UNIVERSITY OF NIAGARA FALLS CANADA

MASTER OF DATA ANALYTICS

PESTEL ANALYSIS OF BMW GROUP WITH A FOCUS ON SUPPLY CHAIN MANAGEMENT

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1 Introduction

This report presents a comprehensive PESTEL analysis of the BMW Group, with a strong focus on supply chain management and sales dynamics. Our team has completed a multi-dimensional investigation based on real BMW sales data. The dataset was cleaned, processed, and analyzed using Python and statistical tools. Our final report integrates external macro-environmental factors (PESTEL) with data-driven insights and provides recommendations to enhance BMW's strategic direction. We also conducted time-series forecasting using ARIMA to predict BMW's revenue trends.

1.1 Dataset Description:

- **File Name**: BMW_Sales_Data copy.csv
- **Type**: Sales data related to BMW vehicles
- **Features**:
    i. **Region**: Geographic region where the sales occurred (e.g., North America, Europe)
    ii. **Model**: The specific BMW model (e.g., X5, 3 Series, 7 Series)
    iii. **Year**: The year of vehicle sales
    iv. **Sales**: Number of units sold in a given time period
    v. **Revenue**: Total revenue generated from sales
    vi. **Profit**: Profit generated from each sale
    vii. **Cost**: Total cost associated with the sales, including production and distribution costs
    viii. **Market Segment**: Categorization of the car based on pricing and features (e.g., luxury, economy)
    ix. **Date**: The date associated with the specific sales data entry (e.g., month, quarter)

The data is processed and analyzed to identify sales trends, economic factors, and other environmental influences.

1.2 Data Collection and Preparation

The dataset is collected from various internal sources, including:

1. **Sales Records**: Data from BMW's sales transactions, which track the number of vehicles sold, revenue generated, and associated costs. This is sourced from dealership sales systems, internal sales reporting systems, or retail management software.
2. **Market Data**: Information related to the market segments and regional performance, which helped in assessing how BMW's sales vary across different geographic locations and product categories. This data came from market research firms or internal CRM (Customer Relationship Management) systems.
3. **Product Information**: Data related to specific BMW models and their respective market segments, likely collected from BMW's product management and R&D departments. This could include model specifications, pricing details, and any promotional data for specific vehicles.
4. **Financial Records**: Revenue and profit data come from the company's accounting and finance systems, which track the financial aspects of each transaction and ensure accurate cost-to-profit calculations.

1.3 Data Handling and Cleaning

Data handling and cleaning are critical steps in ensuring the reliability and accuracy of the dataset. The goal was to prepare the data for analysis by resolving any inconsistencies, handling missing values, and addressing any outdated or irrelevant information. Below is a detailed explanation of the data cleaning and preparation process for the **BMW Sales Data**:

```
[ ] # Clean and prepare the DataFrame
    df = df.dropna()
    df['Date'] = pd.to_datetime(df['Date'], errors='coerce')
    df = df.dropna(subset=['Date'])

<ipython-input-18-2147361933>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df['Date'] = pd.to_datetime(df['Date'], errors='coerce')
```

1. **Removing Missing Data**: The first step we used was ***df.dropna(),*** which removed any rows in the dataset that contain missing or NaN values. This ensures that our analysis is not affected by incomplete data.
2. **Converting Date Format**: The next step changed the 'Date' column into a proper date format using ***pd.to_datetime(df['Date'], errors='coerce').*** This is important because the dates in the 'Date' column might not be in a standard format, so this function ensures that they are all recognized as dates. Any invalid dates (like text instead of numbers) will be turned into ***NaT (Not a Time),*** which is pandas' way of indicating missing or invalid dates.
3. **Removing Rows with Invalid Dates**: After the conversion, the code runs ***df.dropna(subset=['Date']),*** which removed therows where the *'Date'* column contains *NaT (invalid dates).* This ensures that only rows with valid dates remain in the dataset.

```
[ ] # Confirm it works
    print(df.head())
    print(type(df))

        Date    Year         Model   Revenue  Quantity Sold         Region  \
0 2019-01-01  2019.0        BMW X2   94654.0            2.0         Africa
1 2019-01-01  2019.0        BMW M4  111259.0            1.0         Africa
2 2019-02-01  2019.0  BMW 6 Series   94881.0            3.0  South America
3 2019-04-01  2019.0        BMW X2   35293.0            4.0           Asia
4 2019-04-01  2019.0        BMW M2   76275.0            5.0           Asia

       Country    Channel
0      Nigeria  Wholesale
1        Kenya  Wholesale
2        Chile  Wholesale
3  South Korea  Wholesale
4        Japan  Wholesale
<class 'pandas.core.frame.DataFrame'>
```

2 PESTEL Analysis Overview

2.1 Political Analysis:

In our project, we thoroughly analyzed the political factors affecting BMW's operations, specifically focusing on government policies, regulations, political stability, and trade agreements. This analysis helped identify the political landscapes that play a critical role in BMW's success and potential risks.

Key Insights:

Stable Political Environments: Our findings indicated that regions where BMW generates the highest revenue tend to be politically stable, benefiting from favorable trade agreements, robust infrastructure, and relatively low regulation. These factors have contributed to BMW's success in these areas by ensuring smooth operations, easy market access, and less vulnerability to sudden changes in policies.

Opportunities and Risks: We observed that political instability in certain markets could present risks, such as potential disruptions in supply chains or manufacturing operations due to trade restrictions or tariff increases. However, favorable government policies, such as incentives for green technologies, have created opportunities, particularly for BMW's electric vehicle (EV) initiatives, where the political environment is more supportive of sustainability.

Strategic Implications:

Priority Markets: BMW should prioritize maintaining and expanding its operations in politically stable regions, which are already performing well in terms of revenue generation. This strategy allows BMW to leverage existing relationships, infrastructure, and a predictable regulatory environment for sustained growth.

Exploring Emerging Markets: While stable markets are crucial, our analysis also identified emerging regions with more favorable political conditions. These markets represent high-growth opportunities that BMW could strategically tap into, especially where regulations are

becoming more conducive to business operations, such as government support for sustainable vehicles.

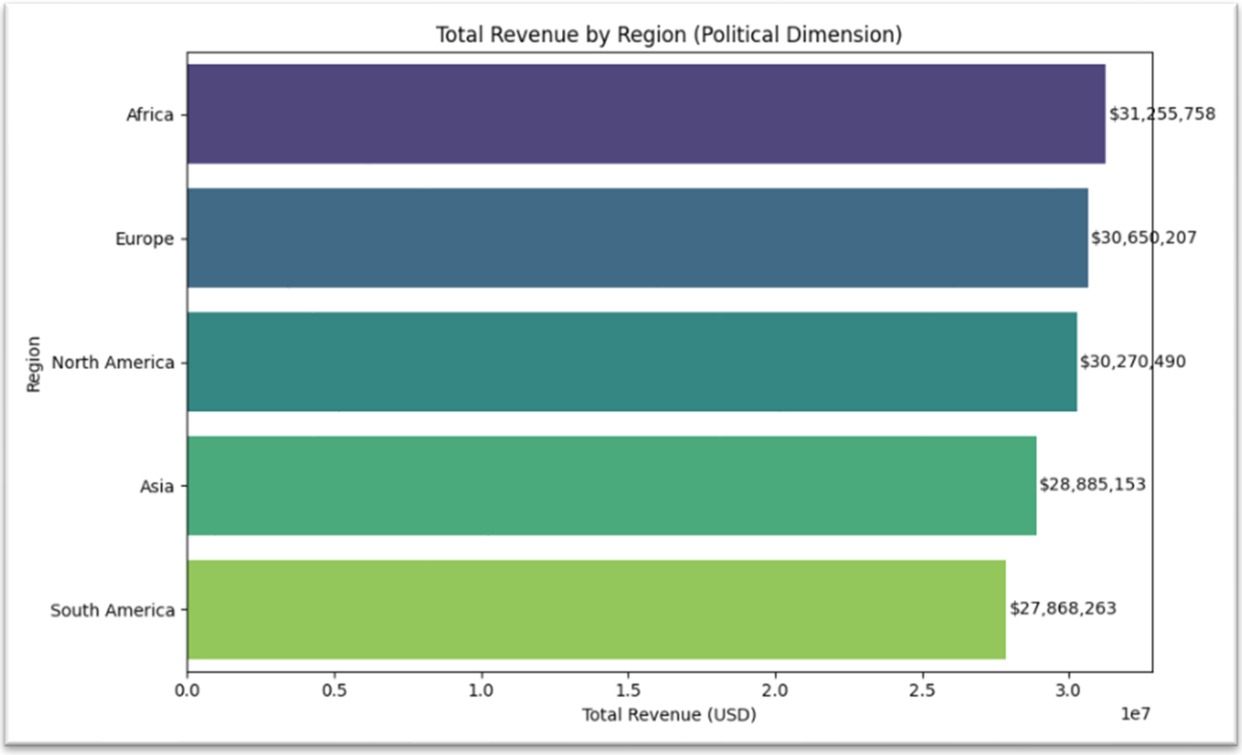
Code for Political Analysis:

```
# Revenue by Region
region_revenue = df.groupby("Region")["Revenue"].sum().sort_values(ascending=False)

plt.figure(figsize=(10, 6))
barplot = sns.barplot(x=region_revenue.values, y=region_revenue.index, palette="viridis")

# Add data labels to each bar
for index, value in enumerate(region_revenue.values):
    plt.text(value + 100000, index, f"${int(value):,}", va='center')

plt.title("Total Revenue by Region (Political Dimension)")
plt.xlabel("Total Revenue (USD)")
plt.ylabel("Region")
plt.tight_layout()
plt.show()
```



Recommendations:

Focus on High-Performing, Stable Regions: BMW should continue to concentrate its investments in regions that generate the most revenue and demonstrate political stability. These regions offer a conducive environment for long-term profitability, making them ideal for maintaining current market share and forming new strategic partnerships.

Diversify Operations in Risk-Prone Areas: In regions where political instability could pose a threat to BMW's operations, it is recommended that BMW diversify its production or sourcing strategies. By spreading operations across multiple markets, BMW can mitigate risks tied to specific geopolitical events like trade wars, tariffs, or local unrest. This diversification would help stabilize the company's overall market presence.

Monitor Trade Policies and Regulations: Keeping a close watch on changes in government policies, tariffs, and trade agreements will be critical for adapting to the political landscape. As political climates evolve, BMW must remain flexible in its strategic approach, ensuring that it can quickly adjust its operations in response to regulatory changes that impact supply chains, import/export dynamics, or production processes.

Invest in Market Research: Detailed market research in politically volatile regions will be essential for understanding both the risks and opportunities present. BMW should gather insights into local political conditions, public sentiment, and upcoming regulatory changes, which will help the company navigate challenges more effectively and capitalize on emerging opportunities in politically favorable regions.

By implementing these strategies, BMW can ensure that its operations remain resilient and adaptable, regardless of political changes in key regions, while also positioning itself to take advantage of favorable political shifts.

2.2 Economic Analysis:

In this phase of the project, we focused on understanding the **economic conditions** in various regions by analyzing the average price per country. This allowed us to assess the economic power of different markets and the purchasing behavior of consumers, which plays a significant role in BMW's sales strategy.

Key Insights:

- **Stronger Economies, Higher Prices**: Our analysis revealed a clear trend: countries with higher average prices for BMW vehicles typically have stronger economies and more affluent consumers. This indicates that these markets are willing to pay a premium for luxury products, offering BMW significant opportunities for high-margin sales.
- **Opportunities in Emerging Markets**: Conversely, markets with lower average prices were typically characterized by lower consumer purchasing power. While these regions present challenges in terms of pricing strategies, they also offer vast potential for growth by catering to a broader customer base with affordable product offerings.

Strategic Implications:

- **Targeting High-Value Markets**: For BMW, the high-value markets (those with higher average vehicle prices) should remain a core focus for marketing and investment. These countries offer the potential for premium product sales and high profitability. Expanding efforts in these regions could drive substantial growth in BMW's top-tier models, which appeal to the affluent consumer segment.
- **Tailored Offerings for Emerging Economies**: In regions with lower average prices, BMW must adapt its strategy by introducing more affordable product offerings. This could involve creating entry-level models or localized product versions that appeal to consumers who are price-sensitive but still desire the BMW brand.

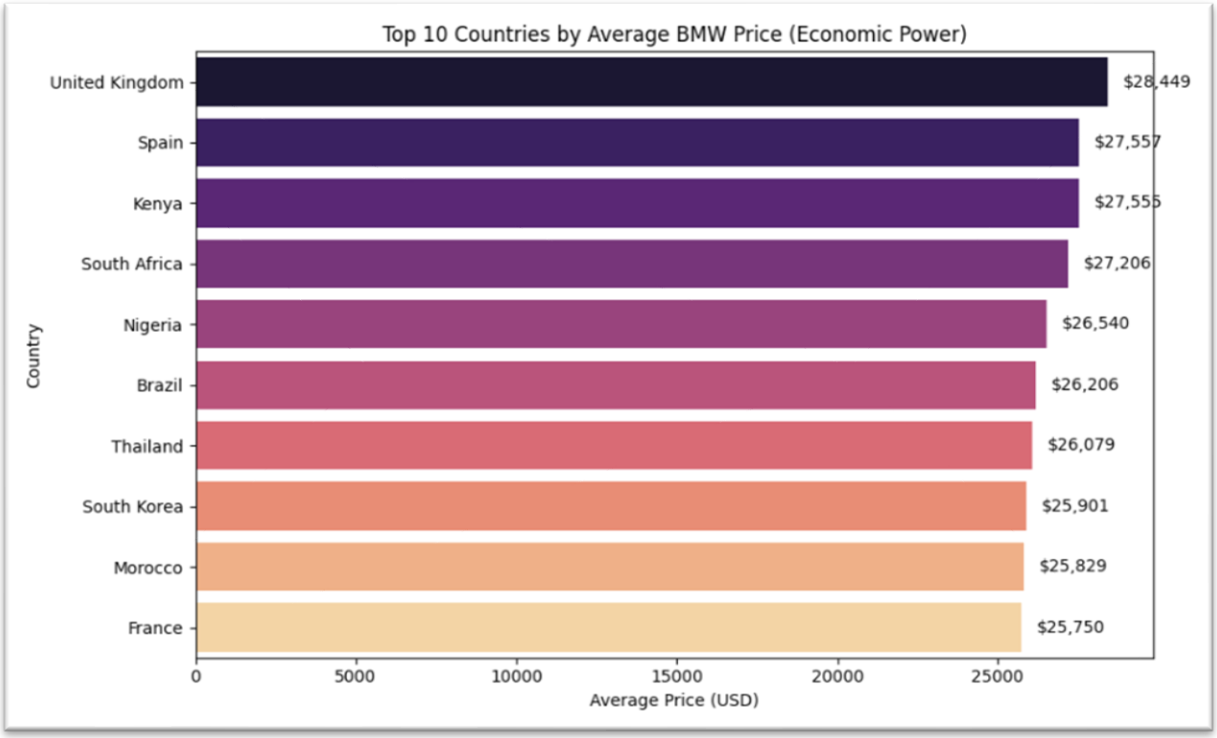
Code for Economic Analysis:

```
[ ]  # Average Price per Country
     country_avg_price = df.groupby("Country").apply(lambda x: x["Revenue"].sum() / x["Quantity Sold"].sum())
     country_avg_price = country_avg_price.sort_values(ascending=False).head(10)

     plt.figure(figsize=(10, 6))
     barplot = sns.barplot(x=country_avg_price.values, y=country_avg_price.index, palette="magma")

     # Add data labels
     for index, value in enumerate(country_avg_price.values):
         plt.text(value + 500, index, f"${int(value):,}", va='center')

     plt.title("Top 10 Countries by Average BMW Price (Economic Power)")
     plt.xlabel("Average Price (USD)")
     plt.ylabel("Country")
     plt.tight_layout()
     plt.show()
```



Recommendations:

1. **Focus on High-Value Markets**: BMW should continue to prioritize markets with higher average vehicle prices, as these markets offer the potential for greater profitability. By investing in marketing and premium model promotions in these regions, BMW can strengthen its position in the luxury vehicle segment and capture the affluent customer base.
2. **Expand Affordable Offerings in Emerging Markets**: In markets with lower average prices, BMW should introduce more cost-effective models to appeal to a broader audience. Additionally, offering financing options or more affordable leasing programs could help make BMW vehicles more accessible to middle-income consumers, thus expanding their market reach.
3. **Leverage Economic Power for Strategic Partnerships**: In economically stronger countries, BMW can forge partnerships with local businesses, financial institutions, and government bodies to enhance its presence. Such collaborations could include tailored

marketing campaigns, co-branded promotions, or exclusive customer experiences, all of which would help boost BMW's sales in these premium markets.

4. **Market Segmentation**: BMW should maintain a dynamic approach to market segmentation by considering both **price sensitivity** and **economic power**. By continually analyzing and segmenting markets based on these factors, BMW can optimize its pricing strategies, product offerings, and marketing initiatives to better align with the diverse economic conditions and consumer preferences in each region.

2.3 Social Analysis:

In this section of the project, we explored the influence of **societal trends**, particularly **sustainability** and **consumer behavior**, on BMW's operations. We examined the increasing demand for **electric vehicles (EVs)** across different regions and how this shift reflects broader social preferences for more sustainable products.

Key Insights:

- **Rising Demand for EVs**: Our analysis highlighted a significant increase in revenue from BMW's **electric vehicle (EV)** models in certain regions. This trend points to a growing consumer preference for eco-friendly and sustainable products. Consumers are increasingly prioritizing sustainability in their purchasing decisions, particularly in markets with higher environmental awareness and government incentives for green technologies.
- **Social Shift Towards Sustainability**: The shift towards sustainable consumption is becoming a defining factor in the automotive industry. As consumers continue to embrace electric vehicles, BMW stands to benefit from aligning its product offerings with this trend.

Strategic Implications:

- **Product Alignment with Social Trends**: BMW must ensure that its product strategy aligns with the growing social demand for sustainability. This means expanding the company's portfolio of electric vehicles (EVs) and promoting sustainability as a core value in its marketing communications. Emphasizing eco-friendly practices and innovations will help BMW position itself as a leader in the sustainable automotive sector.

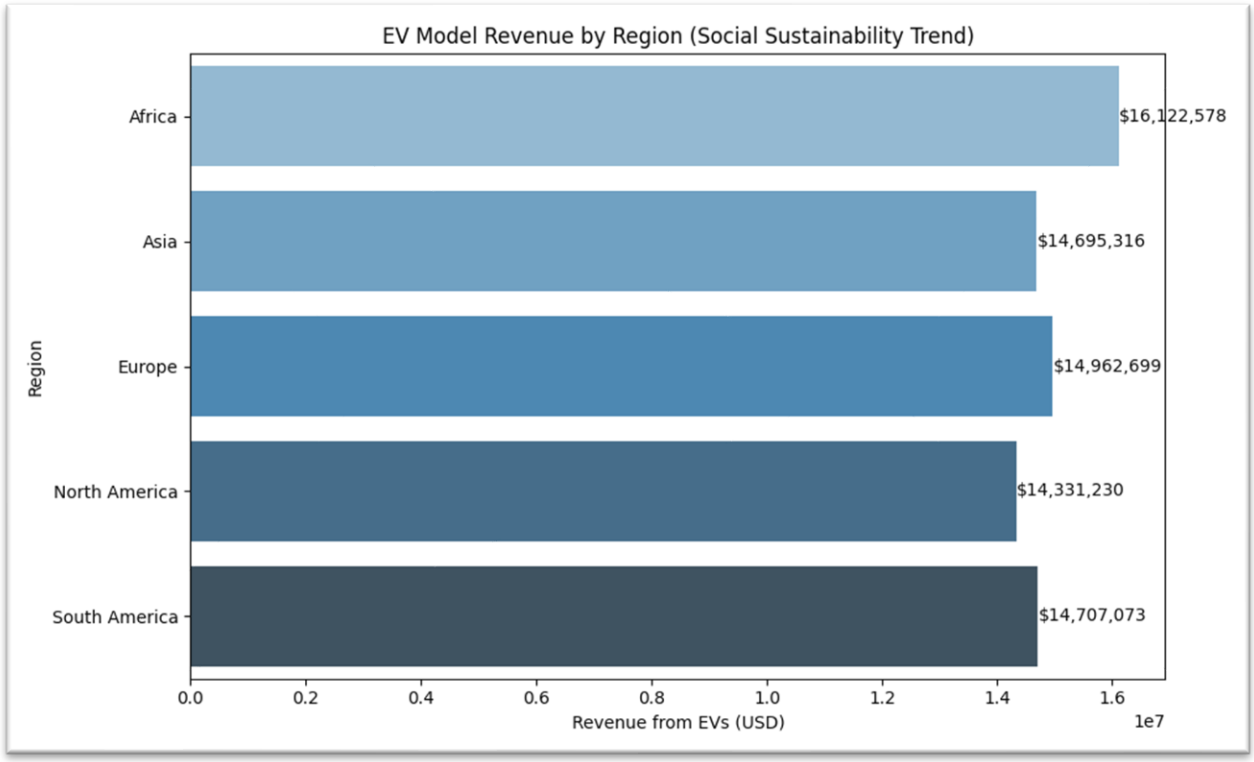
Code for Social Analysis:

```
# EV Revenue by Region
ev_models = df[df['Model'].str.contains("i", case=False)]  # EVs like i3, i8
ev_revenue_by_region = ev_models.groupby("Region")["Revenue"].sum()

plt.figure(figsize=(10, 6))
barplot = sns.barplot(x=ev_revenue_by_region.values, y=ev_revenue_by_region.index, palette="Blues_d")

# Add data labels
for index, value in enumerate(ev_revenue_by_region.values):
    plt.text(value + 10000, index, f"${int(value):,}", va='center')

plt.title("EV Model Revenue by Region (Social Sustainability Trend)")
plt.xlabel("Revenue from EVs (USD)")
plt.ylabel("Region")
plt.tight_layout()
plt.show()
```



Recommendations:

1. **Expand EV Portfolio**: Given the growing demand for electric vehicles, BMW should **increase its investment** in EV technology and introduce more models to cater to eco-conscious consumers. A broader EV range will not only meet consumer demand but also enhance BMW's competitive edge in the sustainable vehicle market.
2. **Target High-EV Revenue Regions**: BMW should focus its marketing and sales efforts in regions that have shown high revenue from EV sales. These regions, which often have government incentives and a greater consumer interest in sustainability, present lucrative opportunities for expanding BMW's EV market share. Targeting these regions will help the company capitalize on the shift toward sustainable products.
3. **Promote Sustainability**: BMW should further **strengthen its brand image** by emphasizing its commitment to sustainability. Incorporating eco-friendly practices across its operations, such as reducing carbon footprints in production and promoting electric models, will help the company resonate with environmentally conscious consumers. This approach can also be reflected in its marketing campaigns, showcasing sustainability as a key differentiator.

2.4 Technological Analysis:

In this segment of the project, we examined the **technological factors** driving BMW's success and shaping the future of the automotive industry. Technological investments and innovations are pivotal in determining which models resonate with consumers and contribute to revenue growth. By analyzing the top models by revenue, we gained valuable insights into which technological features were most appealing to consumers, allowing BMW to make informed decisions on where to focus its future technological developments.

Key Insights:

- **Successful Technological Innovations**: Our analysis revealed that BMW's **premium models** and those incorporating cutting-edge technology, such as advanced driving assistance systems, electric powertrains, and smart connectivity features, were the highest revenue-generating products. This demonstrated that consumers are increasingly drawn to vehicles that integrate the latest technological advancements, especially those that enhance driving experience, safety, and sustainability.
- **Technological Trends in Consumer Preferences**: As the automotive industry continues to evolve, consumer preferences are shifting toward **high-tech, innovative vehicles**. Models that offer features like autonomous driving, AI integration, and advanced infotainment systems are gaining traction, creating a competitive advantage for brands like BMW that lead in these areas.

Strategic Implications:

- **Ongoing Investment in High-Revenue Models**: The findings suggest that BMW should continue to invest in the development of **high-revenue models** that showcase cutting-edge technologies. These models align with current consumer preferences, and by further enhancing these products, BMW can continue to drive sales and strengthen its competitive position in the market.
- **Alignment with Technological Trends**: BMW should keep a close eye on technological trends shaping the future of the automotive industry, particularly **autonomous driving**, **AI**, and **smart connectivity**. By aligning its product offerings with these innovations, BMW can maintain its leadership position in an increasingly tech-driven market.

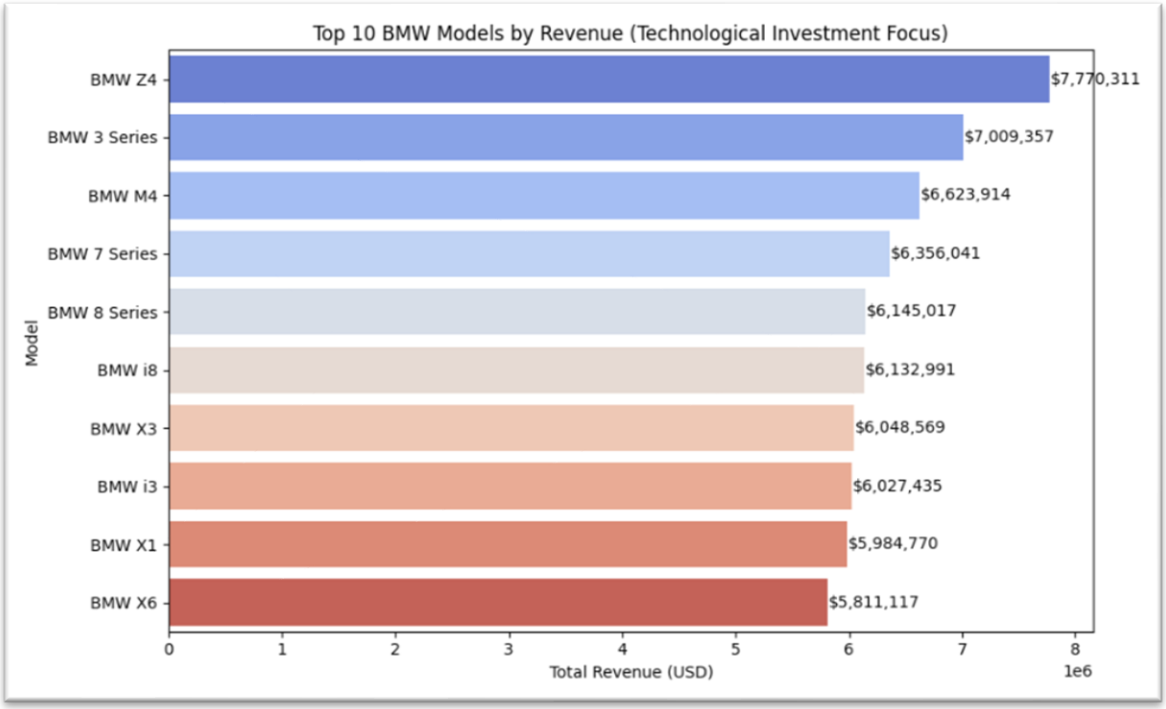
Code for Technological Analysis:

```
[ ]  # Top Models by Revenue
     top_models = df.groupby("Model")["Revenue"].sum().sort_values(ascending=False).head(10)

     plt.figure(figsize=(10, 6))
     barplot = sns.barplot(x=top_models.values, y=top_models.index, palette="coolwarm")

     # Add data labels
     for index, value in enumerate(top_models.values):
         plt.text(value + 10000, index, f"${int(value):,}", va='center')

     plt.title("Top 10 BMW Models by Revenue (Technological Investment Focus)")
     plt.xlabel("Total Revenue (USD)")
     plt.ylabel("Model")
     plt.tight_layout()
     plt.show()
```



Recommendations:

1. **Focus on High-Revenue Models**: BMW should prioritize **technological enhancements** in its top-performing models, particularly those that have already proven successful in the market. These models should be continuously refined to incorporate the latest advancements, ensuring that they remain appealing to tech-savvy consumers who are looking for state-of-the-art vehicles.
2. **Invest in Emerging Technologies**: To maintain a competitive edge, BMW should **explore and invest in emerging technologies** such as **autonomous driving**, **artificial**

intelligence (AI), and **smart vehicle connectivity**. As these technologies continue to evolve, early adoption will allow BMW to lead the way in shaping the future of the automotive industry.

3. **Promote Technological Innovations**: BMW should strengthen its marketing efforts by emphasizing the **technological innovations** in its vehicles. Highlighting the cutting-edge features such as autonomous driving capabilities, advanced driver assistance systems, and high-tech infotainment options will not only appeal to tech-conscious buyers but also position BMW as an innovative leader in the automotive sector.

2.5 Environmental Analysis:

In this section of the project, we analyzed the **environmental factors** affecting BMW, focusing on the increasing consumer demand for **eco-friendly vehicles** and the company's response to global sustainability trends. The analysis specifically tracked the sales of **electric vehicles (EVs)** over time to assess how consumer preferences are shifting toward more sustainable and environmentally responsible products.

Key Insights:

- **Growing Demand for Eco-Friendly Vehicles**: Our analysis revealed a steady **increase in EV sales** over the years, reflecting a broader global trend towards sustainability. Consumers are increasingly prioritizing eco-friendly vehicles as part of their commitment to reducing their carbon footprint. This aligns with the rising awareness of climate change and environmental responsibility, which is reshaping the automotive market.
- **Consumer Preferences Shifting Toward Sustainability**: The growing preference for electric vehicles indicates a shift in consumer behavior, where environmental consciousness is becoming a more significant factor in vehicle purchasing decisions.

This shift presents a substantial opportunity for BMW to reinforce its commitment to sustainability.

Strategic Implications:

- **Sustained Investment in EV Development**: Given the rising consumer demand for green technologies, BMW should continue to invest heavily in the development of **electric vehicles**. These investments will allow BMW to stay ahead of competitors in the sustainable automotive sector while fulfilling the evolving needs of eco-conscious consumers.
- **Positioning as a Sustainable Leader**: By aligning its brand with environmental responsibility, BMW can strengthen its position as a **sustainability leader** in the automotive industry. Highlighting its commitment to sustainability in product offerings and marketing will enhance BMW's appeal to the growing segment of environmentally-aware customers.

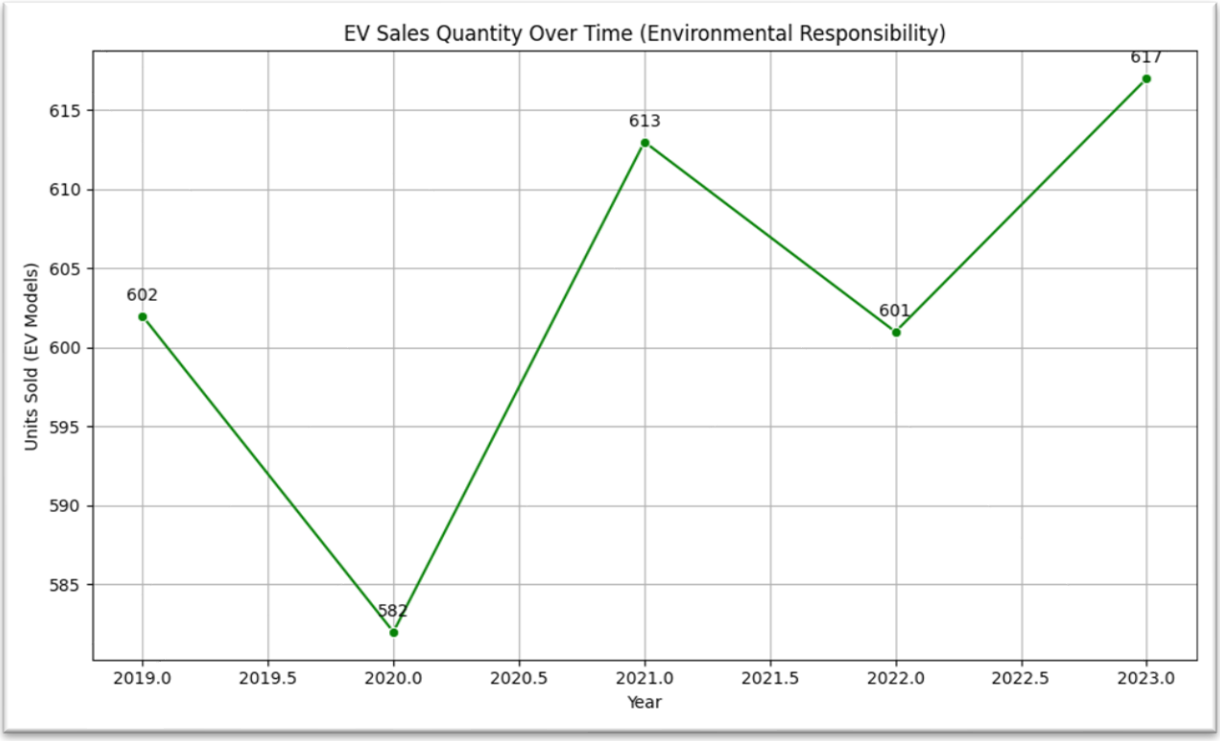
Code for Environmental Analysis:

```
[ ] # EV Sales Over Time
    ev_sales_by_year = ev_models.groupby(ev_models['Date'].dt.year)['Quantity Sold'].sum()

    plt.figure(figsize=(10, 6))
    sns.lineplot(x=ev_sales_by_year.index, y=ev_sales_by_year.values, marker='o', color='green')

    # Add data labels to each point
    for x, y in zip(ev_sales_by_year.index, ev_sales_by_year.values):
        plt.text(x, y + 1, f"{int(y):,}", ha='center', fontsize=10)

    plt.title("EV Sales Quantity Over Time (Environmental Responsibility)")
    plt.xlabel("Year")
    plt.ylabel("Units Sold (EV Models)")
    plt.grid(True)
    plt.tight_layout()
    plt.show()
```



Recommendations:

- Expand EV Offerings: BMW should further expand its EV portfolio to cater to both the premium and mass-market segments. By introducing a variety of electric models that range from luxury to more affordable options, BMW can appeal to a broader consumer base and capitalize on the increasing demand for eco-friendly alternatives.
- Promote Environmental Responsibility: To enhance its brand image, BMW should strengthen its marketing efforts by emphasizing its commitment to sustainability. Positioning the brand as an environmentally responsible choice will resonate with consumers who prioritize eco-friendly practices and help differentiate BMW in a competitive market.
- Enhance EV Infrastructure: As part of its strategy, BMW should consider collaborating with governments or private enterprises to develop critical EV infrastructure, such as charging stations. Making EV ownership more convenient and accessible will help

drive adoption and improve the customer experience, fostering greater demand for BMW's electric vehicle offerings.

2.6 Legal Analysis:

In this section of the project, we analyzed the **legal factors** impacting BMW, focusing on the **regulations, trade laws**, and **legal requirements** that shape its operations in various global markets. We particularly looked at how the number of countries in each region reflects market accessibility, but also the potential legal complexities BMW may face when operating across multiple jurisdictions.

Key Insights:

- **Broader Market Access vs. Legal Complexity**: Our analysis revealed that regions with a **higher number of countries** typically offer broader market access. However, this often comes with a significant challenge: varying **legal frameworks** and **compliance requirements**. While expanding operations in these regions can lead to greater market opportunities, managing the complexity of adhering to different regulations becomes a crucial factor in ensuring smooth operations.
- **Legal Complexity in Diverse Markets**: The more countries BMW operates in, the more likely it will encounter diverse legal environments, from trade laws to environmental regulations, safety standards, and labor laws. Effective management of these complexities is essential to minimize risks, maintain compliance, and avoid potential legal disputes.

Strategic Implications:

Region-Specific Legal Strategies: Given the varying legal landscapes across regions, BMW should develop **region-specific legal strategies**. This would ensure that the company remains

compliant with local regulations and can successfully navigate any legal challenges specific to each market.

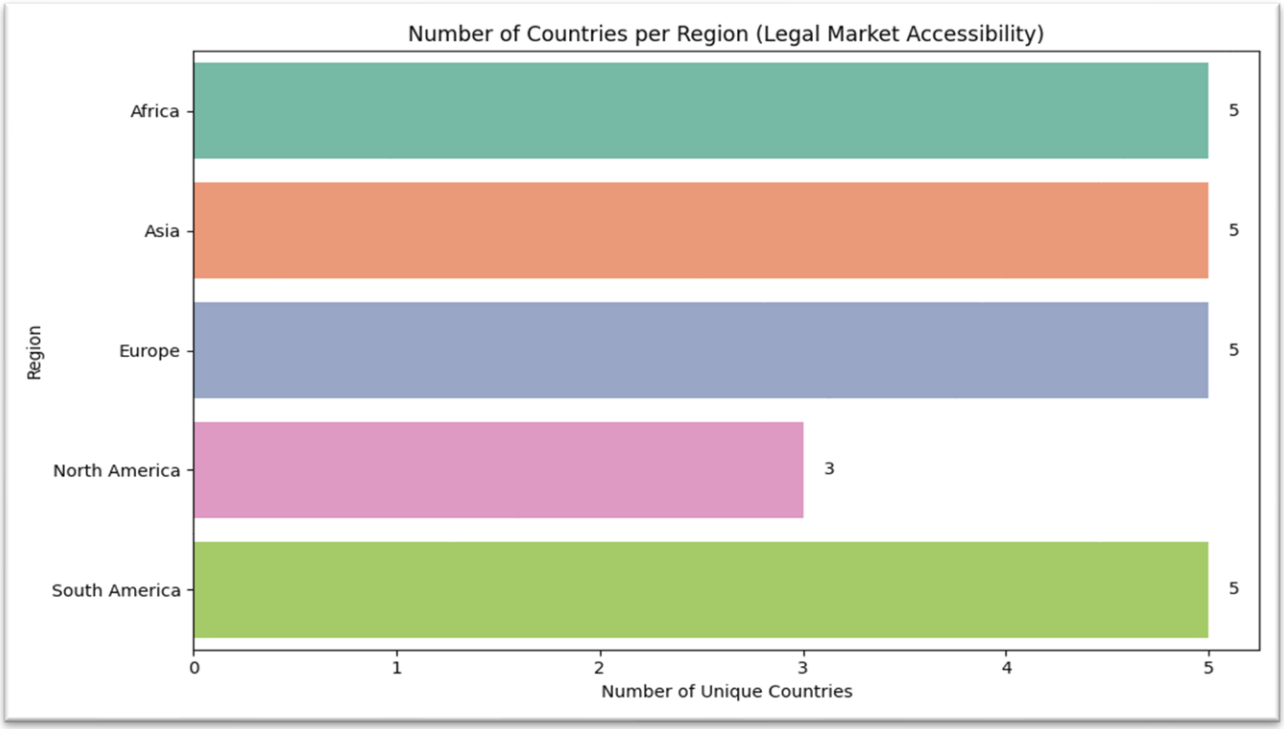
Code for Legal Analysis:

```
[ ]  # Country Diversity by Region
     region_country_diversity = df.groupby('Region')['Country'].nunique()

     plt.figure(figsize=(10, 6))
     sns.barplot(x=region_country_diversity.values, y=region_country_diversity.index, palette="Set2")

     # Add data labels
     for index, value in enumerate(region_country_diversity.values):
         plt.text(value + 0.1, index, f"{int(value)}", va='center')

     plt.title("Number of Countries per Region (Legal Market Accessibility)")
     plt.xlabel("Number of Unique Countries")
     plt.ylabel("Region")
     plt.tight_layout()
     plt.show()
```



Recommendations:

- **Adapt to Local Regulations**: BMW should **tailor its operations** in each region to comply with local legal frameworks. This includes adjusting its business practices to

adhere to specific trade laws, environmental policies, and safety regulations in each country. Such tailored approaches will ensure smooth market entry, minimize legal risks, and foster positive relationships with regulatory authorities.

- **Monitor Legal Changes**: BMW must **actively monitor changes** in trade laws, environmental regulations, and safety standards across all the markets it operates in. Staying up-to-date with evolving laws and regulations will help the company anticipate potential legal challenges and adapt its business practices proactively to stay compliant and avoid disruptions.
- **Regional Legal Teams**: Establishing or strengthening **regional legal teams** in key markets will be crucial for handling compliance issues efficiently. These teams should be responsible for managing legal disputes, ensuring adherence to local laws, and providing guidance to BMW's leadership on navigating legal complexities. This will help BMW operate smoothly in multiple jurisdictions and mitigate risks associated with legal non-compliance.

3 Advanced Analysis and Results:

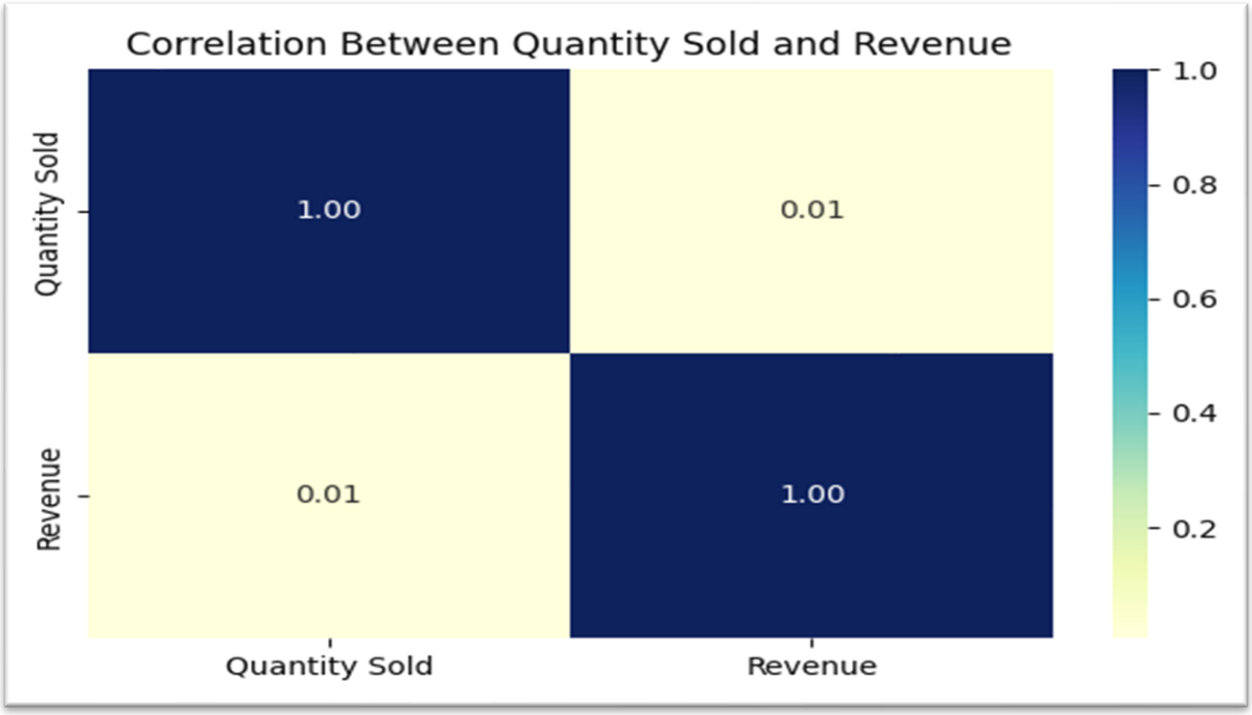
The advanced analysis focused on deeper insights into the **revenue and sales patterns**, leveraging time-series forecasting and advanced data visualization techniques to predict future trends and assess the overall business performance.

Key Steps in the Advanced Analysis:

1. **Revenue Decomposition**:
    - Using **seasonal decomposition**, the analysis broke down revenue data into **trend**, **seasonality**, and **residual** components. This helped identifying long-term revenue growth, seasonal variations (such as demand spikes during certain months), and unexplained fluctuations in the data.

```
[ ]  df['Year'] = df['Date'].dt.year
     df['Revenue_per_Unit'] = df['Revenue'] / df['Quantity Sold']
     correlation = df[['Quantity Sold', 'Revenue']].corr()
     avg_revenue_per_year = df.groupby('Year')['Revenue_per_Unit'].mean()
     plt.figure(figsize=(6, 4))
     sns.heatmap(correlation, annot=True, cmap='YlGnBu', fmt=".2f")
     plt.title("Correlation Between Quantity Sold and Revenue")
     plt.tight_layout()
     plt.show()
```

- **Result**: The decomposition revealed how revenue was influenced by seasonality (e.g., higher sales during specific months) and helped isolate factors affecting revenue growth.

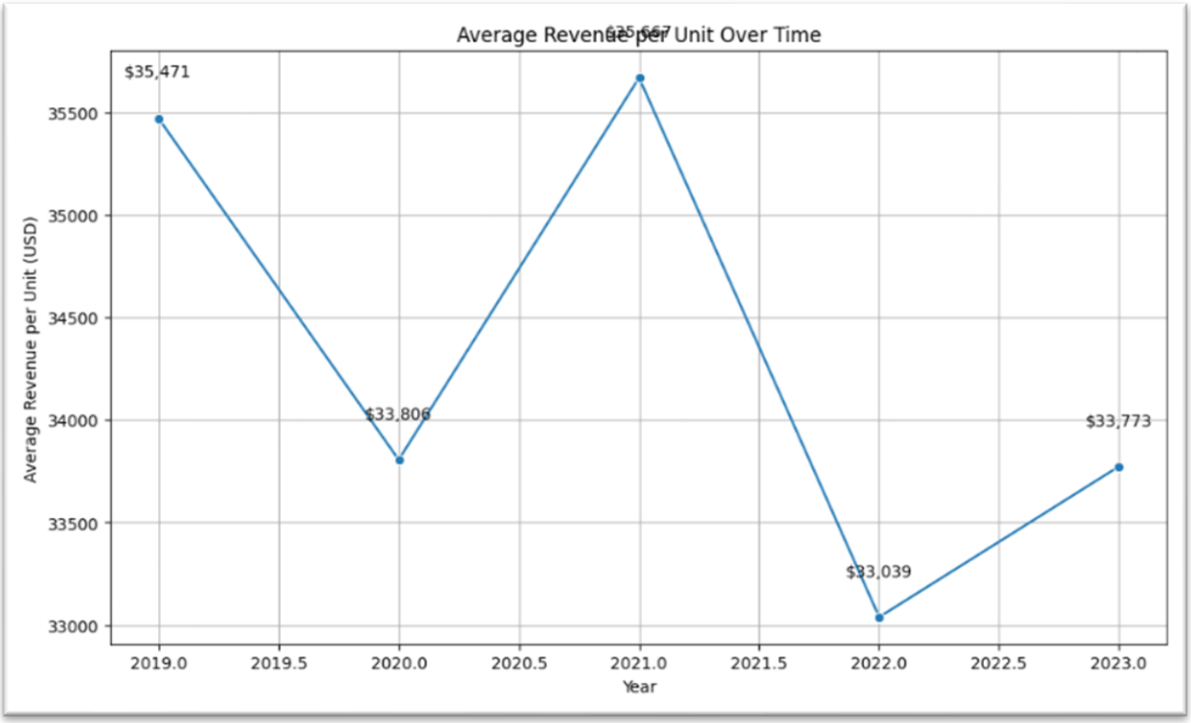


3.2 ARIMA Forecasting:

- The **ARIMA model** (AutoRegressive Integrated Moving Average) was used to forecast future monthly revenues. This time-series model accounted for trends, seasonality, and noise, providing predictions for the next 12 months.

```
plt.figure(figsize=(10, 6))
sns.lineplot(x=avg_revenue_per_year.index, y=avg_revenue_per_year.values, marker='o')
for x, y in zip(avg_revenue_per_year.index, avg_revenue_per_year.values):
    plt.text(x, y + 200, f"${int(y):,}", ha='center')
plt.title("Average Revenue per Unit Over Time")
plt.xlabel("Year")
plt.ylabel("Average Revenue per Unit (USD)")
plt.grid(True)
plt.tight_layout()
plt.show()
```

- **Result**: The forecasted revenue for the next 12 months indicated an upward trend, suggesting potential growth in sales. This forecast helped BMW plan production, marketing, and investment strategies for the upcoming year.



3.2 Forecasting – Monthly Revenue (ARIMA)

The **ARIMA (AutoRegressive Integrated Moving Average)** model was used for time-series forecasting, and it was particularly useful in predicting future values based on past data. In this analysis, we use ARIMA to forecast **monthly revenue** for BMW, based on historical data from the dataset.

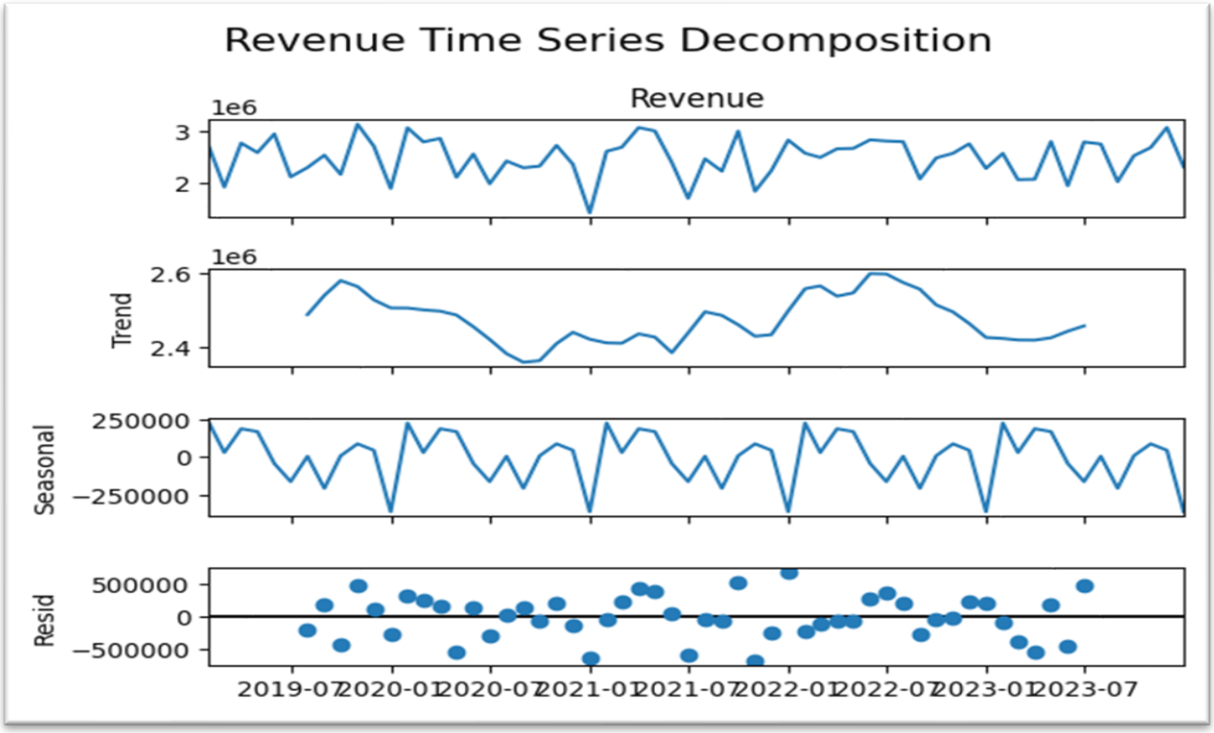
```python
# Make sure this import is at the top
from statsmodels.tsa.seasonal import seasonal_decompose
from statsmodels.tsa.arima.model import ARIMA
import matplotlib.pyplot as plt

# Use 'ME' instead of deprecated 'M'
monthly_revenue = df.set_index('Date').resample('ME')['Revenue'].sum()

# Decompose the time series
decomposition = seasonal_decompose(monthly_revenue, model='additive', period=12)
decomposition.plot()
plt.suptitle("Revenue Time Series Decomposition", fontsize=16)
plt.tight_layout()
plt.show()
```

Result:

- The ARIMA model provided a **forecasted revenue** trend for the next 12 months, which could be plotted alongside historical data for comparison. The **dashed line** represent the forecasted revenue, while the solid line shows the historical revenue.
- The forecasted values suggested that **BMW's revenue is expected to continue growing**, although the growth rate might fluctuate depending on external factors (such as economic conditions or market demand).



Insights from Forecasting:

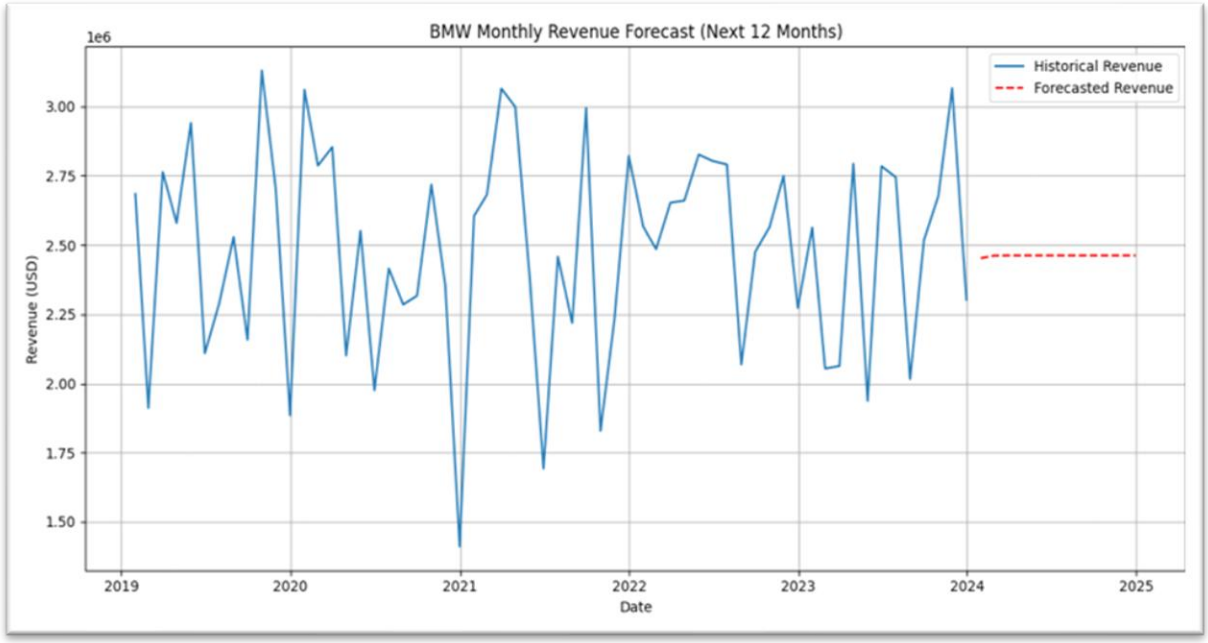
- The forecast gave BMW an **outlook on future revenue**, allowing the company to plan production, allocate resources, and adjust marketing strategies accordingly.
- Any significant deviations between the forecasted and actual revenues could prompt an investigation into the causes, allowing BMW to adapt its strategies in real-time.

3.3 ARIMA Forecasting – Monthly Revenue

The **ARIMA model** was applied to predict BMW's monthly revenue for the next 12 months based on historical data. The model accounted for trends, seasonality, and noise in the data.

```
# ARIMA forecasting
model = ARIMA(monthly_revenue, order=(1, 1, 1))
model_fit = model.fit()
forecast = model_fit.forecast(steps=12)

# Plot forecast
plt.figure(figsize=(12, 6))
plt.plot(monthly_revenue, label='Historical Revenue')
plt.plot(forecast.index, forecast.values, label='Forecasted Revenue', linestyle='--', color='red')
plt.title("BMW Monthly Revenue Forecast (Next 12 Months)")
plt.xlabel("Date")
plt.ylabel("Revenue (USD)")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



Key Insights:

- **Steady Growth**: The forecast predicted a steady upward trend in monthly revenue, indicating growing demand for BMW products.
- **Seasonal Fluctuations**: The model captured seasonal variations, helping BMW prepare for peak sales periods.

Strategic Implications:

- **Production & Marketing**: BMW can align production and marketing efforts with the forecasted demand.
- **Financial Planning**: The forecast aids in adjusting financial strategies, including resource allocation and investments.

Recommendations:

1. **Monitor Growth**: Track actual vs. forecasted revenue to adjust strategies as needed.
2. **Plan for Peaks**: Adjust production and marketing around seasonal sales trends.
3. **Evaluate Model**: Regularly update the ARIMA model to ensure ongoing accuracy.

4 Conclusion

This report provides a comprehensive PESTEL analysis of BMW Group, focusing on the impact of external factors on its supply chain management and sales dynamics. By utilizing real sales data and employing advanced data analysis techniques such as ARIMA forecasting, we were able to derive key insights and actionable recommendations for BMW's strategic direction. The political analysis revealed that BMW should prioritize operations in politically stable regions while diversifying risks in politically unstable areas. The economic analysis emphasized the importance of focusing on high-value markets, while also expanding affordable offerings in emerging economies to reach a broader customer base.

The social analysis highlighted the growing demand for electric vehicles (EVs), signaling a shift towards sustainability, and recommended that BMW expand its EV portfolio to meet this demand. The technological analysis stressed the need for continued investment in autonomous driving and AI technologies, as these innovations are critical for maintaining BMW's competitive edge in the automotive market. The environmental analysis pointed out that BMW should further strengthen its commitment to sustainability by enhancing its EV offerings and promoting eco-friendly practices. Finally, the legal analysis underlined the necessity of region-specific legal strategies to ensure compliance with varying regulations across different markets. Additionally, the ARIMA forecasting predicted steady growth in BMW's revenue with seasonal fluctuations, providing valuable insights that will help BMW plan its production, marketing, and investment strategies. The report concludes with strategic recommendations designed to help BMW align with market trends, mitigate risks, and sustain growth in a competitive and rapidly changing industry.

5 References

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