EDA

November 3, 2024

1 EDA and Data Cleaning

Basic Data Summaries

[309]:
```
import pandas as pd

superstore = pd.read_csv('Sample - Superstore.csv', encoding='ISO-8859-1')

# get a summary of the dataset to check column types and non-null counts
print(superstore.info())

# check basic statistics for numerical columns
print(superstore.describe())

# check for unique values in categorical columns like 'Segment' and 'Category'
print(superstore['Segment'].value_counts())
print(superstore['Category'].value_counts())

# check for missing values
print(superstore.isnull().sum())
```

```
<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
            Row ID   Postal Code         Sales     Quantity     Discount  \
count  9994.000000   9994.000000   9994.000000  9994.000000  9994.000000
mean   4997.500000  55190.379428    229.858001     3.789574     0.156203
std    2885.163629  32063.693350    623.245101     2.225110     0.206452
min       1.000000   1040.000000      0.444000     1.000000     0.000000
25%    2499.250000  23223.000000     17.280000     2.000000     0.000000
50%    4997.500000  56430.500000     54.490000     3.000000     0.200000
75%    7495.750000  90008.000000    209.940000     5.000000     0.200000
max    9994.000000  99301.000000  22638.480000    14.000000     0.800000

            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
Segment
Consumer       5191
Corporate      3020
Home Office    1783
Name: count, dtype: int64
Category
Office Supplies    6026
Furniture          2121
Technology         1847
Name: count, dtype: int64
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
```

[310]:
```python
# convert 'Order Date' and 'Ship Date' columns to datetime format
superstore['Order Date'] = pd.to_datetime(superstore['Order Date'])
superstore['Ship Date'] = pd.to_datetime(superstore['Ship Date'])
```

[311]:
```python
# check for duplicates in the dataset
duplicates = superstore.duplicated()
print(f"Number of duplicate rows: {duplicates.sum()}")

# if duplicates are found, remove them
if duplicates.sum() > 0:
    superstore = superstore.drop_duplicates()
```

```
Number of duplicate rows: 0
```

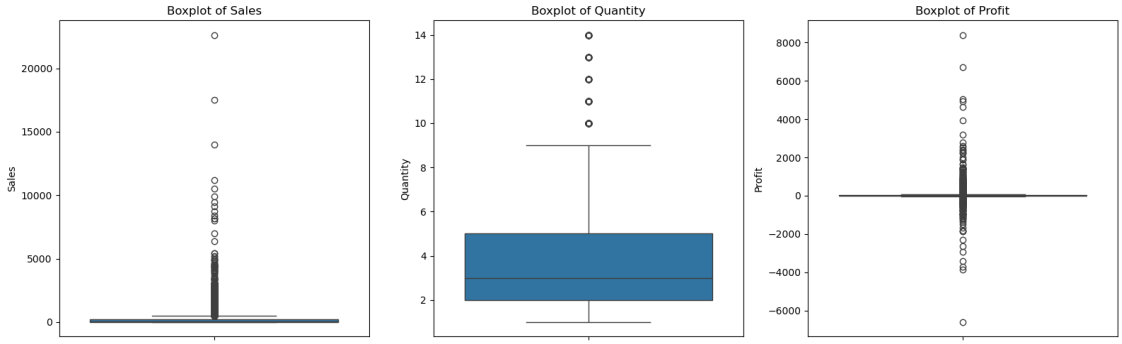
Distribution of Sales, Profit, and Quantity

[312]:
```python
import seaborn as sns
import matplotlib.pyplot as plt

# Set up the figure size for better visibility
plt.figure(figsize=(16, 5))

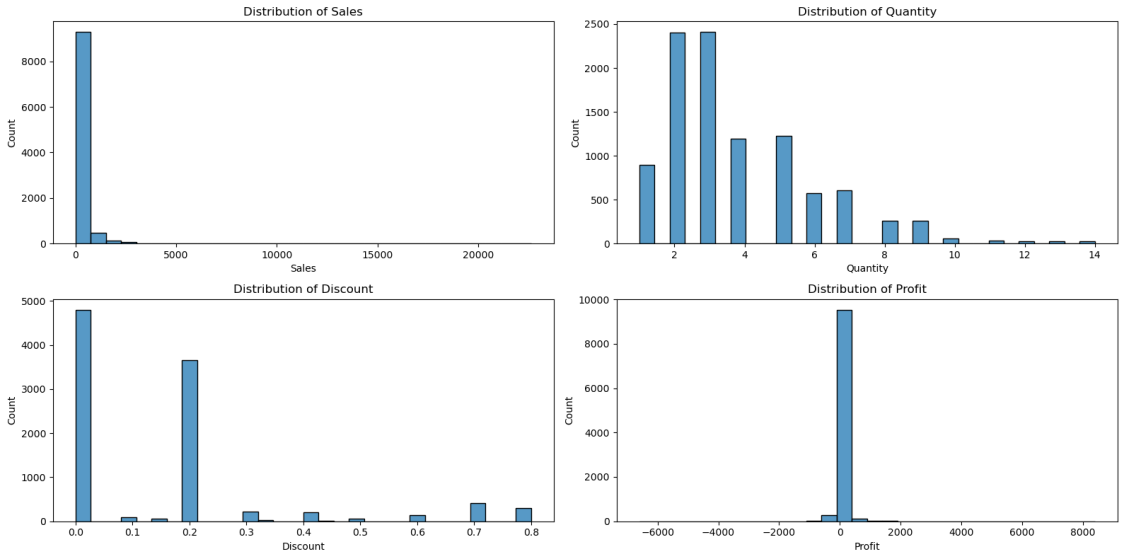
# Plot boxplots for 'Sales', 'Quantity', and 'Profit' columns
for i, column in enumerate(['Sales', 'Quantity', 'Profit'], 1):
    plt.subplot(1, 3, i)
    sns.boxplot(y=superstore[column])
    plt.title(f'Boxplot of {column}')

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



Histogram of Sales, Quantity, Discount, and Profit

[313]:
```
# plot histograms for 'Sales', 'Quantity', 'Discount', and 'Profit'
plt.figure(figsize=(16, 8))
for i, column in enumerate(['Sales', 'Quantity', 'Discount', 'Profit'], 1):
    plt.subplot(2, 2, i)
    sns.histplot(superstore[column], bins=30)
    plt.title(f'Distribution of {column}')
plt.tight_layout()
plt.show()
```



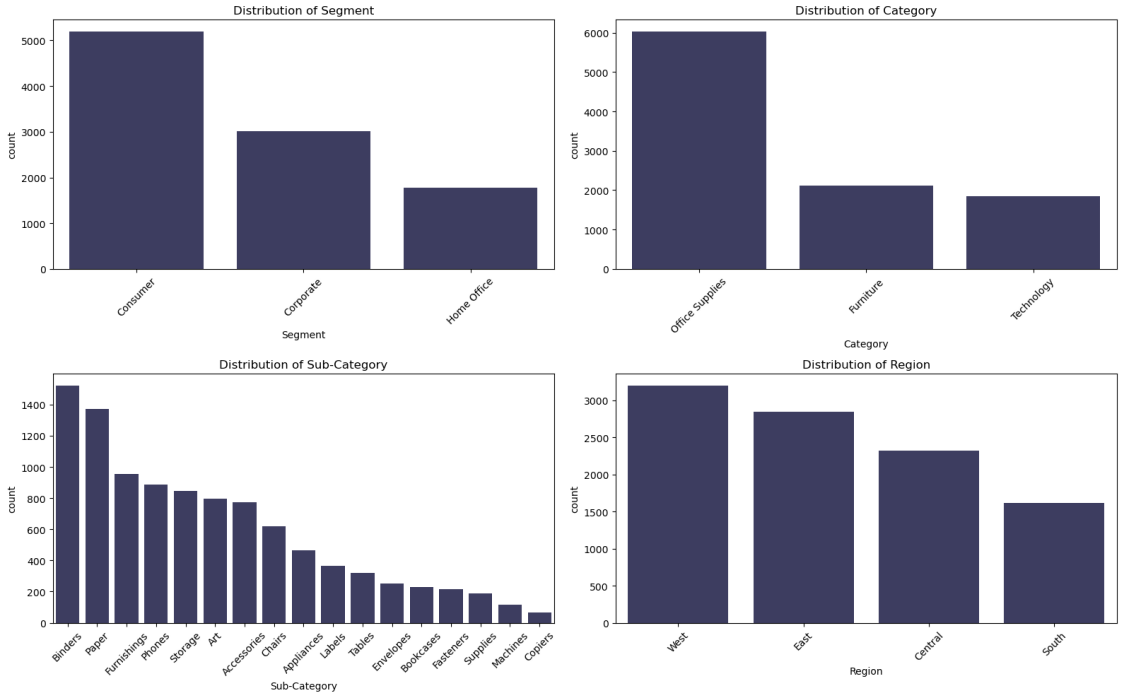
Charts for Categorical Variables

[314]:
```
# plot bar charts for 'Segment', 'Category', 'Sub-Category', and 'Region' in␣
↪descending order
plt.figure(figsize=(16, 10))
```

```
for i, column in enumerate(['Segment', 'Category', 'Sub-Category', 'Region'],␣
 ↪1):
    plt.subplot(2, 2, i)

    # get counts and sort them in descending order
    sorted_order = superstore[column].value_counts().index

    # plot with sorted order
    sns.countplot(data=superstore, x=column, color='#222255',␣
 ↪order=sorted_order, legend=False, alpha=0.9)
    plt.title(f'Distribution of {column}')
    plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



[315]:
```
# aggregate Sales and Profit by each category
data = superstore.groupby('Segment')[['Sales', 'Profit']].sum().
 ↪sort_values(by='Sales', ascending=False).reset_index()

# melt the data so that 'Sales' and 'Profit' can be side by side in the plot
data_melted = data.melt(id_vars='Segment', value_vars=['Sales', 'Profit'],␣
 ↪var_name='Metric', value_name='Amount')

# plot sales and profit side by side
```

```
plt.figure(figsize=(4, 3))
sns.barplot(x='Segment', y='Amount', hue='Metric', data=data_melted,␣
 ↪palette=['#222255', '#FF7F50'], alpha=0.9)
plt.title(f'Total Sales and Profit by Segment')
plt.legend(loc='upper left', bbox_to_anchor=(1, 1), frameon=False)
plt.ylabel('Amount')
plt.xticks(rotation=45)

plt.show()

# aggregate Sales and Profit by each category
data = superstore.groupby('Category')[['Sales', 'Profit']].sum().
 ↪sort_values(by='Sales', ascending=False).reset_index()

# melt the data so that 'Sales' and 'Profit' can be side by side in the plot
data_melted = data.melt(id_vars='Category', value_vars=['Sales', 'Profit'],␣
 ↪var_name='Metric', value_name='Amount')

# plot sales and profit side by side
plt.figure(figsize=(4, 3))
sns.barplot(x='Category', y='Amount',hue='Metric', data=data_melted,␣
 ↪palette=['#222255', '#FF7F50'], alpha=0.9)
plt.title(f'Total Sales and Profit by Category')
plt.legend(loc='upper left', bbox_to_anchor=(1, 1), frameon=False)
plt.ylabel('Amount')
plt.xticks(rotation=45)

plt.show()

# aggregate Sales and Profit by each category
data = superstore.groupby('Sub-Category')[['Sales', 'Profit']].sum().
 ↪sort_values(by='Sales', ascending=False).reset_index()

# melt the data so that 'Sales' and 'Profit' can be side by side in the plot
data_melted = data.melt(id_vars='Sub-Category', value_vars=['Sales', 'Profit'],␣
 ↪var_name='Metric', value_name='Amount')

# plot sales and profit side by side
plt.figure(figsize=(10, 6))
sns.barplot(x='Sub-Category', y='Amount',hue='Metric', data=data_melted,␣
 ↪palette=['#222255', '#FF7F50'], alpha=0.9)
plt.title(f'Total Sales and Profit by Sub-Category')
plt.legend(loc='upper left', bbox_to_anchor=(1, 1), frameon=False)
plt.ylabel('Amount')
plt.xticks(rotation=45)
```

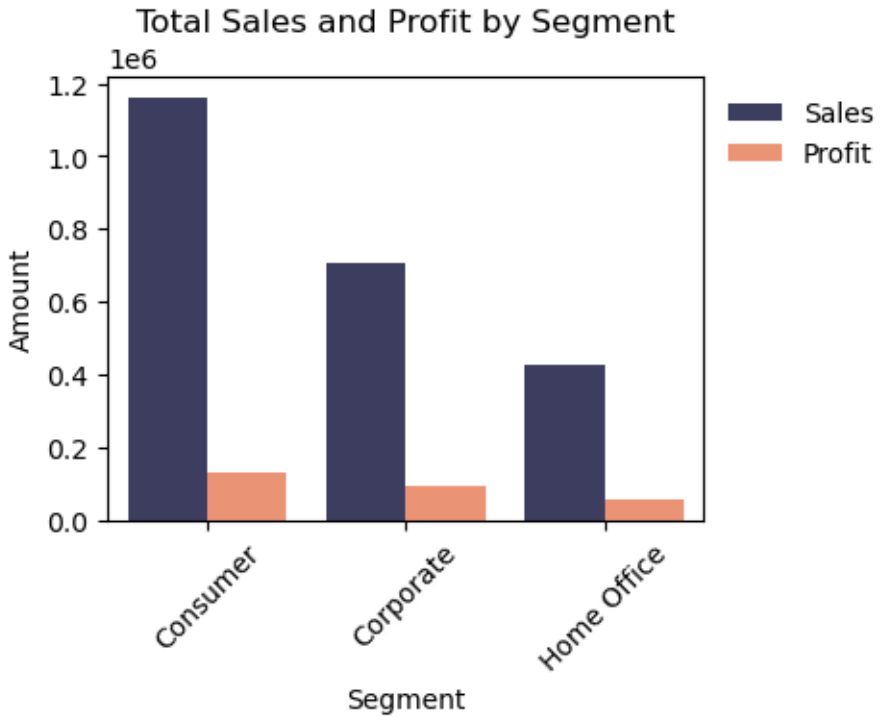
```
plt.show()

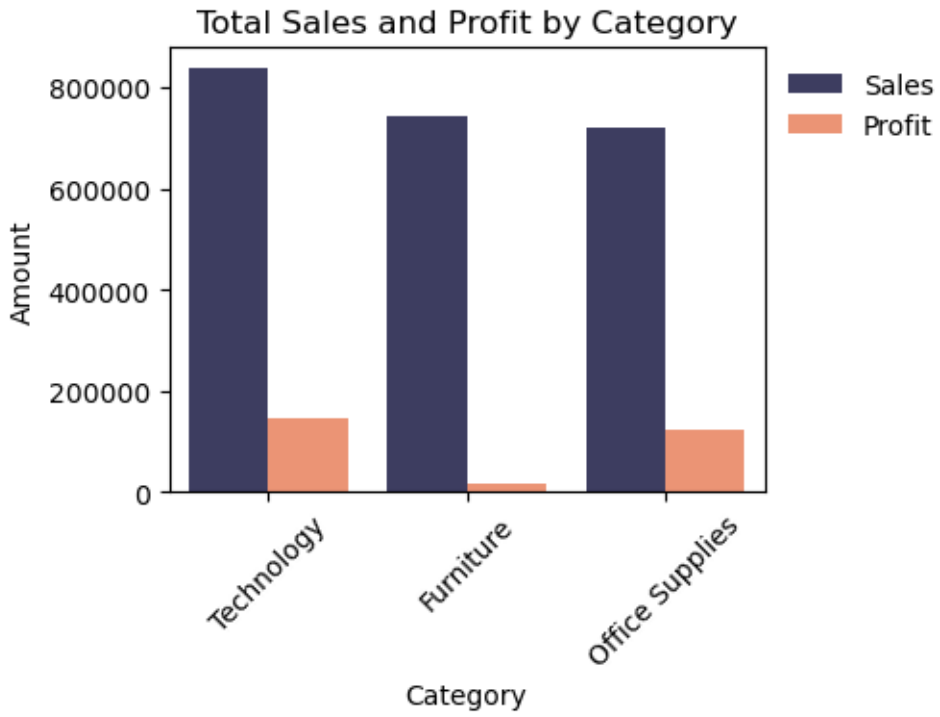
# aggregate Sales and Profit by each category
data = superstore.groupby('Region')[['Sales', 'Profit']].sum().
 ↪sort_values(by='Sales', ascending=False).reset_index()

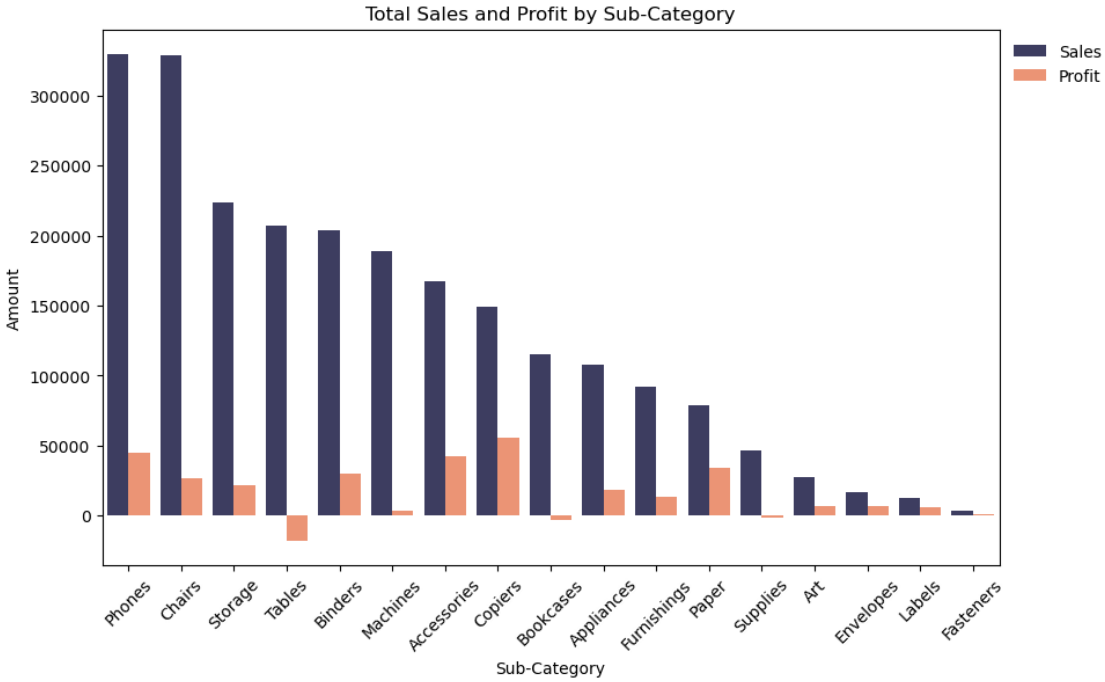
# melt the data so that 'Sales' and 'Profit' can be side by side in the plot
data_melted = data.melt(id_vars='Region', value_vars=['Sales', 'Profit'],␣
 ↪var_name='Metric', value_name='Amount')

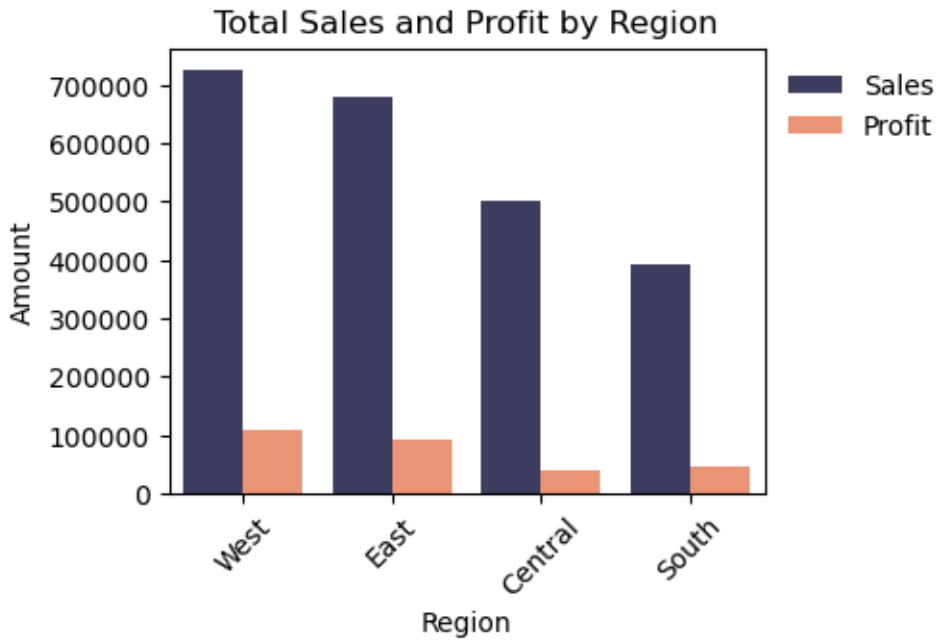
# plot sales and profit side by side
plt.figure(figsize=(4, 3))
sns.barplot(x='Region', y='Amount',hue='Metric', data=data_melted,␣
 ↪palette=['#222255', '#FF7F50'], alpha=0.9)
plt.title(f'Total Sales and Profit by Region')
plt.legend(loc='upper left', bbox_to_anchor=(1, 1), frameon=False)
plt.ylabel('Amount')
plt.xticks(rotation=45)

plt.show()
```




Total Sales and Profit by Category
Sales
Profit
800000
600000
400000
200000
0
Amount
Technology
Furniture
Office Supplies
Category


Total Sales and Profit by Sub-Category
Sales
Profit
300000
250000
200000
150000
100000
50000
0
Amount
Phones
Chairs
Storage
Tables
Binders
Machines
Accessories
Copiers
Bookcases
Appliances
Furnishings
Paper
Supplies
Art
Envelopes
Labels
Fasteners
Sub-Category



[316]:
```
# Define the categorical variables to analyze
categorical_columns = ['Segment', 'Category', 'Sub-Category', 'Region']

# Initialize the plot figure
plt.figure(figsize=(16, 20))

# Loop over each categorical variable
for i, column in enumerate(categorical_columns, 1):
    # Calculate total sales and total profit for each category in the current␣
 ↪column
    data = superstore.groupby(column)[['Sales', 'Profit']].sum()

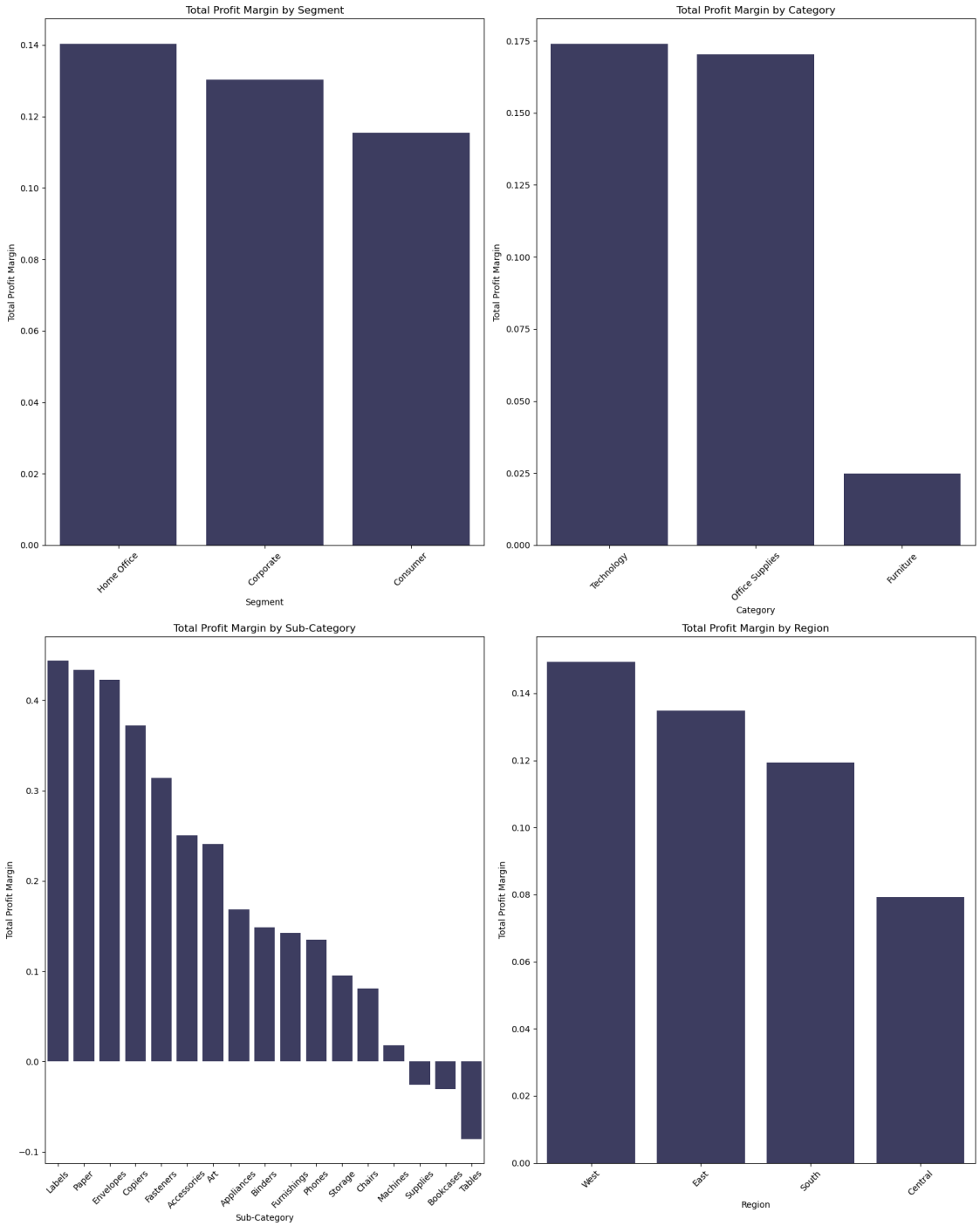
    # Calculate total profit margin (Profit / Sales) for each category
    data['Total Profit Margin'] = data['Profit'] / data['Sales']

    # Sort values in descending order
    data = data.sort_values(by='Total Profit Margin', ascending=False).
 ↪reset_index()

    # Plot the total profit margin
    plt.subplot(2, 2, i)
    sns.barplot(x=column, y='Total Profit Margin', data=data, color='#222255',␣
 ↪alpha=0.9)
    plt.title(f'Total Profit Margin by {column}')
    plt.ylabel('Total Profit Margin')
```

```
    plt.xticks(rotation=45)

# Adjust layout for readability
plt.tight_layout()
plt.show()
```



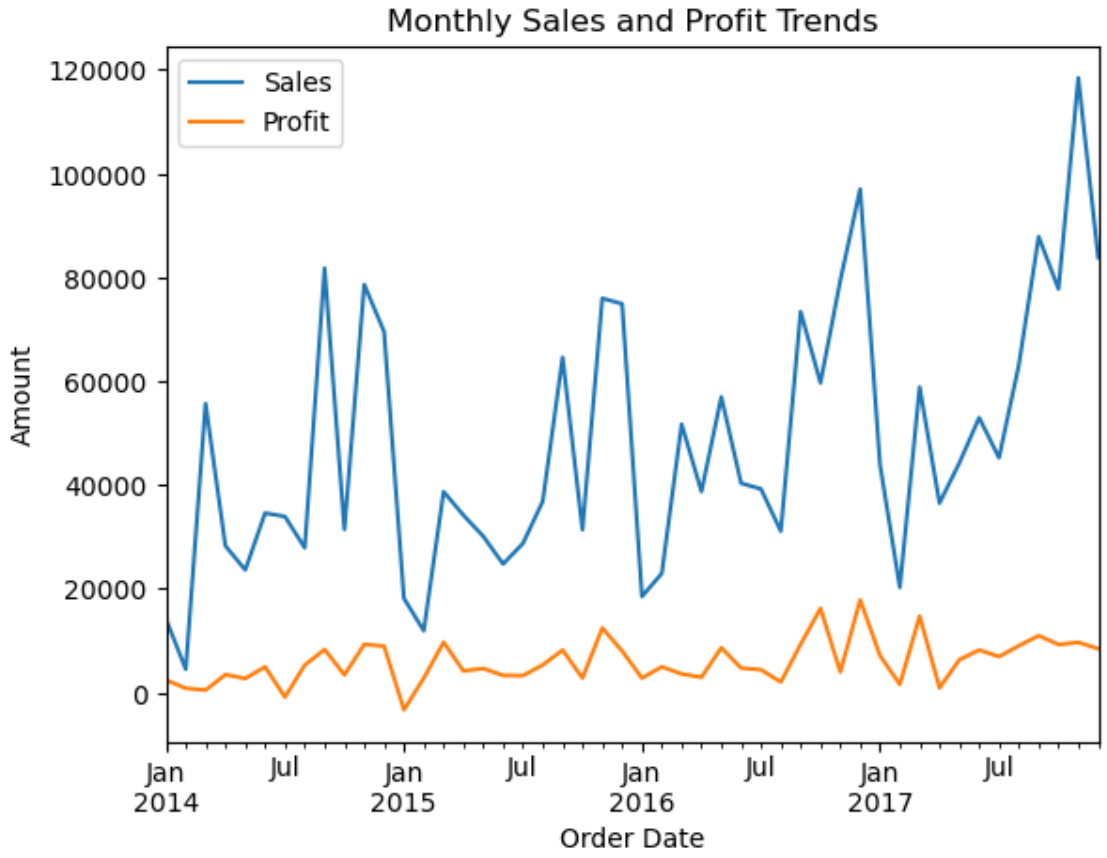
Time-Based Trends

[317]:
```
# set Order Date as index for easy resampling
time_trends = superstore[['Order Date', 'Sales', 'Profit']]
time_trends.set_index('Order Date', inplace=True)

# monthly Sales and Profit Trends
monthly_sales_profit = time_trends.resample('ME')[['Sales', 'Profit']].sum()

monthly_sales_profit.plot()
plt.title("Monthly Sales and Profit Trends")
plt.xlabel("Order Date")
plt.ylabel("Amount")

plt.show()
```



[318]:
```
# Ensure 'Order Date' is in datetime format
superstore['Order Date'] = pd.to_datetime(superstore['Order Date'])
```

```
# Extract month and year from 'Order Date' and add it as a new column for␣
 ↪monthly grouping
superstore['Order Month'] = superstore['Order Date'].dt.month
superstore['Order Year'] = superstore['Order Date'].dt.year

# Group by year and month to calculate total sales and profit for each month
monthly_totals = superstore.groupby(['Order Year', 'Order Month'])[['Sales',␣
 ↪'Profit']].sum().reset_index()

# Now, calculate the average monthly sales and profit across the years
average_monthly_data = monthly_totals.groupby('Order Month')[['Sales',␣
 ↪'Profit']].mean().reset_index()

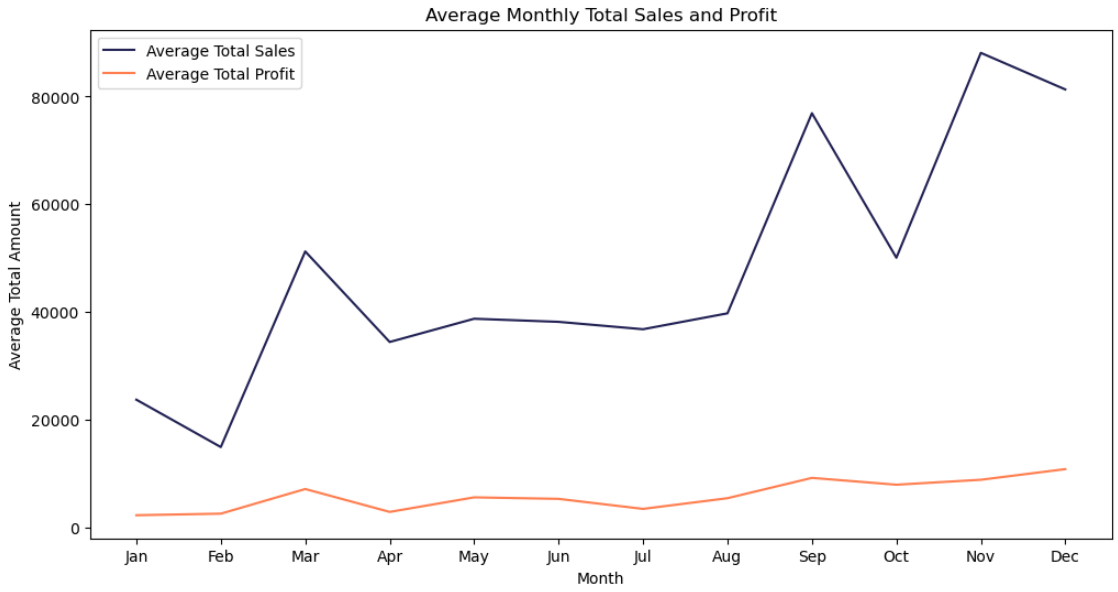
# Plotting
plt.figure(figsize=(12, 6))

# Line plot for average monthly total sales
sns.lineplot(x='Order Month', y='Sales', data=average_monthly_data,␣
 ↪label='Average Total Sales', color='#222255')

# Line plot for average monthly total profit
sns.lineplot(x='Order Month', y='Profit', data=average_monthly_data,␣
 ↪label='Average Total Profit', color='#FF7F50')

# Customize the plot
plt.title('Average Monthly Total Sales and Profit')
plt.xlabel('Month')
plt.ylabel('Average Total Amount')
plt.xticks(ticks=range(1, 13), labels=['Jan', 'Feb', 'Mar', 'Apr', 'May',␣
 ↪'Jun', 'Jul', 'Aug', 'Sep', 'Oct', 'Nov', 'Dec'])
plt.legend()

plt.show()
```



[319]:
```
# Extract quarter from 'Order Date' and add it as a new column
superstore['Order Quarter'] = superstore['Order Date'].dt.quarter

# Group by year and month to calculate total sales and profit for each month
monthly_totals = superstore.groupby(['Order Quarter'])[['Sales', 'Profit']].
 ↪sum().reset_index()

# Now, calculate the average monthly sales and profit across the years
average_monthly_data = monthly_totals.groupby('Order Quarter')[['Sales',␣
 ↪'Profit']].mean().reset_index()

# Plotting
plt.figure(figsize=(12, 6))

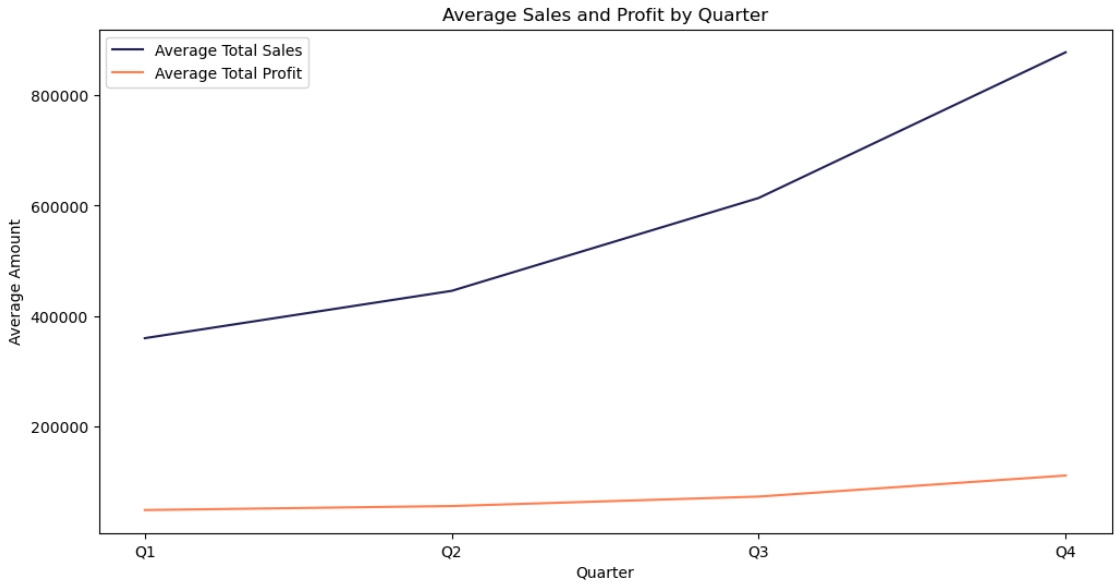
# Line plot for average monthly total sales
sns.lineplot(x='Order Quarter', y='Sales', data=average_monthly_data,␣
 ↪label='Average Total Sales', color='#222255')

# Line plot for average monthly total profit
sns.lineplot(x='Order Quarter', y='Profit', data=average_monthly_data,␣
 ↪label='Average Total Profit', color='#FF7F50')

# Customize the plot
plt.title('Average Sales and Profit by Quarter')
plt.xlabel('Quarter')
plt.ylabel('Average Amount')
plt.xticks([1, 2, 3, 4], labels=['Q1', 'Q2', 'Q3', 'Q4'])
```

```
plt.legend()

plt.show()
```



[320]:
```
# Convert 'Order Date' to datetime if not already in that format
superstore['Order Date'] = pd.to_datetime(superstore['Order Date'])

# Create a new column for month-year
superstore['Order Month'] = superstore['Order Date'].dt.to_period('M')
# Group by 'Category' and 'Order Month' to calculate total profit per category␣
 ↪each month
category_monthly_profit = superstore.groupby(['Category', 'Order␣
 ↪Month'])['Profit'].sum().unstack().fillna(0)

# Set figure size
plt.figure(figsize=(14, 8))

# Plot profit trend for each category
for category in category_monthly_profit.index:
    plt.plot(category_monthly_profit.columns.astype(str),␣
 ↪category_monthly_profit.loc[category], label=category)

# Customize the plot
plt.title('Monthly Profit Trends by Category')
plt.xlabel('Month')
plt.ylabel('Profit')
plt.legend(title='Category', bbox_to_anchor=(1.05, 1), loc='upper left')
```

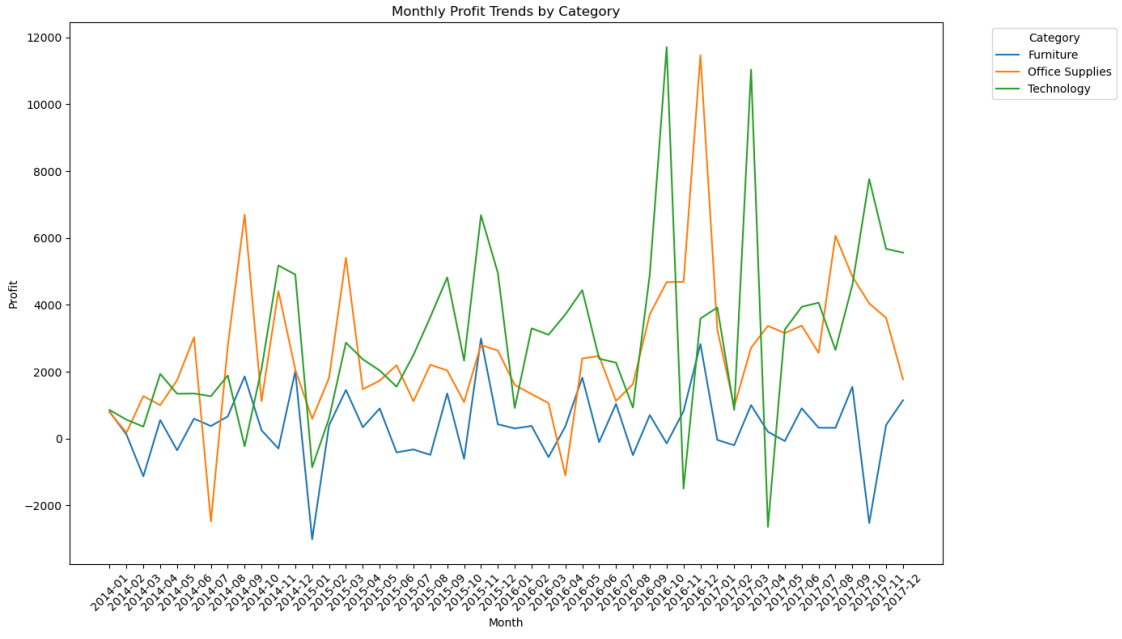
```
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()

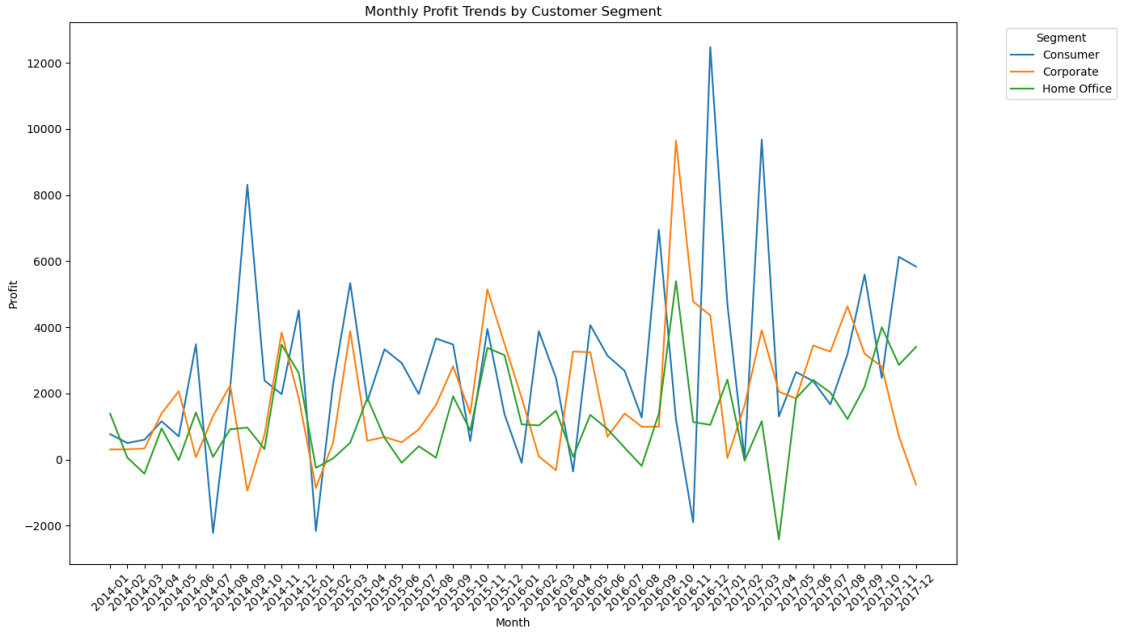
# Group by 'Segment' and 'Order Month' to calculate total profit per segment␣
 ↪each month
segment_monthly_profit = superstore.groupby(['Segment', 'Order␣
 ↪Month'])['Profit'].sum().unstack().fillna(0)

# Set figure size
plt.figure(figsize=(14, 8))

# Plot profit trend for each segment
for segment in segment_monthly_profit.index:
    plt.plot(segment_monthly_profit.columns.astype(str), segment_monthly_profit.
 ↪loc[segment], label=segment)

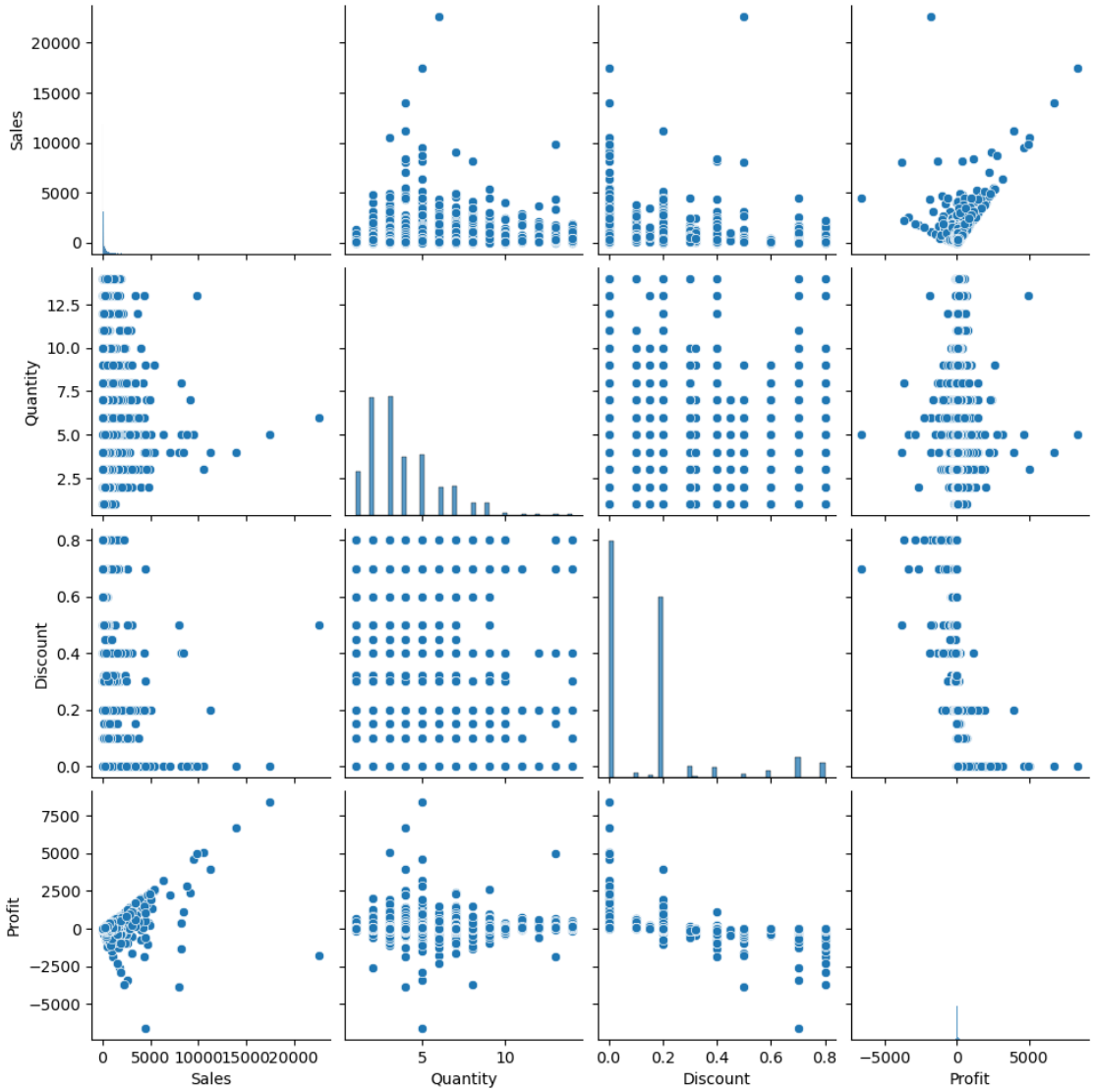
# Customize the plot
plt.title('Monthly Profit Trends by Customer Segment')
plt.xlabel('Month')
plt.ylabel('Profit')
plt.legend(title='Segment', bbox_to_anchor=(1.05, 1), loc='upper left')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```





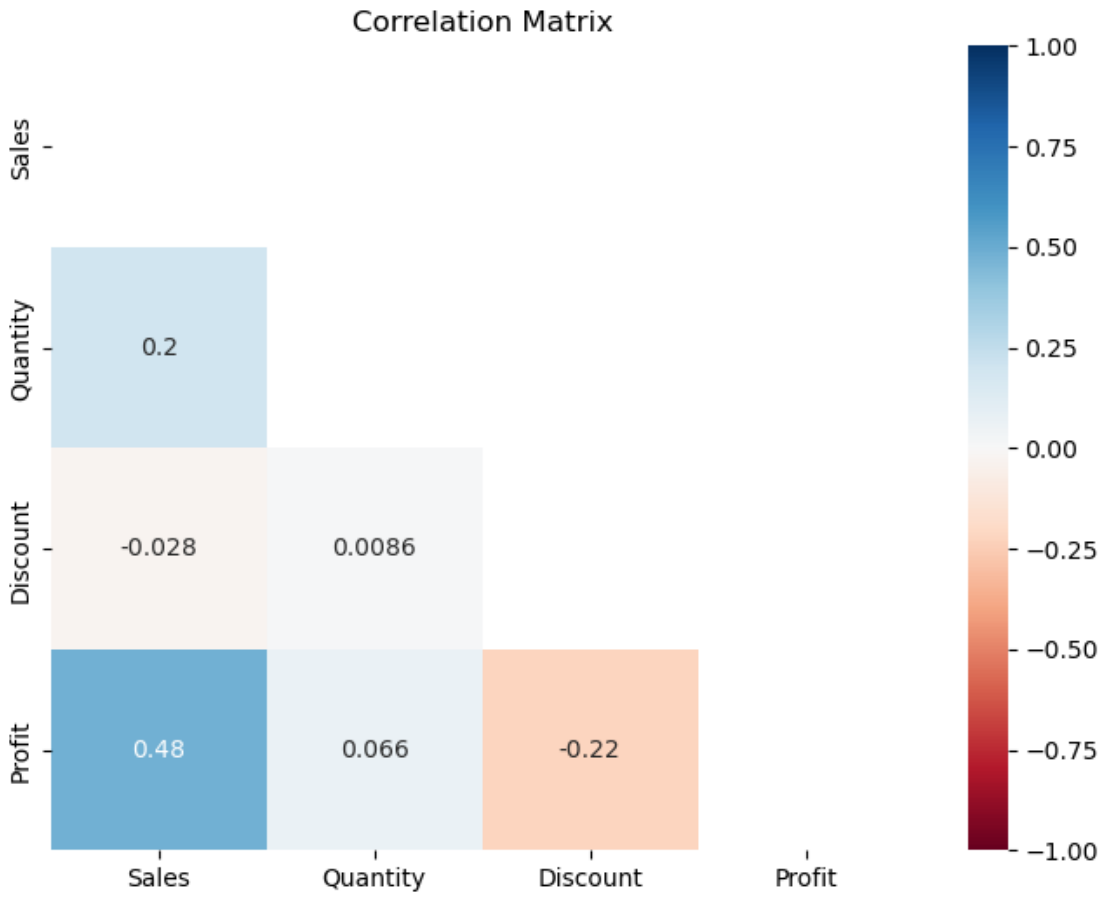
Correlation Analysis

[321]:
```
# pairplot for numerical relationships
sns.pairplot(superstore[['Sales', 'Quantity', 'Discount', 'Profit']])
plt.show()
```

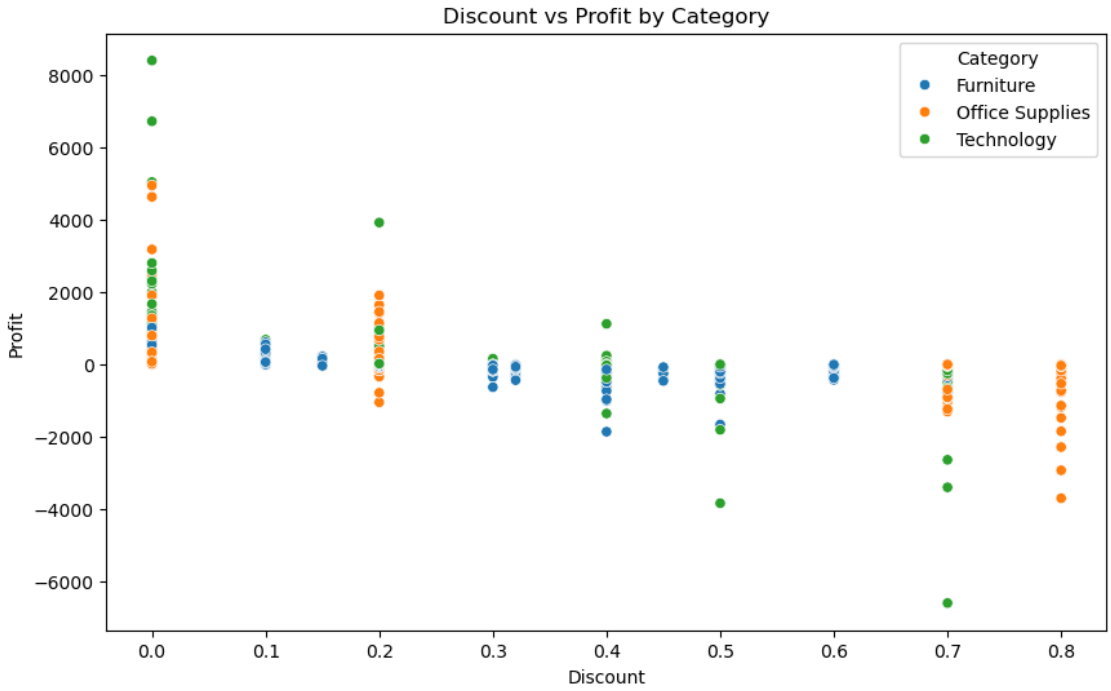


[322]:
```
import numpy as np

# correlation heatmap
corr_matrix = superstore[['Sales', 'Quantity', 'Discount', 'Profit']].corr()
plt.figure(figsize=(8, 6))
sns.heatmap(corr_matrix,
            mask=np.triu(np.ones_like(corr_matrix, dtype=bool)), annot=True,␣
 ↪cmap="RdBu", vmin=-1, vmax=1)
plt.title("Correlation Matrix")
plt.show()
```



[323]:
```
plt.figure(figsize=(10, 6))
sns.scatterplot(data=superstore, x='Discount', y='Profit', hue='Category')
plt.title("Discount vs Profit by Category")
plt.show()
```



Product Analysis

[324]:
```
# Group by product name and calculate total profit for each product
product_profit = superstore.groupby('Product Name')['Profit'].sum().
 ↪reset_index()

# Sort products by total profit
most_profitable_products = product_profit.sort_values(by='Profit',␣
 ↪ascending=False).head(10)
least_profitable_products = product_profit.sort_values(by='Profit').head(10)

print("Most Profitable Products:")
print(most_profitable_products)

print("\nLeast Profitable Products:")
print(least_profitable_products)
```

```
Most Profitable Products:
                                          Product Name      Profit
404              Canon imageCLASS 2200 Advanced Copier  25199.9280
650   Fellowes PB500 Electric Punch Plastic Comb Bin…   7753.0390
805               Hewlett Packard LaserJet 3310 Copier   6983.8836
400                 Canon PC1060 Personal Laser Copier   4570.9347
787   HP Designjet T520 Inkjet Large Format Printer …   4094.9766
165                  Ativa V4110MDD Micro-Cut Shredder   3772.9461
```

```
19     3D Systems Cube Printer, 2nd Generation, Magenta   3717.9714
1276  Plantronics Savi W720 Multi-Device Wireless He…   3696.2820
895                Ibico EPK-21 Electric Binding System   3345.2823
1840                  Zebra ZM400 Thermal Label Printer   3343.5360

Least Profitable Products:
                                          Product Name     Profit
475           Cubify CubeX 3D Printer Double Head Print -8879.9704
985           Lexmark MX611dhe Monochrome Laser Printer -4589.9730
476           Cubify CubeX 3D Printer Triple Head Print -3839.9904
425   Chromcraft Bull-Nose Wood Oval Conference Tabl… -2876.1156
376   Bush Advantage Collection Racetrack Conference… -1934.3976
683           GBC DocuBind P400 Electric Binding System -1878.1662
444   Cisco TelePresence System EX90 Videoconferenci… -1811.0784
1043  Martin Yale Chadless Opener Electric Letter Op… -1299.1836
285                       Balt Solid Wood Round Tables -1201.0581
364   BoxOffice By Design Rectangular and Half-Moon … -1148.4375
```

[325]:
```
# Group by both region and product name to calculate total profit for each␣
 ↪product in each region
regional_product_profit = superstore.groupby(['Region', 'Product␣
 ↪Name'])['Profit'].sum().reset_index()

# For each region, find the most and least profitable products
most_profitable_by_region = regional_product_profit.sort_values(['Region',␣
 ↪'Profit'], ascending=[True, False]).groupby('Region').head(10)
least_profitable_by_region = regional_product_profit.sort_values(['Region',␣
 ↪'Profit']).groupby('Region').head(10)

print("Most Profitable Products by Region:")
print(most_profitable_by_region)

print("\nLeast Profitable Products by Region:")
print(least_profitable_by_region)
```

```
Most Profitable Products by Region:
      Region                                        Product Name      Profit
284   Central              Canon imageCLASS 2200 Advanced Copier   8399.9760
476   Central   GBC Ibimaster 500 Manual ProClick Binding System   3804.9000
280   Central                 Canon PC1060 Personal Laser Copier   2302.9671
634   Central               Ibico EPK-21 Electric Binding System   1700.9910
603   Central  Honeywell Enviracaire Portable HEPA Air Cleane…   1289.7885
636   Central          Ibico Ibimaster 300 Manual Binding System   1159.1685
560   Central  Hewlett Packard 610 Color Digital Copier / Pri…   1074.9785
278   Central                 Canon Imageclass D680 Copier / Fax    874.9875
753   Central                     Maxell iVDR EX 500GB Cartridge    829.3754
281   Central                      Canon PC1080F Personal Copier    803.9866
1606     East              Canon imageCLASS 2200 Advanced Copier  10079.9712
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1422     East                  Ativa V4110MDD Micro-Cut Shredder   3772.9461
1309     East   3D Systems Cube Printer, 2nd Generation, Magenta   3717.9714
2701     East                  Zebra ZM400 Thermal Label Printer   3343.5360
1921     East              Hewlett Packard LaserJet 3310 Copier   3023.9496
1823     East        GBC DocuBind TL300 Electric Binding System   2610.2409
1798     East  Fellowes PB500 Electric Punch Plastic Comb Bin…   2414.8810
1910     East  HP Designjet T520 Inkjet Large Format Printer …   2239.9872
1607     East  Canon imageCLASS MF7460 Monochrome Digital Las…   1995.9900
2267     East  Plantronics Savi W720 Multi-Device Wireless He…   1721.5560
3084    South  Fellowes PB500 Electric Punch Plastic Comb Bin…   3812.9700
3168    South  HP Designjet T520 Inkjet Large Format Printer …   1854.9894
3180    South  Hewlett-Packard Deskjet 3050a All-in-One Color…   1459.2000
3179    South              Hewlett Packard LaserJet 3310 Copier   1439.9760
2959    South                Cisco 9971 IP Video Phone Charcoal   1416.8000
3083    South       Fellowes PB300 Plastic Comb Binding Machine   1276.4871
3494    South                           Samsung Galaxy Mega 6.3   1091.9740
3497    South                         Samsung Galaxy S4 Active    909.9818
3432    South  Plantronics CS510 - Over-the-Head monaural Wir…    871.0680
3210    South  Honeywell Enviracaire Portable HEPA Air Cleane…    850.8395
4081     West             Canon imageCLASS 2200 Advanced Copier   6719.9808
4278     West  Fellowes PB500 Electric Punch Plastic Comb Bin…   3050.3760
4078     West                Canon PC1060 Personal Laser Copier   2267.9676
4413     West              Hewlett Packard LaserJet 3310 Copier   2183.9636
4585     West  Logitech Z-906 Speaker sys - home theater - 5…   1715.9480
4795     West  Plantronics Savi W720 Multi-Device Wireless He…   1670.9220
4479     West              Ibico EPK-21 Electric Binding System   1644.2913
4080     West                                   Canon PC940 Copier   1480.4671
4583     West                Logitech P710e Mobile Speakerphone   1418.7699
4075     West                     Canon Image Class D660 Copier   1379.9770

Least Profitable Products by Region:
       Region                                        Product Name     Profit
471    Central         GBC DocuBind P400 Electric Binding System -3048.6176
443    Central  Fellowes PB500 Electric Punch Plastic Comb Bin… -1525.1880
12     Central  3.6 Cubic Foot Counter Height Office Refrigerator -1378.8216
700    Central         Lexmark MX611dhe Monochrome Laser Printer -1189.9930
635    Central               Ibico Hi-Tech Manual Binding System -1189.4610
489    Central      GBC ProClick 150 Presentation Binding System -1147.0074
614    Central               Hoover Upright Vacuum With Dirt Cup  -929.3913
564    Central       High Speed Automatic Electric Letter Opener  -786.0144
1079   Central          Tenex Chairmat w/ Average Lip, 45" x 53"  -681.1200
474    Central        GBC DocuBind TL300 Electric Binding System  -636.8629
1664      East         Cubify CubeX 3D Printer Double Head Print -9239.9692
2100      East  Martin Yale Chadless Opener Electric Letter Op… -1199.2464
2328      East  Riverside Furniture Oval Coffee Table, Oval En… -1187.5590
1825      East   GBC Ibimaster 500 Manual ProClick Binding System -1065.3720
1630      East                Cisco 9971 IP Video Phone Charcoal  -950.4000
1763      East  Epson TM-T88V Direct Thermal Printer - Monochr…  -935.9595
```

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1624     East  Chromcraft Bull-Nose Wood 48" x 96" Rectangula…  -754.8426
1943     East                      Hon 94000 Series Round Tables  -734.5264
1539     East               Bevis Oval Conference Table, Walnut  -720.3048
2489     East                        Tennsco Single-Tier Lockers  -656.8450
2978    South         Cubify CubeX 3D Printer Triple Head Print -3839.9904
2956    South  Chromcraft Bull-Nose Wood Oval Conference Tabl… -2865.0960
3106    South   GBC Ibimaster 500 Manual ProClick Binding System -1978.5480
2964    South  Cisco TelePresence System EX90 Videoconferenci… -1811.0784
3101    South         GBC DocuBind P400 Electric Binding System -1306.5504
2930    South  Bush Advantage Collection Racetrack Conference… -1111.4302
2883    South                      Balt Solid Wood Round Tables  -968.8833
3206    South                  Hon Racetrack Conference Tables  -648.3997
2723    South    3D Systems Cube Printer, 2nd Generation, White  -571.9956
2881    South                             BPI Conference Tables  -489.2675
4547     West         Lexmark MX611dhe Monochrome Laser Printer -3399.9800
5244     West  Zebra GK420t Direct Thermal/Thermal Transfer P…  -938.2800
4714     West        O'Sullivan 4-Shelf Bookcase in Odessa Pine  -802.0974
4424     West  Hon 2090  Pillow Soft  Series Mid Back Swivel/…  -547.9110
3892     West  Atlantic Metals Mobile 4-Shelf Bookcases, Cust…  -491.7150
4012     West                           Bestar Classic Bookcase  -439.9560
4098     West  Chromcraft 48" x 96" Racetrack Double Pedestal…  -436.0704
4053     West  Bretford  Just In Time  Height-Adjustable Mult…  -425.7480
4306     West         GBC DocuBind 300 Electric Binding Machine  -399.7448
4757     West  Panasonic KX MC6040 Color Laser Multifunction …  -386.9570
```

Discount Analysis

[326]:
```
# Filter for orders where Discount > 0.2 and Profit < 0
discounted_loss_orders = superstore[(superstore['Discount'] > 0.2) &␣
 ↪(superstore['Profit'] < 0)]

# Customers with at least one discounted loss order
discounted_loss_customers = discounted_loss_orders['Customer ID'].unique()

# Calculate total profit per customer and then the average
customer_profit = superstore.groupby('Customer ID')['Profit'].sum()
profitable_customers = customer_profit[customer_profit > 0]

# Average overall profit for customers with at least one discounted loss order
avg_profit_discounted_loss_customers = customer_profit[customer_profit.index.
 ↪isin(discounted_loss_customers)].mean()

# Average overall profit for all customers
avg_profit_all_customers = customer_profit.mean()

# Identify customers with a total profit > 0 among those with discounted loss␣
 ↪orders
```

```
profitable_discounted_loss_customers = customer_profit[customer_profit.index.
 ↪isin(discounted_loss_customers) & (customer_profit > 0)]
percentage_profitable_discounted_loss_customers =␣
 ↪(len(profitable_discounted_loss_customers) / len(discounted_loss_customers))␣
 ↪* 100

# Identify the earliest order date for discounted loss orders per customer
earliest_discounted_loss_orders = discounted_loss_orders.groupby('Customer␣
 ↪ID')['Order Date'].min()

# Merge the earliest discounted loss order date with the full dataset
superstore = superstore.merge(earliest_discounted_loss_orders, on='Customer␣
 ↪ID', how='left', suffixes=('', '_discounted_loss'))

# Filter for customers with a later order after their discounted loss order
repeat_customers = superstore[(superstore['Order Date'] > superstore['Order␣
 ↪Date_discounted_loss']) &
                              (superstore['Customer ID'].
 ↪isin(discounted_loss_customers))]['Customer ID'].unique()

percentage_repeat_discounted_loss_customers = (len(repeat_customers) /␣
 ↪len(discounted_loss_customers)) * 100

print(f"Average overall profit of customers with discounted loss orders:␣
 ↪${avg_profit_discounted_loss_customers:.2f}")
print(f"Average overall profit of all customers: ${avg_profit_all_customers:.
 ↪2f}")
print(f"Percentage of discounted loss customers who were profitable:␣
 ↪{percentage_profitable_discounted_loss_customers:.2f}%")
print(f"Percentage of all customers who were profitable:␣
 ↪{(len(profitable_customers)/len(customer_profit) * 100):.2f}%")
print(f"Percentage of discounted loss customers who made another purchase:␣
 ↪{percentage_repeat_discounted_loss_customers:.2f}%")
```

```
Average overall profit of customers with discounted loss orders: $285.66
Average overall profit of all customers: $361.16
Percentage of discounted loss customers who were profitable: 73.84%
Percentage of all customers who were profitable: 80.45%
Percentage of discounted loss customers who made another purchase: 89.25%
```