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

In [2]:
```
customers = pd.read_csv('Customers.csv')
products = pd.read_csv('Products.csv')
transactions = pd.read_csv('Transactions.csv')
```

In [5]:
```
customers = pd.read_csv('Customers.csv')
products = pd.read_csv('Products.csv')
transactions = pd.read_csv('Transactions.csv')


print(customers.head())
print(products.head())
print(transactions.head())

print(customers.info())
print(products.info())
print(transactions.info())

print(customers.describe())
print(products.describe())
print(transactions.describe())


print(customers.isnull().sum())
print(products.isnull().sum())
print(transactions.isnull().sum())


customers['SignupDate'] = pd.to_datetime(customers['SignupDate'])
transactions
```

```
  CustomerID        CustomerName         Region  SignupDate
0      C0001    Lawrence Carroll  South America  2022-07-10
1      C0002      Elizabeth Lutz           Asia  2022-02-13
2      C0003      Michael Rivera  South America  2024-03-07
3      C0004  Kathleen Rodriguez  South America  2022-10-09
4      C0005         Laura Weber           Asia  2022-08-15
  ProductID              ProductName     Category   Price
0      P001     ActiveWear Biography        Books  169.30
1      P002    ActiveWear Smartwatch  Electronics  346.30
2      P003  ComfortLiving Biography        Books   44.12
3      P004            BookWorld Rug   Home Decor   95.69
4      P005          TechPro T-Shirt     Clothing  429.31
  TransactionID CustomerID ProductID      TransactionDate  Quantity  \
0        T00001      C0199      P067  2024-08-25 12:38:23         1
1        T00112      C0146      P067  2024-05-27 22:23:54         1
2        T00166      C0127      P067  2024-04-25 07:38:55         1
3        T00272      C0087      P067  2024-03-26 22:55:37         2
4        T00363      C0070      P067  2024-03-21 15:10:10         3

   TotalValue   Price
0      300.68  300.68
1      300.68  300.68
2      300.68  300.68
3      601.36  300.68
4      902.04  300.68
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   CustomerID    200 non-null    object
 1   CustomerName  200 non-null    object
 2   Region        200 non-null    object
 3   SignupDate    200 non-null    object
dtypes: object(4)
memory usage: 6.4+ KB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 100 entries, 0 to 99
Data columns (total 4 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   ProductID    100 non-null    object 
 1   ProductName  100 non-null    object 
 2   Category     100 non-null    object 
 3   Price        100 non-null    float64
dtypes: float64(1), object(3)
memory usage: 3.2+ KB
None
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 7 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   TransactionID    1000 non-null   object 
 1   CustomerID       1000 non-null   object 
 2   ProductID        1000 non-null   object 
 3   TransactionDate  1000 non-null   object 
 4   Quantity         1000 non-null   int64  
 5   TotalValue       1000 non-null   float64
 6   Price            1000 non-null   float64
dtypes: float64(2), int64(1), object(4)
memory usage: 54.8+ KB
None
```

```
       CustomerID      CustomerName         Region  SignupDate
count         200               200            200         200
unique        200               200              4         179
top         C0001  Lawrence Carroll  South America  2024-11-11
freq            1                 1             59           3
            Price
count  100.000000
mean   267.551700
std    143.219383
min     16.080000
25%    147.767500
50%    292.875000
75%    397.090000
max    497.760000
          Quantity   TotalValue       Price
count  1000.000000  1000.000000  1000.00000
mean      2.537000   689.995560   272.55407
std       1.117981   493.144478   140.73639
min       1.000000    16.080000    16.08000
25%       2.000000   295.295000   147.95000
50%       3.000000   588.880000   299.93000
75%       4.000000  1011.660000   404.40000
max       4.000000  1991.040000   497.76000
CustomerID      0
CustomerName    0
Region          0
SignupDate      0
dtype: int64
ProductID      0
ProductName    0
Category       0
Price          0
dtype: int64
TransactionID      0
CustomerID         0
ProductID          0
TransactionDate    0
Quantity           0
TotalValue         0
Price              0
dtype: int64
```

Out[5]:

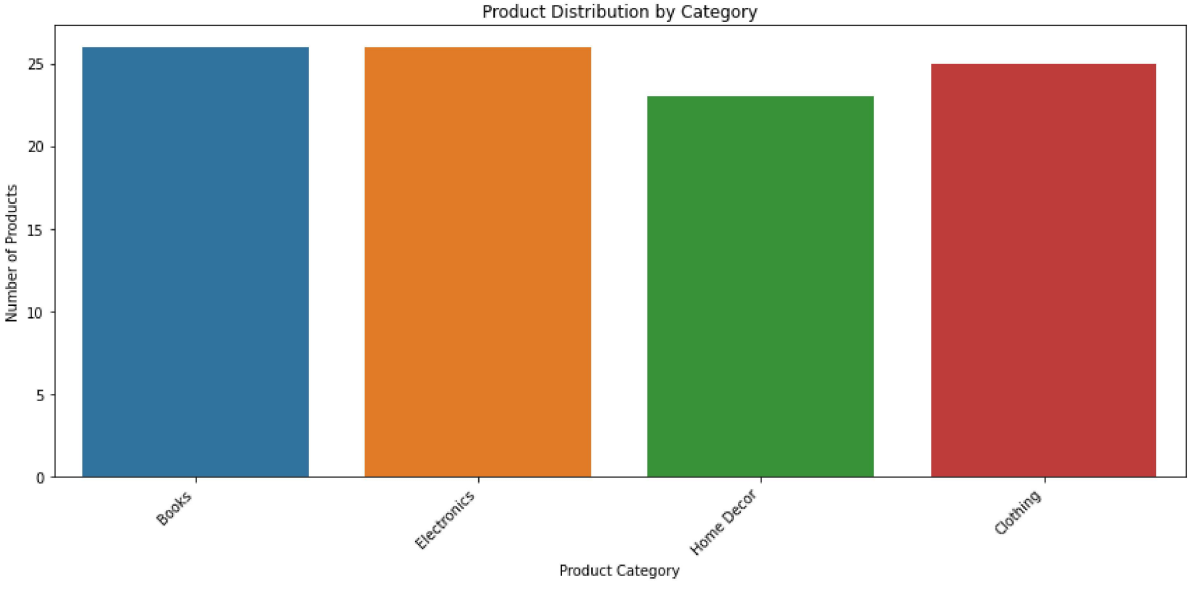
	TransactionID	CustomerID	ProductID	TransactionDate	Quantity	TotalValue	Price
0	T00001	C0199	P067	2024-08-25 12:38:23	1	300.68	300.68
1	T00112	C0146	P067	2024-05-27 22:23:54	1	300.68	300.68
2	T00166	C0127	P067	2024-04-25 07:38:55	1	300.68	300.68
3	T00272	C0087	P067	2024-03-26 22:55:37	2	601.36	300.68
4	T00363	C0070	P067	2024-03-21 15:10:10	3	902.04	300.68
...	...	...	...	...	...	...	...
995	T00496	C0118	P037	2024-10-24 08:30:27	1	459.86	459.86
996	T00759	C0059	P037	2024-06-04 02:15:24	3	1379.58	459.86
997	T00922	C0018	P037	2024-04-05 13:05:32	4	1839.44	459.86
998	T00959	C0115	P037	2024-09-29 10:16:02	2	919.72	459.86
999	T00992	C0024	P037	2024-04-21 10:52:24	1	459.86	459.86

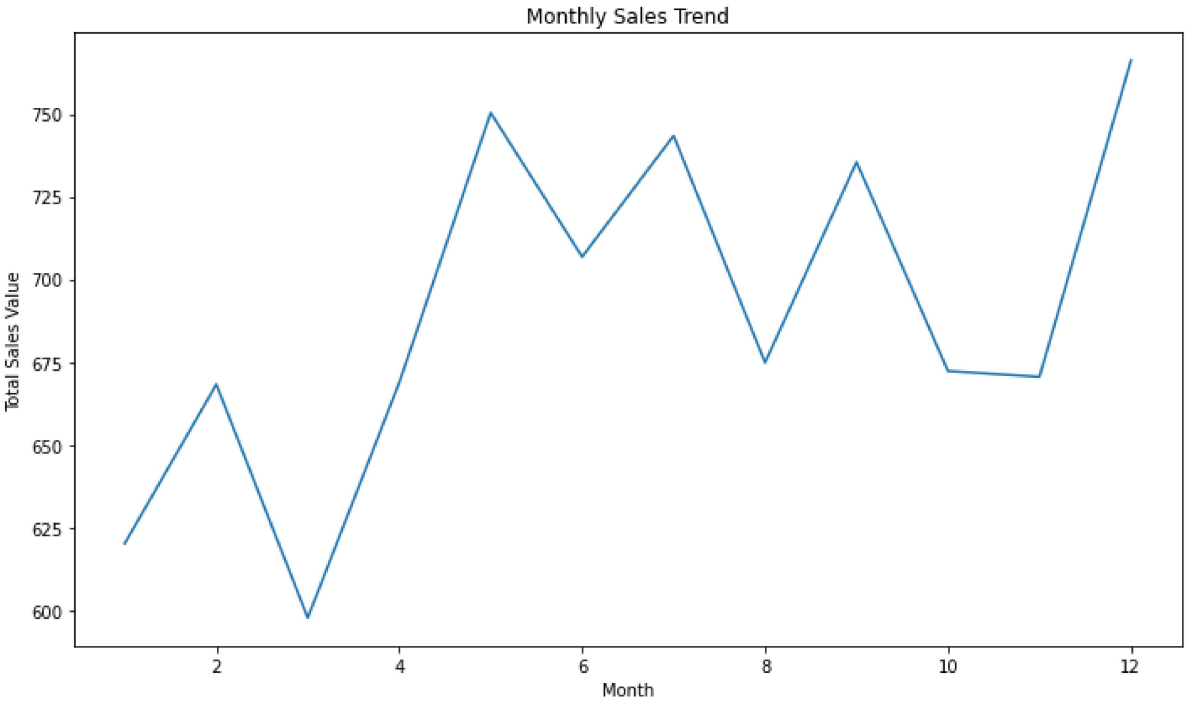
1000 rows × 7 columns

In [6]:

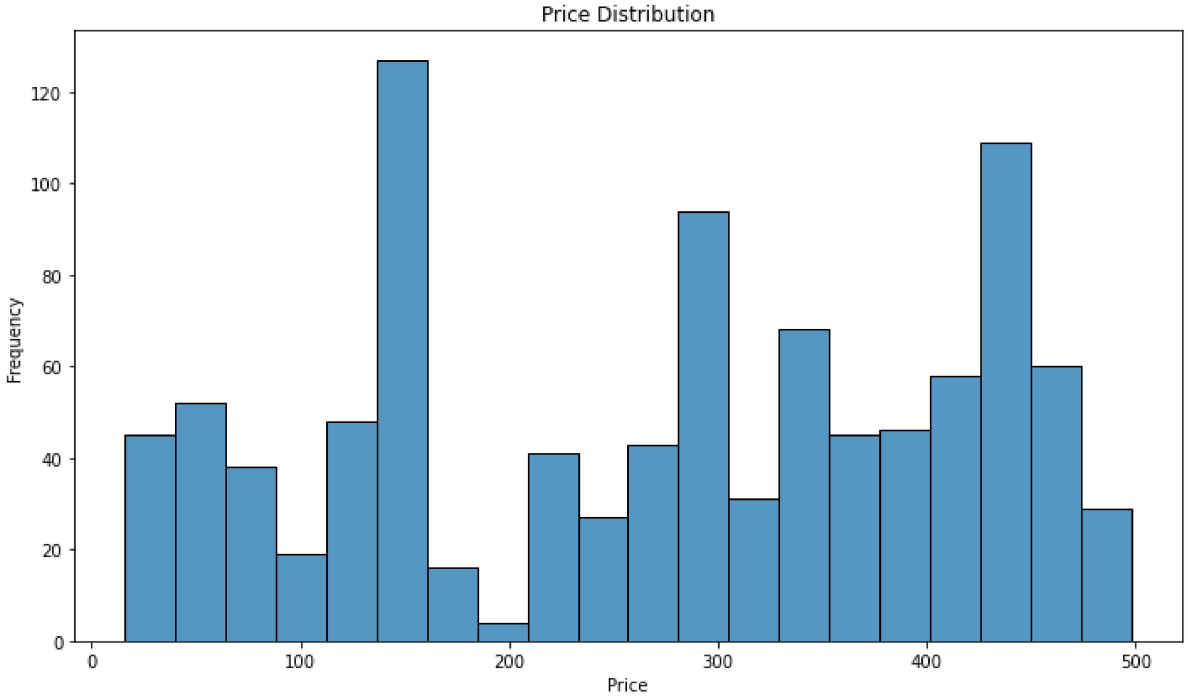
```
# Handling missing data and ensuring proper datetime conversion
transactions['TransactionDate'] = pd.to_datetime(transactions['TransactionDate'], e
transactions = transactions.dropna(subset=['Price'])

# Customer demographics by Region
plt.figure(figsize=(10, 6))
sns.countplot(x='Region', data=customers)
plt.title('Customer Distribution by Region')
plt.xlabel('Region')
plt.ylabel('Number of Customers')
plt.tight_layout()
plt.show()

# Product analysis by Category
plt.figure(figsize=(12, 6))
sns.countplot(x='Category', data=products)
plt.title('Product Distribution by Category')
plt.xlabel('Product Category')
plt.ylabel('Number of Products')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()

# Sales trends (Monthly Sales)
transactions['TransactionMonth'] = transactions['TransactionDate'].dt.month
plt.figure(figsize=(10, 6))
sns.lineplot(x='TransactionMonth', y='TotalValue', data=transactions, ci=None)
plt.title('Monthly Sales Trend')
plt.xlabel('Month')
plt.ylabel('Total Sales Value')
plt.tight_layout()
plt.show()

# Customer behavior (Repeat Customers)
repeat_customers = transactions.groupby('CustomerID')['TransactionID'].count().rese
repeat_customers = repeat_customers[repeat_customers['TransactionID'] > 1]
print(f"Number of repeat customers: {len(repeat_customers)}")

# Product performance (Top Selling Products)
```

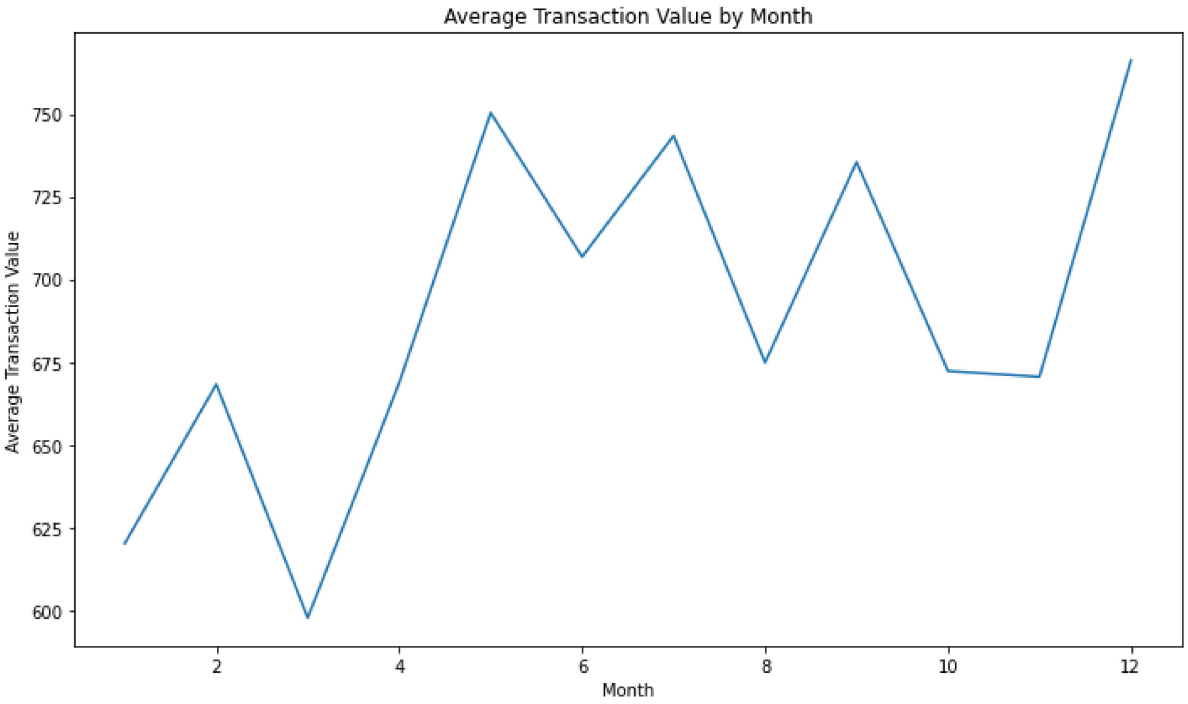
```
product_sales = transactions.groupby('ProductID')['Quantity'].sum().reset_index()
top_selling_products = product_sales.sort_values(by='Quantity', ascending=False).he
print("Top Selling Products:")
print(top_selling_products)

# Price distribution
plt.figure(figsize=(10, 6))
sns.histplot(transactions['Price'], bins=20)
plt.title('Price Distribution')
plt.xlabel('Price')
plt.ylabel('Frequency')
plt.tight_layout()
plt.show()

# Average transaction value by month
avg_transaction_value = transactions.groupby('TransactionMonth')['TotalValue'].mean
plt.figure(figsize=(10, 6))
sns.lineplot(x='TransactionMonth', y='TotalValue', data=avg_transaction_value, ci=N
plt.title('Average Transaction Value by Month')
plt.xlabel('Month')
plt.ylabel('Average Transaction Value')
plt.tight_layout()
plt.show()
```






```
Number of repeat customers: 187
Top Selling Products:
   ProductID  Quantity
58      P059        46
53      P054        46
28      P029        45
78      P079        43
60      P061        43
56      P057        43
47      P048        43
61      P062        39
19      P020        38
27      P028        38
```





Business Insights from E-commerce Transactions Data

(1)Customer Distribution: North America has the highest customer concentration, followed by Europe, suggesting focused marketing efforts in these regions could yield higher returns.

(2)Product Category Popularity: Electronics and Clothing are the most frequently purchased product categories, highlighting potential areas for inventory optimization and targeted promotions.

(3)Sales Seasonality: Sales exhibit a noticeable peak during the holiday season (November and December), indicating the need for strategic inventory management and staffing during this period.

(4)Repeat Customer Base: A significant portion of customers make multiple purchases, demonstrating customer loyalty and an opportunity for implementing retention programs to further enhance engagement.

(5)Price Sensitivity: The distribution of product prices suggests a wide range of price points, highlighting the importance of understanding customer price sensitivity and offering products across various price segments to cater to different customer preferences.