Introduction & Project Overview

Purpose & Objectives

The goal of this project is to analyze sales data to derive actionable business insights that can drive strategic decisions. This analysis focuses on uncovering sales trends, understanding customer demographics, and evaluating product performance.

Data Source Description

The dataset, **sales_data.csv**, contains detailed sales transactions including:

- **Date Information:** Year, month, day.
- **Customer Demographics:** Age, gender, country, state.
- **Product Details:** Category, sub-category, product name.
- **Sales Metrics:** Order quantity, unit cost, unit price, profit, cost, and revenue.

```
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 sales_data.csv to sales_data.csv

```
import pandas as pd
import io

sales_data = pd.read_csv(io.BytesIO(uploaded['sales_data.csv']))

sales_data.head()
```

	Date	Day	Month	Year	Customer_Age	Age_Group	Customer_Gender	Country	Sta
0	2013-11-26	26	November	2013	19	Youth (<25)	M	Canada	Britis Columb
1	2015-11-26	26	November	2015	19	Youth (<25)	M	Canada	Britis Columb

Data Cleaning & Preparation

```
print("Missing values per column")
print(sales_data.isnull().sum())
```

```
Missing values per column
Date                0
Day                 0
Month               0
Year                0
Customer_Age        0
Age_Group           0
Customer_Gender     0
Country             0
State               0
Product_Category    0
Sub_Category        0
Product             0
Order_Quantity      0
Unit_Cost           0
Unit_Price          0
Profit              0
Cost                0
Revenue             0
dtype: int64
```

```
sales_data['Profit_Margin'] = sales_data.apply(
    lambda row: row['Profit'] / row['Revenue'] if row['Revenue'] > 0 else 0, axis=1
)
print("\nCreated 'Profit_Margin' column.")
```

```
Created 'Profit_Margin' column.
```

```
sales_data.head()
sales_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 113036 entries, 0 to 113035
Data columns (total 19 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   Date              113036 non-null  object
 1   Day               113036 non-null  int64
 2   Month             113036 non-null  object
 3   Year              113036 non-null  int64
 4   Customer_Age      113036 non-null  int64
 5   Age_Group         113036 non-null  object
 6   Customer_Gender   113036 non-null  object
 7   Country           113036 non-null  object
```

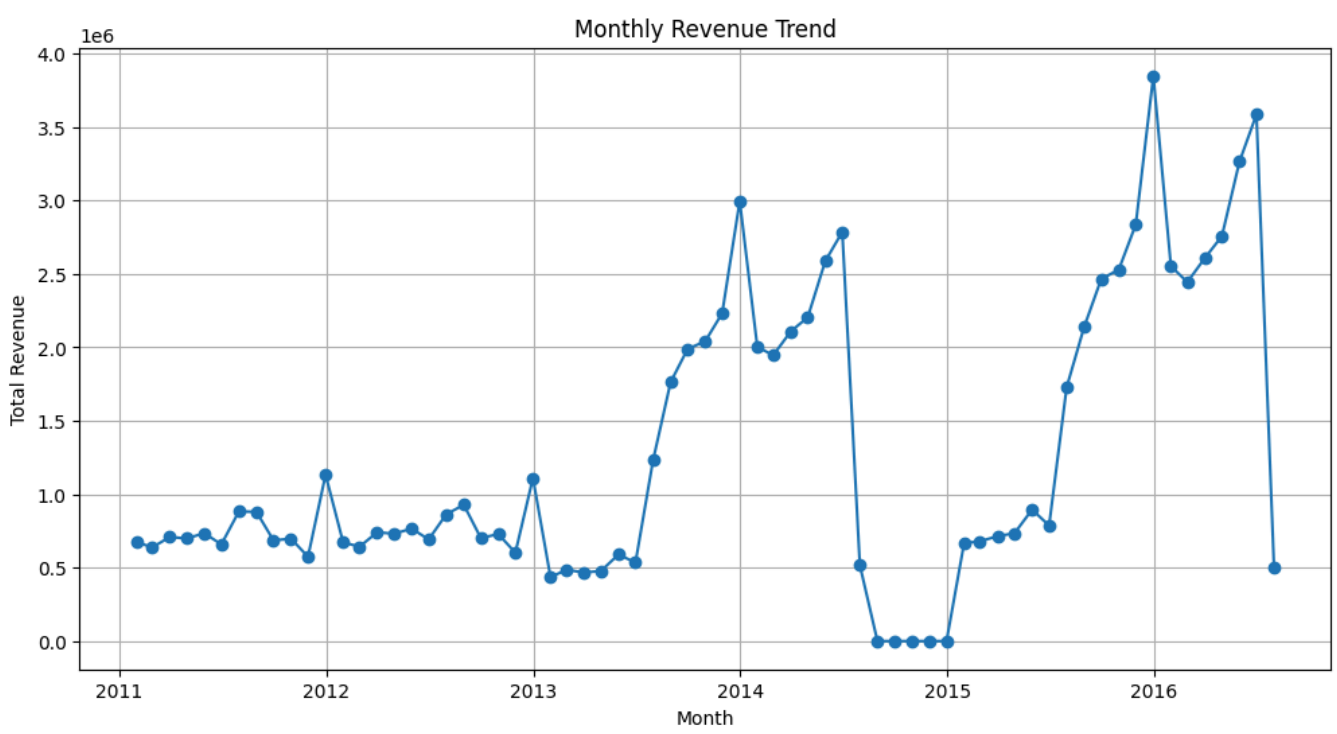
```
 8   State             113036 non-null  object
 9   Product_Category  113036 non-null  object
 10  Sub_Category      113036 non-null  object
 11  Product           113036 non-null  object
 12  Order_Quantity    113036 non-null  int64
 13  Unit_Cost         113036 non-null  int64
 14  Unit_Price        113036 non-null  int64
 15  Profit            113036 non-null  int64
 16  Cost              113036 non-null  int64
 17  Revenue           113036 non-null  int64
 18  Profit_Margin     113036 non-null  float64
dtypes: float64(1), int64(9), object(9)
memory usage: 16.4+ MB
```

Exploratory Data Analysis

```
import matplotlib.pyplot as plt
import matplotlib.dates as mdates
print(sales_data.describe())
```

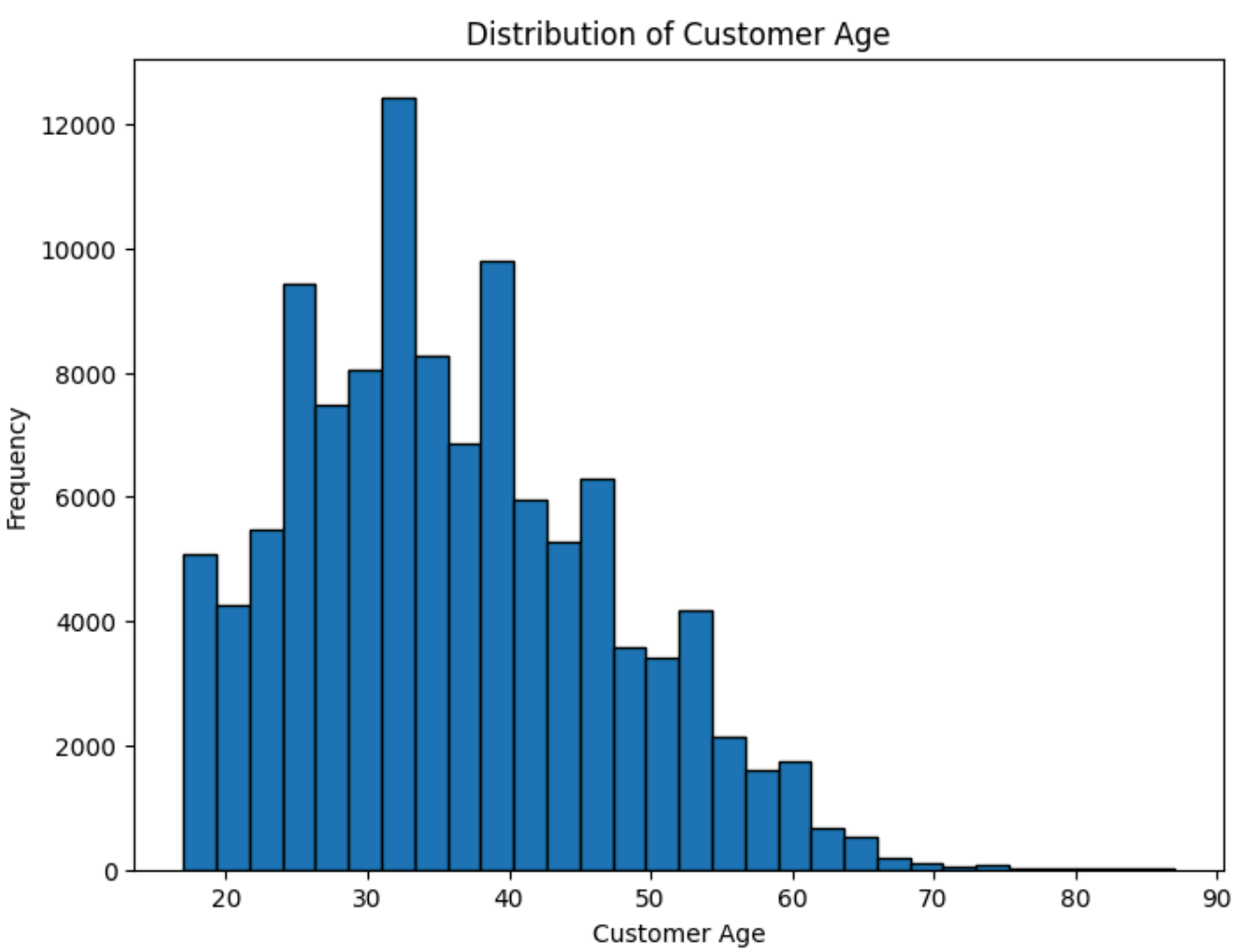
```
                Day           Year   Customer_Age  Order_Quantity  \
count  113036.000000  113036.000000  113036.000000   113036.000000
mean       15.665753    2014.401739      35.919212       11.901660
std         8.781567       1.272510      11.021936        9.561857
min         1.000000    2011.000000      17.000000        1.000000
25%         8.000000    2013.000000      28.000000        2.000000
50%        16.000000    2014.000000      35.000000       10.000000
75%        23.000000    2016.000000      43.000000       20.000000
max        31.000000    2016.000000      87.000000       32.000000

           Unit_Cost     Unit_Price         Profit           Cost  \
count  113036.000000  113036.000000  113036.000000  113036.000000
mean      267.296366     452.938427     285.051665     469.318695
std       549.835483     922.071219     453.887443     884.866118
min         1.000000       2.000000     -30.000000       1.000000
25%         2.000000       5.000000      29.000000      28.000000
50%         9.000000      24.000000     101.000000     108.000000
75%        42.000000      70.000000     358.000000     432.000000
max      2171.000000    3578.000000   15096.000000   42978.000000

             Revenue  Profit_Margin
count  113036.000000  113036.000000
mean      754.370360       0.472518
std      1309.094674       0.163577
min         2.000000      -0.037037
25%        63.000000       0.357143
50%       223.000000       0.526316
75%       800.000000       0.596774
max     58074.000000       0.750000
```

```
if 'Date' not in sales_data.columns:
    sales_data.reset_index(inplace=True)

sales_data['Date'] = pd.to_datetime(sales_data['Date'], errors='coerce')

sales_data.set_index('Date', inplace=True)

monthly_revenue = sales_data['Revenue'].resample('ME').sum()

plt.figure(figsize=(12,6))
plt.plot(monthly_revenue.index, monthly_revenue.values, marker='o')
plt.title("Monthly Revenue Trend")
plt.xlabel("Month")
plt.ylabel("Total Revenue")
plt.grid(True)
plt.show()
```

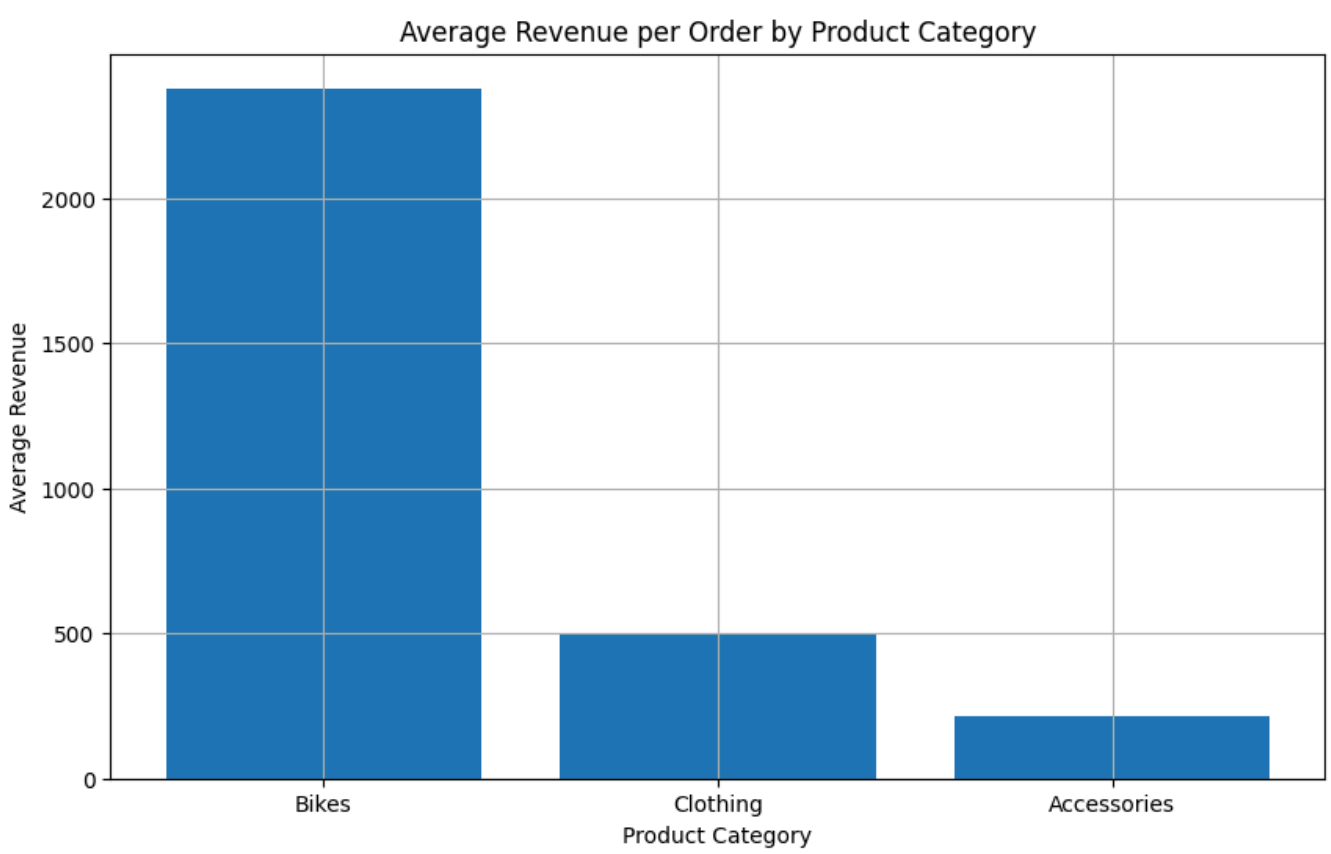



```
plt.figure(figsize=(8,6))
plt.hist(sales_data['Customer_Age'], bins=30, edgecolor='black')
plt.title("Distribution of Customer Age")
plt.xlabel("Customer Age")
```

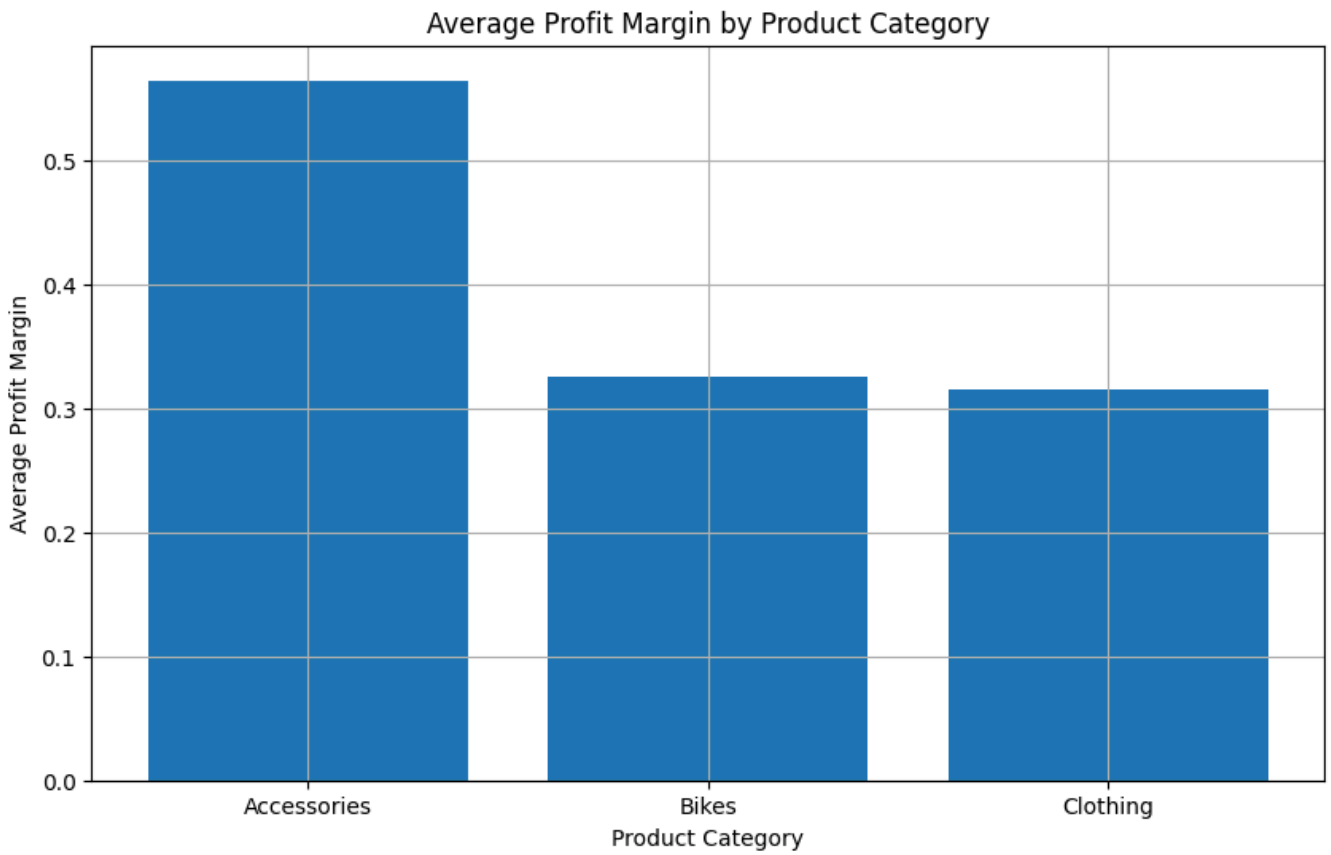
```
plt.ylabel("Frequency")
plt.show()
```



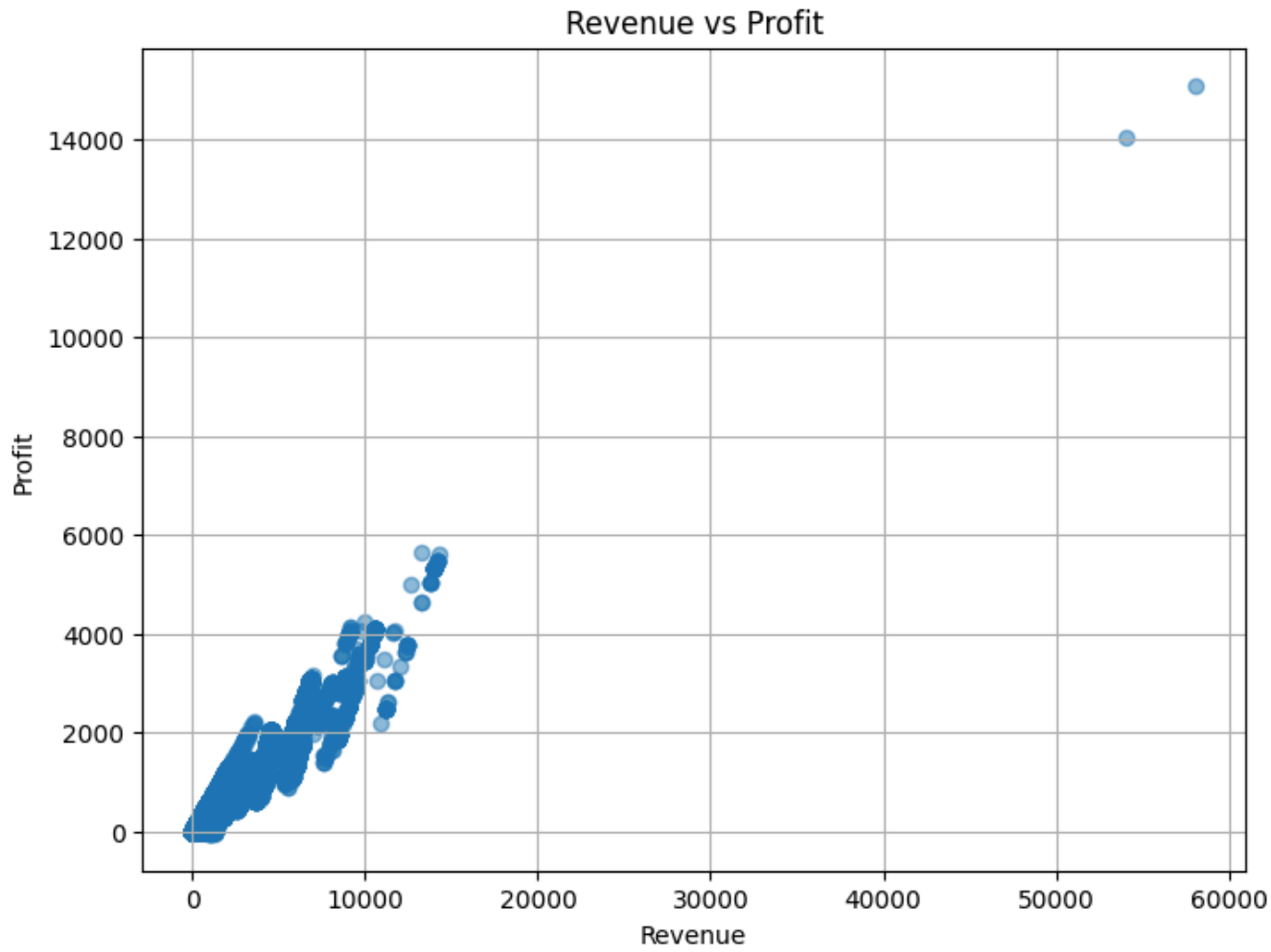

```
category_revenue = sales_data.groupby('Product_Category')['Revenue'].mean().reset_index()

category_revenue = category_revenue.sort_values(by='Revenue', ascending=False)

plt.figure(figsize=(10,6))
plt.bar(category_revenue['Product_Category'], category_revenue['Revenue'])
plt.title("Average Revenue per Order by Product Category")
plt.xlabel("Product Category")
plt.ylabel("Average Revenue")
plt.grid(True)
plt.show()
```




```
if 'Profit_Margin' not in sales_data.columns:
    sales_data['Profit_Margin'] = sales_data['Profit'] / sales_data['Revenue']

category_profit_margin = sales_data.groupby('Product_Category')['Profit_Margin'].mean().rese

category_profit_margin = category_profit_margin.sort_values(by='Profit_Margin', ascending=Fa

plt.figure(figsize=(10,6))
plt.bar(category_profit_margin['Product_Category'], category_profit_margin['Profit_Margin'])
plt.title("Average Profit Margin by Product Category")
plt.xlabel("Product Category")
plt.ylabel("Average Profit Margin")
plt.grid(True)
plt.show()
```




```
plt.figure(figsize=(8,6))
plt.scatter(sales_data['Revenue'], sales_data['Profit'], alpha=0.5)
plt.title("Revenue vs Profit")
plt.xlabel("Revenue")
plt.ylabel("Profit")
plt.grid(True)
plt.show()

correlation = sales_data['Revenue'].corr(sales_data['Profit'])
print("Correlation between Revenue and Profit:", correlation)
```




```
Correlation between Revenue and Profit: 0.9565716640736271
```

Insights and Recommendations

Monthly Revenue Trend

- The chart indicates periods of high and low sales

Recommendation:

- I recommend to increase marketing effots during periods of high sales to further increase revenue
- During periods of low sales, we need to re-think our marketing initiative and come up with a better plan

Costumer Age

- The bar chart reveals that the majority of our cosutmers are age 26-40

Recommendation:

- Create marketing campaigns specifically designed for this age group

Product Performance

- The bar chart for average revenue per order highlights which product categories are driving total revenue

Recommendation:

- See Profitability Analysis (next section), as these go head to head

Profitability Analysis

- The profit margin analysis shows differences in profitability across product categories

Recommendation:

- Since accessories have the highest profit margin, increase marketing effots and promotions to boost the overall profitability
- Continue the support for bikes, as they have the highest revenue, but look into ways to increase their profit margin
- Evaluate pricing for both categories and find an approach that maximizes revenue and profit

Revenue and Profit Correlation

- A strong positive correlation between revenue and profit suggests that increasing overall sales will likely boost profit

Recommendation

- Implement strategies to increase sales volume while keeping an eye on cost control (Bundle Pricing)

Conclusion & Future Work

Summary of Findings:

- **Monthly Revenue Trend:**
  The analysis shows clear seasonal trends, with distinct periods of high and low sales.
- **Customer Demographics:**
  The age distribution indicates the dominant customer segments.

- **Product Performance:**
  While bikes generate the highest total revenue, accessories lead in profit margin.
- **Profitability Analysis:**
  Accessories, despite lower overall revenue, offer higher profit margins compared to bikes.

Business Implications:

- Focus marketing efforts on accessories to maximize profitability.
- Continue promoting bikes due to their strong revenue performance, but explore strategies to improve their profit margins.