchair, Adjustable  50121.5160
Samsung Smart Phone, Cordless                             48653.4600
Nokia Smart Phone, with Caller ID                         47877.7857
Name: sales, dtype: float64

Top 10 products by profit:
product_name
Canon imageCLASS 2200 Advanced Copier                     25199.9280
Cisco Smart Phone, Full Size                              17238.5206
Motorola Smart Phone, Full Size                           17027.1130
Hoover Stove, Red                                         11807.9690
Sauder Classic Bookcase, Traditional                      10672.0730
Harbour Creations Executive Leather Armchair, Adjustable  10427.3260
Nokia Smart Phone, Full Size                               9938.1955
Cisco Smart Phone, with Caller ID                          9786.6408
Nokia Smart Phone, with Caller ID                          9465.3257
Belkin Router, USB                                         8955.0180
Name: profit, dtype: float64
```

[ ]:

```
                sales       profit
month
2011-01   98898.48886   8321.80096
2011-02   91152.15698  12417.90698
2011-03  145729.36736  15303.56826
```

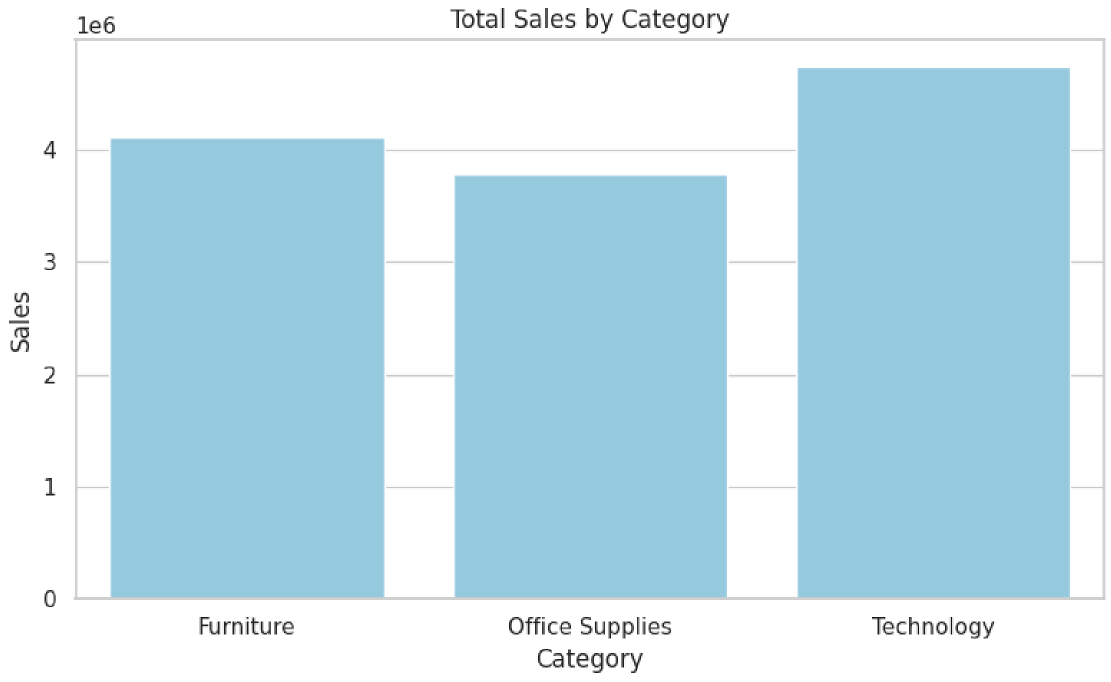
```
2011-04  116915.76418  12902.32438
2011-05  146747.83610  12183.82870
2011-06  215207.38022  23415.24702
2011-07  115510.41912   5585.00352
2011-08  207581.49122  23713.66772
2011-09  290214.45534  35776.88394
2011-10  199071.26404  25963.41834
2011-11  298496.53752  32709.17772
2011-12  333925.73460  40647.98400
```

1.7 Data Visualization

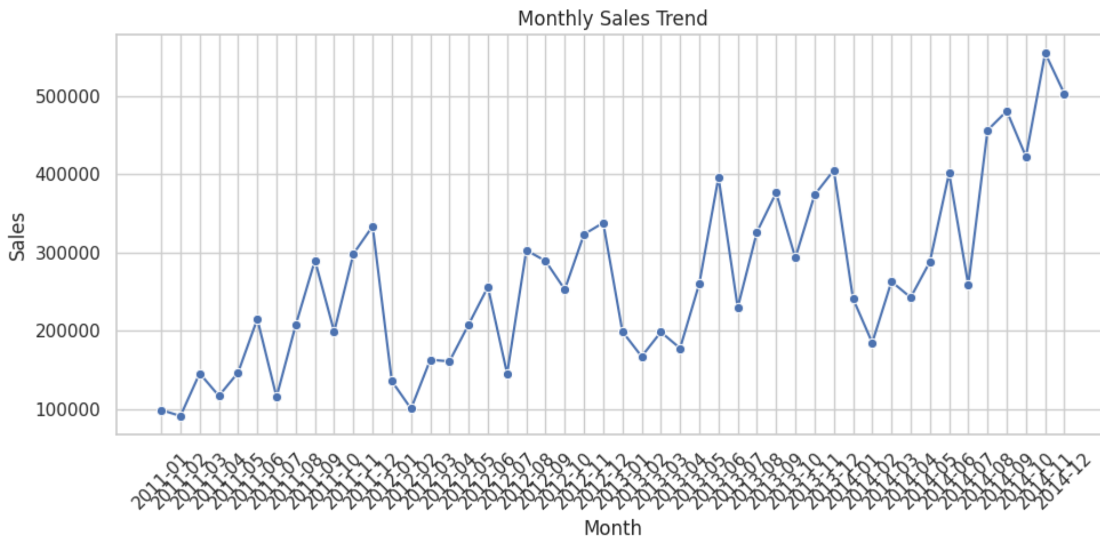
[ ]:
```python
# Step 4 : VISUALIZATIONS

import matplotlib.pyplot as plt
import seaborn as sns

sns.set(style="whitegrid")

# Total Sales by Category
print("Bar Chart: Total Sales by Category - shows which product categories␣
 ↪generate the most revenue.")
category_sales = df.groupby('category')['sales'].sum().reset_index()
plt.figure(figsize=(8,5))
sns.barplot(data=category_sales, x='category', y='sales', color='skyblue')
plt.title("Total Sales by Category")
plt.xlabel("Category")
plt.ylabel("Sales")
plt.tight_layout()  # layout adjustment before show
plt.show()

# Monthly Sales Trend
print("\nLine Chart: Monthly Sales Trend - visualizes how sales change over␣
 ↪time.")
df['month'] = df['order_date'].dt.to_period('M').astype(str)
monthly_sales = df.groupby('month')['sales'].sum().reset_index()
plt.figure(figsize=(10,5))
sns.lineplot(data=monthly_sales, x='month', y='sales', marker='o')
plt.title("Monthly Sales Trend")
plt.xlabel("Month")
plt.ylabel("Sales")
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()

# Sales Distribution by Segment
```

```
print("\nPie Chart: Sales Distribution by Segment - shows the proportion of␣
  ↪sales per customer segment.")
segment_sales = df.groupby('segment')['sales'].sum()
plt.figure(figsize=(6,6))
plt.pie(segment_sales, labels=segment_sales.index, autopct='%1.1f%%',␣
  ↪startangle=140, colors=sns.color_palette('pastel'))
plt.title("Sales Distribution by Segment")
plt.tight_layout()
plt.show()

# Correlation Heatmap
print("\nHeatmap: Correlation between numeric variables - shows relationships␣
  ↪between sales, profit, quantity, discount, and shipping cost.")
plt.figure(figsize=(8,6))
sns.heatmap(df[['sales','profit','discount','quantity','shipping_cost']].
  ↪corr(), annot=True, cmap='coolwarm', fmt=".2f")
plt.title("Correlation Heatmap")
plt.tight_layout()
plt.show()
```

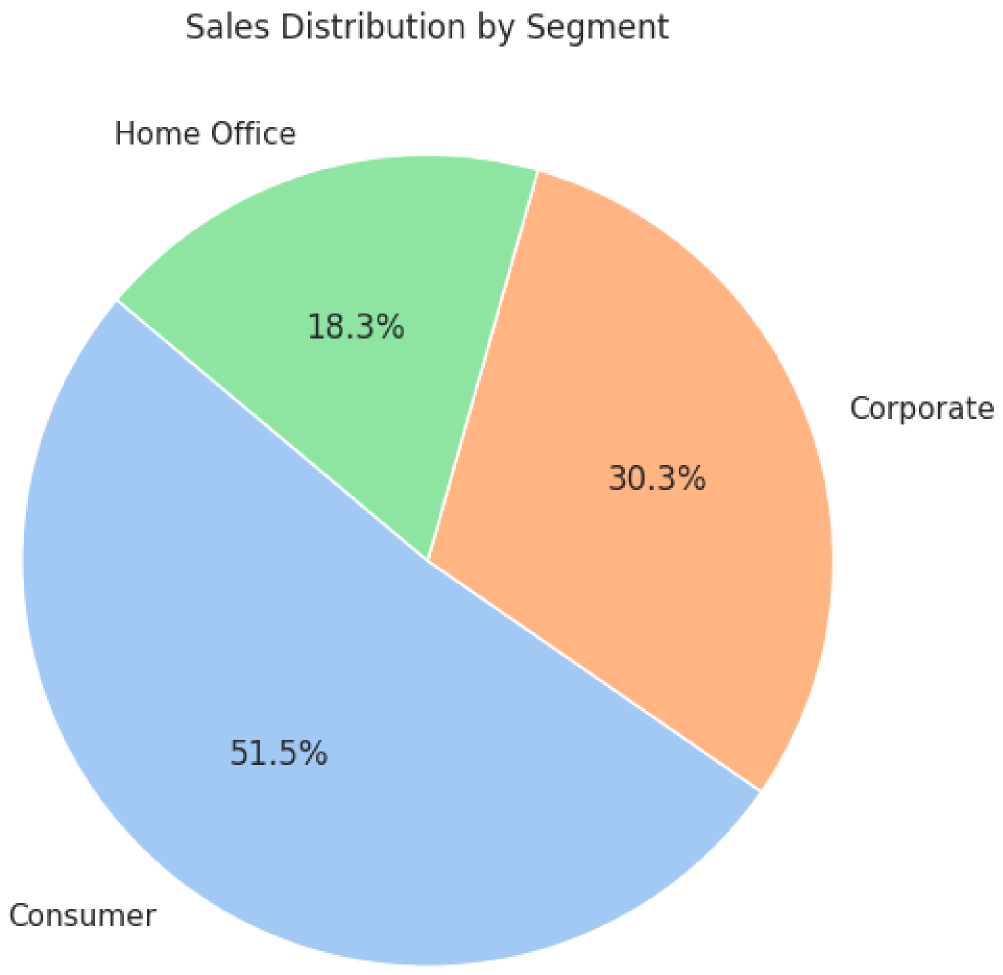
```
Bar Chart: Total Sales by Category - shows which product categories generate the
most revenue.
```



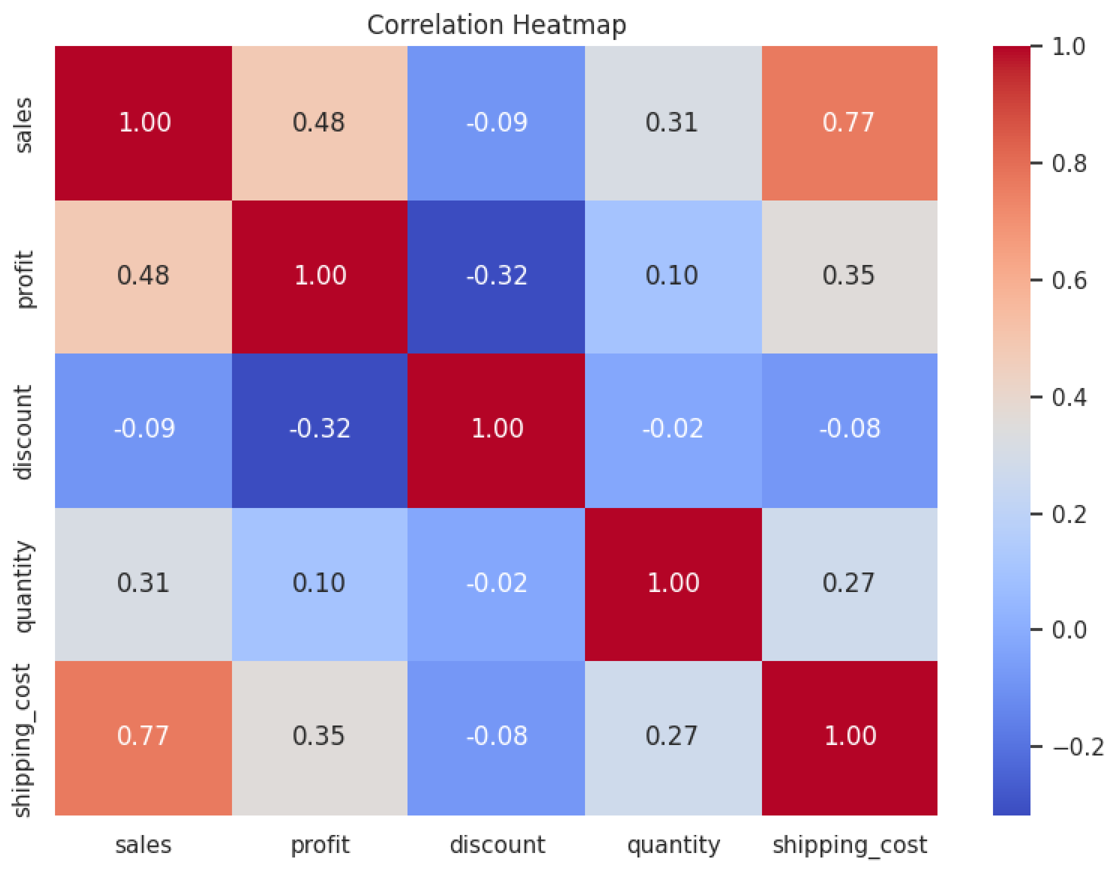
```
Line Chart: Monthly Sales Trend - visualizes how sales change over time.
```



Pie Chart: Sales Distribution by Segment - shows the proportion of sales per customer segment.



Heatmap: Correlation between numeric variables - shows relationships between sales, profit, quantity, discount, and shipping cost.



1.8 Dashboard Creation

This dashboard shows key insights from the Global Superstore dataset: - Total sales and profits by category - Monthly sales trends - Top products - Correlation heatmap

[ ]:
```
!pip install plotly

import plotly.express as px
import plotly.graph_objects as go
import pandas as pd
```

```
Requirement already satisfied: plotly in /usr/local/lib/python3.12/dist-packages
(5.24.1)
Requirement already satisfied: tenacity>=6.2.0 in
/usr/local/lib/python3.12/dist-packages (from plotly) (8.5.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.12/dist-
packages (from plotly) (25.0)
```

[ ]:
```
# Category Summary
```

```
category_summary = df.groupby('category')[['sales','profit']].sum().
↪reset_index()

# Interactive bar chart for sales
fig_sales = px.bar(category_summary,
                   x='category',
                   y='sales',
                   title='Total Sales by Category',
                   labels={'sales':'Sales', 'category':'Category'},
                   color='sales', color_continuous_scale='Blues')

fig_sales.show()

# Interactive bar chart for profit
fig_profit = px.bar(category_summary,
                    x='category',
                    y='profit',
                    title='Total Profit by Category',
                    labels={'profit':'Profit', 'category':'Category'},
                    color='profit', color_continuous_scale='Greens')

fig_profit.show()
```

Insight: Technology leads in sales, but Office Supplies shows stable profit across orders.

[ ]:
```
top_sales = df.groupby('product_name')
['sales'].sum().sort_values(ascending=False).head(10)
top_profit = df.groupby('product_name')
['profit'].sum().sort_values(ascending=False).head(10)

# Top Sales
fig_top_sales = px.bar(top_sales.reset_index(),
                       x='sales', y='product_name',
                       title='Top 10 Products by Sales',
                       orientation='h',
                       color='sales', color_continuous_scale='Blues')
fig_top_sales.show()

# Top Profit
fig_top_profit = px.bar(top_profit.reset_index(),
                        x='profit', y='product_name',
                        title='Top 10 Products by Profit',
                        orientation='h',
                        color='profit', color_continuous_scale='Greens')
fig_top_profit.show()
```

Insight: Sales and profit peak during holiday seasons; some months show negative profit due to discounts.

```
[ ]: df['month'] = df['order_date'].dt.to_period('M')
     monthly_sales = df.groupby('month')[['sales','profit']].sum().reset_index()
     monthly_sales['month'] = monthly_sales['month'].dt.to_timestamp()

     fig_trends = go.Figure()
     fig_trends.add_trace(go.Scatter(x=monthly_sales['month'],␣
      ↪y=monthly_sales['sales'],
                                     mode='lines+markers', name='Sales'))
     fig_trends.add_trace(go.Scatter(x=monthly_sales['month'],␣
      ↪y=monthly_sales['profit'],
                                     mode='lines+markers', name='Profit'))

     fig_trends.update_layout(title='Monthly Sales & Profit Trends',
                              xaxis_title='Month',
                              yaxis_title='Amount',
                              template='plotly_white')
     fig_trends.show()
```

Insight: Smartphones dominate sales, but high-end copiers generate the most profit.

```
[ ]: corr = df[['sales','profit','discount','quantity','shipping_cost']].corr()
     fig_heatmap = px.imshow(corr,
                             text_auto=True,
                             color_continuous_scale='RdBu_r',
                             title='Correlation Heatmap')
     fig_heatmap.show()
```

Insight: Sales and profit are strongly correlated, while discount has a slight negative effect on profit.

1.8.1 Conclusions

Key Insights:
- Technology leads in sales; Office Supplies maintain stable profit.
- Sales and profit peak during holidays; some months show negative profit due to discounts.
- Smartphones dominate sales, high-end copiers drive most profit.
- Sales and profit are strongly correlated; discounts slightly reduce profit.

Recommendations:
- Focus on high-performing categories and profitable products.
- Monitor discount strategies to protect profit margins.
- Plan inventory and marketing around seasonal peaks.