Feynn Labs

EV Market Segment

Analysis Report

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Abstract

The electric vehicle (EV) market is at a critical juncture, with increasing environmental concerns and technological advancements propelling it towards significant growth. This report aims to dissect the EV market through comprehensive segmentation analysis, employing a blend of quantitative and qualitative research methodologies. By analyzing data from various sources, including government databases, industry reports, and consumer surveys, we identify key market segments and their unique characteristics. The findings reveal distinct consumer preferences, behaviors, and expectations, guiding the development of targeted marketing strategies and product offerings. Through machine learning techniques such as Principal Component Analysis (PCA) and K-Means Clustering, we extract and profile potential market segments, highlighting opportunities for strategic engagement and growth. The report culminates in the selection of optimal market segments for targeted interventions, with customized marketing mixes designed to maximize penetration and profitability. This analysis not only provides insights into the current landscape but also outlines a roadmap for stakeholders to navigate the evolving EV market effectively.

Github Link: https://github.com/hsallrounder/EV-Market-Segment-Analysis

Introduction

The surge in environmental awareness and advancements in technology have positioned electric vehicles (EVs) as a sustainable alternative to traditional internal combustion engine vehicles. This transition is not only pivotal for environmental sustainability but also represents a significant market opportunity. However, the EV market is characterized by diverse consumer needs and preferences, necessitating a granular understanding of potential market segments to tailor products and marketing strategies effectively.

This report embarks on a detailed analysis of the EV market, aiming to unearth geographic, demographic, psychographic, and behavioural segments through an extensive examination of various data sources. By leveraging advanced analytics and machine learning techniques, we identify distinct consumer segments, providing valuable insights into their preferences and behaviours. The objective is to equip stakeholders with actionable intelligence to customize the marketing mix and product offerings, ensuring alignment with the specific needs of target consumer segments.

Through this comprehensive market segmentation analysis, we aim to highlight the most promising opportunities for market entry and expansion, facilitating strategic decision-making for businesses looking to capitalize on the burgeoning demand for electric vehicles.

Problem Statement and Fermi Estimation

Problem Statement

You are a team working under an Electric Vehicle Startup. The Startup is still deciding in which vehicle/customer space it will be develop its EVs.

You must analyse the Electric Vehicle market in India using Segmentation analysis and come up with a feasible strategy to enter the market, targeting the segments most likely to use Electric vehicles.

Fermi Estimation

Data Collection and Assessment

- Collect sales data, electric vehicle customer reviews, and technical specifications.
- Assess the data's reliability and comprehensiveness to ensure a solid foundation for analysis.

Segmentation Using Behavioural Variables

- Analyse behavioural data to identify patterns and segments within the customer base.
- Estimate each segment's size and characteristics using data-driven approaches.

Analysis of Psychographic Data

- Delve into psychographic data within each behavioural segment to understand customer motivations and preferences.
- Estimate customers' psychographic traits and preferences within each identified segment.

Technical Specification and Price Analysis

- Assess electric vehicles' technical specifications within identified segments.
- Understand how technical features influence customer preferences and purchasing decisions.

Target Segment Selection

- Select target segments based on comprehensive analysis of behavioural, psychographic, and technical data.
- Prioritize segments that offer the most potential for growth and alignment with the startup’s offerings.

Customization of Marketing Mix

- Tailor the marketing mix specifically for the chosen target segments.
- Develop marketing strategies that resonate with the preferences and needs of the target customer base.

Segment Recommendation

- Finalize segment recommendations by combining the results of the segment analysis and marketing mix customization.
- Recommend target segments that present the highest market potential for a focused and efficient market entry strategy.

This structured approach, underpinned by Fermi estimation at each stage, aims to guide the Electric Vehicle Startup towards informed decision-making, precise market targeting, and the development of marketing strategies that cater specifically to customer needs and preferences, ensuring a successful market entry and sustainable growth.

Data Sources

- **Sales Figs:** Obtained from the Society of Manufacturers of Electric Vehicles, covering the period from 2017 to 2023, this dataset offers a detailed view of market trends and consumer preferences across various electric vehicle categories.
- **Customer Reviews:** Extracted from bikewale.com, these reviews provide behavioral and psychographic insights into electric two-wheeler consumers, offering a qualitative perspective on customer behavior and preferences.
- **Technical Specifications and Pricing:** Also sourced from bikewale.com, this dataset includes detailed information on

electric two-wheelers, allowing for an assessment of technical feasibility and competitive pricing.

Integrating these datasets facilitated a comprehensive understanding of the electric vehicle market, underpinning the analysis with real sales data, customer sentiments, and technical specifics to ensure a data-driven, market-relevant segmentation approach.

In addition to the primary datasets, the IEA-EV-dataEV_salesHistoricalCars dataset was utilized to gain historical perspective on global EV sales trends, further enriching the analysis. Sourced from the International Energy Agency, this dataset tracks the evolution of EV sales worldwide, offering valuable context for understanding growth patterns and predicting future market trajectories. Incorporating this dataset allowed for a deeper analysis of global trends, enhancing the understanding of potential impacts on the Indian EV market.

Data Pre-processing

The data pre-processing phase involved several critical steps to ensure the datasets were clean, consistent, and structured for effective analysis. Utilizing Python and its powerful libraries, the following procedures were applied:

- **Cleaning:** Missing values were identified and handled appropriately, either by imputation or removal, depending on their impact on the analysis. Duplicate entries were also removed to maintain data integrity.
- **Normalization:** Data was normalized to ensure that numeric values had a common scale, preventing any single feature from dominating the analysis due to its scale.
- **Transformation:** Categorical data were encoded into numerical formats to facilitate their use in machine learning models, employing techniques like one-hot encoding.
- **Feature Selection:** Irrelevant features were excluded, and new features were engineered to better represent the underlying patterns in the data.

Libraries Used

- Pandas and NumPy for data manipulation and cleaning.
- Scikit-learn for normalization, encoding, and feature selection.

This meticulous pre-processing ensured the data was primed for the subsequent segmentation and analysis phases, laying a solid foundation for extracting meaningful insights.

Segment Extraction

Using Sales Data:

In this segment, a detailed analysis was conducted based on three significant Figs representing India's electric vehicle market.

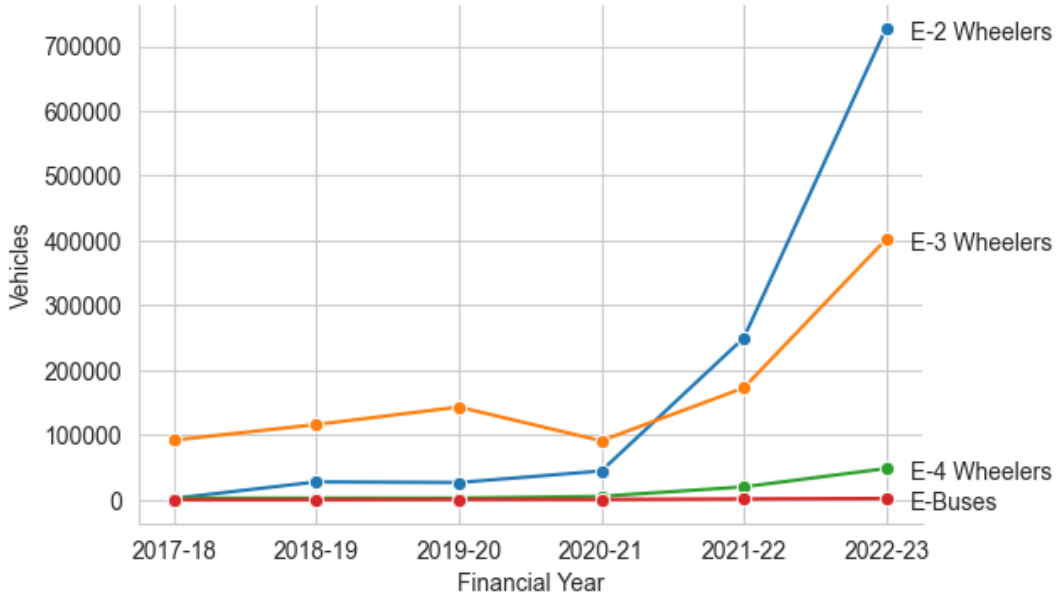

Fig 1

Fig 1 showcased the remarkable growth trajectory of India's two-wheeler market in 2023, underscoring its leading position within the industry.

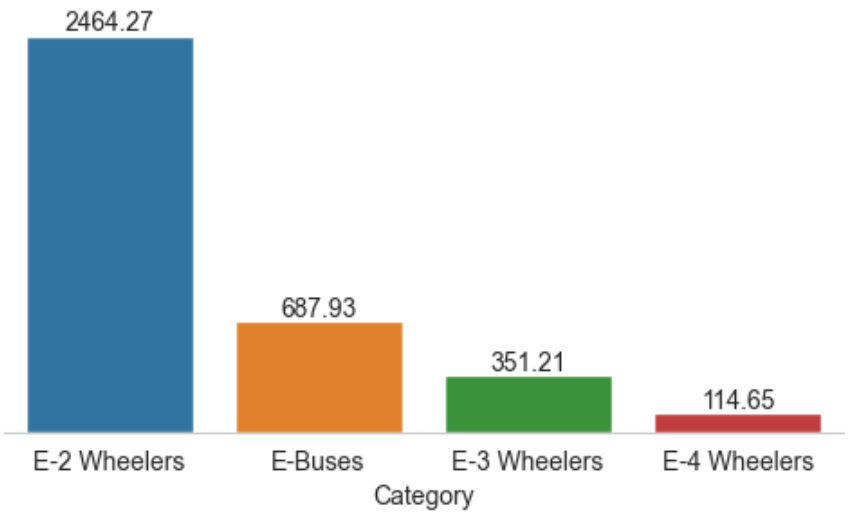

Fig 2

Fig 2 delved into the market's financial perspective, representing the industry's total value in crores. Notably, two-wheelers emerged as the primary revenue generators, highlighting their economic significance.

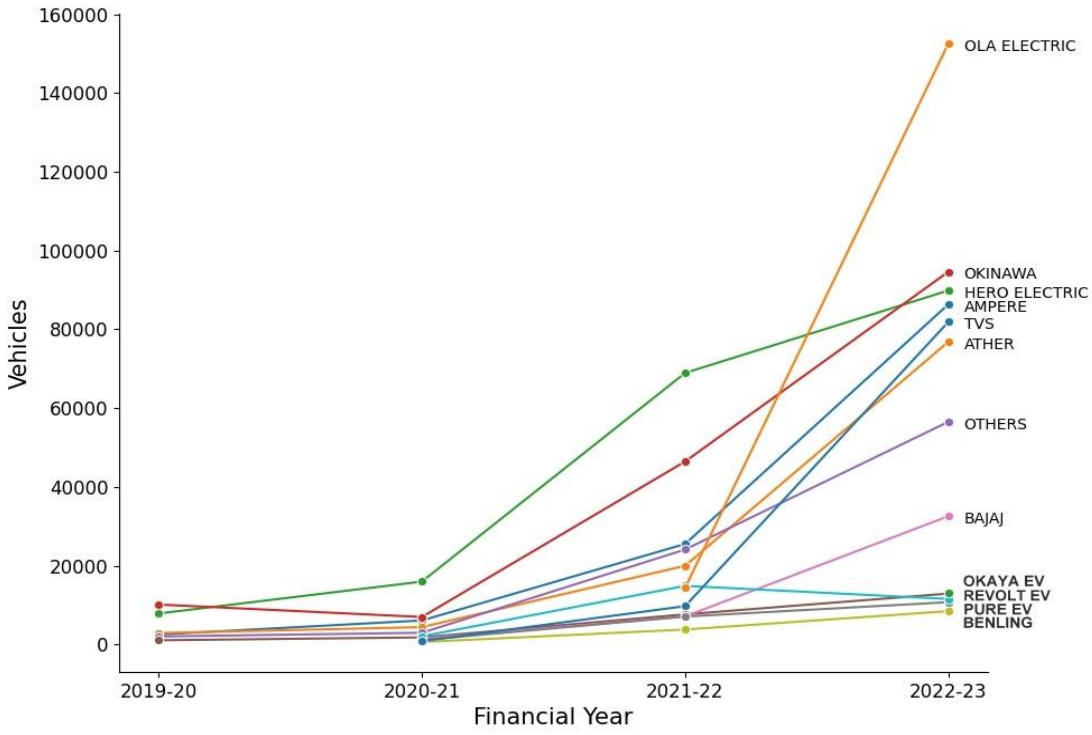

Fig 3

Fig 3 honed in on specific electric two-wheeler companies, with Ola Electric emerging as the market leader in 2023, illustrating industry leadership and market competitiveness.

Upon in-depth analysis of these Figs, it became evident that the electric two-wheeler segment was the most promising area for our detailed study. The robust growth, revenue dominance, and market leadership collectively indicated its prominence and potential, making it the ideal focus for our detailed study.

Using K-Means:

In this subsequent analysis, the standard k-means algorithm was applied to explore market segmentation possibilities within the electric two-wheeler customer reviews data. Solutions were systematically tested for two to eight market segments.

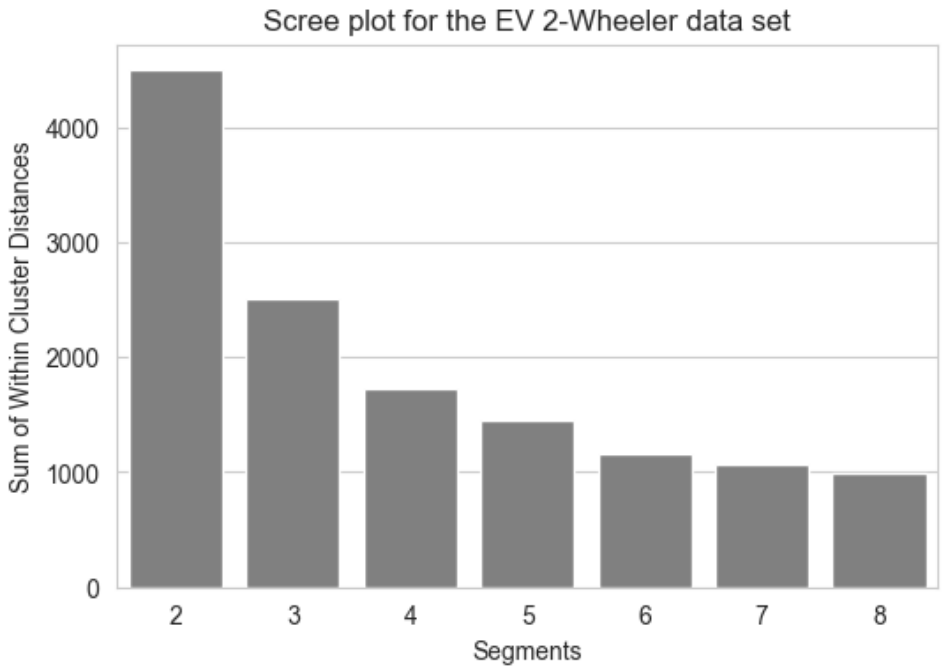

Fig 4

The decision-making process was significantly guided by the scree plot Fig 4, revealing a distinct elbow at four segments. This marked point indicated a substantial reduction in distances, signifying the optimal number of segments for our analysis.

By incorporating insights from these analyses, our focus remained finely tuned on the electric two-wheeler segment, ensuring precision and relevance in our market segmentation approach.

Profiling and Describing Segmentation

Profiling Segments:

This section presents a detailed analysis of our consumer segments, as illustrated in Fig 5. The graph visually captures the diverse perceptions among different segments. Segment 0, representing 15% of consumers, values the electric two-wheeler vehicle for its visual appeal, reliability, performance, service experience, and comfort. Conversely, Segment 1 (39% of consumers) expresses dissatisfaction across all aspects, marking them as the largest but least satisfied group. Segment 2 (33% of consumers) appreciates visual appeal, reliability, service experience, comfort, and notably, perceives a strong value for money. Lastly, Segment 3 (13% of consumers), the smallest segment, values visual appeal, reliability, performance, service experience, extra features, and maintenance cost, showcasing distinct perceptions, particularly on features and costs.

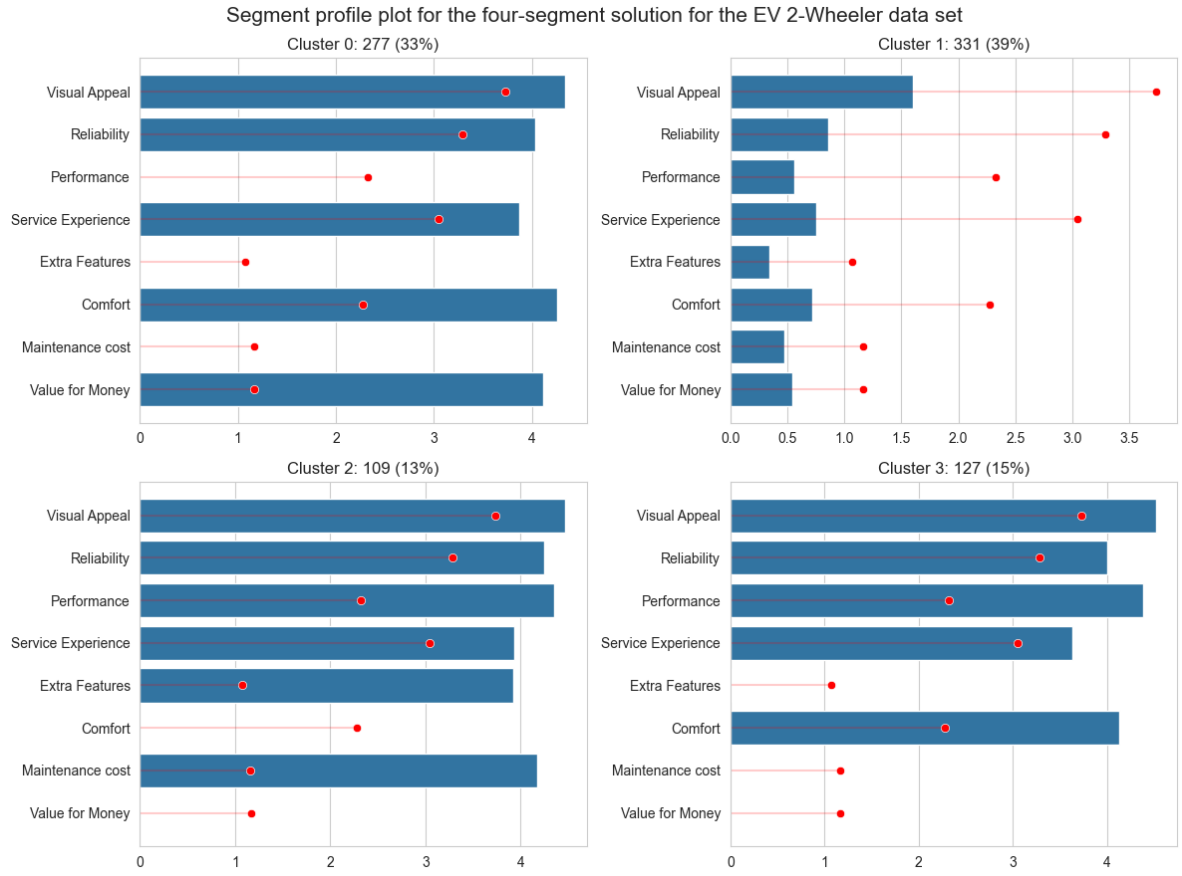

Fig 5

The accompanying Fig 6, utilizing principal components, further emphasizes these differences. Notably, Segment 1, despite being the largest segment, lacks specific opinions, making them unique in their lack of satisfaction. These detailed insights play a pivotal role in shaping our strategy, ensuring our electric vehicles align precisely with the diverse values and priorities of each segment, thus informing our market offerings accurately.

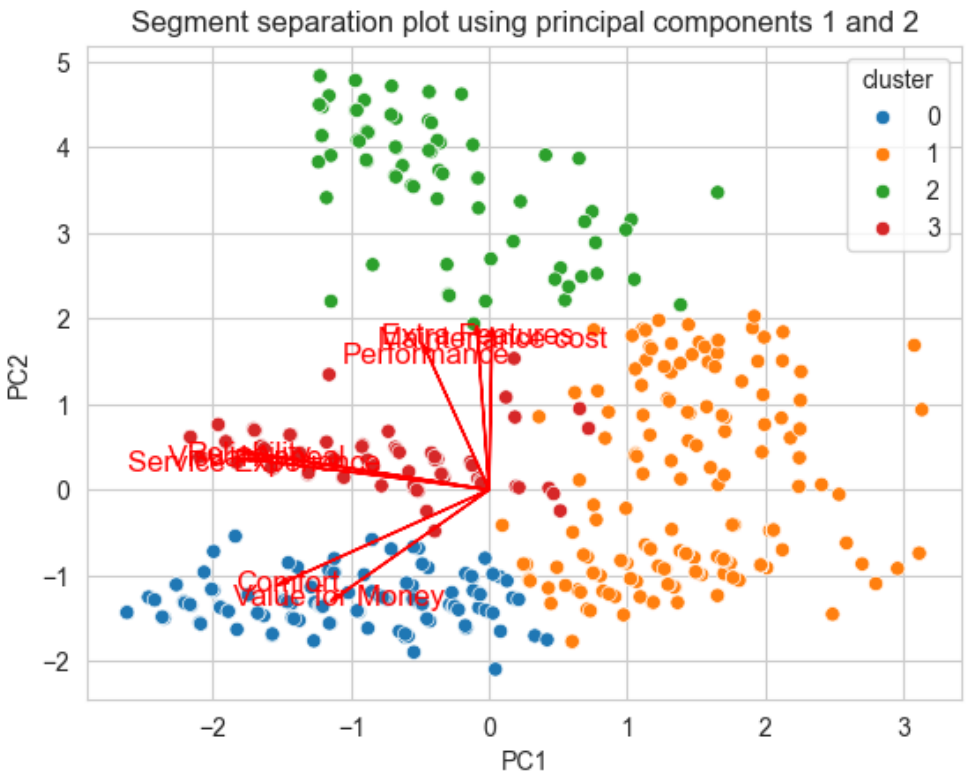

Fig 6

Describing Segments:

This section provides a comprehensive overview based on the insights derived from various mosaic plots and graphical representations. In Fig 7, the mosaic plot illustrates that all segments predominantly use electric vehicles for daily commuting, with limited usage for tours, occasional commuting, and leisure rides.

Moving to Fig 8, the plot delineates the ownership duration of electric vehicles among segments. Segment 1 stands out, owning electric vehicles for more than a year, while Segment 0 has no prior ownership experience. Segment 2 members moderately own vehicles ranging from less than 3 months to over a year, and Segment 3 consumers have owned electric vehicles for a few days to less than 3 months.

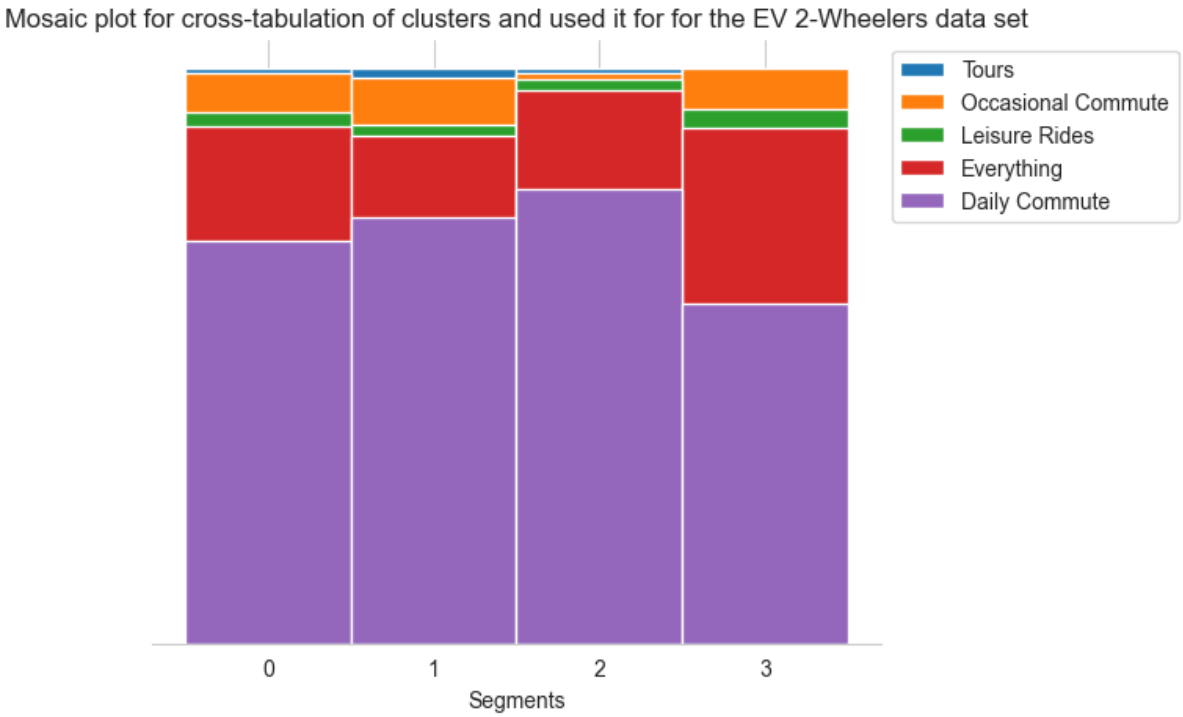
Mosaic plot for cross-tabulation of clusters and used it for for the EV 2-Wheelers data set
Tours
Occasional Commute
Leisure Rides
Everything
Daily Commute
0
1
2
3
Segments

Fig 7

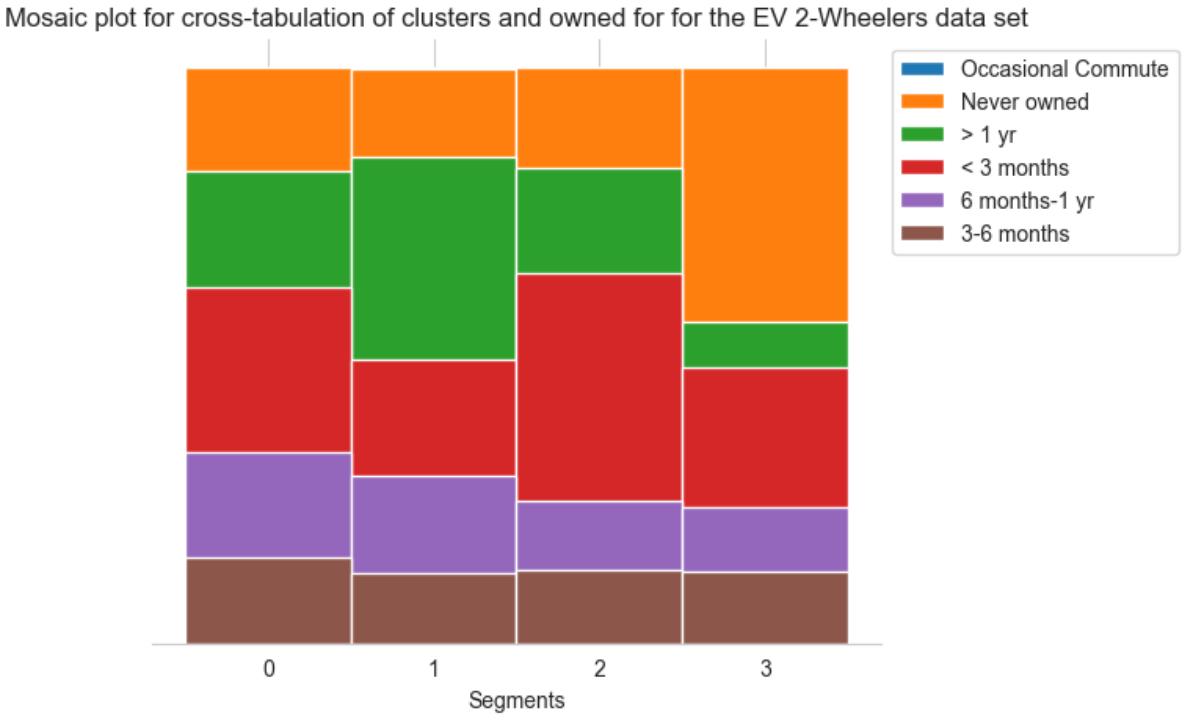
Mosaic plot for cross-tabulation of clusters and owned for for the EV 2-Wheelers data set
Occasional Commute
Never owned
> 1 yr
< 3 months
6 months-1 yr
3-6 months
0
1
2
3
Segments

Fig 8

Fig 9 delves into the distances covered by consumers, indicating that all segments predominantly use electric vehicles for commuting, with most users covering distances below 5000 kms. A small portion falls in the 5000 to 10000 kms range, aligning with their commuting needs.

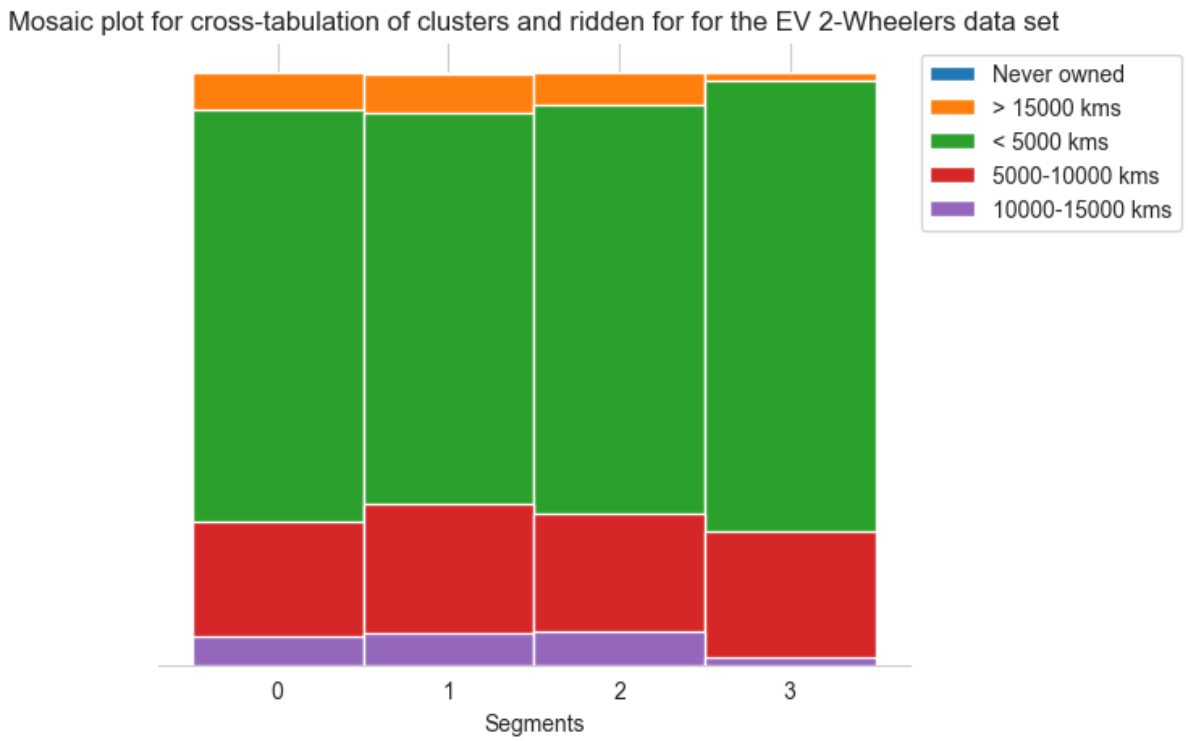

Fig 9

Fig 10 explores consumer sentiments, revealing that all segments, except Segment 1, exhibit positive sentiments. Segment 1 consumers stand out with negative sentiments, indicating dissatisfaction across various aspects.

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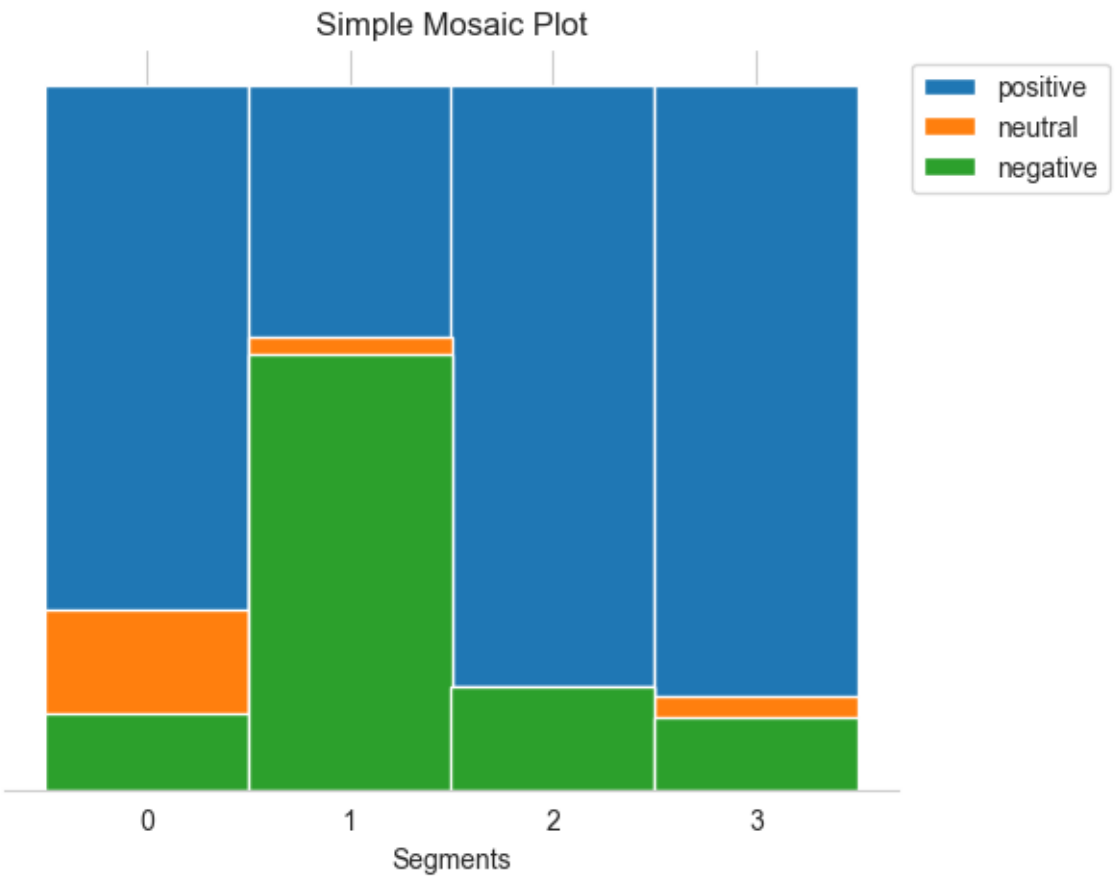

Fig 10

Fig 11, a parallel box and whisker plot, emphasizes significant differences in average ratings among segments. Specifically, Segment 1 consumers express dissatisfaction across all perceptions, leading to lower overall ratings. These graphical representations offer nuanced insights into consumer behaviors, sentiments, and preferences, guiding our strategic decisions for a more tailored approach in the electric vehicle market

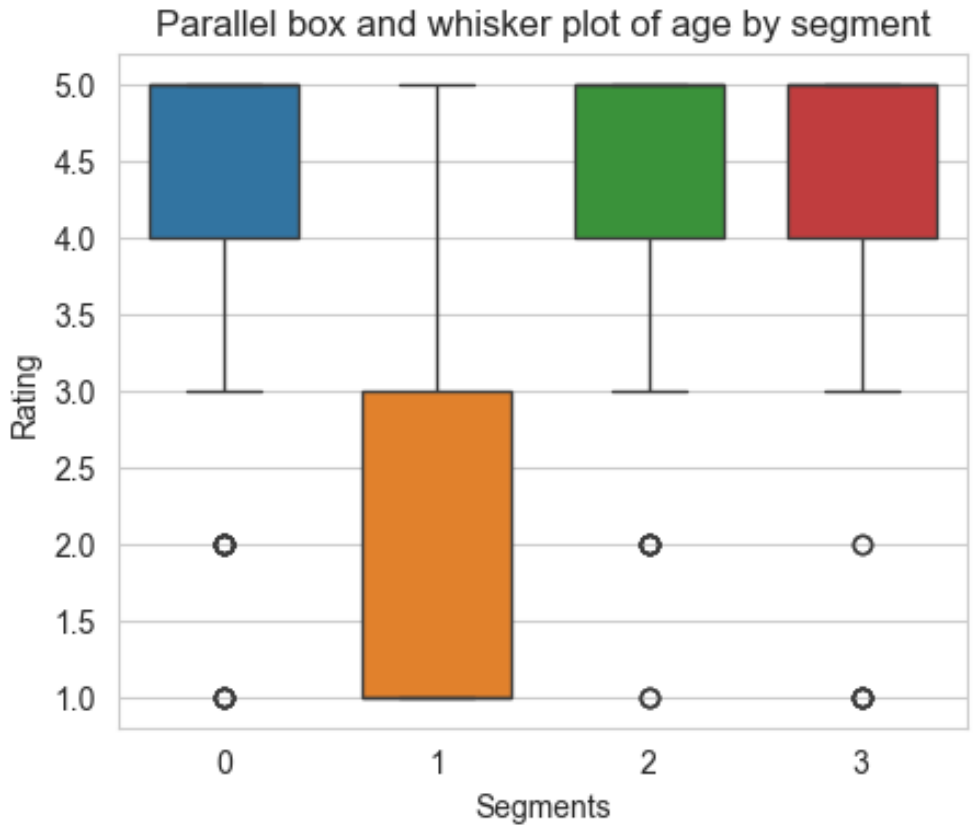

Fig 11

In analyzing the technical specifications of electric vehicles across segments, distinct patterns emerge. Segment 0 showcases a higher price range, emphasizing a preference for premium electric vehicles within this group. This is reflected in Fig 12 (a), a parallel box and whisker plot representing the price range. Conversely, Segment 1 exhibits a lower price range, indicating a focus on more budget-friendly options. Segment 2 and Segment 3 also emphasize affordability, albeit with slight differences. These findings align with consumer preferences, highlighting varied economic considerations within the market.

Moving to riding range, Segment 0 stands out with a higher average riding range, suggesting a preference for electric vehicles with extended range, portrayed in Fig 12 (b). In contrast, Segment 1 and Segment focus on moderate ranges for daily commuting. Segment 3 falls between, catering to consumers desiring slightly longer distances, highlighting nuanced commuting needs.

Considering top speed, Segment 0 and Segment 3 opt for vehicles with higher speeds, while Segment 1 and Segment 2 prioritize lower speeds suitable for city commuting. These trends are depicted in Fig 12 (c). Weight plays a pivotal role, where Segment 0 and Segment 1 favor slightly heavier vehicles, as represented in Fig 12 (d). Segment 2 and Segment 3 lean towards lighter options, accommodating diverse user preferences for vehicle weight.

Lastly, battery charging time demonstrates a noteworthy difference. Segment 0 and Segment 3 opt for slightly longer charging durations, depicted in Fig 12 (e), emphasizing the convenience of overnight charging. Segment 1 and Segment 2 prioritize faster charging, catering to users seeking quicker turnaround times for their electric vehicles. These technical specifications, visually represented in respective Figs, underscore the nuanced preferences and priorities of each segment, shaping the landscape of the electric vehicle market in India.

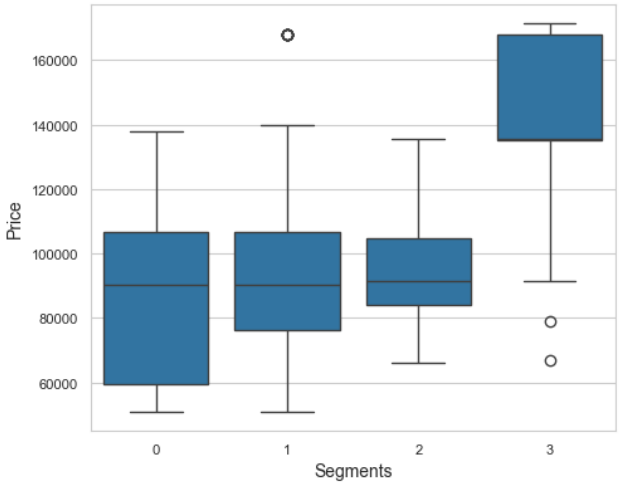

Fig 12 (a)

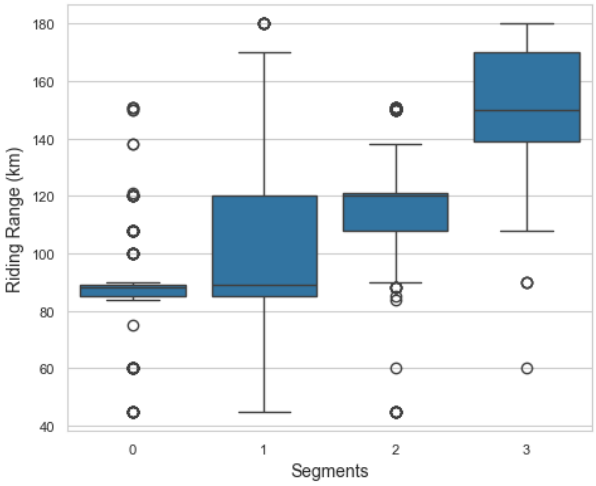

Fig 12 (b)

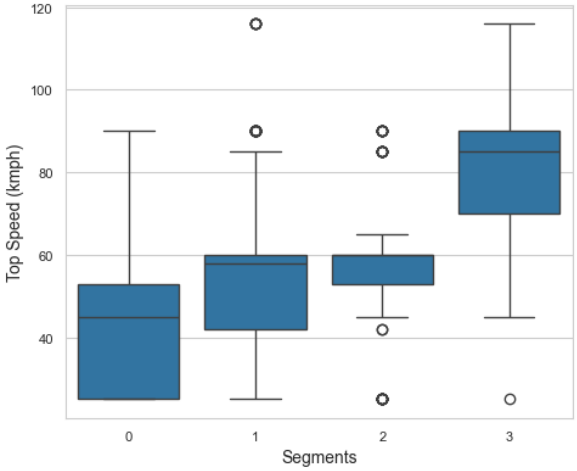

Fig 12 (c)

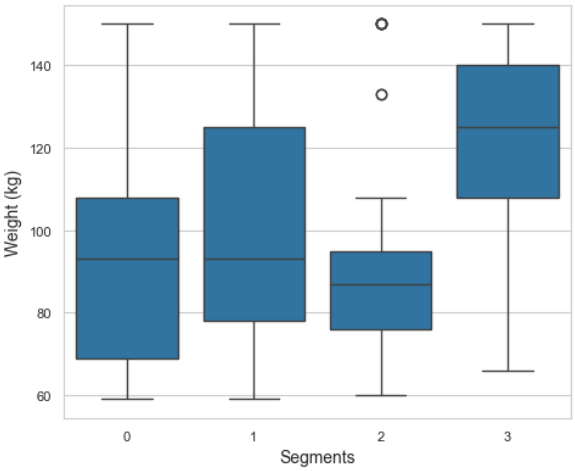

Fig 12 (d)

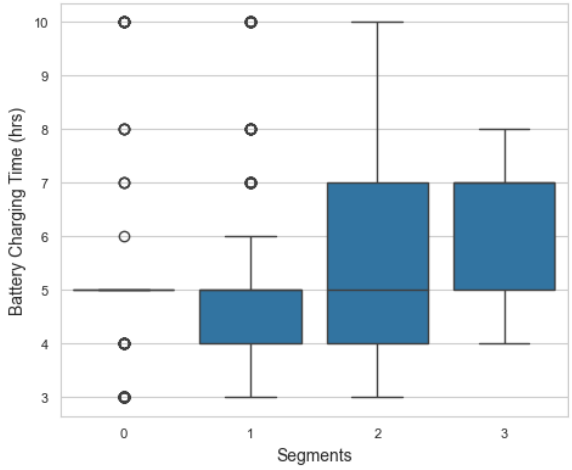

Fig 12 (e)

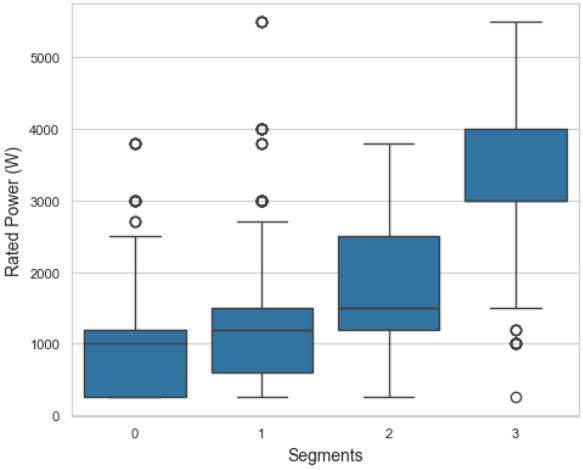

Fig 12 (f)

Selection of Target Segment

In devising our strategy for targeting segments in the electric vehicle market, we have identified Segment 1 and Segment 2 as pivotal focal points. Segment 1, comprising 39% of consumers, represents a significant market base characterized by diverse perceptions and preferences. Our analysis has unveiled various sentiments within this segment, highlighting specific demands and priorities. Recognizing these unique perceptions, particularly areas of dissatisfaction, presents an opportunity for direct intervention to enhance customer satisfaction and foster brand loyalty within this substantial market share. Similarly, Segment 2, encompassing 33% of consumers, presents an attractive prospect. Their discernible preferences, such as valuing visual appeal, reliability, service experience, and comfort, offer invaluable insights. Leveraging these insights, we can tailor our electric vehicles to resonate with the specific perceptions of Segment 2, emphasizing aspects like value for money to establish a strong connection with this consumer group.

Upon thorough examination, Segment 1 poses a distinct challenge and opportunity. By addressing their dissatisfaction points comprehensively and devising electric vehicles that specifically address these concerns, we can anticipate significant results. Concurrently, understanding the positive perceptions of Segment 2 lays the groundwork for further enhancing these features. This dual approach ensures a positive customer experience and reinforces brand

loyalty across both segments. Our strategy emphasizes the refinement of existing features, targeted resolution of dissatisfaction points, and enhancement of positive elements. By aligning our electric vehicles with the distinct expectations of Segment 1 and Segment 2, our strategy is meticulously tailored to meet the specific needs of each segment, thus ensuring a competitive advantage and sustained market growth.

Customizing the Marketing Mix

In our strategic approach to the electric vehicle market, customization of the marketing mix plays a pivotal role in appealing to our target segments, namely Segment 1 and Segment 2. For Product Customization, our focus lies in enhancing features tailored to the specific desires of each segment. This entails addressing dissatisfaction points such as improving performance and service experience for Segment 1, while emphasizing visual appeal and value for money for Segment 2, thereby refining our products to meet their distinct preferences. Offering diverse choices within each segment ensures a comprehensive range of options that cater to varied tastes and budgets.

Price Customization is another key aspect of our strategy, involving the establishment of competitive and flexible pricing structures. Segment 1 will benefit from affordable options, whereas Segment 2 may be open to slightly higher price points for value-added features. Promotion Customization is equally vital, necessitating targeted advertising efforts that focus on reliability and service improvements for Segment

1, and aesthetics and affordability for Segment 2. Tailored promotional events and online campaigns are employed to effectively engage these segments.

Furthermore, Place Customization entails the establishment of accessible distribution channels tailored to the geographic preferences of each segment. This involves focusing on urban areas for Segment 1 and suburban and semi-urban regions for Segment 2. Strengthening our online presence is also prioritized, ensuring seamless online purchasing experiences through virtual showrooms and customer support platforms. Additionally, People and Process Customization involves training our customer service representatives to address segment-specific concerns empathetically. Streamlining our processes for customization requests and service appointments enhances customer satisfaction and fosters brand loyalty. This tailored approach ensures that our electric vehicles resonate with the distinct needs of Segment 1 and Segment 2, thereby fostering market relevance and customer preference.

Potential Customer Base in Early Market

Upon analyzing the potential early market customer base, we have identified two primary segments: Segment 1, consisting of 330 members (39% of consumers), and Segment 2, comprising 277 members (33% of consumers). Examination of the price range data reveals that the logical target price for Segment 1 falls within the range

of ₹51,094 to ₹1,67,844, while for Segment 2, it ranges from ₹51,094 to ₹1,37,890. To estimate potential sales (profit) in this early market scenario, we multiply the number of potential customers in each segment by our targeted price range. For example, setting a target price of ₹1,20,000 for Segment 1 would result in a potential profit of ₹39.60 crores, while a target price of ₹1,10,000 for Segment 2 would yield a potential profit of ₹30.47 crores. Segment 1 emerges as the segment with larger potential, boasting a significantly higher market share and a broader customer base, thus making it the primary focus for our early market penetration efforts. These calculated potential profits highlight the substantial market opportunity within these segments, serving as a crucial factor guiding our strategic decisions effectively.

Most Optimal Market Segments

After conducting a thorough analysis and evaluation, Segment 1 emerges as the most optimal market segment for our electric two-wheeler vehicles. Comprising 39% of consumers, this segment offers substantial opportunities and a vast customer base, making it strategically advantageous for market penetration. Its significant market potential, combined with a well-balanced blend of technical specifications and price range, positions it as the most promising target for our electric vehicles.

For Segment 1, we recommend the following technical specification range, as outlined in Table 1, to ensure alignment with the diverse needs and preferences of the market:

Specification	Recommended Range (in INR)
Price	70,688 – 1,29,063
Riding range	89 - 180 km
Top speed	58 - 116 kmph
Weight	76 - 120 kg
Battery charging time	3 - 5 hours
Rated power	1200 - 5500 W

Table 1

This comprehensive analysis enables us to fine-tune our market entry strategy to cater precisely to the demands and expectations of the selected segment. By focusing on Segment 1, we are setting the stage for a successful and sustainable venture into the electric vehicle market.

Conclusion

In conclusion, our extensive analysis of India's electric vehicle market has pinpointed Segment 1 as the prime target for our venture. Representing a significant 39% of the consumer base, this segment presents a lucrative market opportunity. By tailoring the specifications of our electric two-wheelers to cater to the preferences of Segment 1, we position our products to seamlessly align with the demands of this sizable customer segment. This strategic decision is underpinned by a

comprehensive understanding of market segmentation, consumer behaviour, and technical requirements.

These insights provide a clear roadmap for our market entry strategy, emphasizing the importance of precision and relevance in both product development and marketing endeavours. As we move forward, this approach furnishes us with a solid footing, ensuring that our offerings resonate effectively within the dynamic and evolving landscape of India's electric vehicle industry.

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