SALES DATA EDA PROJECT

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import datetime
```

```
df = pd.read_csv('/content/Superstore.csv', encoding='latin1')


print(f"Dataset shape: {df.shape}")
print(df.info())
```

```
Dataset shape: (9994, 21)
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9994 entries, 0 to 9993
Data columns (total 21 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   Row ID         9994 non-null   int64  
 1   Order ID       9994 non-null   object 
 2   Order Date     9994 non-null   object 
 3   Ship Date      9994 non-null   object 
 4   Ship Mode      9994 non-null   object 
 5   Customer ID    9994 non-null   object 
 6   Customer Name  9994 non-null   object 
 7   Segment        9994 non-null   object 
 8   Country        9994 non-null   object 
 9   City           9994 non-null   object 
 10  State          9994 non-null   object 
 11  Postal Code    9994 non-null   int64  
 12  Region         9994 non-null   object 
 13  Product ID     9994 non-null   object 
 14  Category       9994 non-null   object 
 15  Sub-Category   9994 non-null   object 
 16  Product Name   9994 non-null   object 
 17  Sales          9994 non-null   float64
 18  Quantity       9994 non-null   int64  
 19  Discount       9994 non-null   float64
 20  Profit         9994 non-null   float64
dtypes: float64(3), int64(3), object(15)
memory usage: 1.6+ MB
None
```

```
print(df.head())
```

```
   Row ID        Order ID  Order Date   Ship Date       Ship Mode Customer ID  \
0       1  CA-2016-152156  11-08-2016  11-11-2016    Second Class    CG-12520   
1       2  CA-2016-152156  11-08-2016  11-11-2016    Second Class    CG-12520   
2       3  CA-2016-138688  06-12-2016   6/16/2016    Second Class    DV-13045   
3       4  US-2015-108966  10-11-2015  10/18/2015  Standard Class    SO-20335   
4       5  US-2015-108966  10-11-2015  10/18/2015  Standard Class    SO-20335   

     Customer Name    Segment        Country             City  ...  \
0      Claire Gute   Consumer  United States        Henderson  ...   
1      Claire Gute   Consumer  United States        Henderson  ...   
2  Darrin Van Huff  Corporate  United States      Los Angeles  ...   
```

```
3   Sean O'Donnell   Consumer  United States  Fort Lauderdale  ...
4   Sean O'Donnell   Consumer  United States  Fort Lauderdale  ...

  Postal Code  Region       Product ID         Category Sub-Category  \
0       42420   South  FUR-BO-10001798        Furniture    Bookcases
1       42420   South  FUR-CH-10000454        Furniture       Chairs
2       90036    West  OFF-LA-10000240  Office Supplies       Labels
3       33311   South  FUR-TA-10000577        Furniture       Tables
4       33311   South  OFF-ST-10000760  Office Supplies      Storage

                                        Product Name     Sales  Quantity  \
0                  Bush Somerset Collection Bookcase  261.9600         2
1  Hon Deluxe Fabric Upholstered Stacking Chairs,...  731.9400         3
2  Self-Adhesive Address Labels for Typewriters b...   14.6200         2
3      Bretford CR4500 Series Slim Rectangular Table  957.5775         5
4                     Eldon Fold 'N Roll Cart System   22.3680         2

   Discount    Profit
0      0.00   41.9136
1      0.00  219.5820
2      0.00    6.8714
3      0.45 -383.0310
4      0.20    2.5164

[5 rows x 21 columns]
```

```
df.isnull().sum() # ZERO FOR EVERYTGING AS NO NULL VALUES
```

```
                0
       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   0
       Region   0
   Product ID   0
     Category   0
 Sub-Category   0
 Product Name   0
        Sales   0
     Quantity   0
     Discount   0
       Profit   0

dtype: int64
```

FOR DATA CLEANING - NUMERIC DATA : CHECK FOR NEGATIVES , ZEROS , OUTLIERS , ANOMLIES

DATA CONSISTENCY : SHIP DATE SHOULD BE AFTER ORDER DATE , SPACING ISSUES , INVALID POSTAL CODES (HERE)

-IF MISSING VALUES PRESENT- Handle Missing Data

Example: drop rows with any missing values

df = df.dropna() ......dropna(axis=1) - COLUMNS NOT RECOMMENDED IF IMP VALUES R PRESENT

Updated_df = df.dropna(axis=0) - ROWS ARE DELETED

Or you can fill missing data: IMPUTATIONS - MEAN , MEDIAN , MODE

Updated_df = Updated_df['columnname'].fillna(df['name'].mean())

df['Sales'] = df['Sales'].fillna(0)

-Fix Data Types (especially dates)

```
print(df.columns)
```

```
Index(['Row ID', 'Order ID', 'Order Date', 'Ship Date', 'Ship Mode',
       'Customer ID', 'Customer Name', 'Segment', 'Country', 'City', 'State',
       'Postal Code', 'Region', 'Product ID', 'Category', 'Sub-Category',
       'Product Name', 'Sales', 'Quantity', 'Discount', 'Profit'],
      dtype='object')
```

```
# Convert to datetime (handles mixed formats automatically)
df['Order Date'] = pd.to_datetime(df['Order Date'], format='mixed')
df['Ship Date'] = pd.to_datetime(df['Ship Date'], format='mixed')

# Convert to YYYY-MM-DD string format
df['Order Date'] = df['Order Date'].dt.strftime('%Y-%m-%d')
df['Ship Date'] = df['Ship Date'].dt.strftime('%Y-%m-%d')
```

```
df['Order Date'].head(50)
#df['Order Date'].isnull().sum() - TO COUNT NULL VALUES IF ANY
```

```
    Order Date
0   2016-11-08
1   2016-11-08
2   2016-06-12
3   2015-10-11
4   2015-10-11
5   2014-06-09
6   2014-06-09
7   2014-06-09
8   2014-06-09
9   2014-06-09
10  2014-06-09
11  2014-06-09
12  2017-04-15
13  2016-12-05
14  2015-11-22
15  2015-11-22
```

```
df['Ship Date'].head(15)
```

```
    Ship Date
0   2016-11-11
1   2016-11-11
2   2016-06-16
3   2015-10-18
4   2015-10-18
5   2014-06-14
6   2014-06-14
7   2014-06-14
8   2014-06-14
9   2014-06-14
10  2014-06-14
11  2014-06-14
12  2017-04-20
13  2016-12-10
14  2015-11-26

dtype: object
```

```
17  2014-05-13
19  2014-08-27
21  2016-12-09
23  2017-07-16
25  2016-01-16
27  2015-09-17
29  2015-09-17
31  2015-09-17
33  2015-09-17
34  2017-10-19
```

```
# Duplicate Rows
print(" DUPLICATE ROWS:")
duplicates = df.duplicated().sum()
print(f"Total duplicate rows: {duplicates}")
```

```
 DUPLICATE ROWS:
Total duplicate rows: 0
```

```
# Unique Values Check
print("UNIQUE VALUES (Categorical Columns):")
categorical_cols = ['Ship Mode', 'Segment', 'Country', 'Region', 'Category', 'Sub-Category']
for col in categorical_cols:
    print(f"{col}: {df[col].nunique()} unique values")
    print(f"  Values: {df[col].unique().tolist()}")
    print()
```

```
UNIQUE VALUES (Categorical Columns):
Ship Mode: 4 unique values
  Values: ['Second Class', 'Standard Class', 'First Class', 'Same Day']

Segment: 3 unique values
  Values: ['Consumer', 'Corporate', 'Home Office']

Country: 1 unique values
  Values: ['United States']

Region: 4 unique values
  Values: ['South', 'West', 'Central', 'East']

Category: 3 unique values
  Values: ['Furniture', 'Office Supplies', 'Technology']

Sub-Category: 17 unique values
  Values: ['Bookcases', 'Chairs', 'Labels', 'Tables', 'Storage', 'Furnishings', 'Art', 'Phones', 'Binders', 'Appliances', 'Paper', 'Accessories', 'Envelopes', 'Fasteners', 'Supplies', 'Machin
```

```
# Checking numerical columns for anomalies

# Numerical Columns Analysis
print(" NUMERICAL COLUMNS - STATISTICS & ANOMALIES:")

numerical_cols = ['Sales', 'Quantity', 'Discount', 'Profit']

for col in numerical_cols:
    print(f"\n{col.upper()}:")
    print(df[col].describe())

    # Check for negative values
    if col in ['Sales', 'Quantity']:
        negatives = (df[col] < 0).sum()
        if negatives > 0:
            print(f"  WARNING: {negatives} negative values found!")

    # Check for zeros
    zeros = (df[col] == 0).sum()
    print(f"Zero values: {zeros} ({zeros/len(df)*100:.2f}%)")
```

```
 NUMERICAL COLUMNS - STATISTICS & ANOMALIES:

SALES:
count     9994.000000
mean       229.858001
std        623.245101
min          0.444000
25%         17.280000
50%         54.490000
75%        209.940000
max      22638.480000
Name: Sales, dtype: float64
Zero values: 0 (0.00%)

QUANTITY:
count    9994.000000
mean        3.789574
std         2.225110
min         1.000000
25%         2.000000
50%         3.000000
75%         5.000000
max        14.000000
Name: Quantity, dtype: float64
Zero values: 0 (0.00%)

DISCOUNT:
count    9994.000000
mean        0.156203
std         0.206452
min         0.000000
25%         0.000000
50%         0.200000
75%         0.200000
max         0.800000
Name: Discount, dtype: float64
Zero values: 4798 (48.01%)

PROFIT:
count    9994.000000
mean       28.656896
std       234.260108
min     -6599.978000
25%         1.728750
50%         8.666500
75%        29.364000
max      8399.976000
Name: Profit, dtype: float64
Zero values: 65 (0.65%)
```

```
# Data Consistency Checks
# Check if Ship Date is after Order Date
df_temp = df.copy()
df_temp['Order Date'] = pd.to_datetime(df_temp['Order Date'], format='mixed')
df_temp['Ship Date'] = pd.to_datetime(df_temp['Ship Date'], format='mixed')

invalid_dates = (df_temp['Ship Date'] < df_temp['Order Date']).sum()
print(f"\nShip dates before order dates: {invalid_dates}")

# Calculate shipping time
df_temp['Shipping_Days'] = (df_temp['Ship Date'] - df_temp['Order Date']).dt.days
```

```python
print(f"\nShipping Time Statistics:")
print(df_temp['Shipping_Days'].describe())
print(f"Same day shipping: {(df_temp['Shipping_Days'] == 0).sum()} orders")
```

```
Ship dates before order dates: 0

Shipping Time Statistics:
count    9994.000000
mean        3.958175
std         1.747567
min         0.000000
25%         3.000000
50%         4.000000
75%         5.000000
max         7.000000
Name: Shipping_Days, dtype: float64
Same day shipping: 519 orders
```

```python
# Check for leading/trailing spaces
text_cols = ['Customer Name', 'City', 'State', 'Product Name']
for col in text_cols:
    spaces = (df[col].str.strip() != df[col]).sum()
    if spaces > 0:
        print(f"{col}: {spaces} entries with leading/trailing spaces")
    else:
        print(f"{col}: No spacing issues")
```

```
Customer Name: No spacing issues
City: No spacing issues
State: No spacing issues
Product Name: 16 entries with leading/trailing spaces
```

CREATING CLEANED DATASET

Dates standardized to YYYY-MM-DD format

Product names trimmed (16 entries fixed)

Added 7 new derived columns:

- Shipping_Days
- Order_Year, Order_Month, Order_Quarter
- Order_Day_of_Week")
- Profit_Margin (%)
- Is_Profitable (boolean)

```python
# Creating cleaned dataset

df_cleaned = df.copy()

# Fix dates by converting to datetime objects
df_cleaned['Order Date'] = pd.to_datetime(df_cleaned['Order Date'], format='mixed')
df_cleaned['Ship Date'] = pd.to_datetime(df_cleaned['Ship Date'], format='mixed')
```

```
#  Strip whitespace from Product Name
df_cleaned['Product Name'] = df_cleaned['Product Name'].str.strip()

# Add useful derived columns (these require datetime objects)
df_cleaned['Shipping_Days'] = (df_cleaned['Ship Date'] - df_cleaned['Order Date']).dt.days
df_cleaned['Order_Year'] = df_cleaned['Order Date'].dt.year
df_cleaned['Order_Month'] = df_cleaned['Order Date'].dt.month
df_cleaned['Order_Quarter'] = df_cleaned['Order Date'].dt.quarter
df_cleaned['Order_Day_of_Week'] = df_cleaned['Order Date'].dt.day_name()
df_cleaned['Profit_Margin'] = (df_cleaned['Profit'] / df_cleaned['Sales']) * 100
df_cleaned['Is_Profitable'] = df_cleaned['Profit'] > 0

# Convert dates back to string for storage
df_cleaned['Order Date'] = df_cleaned['Order Date'].dt.strftime('%Y-%m-%d')
df_cleaned['Ship Date'] = df_cleaned['Ship Date'].dt.strftime('%Y-%m-%d')
```

```
print(f"Final dataset shape: {df_cleaned.shape}")
print(f"Columns: {df_cleaned.shape[1]}")
```

```
Final dataset shape: (9994, 28)
Columns: 28
```

```
df_cleaned.to_csv('/content/Superstore_FullyCleaned.csv.gz', index=False, compression='gzip')
print("\nCleaned dataset saved!")
```

```

Cleaned dataset saved!
```

```
df_cleaned.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9994 entries, 0 to 9993
Data columns (total 28 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Row ID             9994 non-null   int64  
 1   Order ID           9994 non-null   object 
 2   Order Date         9994 non-null   object 
 3   Ship Date          9994 non-null   object 
 4   Ship Mode          9994 non-null   object 
 5   Customer ID        9994 non-null   object 
 6   Customer Name      9994 non-null   object 
 7   Segment            9994 non-null   object 
 8   Country            9994 non-null   object 
 9   City               9994 non-null   object 
 10  State              9994 non-null   object 
 11  Postal Code        9994 non-null   int64  
 12  Region             9994 non-null   object 
 13  Product ID         9994 non-null   object 
 14  Category           9994 non-null   object 
 15  Sub-Category       9994 non-null   object 
 16  Product Name       9994 non-null   object 
 17  Sales              9994 non-null   float64
 18  Quantity           9994 non-null   int64  
 19  Discount           9994 non-null   float64
 20  Profit             9994 non-null   float64
 21  Shipping_Days      9994 non-null   int64  
 22  Order_Year         9994 non-null   int32
 23  Order_Month        9994 non-null   int32
 24  Order_Quarter      9994 non-null   int32
 25  Order_Day_of_Week  9994 non-null   object
 26  Profit_Margin      9994 non-null   float64
 27  Is_Profitable      9994 non-null   bool
dtypes: bool(1), float64(4), int32(3), int64(4), object(16)
memory usage: 2.0+ MB
```

```
df_cleaned.describe().round(2)
```

	Row ID	Postal Code	Sales	Quantity	Discount	Profit	Shipping_Days	Order_Year	Order_Month	Order_Quarter	Profit_Margin
count	9994.00	9994.00	9994.00	9994.00	9994.00	9994.00	9994.00	9994.00	9994.00	9994.00	9994.00
mean	4997.50	55190.38	229.86	3.79	0.16	28.66	3.96	2015.72	7.81	2.88	12.03
std	2885.16	32063.69	623.25	2.23	0.21	234.26	1.75	1.12	3.28	1.06	46.68
min	1.00	1040.00	0.44	1.00	0.00	-6599.98	0.00	2014.00	1.00	1.00	-275.00
25%	2499.25	23223.00	17.28	2.00	0.00	1.73	3.00	2015.00	5.00	2.00	7.50
50%	4997.50	56430.50	54.49	3.00	0.20	8.67	4.00	2016.00	9.00	3.00	27.00
75%	7495.75	90008.00	209.94	5.00	0.20	29.36	5.00	2017.00	11.00	4.00	36.25
max	9994.00	99301.00	22638.48	14.00	0.80	8399.98	7.00	2017.00	12.00	4.00	50.00

```
print("BASIC AGGREGATIONS & RANKINGS")
```

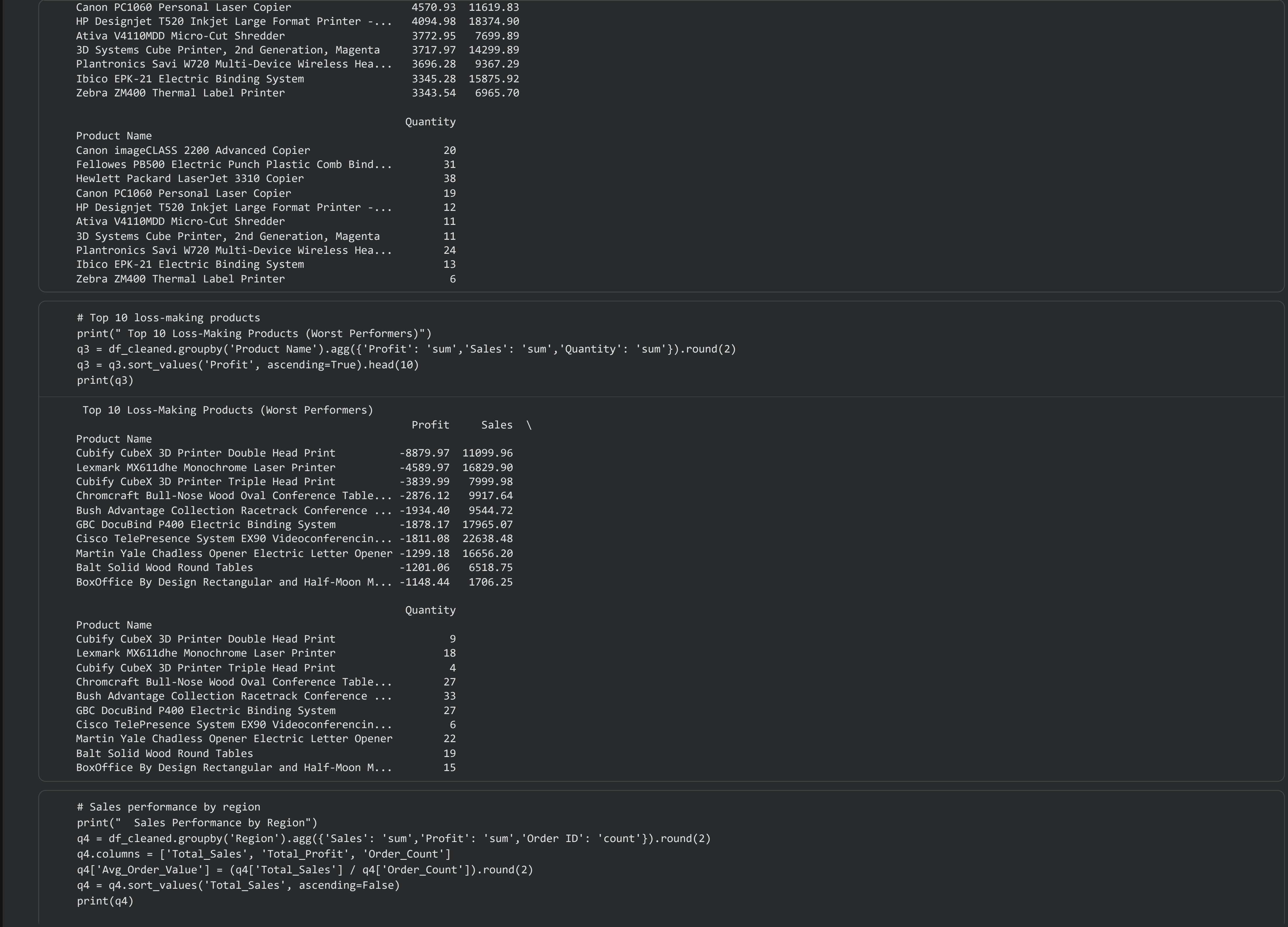
```
BASIC AGGREGATIONS & RANKINGS
```

```
# What are the total sales and profit by category
print("Total Sales and Profit by Category")
q1 = df_cleaned.groupby('Category').agg({'Sales': 'sum','Profit': 'sum','Order ID': 'count'}).round(2)
q1.columns = ['Total_Sales', 'Total_Profit', 'Order_Count']
q1['Profit_Margin_%'] = ((q1['Total_Profit'] / q1['Total_Sales']) * 100).round(2)
q1 = q1.sort_values('Total_Sales', ascending=False)
print(q1)
```

```
Total Sales and Profit by Category
                 Total_Sales  Total_Profit  Order_Count  Profit_Margin_%
Category
Technology         836154.03     145454.95         1847            17.40
Furniture          741999.80      18451.27         2121             2.49
Office Supplies    719047.03     122490.80         6026            17.04
```

```
# Top 10 most profitable products
print(" Top 10 Most Profitable Products")
q2 = df_cleaned.groupby('Product Name').agg({'Profit': 'sum','Sales': 'sum','Quantity': 'sum'}).round(2)
q2 = q2.sort_values('Profit', ascending=False).head(10)
print(q2)
```

```
 Top 10 Most Profitable Products
                                                 Profit     Sales  \
Product Name
Canon imageCLASS 2200 Advanced Copier          25199.93  61599.82
Fellowes PB500 Electric Punch Plastic Comb Bind...   7753.04  27453.38
Hewlett Packard LaserJet 3310 Copier            6983.88  18839.69
```



```
Canon PC1060 Personal Laser Copier                4570.93  11619.83
HP Designjet T520 Inkjet Large Format Printer -...   4094.98  18374.90
Ativa V4110MDD Micro-Cut Shredder                 3772.95   7699.89
3D Systems Cube Printer, 2nd Generation, Magenta  3717.97  14299.89
Plantronics Savi W720 Multi-Device Wireless Hea...   3696.28   9367.29
Ibico EPK-21 Electric Binding System              3345.28  15875.92
Zebra ZM400 Thermal Label Printer                 3343.54   6965.70

                                                 Quantity
Product Name
Canon imageCLASS 2200 Advanced Copier                  20
Fellowes PB500 Electric Punch Plastic Comb Bind...        31
Hewlett Packard LaserJet 3310 Copier                   38
Canon PC1060 Personal Laser Copier                     19
HP Designjet T520 Inkjet Large Format Printer -...        12
Ativa V4110MDD Micro-Cut Shredder                      11
3D Systems Cube Printer, 2nd Generation, Magenta       11
Plantronics Savi W720 Multi-Device Wireless Hea...        24
Ibico EPK-21 Electric Binding System                   13
Zebra ZM400 Thermal Label Printer                       6
```

```
# Top 10 loss-making products
print(" Top 10 Loss-Making Products (Worst Performers)")
q3 = df_cleaned.groupby('Product Name').agg({'Profit': 'sum','Sales': 'sum','Quantity': 'sum'}).round(2)
q3 = q3.sort_values('Profit', ascending=True).head(10)
print(q3)
```

```
 Top 10 Loss-Making Products (Worst Performers)
                                                    Profit     Sales  \
Product Name
Cubify CubeX 3D Printer Double Head Print          -8879.97  11099.96
Lexmark MX611dhe Monochrome Laser Printer          -4589.97  16829.90
Cubify CubeX 3D Printer Triple Head Print          -3839.99   7999.98
Chromcraft Bull-Nose Wood Oval Conference Table... -2876.12   9917.64
Bush Advantage Collection Racetrack Conference ... -1934.40   9544.72
GBC DocuBind P400 Electric Binding System          -1878.17  17965.07
Cisco TelePresence System EX90 Videoconferencin... -1811.08  22638.48
Martin Yale Chadless Opener Electric Letter Opener -1299.18  16656.20
Balt Solid Wood Round Tables                       -1201.06   6518.75
BoxOffice By Design Rectangular and Half-Moon M... -1148.44   1706.25

                                                   Quantity
Product Name
Cubify CubeX 3D Printer Double Head Print                 9
Lexmark MX611dhe Monochrome Laser Printer                18
Cubify CubeX 3D Printer Triple Head Print                 4
Chromcraft Bull-Nose Wood Oval Conference Table...       27
Bush Advantage Collection Racetrack Conference ...       33
GBC DocuBind P400 Electric Binding System                27
Cisco TelePresence System EX90 Videoconferencin...        6
Martin Yale Chadless Opener Electric Letter Opener       22
Balt Solid Wood Round Tables                             19
BoxOffice By Design Rectangular and Half-Moon M...       15
```

```
# Sales performance by region
print("  Sales Performance by Region")
q4 = df_cleaned.groupby('Region').agg({'Sales': 'sum','Profit': 'sum','Order ID': 'count'}).round(2)
q4.columns = ['Total_Sales', 'Total_Profit', 'Order_Count']
q4['Avg_Order_Value'] = (q4['Total_Sales'] / q4['Order_Count']).round(2)
q4 = q4.sort_values('Total_Sales', ascending=False)
print(q4)
```

```
  Sales Performance by Region
         Total_Sales  Total_Profit  Order_Count  Avg_Order_Value
Region
West       725457.82     108418.45         3203           226.49
East       678781.24      91522.78         2848           238.34
Central    501239.89      39706.36         2323           215.77
South      391721.90      46749.43         1620           241.80
```

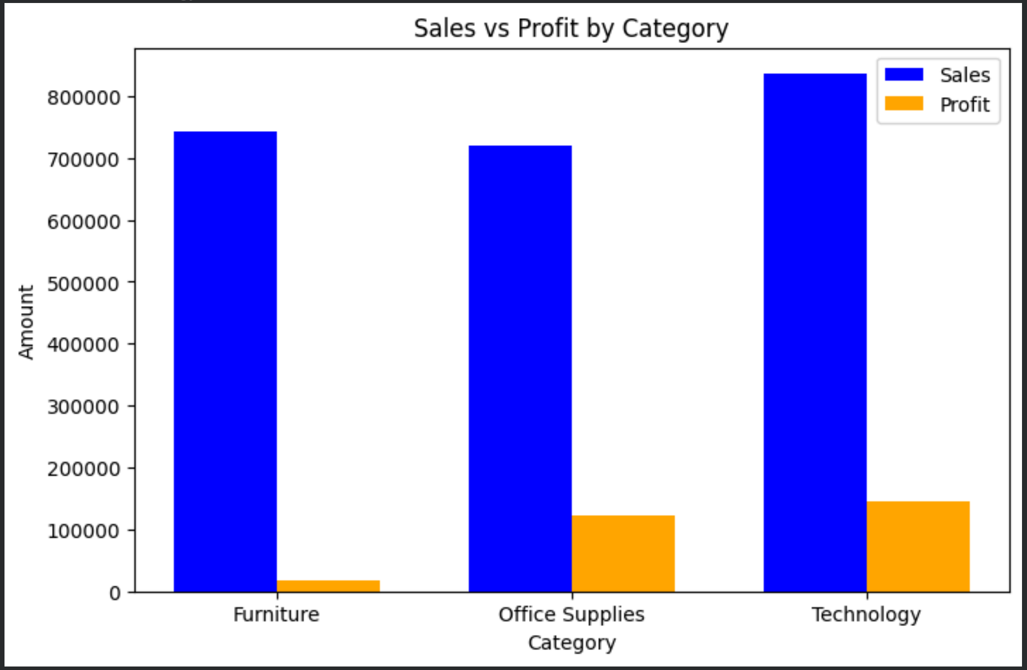
```
#  Monthly sales trend
print("Monthly Sales Trend (2014-2017)")

# Convert df_cleaned['Order Date'] back to datetime objects for time-series operations
df_cleaned['Order Date'] = pd.to_datetime(df_cleaned['Order Date'], format='%Y-%m-%d')
df_cleaned['Year_Month'] = df_cleaned['Order Date'].dt.to_period('M')
q6 = df_cleaned.groupby('Year_Month').agg({'Sales': 'sum','Profit': 'sum','Order ID': 'count'}).round(2)
q6.columns = ['Total_Sales', 'Total_Profit', 'Order_Count']
print(q6.tail(12))  # Last 12 months
```

```
Monthly Sales Trend (2014-2017)
            Total_Sales  Total_Profit  Order_Count
Year_Month
2017-01        43971.37       7140.44          155
2017-02        20301.13       1613.87          107
2017-03        58872.35      14751.89          238
2017-04        36521.54        933.29          203
2017-05        44261.11       6342.58          242
2017-06        52981.73       8223.34          245
2017-07        45264.42       6952.62          226
2017-08        63120.89       9040.96          218
2017-09        87866.65      10991.56          459
2017-10        77776.92       9275.28          298
2017-11       118447.82       9690.10          459
2017-12        83829.32       8483.35          462
```

```
#  Bar Chart - Sales & Profit by Category
print(" Category Sales & Profit Analysis")

# Calculate totals
category_data = df_cleaned.groupby('Category').agg({'Sales':'sum', 'Profit':'sum'}).reset_index()
print(category_data)

# Simple bar chart
plt.figure(figsize=(8,5))
x = range(len(category_data))
width = 0.35

plt.bar([i - width/2 for i in x], category_data['Sales'], width, label='Sales', color='blue')
plt.bar([i + width/2 for i in x], category_data['Profit'], width, label='Profit', color='orange')

plt.xlabel('Category')
plt.ylabel('Amount')
plt.title('Sales vs Profit by Category')
plt.xticks(x, category_data['Category'])
plt.legend()
plt.show()

#  which is highest
```

```
highest_sales = category_data.loc[category_data['Sales'].idxmax()]
print(f"\nHighest sales: {highest_sales['Category']} = {highest_sales['Sales']:.0f}")
```

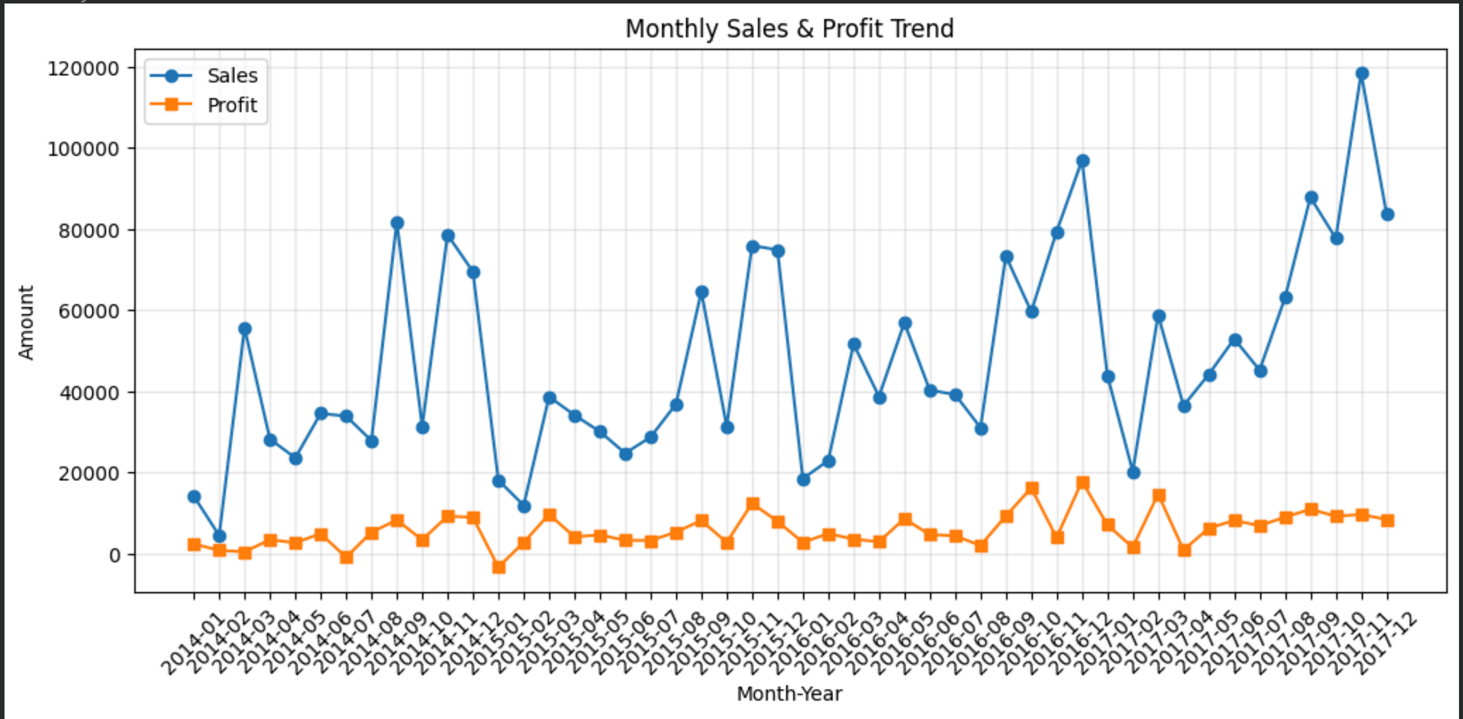
```
 Category Sales & Profit Analysis
          Category        Sales        Profit
0        Furniture  741999.7953   18451.2728
1  Office Supplies  719047.0320  122490.8008
2       Technology  836154.0330  145454.9481
```



```
Highest sales: Technology = 836154
```

```
#  Line Chart - Monthly Sales Trend
print(" Monthly Sales Trend")

df_cleaned['Order Date'] = pd.to_datetime(df_cleaned['Order Date'], format='%Y-%m-%d')

# Group by month using df_cleaned
df_cleaned['YearMonth'] = df_cleaned['Order Date'].dt.strftime('%Y-%m')
monthly_data = df_cleaned.groupby('YearMonth').agg({'Sales':'sum', 'Profit':'sum'}).reset_index()

#line chart
plt.figure(figsize=(12,5))
plt.plot(monthly_data['YearMonth'], monthly_data['Sales'], marker='o', label='Sales')
plt.plot(monthly_data['YearMonth'], monthly_data['Profit'], marker='s', label='Profit')

plt.xlabel('Month-Year')
plt.ylabel('Amount')
plt.title('Monthly Sales & Profit Trend')
plt.xticks(rotation=45)
plt.legend()
plt.grid(True, alpha=0.3)
plt.show()

print(f"Data from {monthly_data['YearMonth'].iloc[0]} to {monthly_data['YearMonth'].iloc[-1]}")
```

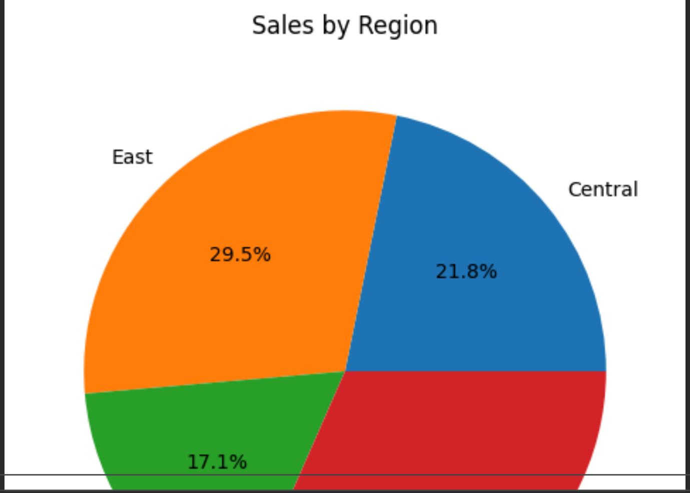
```
Monthly Sales Trend
```



```
Data from 2014-01 to 2017-12
```

```python
#  Pie Chart - Regional Sales Distribution
print(" Regional Sales Distribution")

# Calculate regional sales
region_data = df_cleaned.groupby('Region')['Sales'].sum().reset_index()

# Simple pie chart
plt.figure(figsize=(8,6))
plt.pie(region_data['Sales'], labels=region_data['Region'], autopct='%1.1f%%')
plt.title('Sales by Region')
plt.show()

#  numbers
for index, row in region_data.iterrows():
    print(f"{row['Region']}: {row['Sales']:.0f} ({row['Sales']/region_data['Sales'].sum()*100:.1f}%)")
```

```
Regional Sales Distribution
```



```python
#  Horizontal Bar - Top 10 Sub-Categories
print("Top 10 Sub-Categories by Profit")

# top 10 profitable sub-categories
subcat_data = df_cleaned.groupby('Sub-Category')['Profit'].sum().sort_values(ascending=True).tail(10)

# Simple horizontal bar
plt.figure(figsize=(10,6))
plt.barh(subcat_data.index, subcat_data.values, color='green')
plt.xlabel('Profit')
plt.title('Top 10 Most Profitable Sub-Categories')
plt.show()
```