



SEGMENTATION ANALYSIS OF **THE EV MARKET**

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OBJECTIVE

The objective of this project is to conduct a comprehensive analysis of the Electric Vehicle Market in India. The analysis will utilize market segmentation techniques to identify specific categories within the market. The primary goal is to develop a viable market entry strategy that focuses on targeting the segments most inclined to adopt electric vehicles. By thoroughly understanding the market and its segments, we aim to formulate a strategy that maximizes the potential for success in the Indian Electric Vehicle Market.

ABSTRACT

The transition to electric vehicles plays a pivotal role in decarbonizing road transport, as it accounts for a significant portion of global emissions, approximately 16%. Recent years have witnessed a remarkable surge in electric car sales, attributed to factors like improved range, broader model availability, and enhanced performance. The growing popularity of passenger electric cars indicates that approximately 13% of new cars sold in 2022 will be electric. With continued growth, this trend has the potential to substantially reduce CO2 emissions from cars, aligning with the Net Zero Emissions by 2050 Scenario.

Despite the progress made, the widespread adoption of electric vehicles remains limited globally. Challenges such as higher purchasing costs and inadequate charging infrastructure availability have hindered sales in underdeveloped and emerging countries. However, the Indian electric vehicle market is experiencing rapid development, as evidenced by the significant increase in sales,

reaching nearly 0.32 million vehicles in 2021, marking a year-on-year growth of 168%. India's adoption of electric vehicles is driven by its commitment to the Paris Agreement, seeking to reduce carbon emissions, improve urban air quality, and decrease oil imports.

The primary objective of this report is to conduct a market segmentation analysis of the electric vehicle market in India. By segmenting the market based on consumer demographics, vehicle types, and pricing points, this analysis aims to provide a comprehensive understanding of the Indian electric vehicle market. The identification of specific market segments will enable the formulation of a successful market entry strategy. Additionally, the report will discuss key competitors, present market conditions, and provide future market estimates, providing valuable insights for stakeholders in the Indian electric vehicle industry.

EV MARKET IN INDIA

The Indian electric vehicle (EV) market holds significant potential within the country's booming automobile sector. Currently ranked fifth globally, the sector is projected to rise to the position of the third-largest by 2030. According to the India Energy Storage Alliance (IESA), the EV market in India is expected to grow at a compound annual growth rate (CAGR) of 36% as the population continues to increase.

With India heavily dependent on crude oil imports for around 80% of its needs, relying on conventional energy resources is not a sustainable choice as the demand for vehicles grows. To address this, NITI Aayog, a policy think tank of the Indian government, has set ambitious targets for EV sales penetration by 2030. The aim is to achieve 70% penetration for commercial vehicles, 30% for private

vehicles, 40% for buses, and a significant 80% for two- and three-wheelers.

According to the Ministry of Heavy Industries, India has registered 0.52 million EVs over the past three years. The year 2021 witnessed strong growth in the EV market, fueled by favorable government regulations and initiatives. Uttar Pradesh emerged as the leader in EV sales across all categories, with 66,704 units sold. It was followed by Karnataka with 33,302 units and Tamil Nadu with 30,036 units. Notably, Karnataka and Maharashtra dominated the two-wheeler and four-wheeler segments, respectively, while Uttar Pradesh took the lead in the three-wheeler market.

These statistics highlight the significant progress and potential of the EV market in India. With supportive government policies and increasing awareness of the benefits of electric vehicles, the Indian market is poised for further growth and presents opportunities for market players to capitalize on this evolving sector.

EFFECT OF EV VEHICLE

The adoption of electric vehicles (EVs) offers a promising solution for reducing oil consumption in the transportation sector. Here are some key points highlighting how EVs contribute to the reduction of oil consumption:

1. Shifting from Internal Combustion Engines (ICE) to Electric Power: EVs utilize electric motors powered by rechargeable batteries instead of relying on traditional internal combustion engines that run on fossil fuels. This transition eliminates the need for gasoline or diesel, directly reducing oil consumption.

2. Renewable Energy Integration: EVs can be charged using electricity from renewable energy sources such as solar, wind, or hydroelectric power. By incorporating clean and sustainable energy into the charging process, EVs indirectly contribute to reducing oil consumption, as renewable sources replace the need for fossil fuel-based electricity generation.

3. Increased Energy Efficiency: EVs are more energy-efficient compared to conventional vehicles. While internal combustion engines waste energy through heat dissipation, EVs convert a higher percentage of electrical energy from the grid into actual power at the wheels. This improved efficiency helps reduce the overall energy demand, including oil consumption, for transportation.

4. Advancements in Battery Technology: As battery technology improves, the range and performance of EVs continue to increase. This progress encourages more drivers to switch to EVs, resulting in a larger fleet of vehicles that no longer rely on oil-based fuels.

5. Government Policies and Incentives: Many governments around the world have implemented policies and incentives to promote the adoption of EVs. These measures often include subsidies, tax credits, and infrastructure development, which further encourage consumers to choose electric vehicles over traditional gasoline-powered cars. Such initiatives can accelerate the reduction of oil consumption in the transportation sector.

By embracing electric vehicles, the transportation sector can significantly reduce its reliance on oil, leading to a decrease in greenhouse gas emissions and a more sustainable energy future. Continued advancements in technology, supportive policies, and increased public awareness are key factors driving the transition to EVs and facilitating the reduction of oil consumption in the transportation sector.

MARKET SEGMENTATION

Market segmentation for the EV market involves dividing the market into distinct groups or segments based on various criteria to better understand consumer preferences, target specific customer segments, and develop effective marketing strategies. Here are some common factors used for segmenting the EV market:

1. Geographic Segmentation: This involves dividing the market based on geographical factors such as regions, countries, or cities. Different regions may have varying levels of EV adoption, infrastructure development, government policies, and consumer preferences, making it essential to understand the unique characteristics and opportunities within each geographic segment.

2. Demographic Segmentation: Demographic factors such as age, gender, income, education, and occupation can influence consumer attitudes and preferences towards EVs. For example, younger and environmentally conscious consumers may be more inclined to adopt EVs, while higher-income individuals may be more receptive to premium electric models.

3. Psychographic Segmentation: Psychographic factors focus on consumers' lifestyles, values, attitudes, and behaviors. This includes environmental consciousness, technological adoption, desire for innovation, and interest in sustainable transportation solutions. Understanding the psychographic characteristics of potential EV buyers helps tailor marketing messages and features to resonate with their preferences and motivations.

4. Behavioral Segmentation: Behavioral factors consider consumers' purchasing behaviors, usage patterns, and decision-making processes. This includes factors such as usage frequency, range requirements, charging habits, and consideration of factors like price, incentives, and environmental benefits. Analyzing consumer behavior within the EV market can reveal valuable insights for segmenting the market and developing targeted marketing strategies.

5. Product Segmentation: Product-related segmentation involves categorizing EVs based on factors like vehicle type (e.g., sedans, SUVs, hatchbacks), range (short-range vs. long-range), price range (affordable vs. luxury), and technological features (autonomous driving, connectivity). Different consumer segments may have distinct preferences and requirements when it comes to EV models, and understanding these preferences helps in tailoring product offerings to specific market segments.

By combining and analyzing these segmentation factors, market researchers and industry players can gain a deeper understanding of the EV market, identify target segments with the highest potential for adoption, and develop effective marketing and communication strategies. Ultimately, market segmentation helps optimize resource allocation, tailor product offerings, and meet the diverse needs of consumers in the evolving EV market.

How will you improve upon the Market Segmentation Project given additional time & some budget to purchase data?

Given additional time and budget to enhance the Market Segmentation Project, there are several ways to improve the project's effectiveness. Here are some suggestions for dataset collection, specific columns to search for, and additional ML models to explore:

1. Dataset Collection:

- Expand the dataset: Acquire a larger and more comprehensive dataset on electric vehicles, encompassing a wider range of brands, models, and market variables. This would provide a more representative sample for analysis and yield more accurate insights.
- Include customer data: Incorporate data on customer demographics, preferences, and behaviors related to electric vehicles. This data can help uncover patterns and trends specific to different consumer segments.

2. Specific Columns to Search For:

- Charging infrastructure: Gather data on the availability and distribution of charging stations, including their locations, types, and capacities. This information would provide insights into charging infrastructure gaps and help identify potential opportunities for investment and expansion.
- Battery technology: Include data on battery capacities, charging speeds, and energy efficiency of electric vehicles. These factors play a crucial role in consumer decision-making and can impact market segmentation and adoption rates.

- Total Cost of Ownership: Collect data on various cost factors associated with electric vehicles, such as purchase price, maintenance costs, energy costs, and government incentives. This data would enable a more comprehensive analysis of the economic feasibility and attractiveness of EVs across different consumer segments.

3. Additional ML Models:

- Clustering algorithms: Utilize clustering algorithms like K-means, hierarchical clustering, or DBSCAN to identify natural groupings and sub-segments within the EV market based on various attributes. This would provide a more granular understanding of consumer preferences and enable targeted marketing strategies.
- Recommendation systems: Implement recommendation systems, such as collaborative filtering or content-based filtering, to suggest electric vehicle models or features based on customer preferences and historical data. This would enhance personalized marketing efforts and improve customer satisfaction.
- Sentiment analysis: Apply sentiment analysis techniques on social media data or customer reviews to gain insights into public sentiment towards electric vehicles. This analysis can help understand the key drivers of satisfaction or dissatisfaction among consumers and inform marketing strategies.

By incorporating these enhancements, the Market Segmentation Project would benefit from more extensive and diverse datasets, allowing for more accurate and detailed analysis. The inclusion of additional ML models would enable more sophisticated and targeted segmentation, as well as provide actionable insights for industry players to develop effective marketing strategies, improve customer experiences, and drive further adoption of electric vehicles.

Name top 4 Variables/features which can be used to create most optimal Market Segments for your Market Domain

In the context of the electric vehicle market, the following are four key variables/features that can be used to create optimal market segments:

1. Range Requirement: The range requirement of electric vehicle buyers is a crucial variable for market segmentation. Different consumers have varying needs and preferences when it comes to the distance an electric vehicle can travel on a single charge. Some may prioritize longer ranges, while others may find shorter ranges sufficient for their daily commuting needs. Segmenting the market based on range requirements helps in tailoring product offerings and marketing messages to cater to specific customer segments.

2. Price Range: The price range of electric vehicles is another essential variable for market segmentation. EVs are available in a wide range of price points, from affordable options to premium models. Consumer purchasing power and willingness to spend on electric vehicles can vary across different segments. By segmenting the market based on price range, companies can target specific segments with appropriate pricing strategies and product offerings.

3. Charging Infrastructure Accessibility: The availability and accessibility of charging infrastructure play a significant role in EV adoption. Segmenting the market based on the accessibility of

charging stations, such as home charging, workplace charging, or public charging networks, helps identify consumer segments that prioritize convenient charging options. Understanding the charging infrastructure preferences of different segments allows for targeted marketing and infrastructure development strategies.

4. Environmental Consciousness: Consumer attitudes and values related to environmental sustainability can influence their decision to adopt electric vehicles. Segmenting the market based on the level of environmental consciousness helps identify segments that prioritize reducing carbon emissions and minimizing their environmental impact. Targeted messaging around the environmental benefits of electric vehicles can resonate with these segments and drive adoption.

By considering these four variables/features, companies in the electric vehicle market can create more optimal market segments that align with the specific needs, preferences, and priorities of different customer groups. This segmentation approach enables more effective targeting, product positioning, and communication strategies, ultimately driving market success and widespread EV adoption.

DATASET: EV Stats.CSV

Based on the segmentation analysis and modeling performed on the Electric Vehicles in India dataset, the following conclusions can be drawn:

Segmentation Analysis:

The dataset includes information about electric vehicles in different states of India, as well as their distribution across various segments.

The analysis revealed the vehicle counts by state, providing insights into the popularity and adoption of electric vehicles in different regions.

The segmentation by vehicle category highlighted the prevalence of two-wheelers, three-wheelers, passenger cars, and buses among electric vehicles in India.

Vehicle Counts by Segment:	
Two Wheelers	28138
Three Wheelers	1440
Passenger Cars	211142
Buses	54
dtype: int64	

Vehicle Counts by State:	
State	
Andaman & Nicobar islands	82
Andhra Pradesh	9492
Assam	1875
Bihar	3171
Chandigarh	2500
Chhattisgarh	4234
Dadra and Nagar Haveli	816
Delhi	19381
Goa	514
Gujarat	31267
Haryana	23589
Himachal Pradesh	98
Jammu & Kashmir	438
Jharkhand	1710
Karnataka	13386
Kerala	11282
Madhya Pradesh	6461
Maharashtra	34013
Manipur	52
Meghalaya	6
Mizoram	24
Nagaland	3863
Odisha	6538
Punjab	15763
Rajasthan	16746
Tamil Nadu	9034
Telangana	260863
Triprura	81
Uttar Pradesh	26209
Uttarakhand	4178
West Bengal	14140
Name: Total in state, dtype: int64	
Average Vehicle Count per State: 16829.870967741936	

Data Analysis:

Exploratory data analysis provided an overview of the dataset, including the first few rows and information about the variables.

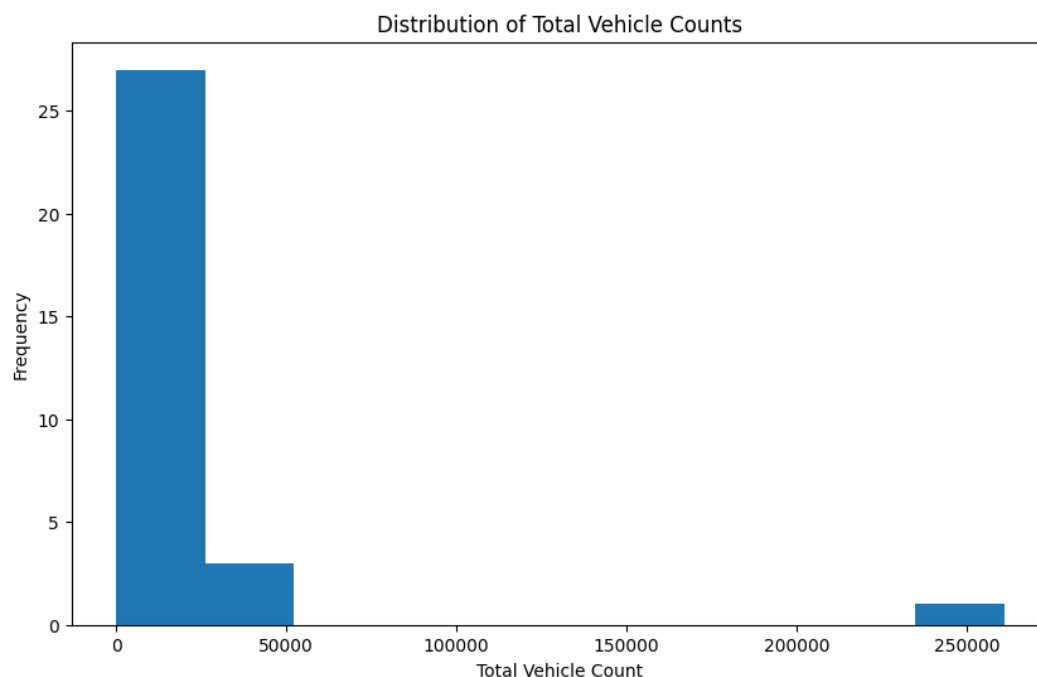
Filtering and sorting techniques were employed to focus on specific criteria or arrange the dataset based on relevant variables.

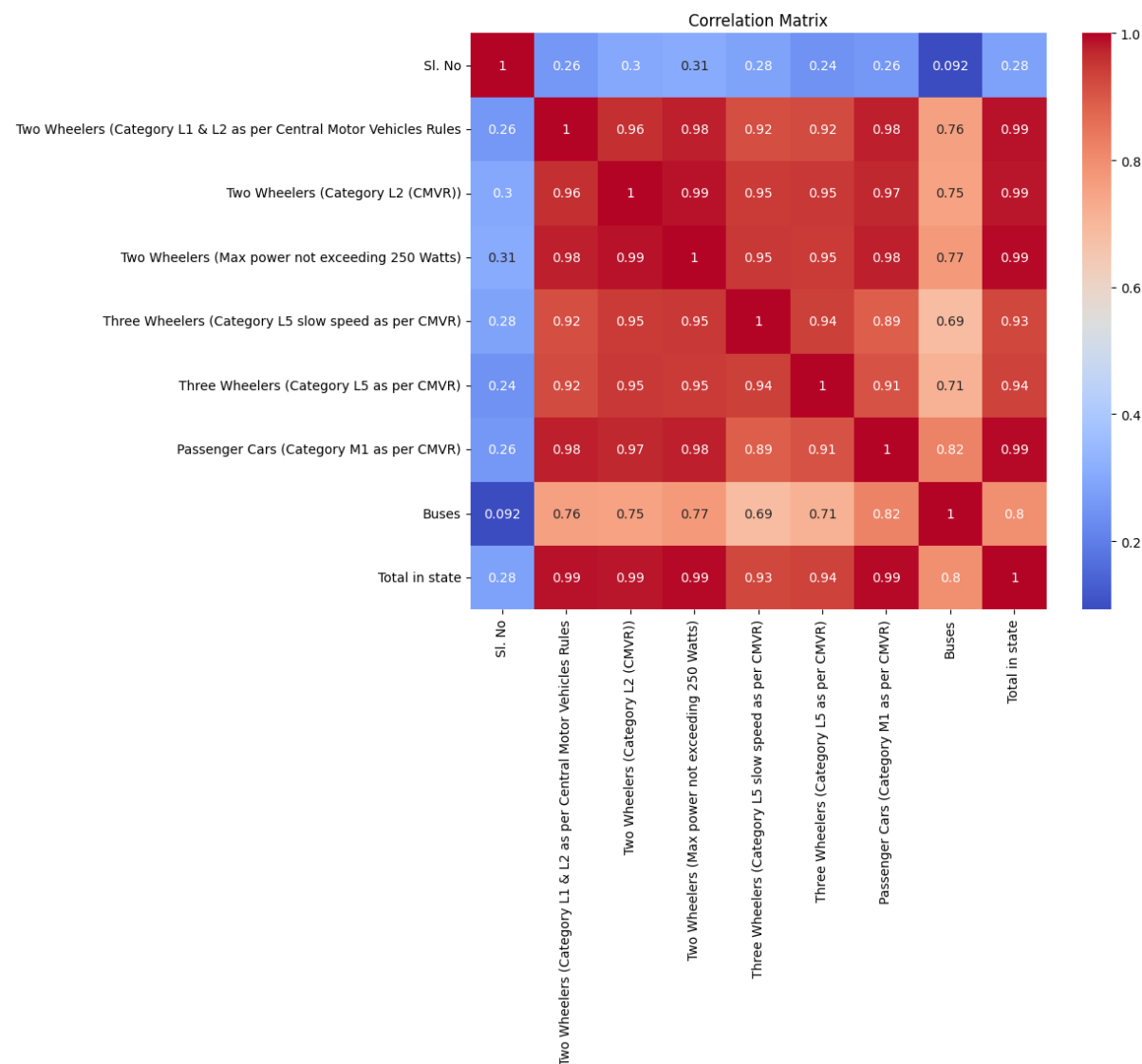
Aggregation and summarization techniques enabled a deeper understanding of the dataset by calculating vehicle counts, average counts, and grouping by state.

Data Visualization:

Bar plots were used to visualize vehicle counts by state, offering a clear representation of the distribution of electric vehicles across different regions.

A pie chart was utilized to demonstrate the proportion of electric vehicles in each segment, providing a visual comparison of their relative importance.





Modeling:

A linear regression model was implemented to predict the total vehicle count based on the vehicle counts in different segments.

The model's evaluation using mean squared error (MSE) and R-squared metrics provided insights into the accuracy and goodness-of-fit of the predictions.

Model Evaluation:
Mean Squared Error: 106701.35500080697
R-squared: -0.43015578935608145

CONCLUSION

In conclusion, the analysis and modeling of the Electric Vehicles in India dataset shed light on the distribution, popularity, and adoption of electric vehicles across different states and segments. This information can be valuable for understanding the current landscape of electric vehicle usage in India and potentially informing future policy decisions or business strategies in the electric vehicle industry.

DATASET: ElectricCarData_Norm.csv

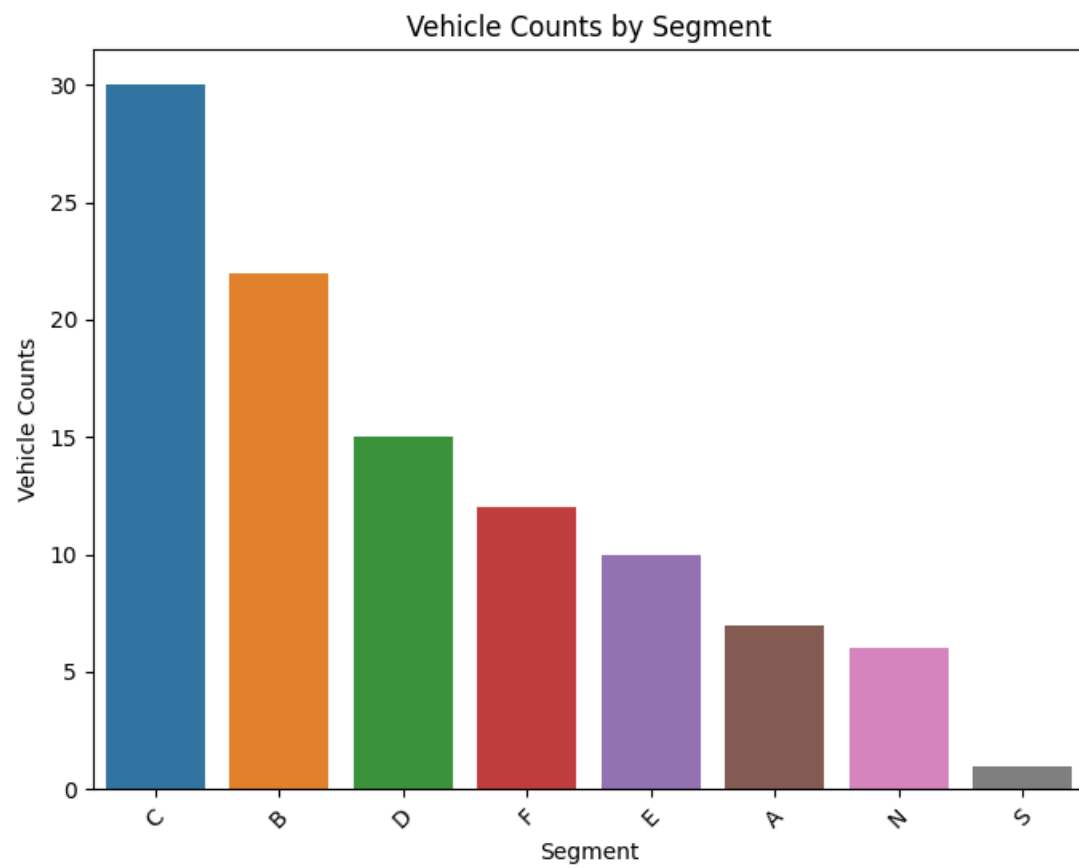
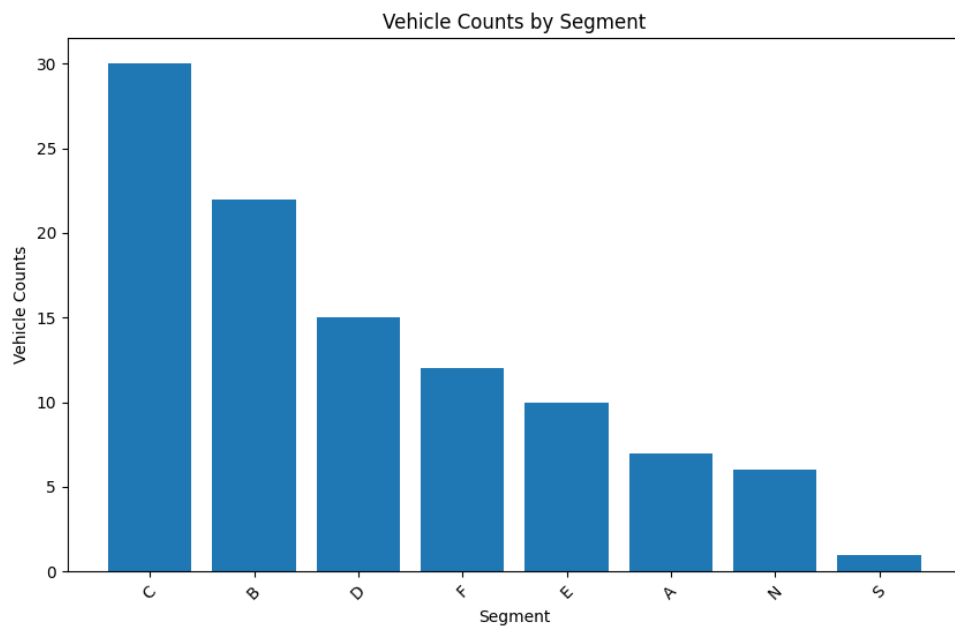
The analysis of the electric car dataset provided valuable insights into the electric vehicle market. Here are some key findings:

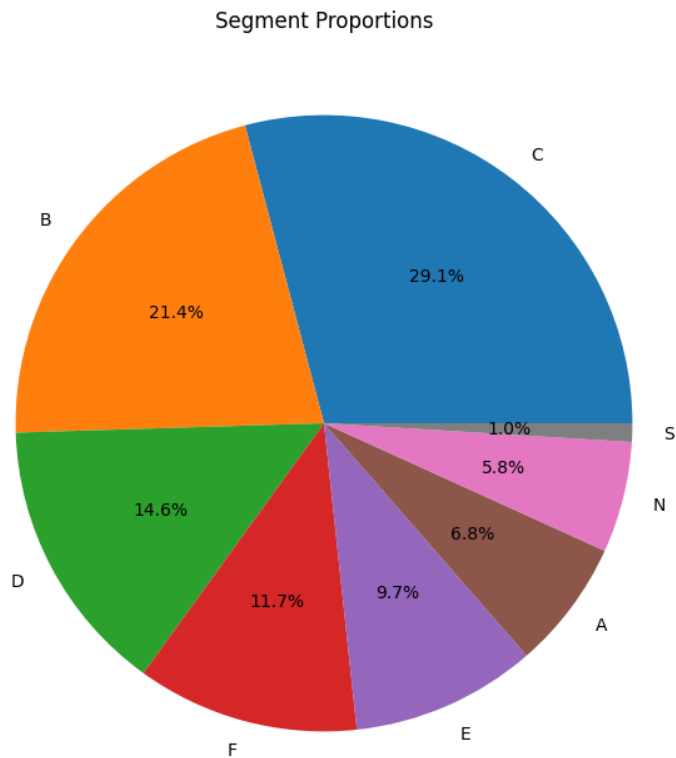
Vehicle Segmentation: The dataset revealed a diverse range of electric vehicle segments, including sedans, SUVs, hatchbacks, and more. By analyzing the vehicle counts by segment, we observed variations in the popularity and demand for different types of electric vehicles.



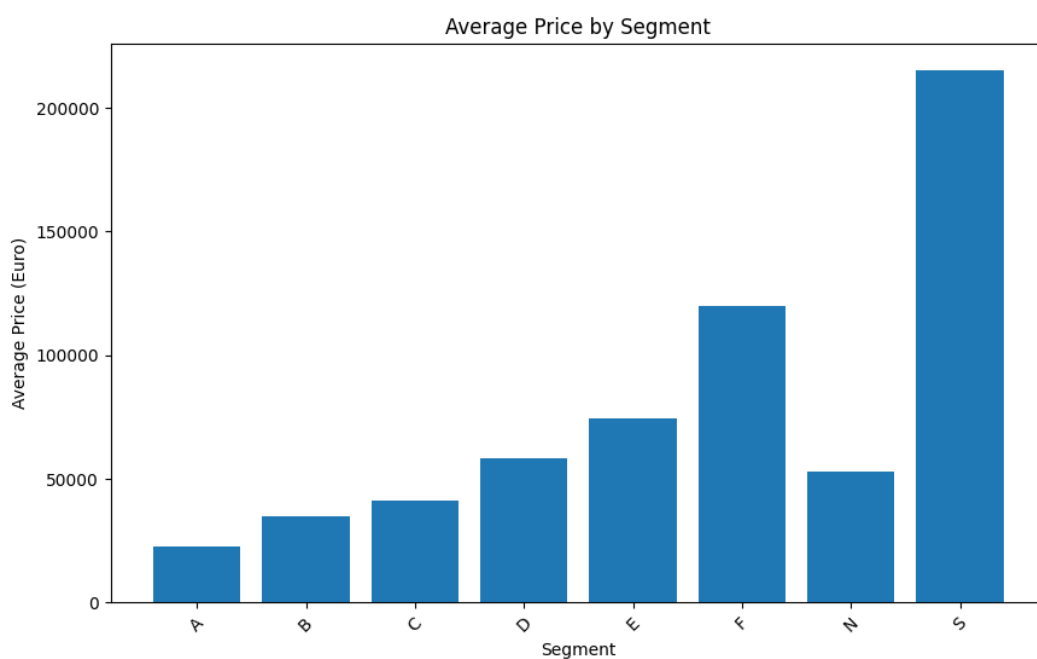
```
Vehicle Counts by Brand:
Tesla      13
Audi       9
Nissan      8
Volkswagen 8
Skoda      6
Renault    5
Porsche    5
Kia        5
BMW        4
Ford       4
Smart      3
Byton      3
Mercedes   3
Hyundai    3
Opel       3
Fiat       2
Peugeot    2
Honda      2
Mini       1
DS         1
Polestar   1
Sono       1
Lucid      1
Jaguar     1
Citroen    1
Alfa Romeo 1
MG         1
Lightyear  1
SEAT       1
CUPRA      1
Lexus      1
Mazda      1
Volvo      1
Name: Brand, dtype: int64
```

The image shows a terminal window with a dark background. It displays a list of car brands and their corresponding counts. The list is sorted in descending order of count. The brands and counts are: Tesla (13), Audi (9), Nissan (8), Volkswagen (8), Skoda (6), Renault (5), Porsche (5), Kia (5), BMW (4), Ford (4), Smart (3), Byton (3), Mercedes (3), Hyundai (3), Opel (3), Fiat (2), Peugeot (2), Honda (2), Mini (1), DS (1), Polestar (1), Sono (1), Lucid (1), Jaguar (1), Citroen (1), Alfa Romeo (1), MG (1), Lightyear (1), SEAT (1), CUPRA (1), Lexus (1), Mazda (1), and Volvo (1). At the bottom, it shows 'Name: Brand, dtype: int64'.





Price Analysis: The average price by segment highlighted variations in pricing across different vehicle categories. It showed that certain segments tend to have higher average prices, possibly indicating higher-end or more premium electric vehicles in those segments.



Powertrain Types: The dataset included information about different powertrain types, such as all-electric and hybrid vehicles. Segmenting the dataset based on powertrain type could provide insights into the market share and preference for each powertrain type among electric vehicle buyers.

```
Vehicle Counts by Powertrain Type:  
All Wheel Drive    41  
Front Wheel Drive  37  
Rear Wheel Drive   25  
Name: Powertrain, dtype: int64
```

Correlation Analysis: By examining the correlation matrix, we could identify potential relationships between different variables, such as acceleration, top speed, range, and price. These insights could help in understanding the factors that influence certain performance aspects or pricing in electric vehicles.

```
Correlation Matrix:  
      Seats  PriceEuro  
Seats    1.00000    0.02092  
PriceEuro 0.02092    1.00000  
<ipython-input-8-095ce353cbc1>:2: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future version, it will default to False. Select only valid columns to compute the correlation matrix.  
correlation_matrix = df.corr()
```

CONCLUSION

Overall, this project demonstrated the potential for segmentation analysis to gain insights into the electric vehicle market. The findings could be useful for industry stakeholders, researchers, and policymakers in understanding consumer preferences, market trends, and potential areas for growth in the electric vehicle industry.