

Market Segmentation

“Analyzing the electric vehicle market with a primary focus on the two-wheeler segment, we aim to segment the market effectively to place our product in a segment that will yield considerable profit.”

by

Aayush Garg

Overview

The electric vehicle (EV) market in India is experiencing rapid growth, driven by increasing environmental awareness, government policies, and technological advancements. With a focus on reducing carbon emissions and dependence on fossil fuels, India is making significant strides toward electrification in transportation.

The Indian government has introduced several initiatives to promote the adoption of electric vehicles. Key policies include the FAME II (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) Scheme, launched in 2019, which aims to promote EV adoption through subsidies for electric two-wheelers, three-wheelers, four-wheelers, and buses, while also focusing on establishing charging infrastructure across the country. The National Electric Mobility Mission Plan (NEMMP) envisions achieving 6-7 million sales of hybrid and electric vehicles annually in the coming years. Additionally, various states have introduced their own incentives, such as subsidies, tax exemptions, and rebates to encourage EV adoption.

In terms of market segmentation, the two-wheeler segment is a major focus due to its dominance in India's vehicle population. Electric scooters and motorcycles are gaining popularity, especially in urban areas. The four-wheeler segment, which includes electric cars and commercial vehicles, is limited but growing, with increasing offerings from both domestic and international manufacturers. The three-wheeler segment, encompassing electric rickshaws (e-rickshaws) and auto-rickshaws, is significant for last-mile connectivity and urban transport. Additionally, the commercial vehicle segment, including electric buses and light commercial vehicles, is driven by public transport needs and logistics sectors.

Key players in the Indian EV market include domestic manufacturers like Hero Electric, Ather Energy, Ola Electric, TVS, and Bajaj Auto, as well as international manufacturers such as Tesla, MG Motors, Hyundai, and Tata Motors.

Despite the growth potential, the market faces several challenges. Inadequate charging infrastructure remains a major barrier to widespread adoption. The high initial cost of EVs, despite subsidies, is another significant hurdle compared to conventional vehicles. Additionally, battery technology limitations, such as limited range and longer charging times, need improvement. Educating consumers on the benefits and practicality of EVs is also crucial for wider adoption.

However, there are numerous opportunities in the Indian EV market. Technological advancements, especially in battery technology and range, promise to make EVs more practical and affordable. Rapid urbanization and increasing pollution levels in cities drive the demand for cleaner transportation solutions. Continued and enhanced government policy support and incentives, along with growing interest from investors and automotive companies in the EV sector, further bolster the market's potential.

In conclusion, the electric vehicle market in India is poised for significant growth, particularly in the two-wheeler segment. Government policies, increasing environmental awareness, and technological advancements are key drivers. Addressing challenges such as infrastructure development, cost, and consumer awareness will be essential to unlock the full potential of the market.

Problem Statement:

To identify and target the most promising customer segments for our EV two-wheelers in the Indian market through detailed segmentation analysis, considering the limitations and availability of various data categories, to formulate a feasible market entry strategy.

Sales Data:

Sales data covering electric vehicles from 2017 to 2024 has been sourced from the Society of Manufacturers of Electric Vehicles. The dataset encompasses sales figures for electric two-wheelers, three-wheelers, four-wheelers, and buses, offering a detailed perspective on market dynamics and consumer choices throughout the specified period.

```
>> data_smev = pd.read_excel("2w_data.xlsx", sheet_name=None)
```

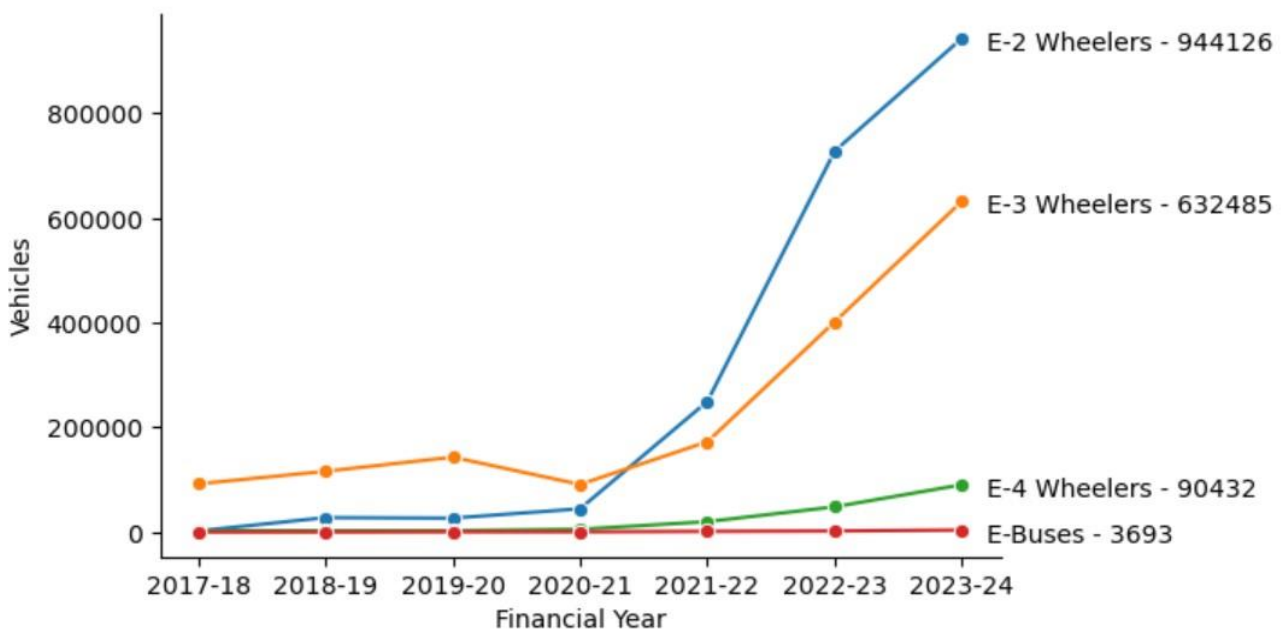


Fig 1: Electric vehicle sales with respect to financial years.

The presented above figure highlights the significant growth path of **India's two-wheeler market in 2024**, emphasizing its dominant position in the industry with the recorded sale of **944126**.

- The details of demand incentives provided under the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles in India (FAME) scheme Phase-II until October 2022, categorized as follows, are:

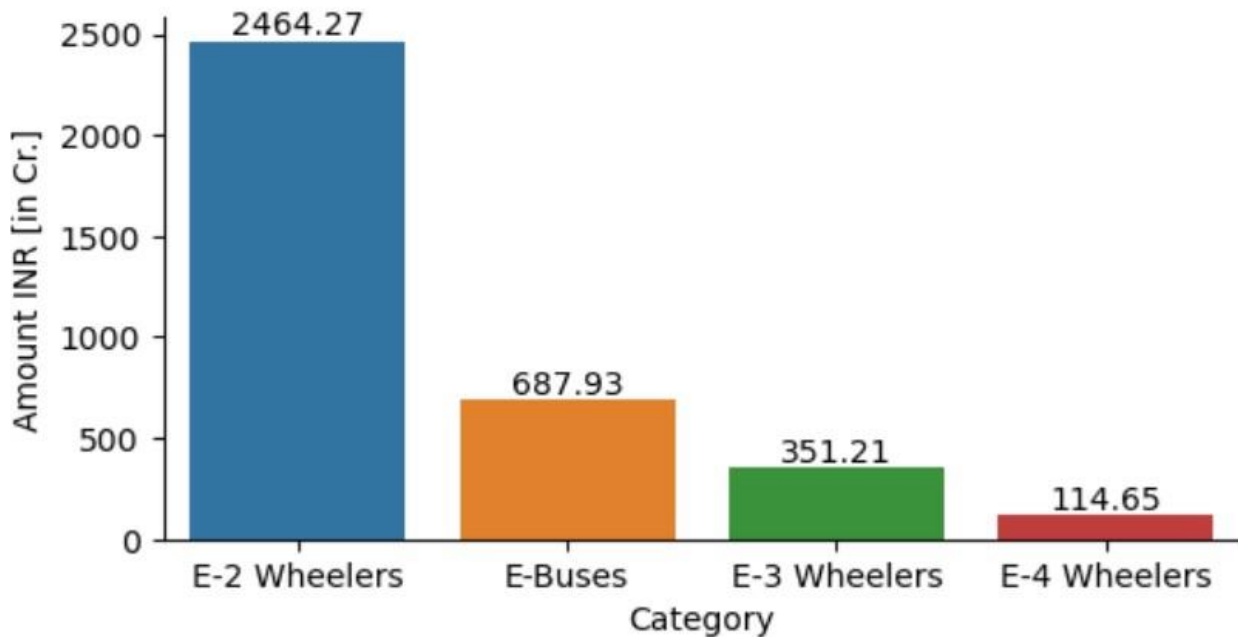


Fig 2: Incentives provided under the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles in India (FAME) scheme Phase-II until October 2022.

The Above figure delves into the financial aspect of the market, illustrating the industry's total value in crores. Particularly, **two-wheelers emerged as the principal revenue contributors with 2464.27 Cr. according to the Society of Manufacturers of Electric Vehicles 2022 report**, underscoring their economic importance.

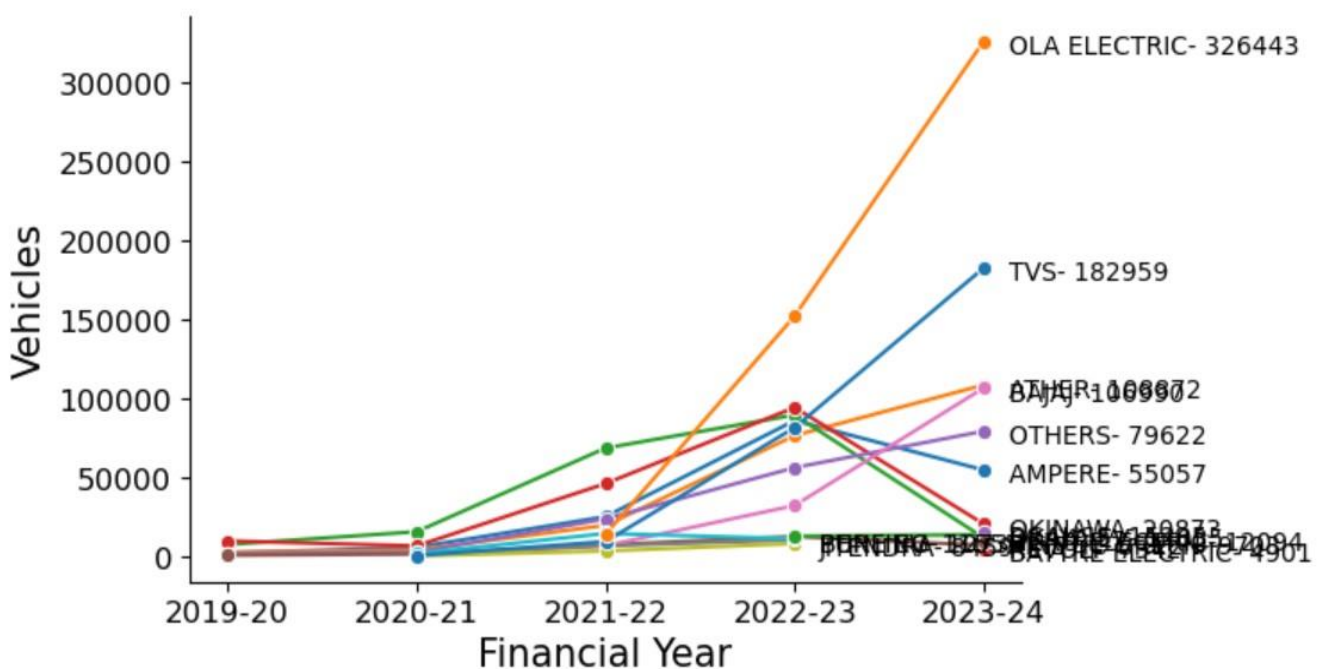


Fig 3: figure shows the vehicles sales for a particular maker w.r.t financial years.

The above figure focused on individual electric two-wheeler companies, highlighting **Ola Electric's** dominance as the market leader with the **highest recorded sale of 3,26,443 in the 2023-24 financial year**. This underscores their industry leadership and competitiveness in the market.

Analysis and Approaches used for Segmentation:

Clustering

Clustering is one of the most common exploratory data analysis techniques used to get an intuition about the structure of the data. It can be defined as the task of identifying subgroups in the data such that data points in the same subgroup (cluster) are very similar while data points in different clusters are very different. In other words, we try to find homogeneous subgroups within the data such that data points in each cluster are as similar as possible according to a similarity measure such as euclidean-based distance or correlation-based distance. The decision of which similarity measure to use is application-specific. Clustering analysis can be done on the basis of features where we try to find subgroups of samples based on features or on the basis of samples where we try to find subgroups of features based on samples.

K Means Algorithm

K Means algorithm is an iterative algorithm that tries to partition the dataset into pre-defined distinct non-overlapping subgroups (clusters) where each data point belongs to only one group. It tries to make the intra-cluster data points as similar as possible while also keeping the clusters as different (far) as possible. It assigns data points to a cluster such that the sum of the squared distance between the data points and the cluster's centroid (arithmetic mean of all the data points that belong to that cluster) is at the minimum. The less variation we have within clusters, the more homogeneous (similar) the data points are within the same cluster. The way k means algorithm works is as follows:

1. Specify number of clusters K.
2. Initialize centroids by first shuffling the dataset and then randomly selecting K data points for the centroids without replacement.
3. Keep iterating until there is no change to the centroids. i.e assignment of data points to clusters isn't changing.

The approach k-means follows to solve the problem is expectation maximization. The E-step is assigning the data points to the closest cluster. The M-step is computing the centroid of each cluster.

Applications

K means algorithm is very popular and used in a variety of applications such as market segmentation, document clustering, image segmentation and image compression, etc. The goal usually when we undergo a cluster analysis is either:

1. Get a meaningful intuition of the structure of the data we're dealing with.
2. Cluster-then-predict where different models will be built for different subgroups if we believe there is a wide variation in the behaviors of different subgroups.

Data Collection:

The dataset utilized for market segmentation analysis, sourced from bikewale.com, includes customer reviews of electric two-wheelers, providing essential behavioral and psychographic insights. Additionally, it provides comprehensive technical specifications and pricing details for electric two-

wheelers. This dataset enabled us to evaluate the technical feasibility and price points essential for our market segmentation strategy.

```
data_bw = pd.read_csv("ev2w_bikewale.csv")
data_model = pd.read_csv("ev2w_model_spec.csv")
```

```
data = data_bw.join(data_model.set_index('Model Name'), on='Model Name', how='left')
```

```
data.shape
```

```
(844, 20)
```

```
data.head()
```

	review	Used it for	Owned for	Ridden for	rating	Visual Appeal	Reliability	Performance	Service Experience	Extra Features	Comfort	Maintenance cost	Value for Money	Model Name	Price	Riding Range (km)
0	We all checked the bike's capacity to be 150 k...	Daily Commute	Never owned	NaN	1	3.0	4.0	NaN	NaN	NaN	4.0	NaN	1.0	TVS iQube	137890	100
1	Performance is very poor on this bike. The cha...	Everything	> 1 yr	< 5000 kms	1	3.0	1.0	NaN	1.0	NaN	3.0	NaN	3.0	TVS iQube	137890	100
2	I purchased this in April 2022 and the sales s...	Daily Commute	< 3 months	< 5000 kms	3	4.0	4.0	NaN	2.0	NaN	5.0	NaN	2.0	TVS iQube	137890	100
3	If any issues come in scooty parts not availab...	Daily Commute	6 months-1 yr	5000-10000 kms	1	1.0	1.0	NaN	1.0	NaN	1.0	NaN	1.0	TVS iQube	137890	100

Data Pre-processing:

Finding the null values using below code.

```
((data.isna().mean()) * 100).sort_values(ascending=False)
```

```
Maintenance cost          78.672986
Extra Features             78.080569
Performance               59.123223
Value for Money           53.791469
Comfort                   37.203791
Ridden for                20.853081
Service Experience        16.706161
Reliability               15.165877
Visual Appeal             12.440758
review                    5.568720
Used it for                0.000000
rating                    0.000000
Owned for                 0.000000
Model Name                0.000000
Price                     0.000000
Riding Range (km)         0.000000
Top Speed (kmph)          0.000000
Weight (kg)               0.000000
Battery Charging Time (hrs) 0.000000
Rated Power (W)           0.000000
dtype: float64
```

We need to determine the sentiments of customers from the given reviews. By using the TextBlob library, we can identify the sentiment of each review as positive, negative, or neutral.

```
from textblob import TextBlob

def get_sentiment(review_text):
    if pd.isna(review_text):
        return 'neutral'
    blob = TextBlob(review_text)
    polarity = blob.sentiment.polarity
    if polarity > 0:
        return 'positive'
    elif polarity < 0:
        return 'negative'
    else:
        return 'neutral'

data['sentiment'] = data['review'].apply(lambda x: get_sentiment(x))

data['sentiment'].value_counts()
```

Output:

Sentiment:- Positive - 587, Negative - 205, Neutral – 52

Extracting the most important features that affect the analysis and fill the null values to standardized the data.

```
data_segment = data.iloc[:, 5:13].copy()
```

```
data_segment.head()
```

	Visual Appeal	Reliability	Performance	Service Experience	Extra Features	Comfort	Maintenance cost	Value for Money
0	3.0	4.0	NaN	NaN	NaN	4.0	NaN	1.0
1	3.0	1.0	NaN	1.0	NaN	3.0	NaN	3.0
2	4.0	4.0	NaN	2.0	NaN	5.0	NaN	2.0
3	1.0	1.0	NaN	1.0	NaN	1.0	NaN	1.0
4	3.0	4.0	NaN	1.0	NaN	3.0	NaN	2.0

Above data is having some null values. Next step is to handling the null values.

```
data_segment = data_segment.fillna(0.)
```

```
data_segment.info()
```

```
data_segment.head()
```

	Visual Appeal	Reliability	Performance	Service Experience	Extra Features	Comfort	Maintenance cost	Value for Money
0	3.0	4.0	0.0	0.0	0.0	4.0	0.0	1.0
1	3.0	1.0	0.0	1.0	0.0	3.0	0.0	3.0
2	4.0	4.0	0.0	2.0	0.0	5.0	0.0	2.0
3	1.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0
4	3.0	4.0	0.0	1.0	0.0	3.0	0.0	2.0

Segmentation:

Using K-means:

We can use the Elbow method to find the optimum K value.

For this our plot is something like this.

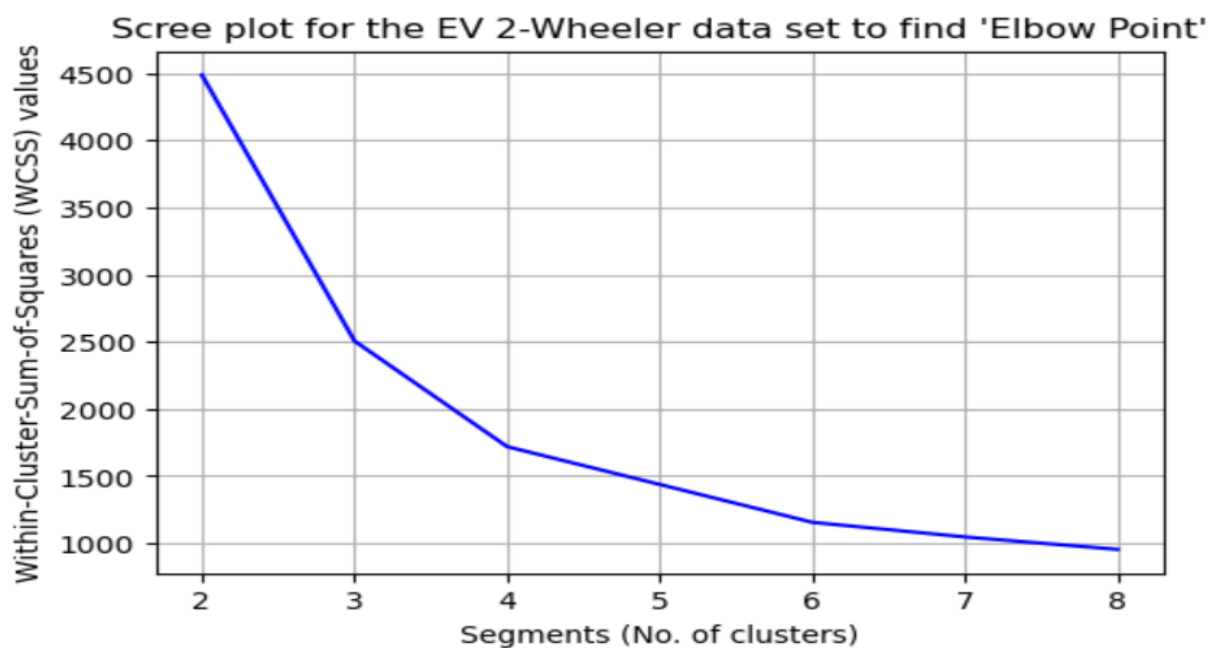
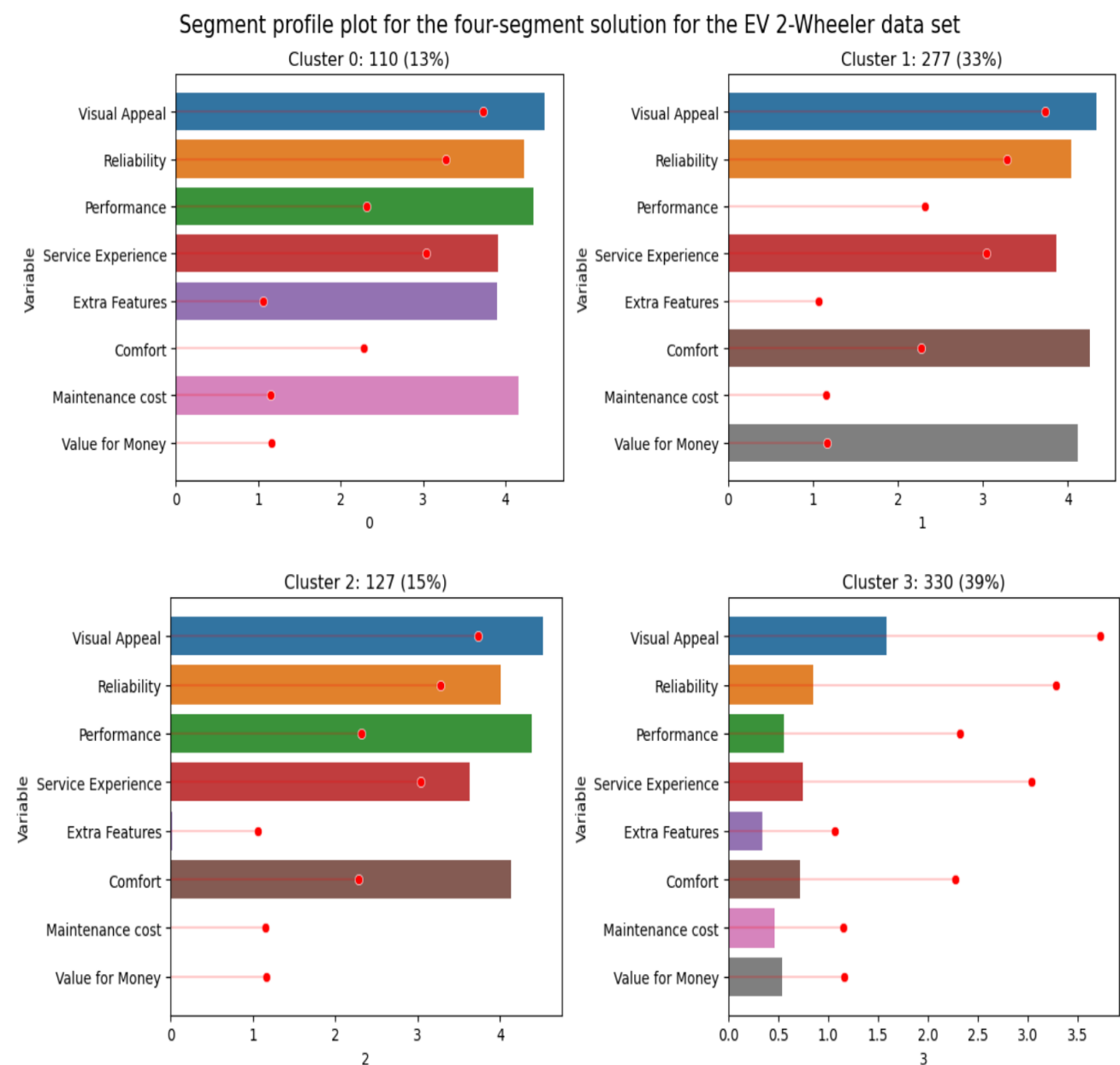


Fig: Scree plot to get segmentation.

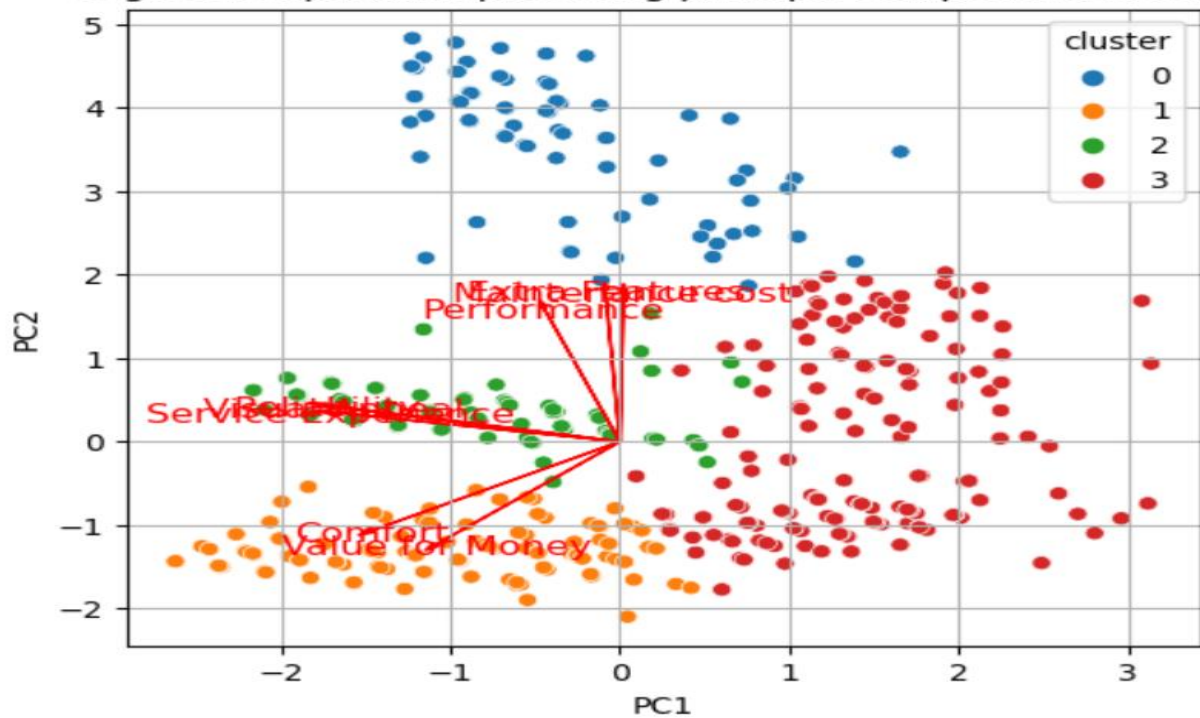
The decision-making process heavily relied on the insights gained from the scree plot depicted above. It unveiled a noticeable elbow at four segments, indicating a substantial decrease in distances. This pivotal point suggested the optimal number of segments for our analysis.

Profiling Segment:



The visual representation above encapsulates the varying perspectives among different segments. Beginning with Segment 0, the smallest group comprising 13% of consumers, there is a notable appreciation for visual appeal, reliability, performance, service experience, extra features, and maintenance cost. Moving to Segment 1, representing 33% of consumers, there is a similar appreciation for visual appeal, reliability, service experience, and comfort, with a significant emphasis on perceiving strong value for money. Segment 2, comprising 15% of consumers, places high value on visual appeal, reliability, performance, service experience, and comfort. Conversely, Segment 3, the largest segment consisting of 39% of consumers, expresses dissatisfaction across all aspects, making them the largest but least satisfied group. This segmentation highlights distinct perceptions, particularly regarding features and costs.

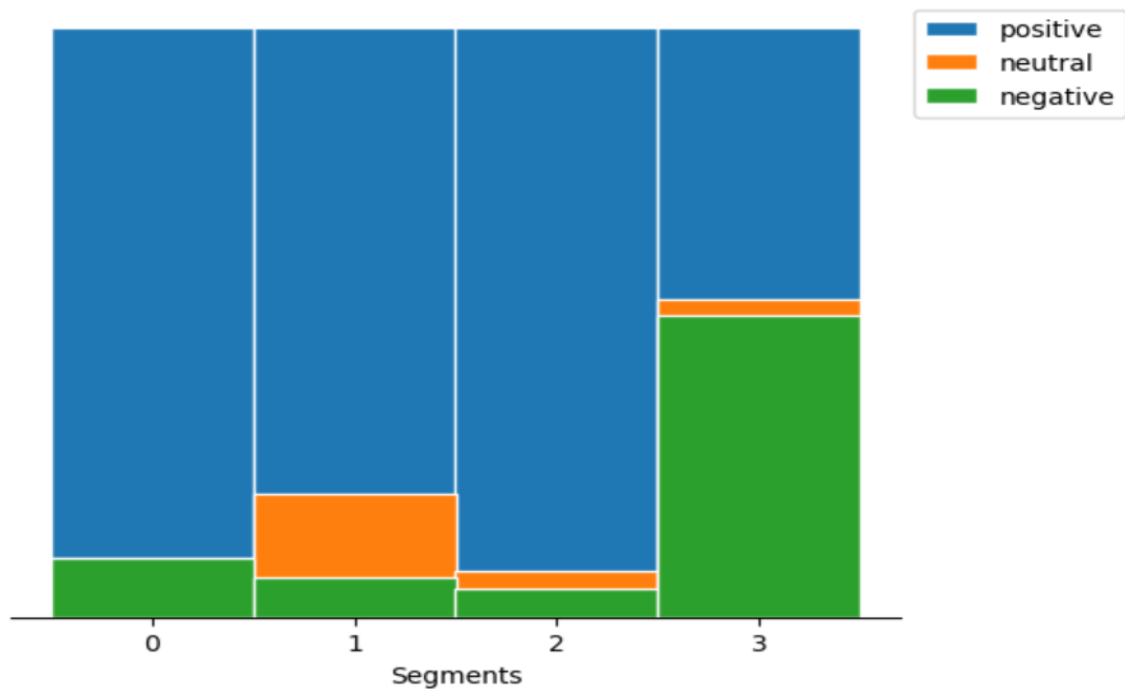
Segment separation plot using principal components 1 and 2



Above Figure, utilizing principal components, further emphasizes the differences among segments. Notably, Segment 3, despite being the largest segment, lacks specific opinions, making them unique in their lack of satisfaction.

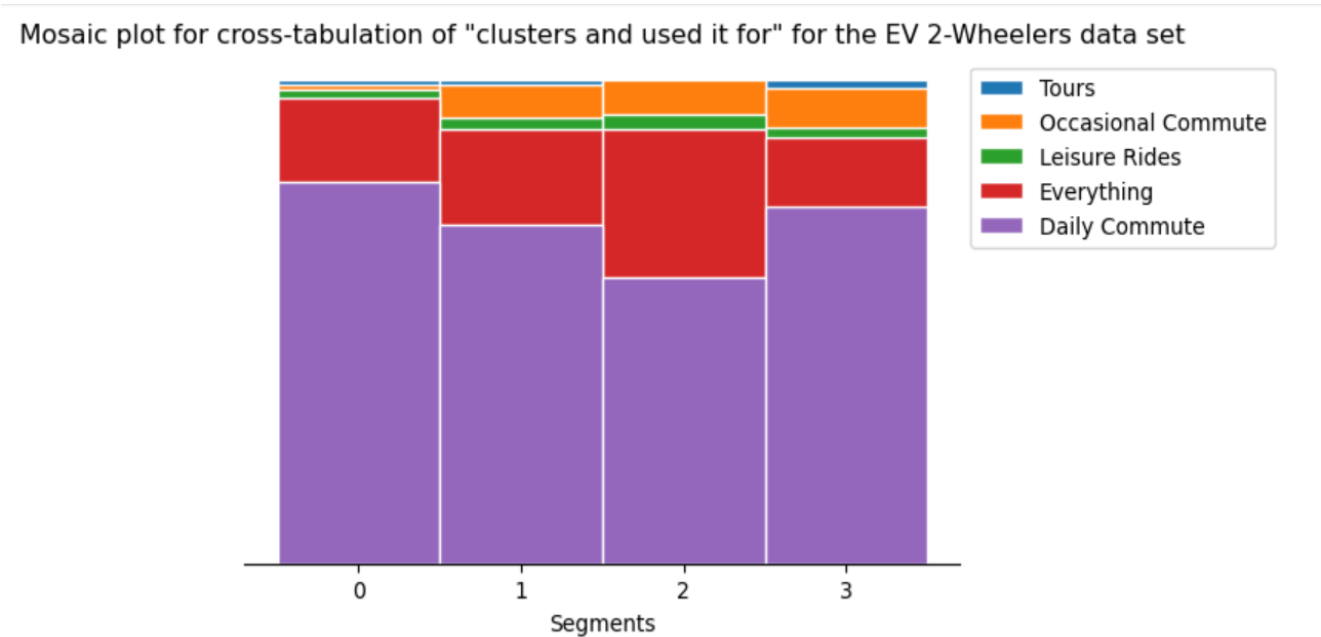
Describing Segment:

Simple Mosaic Plot

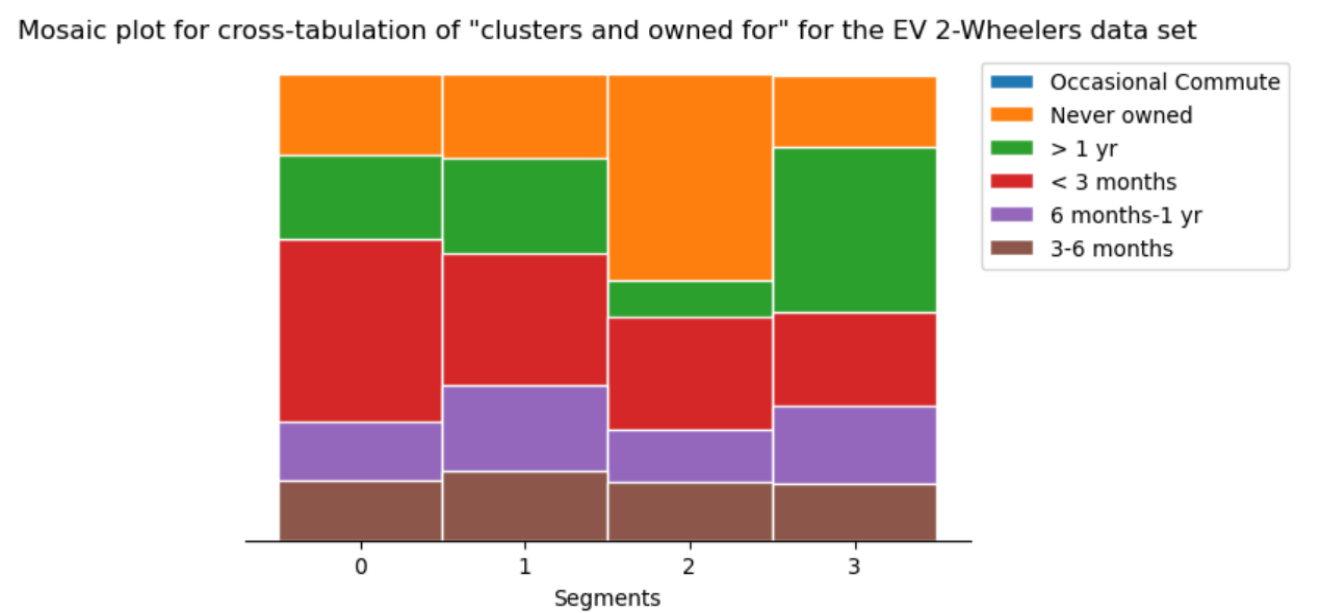


The above mosaic plot delves into consumer sentiments, uncovering that all segments, except Segment 3, demonstrate positive sentiments. Conversely, consumers in Segment 3 are notable for expressing

negative sentiments, suggesting dissatisfaction across various aspects. This analysis sheds light on the distinct sentiment patterns within each segment, providing valuable insights into consumer perceptions and preferences.

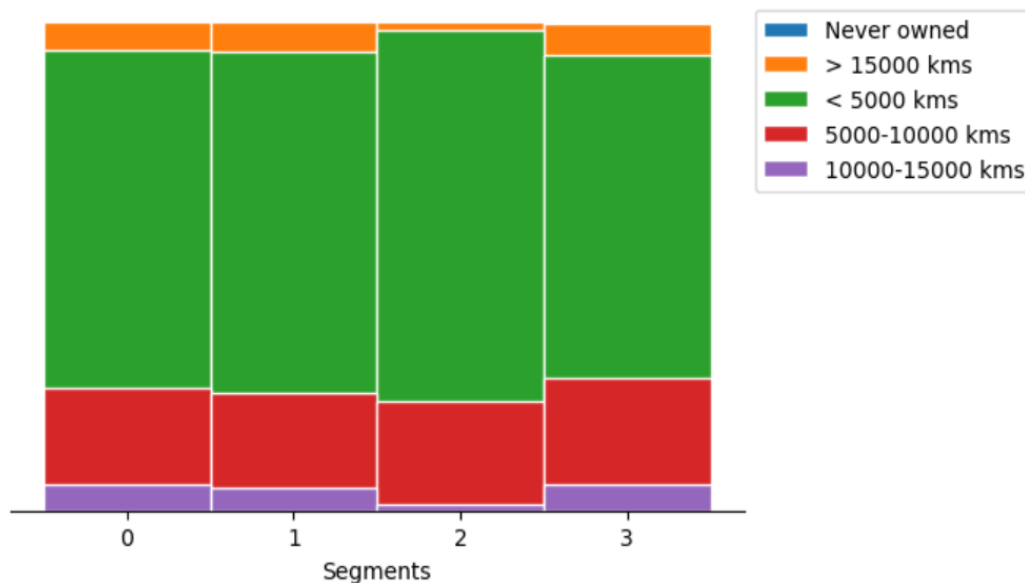


The above mosaic plot illustrates that all segments primarily utilize electric vehicles for daily commuting, with limited usage for tours, occasional commuting, and leisure rides. This analysis highlights the commonality in the usage pattern across different segments, emphasizing the predominant role of electric vehicles in daily transportation needs.



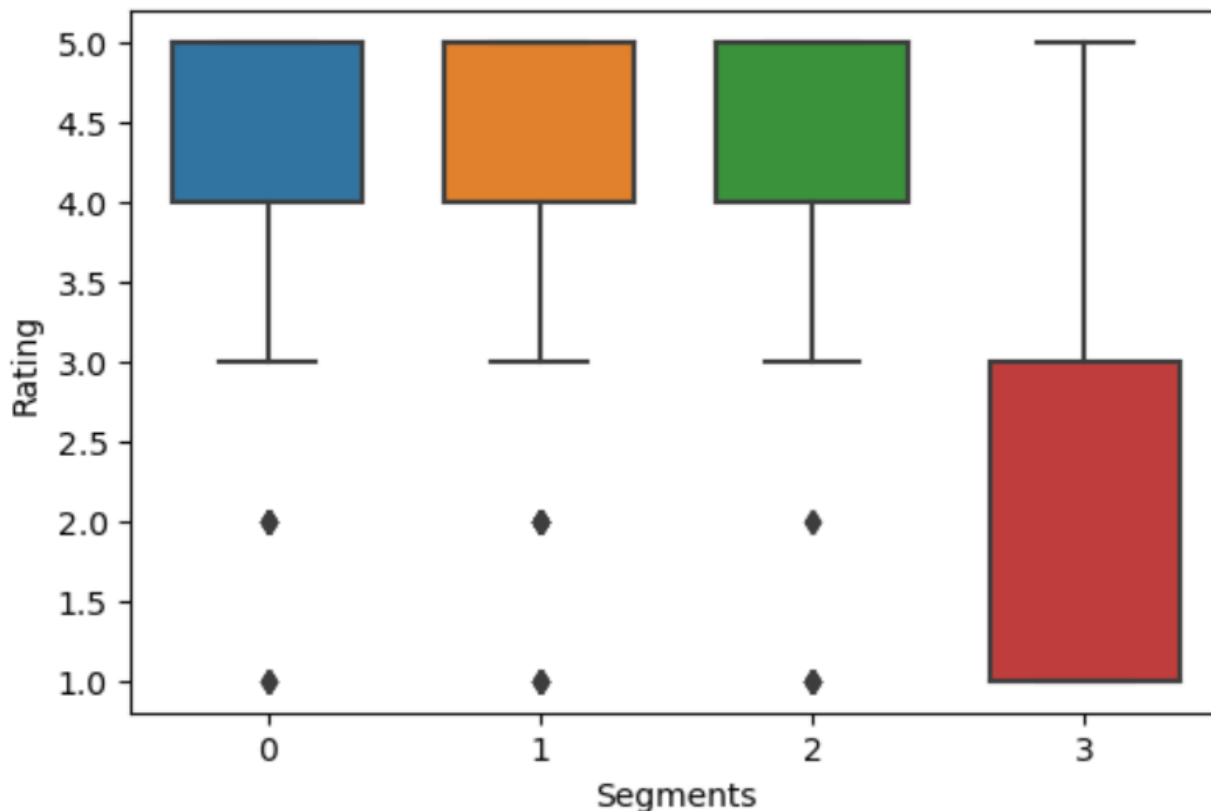
Above mosaic plot delineates the ownership duration of electric vehicles among segments. Segment 3 stands out, owning electric vehicles for more than a year, while Segment 2 has no prior ownership experience. Segment 1 members moderately own vehicles ranging from less than 3 months to over a year, and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

Mosaic plot for cross-tabulation of "clusters and ridden for" for the EV 2-Wheelers data set

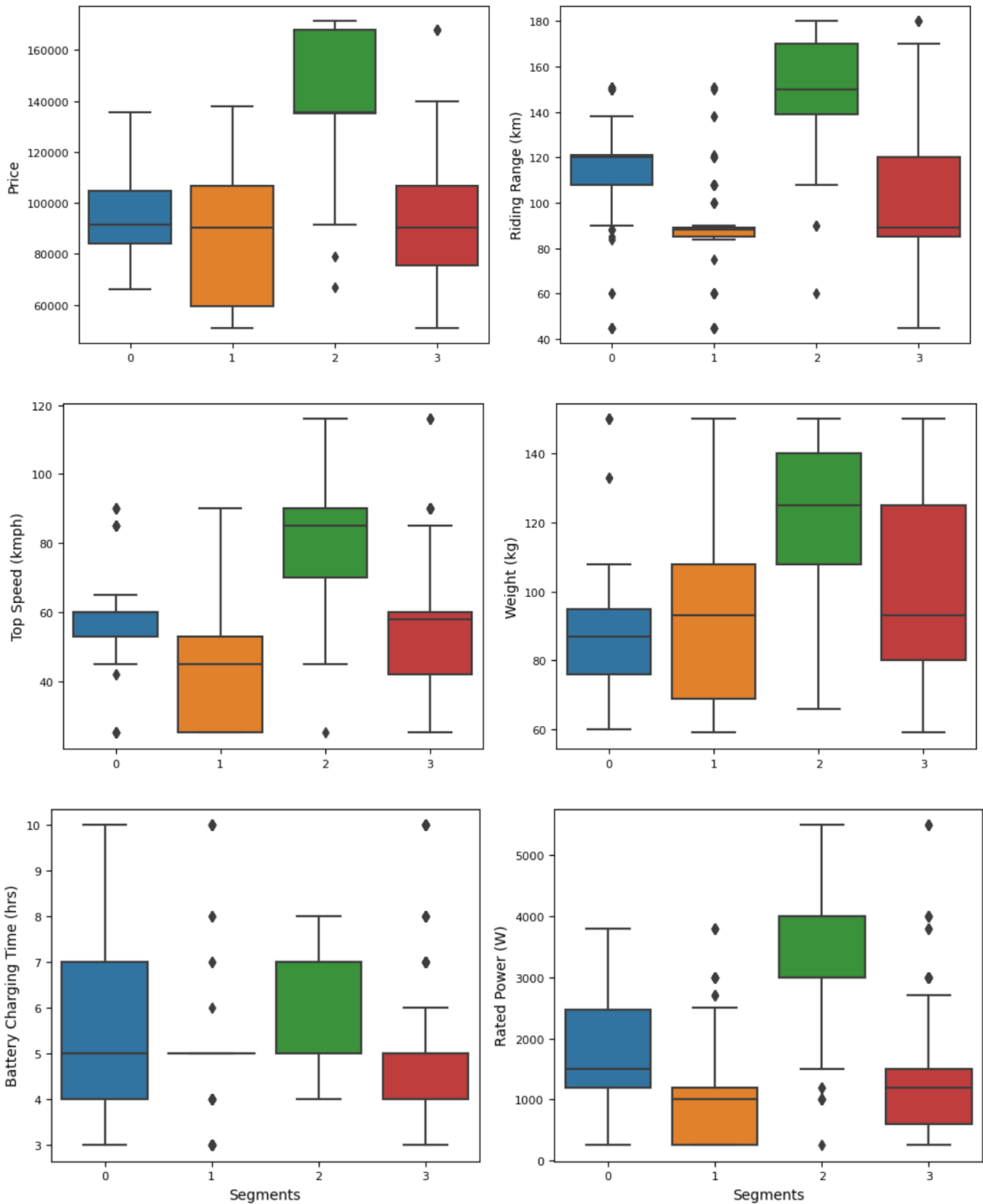


The mosaic plot above examines the distances covered by consumers, revealing that all segments primarily utilize electric vehicles for commuting, with the majority of users covering distances below 5000 kilometers. A small portion falls within the range of 5000 to 10000 kilometers, which aligns with their commuting needs. This analysis underscores the prevalent usage of electric vehicles for daily commuting purposes across different segments.

Parallel box and whisker plot of age by segment



The parallel box and whisker plot above highlight substantial differences in average ratings among segments. Particularly, consumers in Segment 3 exhibit dissatisfaction across all perceptions, resulting in lower overall ratings. This visualization underscores the varying perceptions and satisfaction levels among different segments of consumers.



Analyzing the technical specifications of electric vehicles across different segments reveals distinct patterns. Segment 2 exhibits a preference for premium EVs characterized by a higher price range and

extended riding range, reflecting consumer inclination towards luxury and long-distance travel. In contrast, Segment 3 gravitates towards budget-friendly options with lower prices and moderate riding ranges, ideal for daily commuting. Both Segment 0 and Segment 1 prioritize affordability, albeit with slight variations in riding range and speed preferences. Weight preferences diverge, with Segment 2 and Segment 3 showing a preference for heavier vehicles, while Segment 0 and Segment 1 lean towards lighter options. Additionally, charging time preferences vary, with Segment 2 and Segment 0 opting for longer durations for overnight charging, while Segment 1 and Segment 3 prioritize faster charging for quick turnaround times. These nuanced preferences collectively shape the electric vehicle market landscape in India.

Selection of Target Segment:

In the electric vehicle market, the strategic focus lies on two key segments: Segment 1, representing 33% of consumers, and Segment 3, representing 39% of consumers. Segment 1 prioritizes visual appeal, reliability, service experience, and comfort, suggesting an opportunity to tailor electric vehicles to meet these preferences while emphasizing their value for money. On the other hand, Segment 3 exhibits diverse preferences and areas of dissatisfaction, offering a chance to enhance customer satisfaction and loyalty by directly addressing their specific needs. By targeting the dissatisfaction points in Segment 3 and amplifying the positive aspects in Segment 1, the strategy aims to align electric vehicles with the unique expectations of each segment, thereby securing a competitive edge and fostering continuous market expansion.

Customizing the Marketing Mix:

In our electric vehicle market strategy, the customization of the marketing mix plays a pivotal role in appealing to our target segments, Segment 1 and Segment 3.

- Product customization entails enhancing features to cater to specific desires, addressing dissatisfaction points for Segment 3, and highlighting visual appeal and value for money for Segment 1. We offer diverse options to accommodate varied tastes and budgets within each segment.
- Price customization involves competitive pricing for Segment 1 and a slightly elevated price point for value-added features in Segment 3.
- Promotion customization is centered on targeted advertising and tailored promotional events that align with the preferences of each segment.
- Place customization focuses on establishing accessible distribution channels in urban areas for Segment 3 and in suburban/semi-urban regions for Segment 1. Additionally, we prioritize a robust online presence and efficient customer support.
- People and Process Customization entails training customer service representatives to address segment-specific concerns and ensuring streamlined processes for customization requests and service appointments.

This tailored approach ensures that our electric vehicles resonate with the distinct needs of Segment 1 and Segment 3, ultimately boosting market relevance and customer preference.

Potential Early Market Customer Base:

In the analysis of the early market customer base, two primary segments are identified: Segment 1 with 277 members (33% of consumers) and Segment 3 with 330 members (39% of consumers). The target price range for Segment 1, it ranges from ₹51,094 to ₹1,37,890 and for Segment 3 falls between ₹51,094 and ₹1,67,844. By multiplying the number of potential customers in each segment by the targeted price

range, potential profits can be calculated. For example, with a target price of ₹1,30,000 for Segment 3, the potential revenue amounts to be ₹4.29 crores, and for Segment 1 with a target price of ₹1,15,000, the potential revenue is ₹3.2 crores (approx.). Segment 3, being larger in potential market share, is the primary focus for early market penetration efforts due to its significant profit opportunity.

Most Optimal Market Segments:

Following in-depth analysis and assessment, Segment 3, comprising 39% of consumers, emerges as the prime market segment for electric two-wheeler vehicles. With its sizable customer base and a well-rounded combination of technical specifications and price range, this segment presents significant market potential. The recommended technical specifications for Segment 3 encompass a price range spanning from ₹70,688 to ₹1,29,063, a riding range of 89 to 180 km, a top speed ranging from 58 to 116 kmph, a weight between 76 to 120 kg, a battery charging time of 3 to 5 hours, and a rated power ranging from 1200 to 5500 W. This targeted strategy ensures alignment with the diverse needs and preferences of the market, establishing a robust groundwork for a prosperous and enduring foray into the electric vehicle market.

Conclusion:

In conclusion, our extensive analysis of India's electric vehicle market has led us to pinpoint Segment 3 as the ideal target. With a substantial 39% share of consumers, this segment presents a significant market opportunity. By customizing our electric two-wheeler specifications to cater to the preferences of this segment, we guarantee that our products seamlessly align with the needs of a large customer base. This strategic choice is informed by a comprehensive understanding of market segmentation, consumer behavior, and technical requirements. These insights provide clear guidance for our market entry, emphasizing accuracy and relevance in both product development and marketing strategies. Going forward, this approach provides us with a solid footing, ensuring that our offerings resonate effectively within the dynamic landscape of India's electric vehicle market.