In [1]:

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sb

# Disable scientific notation for large numbers
pd.options.display.float_format = '{:.0f}'.format

# Setting display options for Pandas to show three decimal places for floati
pd.set_option('display.float_format', lambda x: '%.2f' % x)
```

Data Loading

In [2]:

```
# import data
sales_df = pd.read_csv('/content/drive/MyDrive/Global_Superstore.csv', encod
```

Data Exploration

In [3]:

```
sales_df.info() # Display information about the DataFrame, including data ty
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 51290 entries, 0 to 51289
Data columns (total 24 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  object 
 3   Ship Date       51290 non-null  object 
 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 
dtypes: float64(5), int64(2), object(17)
memory usage: 9.4+ MB
```

In [4]:

```
sales_df.head() # Display top 5 records
```

Out[4]:

	Row ID	Order ID	Order Date	Ship Date	Ship Mode	Customer ID	Customer Name	Segment	
0	32298	CA-2012-124891	31-07-2012	31-07-2012	Same Day	RH-19495	Rick Hansen	Consumer	Ne
1	26341	IN-2013-77878	05-02-2013	07-02-2013	Second Class	JR-16210	Justin Ritter	Corporate	Wollo
2	25330	IN-2013-71249	17-10-2013	18-10-2013	First Class	CR-12730	Craig Reiter	Consumer	Br
3	13524	ES-2013-1579342	28-01-2013	30-01-2013	First Class	KM-16375	Katherine Murray	Home Office	
4	47221	SG-2013-4320	05-11-2013	06-11-2013	Same Day	RH-9495	Rick Hansen	Consumer	

5 rows × 24 columns

In [5]:

```
sales_df[['Sales','Quantity','Discount','Profit','Shipping Cost']].describe(
```

Out[5]:

	Sales	Quantity	Discount	Profit	Shipping Cost
count	51290.00	51290.00	51290.00	51290.00	51290.00
mean	246.49	3.48	0.14	28.61	26.38
std	487.57	2.28	0.21	174.34	57.30
min	0.44	1.00	0.00	-6599.98	0.00
25%	30.76	2.00	0.00	0.00	2.61
50%	85.05	3.00	0.00	9.24	7.79
75%	251.05	5.00	0.20	36.81	24.45
max	22638.48	14.00	0.85	8399.98	933.57

In [6]:

```
sales_df.isna().sum() # Find sum of missing values
```

```
Out[6]:
                     0
         Row ID      0
       Order ID      0
     Order Date      0
      Ship Date      0
      Ship Mode      0
    Customer ID      0
  Customer Name      0
        Segment      0
           City      0
          State      0
        Country      0
    Postal Code  41296
         Market      0
         Region      0
     Product ID      0
       Category      0
   Sub-Category      0
   Product Name      0
          Sales      0
       Quantity      0
       Discount      0
         Profit      0
  Shipping Cost      0
 Order Priority      0

dtype: int64
```

```
In [7]: sales_df.fillna(0,inplace=True) # Replace missing values with 0
```

```
In [8]: sales_df.isna().sum() # Find sum of missing values after cleaning
```

Out[8]:

	0
Row ID	0
Order ID	0
Order Date	0
Ship Date	0
Ship Mode	0
Customer ID	0
Customer Name	0
Segment	0
City	0
State	0
Country	0
Postal Code	0
Market	0
Region	0
Product ID	0
Category	0
Sub-Category	0
Product Name	0
Sales	0
Quantity	0
Discount	0
Profit	0
Shipping Cost	0
Order Priority	0

dtype: int64

In [9]:

```
print(sales_df.duplicated().sum()) # Find sum of duplicate records
```

```
0
```

Since, sum of duplicated values is zero, so there is no need to drop duplicates.

In [10]:

```
# Convert date column to datetime
sales_df['Order Date'] = pd.to_datetime(sales_df['Order Date'])
sales_df['Ship Date'] = pd.to_datetime(sales_df['Ship Date'])
```

```
/tmp/ipython-input-10-1068123818.py:2: UserWarning: Parsing dates in %d-%m-%
Y format when dayfirst=False (the default) was specified. Pass `dayfirst=Tru
e` or specify a format to silence this warning.
  sales_df['Order Date'] = pd.to_datetime(sales_df['Order Date'])
/tmp/ipython-input-10-1068123818.py:3: UserWarning: Parsing dates in %d-%m-%
Y format when dayfirst=False (the default) was specified. Pass `dayfirst=Tru
e` or specify a format to silence this warning.
  sales_df['Ship Date'] = pd.to_datetime(sales_df['Ship Date'])
```

In [11]:

```
sales_df.head()
```

Out[11]:

	Row ID	Order ID	Order Date	Ship Date	Ship Mode	Customer ID	Customer Name	Segment	
0	32298	CA-2012-124891	2012-07-31	2012-07-31	Same Day	RH-19495	Rick Hansen	Consumer	Ne
1	26341	IN-2013-77878	2013-02-05	2013-02-07	Second Class	JR-16210	Justin Ritter	Corporate	Wollo
2	25330	IN-2013-71249	2013-10-17	2013-10-18	First Class	CR-12730	Craig Reiter	Consumer	Br
3	13524	ES-2013-1579342	2013-01-28	2013-01-30	First Class	KM-16375	Katherine Murray	Home Office	
4	47221	SG-2013-4320	2013-11-05	2013-11-06	Same Day	RH-9495	Rick Hansen	Consumer	

5 rows × 24 columns

In [12]:

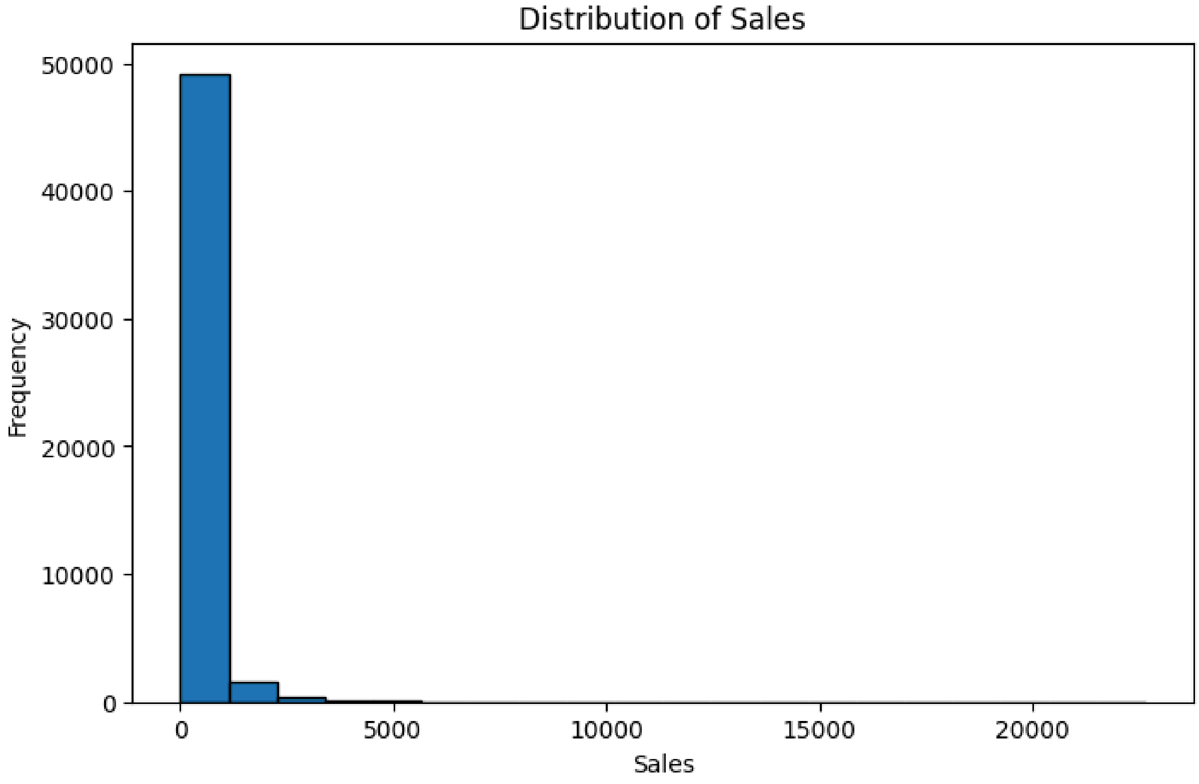
```
# Save cleaned data
sales_df.to_csv('/content/drive/MyDrive/Global_Superstore_final.csv', index=
```

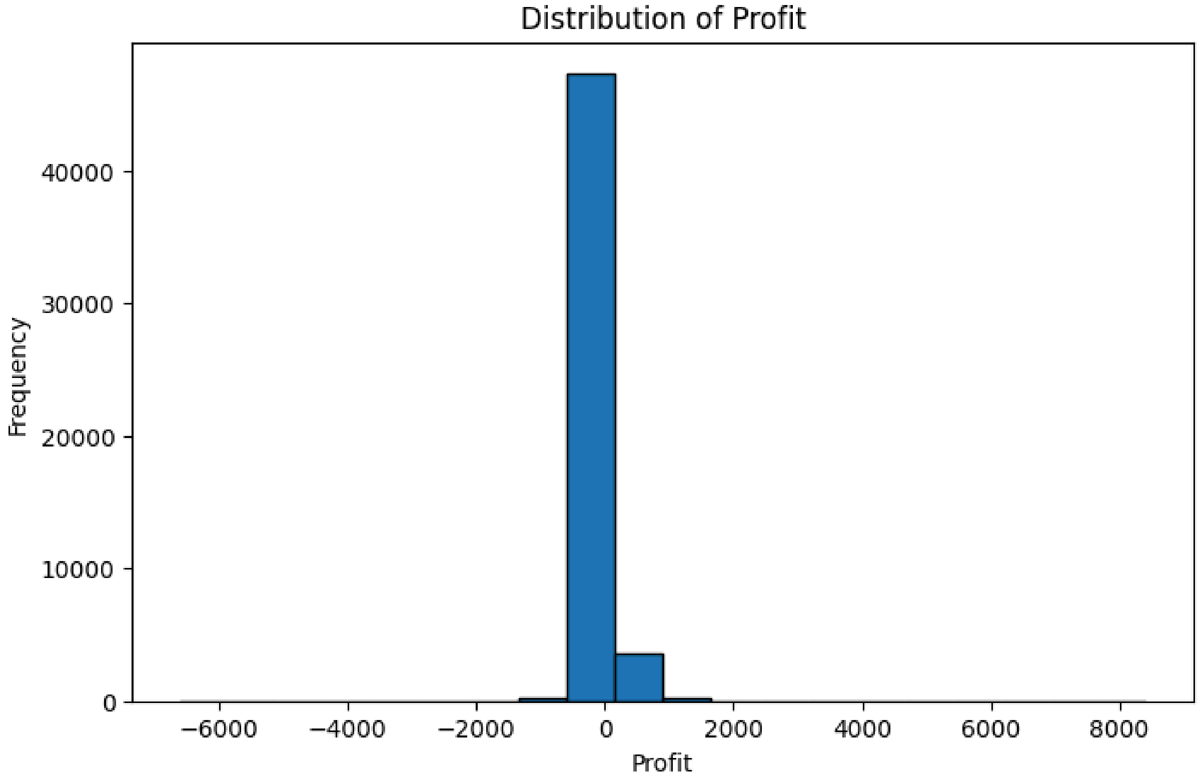
Data Visualization

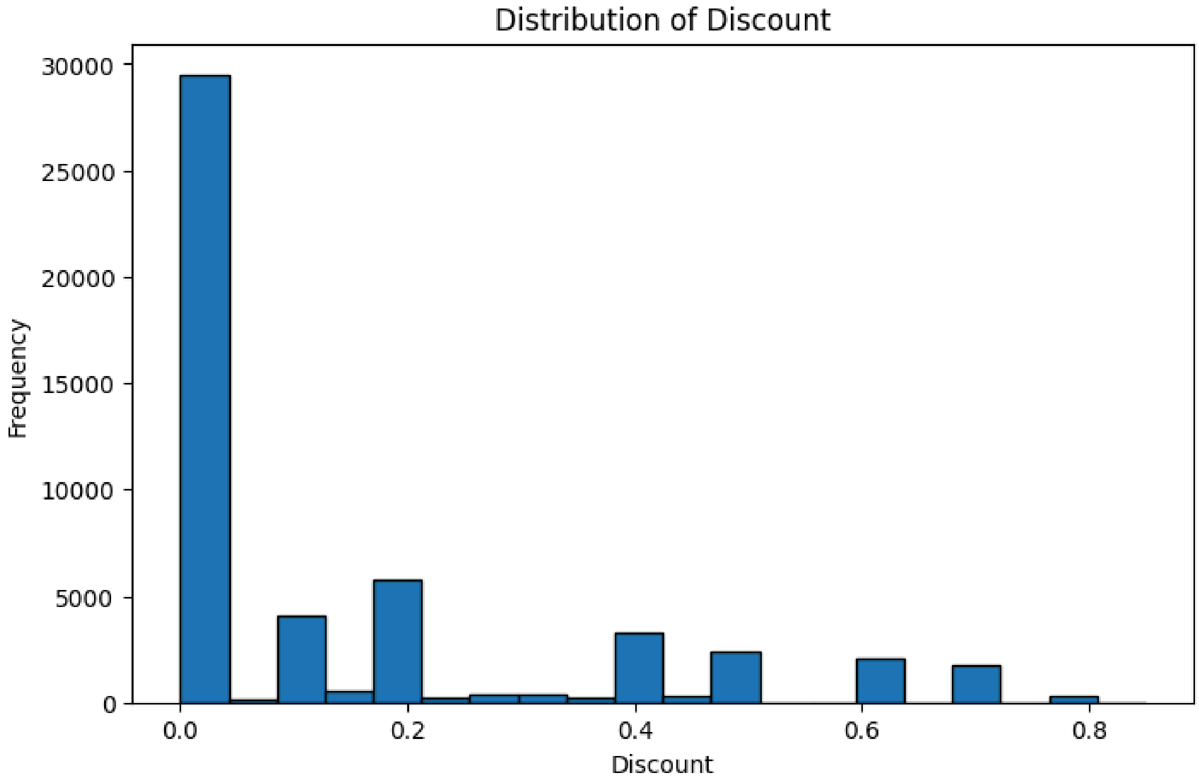
In [13]:

```
# Explore distributions of numerical data
# List of numerical columns to be explored
num_cols = ['Sales', 'Profit', 'Discount']

# Create histograms for each numerical column
for col in num_cols:
    plt.figure(figsize=(8, 5))
    sales_df[col].hist(bins=20, edgecolor='black')
    plt.title(f'Distribution of {col}')
    plt.xlabel(col)
    plt.ylabel('Frequency')
    plt.grid(False)
    plt.show()
```


Distribution of Sales

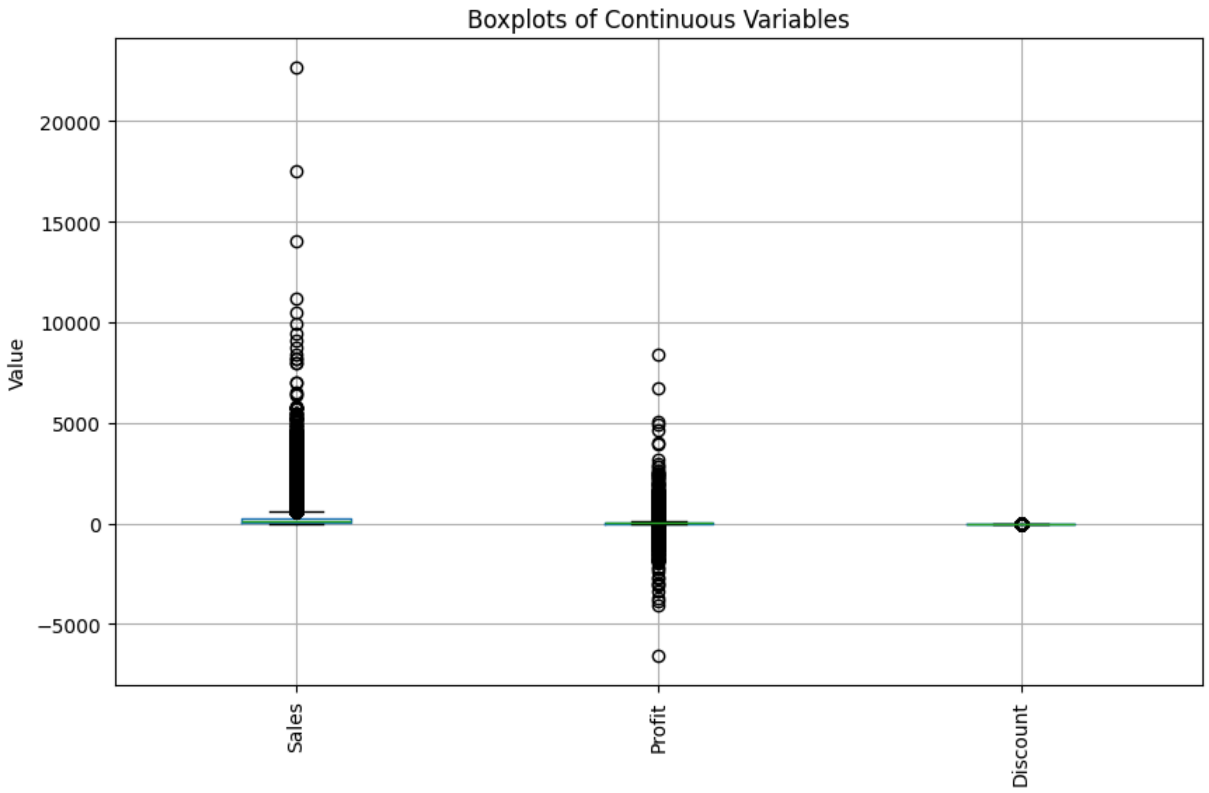

Distribution of Profit



In [14]:

```
# Identify outliers in continuous variables
# List of continuous (numerical) columns
continuous_cols = ['Sales', 'Profit', 'Discount']

# Create boxplots for each continuous variable
plt.figure(figsize=(10, 6))
sales_df[continuous_cols].boxplot()
plt.title('Boxplots of Continuous Variables')
plt.ylabel('Value')
plt.xticks(rotation=90)
plt.grid(True)
plt.show()
```

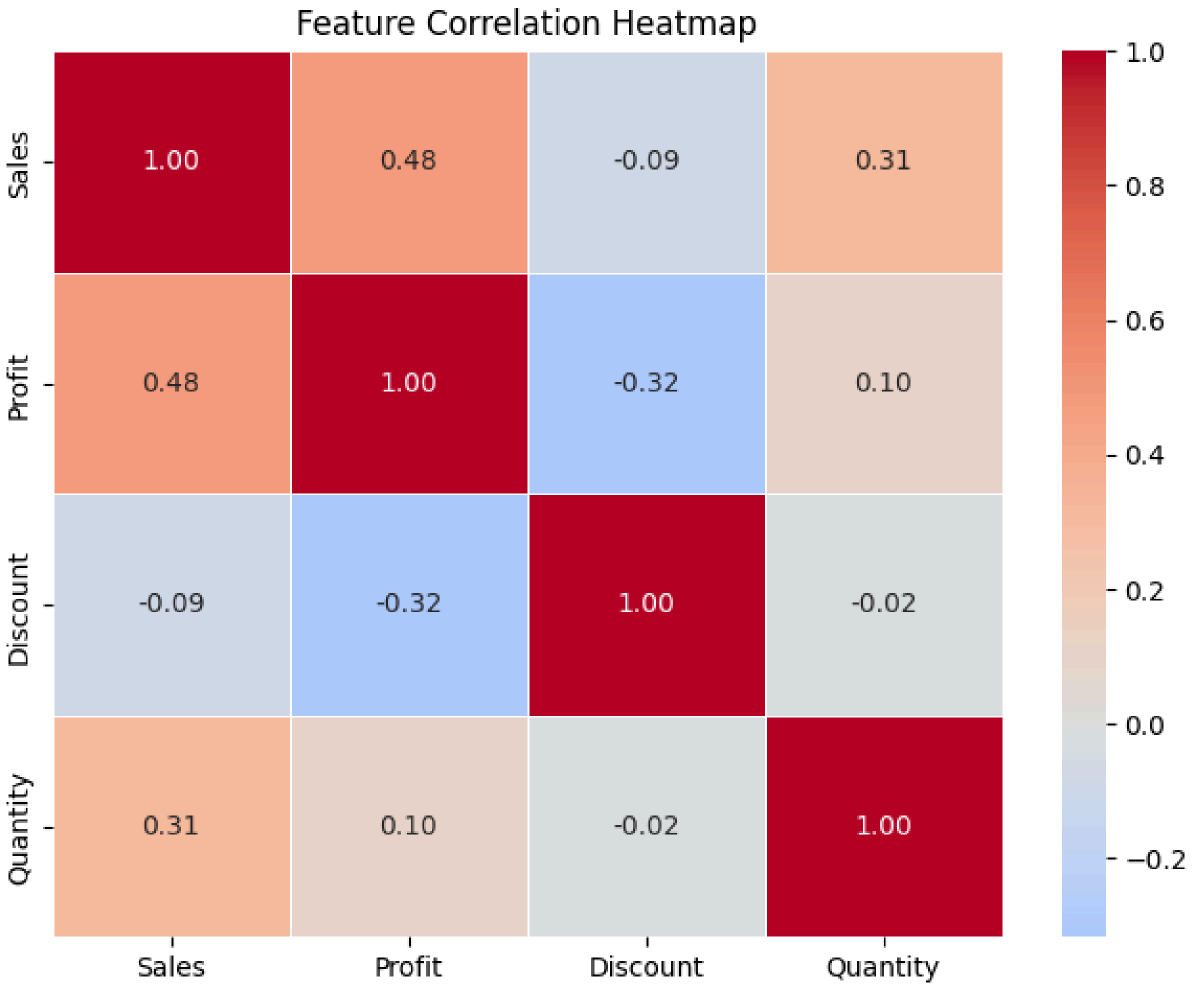


In [15]:

```
# Visualize correlations and relationships between features
# Select numerical columns for correlation analysis
num_cols = ['Sales', 'Profit', 'Discount', 'Quantity']

# Calculate the correlation matrix
corr_matrix = sales_df[num_cols].corr()

# Create the heatmap
plt.figure(figsize=(8, 6))
sb.heatmap(corr_matrix, annot=True, cmap='coolwarm', center=0, fmt=".2f", li
plt.title('Feature Correlation Heatmap')
plt.show()
```

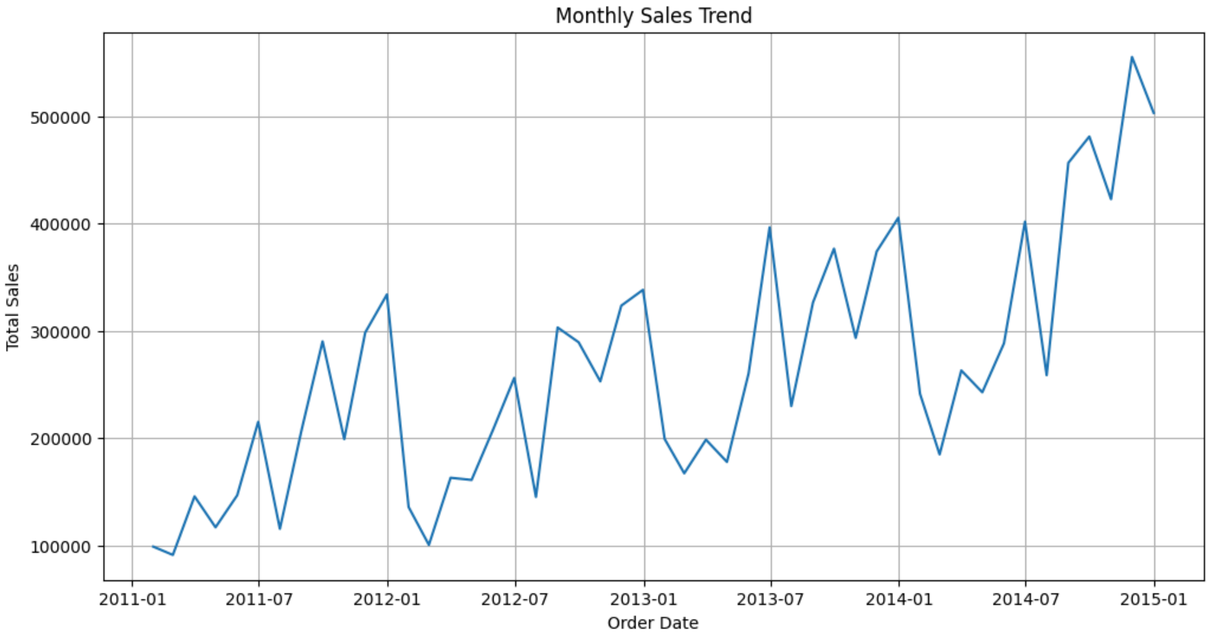


In [16]:

```
# Remove outliers using IQR method
#Q1 = sales_df.quantile(0.25)
#Q3 = sales_df.quantile(0.75)
#IQR = Q3 - Q1
# Filter dataframe to keep only rows within 1.5*IQR range for all numerical
#sales_df_clean = sales_df[~((sales_df < (Q1 - 1.5 * IQR)) | (sales_df > (Q3
```

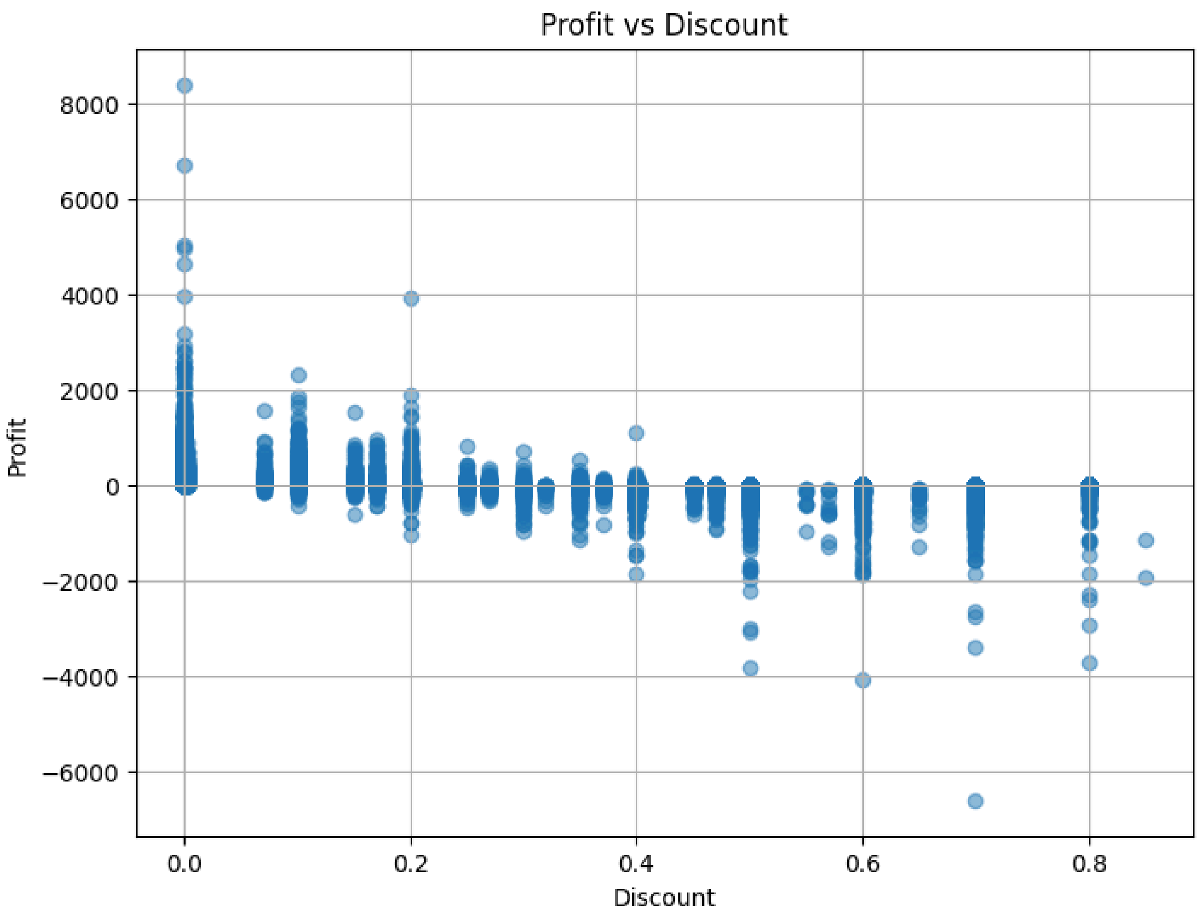
In [17]:

```
# Observe trends in Sales over time.
plt.figure(figsize=(12, 6))
#sales_df.groupby('Order Date')['Sales'].sum().plot(kind='line', marker='o')
trend_data = sales_df.groupby(pd.Grouper(key='Order Date', freq='ME'))['Sale
sb.lineplot(x=trend_data.index, y=trend_data.values)
plt.title('Monthly Sales Trend')
plt.xlabel('Order Date')
plt.ylabel('Total Sales')
plt.grid(True)
plt.show()
```



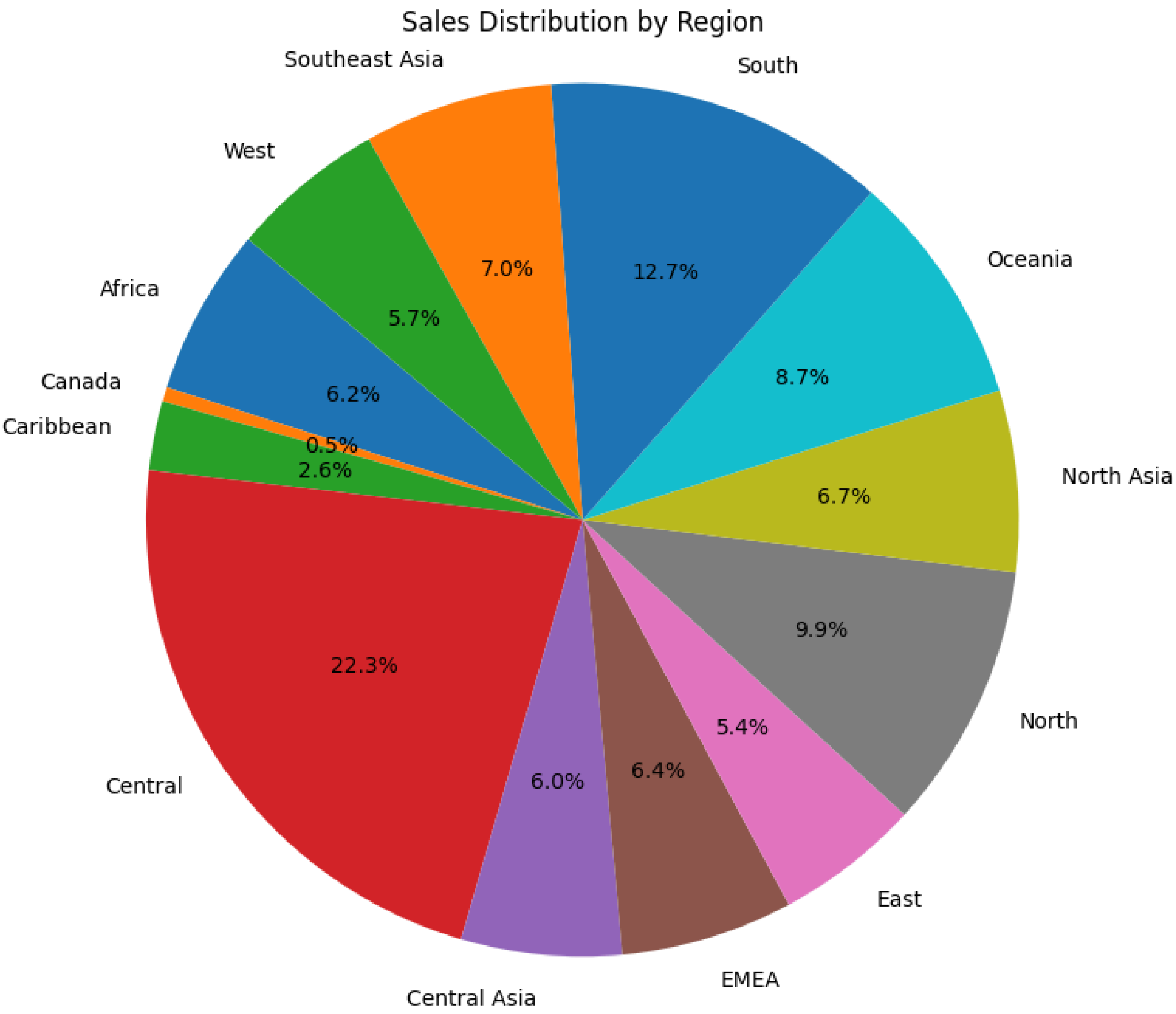
In [25]:

```
# Relationship between Profit and Discount
plt.figure(figsize=(8, 6))
plt.scatter(sales_df['Discount'], sales_df['Profit'], alpha=0.5)
plt.xlabel('Discount')
plt.ylabel('Profit')
plt.title('Profit vs Discount')
plt.grid(True)
plt.show()
```



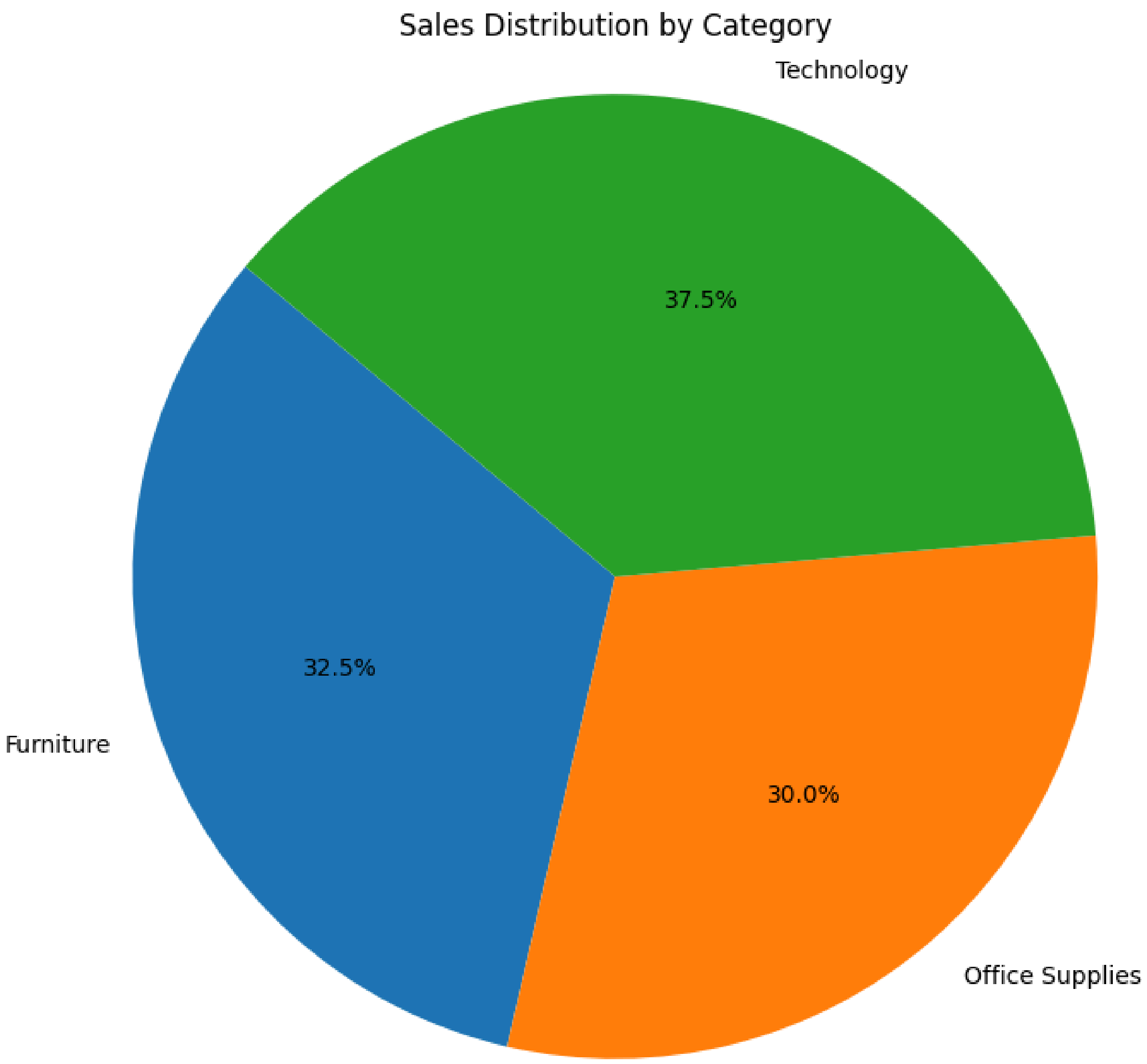
Visualize sales distribution by Region and Category

In [19]:
```
# Plot pie chart of sales distribution by Region
region_sales = sales_df.groupby('Region')['Sales'].sum()
plt.figure(figsize=(8, 8))
plt.pie(region_sales, labels=region_sales.index, autopct='%1.1f%%', startang
plt.title('Sales Distribution by Region')
plt.axis('equal')
plt.show()
```



In [20]:

```
# Plot pie chart of sales distribution by Category
category_sales = sales_df.groupby('Category')['Sales'].sum()
plt.figure(figsize=(8, 8))
plt.pie(category_sales, labels=category_sales.index, autopct='%1.1f%%', star
plt.title('Sales Distribution by Category')
plt.axis('equal')
plt.show()
```



Train a Linear Regression Model and evaluate model performance

```
In [21]: from sklearn.model_selection import train_test_split
         from sklearn.linear_model import LinearRegression
         from sklearn.metrics import mean_squared_error, r2_score
```

```
In [22]: # Feature Engineering
         X = sales_df[['Profit', 'Discount']]
         y = sales_df['Sales']

         # Split data (training data 80% test data 20%)
         X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, rar

         # Initialize and train model
         model = LinearRegression()
         model.fit(X_train, y_train)

         # Generate predictions
         y_pred = model.predict(X_test)
```

```python
# Calculate evaluation metrics
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

# Print model performance
print(f"Mean Squared Error: {mse:.2f}")
print(f"R-squared: {r2:.2f}")
```

```
Mean Squared Error: 187787.80
R-squared: 0.16
```