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

df_transaction=pd.read_csv('Transactions.csv')
df_Products=pd.read_csv('Products.csv')
df_Customers=pd.read_csv('Customers.csv')

print(f"Shape of df_transaction : {df_transaction.shape}")
print(f"Shape of df_Products: {df_Products.shape}")
print(f"Shape of df_Customers : {df_Customers.shape}")
```

```
Shape of df_transaction : (1000, 7)
Shape of df_Products: (100, 4)
Shape of df_Customers : (200, 4)
```

```python
print(f"Null values in df_transaction :
{df_transaction.isnull().sum()}")
print(f"Null values in df_Products: {df_Products.isnull().sum()}")
print(f"Null values in df_Customers : {df_Customers.isnull().sum()}")
```

```
Null values in df_transaction : TransactionID      0
CustomerID         0
ProductID          0
TransactionDate    0
Quantity           0
TotalValue         0
Price              0
dtype: int64
Null values in df_Products: ProductID      0
ProductName    0
Category       0
Price          0
dtype: int64
Null values in df_Customers : CustomerID      0
CustomerName    0
Region          0
SignupDate      0
dtype: int64
```

```python
print(f"Null values in df_transaction :
{df_transaction.duplicated().sum()}")
print(f"Null values in df_Products: {df_Products.duplicated().sum()}")
print(f"Null values in df_Customers :
{df_Customers.duplicated().sum()}")
```

```
Null values in df_transaction : 0
Null values in df_Products: 0
Null values in df_Customers : 0
```

```
df_transaction.head(3)
```

```
  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

   TotalValue   Price
0      300.68  300.68
1      300.68  300.68
2      300.68  300.68
```

```
df_Customers.head(3)
```

```
  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
```

```
df_Products.head(3)
```

```
  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
```

```
Transactions_with_Customers = df_transaction.merge(df_Customers,
on='CustomerID', how='left')
Merged_data = Transactions_with_Customers.merge(df_Products,
on='ProductID', how='left')
```

```
Merged_data
```

```
    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

..            ...        ...       ...                  ...       ...

995        T00496      C0118      P037  2024-10-24 08:30:27         1

996        T00759      C0059      P037  2024-06-04 02:15:24         3

997        T00922      C0018      P037  2024-04-05 13:05:32         4
```

```
998        T00959      C0115      P037  2024-09-29 10:16:02         2

999        T00992      C0024      P037  2024-04-21 10:52:24         1


     TotalValue  Price_x           CustomerName         Region
SignupDate  \
0        300.68   300.68         Andrea Jenkins         Europe  2022-
12-03
1        300.68   300.68        Brittany Harvey           Asia  2024-
09-04
2        300.68   300.68        Kathryn Stevens         Europe  2024-
04-04
3        601.36   300.68        Travis Campbell  South America  2024-
04-11
4        902.04   300.68          Timothy Perez         Europe  2022-
03-15
..          ...      ...                    ...            ...
...
995      459.86   459.86             Jacob Holt  South America  2022-
01-22
996     1379.58   459.86  Mrs. Kimberly Wright  North America  2024-
04-07
997     1839.44   459.86           Tyler Haynes  North America  2024-
09-21
998      919.72   459.86        Joshua Hamilton           Asia  2024-
11-11
999      459.86   459.86         Michele Cooley  North America  2024-
02-05

                          ProductName     Category  Price_y
0    ComfortLiving Bluetooth Speaker  Electronics   300.68
1    ComfortLiving Bluetooth Speaker  Electronics   300.68
2    ComfortLiving Bluetooth Speaker  Electronics   300.68
3    ComfortLiving Bluetooth Speaker  Electronics   300.68
4    ComfortLiving Bluetooth Speaker  Electronics   300.68
..                               ...          ...      ...
995             SoundWave Smartwatch  Electronics   459.86
996             SoundWave Smartwatch  Electronics   459.86
997             SoundWave Smartwatch  Electronics   459.86
998             SoundWave Smartwatch  Electronics   459.86
999             SoundWave Smartwatch  Electronics   459.86

[1000 rows x 13 columns]

Merged_data.isnull().sum()

TransactionID      0
CustomerID         0
```

```
ProductID          0
TransactionDate    0
Quantity           0
TotalValue         0
Price_x            0
CustomerName       0
Region             0
SignupDate         0
ProductName        0
Category           0
Price_y            0
dtype: int64
```

```
Merged_data.describe()
```

```
          Quantity   TotalValue     Price_x     Price_y
count  1000.000000  1000.000000  1000.00000  1000.00000
mean      2.537000   689.995560   272.55407   272.55407
std       1.117981   493.144478   140.73639   140.73639
min       1.000000    16.080000    16.08000    16.08000
25%       2.000000   295.295000   147.95000   147.95000
50%       3.000000   588.880000   299.93000   299.93000
75%       4.000000  1011.660000   404.40000   404.40000
max       4.000000  1991.040000   497.76000   497.76000
```

```
Merged_data.info()
```

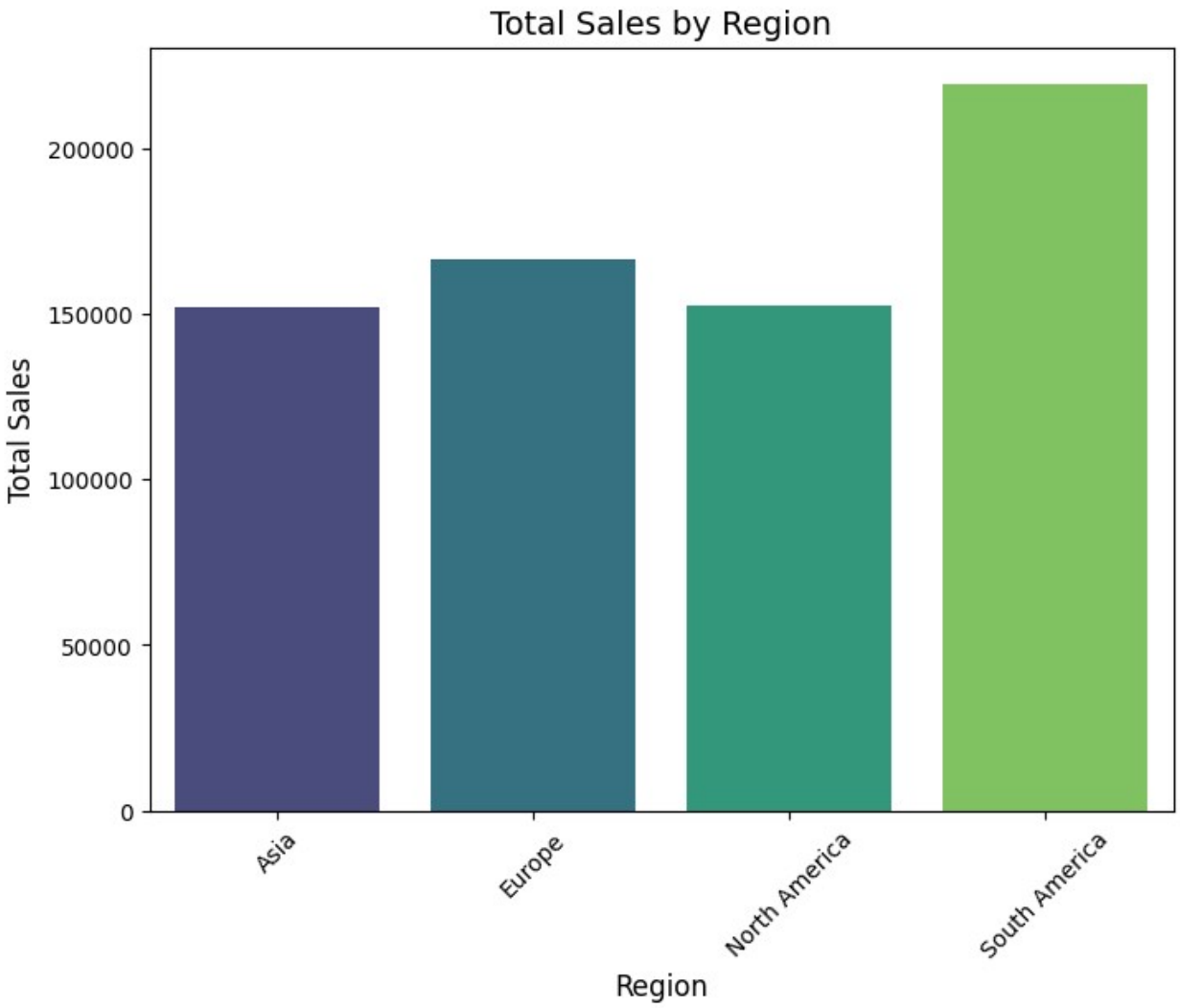
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 13 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   TransactionID    1000 non-null   object 
 1   CustomerID       1000 non-null   object 
 2   ProductID        1000 non-null   object 
 3   TransactionDate  1000 non-null   object 
 4   Quantity         1000 non-null   int64  
 5   TotalValue       1000 non-null   float64
 6   Price_x          1000 non-null   float64
 7   CustomerName     1000 non-null   object 
 8   Region           1000 non-null   object 
 9   SignupDate       1000 non-null   object 
 10  ProductName      1000 non-null   object 
 11  Category         1000 non-null   object 
 12  Price_y          1000 non-null   float64
dtypes: float64(3), int64(1), object(9)
memory usage: 101.7+ KB
```

```
Merged_data.head(3)
```

```
  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

   TotalValue  Price_x     CustomerName  Region  SignupDate  \
0      300.68   300.68   Andrea Jenkins  Europe  2022-12-03
1      300.68   300.68  Brittany Harvey    Asia  2024-09-04
2      300.68   300.68  Kathryn Stevens  Europe  2024-04-04

                       ProductName     Category  Price_y
0  ComfortLiving Bluetooth Speaker  Electronics   300.68
1  ComfortLiving Bluetooth Speaker  Electronics   300.68
2  ComfortLiving Bluetooth Speaker  Electronics   300.68
```

```
sales_by_region = Merged_data.groupby("Region")
["TotalValue"].sum().reset_index()

plt.figure(figsize=(8, 6))
sns.barplot(data=sales_by_region, x="Region", y="TotalValue",
palette="viridis")
plt.title("Total Sales by Region", fontsize=14)
plt.xlabel("Region", fontsize=12)
plt.ylabel("Total Sales", fontsize=12)
plt.xticks(rotation=45)
plt.show()
```

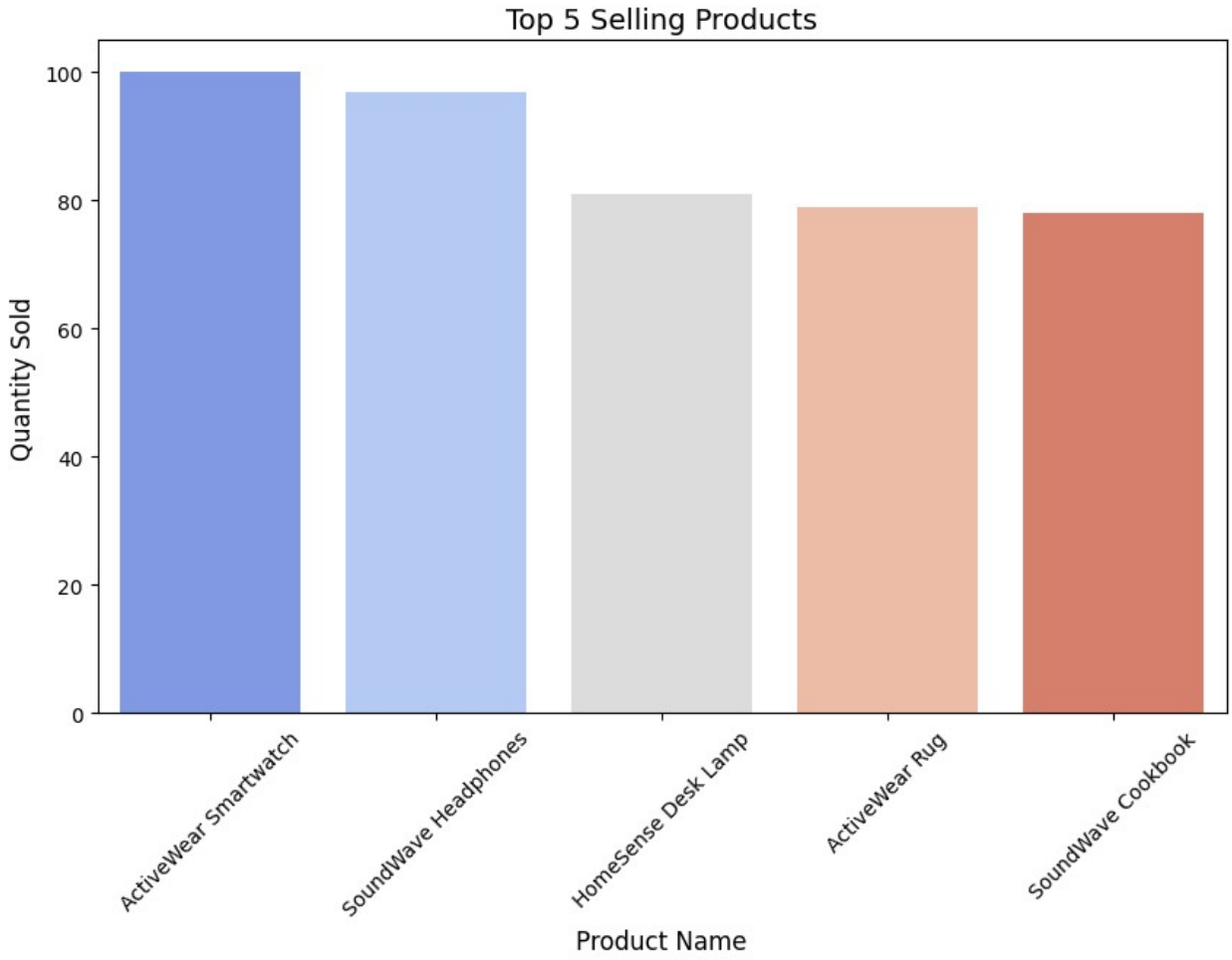
```
C:\Users\hp\AppData\Local\Temp\ipykernel_4788\2835220877.py:4:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.barplot(data=sales_by_region, x="Region", y="TotalValue",
palette="viridis")
```



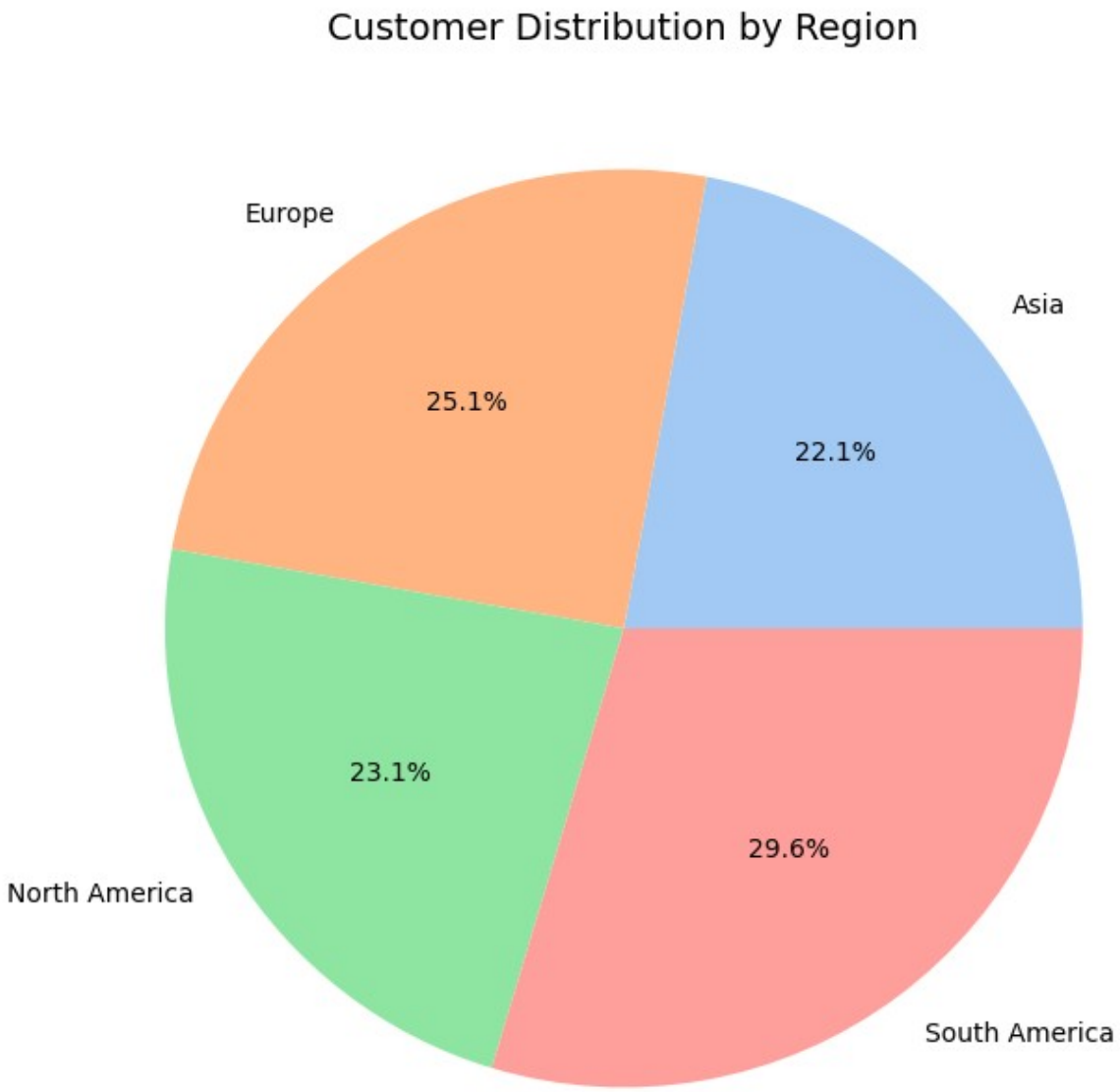

```
top_products = Merged_data.groupby("ProductName")
["Quantity"].sum().sort_values(ascending=False).head(5).reset_index()

plt.figure(figsize=(10, 6))
sns.barplot(data=top_products, x="ProductName", y="Quantity",
palette="coolwarm")
plt.title("Top 5 Selling Products", fontsize=14)
plt.xlabel("Product Name", fontsize=12)
plt.ylabel("Quantity Sold", fontsize=12)
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\hp\AppData\Local\Temp\ipykernel_4788\799798849.py:4:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.
```

```
  sns.barplot(data=top_products, x="ProductName", y="Quantity",
palette="coolwarm")
```

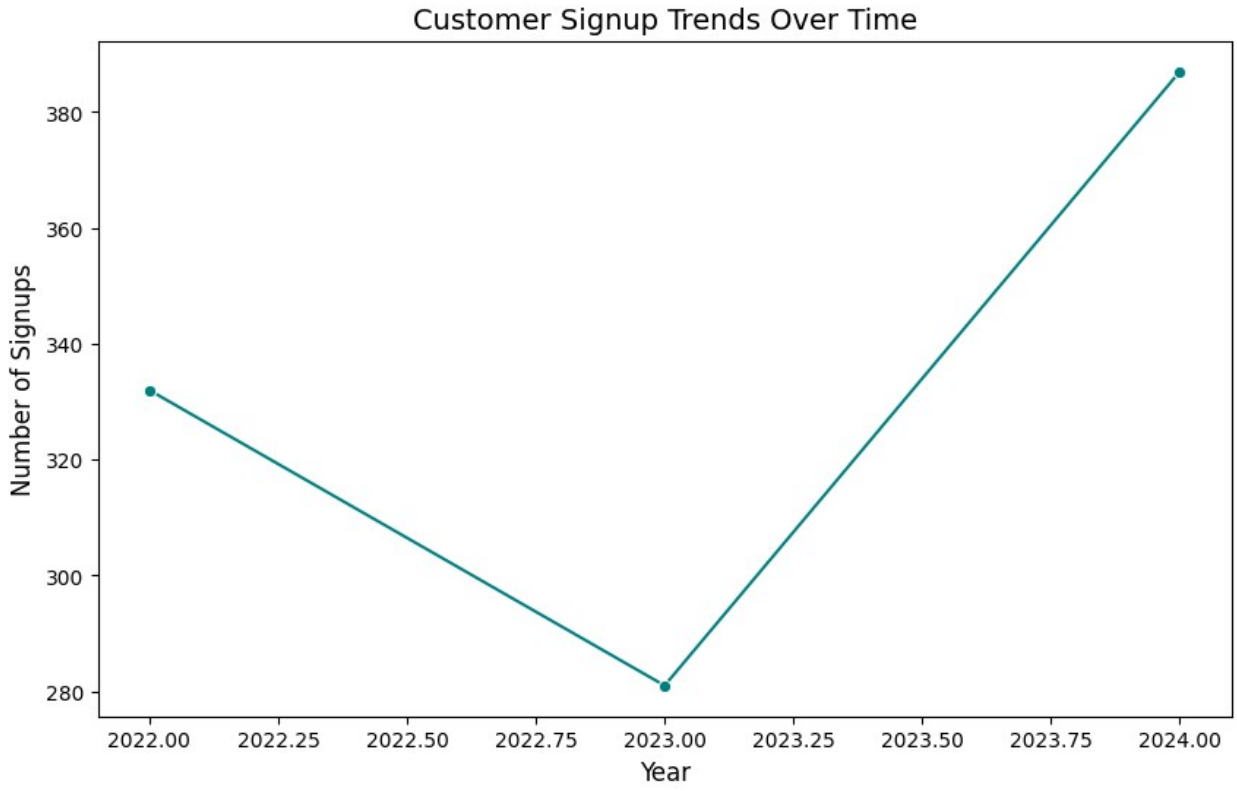



```
customers_by_region = Merged_data.groupby("Region")
["CustomerID"].nunique().reset_index()

plt.figure(figsize=(8, 8))
plt.pie(customers_by_region["CustomerID"],
labels=customers_by_region["Region"], autopct='%1.1f%%',
colors=sns.color_palette("pastel"))
plt.title("Customer Distribution by Region", fontsize=14)
plt.show()
```

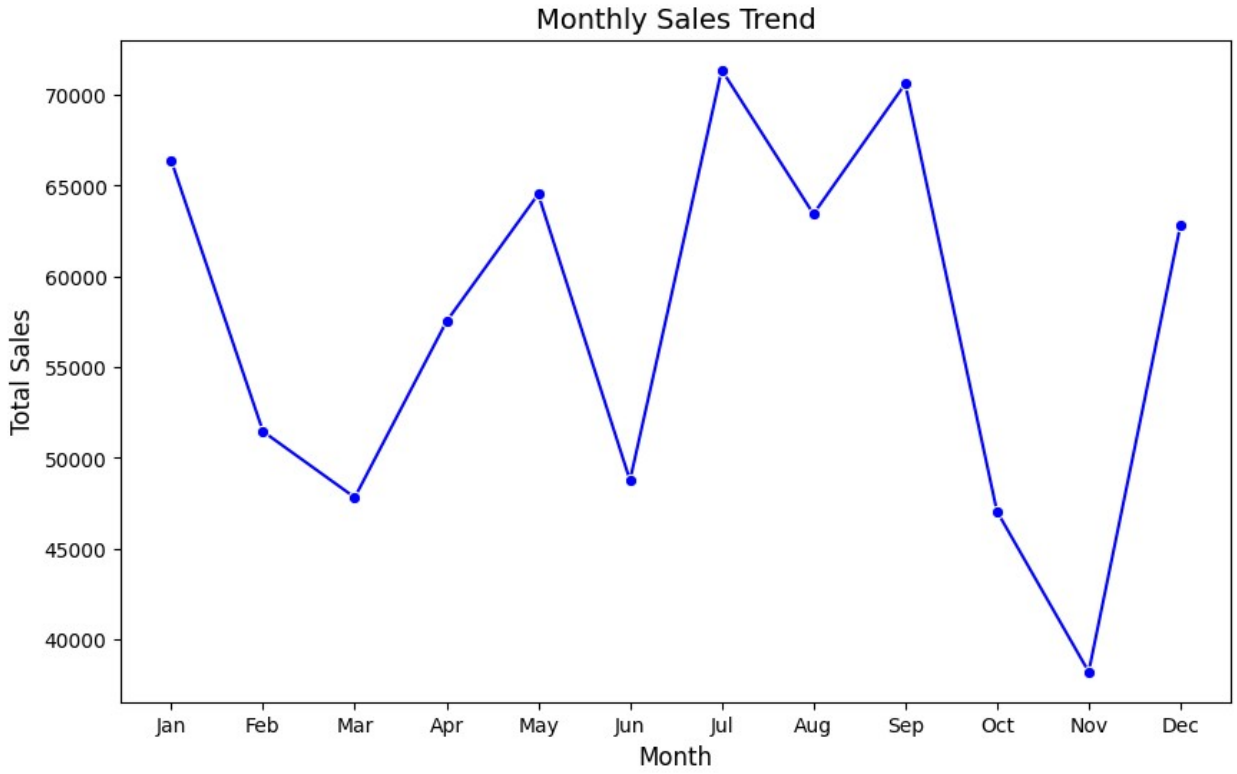



```
Merged_data["SignupDate"] = pd.to_datetime(Merged_data["SignupDate"],
errors="coerce")


Merged_data["SignupYear"] = Merged_data["SignupDate"].dt.year

signup_trends =
Merged_data["SignupYear"].value_counts().sort_index().reset_index()
signup_trends.columns = ["Year", "Signups"]

plt.figure(figsize=(10, 6))
sns.lineplot(data=signup_trends, x="Year", y="Signups", marker="o",
color="teal")
```

```
plt.title("Customer Signup Trends Over Time", fontsize=14)
plt.xlabel("Year", fontsize=12)
plt.ylabel("Number of Signups", fontsize=12)
plt.show()
```

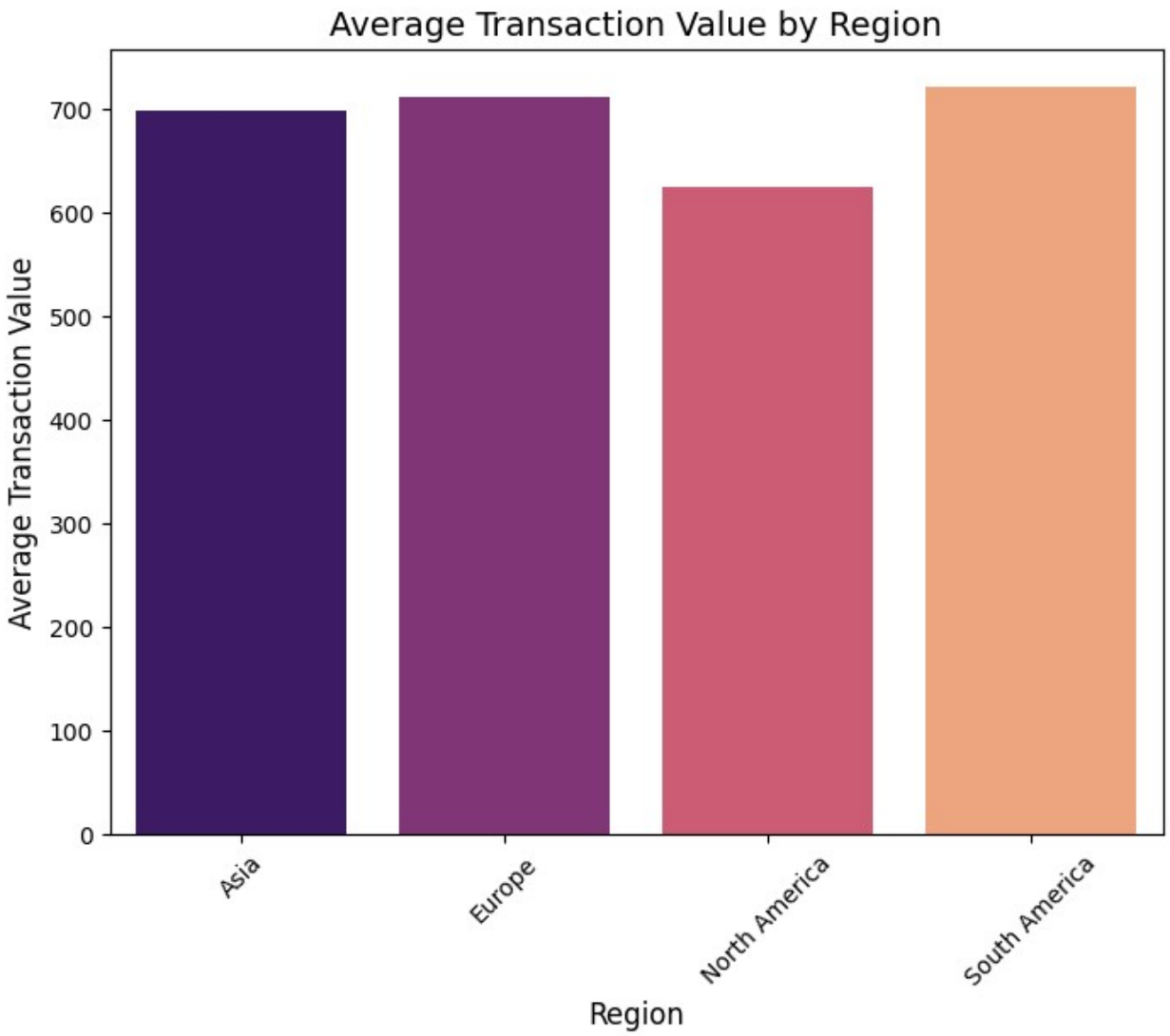



```
Merged_data["TransactionDate"]=pd.to_datetime(Merged_data["Transaction
Date"], errors="coerce")

Merged_data["TransactionMonth"] =
Merged_data["TransactionDate"].dt.month

monthly_sales = Merged_data.groupby("TransactionMonth")
["TotalValue"].sum().reset_index()

plt.figure(figsize=(10, 6))
sns.lineplot(data=monthly_sales, x="TransactionMonth", y="TotalValue",
marker="o", color="blue")
plt.title("Monthly Sales Trend", fontsize=14)
plt.xlabel("Month", fontsize=12)
plt.ylabel("Total Sales", fontsize=12)
plt.xticks(ticks=range(1, 13), labels=["Jan", "Feb", "Mar", "Apr",
"May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"])
plt.show()
```

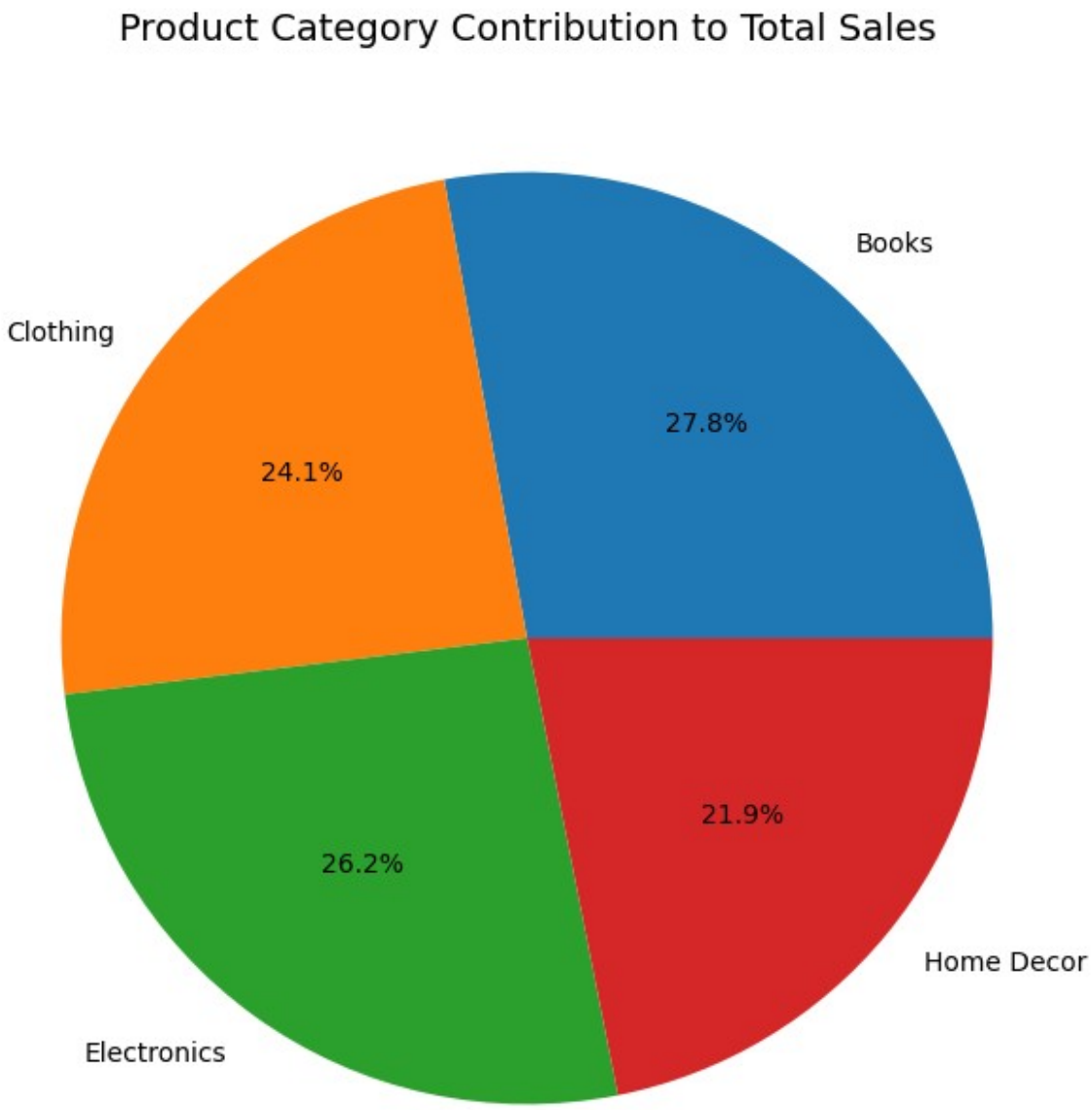



```
avg_transaction_by_region = Merged_data.groupby("Region")
["TotalValue"].mean().reset_index()

plt.figure(figsize=(8, 6))
sns.barplot(data=avg_transaction_by_region, x="Region",
y="TotalValue", palette="magma")
plt.title("Average Transaction Value by Region", fontsize=14)
plt.xlabel("Region", fontsize=12)
plt.ylabel("Average Transaction Value", fontsize=12)
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\hp\AppData\Local\Temp\ipykernel_4788\369699262.py:4:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.barplot(data=avg_transaction_by_region, x="Region",
y="TotalValue", palette="magma")
```

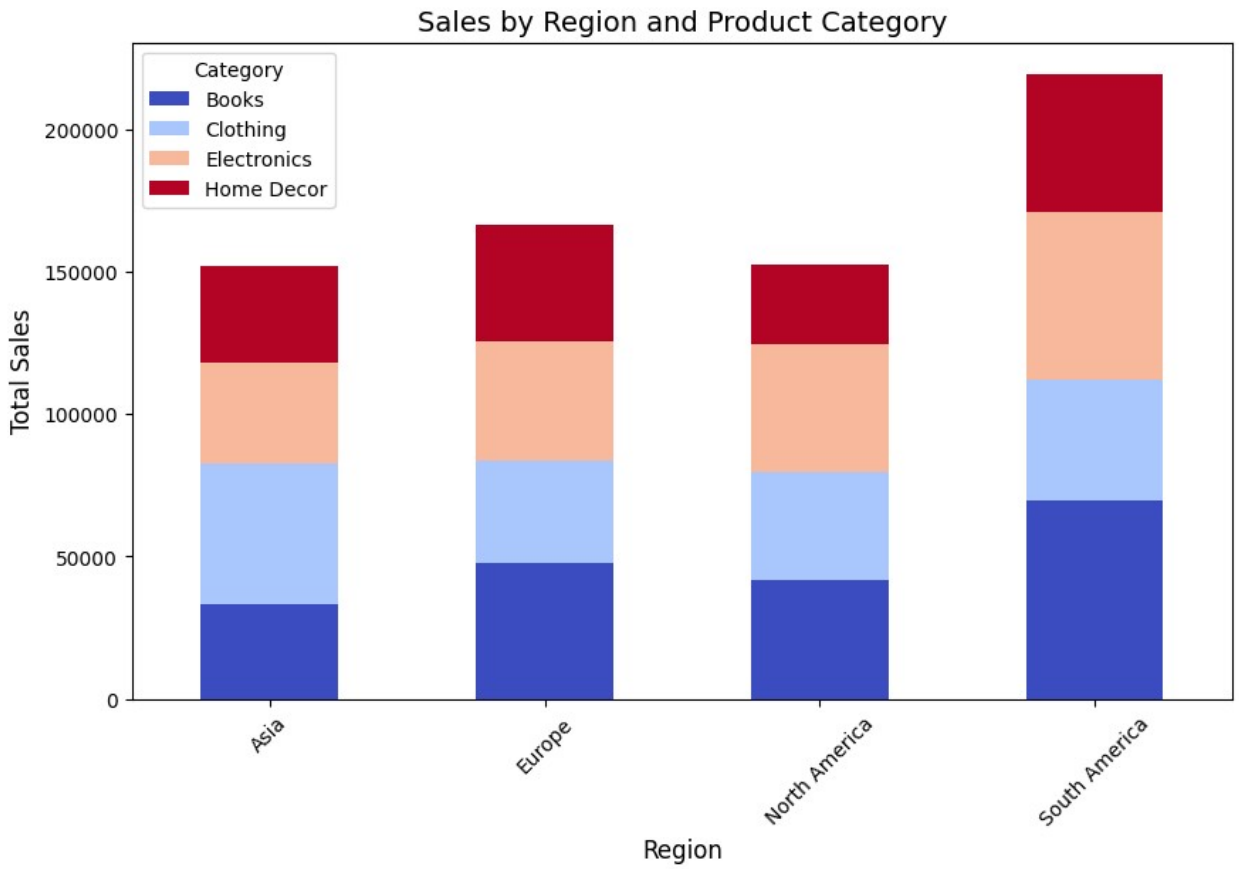



```
sales_by_category = Merged_data.groupby("Category")
["TotalValue"].sum().reset_index()

plt.figure(figsize=(8, 8))
plt.pie(sales_by_category["TotalValue"],
labels=sales_by_category["Category"], autopct='%1.1f%%',
colors=sns.color_palette("tab10"))
plt.title("Product Category Contribution to Total Sales", fontsize=14)
plt.show()
```



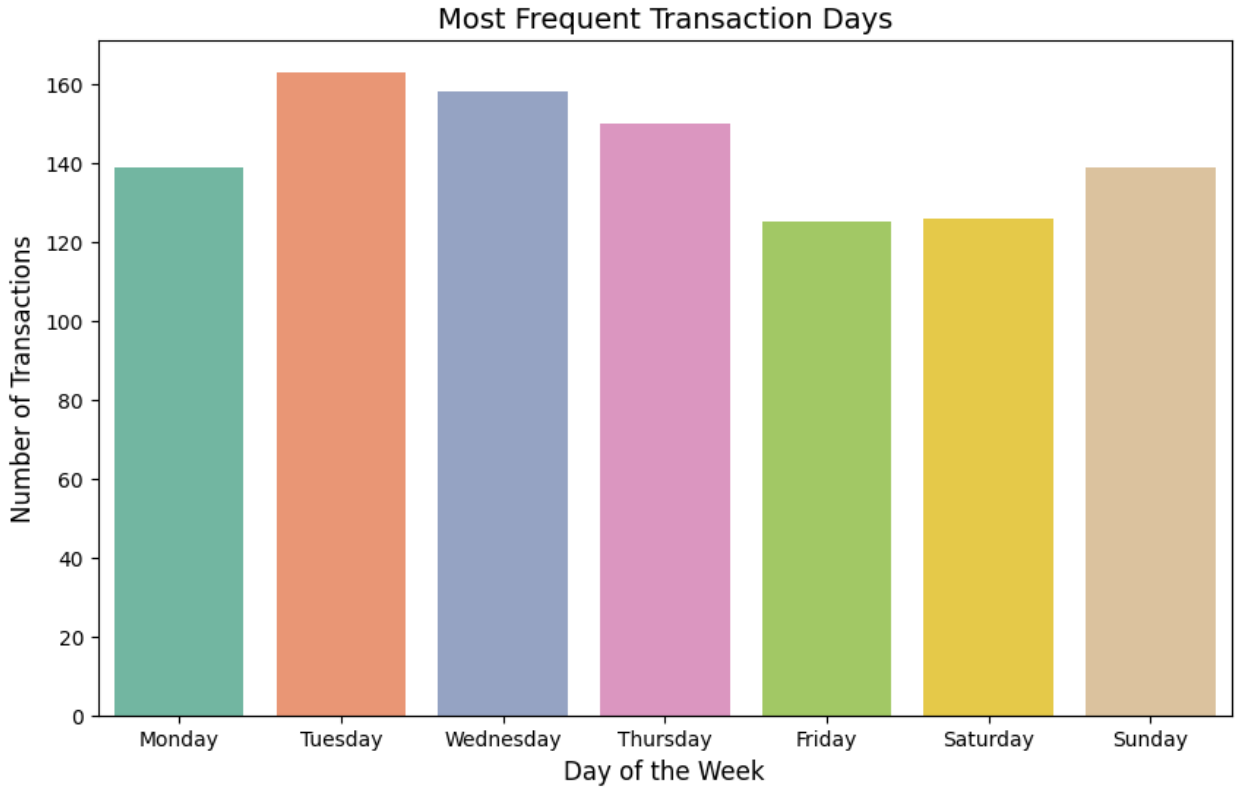

```
category_region_sales = Merged_data.pivot_table(values="TotalValue",
index="Region", columns="Category", aggfunc="sum", fill_value=0)

category_region_sales.plot(kind="bar", stacked=True, figsize=(10, 6),
colormap="coolwarm")
plt.title("Sales by Region and Product Category", fontsize=14)
plt.xlabel("Region", fontsize=12)
plt.ylabel("Total Sales", fontsize=12)
plt.xticks(rotation=45)
```

```
plt.legend(title="Category")
plt.show()
```

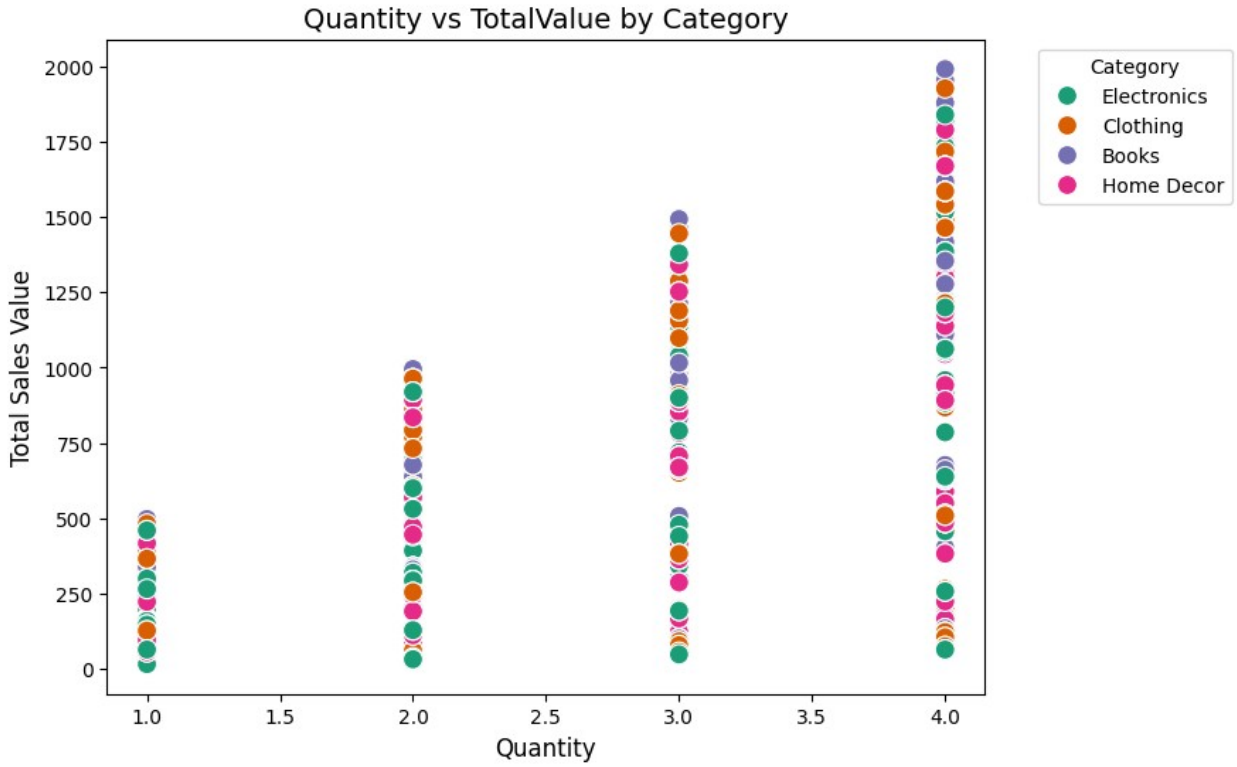



```
Merged_data["TransactionDay"] =
Merged_data["TransactionDate"].dt.day_name()

transactions_by_day =
Merged_data["TransactionDay"].value_counts().reset_index()
transactions_by_day.columns = ["Day", "Transactions"]

plt.figure(figsize=(10, 6))
sns.barplot(data=transactions_by_day, x="Day", y="Transactions",
palette="Set2", order=["Monday", "Tuesday", "Wednesday", "Thursday",
"Friday", "Saturday", "Sunday"])
plt.title("Most Frequent Transaction Days", fontsize=14)
plt.xlabel("Day of the Week", fontsize=12)
plt.ylabel("Number of Transactions", fontsize=12)
plt.show()

C:\Users\hp\AppData\Local\Temp\ipykernel_4788\1105637299.py:7:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
```

```
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.barplot(data=transactions_by_day, x="Day", y="Transactions",
palette="Set2", order=["Monday", "Tuesday", "Wednesday", "Thursday",
"Friday", "Saturday", "Sunday"])
```

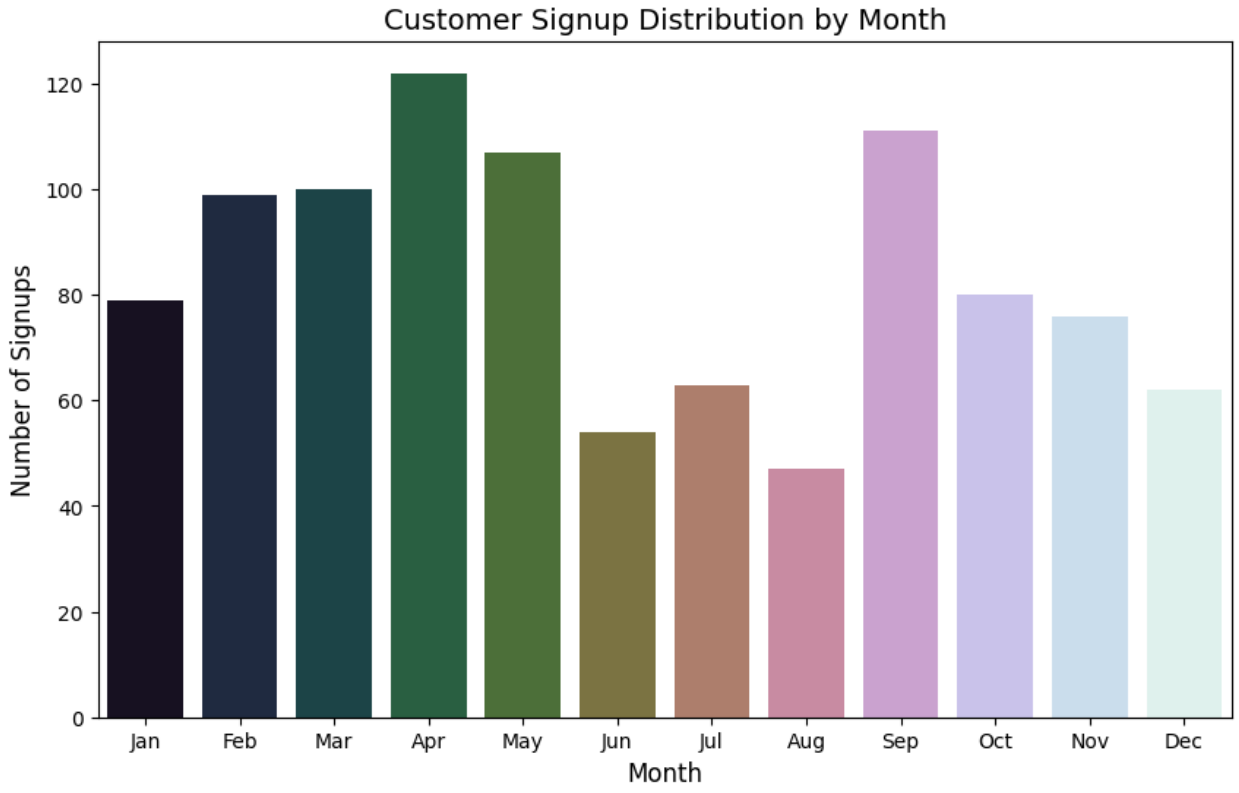



```
plt.figure(figsize=(8, 6))
sns.scatterplot(data=Merged_data, x="Quantity", y="TotalValue",
hue="Category", palette="Dark2", s=100)
plt.title("Quantity vs TotalValue by Category", fontsize=14)
plt.xlabel("Quantity", fontsize=12)
plt.ylabel("Total Sales Value", fontsize=12)
plt.legend(title="Category", bbox_to_anchor=(1.05, 1), loc='upper
left')
plt.show()
```

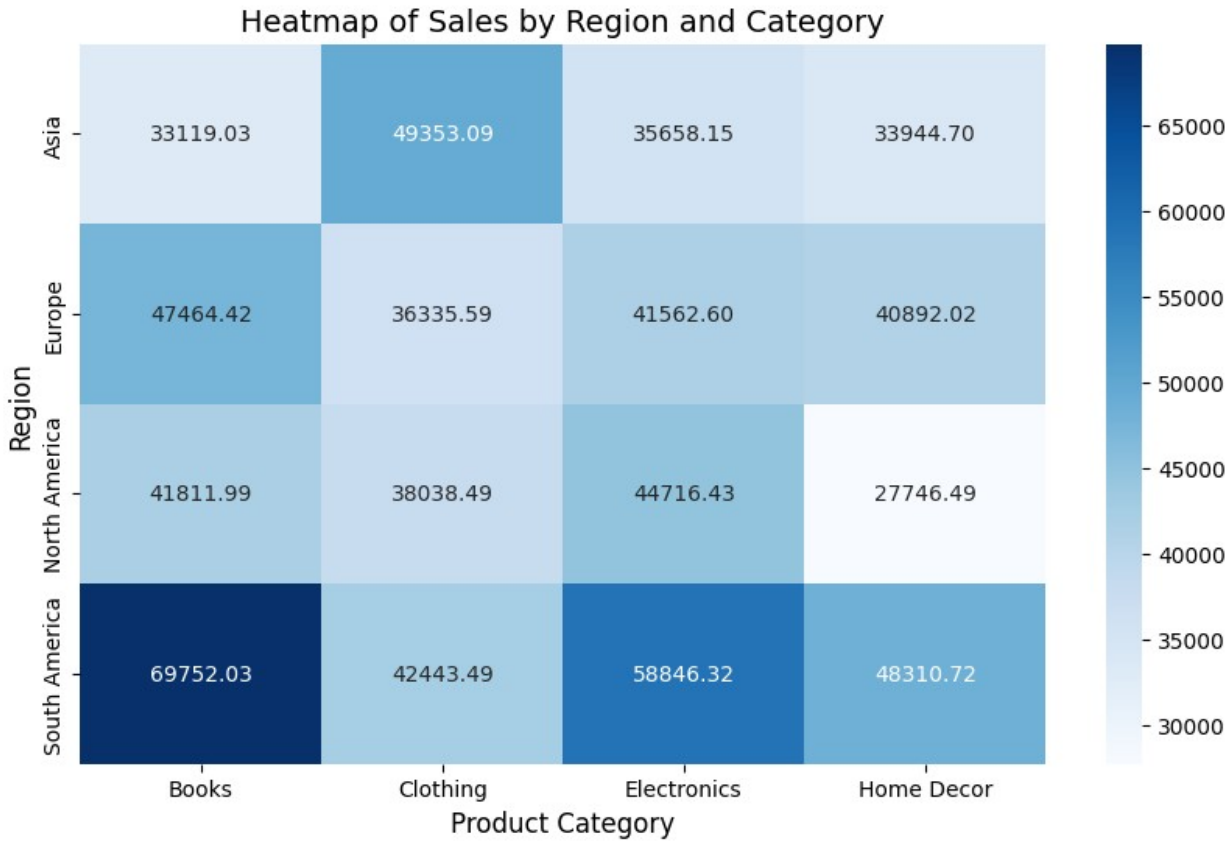



```
Merged_data["SignupMonth"] = Merged_data["SignupDate"].dt.month

signups_by_month =
Merged_data["SignupMonth"].value_counts().sort_index().reset_index()
signups_by_month.columns = ["Month", "Signups"]

plt.figure(figsize=(10, 6))
sns.barplot(data=signups_by_month, x="Month", y="Signups",
palette="cubehelix")
plt.title("Customer Signup Distribution by Month", fontsize=14)
plt.xlabel("Month", fontsize=12)
plt.ylabel("Number of Signups", fontsize=12)
plt.xticks(ticks=range(12), labels=["Jan", "Feb", "Mar", "Apr", "May",
"Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"])
plt.show()
```

```
C:\Users\hp\AppData\Local\Temp\ipykernel_4788\3026397383.py:7:
FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be
removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.barplot(data=signups_by_month, x="Month", y="Signups",
palette="cubehelix")
```




```
heatmap_data = Merged_data.pivot_table(values="TotalValue",
index="Region", columns="Category", aggfunc="sum", fill_value=0)

plt.figure(figsize=(10, 6))
sns.heatmap(heatmap_data, annot=True, fmt=".2f", cmap="Blues")
plt.title("Heatmap of Sales by Region and Category", fontsize=14)
plt.xlabel("Product Category", fontsize=12)
plt.ylabel("Region", fontsize=12)
plt.show()
```


Heatmap of Sales by Region and Category
Region
Asia
Europe
North America
South America
33119.03
49353.09
35658.15
33944.70
47464.42
36335.59
41562.60
40892.02
41811.99
38038.49
44716.43
27746.49
69752.03
42443.49
58846.32
48310.72
Books
Clothing
Electronics
Home Decor
Product Category
65000
60000
55000
50000
45000
40000
35000
30000