Amazon Sales

In [1]:
```
from IPython.display import Image
Image(filename='amazon_pic.png', width="800", height='50')
```

Out[1]:

Problem Statement

Sales management has gained importance to meet increasing competition and the need for improved methods of distribution to reduce cost and to increase profits. Sales management today is the most important function in a commercial and business enterprise.

Do ETL: Extract-Transform-Load some Amazon dataset and find for me Sales-trend -> month-wise, year-wise, yearly_month-wise

Find key metrics and factors and show the meaningful relationships between attributes. Do your own research and come up with your findings.

About Data

The dataset contains 100 entries with the following columns:

1. Region: Geographic region of the sale.
2. Country: Country where the sale occurred.
3. Item Type: Type of item sold.
4. Sales Channel: Whether the sale was online or offline.
5. Order Priority: Priority level of the order.
6. Order Date: Date the order was placed.
7. Order ID: Unique identifier for the order.
8. Ship Date: Date the order was shipped.
9. Units Sold: Number of units sold.
10. Unit Price: Price per unit.
11. Unit Cost: Cost per unit.
12. Total Revenue: Total revenue from the sale.
13. Total Cost: Total cost of the sale.

14. Total Profit: Total profit from the sale.

Importing Libraries

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings(action = 'ignore')
import seaborn as sns

# Set the asthetic style of the plots
sns.set_style("whitegrid")
```

Loading and Previewing Data

In [2]:

```
data = pd.read_csv("Amazon Sales data.csv")
data.head()
```

Out[2]:

	Region	Country	Item Type	Sales Channel	Order Priority	Order Date	Order ID	Ship Date	Units Sold	P
0	Australia and Oceania	Tuvalu	Baby Food	Offline	H	5/28/2010	669165933	6/27/2010	9925	25
1	Central America and the Caribbean	Grenada	Cereal	Online	C	8/22/2012	963881480	9/15/2012	2804	20
2	Europe	Russia	Office Supplies	Offline	L	5/2/2014	341417157	5/8/2014	1779	65
3	Sub-Saharan Africa	Sao Tome and Principe	Fruits	Online	C	6/20/2014	514321792	7/5/2014	8102	
4	Sub-Saharan Africa	Rwanda	Office Supplies	Offline	L	2/1/2013	115456712	2/6/2013	5062	65

In [3]:
```
data.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
```

In [4]:
```
data.shape
```

Out[4]:
```
(100, 14)
```

In [5]:
```
data.describe()
```

Out[5]:

	Order ID	Units Sold	Unit Price	Unit Cost	Total Revenue	Total Cost	Tot
count	1.000000e+02	100.000000	100.000000	100.000000	1.000000e+02	1.000000e+02	1.000
mean	5.550204e+08	5128.710000	276.761300	191.048000	1.373488e+06	9.318057e+05	4.416
std	2.606153e+08	2794.484562	235.592241	188.208181	1.460029e+06	1.083938e+06	4.385
min	1.146066e+08	124.000000	9.330000	6.920000	4.870260e+03	3.612240e+03	1.258
25%	3.389225e+08	2836.250000	81.730000	35.840000	2.687212e+05	1.688680e+05	1.214
50%	5.577086e+08	5382.500000	179.880000	107.275000	7.523144e+05	3.635664e+05	2.907
75%	7.907551e+08	7369.000000	437.200000	263.330000	2.212045e+06	1.613870e+06	6.358
max	9.940222e+08	9925.000000	668.270000	524.960000	5.997055e+06	4.509794e+06	1.719

Checking Missing Values

In [6]:
```
data.isnull().sum()
```

Out[6]:
```
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
```

In [7]:
```
data.columns
```

Out[7]:
```
Index(['Region', 'Country', 'Item Type', 'Sales Channel', 'Order Priorit
y',
       'Order Date', 'Order ID', 'Ship Date', 'Units Sold', 'Unit Price',
       'Unit Cost', 'Total Revenue', 'Total Cost', 'Total Profit'],
      dtype='object')
```

In [8]:
```
# Convert 'Order Date' and 'Ship Date' to datetime format
data['Order Date'] = pd.to_datetime(data['Order Date'])
data['Ship Date'] = pd.to_datetime(data['Ship Date'])

# Extract year and month from 'Order Date'
data['Order Year'] = data['Order Date'].dt.year
data['Order Month'] = data['Order Date'].dt.month

# Summarize sales data by year
yearly_sales = data.groupby('Order Year').agg({
    'Total Revenue': 'sum',
    'Total Cost': 'sum',
    'Total Profit': 'sum',
    'Units Sold': 'sum'
}).reset_index()

# Summarize sales data by month
monthly_sales = data.groupby('Order Month').agg({
    'Total Revenue': 'sum',
    'Total Cost': 'sum',
    'Total Profit': 'sum',
    'Units Sold': 'sum'
}).reset_index()
```

In [9]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 100 entries, 0 to 99
Data columns (total 16 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    datetime64[ns]
 6   Order ID        100 non-null    int64         
 7   Ship Date       100 non-null    datetime64[ns]
 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       
 14  Order Year      100 non-null    int32         
 15  Order Month     100 non-null    int32         
dtypes: datetime64[ns](2), float64(5), int32(2), int64(2), object(5)
memory usage: 11.8+ KB
```

In [10]:
```
data.head()
```

Out[10]:

	Region	Country	Item Type	Sales Channel	Order Priority	Order Date	Order ID	Ship Date	Units Sold	Unit Price	
0	Australia and Oceania	Tuvalu	Baby Food	Offline	H	2010-05-28	669165933	2010-06-27	9925	255.28	1
1	Central America and the Caribbean	Grenada	Cereal	Online	C	2012-08-22	963881480	2012-09-15	2804	205.70	1
2	Europe	Russia	Office Supplies	Offline	L	2014-05-02	341417157	2014-05-08	1779	651.21	5
3	Sub-Saharan Africa	Sao Tome and Principe	Fruits	Online	C	2014-06-20	514321792	2014-07-05	8102	9.33	
4	Sub-Saharan Africa	Rwanda	Office Supplies	Offline	L	2013-02-01	115456712	2013-02-06	5062	651.21	5

Exploratory Data Analysis (EDA)

In [11]:
```
# Calculate the Number of Regions
data["Region"].nunique()
```

Out[11]:
```
7
```

In [12]:
```
# Calculate the Number of Countries
data['Country'].nunique()
```

Out[12]:
```
76
```

In [13]:
```
# Calculate the Items Type
data['Item Type'].nunique()
```

Out[13]:
```
12
```

In [14]:
```
# Calculate the Total Unit Sold
print("Total Unit Sold" ,data['Units Sold'].sum())
```

```
Total Unit Sold 512871
```

In [15]:
```
# Calculate the Total Revenue
print("Total Revenue : ", data['Total Revenue'].sum())
```

```
Total Revenue :  137348768.31
```

In [16]:
```
# Calculate Total Cost
print("Total Cost : ", data['Total Cost'].sum())
```

```
Total Cost :  93180569.91000001
```

In [17]:
```
# Calculate Total Profit
print("Total Profit : ", data['Total Profit'].sum())
```

```
Total Profit :  44168198.39999999
```

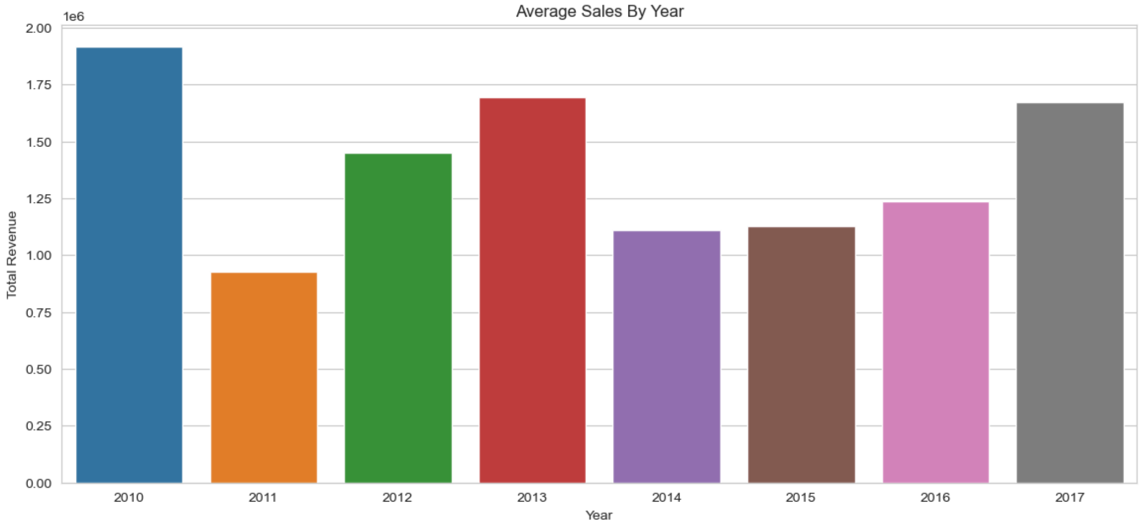
In [18]:
```
# Showing the groupby regional sales
data.groupby(['Region', 'Sales Channel'])['Total Profit'].sum()
```

Out[18]:
```
Region                             Sales Channel
Asia                               Offline          3584286.33
                                   Online           2529559.54
Australia and Oceania              Offline          1886283.82
                                   Online           2835876.21
Central America and the Caribbean  Offline          2475814.99
                                   Online            371092.86
Europe                             Offline          5574539.91
                                   Online           5508398.72
Middle East and North Africa       Offline          2169081.08
                                   Online           3592110.78
North America                      Offline          1457942.76
Sub-Saharan Africa                 Offline          7772777.78
                                   Online           4410433.62
Name: Total Profit, dtype: float64
```

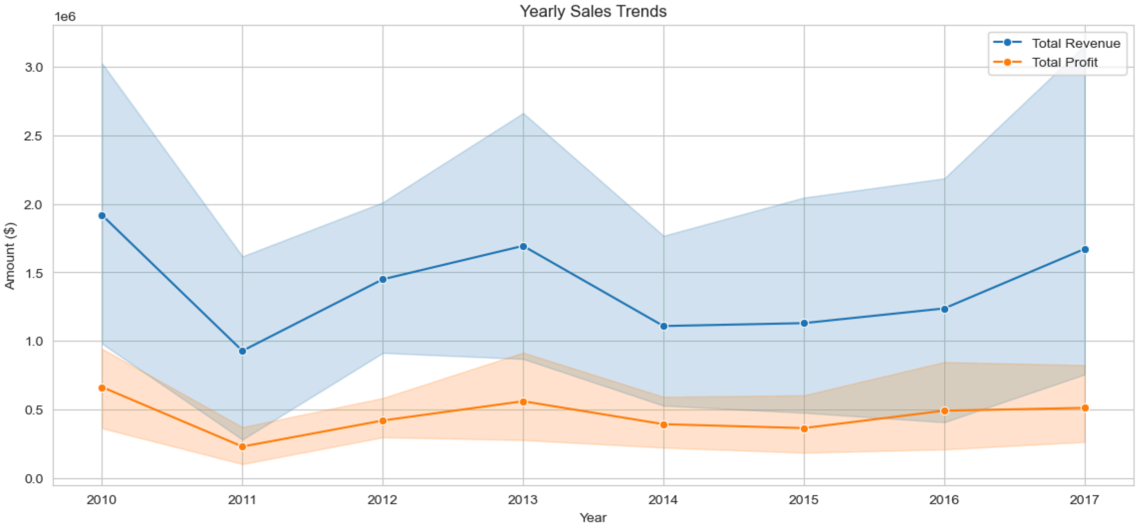
Visaluaization of Key Trends

In [19]:
```
# Yearwise sales
year_sales = data.groupby('Order Year')['Total Revenue'].mean()
plt.figure(figsize = (14,6))
sns.barplot(x = year_sales.index, y = year_sales.values)
plt.title("Average Sales By Year")
plt.xlabel("Year")
plt.ylabel("Total Revenue")
```

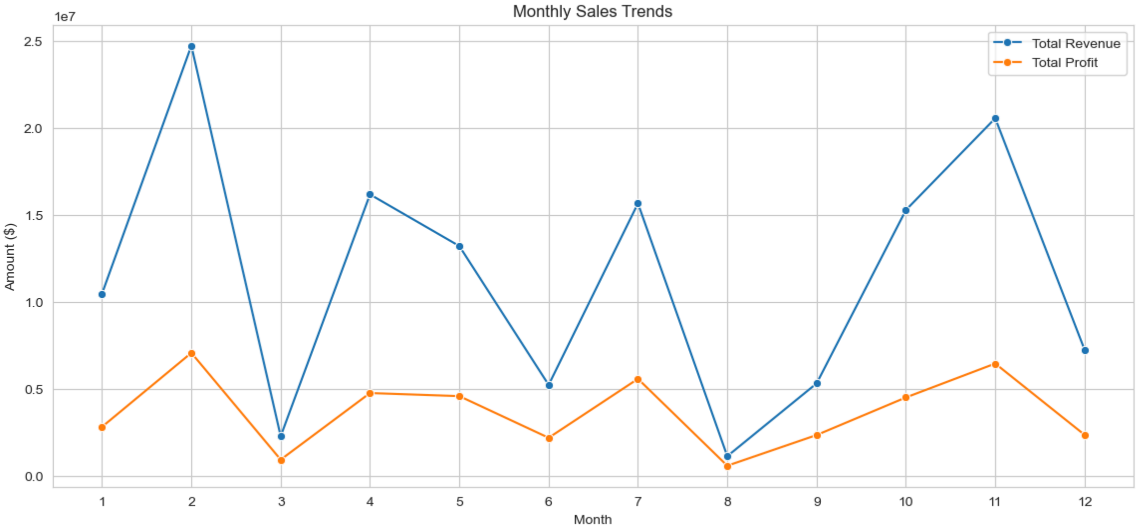
Out[19]:
```
Text(0, 0.5, 'Total Revenue')
```



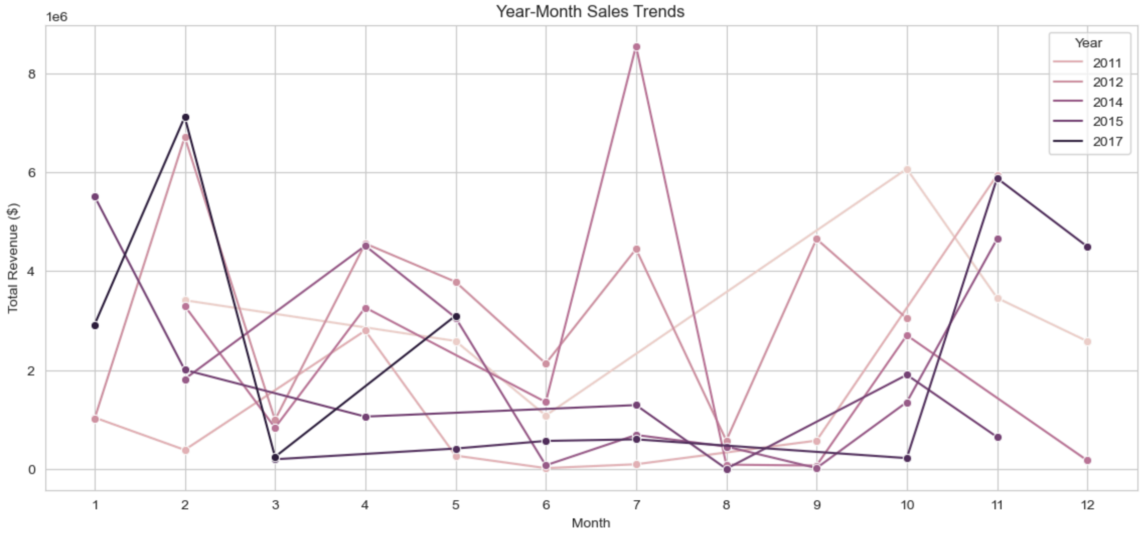
In [20]:
```
# Yearly Sales Trends
plt.figure(figsize=(14, 6))
plt.title("Yearly Sales Trends")
sns.lineplot(data=data, x='Order Year', y='Total Revenue', label='Total Reve
sns.lineplot(data=data, x='Order Year', y='Total Profit', label='Total Profi
plt.xlabel("Year")
plt.ylabel("Amount ($)")
plt.legend()
plt.show()
```



In [21]:
```
# Monthly Sales Trends
plt.figure(figsize=(14, 6))
plt.title("Monthly Sales Trends")
sns.lineplot(data=monthly_sales, x='Order Month', y='Total Revenue', label=
sns.lineplot(data=monthly_sales, x='Order Month', y='Total Profit', label='
plt.xlabel("Month")
plt.ylabel("Amount ($)")
plt.xticks(range(1, 13))
plt.legend()
plt.show()
```

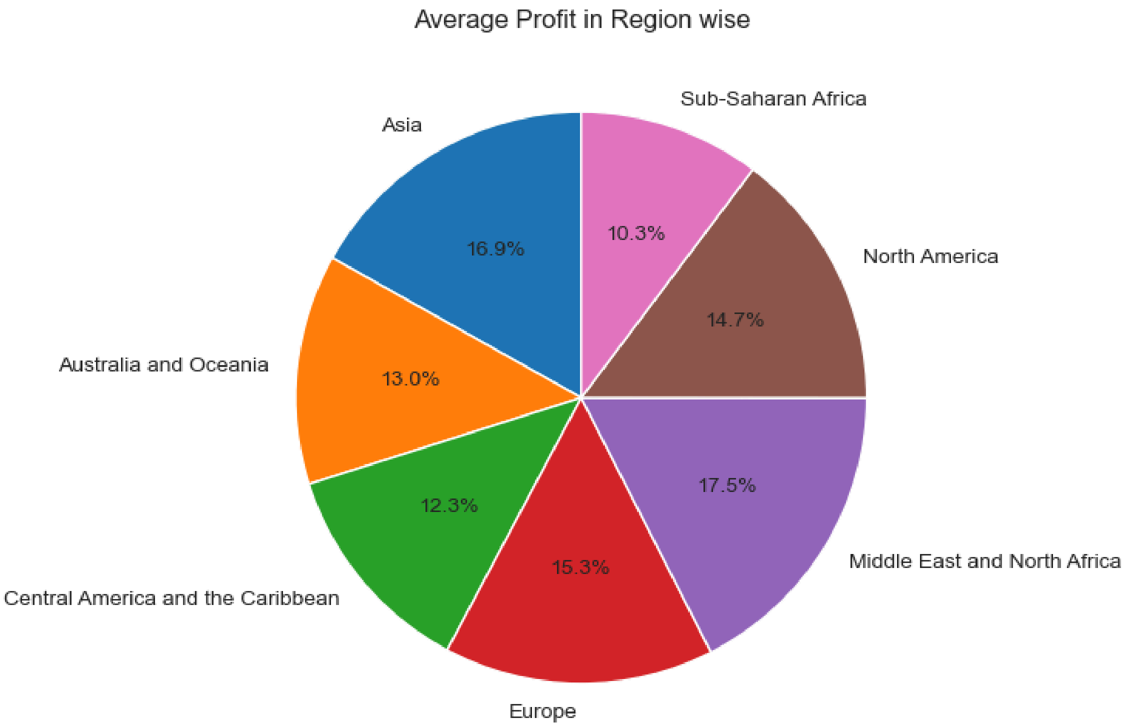


```
In [22]: # Summarize sales data by year and month
         year_month_sales = data.groupby(['Order Year', 'Order Month']).agg({
             'Total Revenue': 'sum',
             'Total Cost': 'sum',
             'Total Profit': 'sum',
             'Units Sold': 'sum'
         }).reset_index()

         # Year-Month Sales Trends
         plt.figure(figsize=(14, 6))
         plt.title("Year-Month Sales Trends")
         sns.lineplot(data=year_month_sales, x='Order Month', y='Total Revenue', hue=
         plt.xlabel("Month")
         plt.ylabel("Total Revenue ($)")
         plt.xticks(range(1, 13))
         plt.legend(title='Year')
         plt.show()
```



In [23]:
```
# Pie Chart of Total Profit in region wise
plt.figure(figsize = (6,6))
region_TotalRevenue = data.groupby("Region")['Total Profit'].mean()
plt.pie(region_TotalRevenue, startangle = 90, labels = region_TotalRevenue.
plt.title("Average Profit in Region wise")
```

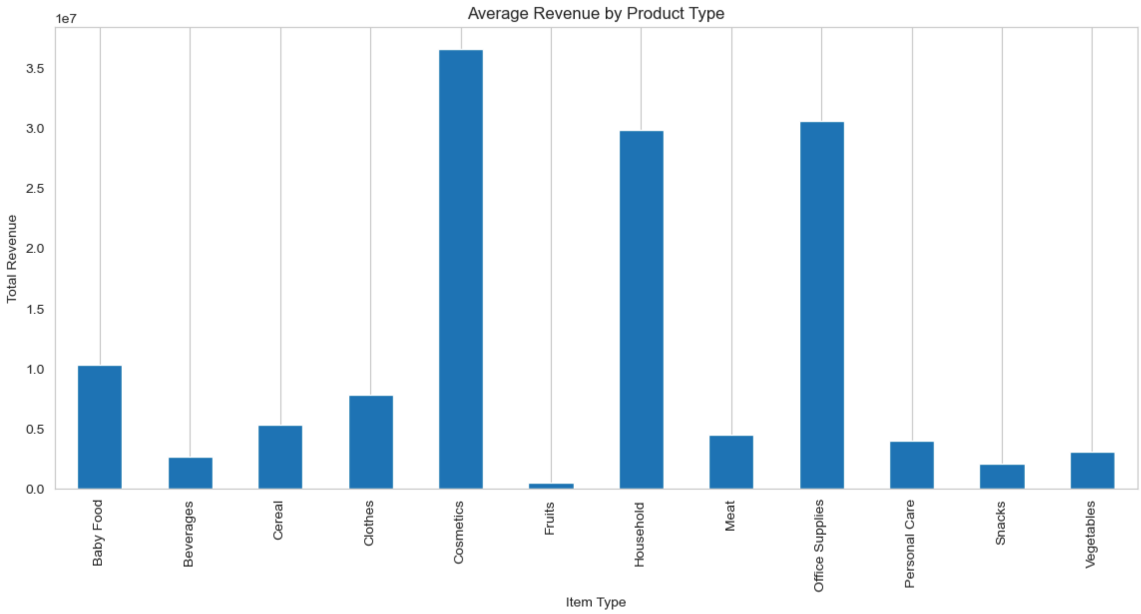
Out[23]:
```
Text(0.5, 1.0, 'Average Profit in Region wise')
```



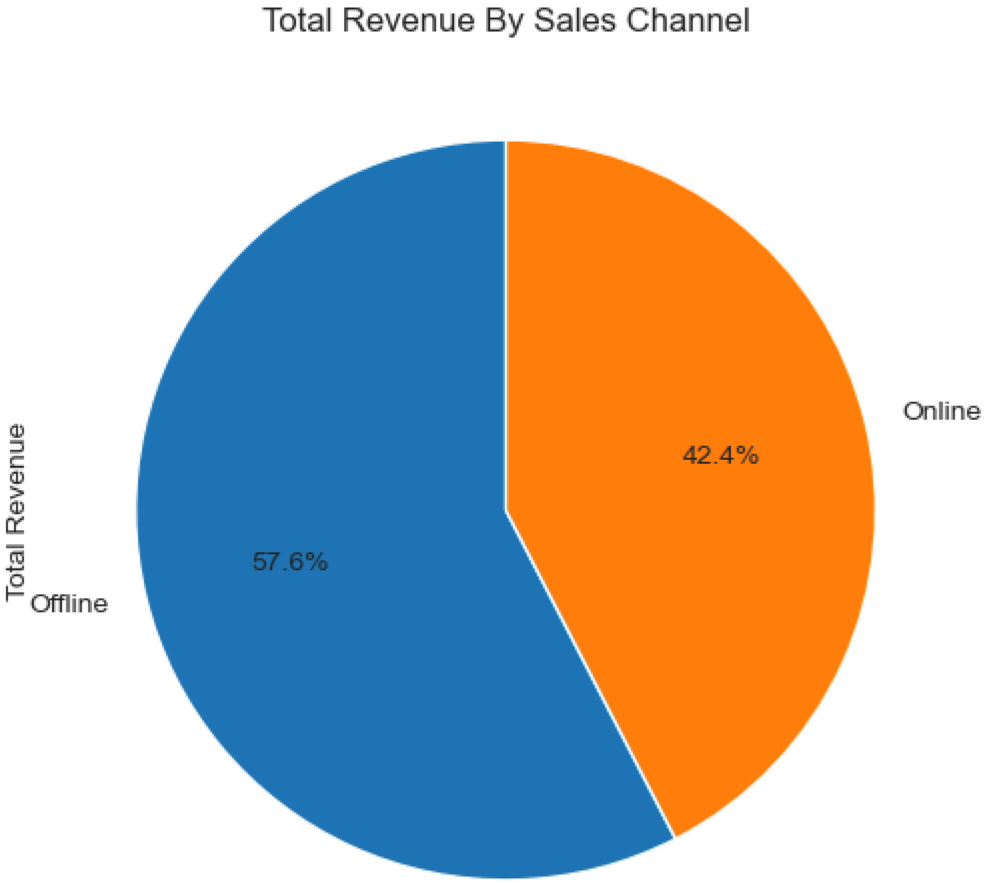
In [24]:
```
# Group Total Revenue by Item type
TotalRevenue_ItemType = data.groupby('Item Type')['Total Revenue'].sum()
```

In [26]:

```
# Bar chat for total Revenue by item type
plt.figure(figsize = (14,6))
TotalRevenue_ItemType.plot(kind = 'bar')
plt.xlabel('Item Type')
plt.ylabel('Total Revenue')
plt.title("Average Revenue by Product Type")
plt.grid(axis ='y')
plt.show()
```

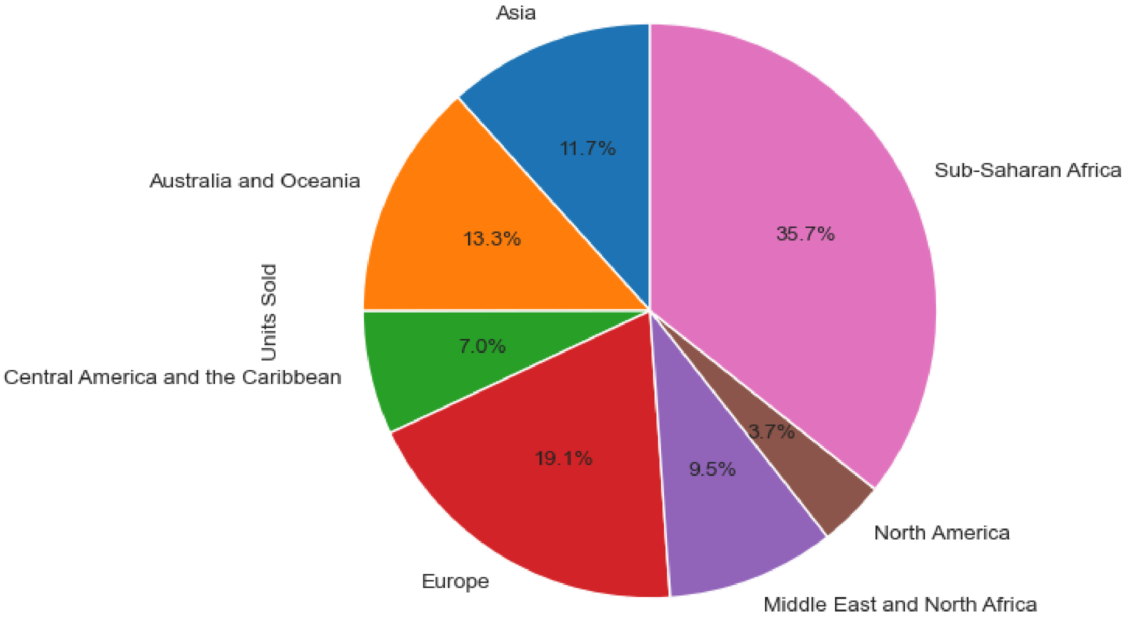


```
In [27]: # Pie Chart for Total Revenue by Sales Channel
         TotalRevenue_SalesChannel = data.groupby('Sales Channel')['Total Revenue'].r
         plt.figure(figsize = (6,6))
         TotalRevenue_SalesChannel.plot(kind = 'pie', startangle = 90, autopct='%1.1
         plt.title("Total Revenue By Sales Channel")
         plt.show()
```



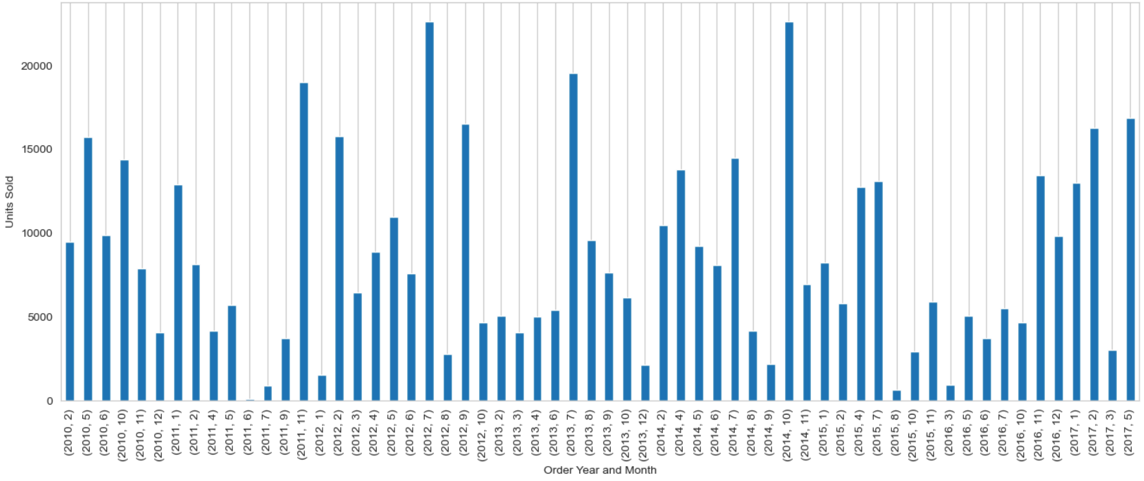
```
In [28]: Region_UnitSold = data.groupby("Region")['Units Sold'].sum()
         plt.figure(figsize=(6,6))
         Region_UnitSold.plot(kind = 'pie', labels = Region_UnitSold.index, startang]
```

```
Out[28]: <Axes: ylabel='Units Sold'>
```



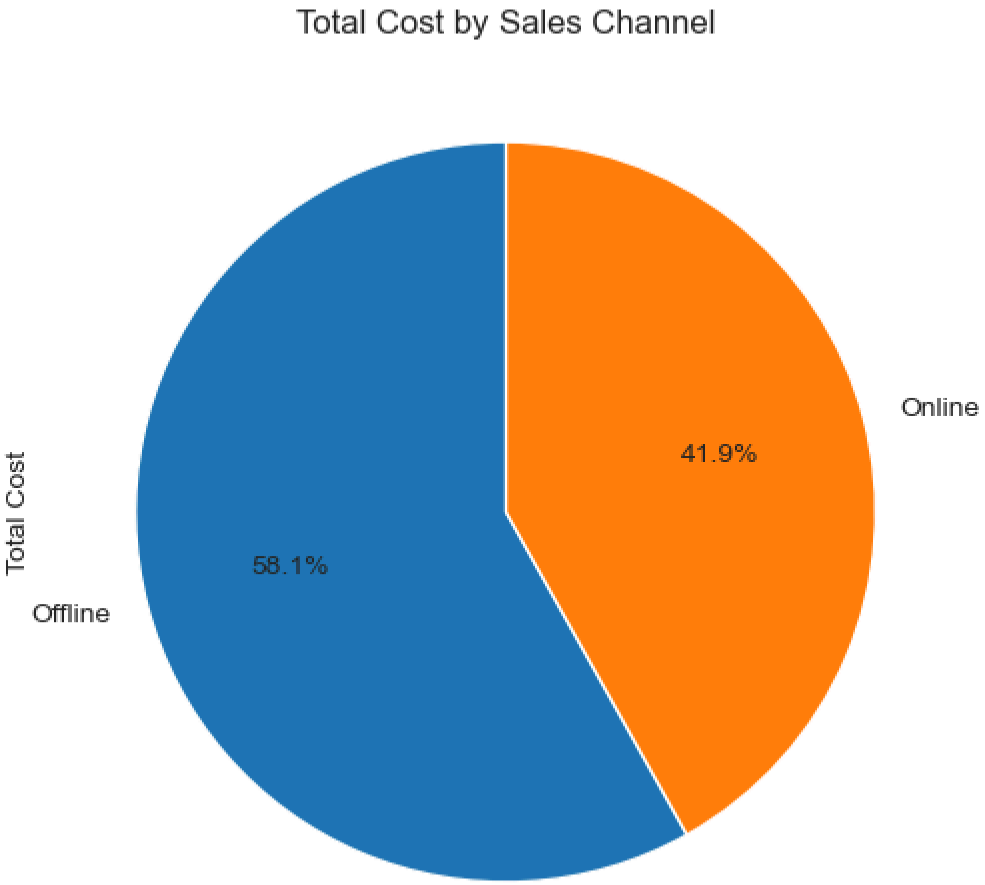
```
In [29]: # Bar Chart for Units Sold by Year and Month
         YearMonth_UnitsSold = data.groupby(['Order Year', 'Order Month'])['Units Sol
         plt.figure(figsize = (14,6))
         YearMonth_UnitsSold.plot(kind= 'bar')
         plt.xlabel("Order Year and Month")
         plt.ylabel("Units Sold")
         plt.tight_layout()
         plt.grid(axis = 'y')
         plt.show
```

```
Out[29]: <function matplotlib.pyplot.show(close=None, block=None)>
```



In [30]:

```
# Pie Chart for Total cost by Sales Channel
TotalCost_SalesChannel = data.groupby('Sales Channel')['Total Cost'].sum()
plt.figure(figsize = (6,6))
TotalCost_SalesChannel.plot(kind = 'pie', startangle = 90, autopct = '%1.1f%
plt.title("Total Cost by Sales Channel")
plt.show()
```

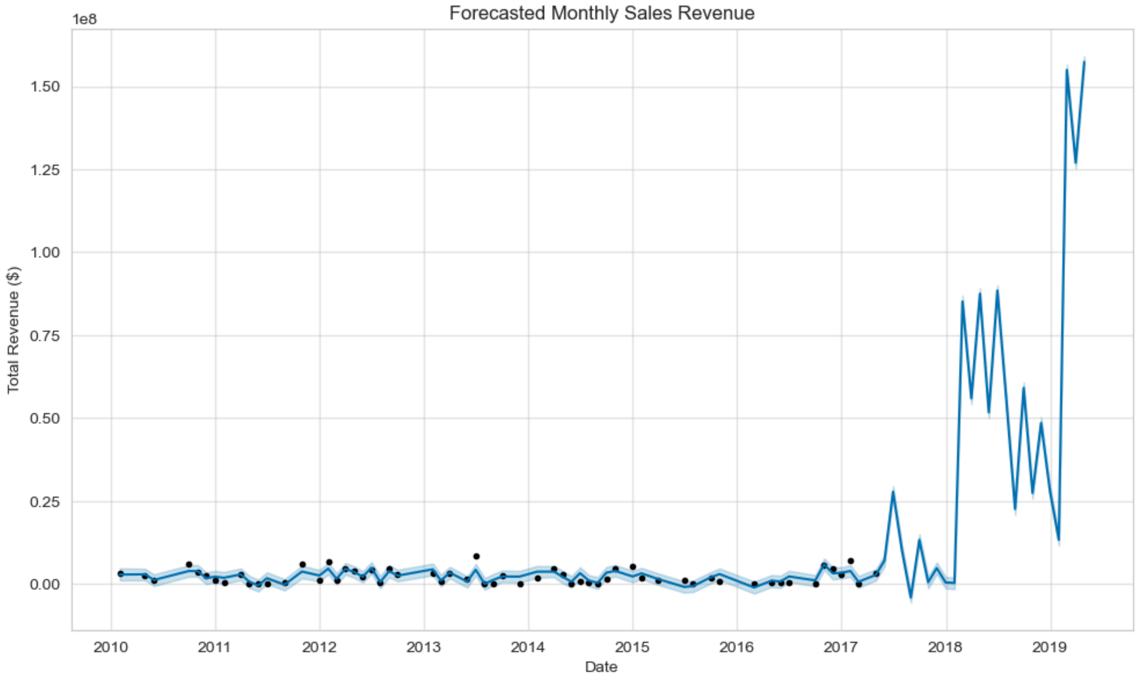


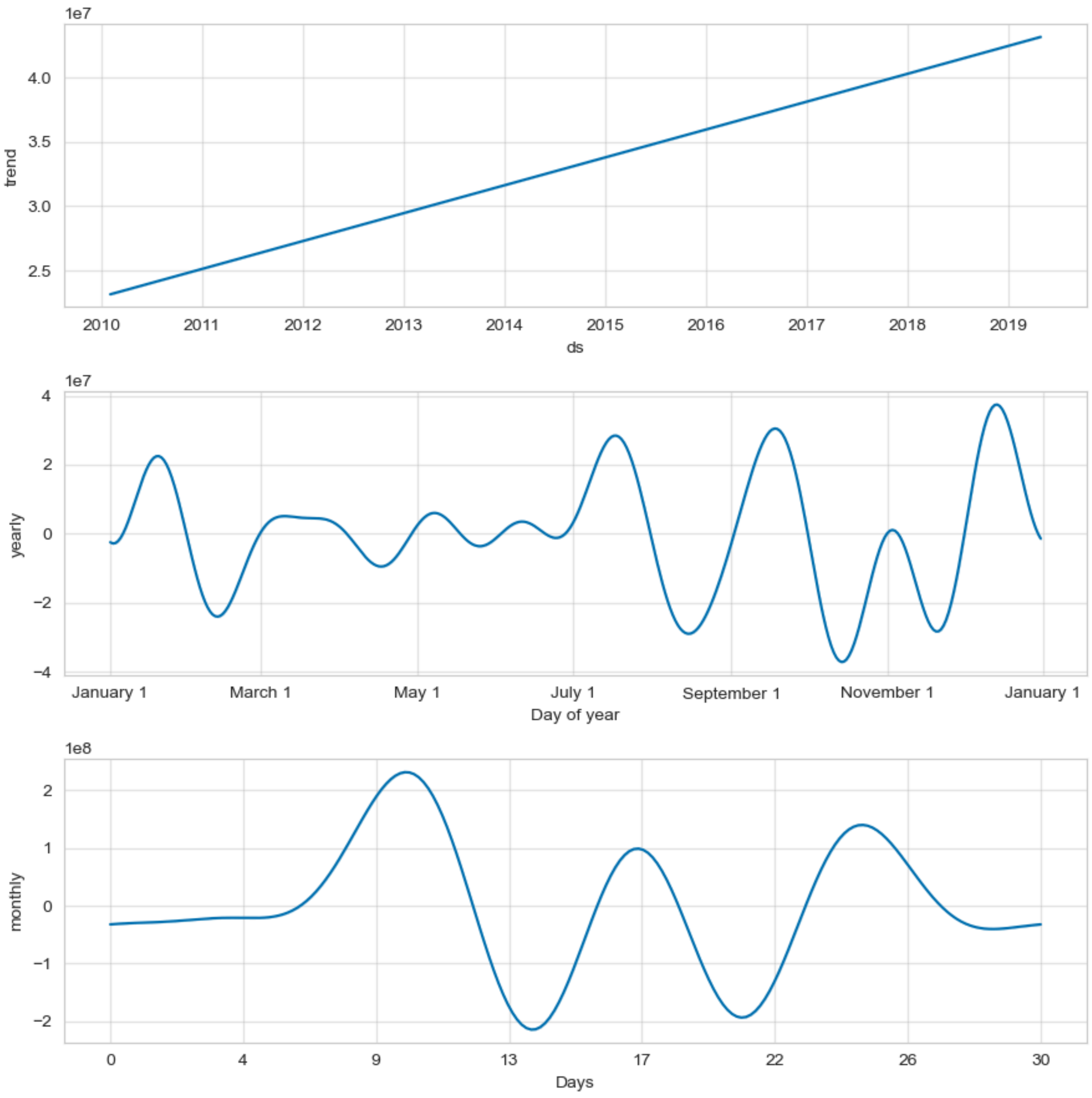
Modelling Approach

In [31]:

```
from prophet import Prophet

monthly_sales = data.groupby(data['Order Date'].dt.to_period('M')).agg({
    'Total Revenue': 'sum'
}).reset_index()

# Prophet requires columns 'ds' and 'y'
monthly_sales.columns = ['ds', 'y']
monthly_sales['ds'] = monthly_sales['ds'].dt.to_timestamp()

# Initialize and fit the model
model = Prophet(yearly_seasonality=True)
model.add_seasonality(name = 'monthly', period = 30.5,  fourier_order = 5)
model.fit(monthly_sales)

# Create a DataFrame to hold predictions (for the next 24 months)
future = model.make_future_dataframe(periods=24, freq='M')
forecast = model.predict(future)

# Plot the forecast
fig1 = model.plot(forecast)
plt.title("Forecasted Monthly Sales Revenue")
plt.xlabel("Date")
plt.ylabel("Total Revenue ($)")
plt.show()

# Plot the forecast components
fig2 = model.plot_components(forecast)
plt.show()
```

```
16:33:36 - cmdstanpy - INFO - Chain [1] start processing
16:33:36 - cmdstanpy - INFO - Chain [1] done processing
```





Summary

- **Data Overview:**

  The dataset contains information on sales transactions, including regions, countries, item types, sales channels, order dates, units sold, unit prices, costs, and financial metrics such as total revenue, total cost, and total profit.

- **Key Findings:**

  1. Yearly Sales Trends:

     2012 had the highest total revenue ($31.9 million) and total profit ($9.2 million), indicating a peak in sales and profitability.
     2010 also showed significant performance with a total revenue of $19.2 million and a profit of $6.6 million.
     The number of units sold was highest in 2012, reaching 97,967 units.

  2. Monthly Sales Trends:

February emerged as the month with the highest total revenue ($24.7 million) and profit ($7.07 million), suggesting it might be a peak sales period, possibly due to seasonal or promotional activities.
July also exhibited strong sales figures, indicating potential seasonality in sales.

3. Year-Month Analysis:

    A detailed breakdown showed variability in sales across different months in different years, highlighting the importance of both yearly and monthly trends in understanding overall sales performance.

- **Modelling Approach**
    - Prophet Library:

        Used for forecasting, Prophet handles seasonality and holiday effects well and is user-friendly for business users and data scientists alike.

    - Custom Seasonality :

        Although Prophet handles yearly seasonality by default, custom monthly seasonality was added to capture monthly variations in sales.

In [32]:
```
data.to_csv('amazon_sales_data1.csv', index=False)
```