Market Segmentation Analysis of Electric Vehicles in India

Introduction:

The Indian automobile market presents a significant opportunity for electric vehicle manufacturers and suppliers. With growing concerns about environmental sustainability and the rising demand for efficient and eco-friendly transportation solutions, the adoption of EVs in India is expected to accelerate in the coming years.

This report presents data analysis of the electric vehicle market, with the goal of identifying potential target segments and developing a feasible strategy for entering the market. This analysis is conducted on consumer behavior, demographics, and geographic factors revealed valuable insights for identifying the most promising target segments for EVs in India. We used the dataset “Indian Automobile buying behavior study” for analysis.

In this analysis, we mainly focus on finding which age group and of which geographic region has most demand of Electric Vehicle.

Data Preprocessing:

The analysis begins with importing the necessary libraries and reading the data into a pandas DataFrame. The data is then inspected for null values, and any inconsistencies or errors are addressed. In this case, the only issue identified was the presence of the value 'm' in the 'Wife Working' column, which was replaced with 'No'.

Behavioral and Psychographic Analysis:

The behavioral and psychographic analysis examines the relationships between various consumer attributes and their vehicle preferences. Several interesting observations are made:

1. Younger consumers tend to purchase less expensive vehicles.
2. Consumers with more dependents prefer vehicles with more seats, such as SUVs.
3. The price of the vehicle correlates strongly with the consumer's total salary.

These observations are supported by visualizations, including violin plots and scatter plots, which illustrate the relationships between age, dependents, salary, and vehicle make/price.

Geographic Analysis:

The geographic analysis explores the distribution of electric vehicle ownership across different states in India. The data reveals that certain states, such as Maharashtra, Gujarat, and Uttar Pradesh, have a higher concentration of electric vehicles, particularly in categories like two-wheelers, three-wheelers, and passenger cars. This information can be valuable when targeting specific regions for increased electric vehicle sales.

Demographic Analysis:

The demographic analysis examines the distribution of consumer attributes such as age, salary, and vehicle price.

Key observations include:

1. The majority of consumers fall within the age range of 25 to 50 years.
2. Consumers with an average total salary of around 30 lakhs tend to purchase vehicles more frequently.
3. Most vehicle purchases fall within the price range of 10 to 20 lakhs.

These observations are supported by distribution plots and pair plots, which provide visual representations of the data.

Model Deployment: K-Means Clustering

To identify potential target segments, the report employs K-Means clustering, an unsupervised learning algorithm. The dataset is preprocessed by encoding categorical variables and scaling numerical features.

The optimal number of clusters (K) is determined using the Elbow Method, which examines the Within-Cluster Sum of Squares (WCSS) for different values of K. Based on the elbow plot, two potential values of K (3 and 5) are identified.

K-Means clustering is performed for both K=3 and K=5, and the resulting clusters are analyzed. The analysis suggests that K=3 provides more meaningful and interpretable clusters, which can be described as follows:

1. Cluster 0: Consumers with a total salary close to the husband's salary (lower income).

2. Cluster 1: Consumers with a total salary close to the husband's salary (higher income).
3. Cluster 2: Consumers with a total salary higher than the husband's salary.

Target Segment Identification

Based on the analysis, the report recommends targeting a specific segment for electric vehicle sales in India. This segment consists of consumers aged 30 to 40 years, residing in urban areas with available infrastructure and education about technology and its benefits.

Additionally, the target segment should include married individuals with dependents, as they are more likely to purchase vehicles. The target income range should be around 30 lakhs per annum, with a vehicle budget in the range of 10 to 20 lakhs for automobiles and lower for two-wheelers.

Conclusion:

The market segmentation analysis conducted in this study has provided valuable insights into the Indian electric vehicle market and has identified a potential target segment for successful market entry and promotion of electric vehicles. By leveraging data-driven technologies and exploring various consumer attributes, behavioral patterns, and geographical distributions, a comprehensive understanding of the market landscape has been achieved.

The analysis began with a thorough data preprocessing step, ensuring the integrity and quality of the dataset. Any inconsistencies or errors were addressed, such as the replacement of the 'm' value in the 'Wife Working' column with 'No'. This step laid the foundation for accurate and reliable analysis.

The behavioral and psychographic analysis revealed several interesting observations. Firstly, it was noted that younger consumers tend to gravitate towards less expensive vehicles. This finding aligns with the general perception that younger individuals may have more limited financial resources or prioritize affordability over other factors. However, it is important to recognize that this observation may not hold true for all segments of the younger population, as individual preferences and purchasing power can vary.

Another notable observation was the tendency of consumers with more dependents to prefer vehicles with more seating capacity, such as SUVs. This behavior can be attributed to the practical need for accommodating larger families or multiple passengers. It highlights the importance of considering not only individual preferences but also the broader family dynamics and requirements when analyzing consumer behavior.

Perhaps the most significant finding from the behavioral and psychographic analysis was the strong correlation between the price of the vehicle and the consumer's total salary. This relationship suggests that consumers tend to make vehicle purchases that align with their financial capabilities, indicating a rational decision-making process based on affordability. This observation underscores the importance of considering income levels and purchasing power when targeting specific market segments.

The geographic analysis provided insights into the distribution of electric vehicle ownership across different states in India. It revealed that states like Maharashtra, Gujarat, and Uttar Pradesh have a higher concentration of electric vehicles, particularly in categories such as two-wheelers, three-wheelers, and passenger cars. This information can be invaluable for companies looking to target specific regions for increased electric vehicle sales and promotion efforts.

The demographic analysis examined the distribution of consumer attributes such as age, salary, and vehicle price. One notable observation was that the majority of consumers fell within the age range of 25 to 50 years. This age group is often associated with career advancement, financial stability, and the ability to make substantial purchases, such as vehicles. Understanding the age distribution of potential consumers can inform marketing strategies and product positioning.

Another key finding from the demographic analysis was that consumers with an average total salary of around 30 lakhs tended to purchase vehicles more frequently. This income level appears to be a sweet spot where individuals have sufficient disposable income to invest in vehicle purchases. Additionally, it was observed that most vehicle purchases fell within the price range of 10 to 20 lakhs, providing further insight into the financial boundaries within which consumers operate.

To identify potential target segments, the study employed K-Means clustering, an unsupervised learning algorithm. This approach allowed for the identification of distinct consumer groups based on their similarities in attributes such as age, salary, and vehicle preferences.

The optimal number of clusters (K) was determined using the Elbow Method, which examines the Within-Cluster Sum of Squares (WCSS) for different values of K. Based on the elbow plot, two potential values of K (3 and 5) were identified as potential candidates for clustering.

K-Means clustering was performed for both K=3 and K=5, and the resulting clusters were analyzed. The analysis suggested that K=3 provided more meaningful and interpretable clusters. These clusters can be described as follows:

1. Cluster 0: Consumers with a total salary close to the husband's salary (lower income).
2. Cluster 1: Consumers with a total salary close to the husband's salary (higher income).
3. Cluster 2: Consumers with a total salary higher than the husband's salary.

The identification of these clusters provides valuable insights into the stratification of consumers based on their financial capabilities and income levels. It allows for the development of targeted marketing strategies and product offerings tailored to the needs and preferences of each cluster.

Based on the comprehensive analysis, the report recommends targeting a specific segment for electric vehicle sales in India. This segment consists of consumers aged 30 to 40 years, residing in urban areas with available infrastructure and education about technology and its benefits.

The rationale behind targeting this segment is multifaceted. Firstly, the age range of 30 to 40 years represents a demographic that is often characterized by career stability, disposable income, and an openness to embracing new technologies. Individuals in this age group are typically well-established in their careers and have the financial means to make substantial purchases, such as electric vehicles.

Furthermore, targeting urban areas with established infrastructure and educational resources is crucial for the successful adoption of electric vehicles. Urban environments are more likely to have the necessary charging infrastructure and support systems in place to facilitate the widespread use of electric vehicles. Additionally, individuals residing in urban areas are typically more exposed to information and awareness campaigns about the benefits of electric vehicles, such as environmental sustainability and cost savings in the long run.

Another key factor in the recommended target segment is the inclusion of married individuals with dependents. This demographic group is more likely to prioritize practical considerations when making vehicle purchases, such as seating capacity, safety features, and long-term reliability. Electric vehicles can offer solutions that cater to these needs, making them an attractive option for families.

The target income range of around 30 lakhs per annum aligns with the findings from the demographic analysis, which indicated that consumers with an average total salary in this range are more inclined to purchase vehicles. Additionally, the recommended vehicle budget of 10 to 20 lakhs for automobiles and lower for two-wheelers takes into account the pricing trends observed in the data, ensuring that the target segment has the financial means to acquire electric vehicles within their budget constraints.

It is important to note that while this analysis provides a data-driven foundation for identifying a potential target segment, it does not encompass all the factors that should be considered when developing a comprehensive market entry strategy. Additional elements, such as consumer preferences, infrastructure availability, government policies, and technological advancements, should also be evaluated to ensure a holistic approach to market penetration.

Consumer preferences play a crucial role in the adoption of electric vehicles. Factors such as range anxiety, charging time, and perceived environmental benefits can influence consumer decision-making. Companies should invest in understanding these preferences through market research and consumer surveys to tailor their product offerings and marketing campaigns accordingly.

Infrastructure availability is another critical consideration. While urban areas are generally better equipped with charging stations and support systems, the widespread adoption of electric vehicles relies on the expansion of infrastructure across various regions. Collaboration between automakers, governments, and infrastructure providers is essential to ensure a seamless transition to electric mobility.

Government policies and incentives can significantly impact the adoption of electric vehicles. Favorable policies, such as tax incentives, subsidies, and regulations promoting sustainable transportation, can accelerate the growth of the electric vehicle market. Companies should stay informed about policy developments and leverage available incentives to make electric vehicles more accessible and attractive to consumers.

Technological advancements play a pivotal role in the evolution of the electric vehicle industry. Improvements in battery technology, charging infrastructure, and vehicle range can address consumer concerns and enhance the overall user experience. Companies should invest in research and development to stay ahead of the curve and offer cutting-edge solutions that meet the evolving needs of consumers.

In conclusion, the market segmentation analysis has provided a solid foundation for understanding the Indian electric vehicle market and identifying a potential target segment. By focusing on consumers aged 30 to 40 years, residing in urban areas, with a specific income range and vehicle budget, companies can effectively promote and sell electric vehicles in India.

However, it is crucial to recognize that this analysis is based on the provided dataset and should be complemented by additional research and considerations. A holistic approach that encompasses consumer preferences, infrastructure availability, government policies, and technological advancements is essential for developing a comprehensive and successful market entry strategy.

The electric vehicle industry is poised for significant growth in India, driven by rising environmental concerns, technological advancements, and changing consumer attitudes. By leveraging the insights gained from this study and adopting a strategic, data-driven approach, companies can position themselves at the forefront of this burgeoning market, contributing to a more sustainable and eco-friendly future for transportation in India.

Conclusion :

The customer segmentation analysis conducted in this study has yielded valuable insights and a comprehensive understanding of the potential target segment for Electric Vehicle (EV) adoption. By leveraging data-driven techniques and a meticulous examination of demographic, psychographic, and behavioral attributes, distinct customer segments have been identified, each with unique characteristics and preferences. Among these segments, a specific target group has emerged as the most viable and promising for focused marketing efforts and strategic positioning of EVs in the market.

The target segment, identified as Cluster 2, comprises individuals and households characterized by higher total incomes, typically representing dual-income scenarios

or individuals with substantial supplementary income sources. This segment's financial capabilities position them favorably to afford the relatively higher upfront costs associated with EVs, a factor that has historically been a barrier to widespread adoption. Additionally, their economic standing suggests a greater propensity for exploring and embracing new technologies, aligning with the innovative nature of EVs and the sustainable transportation paradigm.

Furthermore, the analysis has highlighted the significance of age and geographic location in shaping consumer preferences and receptiveness towards EVs. The recommended age range for the target segment is 30 to 40 years, as individuals within this cohort are often at a stage in their lives where they are financially stable, open to exploring new technologies, and conscious of their environmental impact. This age group is also likely to have dependents, further motivating their desire for sustainable and environmentally responsible transportation choices that contribute to a cleaner future for their families.

Complementing the age factor, the analysis suggests focusing on urban areas with well-established EV infrastructure and educational initiatives promoting the benefits of EVs. Urban dwellers are more likely to be exposed to the challenges of pollution and congestion, fostering a greater appreciation for sustainable mobility solutions. Additionally, the availability of charging stations and supportive infrastructure in urban environments can alleviate range anxiety and facilitate the seamless integration of EVs into daily life.

By targeting this specific segment, comprising dual-income households or individuals with higher total incomes, within the age range of 30 to 40 years, and residing in urban areas with accessible EV infrastructure, automakers and marketers can effectively position their EV offerings. Tailored marketing strategies and product positioning can resonate with the unique preferences and motivations of this segment, ultimately driving increased adoption and contributing to the transition towards sustainable transportation.

However, it is crucial to recognize that customer segmentation is an ongoing process, as consumer preferences and market dynamics are constantly evolving. Continuous monitoring and adaptation to changing trends, technological advancements, and regulatory landscape are essential for sustained success in the EV market. Automakers and marketers must remain agile and responsive, refining their strategies and targeting approaches as new insights emerge and market conditions shift.

One aspect that warrants further exploration is the potential impact of incentives and government policies on consumer behavior and the adoption of EVs. Favorable incentives, such as tax credits, subsidies, or preferential pricing structures, can significantly influence the perceived affordability and value proposition of EVs, potentially broadening the target segment or accelerating adoption within the identified segment. Collaborating with policymakers and advocating for supportive policies can create a conducive environment for EV proliferation and foster a more inclusive market.

Additionally, addressing range anxiety and the availability of charging infrastructure remains a critical consideration. While urban areas may offer more developed charging networks, extending the infrastructure to suburban and rural regions can further expand the potential customer base. Innovative solutions, such as mobile charging stations, battery swapping technologies, or partnerships with existing fuel station networks, could enhance the accessibility and convenience of EV charging, alleviating a significant barrier to widespread adoption.

Moreover, leveraging the power of consumer education and awareness campaigns can play a pivotal role in shaping perceptions and driving adoption within the target segment. Highlighting the environmental benefits, long-term cost savings, and technological advancements of EVs can resonate with the values and priorities of the identified target group. Engaging influencers, leveraging social media platforms, and fostering community-driven initiatives can effectively disseminate information and foster a culture of sustainable mobility.

It is also essential to recognize the potential diversification of the target segment as the EV market matures and evolves. As technology advances and costs become more competitive, the affordability barrier may diminish, allowing for a broader demographic to consider EVs as a viable option. Continuously reassessing and refining the target segment based on emerging market trends and consumer preferences will be crucial for sustained growth and market dominance.

Furthermore, embracing a customer-centric approach and fostering open communication channels can provide valuable insights into the evolving needs and expectations of the target segment. Gathering feedback, conducting surveys, and analyzing customer behavior can inform product development, service offerings, and overall brand positioning. By actively listening to the voice of the customer, automakers and marketers can stay ahead of the curve and proactively address emerging challenges or capitalize on emerging opportunities.

In summary, the customer segmentation analysis has provided a solid foundation for targeting and positioning EVs in the market. By focusing on the identified target segment of dual-income households or individuals with higher total incomes, within the age range of 30 to 40 years, and residing in urban areas with established EV infrastructure, automakers and marketers can effectively promote EV adoption and contribute to the transition towards sustainable transportation.

However, it is imperative to recognize that this analysis represents a snapshot in time and that continuous adaptation and refinement are essential to maintain relevance and market competitiveness. Embracing a holistic approach that combines data-driven insights, consumer education, policy advocacy, infrastructure development, and customer-centric strategies will be pivotal in driving sustained success in the dynamic and rapidly evolving EV market.

Dataset used:- 1. Indian Automobile buying behavior study

2. EV Stats (For Geographic Study)

Github Link:- Feynn-Lab-and-Services/EV_Marget_Segmentation.ipynb at EV-Market-Analysis-Segmentation · Pratikkumar201/Feynn-Lab-and-Services (github.com)