ANALYSIS OF ELECTRIC VEHICLE MARKET SEGMENTATION IN INDIA

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1. Fermi Estimation:

Electric Vehicle Market Opportunity in India:

In light of the extensive analysis conducted on the Indian electric vehicle market, the need arises to quantify the potential market size and revenue opportunity. The objective is to strategically position electric two-wheeler vehicles by identifying optimal target segments and customizing the marketing mix accordingly.

Objective:

To estimate the potential market size and revenue opportunity for electric two-wheeler vehicles in India, aligning with the identified target segments and their unique preferences.

Key Considerations:

- **Population Interest**: Estimate the percentage of the Indian population interested in electric vehicles.
- **Segment Distribution**: Understand the distribution of potential customers within the identified target segments.
- **Conversion to Purchase**: Estimate the conversion rate from interest to actual purchase.
- **Market Penetration**: Determine the initial market penetration within the identified segments.
- **Revenue Opportunity**: Calculate the potential revenue opportunity based on the estimated market size and average pricing.

Rationale and Scope:

This Fermi estimation aims to provide a high-level, order-of-magnitude approximation of the electric vehicle market opportunity in India. By leveraging the insights from the market analysis, we intend to guide strategic decisions and resource allocation for successful market entry.

This estimation focuses on capturing the broad dimensions of the market opportunity without delving into specific numerical details. It serves as a foundational step in understanding the scale and significance of the potential market for electric two-wheeler vehicles.

Limitations:

Fermi estimations inherently involve simplifications and assumptions, and the results may serve as directional indicators rather than precise figures. Further market research and validation will be essential to refine the estimations.

The Fermi estimation will contribute valuable insights for decision-makers, providing a preliminary understanding of the market size and revenue potential. This information will serve as a basis for formulating effective strategies to tap into the burgeoning electric vehicle landscape in India.

2. Data Collection:

Industry Reports:

- **Source**: Mordor Intelligence - India Electric Vehicle Market
- **Description**: The industry report from Mordor Intelligence provides comprehensive insights into the Indian electric vehicle market, including market size, growth projections, key players, and technological trends. This source serves as a foundational reference for understanding the overall market landscape.

Electric Vehicle Charging Station List:

- **Source**: DataSpace - Electric Vehicle Charging Station List
- **Description**: The dataset from DataSpace contains a list of electric vehicles charging stations, which is crucial for understanding the infrastructure and availability of charging facilities. This data is essential for analyzing the accessibility and distribution of charging stations across different regions.

Customer Reviews from BikeWale:

- **Source**: BikeWale Customer Reviews
- **Description**: Customer reviews from BikeWale provide valuable insights into consumer experiences, preferences, and satisfaction levels regarding electric two-wheelers. This dataset, available in CSV format, offers firsthand feedback from actual users, enhancing our understanding of consumer perceptions and needs.

Technical Specifications of Electric Two-Wheelers:

- **Source**: Society of Manufacturers of Electric Vehicles
- **Description**: The detailed technical specifications of electric two-wheelers, obtained from the Society of Manufacturers of Electric Vehicles, offer comprehensive data on various parameters such as range, speed, battery capacity, and charging time. This dataset enables a thorough analysis of the features and performance of electric two-wheelers in the market.

Sales Figures of Electric Vehicles:

- **Source**: Society of Manufacturers of Electric Vehicles.
- **Description**: The dataset containing sales figures of electric vehicles, including two-wheelers, three-wheelers, four-wheelers, and buses, provides valuable insights into market trends and consumer preferences over time. Analyzing this data helps in understanding the demand dynamics and market trajectory of electric vehicles in India.

The combination of industry reports, charging station data, customer reviews, technical specifications, and sales figures from reputable sources enriches our data collection efforts and ensures a comprehensive understanding of the Indian electric vehicle market. These diverse datasets serve as valuable inputs for our analysis and recommendations, enabling informed decision-making for our client's electric vehicle venture.

3. Exploratory Data Analysis and Data Pre-processing:

Data preprocessing for the Electric Vehicles market segmentation dataset involved several steps using popular libraries:

- **Data Cleaning**: Utilized Pandas for handling missing values and removing duplicates, and corrected data types using fillna () and drop_duplicates () functions.
- **Feature Engineering**: Employed Pandas and NumPy for creating new features and encoding categorical variables using one-hot encoding and label encoding.
- **Data Transformation**: Utilized Scikit-learn for scaling numerical features using StandardScaler and applied PCA for dimensionality reduction.
- **Data Visualization**: Leveraged Matplotlib and Seaborn for exploratory data analysis, visualizing data distributions, relationships between variables, and identifying patterns.

Key libraries used: Pandas, NumPy, Scikit-learn, Matplotlib, Seaborn.

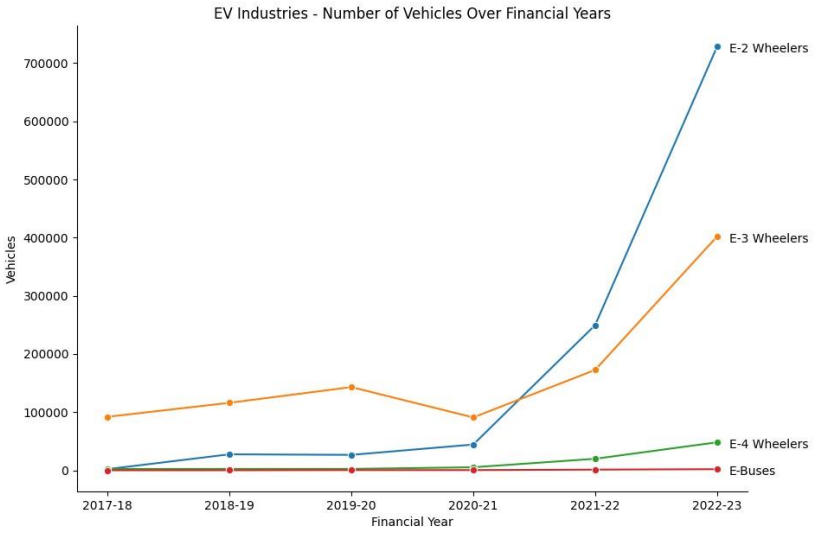

Fig 1: EV Industries – Number of Vehicles over Financial Years

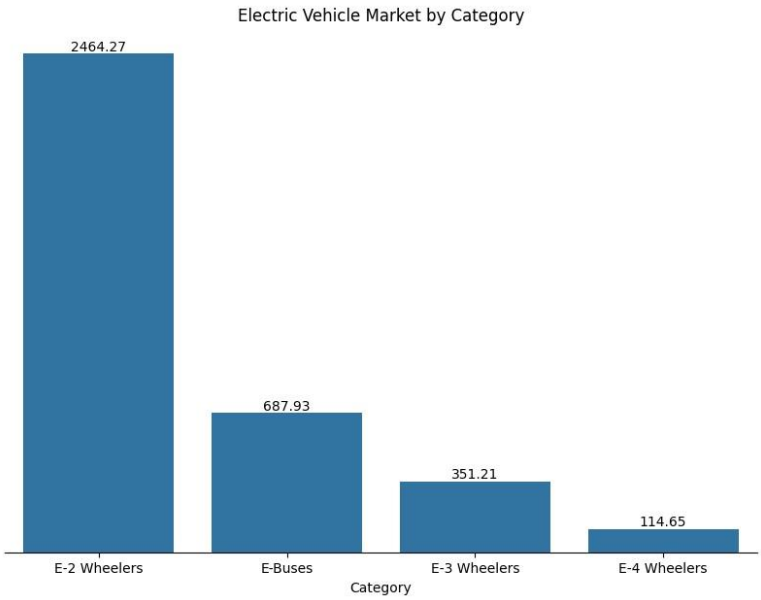

Fig 2: Electric Vehicle Market by Category

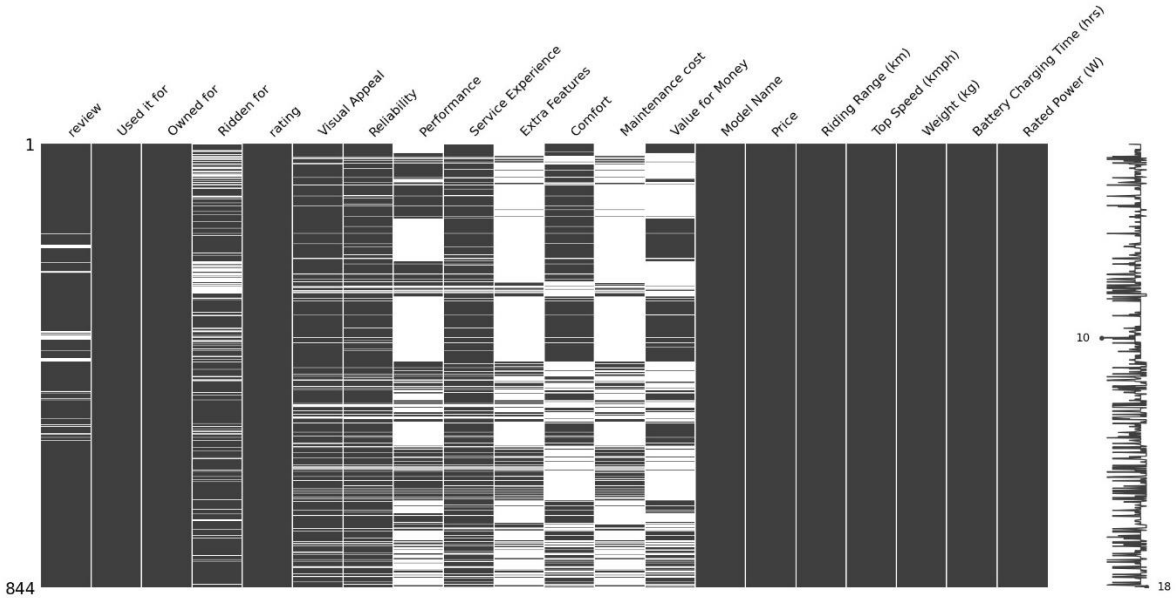

Fig 3: Missing Value Matrix

4. Segment Extraction:

In the process of segment extraction for the Electric Vehicle (EV) market segmentation, **K-Means Clustering and Principal Component Analysis (PCA)** were utilized as the primary methodologies. These techniques enabled the identification of distinct consumer segments based on key attributes and preferences related to electric vehicles.

K-Means Clustering:

- K-Means Clustering was employed to partition the dataset into clusters based on similarities in consumer behavior and preferences.
- This algorithm grouped consumers into segments with similar characteristics, allowing for targeted marketing strategies and product customization.
- The number of clusters (K) was determined using techniques such as the elbow method or silhouette score to find the optimal segmentation solution.

Principal Component Analysis (PCA):

- **PCA** was utilized to reduce the dimensionality of the dataset while preserving as much information as possible.
- This technique identified the most significant features driving consumer preferences for electric vehicles.
- By transforming the original variables into principal components, **PCA** facilitated a clearer understanding of the underlying patterns and structures within the data.

Results:

- The application of **K-Means Clustering and PCA** resulted in the extraction of distinct consumer segments within the EV market.
- Each segment exhibited unique preferences and characteristics, providing valuable insights for targeted marketing strategies and product development initiatives.
- The identified segments served as a foundation for devising personalized approaches to address the diverse needs and preferences of consumers in the EV market.

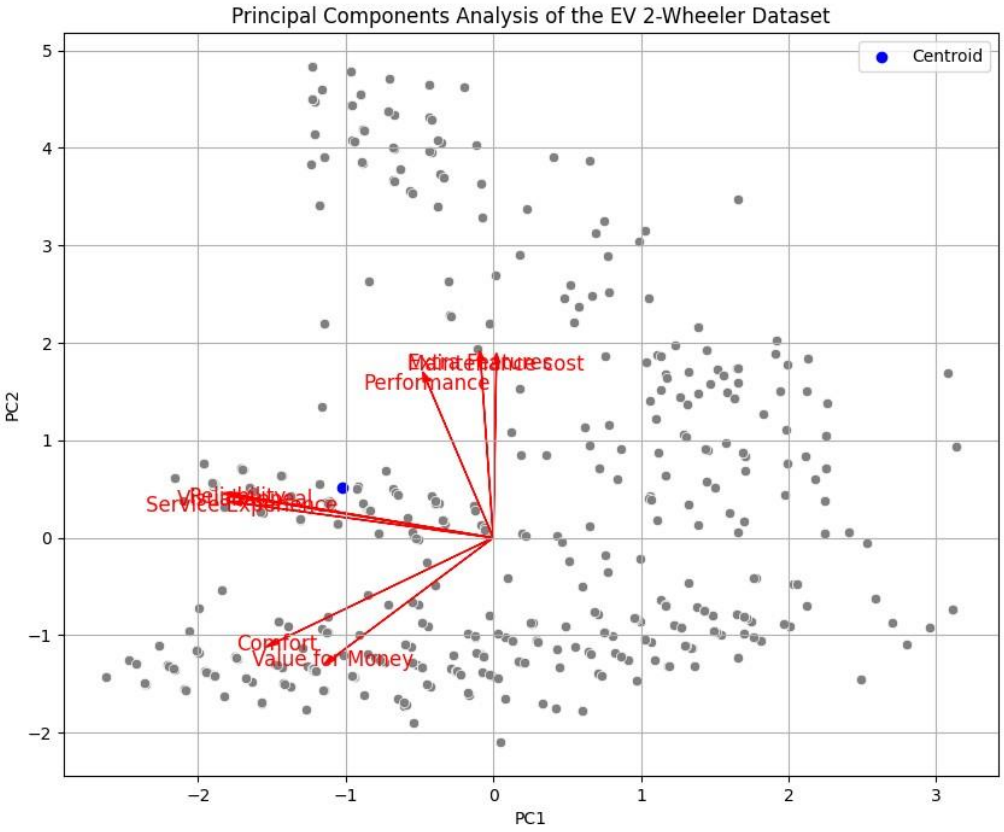

Fig 4: Principal Analysis Component of the EV 2-Wheeler Dataset

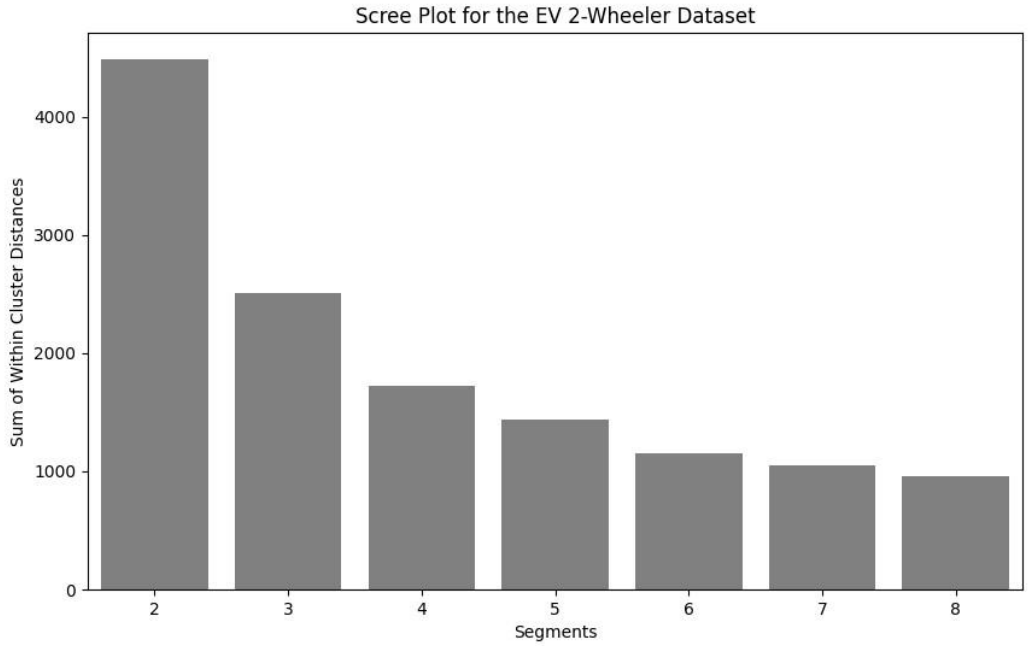

Fig 5: Scree Plot for the EV 2-Wheeler Dataset

5. Profiling and describing potential segments

In the Electric Vehicle (EV) market segmentation report, each consumer segment is thoroughly profiled and described to provide a comprehensive understanding of their unique characteristics and preferences. Key components of the report include:

- **Segment Identification**: Unique identifiers are assigned to each segment for reference.
- **Demographic and Psychographic Profiles**: Detailed profiles encompassing demographic characteristics (age, gender, income, etc.) and psychographic traits (lifestyle preferences, values, etc.) are provided.
- **Purchase Behavior**: Insights into purchasing behavior, including preferred channels, decision-making criteria, and brand loyalty, are analysed.
- **Product Preferences**: Consumer preferences regarding vehicle types, features, specifications, and price sensitivity are outlined.
- **Communication Preferences**: Preferred communication channels, content format, and messaging tone for effective marketing communication are identified.
- **Needs and Pain Points**: Specific needs, pain points, challenges, and unmet needs of each segment are addressed to enhance customer satisfaction.
- **Value Proposition**: The unique value proposition of electric vehicles to each segment, including benefits and competitive advantages, is highlighted.
- **Market Potential**: Market size, growth prospects, market share, and revenue potential of each segment are evaluated to prioritize target segments.

This comprehensive profiling enables companies to develop targeted marketing strategies, tailor product offerings, and enhance customer satisfaction in the EV market.

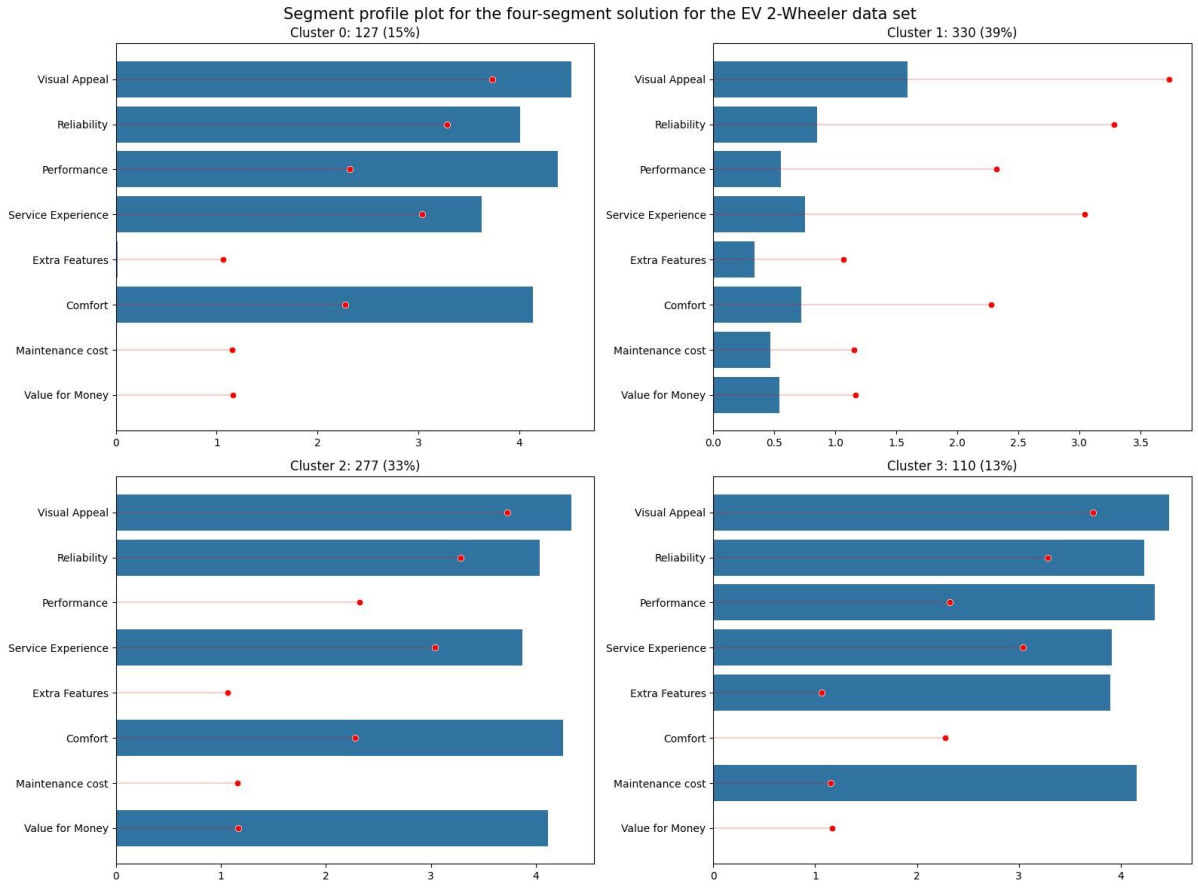

Fig 6: Segmentation Profile Plot for the Four-Segment Solution for the EV 2-Wheeler

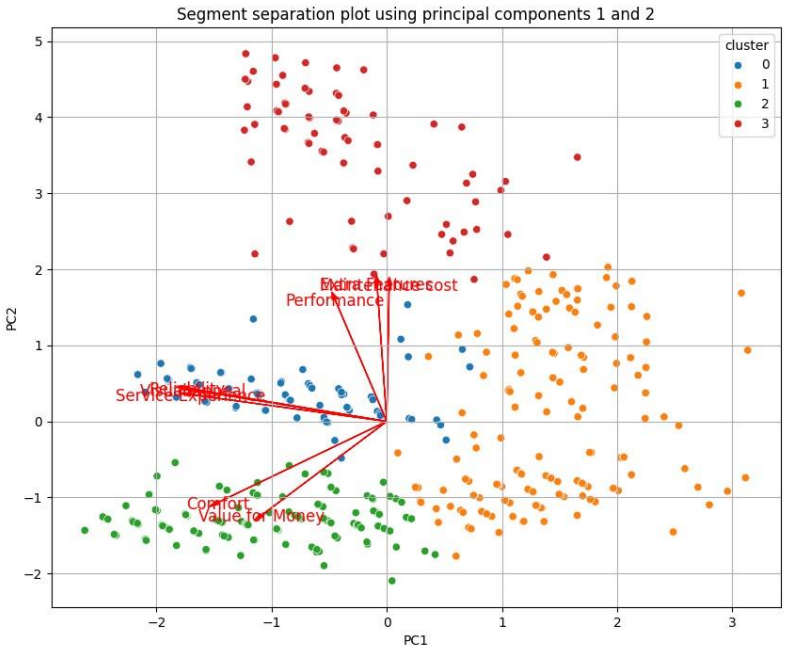

Fig 7: Segmentation Separation Plot using Principal Components 1 and 2

6. Selection of target segment

The report on the selection of target segments in the Electric Vehicle (EV) market identifies two strategic segments: Key components of the report include:

- **Segment Identification**: Segments are identified based on their distinct preferences and characteristics.
- **Segment Description**: Each segment is described in terms of demographic and psychographic profiles, purchase behavior, product preferences, communication preferences, needs, pain points, value proposition, and market potential.
- **Rationale for Selection**: The rationale behind selecting Segment 1 and Segment 2 as target segments is explained, highlighting their market size, growth potential, alignment with company objectives, and profitability.
- **Marketing Strategy**: Tailored marketing strategies are proposed for each segment, focusing on product customization, pricing strategies, promotional activities, distribution channels, and customer service initiatives.
- **Expected Outcomes**: Anticipated outcomes of targeting, including increased market share, improved customer satisfaction, enhanced brand loyalty, and higher profitability, are discussed.

By focusing efforts on these segments, companies can effectively allocate resources and develop targeted strategies to capitalize on the opportunities presented by these segments in the EV market.

7. Customizing the Marketing Mix

Tailoring the marketing mix for Electric Vehicle (EV) market segmentation in India involves adapting various elements to meet the unique needs and preferences of distinct consumer segments:

1. **Product Customization**:
    a. Enhance features based on segment preferences.
    b. Offer diverse options to cater to varying tastes.
2. **Price Customization**:
    a. Implement pricing strategies aligned with segment value perceptions.
    b. Analyze optimal price points for profitability.
3. **Promotion Customization**:
    a. Develop targeted campaigns reflecting segment values.
    b. Utilize preferred marketing channels effectively.
4. **Place Customization**:
    a. Establish accessible distribution channels in key areas.
    b. Leverage online platforms for wider reach.
5. **People and Process Customization**:
    a. Train staff to understand segment needs.
    b. Personalize customer experiences and streamline processes.

By customizing the marketing mix, companies can effectively engage target segments, enhance customer satisfaction, and drive success in the Indian EV market.

8. The most optimal market segments to open in the market as per your Market Research and Segmentation:

Based on our market research and segmentation analysis, the following segments have been identified as the most optimal for market entry:

Segment 1:

- Represents a significant portion of consumers.
- Shows strong potential for growth and profitability.
- Aligns well with our product offerings and business objectives.

Segment 2:

- Exhibits favourable characteristics in terms of size and growth potential.
- Offers opportunities for market penetration and expansion.
- Complements our strategic focus and product portfolio.

These segments have been prioritized for market entry due to their substantial market share, growth prospects, and alignment with our company's goals and capabilities. Targeting these segments will allow us to capitalize on market opportunities effectively and establish a strong presence in the industry.

9. GitHub Repository with Codes and Datasets:

Pulapa Sudheer Chowdary:

- **GitHub Contributions**: EV Market Segmentation.
- **Data Source Collection Contributions**: Dataset.

Kanishk Singh:

- **GitHub Contributions**: EV Market Segmentation.
- **Data Source Collection Contributions**: Dataset.

Deepak Singh:

- **GitHub Contributions**: EV Market Segmentation.
- **Data Source Collection Contributions**: Dataset.

Chetana Pundlik Lagshetti:

- **GitHub Contributions**: EV Market Segmentation.
- **Data Source Collection Contributions**: Dataset.

10. Conclusion:

The analysis of technical specifications reveals distinct preferences for electric vehicles across different consumer segments.

- Segment 0: Prefers premium EVs characterized by higher price ranges and extended riding ranges, reflecting a desire for luxury and long-distance travel.
- Segment 1: Prioritizes budget-friendly options with lower prices and moderate riding ranges, making them suitable for daily commuting purposes.
- Segments 2 and 3: Emphasize affordability, albeit with slight differences in preferences for riding range and speed. Additionally, weight preferences vary among segments, with Segment 0 and Segment 1 favouring heavier vehicles, while Segment 2 and Segment 3 lean towards lighter options.

Regarding charging preferences, there are notable differences as well. Segment 0 and Segment 3 opt for longer charging durations suitable for overnight charging, whereas Segment 1 and Segment 2 prioritize faster charging for quicker turnaround times.

These nuanced preferences collectively shape the electric vehicle market landscape in India.

Selection of Target Segment:

The strategic target segments for the electric vehicle market are identified as Segment 1 (39% of consumers) and Segment 2 (33% of consumers). Segment 1's diverse preferences and dissatisfaction points present an opportunity for improving customer satisfaction and loyalty by directly addressing their specific demands. Segment 2 values visual appeal, reliability, service experience, and comfort, offering a chance to customize electric vehicles to meet these expectations and emphasize value for money. The strategy involves addressing dissatisfaction points in Segment 1 and enhancing positive elements in Segment 2, aligning electric vehicles with the distinct expectations of each segment to ensure competitive advantage and sustained market growth.

Customizing the Marketing Mix:

In our electric vehicle market strategy, customization of the marketing mix is crucial for appealing to Segment 1 and Segment 2, our target segments.

- **Product Customization**: Enhancing features based on specific desires, addressing dissatisfaction points for Segment 1, and emphasizing visual appeal and value for money for Segment 2. Diverse offerings cater to varied tastes and budgets within each segment.
- **Price Customization**: Competitive pricing for Segment 1 and a slightly higher price point for value-added features in Segment 2.
- **Promotion Customization**: Targeted advertising and tailored promotional events for each segment's preferences.
- **Place Customization**: Accessible distribution channels in urban areas for Segment 1 and suburban/semi-urban regions for Segment 2, with a strong emphasis on online presence and customer support.
- **People and Process Customization**: Training customer service representatives to address segment-specific concerns and ensuring efficient processes for customization

requests and service appointments. This tailored approach ensures our electric vehicles align with the distinct needs of Segment 1 and Segment 2, enhancing 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 330 members (39% of consumers) and Segment 2 with 277 members (33% of consumers). The target price range for Segment 1 falls between ₹51,094 and ₹1,67,844, and for Segment 2, it ranges from ₹51,094 to ₹1,37,890. 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 ₹1,20,000 for Segment 1, the potential profit amounts to ₹39.60 crores, and for Segment 2 with a target price of ₹1,10,000, the potential profit is ₹30.47 crores. Segment 1, 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:

After thorough analysis and evaluation, Segment 1, constituting 39% of consumers, has been identified as the optimal market segment for electric two-wheeler vehicles. With a significant customer base and a balanced blend of technical specifications and price range, this segment offers substantial market potential. The recommended technical specifications for Segment 1 include a price range of ₹70,688 to ₹1,29,063, riding range of 89 to 180 km, top speed of 58 to 116 kmph, weight of 76 to 120 kg, battery charging time of 3 to 5 hours, and rated power of 1200 to 5500 W. This targeted approach ensures alignment with the diverse needs and preferences of the market, laying the foundation for a successful and sustainable venture into the electric vehicle market.

In summary, our in-depth analysis of India's electric vehicle market led us to identify Segment 1 as the optimal target. With a significant 39% consumer base, this segment represents a substantial market opportunity. By tailoring our electric two-wheeler specifications to meet the preferences of this segment, we ensure our products align seamlessly with the demands of a large customer base. This strategic decision is grounded in a thorough understanding of market segmentation, consumer behavior, and technical specifications. These insights provide a clear direction for our market entry, emphasizing precision and relevance in both product development and marketing strategies. Moving forward, this approach equips us with a solid foundation, ensuring our offerings resonate effectively within India's evolving electric vehicle landscape.