Analysing Amazon Sales Data

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

```
from google.colab import files
uploaded = files.upload()
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving Amazon Sales data.csv to Amazon Sales data.csv
```

```
df = pd.read_csv('/content/Amazon Sales data.csv')
```

Data Exploration

```
df.head()
```

	Region	Country	Item Type	Sales Channel	Order Priority	Order Date	Order ID	Ship Date	Units Sold	Unit Price	Unit Cost	Total Revenue	Total Cost	To Pro
0	Australia and Oceania	Tuvalu	Baby Food	Offline	H	5/28/2010	669165933	6/27/2010	9925	255.28	159.42	2533654.00	1582243.50	95141
1	Central America and the Caribbean	Grenada	Cereal	Online	C	8/22/2012	963881480	9/15/2012	2804	205.70	117.11	576782.80	328376.44	24840
2	Europe	Russia	Office Supplies	Offline	L	5/2/2014	341417157	5/8/2014	1779	651.21	524.96	1158502.59	933903.84	22459
		Sao												

```
df.tail()
```

	Region	Country	Item Type	Sales Channel	Order Priority	Order Date	Order ID	Ship Date	Units Sold	Unit Price	Unit Cost	Total Revenue	Total Cost
95	Sub-Saharan Africa	Mali	Clothes	Online	M	7/26/2011	512878119	9/3/2011	888	109.28	35.84	97040.64	31825.92
96	Asia	Malaysia	Fruits	Offline	L	11/11/2011	810711038	12/28/2011	6267	9.33	6.92	58471.11	43367.64
97	Sub-Saharan Africa	Sierra Leone	Vegetables	Offline	C	6/1/2016	728815257	6/29/2016	1485	154.06	90.93	228779.10	135031.05
98	North America	Mexico	Personal Care	Offline	M	7/30/2015	559427106	8/8/2015	5767	81.73	56.67	471336.91	326815.89

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 100 entries, 0 to 99
Data columns (total 14 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   Region          100 non-null    object 
 1   Country         100 non-null    object 
 2   Item Type       100 non-null    object 
 3   Sales Channel   100 non-null    object 
 4   Order Priority  100 non-null    object 
 5   Order Date      100 non-null    object 
 6   Order ID        100 non-null    int64  
 7   Ship Date       100 non-null    object 
 8   Units Sold      100 non-null    int64  
 9   Unit Price      100 non-null    float64
 10  Unit Cost       100 non-null    float64
 11  Total Revenue   100 non-null    float64
 12  Total Cost      100 non-null    float64
 13  Total Profit    100 non-null    float64
dtypes: float64(5), int64(2), object(7)
```

```
memory usage: 11.1+ KB
```

```
df.describe()
```

```
            Order ID   Units Sold  Unit Price  Unit Cost  Total Revenue    Total Cost  Total Profit
count   1.000000e+02   100.000000  100.000000 100.000000   1.000000e+02  1.000000e+02  1.000000e+02
mean    5.550204e+08  5128.710000  276.761300 191.048000   1.373488e+06  9.318057e+05  4.416820e+05
std     2.606153e+08  2794.484562  235.592241 188.208181   1.460029e+06  1.083938e+06  4.385379e+05
min     1.146066e+08   124.000000    9.330000   6.920000   4.870260e+03  3.612240e+03  1.258020e+03
25%     3.389225e+08  2836.250000   81.730000  35.840000   2.687212e+05  1.688680e+05  1.214436e+05
50%     5.577086e+08  5382.500000  179.880000 107.275000   7.523144e+05  3.635664e+05  2.907680e+05
75%     7.907551e+08  7369.000000  437.200000 263.330000   2.212045e+06  1.613870e+06  6.358288e+05
max     9.940222e+08  9925.000000  668.270000 524.960000   5.997055e+06  4.509794e+06  1.719922e+06
```

```
df.columns
```

```
Index(['Region', 'Country', 'Item Type', 'Sales Channel', 'Order Priority',
       'Order Date', 'Order ID', 'Ship Date', 'Units Sold', 'Unit Price',
       'Unit Cost', 'Total Revenue', 'Total Cost', 'Total Profit'],
      dtype='object')
```

```
df['Item Type']
```

```
         Item Type
 0       Baby Food
 1          Cereal
 2 Office Supplies
 3          Fruits
 4 Office Supplies
...            ...
95         Clothes
96          Fruits
97      Vegetables
98   Personal Care
99       Household
100 rows × 1 columns

dtype: object
```

```
df['Item Type'].value_counts()
```

```
                 count
    Item Type
    Clothes         13
   Cosmetics        13
Office Supplies     12
     Fruits         10
 Personal Care      10
   Household         9
   Beverages         8
   Baby Food         7
    Cereal           7
  Vegetables         6
    Snacks           3
     Meat            2

dtype: int64
```

```
for col in ['Region', 'Country', 'Order Priority']:
    print(f"Unique values for {col}:\n", df[col].value_counts(), "\n")
```

```
Unique values for Region:
 Region
Sub-Saharan Africa                   36
Europe                               22
Australia and Oceania                11
Asia                                 11
Middle East and North Africa         10
Central America and the Caribbean     7
North America                         3
Name: count, dtype: int64

Unique values for Country:
 Country
The Gambia               4
Sierra Leone             3
Sao Tome and Principe    3
Mexico                   3
Australia                3
                        ..
Comoros                  1
Iceland                  1
Macedonia                1
Mauritania               1
Mozambique               1
Name: count, Length: 76, dtype: int64

Unique values for Order Priority:
 Order Priority
H    30
L    27
C    22
M    21
Name: count, dtype: int64
```

```
missing_values = df.isnull().sum()
print("Missing Values\n", missing_values)
```

```
Missing Values
 Region            0
Country           0
Item Type         0
Sales Channel     0
Order Priority    0
Order Date        0
Order ID          0
Ship Date         0
Units Sold        0
Unit Price        0
Unit Cost         0
Total Revenue     0
Total Cost        0
Total Profit      0
dtype: int64
```

```
duplicate_values = df.duplicated().sum()
print('Number of duplicates', duplicate_values)
```

```
Number of duplicates 0
```

```
# Convert 'Order Date' and 'Ship Date' to datetime format and extract month and year for analysis
df['Order Date'] = pd.to_datetime(df['Order Date'])
df['Ship Date'] = pd.to_datetime(df['Ship Date'])

# Extracting year and month from 'Order Date' for analysis
df['Order Year'] = df['Order Date'].dt.year
df['Order Month'] = df['Order Date'].dt.month

# Now let's take a look at the transformed dataset
df[['Order Date', 'Order Year', 'Order Month']].head()
```

	Order Date	Order Year	Order Month
0	2010-05-28	2010	5
1	2012-08-22	2012	8
2	2014-05-02	2014	5
3	2014-06-20	2014	6
4	2013-02-01	2013	2

KPI's

Revenue Based

1) Total Sales

```
total_sales = round((df['Total Revenue'].sum()/1000000),2)
print("Total Sales: $ {} M ".format(total_sales))
```

```
Total Sales: $ 137.35 M
```

2) Sales Growth Rate

Growth Rate (%)=(Revenue in Current Period - Revenue in Previous Period) / Revenue in Previous Period) * 100

```
# Grouping data by year and summing up the total revenue
year_wise_sales = df.groupby('Order Year')['Total Revenue'].sum()

# Calculating Year-over-Year Sales Growth Rate (%)
sales_growth_rate = year_wise_sales.pct_change() * 100

# Printing the result
print("Yearly Sales Growth Rate (%):", sales_growth_rate)
```

```
Yearly Sales Growth Rate (%): Order Year
2010           NaN
2011    -41.993372
2012    186.622055
2013    -36.265478
2014    -18.200455
2015    -25.268655
2016     -0.443480
2017      8.086666
Name: Total Revenue, dtype: float64
```

3) Total Units Sold

```
# Calculate total units sold
total_units_sold = df['Units Sold'].sum()

# Print total units sold
print("Total Units Sold:", total_units_sold)
```

```
Total Units Sold: 512871
```

4) Average Order Value (AOV)

Total Revenue/ Total Number of Orders

```
# Calculate total number of orders
total_orders = df['Order ID'].nunique()

# Calculate Average Order Value (AOV)
aov = total_sales / total_orders if total_orders > 0 else 0

# Print AOV
print("Average Order Value (AOV): $", aov)
```

```
Average Order Value (AOV): $ 1373487.6831
```

5) Sales By Region

```
# Grouping by 'Region' to find total revenue
sales_by_region = df.groupby('Region')['Total Revenue'].sum()

# Print sales by region
print("Sales by Region:")
print(sales_by_region)
```

```
Sales by Region:
Region
Asia                                 21347091.02
Australia and Oceania                14094265.13
Central America and the Caribbean     9170385.49
Europe                               33368932.11
Middle East and North Africa         14052706.58
North America                         5643356.55
Sub-Saharan Africa                   39672031.43
Name: Total Revenue, dtype: float64
```

6) Sales By Item Type

```
# Grouping by 'Item Type' to analyze revenue
sales_by_item_type = df.groupby('Item Type')['Total Revenue'].sum()

# Print sales by item type
print("Sales by Item Type:")
print(sales_by_item_type)
```

```
Sales by Item Type:
Item Type
Baby Food          10350327.60
Beverages           2690794.60
Cereal              5322898.90
Clothes             7787292.80
Cosmetics          36601509.60
Fruits               466481.34
Household          29889712.29
Meat                4503675.75
Office Supplies    30585380.07
Personal Care       3980904.84
Snacks              2080733.46
Vegetables          3089057.06
Name: Total Revenue, dtype: float64
```

7) Sales Channel Performance

```
# Grouping by 'Sales Channel' to analyze revenue
sales_channel_performance = df.groupby('Sales Channel')[['Total Revenue', 'Total Cost']].sum()

# Print sales channel performance
print("Sales Channel Performance:")
print(sales_channel_performance)
```

```
Sales Channel Performance:
               Total Revenue   Total Cost
Sales Channel
Offline          79094809.20  54174082.53
Online           58253959.11  39006487.38
```

8) Order Fulfillment Time

Fulfillment Time = Ship Date - Order Date

```
df['Fulfillment Time'] = (df['Ship Date'] - df['Order Date']).dt.days
avg_fulfillment_time = df['Fulfillment Time'].mean()
print("Avg Fulfillment Time (days):", avg_fulfillment_time, 'days' )
```

```
Avg Fulfillment Time (days): 23.36 days
```

9) Total Order Counts

```
# Counting the total number of orders by counting the unique values in the 'Order ID' column
Total_orders = df['Order ID'].count()
```

```
# Printing the total number of orders
print("Total orders :", Total_orders)
```

```
Total orders : 100
```

Cost Based

1) Total Cost

```
# Calculate total cost
total_cost = round((df['Total Cost'].sum()/1000000),2)

# Print the total cost
print("Total Cost: $ {}M".format(total_cost))
```

```
Total Cost: $ 93.18M
```

2) Cost of Goods Sold (COGS)

```
# Calculate Cost of Goods Sold (COGS)
cogs = round(((df['Unit Cost'] * df['Units Sold']).sum()/1000000),2)

# Print COGS
print("Cost of Goods Sold (COGS): $ {}M".format(cogs))
```

```
Cost of Goods Sold (COGS): $ 93.18M
```

3) Total Profit

```
# Calculate total profit
total_profit = round((df['Total Profit'].sum()/1000000),2)

# Print total profit
print("Total Profit: $ {} M".format(total_profit))
```

```
Total Profit: $ 44.17 M
```

4) Profit Margin

```
# Calculate Profit Margin
profit_margin = (total_profit / total_sales) * 100

# Print profit margin
print("Profit Margin (%):", profit_margin, '%')
```

```
Profit Margin (%): 32.1587186021114 %
```

5) Average Cost Per Unit

```
# Calculate Total Units Sold
total_units_sold = df['Units Sold'].sum()

# Calculate Average Cost per Unit
average_cost_per_unit = total_cost / total_units_sold if total_units_sold > 0 else 0

# Print average cost per unit
print("Average Cost per Unit: $", average_cost_per_unit)
```

```
Average Cost per Unit: $ 181.68422451259676
```

Data Analysis and Visualisation

Sales Trends

```
# 1. Month-wise sales trends (aggregating by month across all years)
month_wise_sales = df.groupby('Order Month')[['Total Revenue', 'Total Profit']].sum()
```

```
# 2. Year-wise sales trends (aggregating by year)
year_wise_sales = df.groupby('Order Year')[['Total Revenue', 'Total Profit']].sum()

# 3. Yearly month-wise sales trends (aggregating by year and month)
yearly_month_wise_sales = df.groupby(['Order Year', 'Order Month'])[['Total Revenue', 'Total Profit']].sum()

# Displaying the results
month_wise_sales, year_wise_sales, yearly_month_wise_sales.head()
```

```
(              Total Revenue  Total Profit
 Order Month
 1               10482467.12    2816857.02
 2               24740517.77    7072050.51
 3                2274823.87     928351.06
 4               16187186.33    4760208.35
 5               13215739.99    4582692.30
 6                5230325.77    2185379.43
 7               15669518.50    5578463.06
 8                1128164.91     579276.67
 9                5314762.56    2344166.03
 10              15287576.61    4506923.25
 11              20568222.76    6457600.65
 12               7249462.12    2356230.07,
             Total Revenue  Total Profit
 Order Year
 2010          19186024.92    6629567.43
 2011          11129166.07    2741008.23
 2012          31898644.52    9213010.12
 2013          20330448.66    6715420.04
 2014          16630214.43    5879461.68
 2015          12427982.86    3996539.44
 2016          12372867.22    4903838.01
 2017          13373419.63    4089353.45,
                         Total Revenue  Total Profit
 Order Year Order Month
 2010       2               3410661.12    1424410.94
            5               2587973.26     965441.52
            6               1082418.40     727423.20
            10              6064933.75    1495392.79
            11              3458252.00    1375311.70)
```

```
# Grouping by 'Region' to find total revenue and profit
region_wise_sales = df.groupby('Region')[['Total Revenue', 'Total Profit']].sum()

# Displaying the result
print(region_wise_sales)
```

```
                                   Total Revenue  Total Profit
Region
Asia                                 21347091.02    6113845.87
Australia and Oceania                14094265.13    4722160.03
Central America and the Caribbean     9170385.49    2846907.85
Europe                               33368932.11   11082938.63
Middle East and North Africa         14052706.58    5761191.86
North America                         5643356.55    1457942.76
Sub-Saharan Africa                   39672031.43   12183211.40
```

```
# Grouping by 'Item Type' to analyze revenue and profit for each category
item_type_sales = df.groupby('Item Type')[['Total Revenue', 'Total Profit']].sum()

# Displaying the result
print(item_type_sales)
```

```
                  Total Revenue  Total Profit
Item Type
Baby Food           10350327.60    3886643.70
Beverages            2690794.60     888047.28
Cereal               5322898.90    2292443.43
Clothes              7787292.80    5233334.40
Cosmetics           36601509.60   14556048.66
Fruits                466481.34     120495.18
Household           29889712.29    7412605.71
Meat                 4503675.75     610610.00
Office Supplies     30585380.07    5929583.75
Personal Care        3980904.84    1220622.48
Snacks               2080733.46     751944.18
Vegetables           3089057.06    1265819.63
```

```
# Grouping by 'Sales Channel' and 'Order Priority'
sales_channel_priority = df.groupby(['Sales Channel', 'Order Priority'])[['Total Revenue', 'Total Profit']].sum()
```

```
# Displaying the result
print(sales_channel_priority)
```

```
                              Total Revenue  Total Profit
Sales Channel Order Priority
Offline       C                 10316782.15    3625315.71
              H                 31772954.03    9875825.95
              L                 22142428.99    6341300.86
              M                 14862644.03    5078284.15
Online        C                  8538280.90    3123012.75
              H                 16976592.02    7015773.63
              L                 14485698.47    4517427.00
              M                 18253387.72    4591258.35
```

Grouping By Order Priority

```
# Mapping dictionary to convert priority codes to their corresponding names
Order_Priority_abb = { 'C' : 'Critical' , 'H' : 'High' , 'L' : 'Low' , 'M' : 'Medium'}
Priority_wise = df.groupby('Order Priority')['Total Revenue'].sum()
Priority_wise = Priority_wise.reset_index()
Priority_wise['Order Priority'] = Priority_wise['Order Priority'].map(Order_Priority_abb)
Priority_wise['Total Revenue'] = round(Priority_wise['Total Revenue'] / 1000000, 2)
Priority_wise.rename(columns={'Total Revenue': 'Total Sales (in Mil.)'}, inplace=True)
# Displaying the result
Priority_wise
```

	Order Priority	Total Sales (in Mil.)
0	Critical	18.86
1	High	48.75
2	Low	36.63
3	Medium	33.12

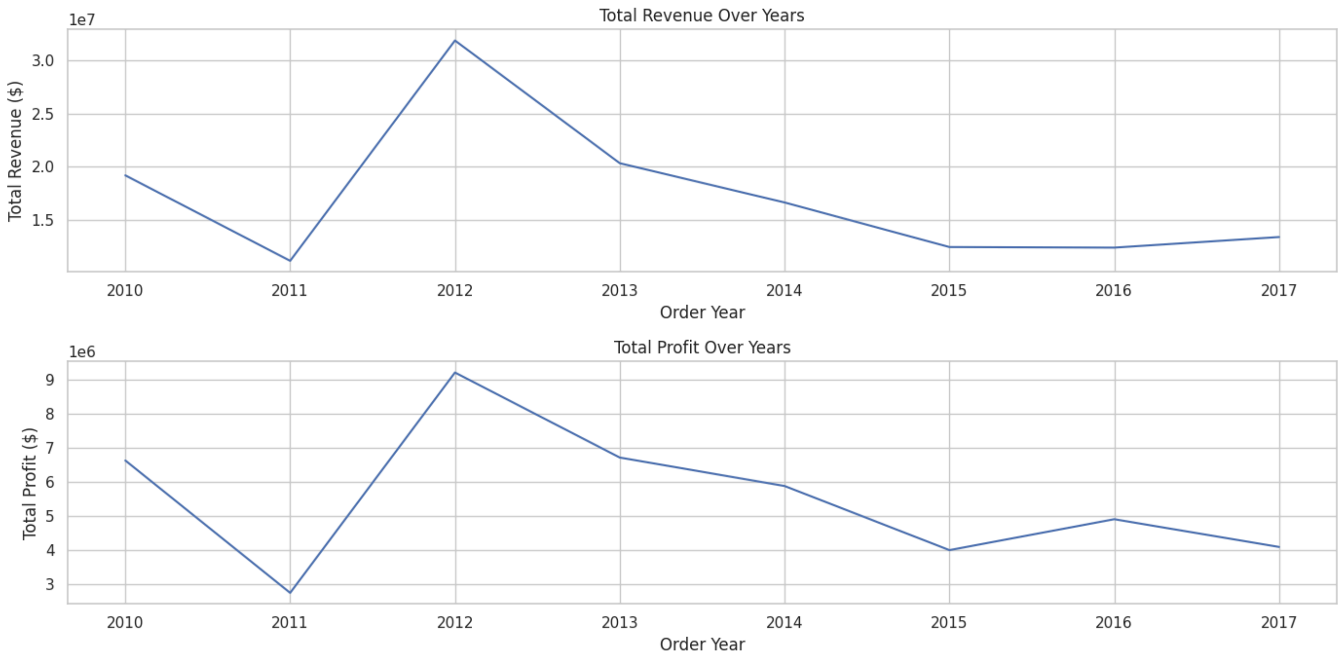
Sales Channel wise Units Sold

```
# Grouping the data by 'Sales Channel' and summing up the 'Units Sold' for each channel
Channel_wise_Units = df.groupby('Sales Channel')['Units Sold'].sum()

# Resetting the index to convert the GroupBy object to a DataFrame and make 'Sales Channel' a column again
Channel_wise_Units = Channel_wise_Units.reset_index()

# Converting the 'Units Sold' values from units to thousands and rounding to two decimal places
Channel_wise_Units['Units Sold'] = Channel_wise_Units['Units Sold'].apply(lambda x : x/1000).round(2)

# Sorting the DataFrame by 'Units Sold' in descending order
Channel_wise_Units.sort_values(by = ['Units Sold'], ascending = False, inplace = True)

# Renaming the 'Units Sold' column to 'Units Sold (in 1000s)' for clarity
Channel_wise_Units.rename(columns = {'Units Sold' : 'Units Sold (in 1000s)'}, inplace = True)

# Displaying the modified DataFrame
Channel_wise_Units
```

	Sales Channel	Units Sold (in 1000s)
0	Offline	276.78
1	Online	236.09

Year-Wise Sales Trends

```
# Visualising total revenue and total profit over time.

# Set the style of the visualization
sns.set(style="whitegrid")

# Plotting total revenue and total profit over the years
plt.figure(figsize=(14, 7))

# Create a line plot for revenue
plt.subplot(2, 1, 1)
sns.lineplot(data=year_wise_sales.reset_index(), x='Order Year', y='Total Revenue')
plt.title('Total Revenue Over Years')
plt.ylabel('Total Revenue ($)')
plt.xticks(year_wise_sales.index, year_wise_sales.index)

# Create a line plot for profit
plt.subplot(2, 1, 2)
sns.lineplot(data=year_wise_sales.reset_index(), x='Order Year', y='Total Profit')
plt.title('Total Profit Over Years')
plt.ylabel('Total Profit ($)')
plt.xticks(year_wise_sales.index, year_wise_sales.index)

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



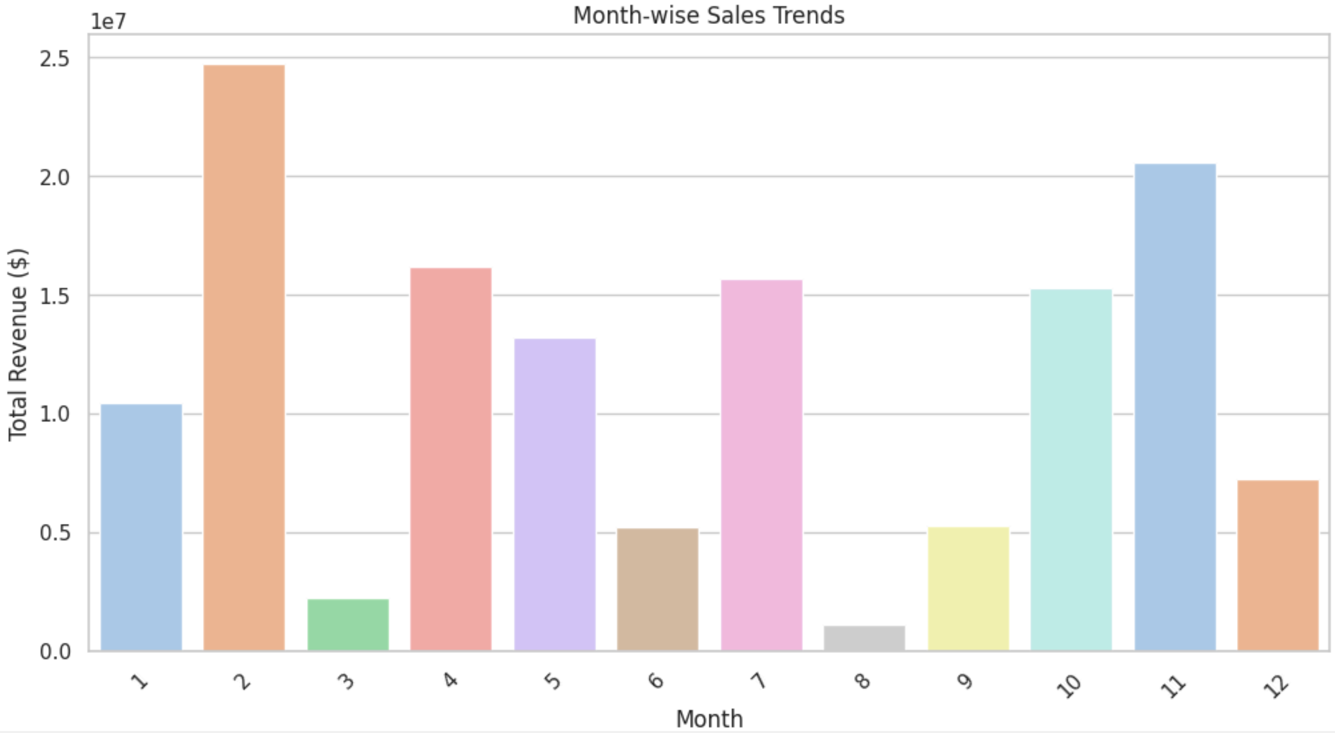
```
year_wise_sales
```

Order Year	Total Revenue	Total Profit
2010	19186024.92	6629567.43
2011	11129166.07	2741008.23
2012	31898644.52	9213010.12
2013	20330448.66	6715420.04
2014	16630214.43	5879461.68
2015	12427982.86	3996539.44
2016	12372867.22	4903838.01
2017	13373419.63	4089353.45

Month-Wise Sales Trends

```
# Plotting month-wise sales trends
plt.figure(figsize=(12, 6))
sns.barplot(x=month_wise_sales.index, y='Total Revenue', data=month_wise_sales.reset_index(), palette='pastel')
plt.title('Month-wise Sales Trends')
plt.xlabel('Month')
plt.ylabel('Total Revenue ($)')
plt.xticks(rotation=45)
plt.show()
```

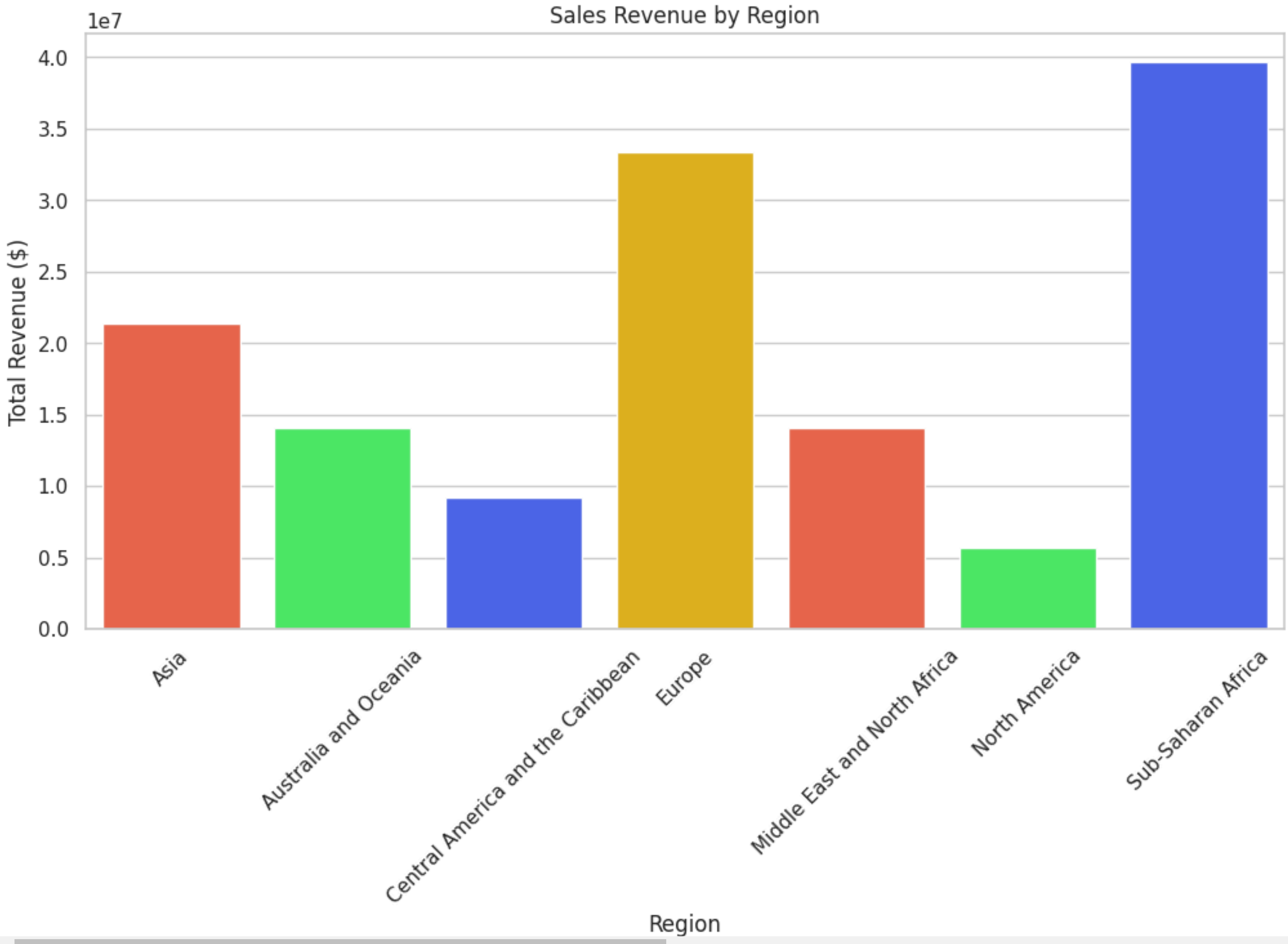
```
<ipython-input-136-255b2f6b5f2c>:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.barplot(x=month_wise_sales.index, y='Total Revenue', data=month_wise_sales.reset_index(), palette='pastel')
```



Sales By Region

```
# Plotting revenue by region
custom_colors = ['#FF5733', '#33FF57', '#3357FF', '#FFC300']
plt.figure(figsize=(12, 6))
sns.barplot(x=region_wise_sales.index, y='Total Revenue', data=region_wise_sales.reset_index(), palette=custom_colors)
plt.title('Sales Revenue by Region')
plt.xlabel('Region')
plt.ylabel('Total Revenue ($)')
plt.xticks(rotation=45)
plt.show()
```

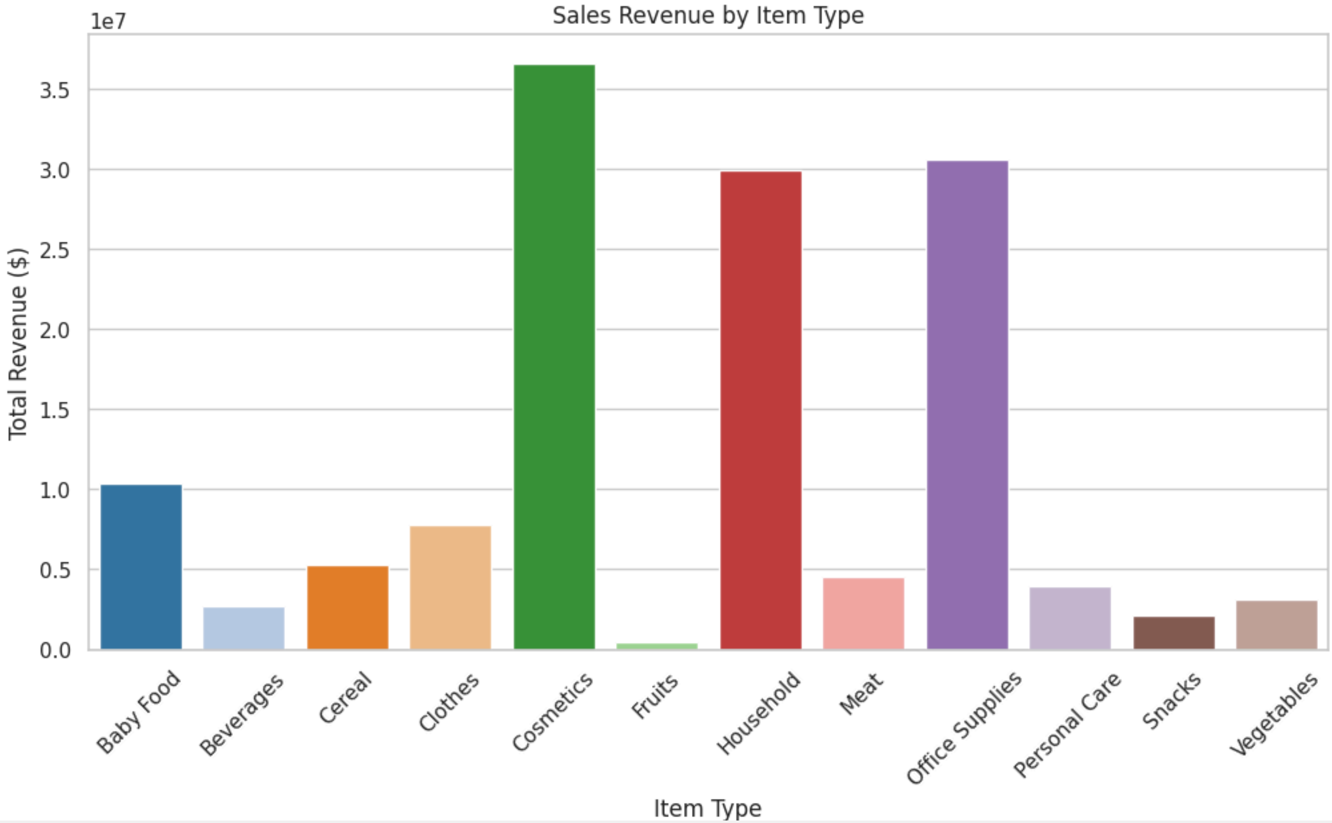
```
<ipython-input-138-2676c87c73bd>:4: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.barplot(x=region_wise_sales.index, y='Total Revenue', data=region_wise_sales.reset_index(), palette=custom_colors)
<ipython-input-138-2676c87c73bd>:4: UserWarning:
The palette list has fewer values (4) than needed (7) and will cycle, which may produce an uninterpretable plot.
  sns.barplot(x=region_wise_sales.index, y='Total Revenue', data=region_wise_sales.reset_index(), palette=custom_colors)
```



Sales By Item Type

```
# Plotting revenue by item type
colors = plt.cm.tab20.colors
plt.figure(figsize=(12, 6))
sns.barplot(x=item_type_sales.index, y='Total Revenue', data=item_type_sales.reset_index(), palette=colors[:len(df)])
plt.title('Sales Revenue by Item Type')
plt.xlabel('Item Type')
plt.ylabel('Total Revenue ($)')
plt.xticks(rotation=45)
plt.show()
```

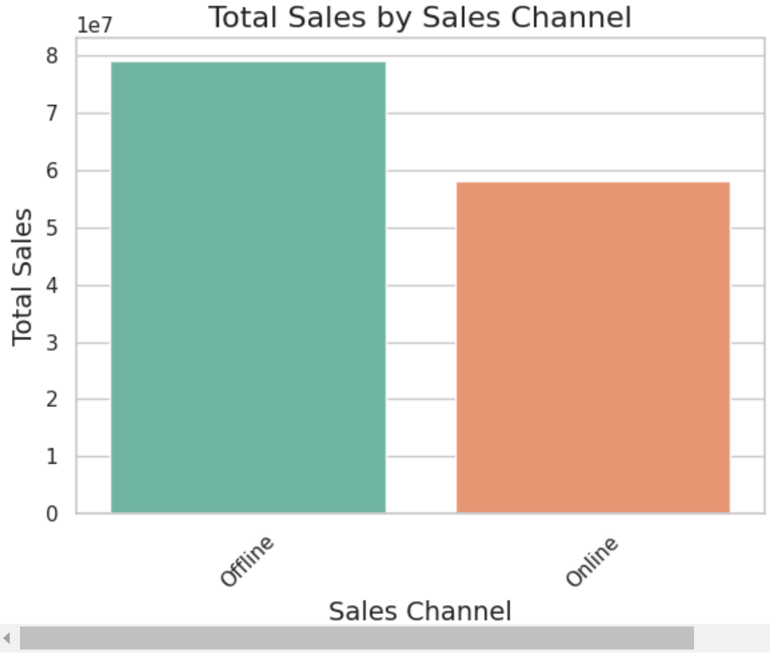
```
<ipython-input-139-06bbc7b164e1>:4: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.barplot(x=item_type_sales.index, y='Total Revenue', data=item_type_sales.reset_index(), palette=colors[:len(df)])
```



Sales Channel Wise

```
# Create a bar plot
plt.figure(figsize=(6, 5))
sns.barplot(data=sales_channel_performance , x='Sales Channel', y='Total Revenue', palette='Set2')

# Add titles and labels
plt.title('Total Sales by Sales Channel', fontsize=16)
plt.xlabel('Sales Channel', fontsize=14)
plt.ylabel('Total Sales', fontsize=14)
plt.xticks(rotation=45)
plt.tight_layout()

# Show the plot
plt.show()
```

```
<ipython-input-153-5fd3b8d53c7d>:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.barplot(data=sales_channel_performance , x='Sales Channel', y='Total Revenue', palette='Set2')
```



Sales Channel Wise Units Sold

```
plt.figure(figsize=(8, 8))

# Use a different colormap
channel_pieplot = plt.pie(Channel_wise_Units['Units Sold (in 1000s)'],
                           labels=Channel_wise_Units['Sales Channel'],
                           autopct='%1.f%%',
                           colors=plt.cm.Set2.colors)  # Changed colormap to Set2

# Add title
plt.title('Order Distribution by Sales Channel')
plt.show()
```

Correlation

```
# Compute the correlation matrix
correlation_matrix = df[['Total Revenue', 'Total Profit', 'Total Cost', 'Units Sold']].corr()

# Plotting the correlation matrix
plt.figure(figsize=(8, 6))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt='.2f')
plt.title('Correlation Matrix')
plt.show()
```