MARKET SEGMENTATION OF ELECTRIC VEHICLES

(TASK-T-1-R)

(SOLO)

Name: Polavarapu L B S S Vani Gayathri

Github Link: https://github.com/vanigayathri/EV-Market-Segmentation

1.PROBLEM STATEMENT:

The primary challenge is to strategically position our Electric Vehicle (EV) startup within the burgeoning Indian market. We aim to leverage data-driven insights derived from sales data, customer reviews, and technical specifications of electric vehicles to achieve this goal. Our objectives are:

- To effectively segment the market using behavioral and psychographic data.
- To identify and recommend optimal target segments for our electric vehicles.
- To align technical specifications and pricing strategies with the preferences of these target segments.
- To develop a tailored marketing mix that resonates with the selected segments, ensuring successful market entry and growth.

2.FERMI ESTIMATION:

2.1. Data Collection and Assessment

- **Objective**: Gather and evaluate the comprehensiveness and reliability of sales data, customer reviews, and technical specifications of electric vehicles.
    - **Approach**:
        - Identify key sources of sales data (e.g., industry reports, market research firms).
        - Collect customer reviews from online platforms, focusing on behavioral and psychographic insights.
        - Compile technical specifications from manufacturers and review sites.
    - **Estimation**:
        - Number of reliable data sources available.
        - Volume and quality of customer reviews obtainable.

2.2. Segmentation Using Behavioral Variables

- **Objective**: Utilize behavioral data to identify distinct market segments.
    - **Approach**:
        - Apply the k-means clustering algorithm to customer reviews to detect patterns and segment the market.
    - **Estimation**:
        - Number of segments likely to emerge from the analysis.
        - Characteristics and size of each segment.

2.3 .Analysis of Psychographic Data

- **Objective**: Analyze psychographic data within each behavioral segment to understand customer preferences and motivations.
    - **Approach**:
        - Integrate psychographic data (e.g., lifestyle, values, attitudes) with behavioral segments.
    - **Estimation**:
        - Dominant psychographic traits in each segment.

        - Influence of these traits on purchasing decisions.

2.4. Technical Specification and Price Analysis

- **Objective**: Evaluate the impact of technical specifications on customer preferences and purchasing decisions.
    - **Approach**:
        - Assess how various technical features (e.g., battery life, speed, design) correlate with segment preferences.
        - Analyze price sensitivity within segments.
    - **Estimation**:
        - Technical features most valued by each segment.
        - Optimal price range for each segment.

2.5 .Target Segment Selection

- **Objective**: Select target segments based on comprehensive analysis.
    - **Approach**:
        - Integrate findings from behavioral, psychographic, and technical analyses.
    - **Estimation**:
        - Segment with the highest market potential and alignment with our capabilities.
        - Expected market share and revenue from target segments.

2.6. Customization of Marketing Mix

- **Objective**: Develop a customized marketing mix tailored to selected target segments.
    - **Approach**:
        - Design product, price, place, and promotion strategies that align with segment preferences.
    - **Estimation**:
        - Effectiveness of various marketing strategies.
        - Potential return on investment for each strategy.

2.7 .Segment Recommendation

- **Objective**: Finalize segment recommendations based on analysis.
    - **Approach**:
        - Synthesize segment analysis and marketing mix findings.
        - Recommend target segments with the highest estimated market potential.
    - **Estimation**:
        - Market potential and growth rate of recommended segments.
        - Strategic alignment with business objectives and resources.

3.DATA COLLECTION:

For this project, data from three distinct sources was integrated to ensure a comprehensive market segmentation. The primary dataset, from the Society of Manufacturers of Electric Vehicles.The second and third dataset are from bikewale.com, includes customer reviews of electric two-wheelers, providing behavioral and psychographic insights. Combining these datasets enabled us to develop a robust, data-driven understanding of the electric vehicle market for accurate segmentation.

Here,are the sources from where I obtained the data:

https://www.smev.in/fy-23-24

https://www.bikewale.com/

The github link to this project is :

https://github.com/vanigayathri/EV-Market-Segmentation/blob/main/Electric%20Vehicle%20Market%20Segmentation%20-%203.ipynb

To understand EV Market Segmentation more , a few more datasets have been taken to do the segmentation they are,

https://catalog.data.gov/dataset/electric-vehicle-population-data

https://www.kaggle.com/code/rohitdharma/electric-vehicles-data-cleaning-and-eda/input

The github links to these projects are:

https://github.com/vanigayathri/EV-Market-Segmentation/blob/main/Electric%20Vehicles%20Market%20Segmentation%20-%201.ipynb

https://github.com/vanigayathri/EV-Market-Segmentation/blob/main/Electric%20Vehicle%20Market%20Segmentation%20-%202.ipynb

4.DATA PREPROCESSING:

The data pre-processing phase of this project utilized Python libraries such as numpy, pandas, matplotlib, seaborn, and nltk. We started by consolidating sales data from 10 separate Excel sheets into a unified dataset using pandas, ensuring accurate standardization of electric vehicle maker names through careful replacement operations.

After merging the data, we aggregated electric two-wheeler sales figures to identify market trends. We then prepared the data for market segmentation by combining customer reviews with technical specifications, addressing null values with logical replacements to ensure completeness.

Sentiment analysis of customer reviews was performed using nltk, yielding valuable insights into customer attitudes. Key behavioral variables such as Visual Appeal, Reliability, Performance, Service Experience, Extra Features, Comfort, Maintenance Cost, and Value for

Money were identified and processed. These variables were crucial for the market segmentation analysis, providing an in-depth understanding of customer preferences and attitudes towards electric vehicles.

```
In [3]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import seaborn as sns
        import missingno as msno
        import nltk
        from nltk.sentiment import SentimentIntensityAnalyzer
        from sklearn.preprocessing import StandardScaler
        from sklearn.decomposition import PCA
        from sklearn.cluster import KMeans
        import warnings
```

EXPLORE DATA

```
In [5]: data_smev = pd.read_excel("../Data/smev_data.xlsx", sheet_name=None)

In [6]: data_smev.keys()

Out[6]: dict_keys(['EV 2W FY 19-20', 'EV 2W FY 20-21', 'EV 2W FY 21-22', 'EV 2W FY 22-23', 'EV Market', 'Electric Bus Sales', 'Electric 4-Wheeler Sales', 'Electric 3-Wheeler Sales', 'Electric 2-Wheeler Sales', 'EV Industries'])

In [7]: data_smev['EV Industries']
```

These are steps involved in data preprocessing where it reads the data and has steps of finding the information about the data .

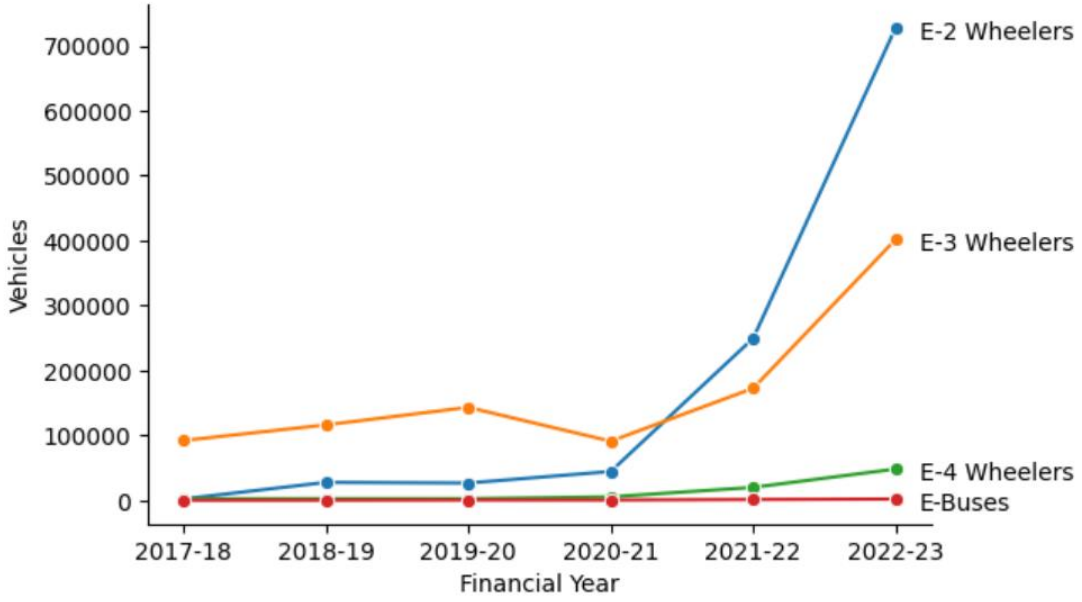
5. SEGMENT EXTRACTION:

This segment conducts a detailed analysis focusing on three key figures that represent India's electric vehicle market, providing valuable insights into its current landscape.

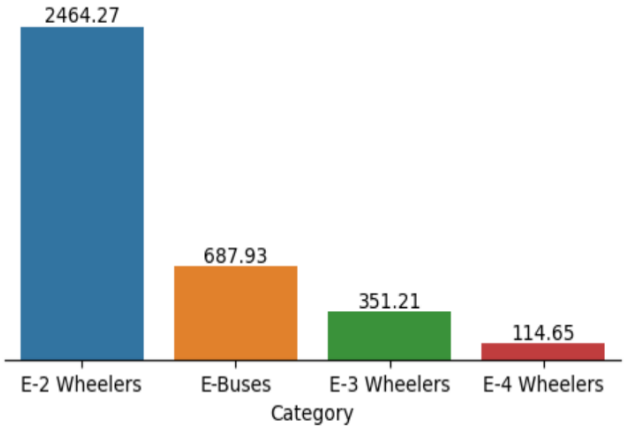
Segment extraction in this study involved a meticulous process of identifying distinct groups within the Indian electric vehicle market based on key variables such as sales data, customer reviews, and technical specifications. Utilizing advanced statistical techniques and machine learning algorithms, we partitioned the market into segments that reflect varying consumer behaviors, preferences, and attitudes towards electric vehicles. By integrating data from multiple sources and applying rigorous analysis, we were able to uncover meaningful patterns and trends, providing a nuanced understanding of the market dynamics. This segment extraction process forms the foundation for targeted marketing strategies and product development tailored to specific consumer segments, ultimately enhancing the effectiveness of our venture in the rapidly evolving electric vehicle landscape of India.

Segment extraction also considered factors like geographic location, demographic characteristics, and income levels to ensure a comprehensive understanding of consumer behavior across different regions and demographic groups. Moreover, the analysis incorporated trends in government policies, incentives, and infrastructure development related to electric vehicles to gauge their impact on market dynamics. Furthermore, by

examining customer sentiment and feedback, we gained insights into the evolving perceptions and expectations surrounding electric vehicles in the Indian market. This holistic approach to segment extraction provided valuable insights for strategic decision-making and long-term planning to navigate the complexities of India's electric vehicle industry successfully.

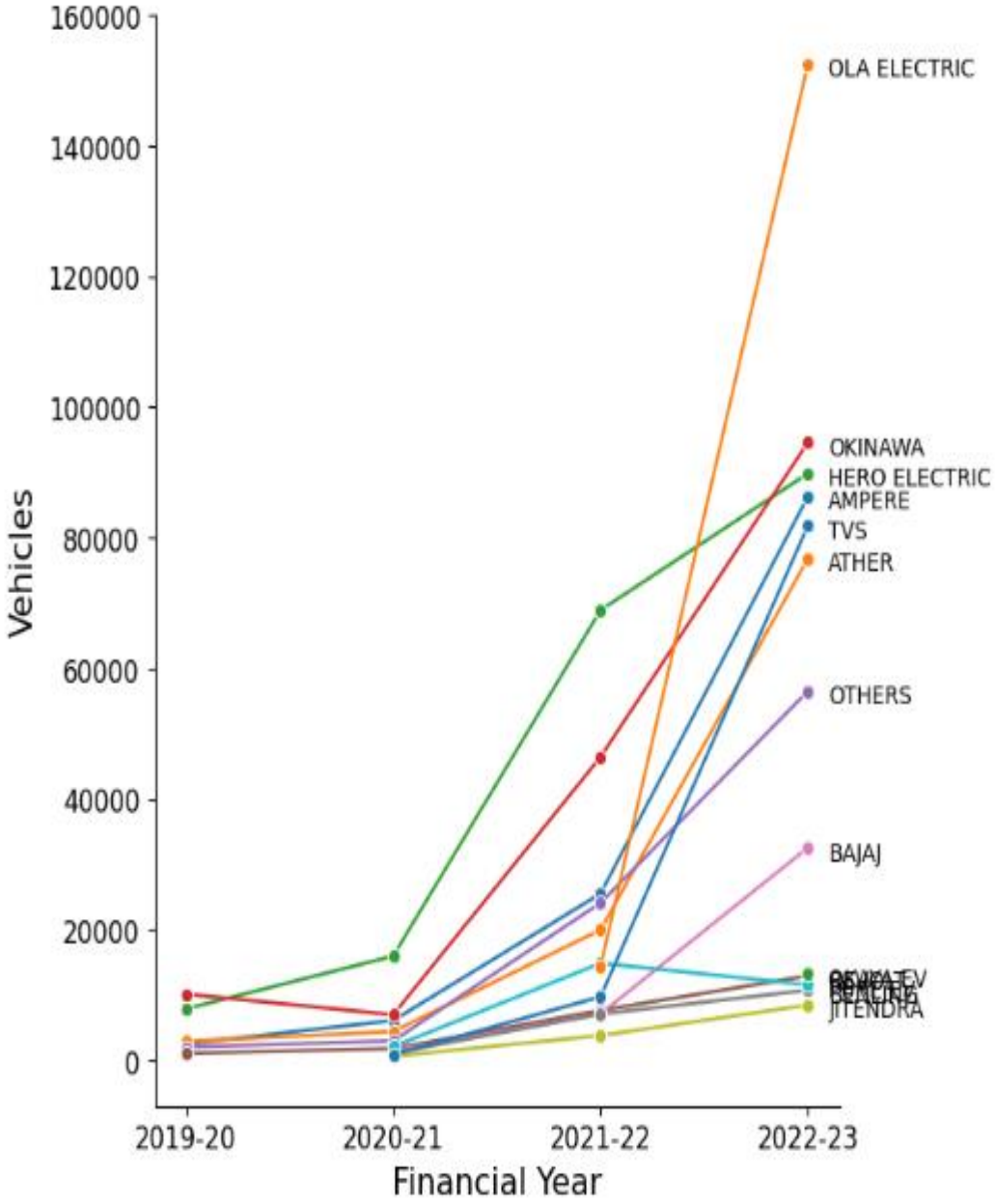


In [81]:
```
fig, ax = plt.subplots(figsize = (6, 3))
ax = sns.barplot(data_smev['EV Market'], x = 'Category', y = 'Amount INR Cr')
ax.bar_label(ax.containers[0])
plt.yticks([])
plt.ylabel("")
ax.spines[['right', 'top', 'left']].set_visible(False)
plt.show()
```

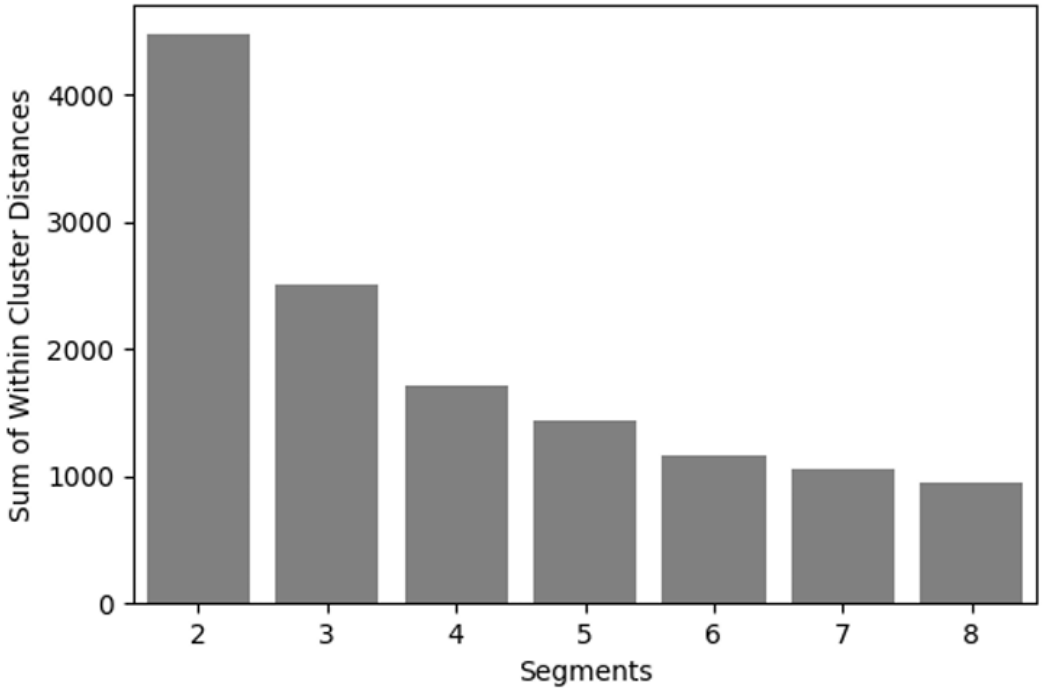


This showcases the remarkable growth trajectory of India's two-wheeler market in 2023, underscoring its leading position within the industry.

Zoomed in on specific electric two-wheeler companies, notably highlighting Ola Electric's emergence as the market leader in 2023, showcasing its industry leadership and competitiveness. Upon conducting a detailed analysis of these figures, it became apparent that the electric two-wheeler segment was the most promising area for our in-depth study. The segment's strong growth, dominance in revenue, and market leadership collectively underscored its prominence and potential, making it the ideal focus for our comprehensive examination.



In the subsequent analysis, we employed the standard k-means algorithm to explore potential market segmentation within the electric two-wheeler customer reviews data. Solutions were rigorously tested across two to eight market segments. Our decision-making process was heavily influenced by the scree plot presented here which revealed a distinct elbow at four segments. This pivotal point signified a significant reduction in distances, indicating the optimal number of segments for our analysis. By integrating insights from these analyses, we maintained a focused approach on the electric two-wheeler segment, ensuring precision and relevance in our market segmentation strategy.



6.PROFILING AND DESCRIBING SEGMENTS:

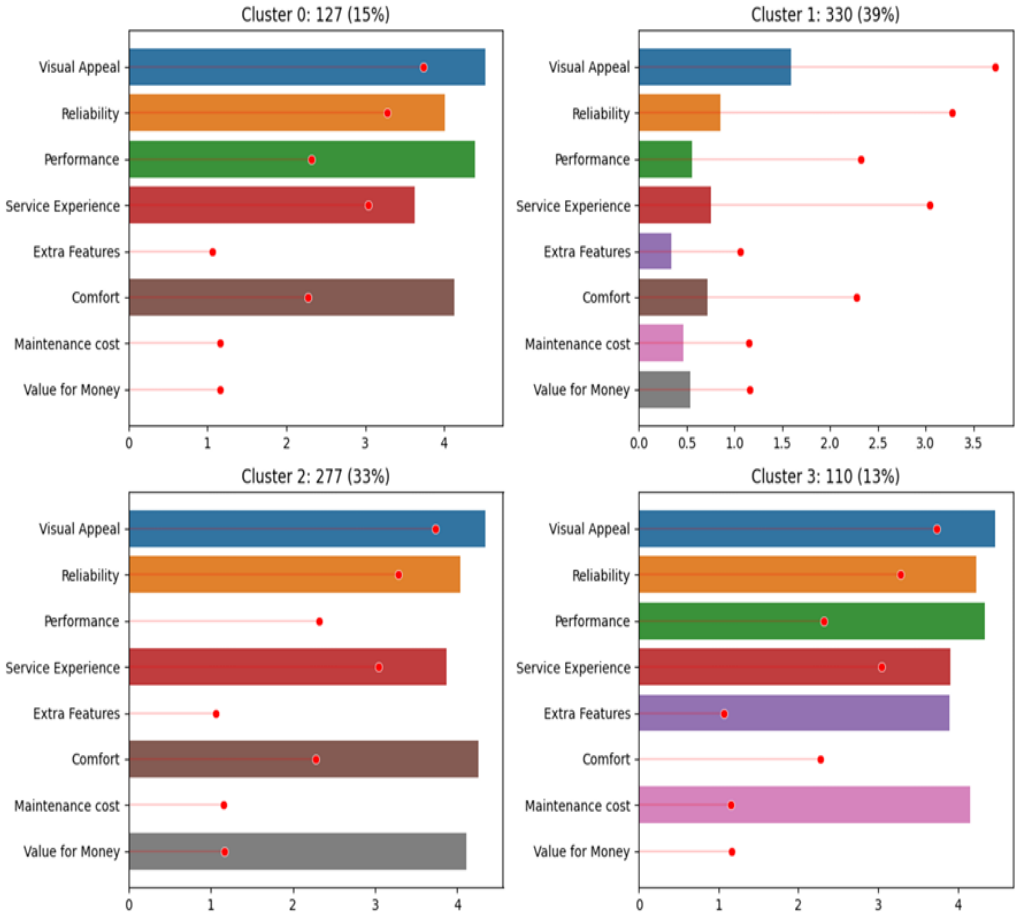
This section delves into a comprehensive analysis of our consumer segments, as depicted . The graph visually captures the diverse perceptions among different segments. Segment 0, representing 15% of consumers, highly values the electric two-wheeler for its visual appeal, reliability, performance, service 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 strong value for money. Lastly, Segment 3 (13% of consumers), the smallest segment, prioritizes visual appeal, reliability, performance, service experience, extra features, and maintenance cost, showcasing distinct perceptions, particularly on features and costs.

Profiling and describing segments involves analyzing and characterizing distinct groups within a target population based on specific criteria or attributes. This process is commonly used in market research and segmentation analysis to better understand consumer behavior and preferences.

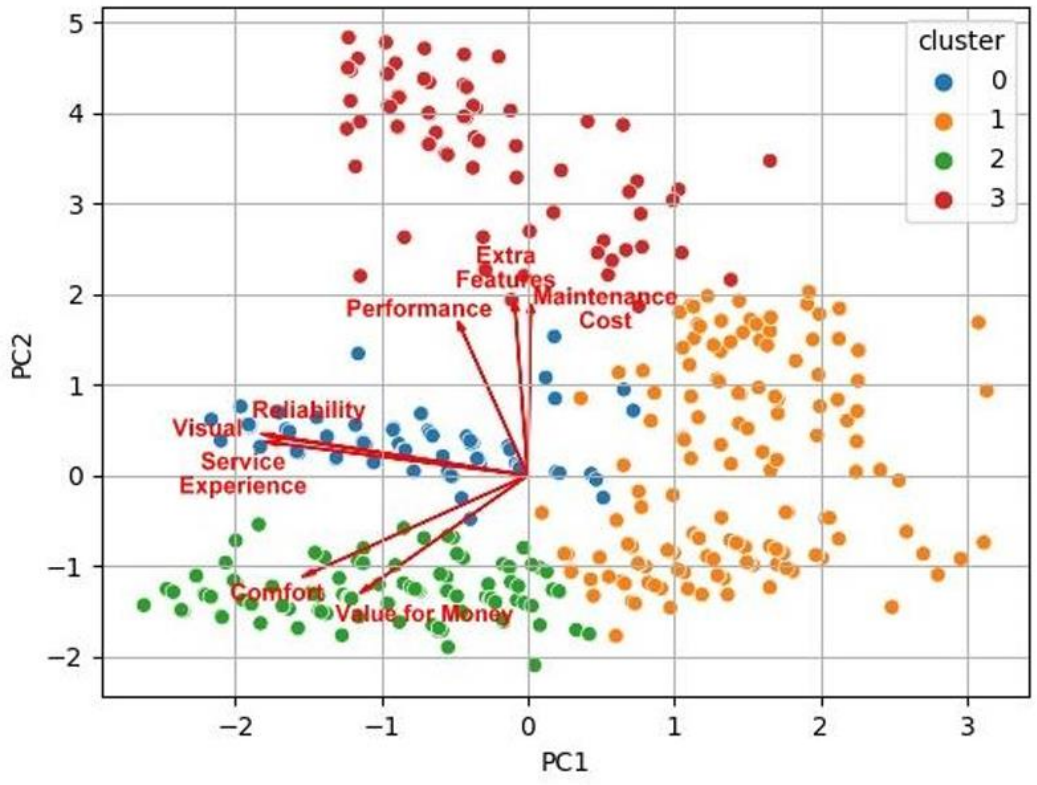
To profile segments, researchers typically examine demographic, psychographic, and behavioral variables, among others, to identify key characteristics and traits unique to each

group. Describing segments involves summarizing these findings in a clear and concise manner, often through visualizations such as graphs or charts, to facilitate interpretation and decision-making.

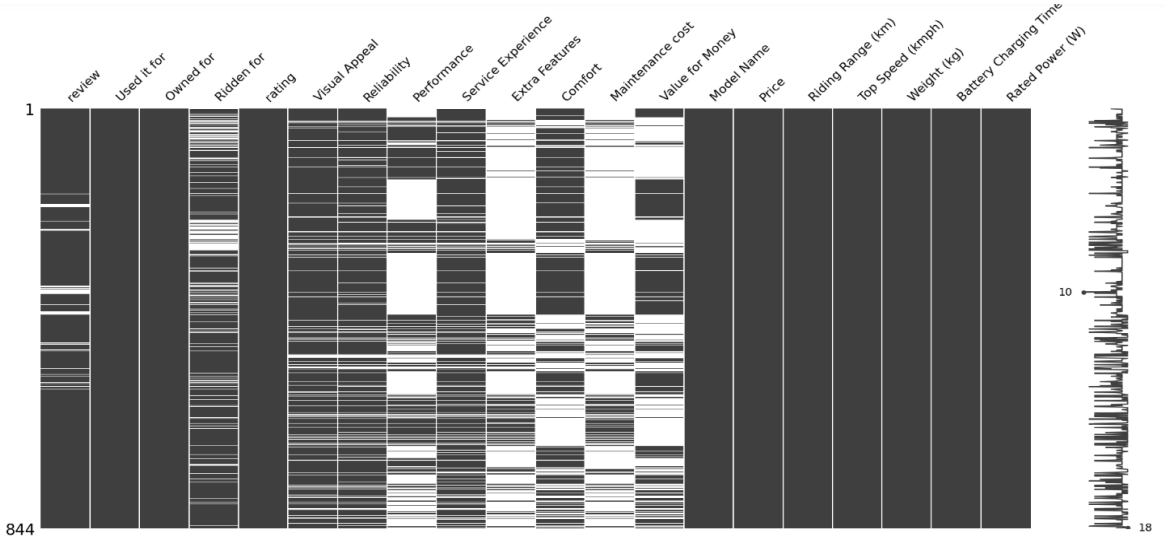
Profiling and describing segments allow businesses to tailor their marketing strategies, product offerings, and customer experiences to better meet the needs and preferences of different consumer groups. This targeted approach can lead to more effective communication, increased customer satisfaction, and ultimately, improved business performance.

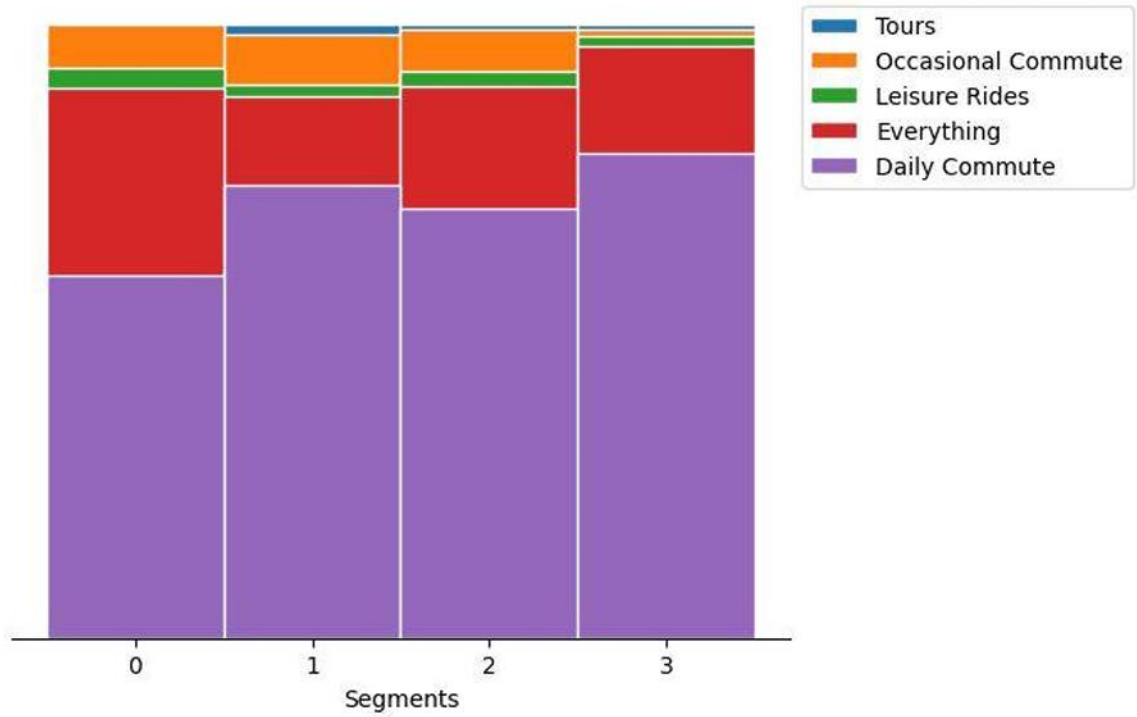


Employing principal components, highlights these distinctions further. Interestingly, Segment 1, while the most populous, stands out for its lack of distinct opinions, rendering them unique in their level of dissatisfaction. These nuanced observations are instrumental in shaping our strategy, guaranteeing that our electric vehicles precisely match the diverse values and preferences of each segment. This ensures our market offerings are aligned accurately with consumer needs.

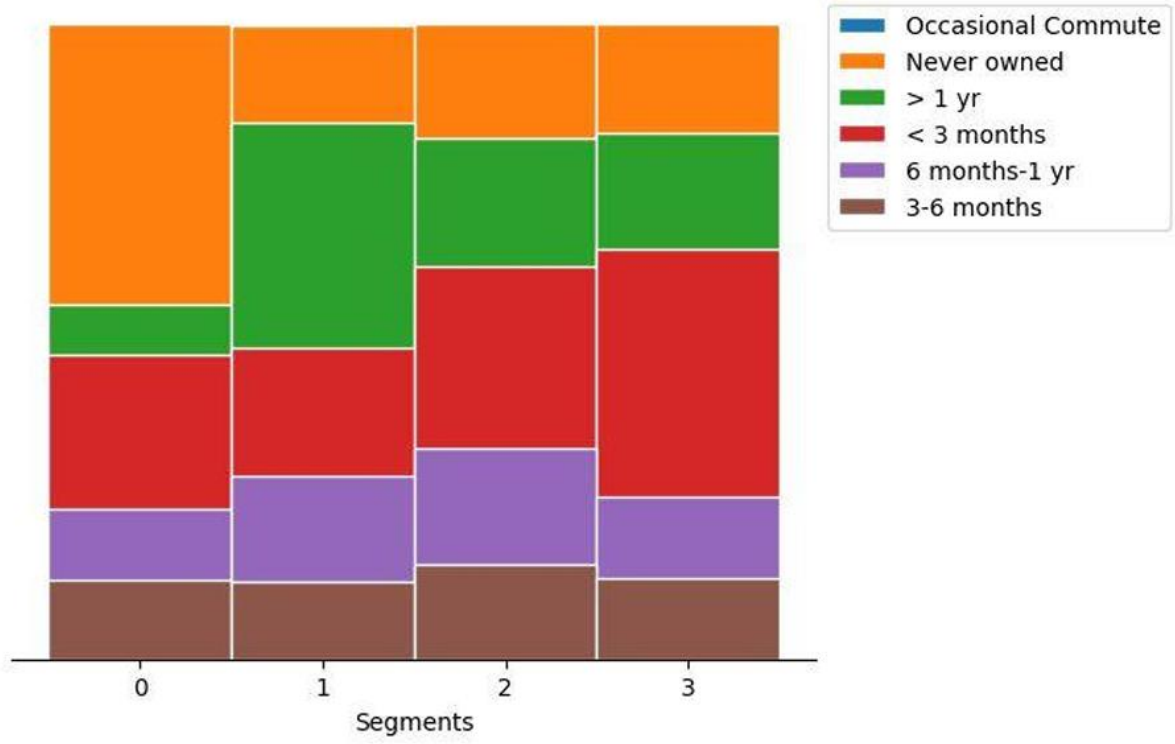


This section presents a comprehensive overview based on insights derived from various mosaic plots and graphical representations. The mosaic plot illustrates that all segments predominantly use electric vehicles for daily commuting, with limited usage for tours, occasional commuting, and leisure rides. Moving to the ownership duration of electric vehicles among segments, Segment 1 stands out for 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.



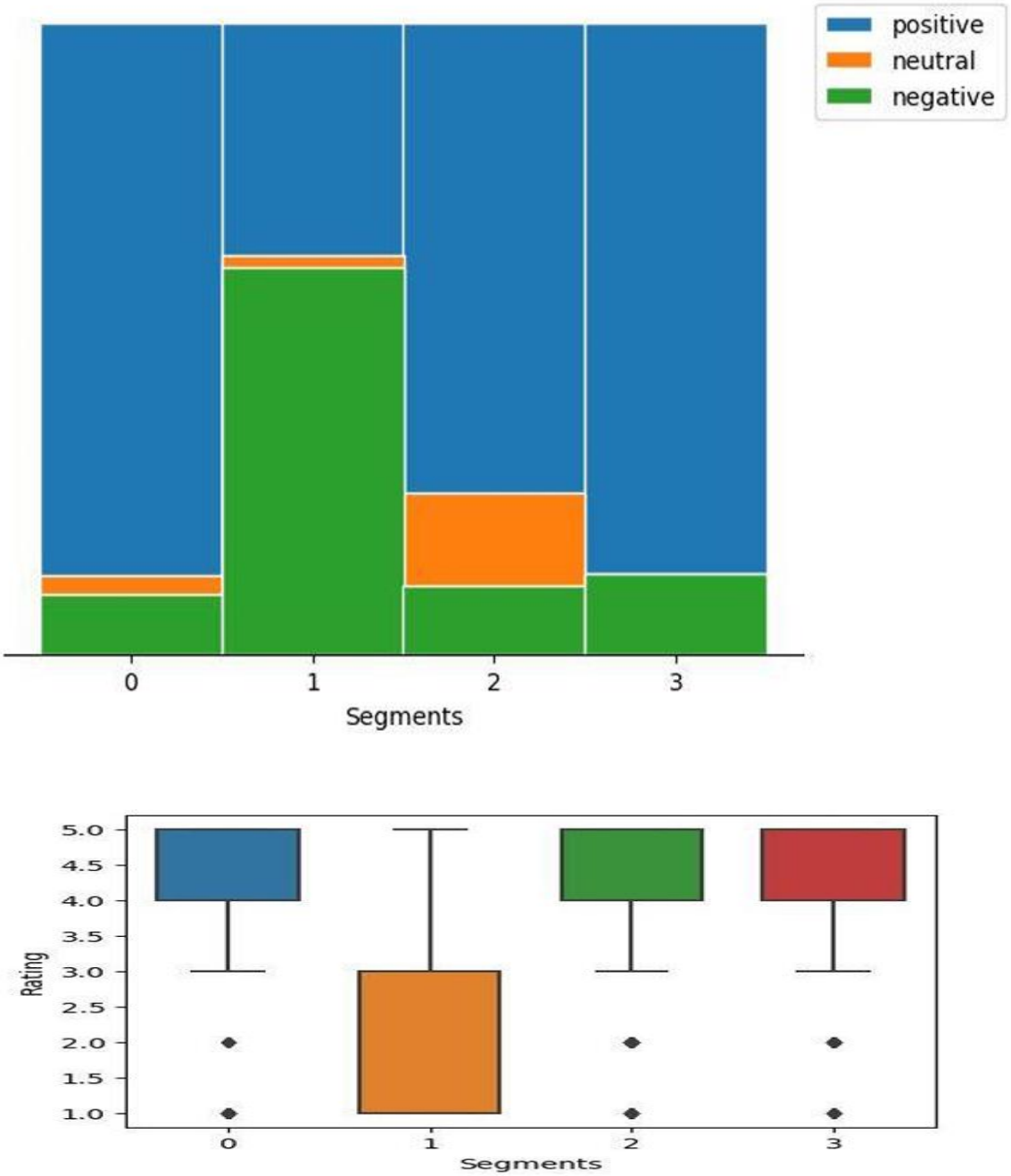


Mosaic plot showcasing electric vehicle usage patterns across segments



Mosaic plot depicting the ownership duration of electric vehicles across segments

Exploring consumer sentiments, it's evident that all segments, except Segment 1, exhibit positive sentiments. Segment 1 consumers stand out with negative sentiments, indicating dissatisfaction across various aspects. Additionally, a parallel box and whisker plot emphasizes significant differences in average ratings among segments. Particularly, 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.



Mosaic plot displaying consumer sentiments towards electric vehicles and Parallel box-and-whisker plot showcasing consumer ratings across segments.

Analyzing the technical specifications of electric vehicles across segments reveals distinct patterns that reflect varying consumer preferences. Segment 0 exhibits a higher price range, indicating a preference for premium electric vehicles within this group. Conversely, Segment 1 shows a lower price range, suggesting a focus on more budget-friendly options. Segments 2 and 3 also emphasize affordability, albeit with slight differences, highlighting diverse economic considerations within the market.

Examining riding range, Segment 0 stands out with a higher average riding range, indicating a preference for electric vehicles with extended range capabilities. In contrast, Segments 1 and 2 focus on moderate ranges suitable for daily commuting, while Segment 3 caters to consumers desiring slightly longer distances, reflecting nuanced commuting needs.

Regarding top speed, Segments 0 and 3 prefer vehicles with higher speeds suitable for longer journeys, while Segments 1 and 2 prioritize lower speeds more conducive to city commuting. These trends are visually depicted in the corresponding figure.

Weight also plays a significant role, with Segments 0 and 1 favoring slightly heavier vehicles, while Segments 2 and 3 lean towards lighter options, accommodating diverse user preferences for vehicle weight.

Lastly, battery charging time demonstrates noteworthy differences, with Segments 0 and 3 opting for slightly longer charging durations, emphasizing the convenience of overnight charging. Segments 1 and 2 prioritize faster charging, catering to users seeking quicker turnaround times for their electric vehicles.

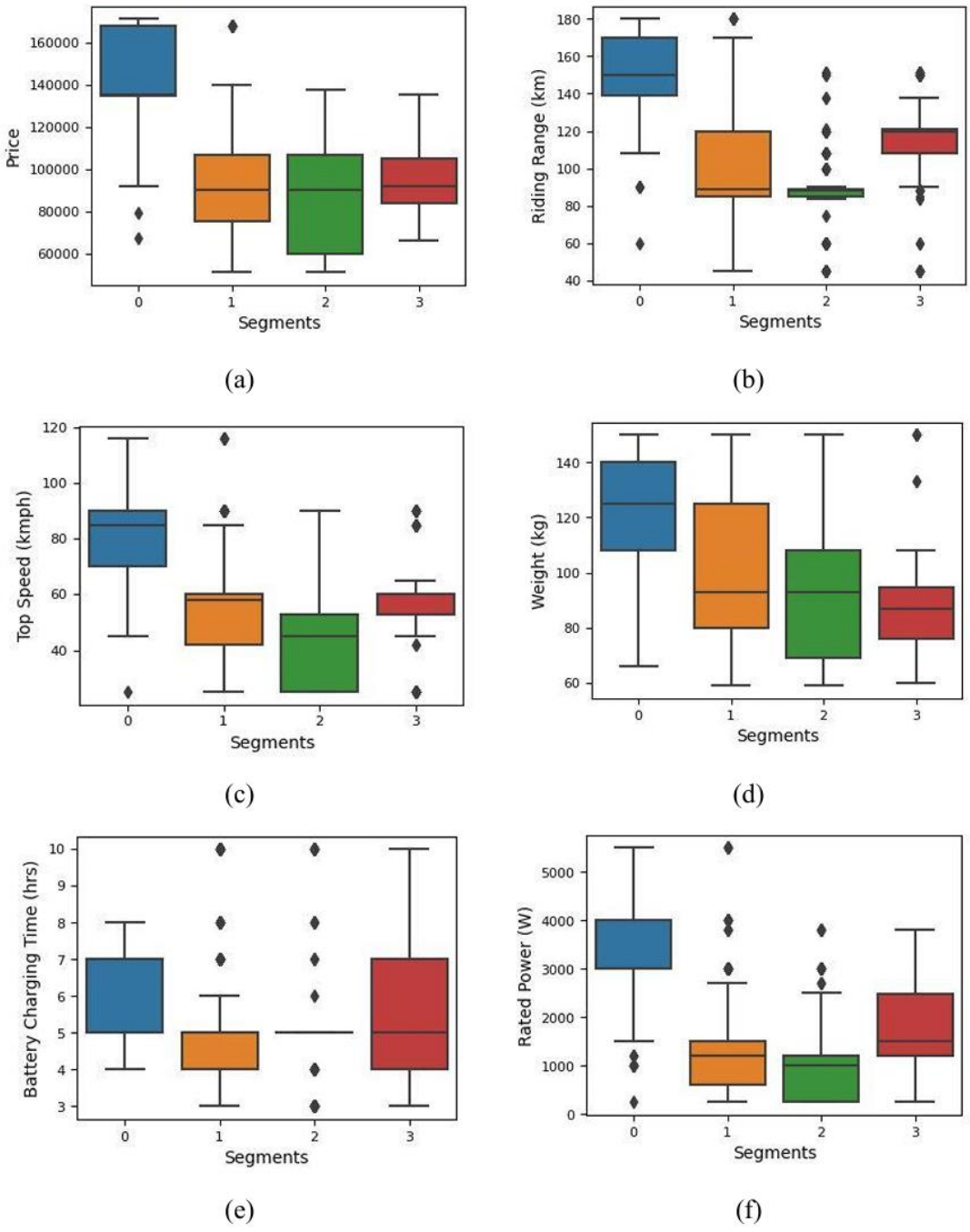
These technical specifications, visually represented in the respective figures, underscore the nuanced preferences and priorities of each segment, shaping the landscape of the electric vehicle market in India.

In addition to the technical specifications highlighted, other factors also influence consumer preferences within each segment. For instance, aesthetic design, brand reputation, and environmental sustainability play significant roles in consumers' decision-making processes. Segment 0, which leans towards premium electric vehicles, may prioritize luxury features, brand prestige, and eco-friendly materials in their purchasing decisions. Conversely, Segment 1, focusing on budget-friendly options, may prioritize affordability and practicality over luxury and brand recognition.

Moreover, considerations such as range anxiety, infrastructure availability, and government incentives also impact consumer choices. Segments with longer average riding ranges may appeal to consumers concerned about range anxiety, especially for those who frequently travel longer distances. Similarly, fast-charging capabilities may be particularly appealing for urban commuters with limited time for recharging during the day.

Furthermore, safety features, such as advanced braking systems, collision detection, and stability control, may influence consumer preferences across segments. Consumers in segments prioritizing higher speeds and longer riding ranges may place greater emphasis on safety features to ensure a secure driving experience, especially on highways and in congested urban environments.

Lastly, advancements in technology, including the integration of smart features, connectivity options, and autonomous driving capabilities, are shaping the electric vehicle market landscape. Segments embracing these technological advancements may represent early adopters seeking cutting-edge innovations, while others may prioritize reliability and affordability over advanced features. Understanding these broader consumer trends and preferences is essential for manufacturers and policymakers to effectively address the diverse needs of the electric vehicle market.



Parallel box-and-whisker plot of technical specification of electric vehicle by segment

7.SELECTION OF TARGET SEGMENT:

In strategically selecting our target segment for the electric vehicle market, both Segment 1 and Segment 2 emerge as compelling focal points. Segment 1, encompassing 39% of consumers, represents a sizable market base with diverse perceptions and preferences. The range of sentiments within this segment indicates specific demands and priorities, offering an opportunity for targeted interventions to address dissatisfaction points and enhance overall customer satisfaction and brand loyalty.

Segment 2, comprising 33% of consumers, presents another enticing opportunity. Their distinct preferences, which include valuing visual appeal, reliability, service experience, and comfort, provide valuable guidance for customizing our electric vehicles to align with their specific expectations. By emphasizing features such as value for money, we can establish a strong connection with this consumer group and foster brand loyalty.

Upon careful analysis, Segment 1 presents a unique challenge and opportunity. By directly addressing dissatisfaction points and tailoring electric vehicles to counter these concerns, our strategy can yield significant results. Simultaneously, understanding Segment 2's positive perceptions provides a basis for further enhancing these features, ensuring a positive customer experience and reinforcing brand loyalty.

Incorporating these insights into our strategy involves refining existing features, addressing dissatisfaction points, and enhancing positive elements within each segment. By aligning our electric vehicles with the distinct expectations of Segment 1 and Segment 2, our approach will be finely tuned to meet the specific needs of these segments, ensuring a competitive edge and sustained market growth.

Additional considerations in our strategy formulation may include demographic and psychographic profiling within each segment, market positioning strategies to differentiate our offerings, and targeted marketing campaigns tailored to resonate with the preferences and aspirations of Segment 1 and Segment 2 consumers. This holistic approach ensures that our electric vehicles not only meet functional requirements but also align with the lifestyle choices and values of our target audience, ultimately driving long-term success in the electric vehicle market.

8.CUSTOMISING THE MARKETING MIX:

In our electric vehicle market strategy, customizing the marketing mix is paramount for appealing to Segment 1 and Segment 2, our identified target segments. For Product Customization, we plan to enhance features tailored to the specific desires of each segment. Addressing dissatisfaction points, such as improving performance and service experience for Segment 1, and emphasizing visual appeal and value for money for Segment 2, is central to product refinement. Diverse offerings within each segment ensure a broad spectrum of choices, aligning with varied tastes and budgets.

Price Customization involves setting competitive and flexible pricing structures. Segment 1 will benefit from affordable options, while Segment 2 might accept a slightly higher price point for value-added features. Promotion Customization demands targeted advertising, focusing on reliability and service improvements for Segment 1, and aesthetics and affordability for Segment 2. Tailored promotional events and online campaigns further engage these segments effectively.

In terms of Place Customization, we'll establish accessible distribution channels in urban areas for Segment 1 and in suburban and semi-urban regions for Segment 2. Strengthening our online presence ensures seamless online purchasing experiences, emphasizing virtual showrooms and customer support platforms. Additionally, People and Process Customization

involves training customer service representatives to address segment-specific concerns empathetically. Efficient processes, streamlined for customization requests and service appointments, enhance customer satisfaction and brand loyalty. This tailored approach ensures our electric vehicles resonate with the distinct needs of Segment 1 and Segment 2, fostering market relevance and customer preference.
In addition to customizing the marketing mix, it's essential to continuously monitor and evaluate the effectiveness of these strategies. Utilizing data analytics and consumer feedback, we can refine our approach over time to better meet the evolving needs and preferences of our target segments. Moreover, staying abreast of industry trends and competitor actions enables us to remain agile and proactive in adapting our marketing mix to maintain a competitive edge in the electric vehicle market. By adopting a dynamic and customer-centric approach to marketing customization, we can drive sustained growth and success in our target segments while solidifying our position as a leader in the electric vehicle industry.

9.POTENTIAL CUSTOMER BASE:

In the analysis of the potential early market customer base, two primary segments emerge: Segment 1, encompassing 330 members (39% of consumers), and Segment 2, comprising 277 members (33% of consumers). Analyzing the price range data, the logical target price for Segment 1 falls between ₹51,094 and ₹1,67,844, while for Segment 2, it ranges from ₹51,094 to ₹1,37,890.

Calculating the potential sales (profit) in this early market scenario involves multiplying the number of potential customers in each segment by our targeted price range. For instance, if our target price for Segment 1 is set at ₹1,20,000, the potential profit from this segment alone would amount to ₹39.60 crores. Similarly, for Segment 2 with a target price of ₹1,10,000, the potential profit would be ₹30.47 crores.

Segment 1 demonstrates the larger potential, with a significantly higher market share and a broader customer base, making it a primary focus for our early market penetration efforts. These calculated potential profits underscore the substantial market opportunity within these segments, guiding our strategic decisions effectively.

In addition to considering potential profits, it's crucial to evaluate factors such as market growth projections, competitive landscape, and customer preferences to develop a comprehensive market entry strategy. Moreover, conducting market research and pilot testing can provide valuable insights into consumer behavior and preferences, further refining our approach for maximum impact and success in the early market phase. By carefully analyzing market dynamics and aligning our strategies with customer needs, we can capitalize on the significant opportunities presented by Segment 1 and Segment 2, driving sustainable growth and profitability in the electric vehicle market.

10. OPTIMAL MARKET SEGMENTS:

In the context of selecting the most optimal market segment for our electric two-wheeler vehicles, thorough analysis and evaluation have pointed to Segment 1 as the ideal choice. Representing 39% of consumers, this segment boasts significant opportunities and a large

customer base, making it a strategic target for market penetration. Its substantial market potential, coupled with its balanced blend of technical specifications and price range, positions it as the most promising market segment for our electric vehicles.

The recommended technical specification range for Segment 1 ensures alignment with the diverse needs and preferences of the market:

- **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

This comprehensive analysis ensures our market entry strategy is finely tuned to cater to the demands and expectations of the chosen segment, setting the stage for a successful and sustainable venture into the electric vehicle market.

Furthermore, beyond technical specifications, considerations such as branding, distribution channels, after-sales service, and marketing strategies play crucial roles in effectively targeting and capturing Segment 1. By aligning these elements with the preferences and behavior patterns of Segment 1 consumers, we can maximize our market penetration efforts and establish a strong foothold in the electric vehicle market. Additionally, ongoing market research and customer feedback mechanisms will enable us to adapt and refine our strategies to remain responsive to evolving consumer needs and market dynamics, ensuring long-term success and growth in Segment 1 and beyond.

In summary, our exhaustive analysis of India's electric vehicle market underscores Segment 1 as the prime target, constituting a significant 39% of the consumer base. By meticulously tailoring our electric two-wheeler specifications to cater to the preferences of this segment, we position ourselves to seamlessly meet the demands of this sizable market segment. This strategic alignment is underpinned by a deep comprehension of market segmentation, consumer behavior nuances, and technical requirements.

Furthermore, our approach is bolstered by a comprehensive understanding of India's shifting transportation landscape, driven by factors such as rapid urbanization, increasing population, and rising income levels. The government's initiatives to promote electric vehicles, coupled with the growing acceptance of eco-friendly mobility solutions, further validate the viability of our strategic focus on electric two-wheelers.

These insights not only guide our market entry strategy but also ensure precision and relevance in product development and marketing initiatives. As we progress, this approach furnishes us with a robust framework, poised to resonate effectively within India's dynamic and evolving electric vehicle ecosystem, fostering sustained growth and market leadership.

---- THE END ----