In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
C:\Users\CHIBUIKE OGODO\anaconda3\lib\site-packages\pandas\core\computatio
n\expressions.py:21: UserWarning: Pandas requires version '2.8.4' or newer
of 'numexpr' (version '2.8.3' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
C:\Users\CHIBUIKE OGODO\anaconda3\lib\site-packages\pandas\core\arrays\mas
ked.py:60: UserWarning: Pandas requires version '1.3.6' or newer of 'bottl
eneck' (version '1.3.5' currently installed).
  from pandas.core import (
C:\Users\CHIBUIKE OGODO\anaconda3\lib\site-packages\scipy\__init__.py:155:
UserWarning: A NumPy version >=1.18.5 and <1.25.0 is required for this ver
sion of SciPy (detected version 1.26.4
  warnings.warn(f"A NumPy version >={np_minversion} and <{np_maxversion}"
```

In [3]:
```
df = pd.read_csv(r"C:\Users\CHIBUIKE OGODO\Desktop\Data/OfficeSupply.csv")
```

In [4]:
```
df
```

Out[4]:

	Segment	State	Product	Discount Band	UnitsSold	ManufacturingPrice	SalePrice	
0	Government	Lagos State	A4 Paper	None	1618.5	3	20	Wednes 1 Jar
1	Government	Osun State	A4 Paper	None	1321.0	3	20	Wednes 1 Jar
2	Midmarket	Ogun State	A4 Paper	None	2178.0	3	15	Sund June
3	Midmarket	Enugu state	A4 Paper	None	888.0	3	15	Sund June
4	Midmarket	Ondo State	A4 Paper	None	2470.0	3	15	Sund June
...	...	...	...	...	...	...	...	
695	Small Business	Imo State	Stapler	High	2475.0	260	300	Saturd March
696	Small Business	Ondo State	Stapler	High	546.0	260	300	Wednes 1 Oct
697	Government	Ondo State	Pencil	High	1368.0	5	7	Saturd Feb
698	Government	Imo State	Biro	High	723.0	10	7	Tuesd April
699	Channel Partners	Oyo State	Notepad	High	1806.0	250	12	Thursd May

700 rows × 8 columns

1. Data Clearning Phase

In [12]:
```
#Checking for duplicates
df.duplicated().sum()
```

Out[12]:
```
0
```

In [13]:
```
#checking for null values
df.isnull().sum()
```

Out[13]:
```
Segment              0
State                0
Product              0
Discount Band        0
UnitsSold            0
ManufacturingPrice   0
SalePrice            0
Date                 0
dtype: int64
```

In [15]:
```
#checking the datatypes and correcting our data types
df.dtypes
```

Out[15]:
```
Segment               object
State                 object
Product               object
Discount Band         object
UnitsSold            float64
ManufacturingPrice     int64
SalePrice              int64
Date                  object
dtype: object
```

In [19]:
```
#changing the Date datatype
df['Date'] = pd.to_datetime(df['Date'])

#changing ManufacturingPrice and SalePrice to Float because its currrency
df['ManufacturingPrice'] = df['ManufacturingPrice'].astype(float)
df['SalePrice'] = df['SalePrice'].astype(float)
```

In [20]:
```
df.dtypes
```

Out[20]:
```
Segment                      object
State                        object
Product                      object
Discount Band                object
UnitsSold                   float64
ManufacturingPrice          float64
SalePrice                   float64
Date                 datetime64[ns]
dtype: object
```

In [21]:
```
# Handling Outliers
# Calculate the IQR for 'Sales Price' and 'Manufacture Cost'
Q1 = df[['SalePrice', 'ManufacturingPrice']].quantile(0.25)
Q3 = df[['SalePrice', 'ManufacturingPrice']].quantile(0.75)
IQR = Q3 - Q1

# Filter out outliers
df = df[~((df[['SalePrice', 'ManufacturingPrice']] < (Q1 - 1.5 * IQR)) | (d
```

In [22]:
```
df
```

Out[22]:

	Segment	State	Product	Discount Band	UnitsSold	ManufacturingPrice	SalePrice	Date
0	Government	Lagos State	A4 Paper	None	1618.5	3.0	20.0	2014-01-01
1	Government	Osun State	A4 Paper	None	1321.0	3.0	20.0	2014-01-01
2	Midmarket	Ogun State	A4 Paper	None	2178.0	3.0	15.0	2014-06-01
3	Midmarket	Enugu state	A4 Paper	None	888.0	3.0	15.0	2014-06-01
4	Midmarket	Ondo State	A4 Paper	None	2470.0	3.0	15.0	2014-06-01
...	...	...	...	...	...	...	...	...
695	Small Business	Imo State	Stapler	High	2475.0	260.0	300.0	2014-03-01
696	Small Business	Ondo State	Stapler	High	546.0	260.0	300.0	2014-10-01
697	Government	Ondo State	Pencil	High	1368.0	5.0	7.0	2014-02-01
698	Government	Imo State	Biro	High	723.0	10.0	7.0	2014-04-01
699	Channel Partners	Oyo State	Notepad	High	1806.0	250.0	12.0	2014-05-01

700 rows × 8 columns

In [25]:
```
#Standardizing and removing white spaces from every Categorical data
df['Segment']= df['Segment'].str.title().str.strip()
df['State']= df['State'].str.title().str.strip()
df['Product']= df['Product'].str.title().str.strip()
df['Discount Band']= df['Discount Band'].str.title().str.strip()
```

In [26]:
```
#Checking the summary statistics to ensure data integrity
df.describe()
```

Out[26]:

	UnitsSold	ManufacturingPrice	SalePrice	Date
count	700.000000	700.000000	700.000000	700
mean	1608.294286	96.477143	118.428571	2014-04-28 21:36:00
min	200.000000	3.000000	7.000000	2013-09-01 00:00:00
25%	905.000000	5.000000	12.000000	2013-12-24 06:00:00
50%	1542.500000	10.000000	20.000000	2014-05-16 12:00:00
75%	2229.125000	250.000000	300.000000	2014-09-08 12:00:00
max	4492.500000	260.000000	350.000000	2014-12-01 00:00:00
std	867.427859	108.602612	136.775515	NaN

2. Exploratory Analysis

Question 1: Which Products Generate the Highest Sales and Profits?

In [28]:
```
#Step 1: Calculate Total Sales and Profit for Each Product

# Calculate total sales for each product
df['Total Sales'] = df['UnitsSold'] * df['SalePrice']

# Calculate profit for each product
df['Profit'] = (df['SalePrice'] - df['ManufacturingPrice']) * df['UnitsSold

# Group by product and calculate total sales and profit
product_sales_profit = df.groupby('Product').agg({'Total Sales': 'sum', 'Pro
product_sales_profit
```

Out[28]:

	Product	Total Sales	Profit
0	A4 Paper	14937520.5	14496982.5
1	Biro	35611662.0	32229267.0
2	Markers	19826768.5	335828.5
3	Notepad	21968533.5	-20227216.5
4	Pencil	16549834.5	15778844.5
5	Stapler	19037279.5	-21344620.5

In [29]:
```
df
```

Out[29]:

	Segment	State	Product	Discount Band	UnitsSold	ManufacturingPrice	SalePrice	Date
0	Government	Lagos State	A4 Paper	None	1618.5	3.0	20.0	2014-01-01
1	Government	Osun State	A4 Paper	None	1321.0	3.0	20.0	2014-01-01
2	Midmarket	Ogun State	A4 Paper	None	2178.0	3.0	15.0	2014-06-01
3	Midmarket	Enugu State	A4 Paper	None	888.0	3.0	15.0	2014-06-01
4	Midmarket	Ondo State	A4 Paper	None	2470.0	3.0	15.0	2014-06-01
...	...	...	...	...	...	...	...	...
695	Small Business	Imo State	Stapler	High	2475.0	260.0	300.0	2014-03-01
696	Small Business	Ondo State	Stapler	High	546.0	260.0	300.0	2014-10-01
697	Government	Ondo State	Pencil	High	1368.0	5.0	7.0	2014-02-01
698	Government	Imo State	Biro	High	723.0	10.0	7.0	2014-04-01
699	Channel Partners	Oyo State	Notepad	High	1806.0	250.0	12.0	2014-05-01

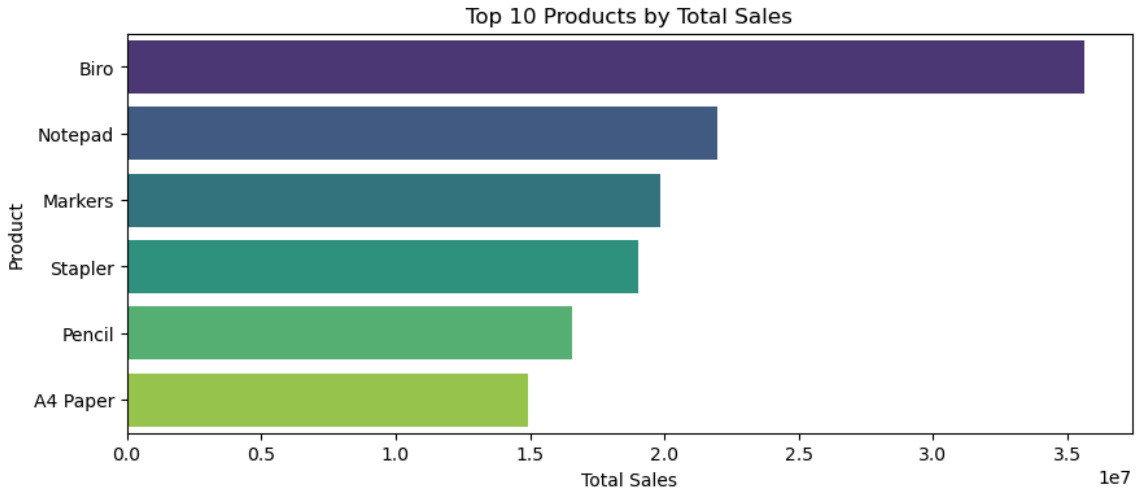
700 rows × 10 columns

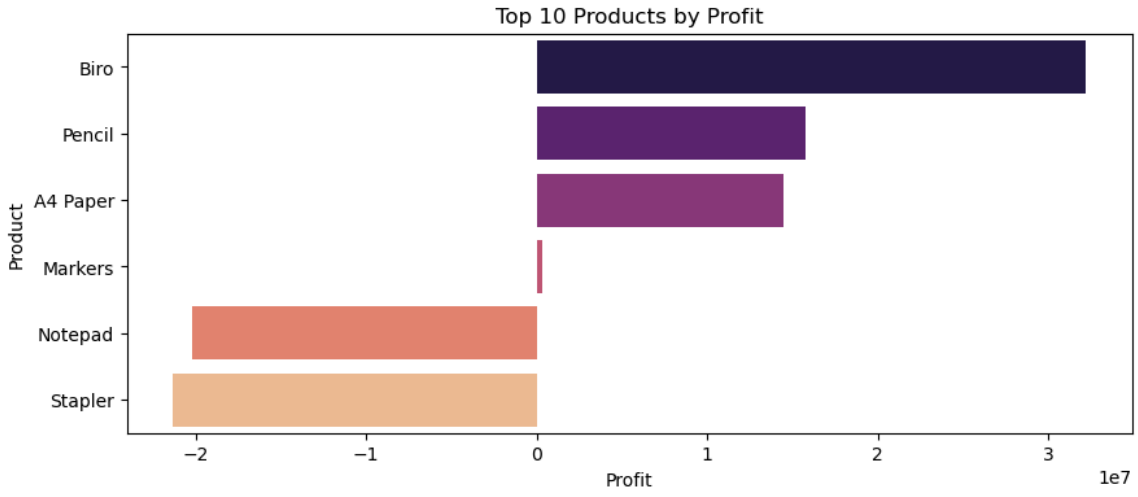
In [31]:
```
#Step 2: Rank Products Based on Sales and Profit

# Rank products based on total sales
product_sales_profit['Sales Rank'] = product_sales_profit['Total Sales'].ran

# Rank products based on profit
product_sales_profit['Profit Rank'] = product_sales_profit['Profit'].rank(as

product_sales_profit
```

Out[31]:

	Product	Total Sales	Profit	Sales Rank	Profit Rank
0	A4 Paper	14937520.5	14496982.5	6.0	3.0
1	Biro	35611662.0	32229267.0	1.0	1.0
2	Markers	19826768.5	335828.5	3.0	4.0
3	Notepad	21968533.5	-20227216.5	2.0	5.0
4	Pencil	16549834.5	15778844.5	5.0	2.0
5	Stapler	19037279.5	-21344620.5	4.0	6.0

In [35]:
```
#Step 3: Visualize the Top-Performing Products

# Top 10 products by total sales
top_10_sales = product_sales_profit.sort_values('Total Sales', ascending=Fal

# Top 10 products by profit
top_10_profit = product_sales_profit.sort_values('Profit', ascending=False)

# Plotting top 10 products by sales
plt.figure(figsize=(10, 4))
sns.barplot(data=top_10_sales, x='Total Sales', y='Product', palette='viridi
plt.title('Top 10 Products by Total Sales')
plt.xlabel('Total Sales')
plt.ylabel('Product')
plt.show()

# Plotting top 10 products by profit
plt.figure(figsize=(10, 4))
sns.barplot(data=top_10_profit, x='Profit', y='Product', palette='magma')
plt.title('Top 10 Products by Profit')
plt.xlabel('Profit')
plt.ylabel('Product')
plt.show()
```

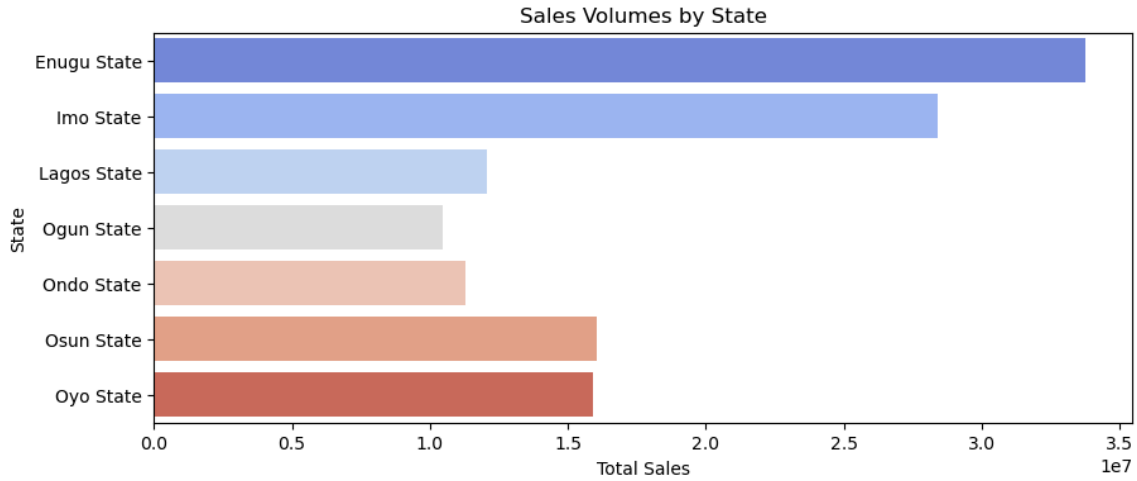




Question 2: Which State Have the Highest and Lowest Sales Volumes?

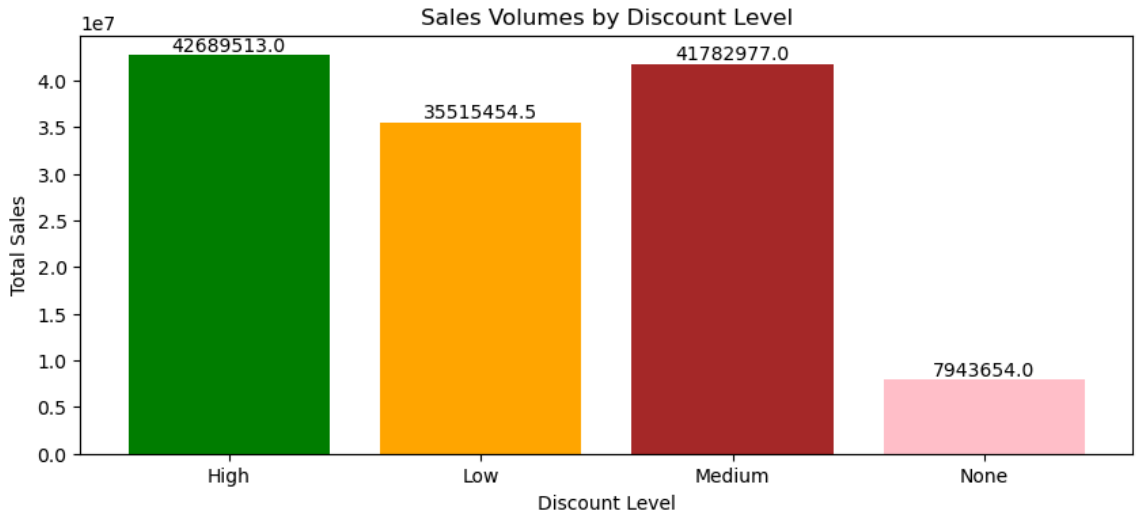
In [ ]:

In [39]:
```
# Calculate total sales for each State
state_sales = df.groupby('State')['Total Sales'].sum().reset_index()

# Rank regions based on total sales
state_sales['Sales Rank'] = state_sales['Total Sales'].rank(ascending=False)

# Plotting sales volumes by region
plt.figure(figsize=(10, 4))
sns.barplot(data=state_sales, x='Total Sales', y='State', palette='coolwarm
plt.title('Sales Volumes by State')
plt.xlabel('Total Sales')
plt.ylabel('State')
plt.show()
```



Question 3: How Does the Discount Bands Affect Sales Volumes?

In [50]:
```
# Calculate total sales for each discount level
discount_sales = df.groupby('Discount Band')['Total Sales'].sum().reset_inde
plt.figure(figsize=(10, 4))
bars = plt.bar(discount_sales['Discount Band'],discount_sales['Total Sales']
for index, value in enumerate(discount_sales['Total Sales']):
    plt.text(index, value, str(value), ha='center', va='bottom')
plt.title('Sales Volumes by Discount bands')
plt.xlabel('Discount Level')
plt.ylabel('Total Sales')
plt.show()
```



Question 4: What is the Trend of Sales of product Over Time?

In [62]:
```
# Ensure the 'Date' column is in datetime format
df['Date'] = pd.to_datetime(df['Date'])

# Extract year and month from the 'Date' column
df['Month'] = df['Date'].dt.month_name()
df
```

Out[62]:

	Segment	State	Product	Discount Band	UnitsSold	ManufacturingPrice	SalePrice	Date
0	Government	Lagos State	A4 Paper	None	1618.5	3.0	20.0	2014-01-01
1	Government	Osun State	A4 Paper	None	1321.0	3.0	20.0	2014-01-01
2	Midmarket	Ogun State	A4 Paper	None	2178.0	3.0	15.0	2014-06-01
3	Midmarket	Enugu State	A4 Paper	None	888.0	3.0	15.0	2014-06-01
4	Midmarket	Ondo State	A4 Paper	None	2470.0	3.0	15.0	2014-06-01
...	...	...	...	...	...	...	...	...
695	Small Business	Imo State	Stapler	High	2475.0	260.0	300.0	2014-03-01
696	Small Business	Ondo State	Stapler	High	546.0	260.0	300.0	2014-10-01
697	Government	Ondo State	Pencil	High	1368.0	5.0	7.0	2014-02-01
698	Government	Imo State	Biro	High	723.0	10.0	7.0	2014-04-01
699	Channel Partners	Oyo State	Notepad	High	1806.0	250.0	12.0	2014-05-01

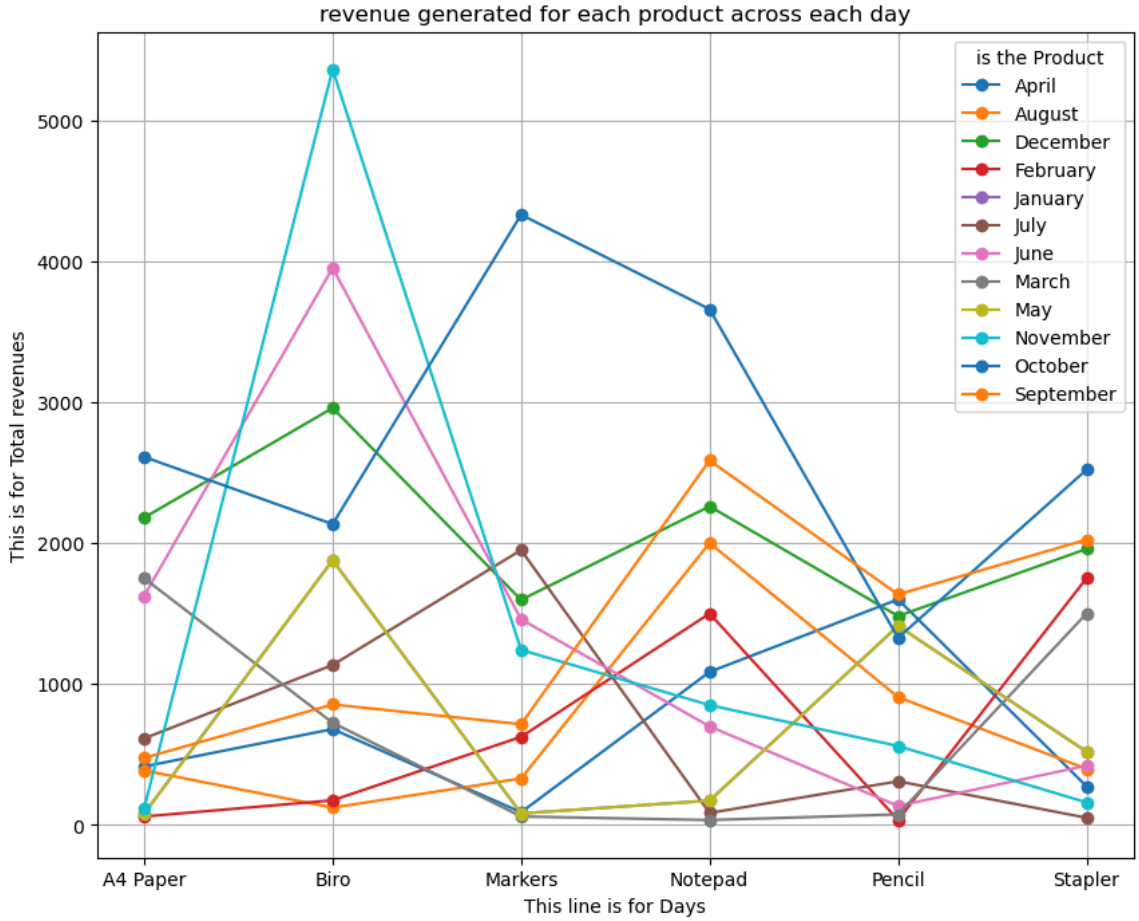
700 rows × 11 columns

In [69]:
```
#Grouping the products and the months as against the salesprice
product_sales_overtime = df.groupby(['Product','Month'])['SalePrice'].sum()

#Creating a pivot table for properly visualise it
pivotAnalysis = product_sales_overtime.pivot(index='Product', columns='Month
pivotAnalysis
```

Out[69]:

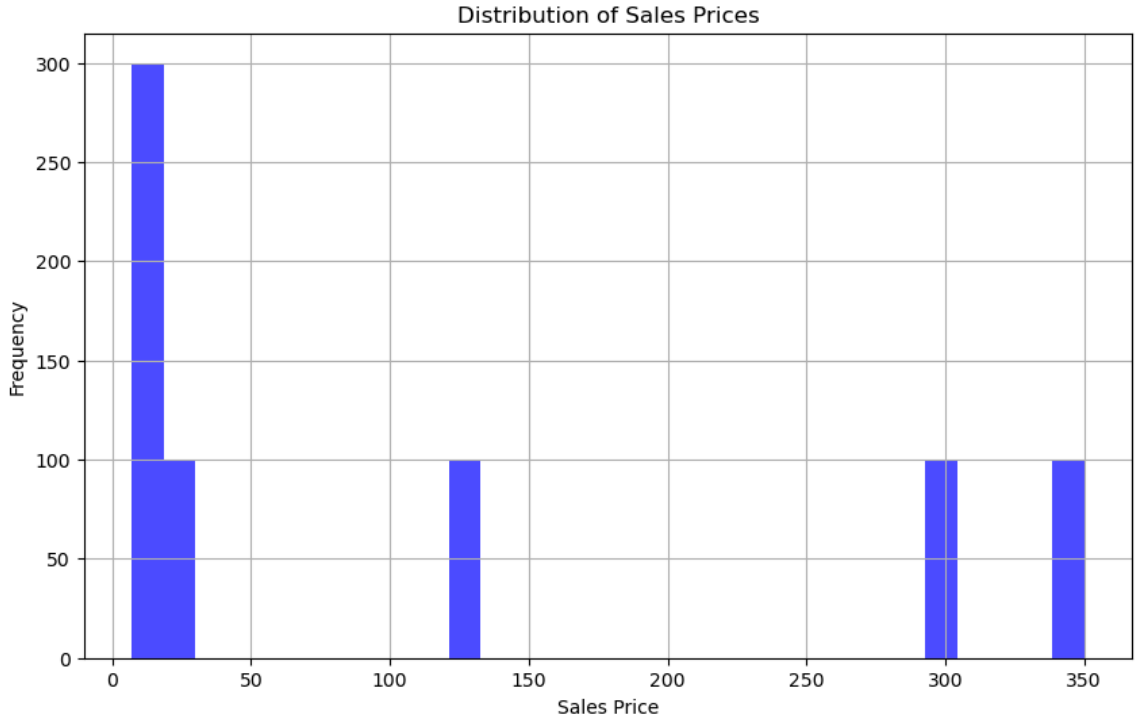
Month	April	August	December	February	January	July	June	March	May	Nove
Product										
A4 Paper	415.0	387.0	2180.0	60.0	80.0	614.0	1625.0	1750.0	80.0	
Biro	680.0	123.0	2958.0	175.0	1878.0	1135.0	3951.0	725.0	1878.0	5
Markers	90.0	330.0	1597.0	625.0	82.0	1950.0	1459.0	60.0	82.0	1
Notepad	1086.0	2000.0	2260.0	1500.0	173.0	85.0	699.0	35.0	173.0	
Pencil	1600.0	907.0	1482.0	35.0	1412.0	310.0	135.0	75.0	1412.0	
Stapler	274.0	398.0	1958.0	1750.0	520.0	51.0	421.0	1500.0	520.0	

In [72]:
```
pivotAnalysis.plot(kind='line', marker='o', figsize=(10,8))
plt.xlabel('This line is for Days')
plt.ylabel('This is for Total revenues')
plt.title('revenue generated for each product across each day')
plt.legend(title='is the Product')
plt.grid(True)
plt.show()
```



Question 5: What is the Distribution of Sales Prices?

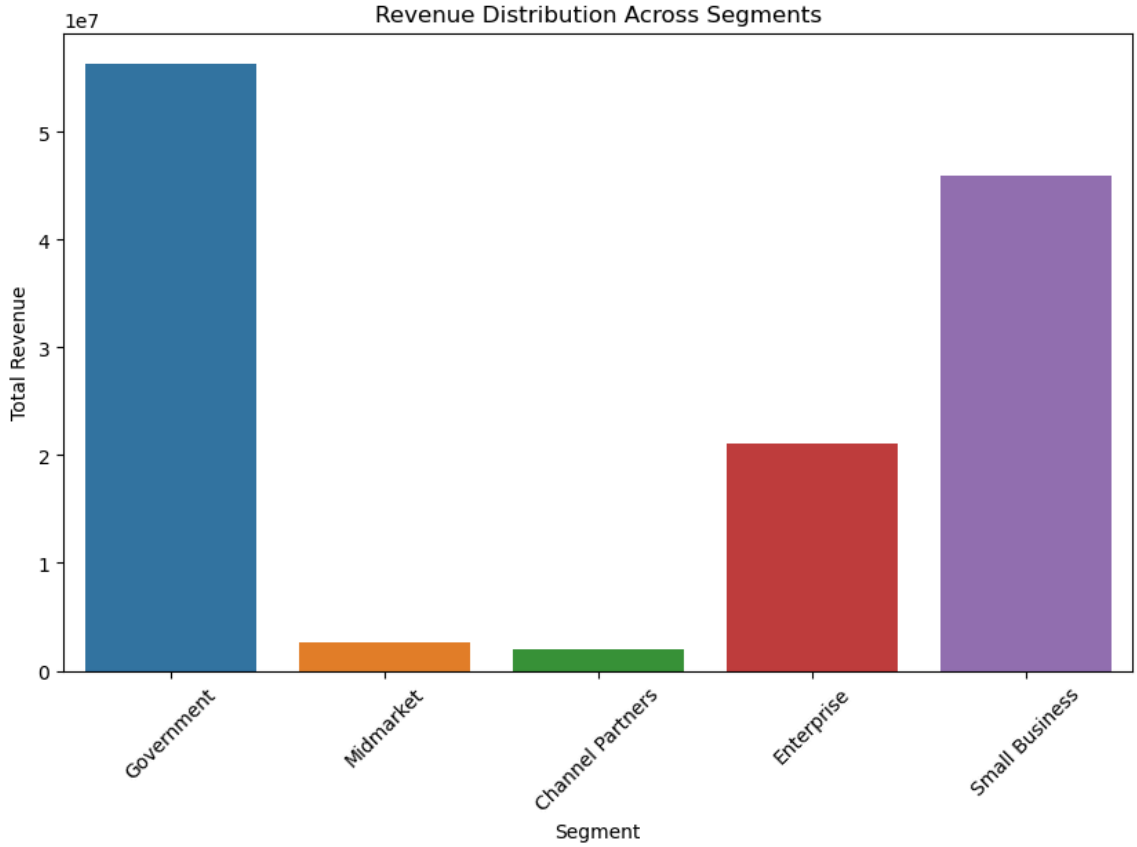
In [8]:
```
# Plot histogram for 'Sales Price'
plt.figure(figsize=(10, 6))
plt.hist(df['SalePrice'], bins=30, color='blue', alpha=0.7)
plt.title('Distribution of Sales Prices')
plt.xlabel('Sales Price')
plt.ylabel('Frequency')
plt.grid(True)
plt.show()
```

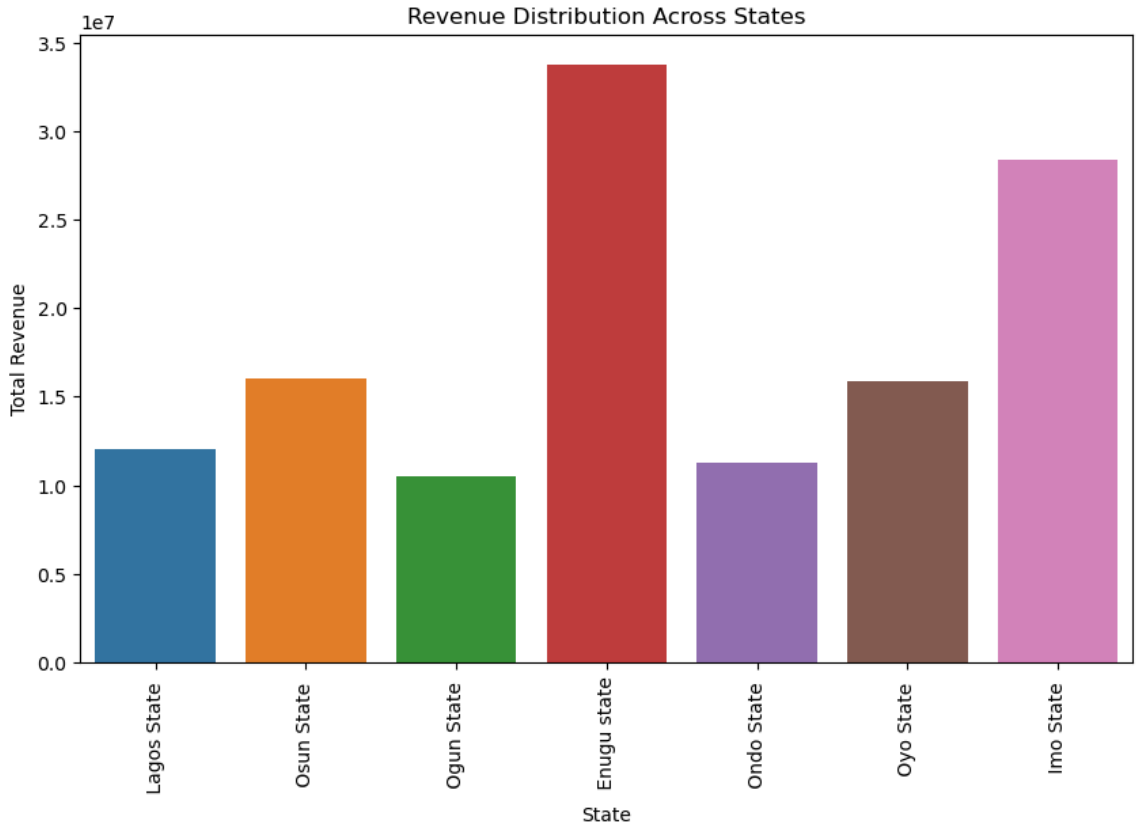


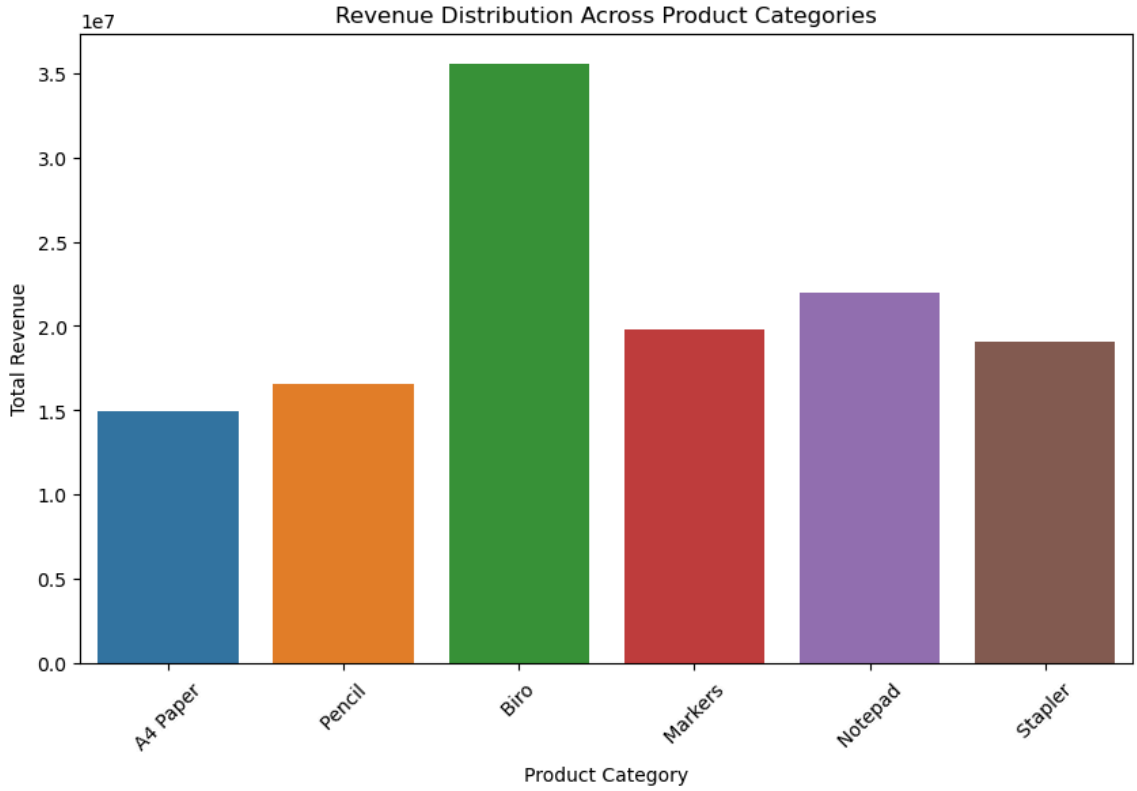
In [10]:
```
# Calculate summary statistics
mean_sales_price = df['SalePrice'].mean()
median_sales_price = df['SalePrice'].median()
std_sales_price = df['SalePrice'].std()

print(f"Mean Sales Price: {mean_sales_price}")
print(f"Median Sales Price: {median_sales_price}")
print(f"Standard Deviation of Sales Price: {std_sales_price}")
```

```
Mean Sales Price: 118.42857142857143
Median Sales Price: 20.0
Standard Deviation of Sales Price: 136.7755145691398
```

In [13]:
```
df['Revenue'] = df['UnitsSold'] * df['SalePrice']
# Distribution across segments
plt.figure(figsize=(10, 6))
sns.barplot(x='Segment', y='Revenue', data=df, estimator=sum, ci=None)
plt.title('Revenue Distribution Across Segments')
plt.xlabel('Segment')
plt.ylabel('Total Revenue')
plt.xticks(rotation=45)
plt.show()

# Distribution across states
plt.figure(figsize=(10, 6))
sns.barplot(x='State', y='Revenue', data=df, estimator=sum, ci=None)
plt.title('Revenue Distribution Across States')
plt.xlabel('State')
plt.ylabel('Total Revenue')
plt.xticks(rotation=90)
plt.show()

# Distribution across product categories
plt.figure(figsize=(10, 6))
sns.barplot(x='Product', y='Revenue', data=df, estimator=sum, ci=None)
plt.title('Revenue Distribution Across Product Categories')
plt.xlabel('Product Category')
plt.ylabel('Total Revenue')
plt.xticks(rotation=45)
plt.show()
```




Revenue Distribution Across States
1e7
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Total Revenue
Lagos State
Osun State
Ogun State
Enugu state
Ondo State
Oyo State
Imo State
State


Revenue Distribution Across Product Categories
1e7
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Total Revenue
A4 Paper
Pencil
Biro
Markers
Notepad
Stapler
Product Category

In [ ]: