ELECTRIC VEHICLE MARKET ANALYSIS FOR INDIAN MARKET

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Submitted by-

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Abstract

The growing urgency to combat climate change and reduce carbon emissions has brought the spotlight on sustainable transportation solutions. With fossil fuel-based vehicles contributing significantly to environmental degradation and air pollution, a shift towards cleaner alternatives has become essential. Electric vehicles (EVs) present a viable solution, offering a more sustainable mode of transportation by minimizing dependence on fossil fuels and reducing greenhouse gas emissions.

In the context of India's commitment to sustainability and the global push towards cleaner energy, understanding the EV market is crucial for manufacturers, policymakers, and investors. This project aims to analyze the current state of EV adoption, infrastructure readiness, and market potential in India. By identifying key regional trends and consumer behavior, this analysis helps stakeholders navigate the transition to electric mobility, ensuring informed decision-making and positioning India as a leader in sustainable transportation.

Introduction

The electric vehicle (EV) market is experiencing significant growth, driven by increasing consumer demand for sustainable transportation and government policies promoting green energy. As the market expands, manufacturers and investors need clear insights into which EV types are gaining popularity and where. Understanding market dynamics, regional adoption patterns, and future demand trends is critical for making informed decisions. This project aims to analyze EV data through advanced machine learning and time-series modelling techniques. By segmenting the market and forecasting demand, it provides valuable insights into EV adoption trends, helping stakeholders optimize production, marketing, and investment strategies to stay competitive in this rapidly evolving landscape.

Problem Statement

In the context of the rapidly evolving electric vehicle (EV) market, a start-up or company is faced with the challenge of making strategic decisions about which types of EVs to manufacture and which markets to target. With a forecasted continual increase in EV adoption, the company needs to determine which vehicle categories—ranging from personal and commercial vehicles to more niche segments like buses and goods vehicles—will meet the growing demand. Additionally, it must identify which geographic regions will be most receptive to their offerings. The goal is to make informed decisions that align with both current trends and future market potential, ensuring successful entry and competitive positioning in the EV industry.

Fermi Estimation is a problem-solving technique that breaks down complex questions into smaller, manageable components, allowing for logical estimates based on assumptions and available data. It is particularly useful when precise data is unavailable, enabling informed decision-making through reasoned approximations.

1. Problem Breakdown (Fermi Estimation)

To strategically approach the Electric Vehicle (EV) market in India, we begin by using the Fermi Estimation technique. This technique allows us to address complex questions by breaking them into smaller, manageable components based on assumptions, data, and logical estimates. Our first step involves formulating key questions based on the client's requirements and market considerations.

1.1 Formulating Key Questions

The primary objective is to answer two fundamental questions:

1. What type of EV should the company produce?

This focuses on whether the start-up should target:

- Personal EVs (Two-wheelers, Cars, SUVs) for individual consumers, which requires understanding personal vehicle ownership trends, urban driving needs, and consumer preferences.

- B2B EVs (Commercial fleets, Logistics, Ride-sharing) to cater to businesses, fleet operators, or public transportation sectors.

2. To whom will the company sell?

Defining the target market requires identifying potential customer segments. The company must determine:

- Demographics: Who are the early adopters in terms of age, income, education, and occupation?

- Psychographics: What are their attitudes, values, and lifestyles, especially towards sustainability and technology adoption?

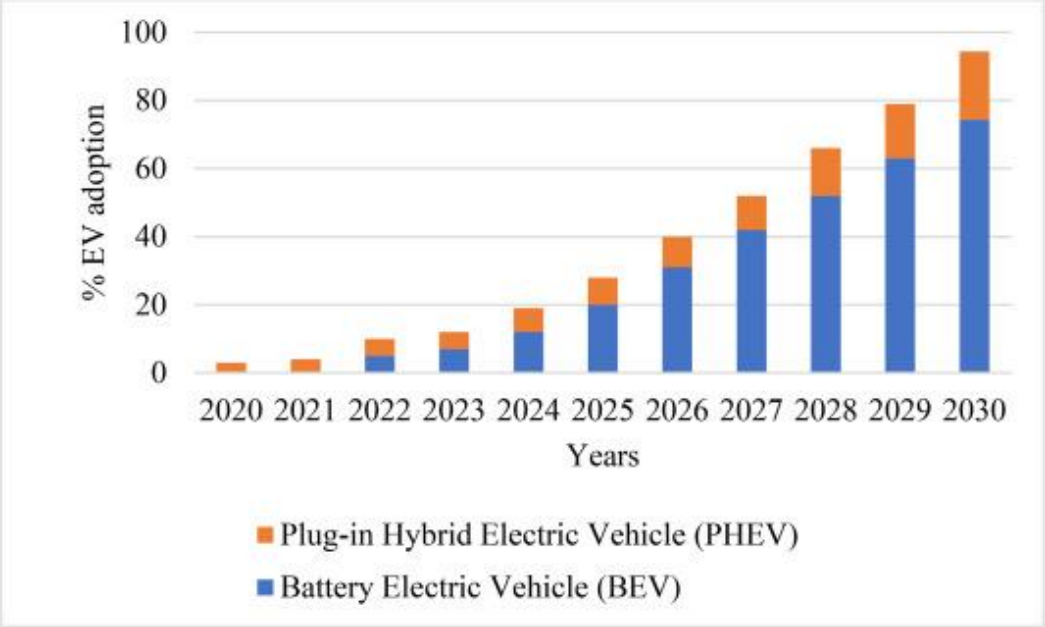
- Behavioral Traits: What are their vehicle usage patterns? How frequently do they travel, and for what purpose (commuting, leisure, etc.)?

With these overarching questions in mind, we break down the problem further by formulating specific questions that will guide data collection and analysis.

2. Core Questions for Problem Breakdown:

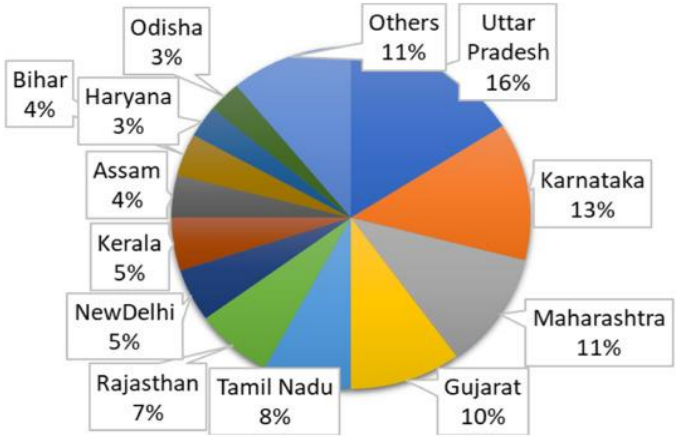
2.1 Market Feasibility:

- How many early EV adopters are there in India?
- What percentage of the market is ready to switch to EVs in the next 5 years?
- What is the current split between personal and commercial vehicle ownership?



2.2 Geographic Suitability:

- Which regions in India show the highest potential for early EV adoption based on income levels, infrastructure, and urbanization?
- How do current EV adoption rates vary across major metropolitan areas like Delhi, Mumbai, Bengaluru, and Pune?



2.3 Demographic and Behavioral Analysis:

- What age groups and income levels are most likely to adopt EVs?

- How do vehicle usage patterns (e.g., daily commuting, long-distance travel) influence the likelihood of adopting an EV?

- What are the key factors influencing buying behavior for EVs (e.g., cost savings, environmental impact, government incentives)?

2.4 Infrastructure Readiness:

- How many EV charging stations are currently available in major cities, and how many more are required to meet future demand?

- What is the average distance between charging stations, and does it support long-distance travel?

2.5 Product Focus:

- Should the company focus on two-wheelers, compact cars, or larger vehicles like SUVs to appeal to personal EV customers?

- For B2B, should the focus be on fleets for logistics, ride-hailing services, or public transportation?

2.6 Price Sensitivity:

- What is the expected price range that early adopters are willing to pay for an EV?

- How does strategic pricing impact customer adoption, especially for the early market segment?

- Can the pricing strategy differentiate between personal and B2B segments?

2.7 Government Policies and Incentives:

- What government incentives (e.g., subsidies, tax benefits) are available for EV purchases, and how can these be leveraged to boost early adoption?

- How do regional policies on EV adoption vary, and which states offer the most supportive regulatory environment?

3. Data Sources and Collection

The data for this project has been sourced from a variety of reputable platforms to ensure a comprehensive and accurate analysis of the electric vehicle (EV) market in India. One of the key sources is the **Clean Mobility Shift EV Dashboard**, a detailed platform that provides in-depth insights into the EV landscape. This dashboard offers a wide array of data, including vehicle types, fuel usage, geographic distribution, and overall market trends. By leveraging this data, the project aims to analyze regional EV adoption patterns, identify critical market segments, and forecast future demand. The reliability and regular updates of this platform ensure the relevance of our analysis for strategic decision-making.

In addition to the Clean Mobility Shift Dashboard, we utilized data from **three other key sources**. The primary dataset, provided by the **Society of Manufacturers of Electric Vehicles (SMEV)**, covers the period from 2017 to 2023 and includes sales data for electric two-wheelers, three-wheelers, four-wheelers, and buses. This dataset offers a comprehensive overview of market dynamics, allowing us to track sales trends and consumer preferences over time. The second dataset, sourced from **bikewale.com**, consists of customer reviews for electric two-wheelers, providing valuable behavioural and psychographic insights that helped us better understand consumer attitudes, preferences, and motivations. This qualitative data was instrumental in identifying key factors influencing consumer decision-making in the EV space.

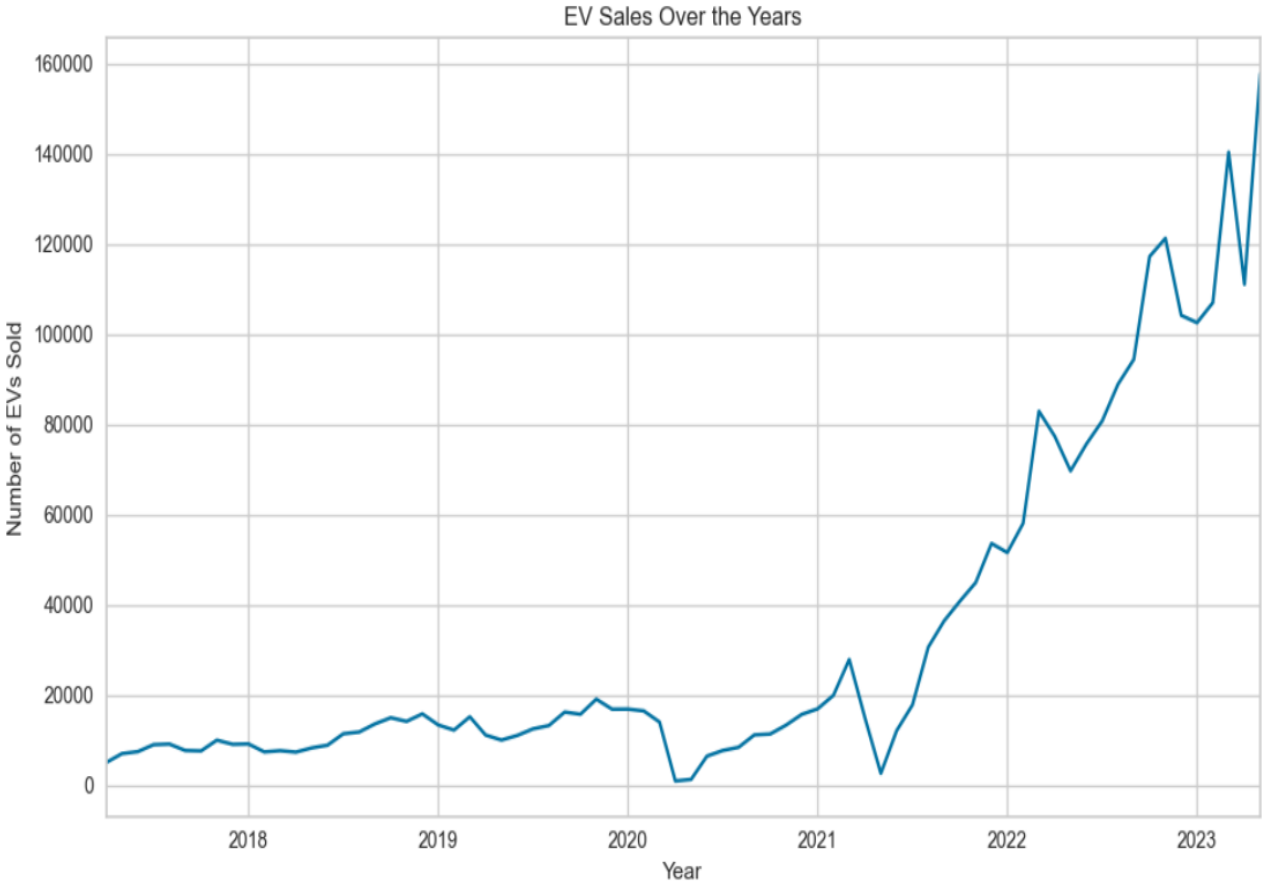
The dataset from **bikewale.com** includes detailed technical specifications and pricing information for electric two-wheelers, allowing for a thorough evaluation of the technical viability and pricing strategies needed for market segmentation. Furthermore, additional data was sourced from **Indian government websites**, which offered insights into policy frameworks, subsidies, and infrastructure development initiatives critical to EV adoption. These governmental datasets were pivotal in understanding the regulatory environment and infrastructure readiness across various regions in India.

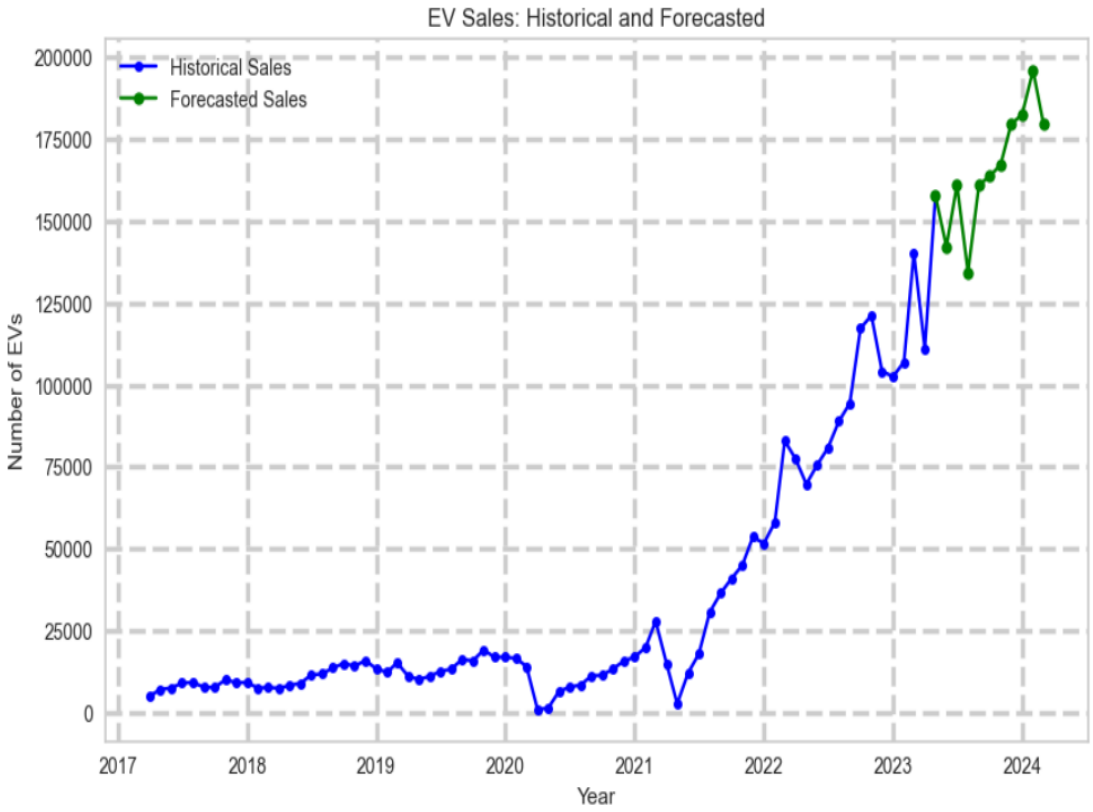
Lastly, to gain insights into the four-wheeler EV market, data from **Cardekho.com** was incorporated, providing a detailed view of the current trends in the electric four-wheeler segment, including customer feedback, technical specifications, and pricing comparisons. By synthesizing data from these diverse sources, the project delivers a well-rounded, data-driven approach to segmenting and analyzing the Indian EV market, ensuring that the findings are both market-relevant and actionable for stakeholders.

4. Market Overview

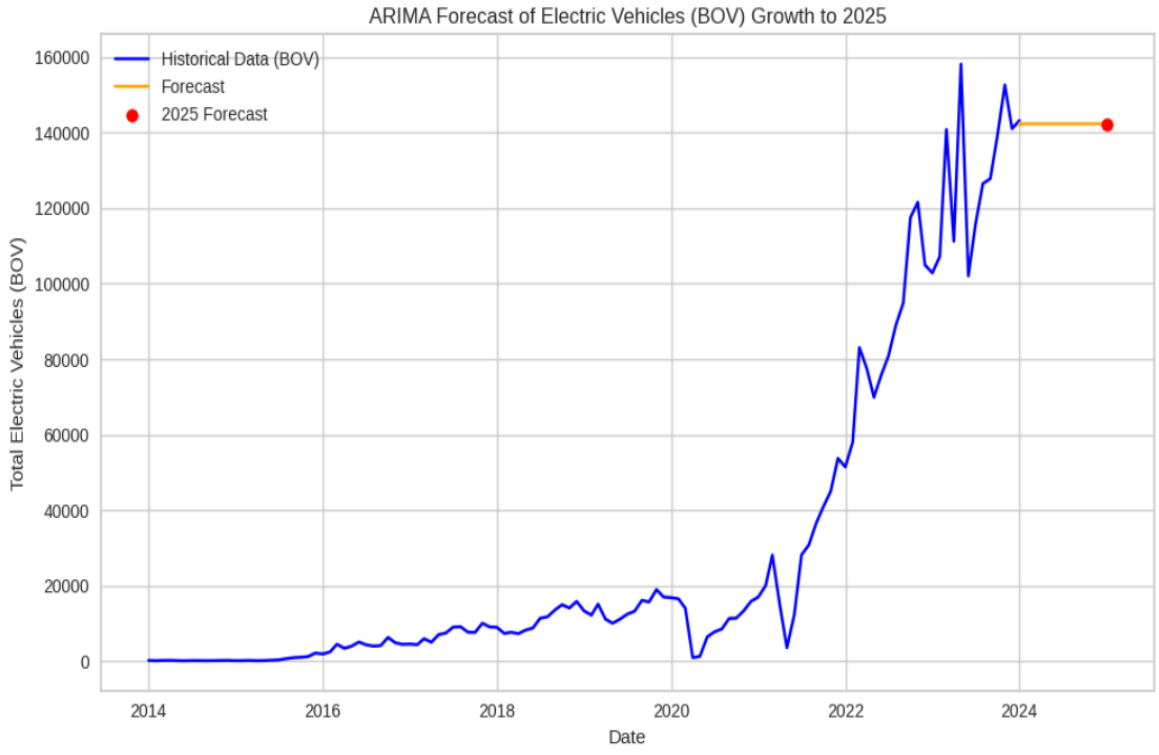
This report aims to analyze and provide insights into the adoption of electric vehicles (EVs) and the deployment of charging infrastructure across various states in India. By uncovering regional trends and patterns in EV adoption and infrastructure development, we offer a comprehensive understanding of how different geographical areas are transitioning toward electric mobility. The dataset provides a unified perspective that reveals the dynamics influencing this transition, ensuring the analysis's consistency and reliability.

The current market for electric vehicles in India is on an upward trajectory, fuelled by growing environmental awareness, government incentives, and advancements in EV technology. With a surge in demand driven by the need for sustainable transportation solutions, manufacturers are increasingly focusing on expanding their offerings and improving charging infrastructure. This shift reflects a broader commitment to reducing carbon emissions and enhancing energy efficiency, positioning India as a key player in the global transition to electric mobility.





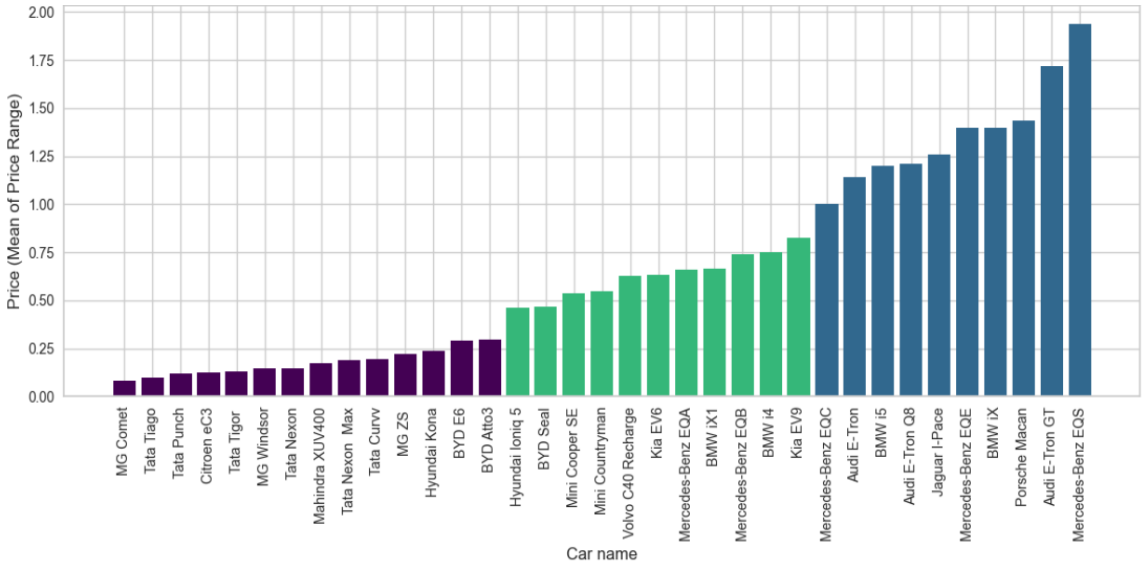
The **ARIMA** (AutoRegressive Integrated Moving Average) time series analysis conducted on the collected EV market data reveals a promising outlook for the electric vehicle industry in India. The analysis indicates a strong upward trend in EV adoption, suggesting that the market is poised for significant growth in the coming years as consumer preferences shift toward sustainable transportation options.



5. Analyzing the Current Indian EV Market

The Indian electric vehicle (EV) market is undergoing a transformative phase, driven by increasing environmental awareness, technological advancements, and supportive government policies. As the country grapples with severe air pollution and climate change challenges, the shift towards electric mobility has gained significant momentum. The current market landscape showcases a diverse array of electric vehicles, particularly in the four-wheeler segment, which is crucial for urban transportation.

Recent data indicates that the adoption of electric four-wheelers in India is witnessing exponential growth. The rise in sales can be attributed to several factors, including enhanced consumer awareness of the environmental benefits of EVs, the availability of government incentives, and a burgeoning network of charging infrastructure. Visualizations illustrating the current four-wheeler EV market highlight the regional disparities in adoption rates, with metropolitan areas such as Delhi, Mumbai, and Bengaluru leading the charge. These cities are benefiting from concentrated efforts to promote electric mobility, which include the deployment of charging stations and the establishment of regulatory frameworks that encourage the use of EVs.



The Indian EV market displays a diverse range of pricing for electric vehicles, reflecting a growing interest across both economy and luxury segments. On the lower end, models like the **MG Comet**, **Tata Tiago**, and **Tata Punch** offer affordable EV options, with prices significantly lower than luxury alternatives. These vehicles cater to the price-sensitive Indian market, particularly in metropolitan areas where compact and mid-range electric cars are popular due to their cost-effectiveness and government incentives.

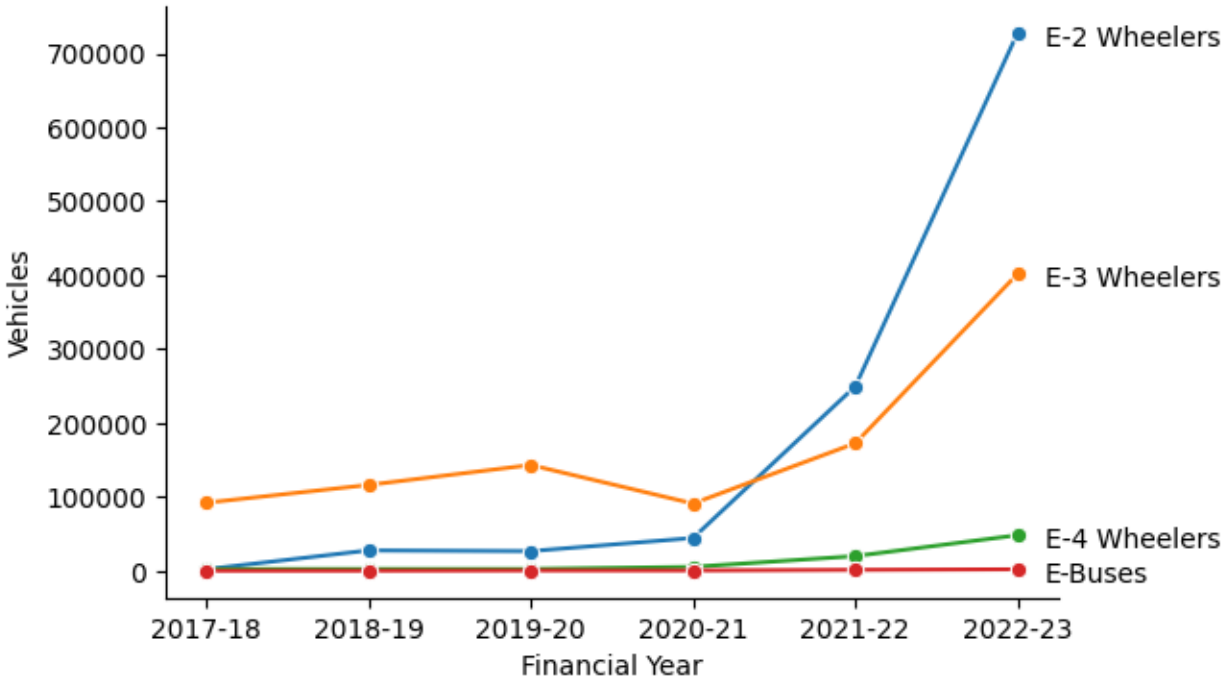
In contrast, luxury EVs such as **Mercedes-Benz EQS**, **Porsche Taycan**, and **Audi E-Tron GT** are positioned at the higher end of the spectrum, targeting high-income individuals seeking both performance and sustainability. This demonstrates a growing

appetite for premium electric vehicles in India, especially among affluent urban consumers.

A closer look at the types of electric vehicles being sold reveals an interesting trend. Currently, electric cars, particularly compact and mid-sized models, dominate the market. Models from well-established manufacturers, such as Tata Motors and Mahindra & Mahindra, have gained significant traction, appealing to consumers' preferences for affordability and practicality. Additionally, there has been a notable increase in the popularity of luxury electric vehicles, with brands like Audi and Mercedes-Benz entering the market, thereby catering to higher-income consumers who are keen on sustainable yet premium offerings.

Furthermore, the rise of electric SUVs has been particularly noteworthy, as consumers increasingly favor larger vehicles that combine spaciousness with the benefits of electric mobility. This shift aligns with global trends where SUVs are becoming the preferred choice for many drivers. The government's push for electric mobility through policies and incentives, such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, has further fueled the demand for electric SUVs, making them a vital part of the market strategy for manufacturers.

As we analyze the current state of the Indian EV market, it becomes clear that the landscape is evolving rapidly, with a growing number of consumers embracing electric four-wheelers. The visualizations included in this report provide further insights into sales trends, popular vehicle categories, and the overall market share of electric vehicles within the broader automotive sector. By understanding these dynamics, stakeholders can better navigate the market, aligning their strategies with consumer preferences and the ongoing shift towards sustainable transportation.



6. Demographic and Behavioral Analysis:

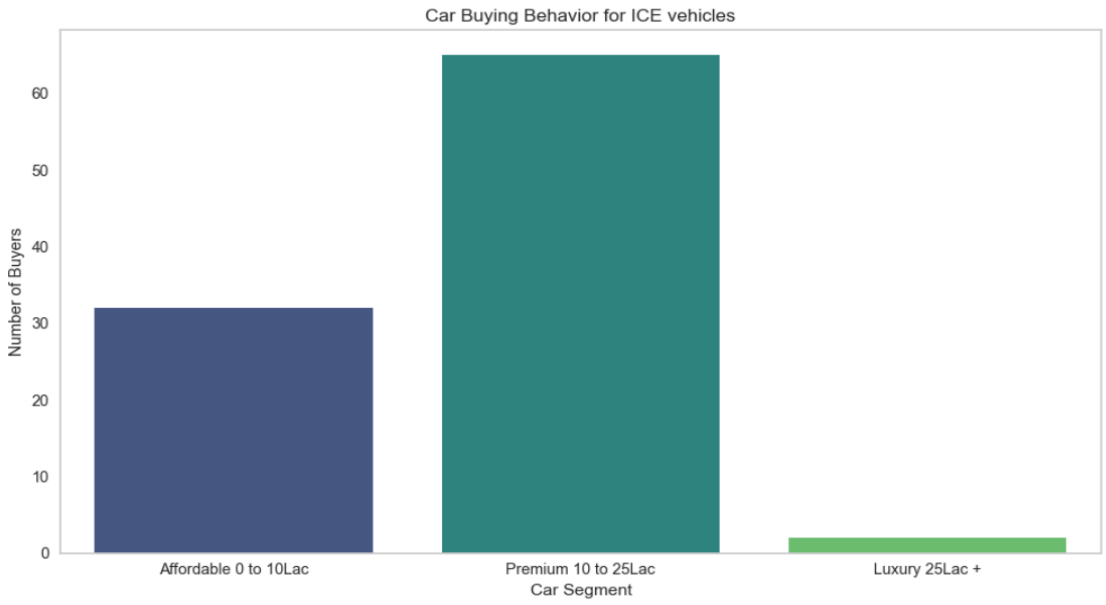
6.1 Explanation of EV Price Premium:

On average, electric vehicles tend to be about 30% more expensive than their internal combustion engine (ICE) counterparts. This price premium can be attributed to several factors, including the high cost of battery production, advanced electric drivetrain technology, and the relatively low scale of EV manufacturing compared to traditional vehicles. However, with government subsidies, tax incentives, and the lower long-term operating costs of EVs, this price difference is expected to narrow in the coming years, making EVs a more attractive option for mainstream consumers.

6.2 Why It's Necessary to Analyze Indian Customer Buying Behavior?

Understanding Indian customer buying behavior is essential for boosting the adoption of electric vehicles (EVs). While EVs offer long-term benefits like lower running costs and environmental advantages, their higher upfront cost often deters price-sensitive consumers in India. Factors like awareness of government incentives, availability of charging infrastructure, and concerns about range anxiety significantly influence purchasing decisions.

By analyzing these preferences, manufacturers and policymakers can create strategies that resonate with Indian buyers. For instance, focusing on long-term cost savings or developing more affordable EV models can encourage adoption. Additionally, understanding early adopters, such as urban, environmentally conscious consumers, can guide targeted marketing and product development, helping drive sustainable growth in the EV market.



After applying the Random Forest Classifier to the Indian customer buying behavior dataset for internal combustion engine (ICE) vehicles, the analysis revealed that the premium segment, priced between ₹10 lakh and ₹25 lakh, attracts the most buyers. This insight is crucial because it indicates a strong preference for vehicles in this price range, where consumers seek a balance between affordability, performance, and features. In contrast, the electric vehicle (EV) market operates under different economic dynamics. Due to factors like the higher cost of battery technology and limited economies of scale, EVs tend to be priced approximately 30% higher than their ICE counterparts.

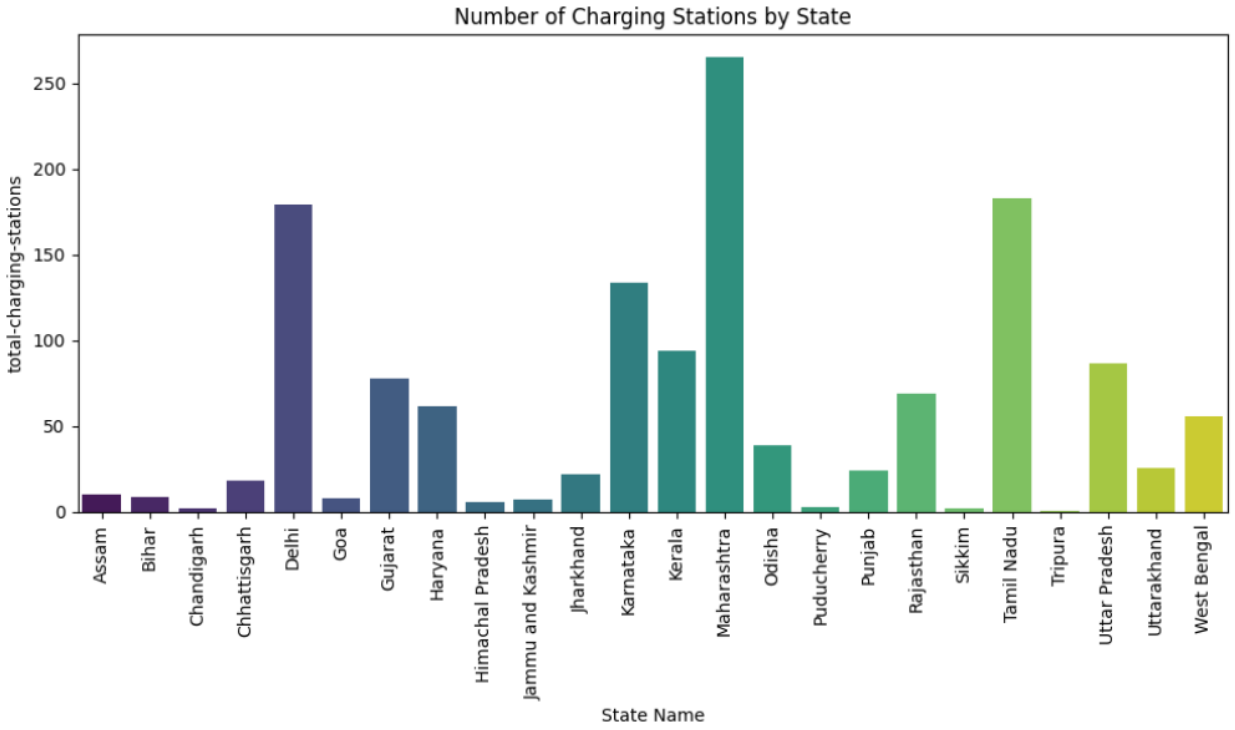
As a result, what is considered a premium segment in the ICE market (₹10 lakh to ₹25 lakh) translates to an "affordable" segment in the EV market, typically ranging between ₹1 lakh and ₹30 lakh. **This shift in price perception means that for a start-up aiming to develop a product in the 4-wheeler EV category, focusing on this ₹10 lakh to ₹30 lakh range would be strategically beneficial.** This pricing aligns with current market expectations for affordable electric vehicles, making it more appealing to mainstream consumers who are transitioning from traditional ICE vehicles to EVs. By targeting this segment, the start-up can capitalize on the growing demand for affordable yet technologically advanced electric vehicles in India.

7. Geographic Suitability:

The adoption of electric vehicles (EVs) in India varies significantly across different states, influenced by factors such as infrastructure, regional policies, and consumer preferences. From the bar chart, it is clear that states like **Maharashtra**, **Karnataka**, **Tamil Nadu**, and **Delhi** are leading the way in electric vehicle adoption, as reflected by the noticeable presence of **Electric (BOV)** vehicles in these regions. These states have been early movers in developing charging infrastructure and offering subsidies for electric vehicles, making them more attractive to potential EV buyers.

In contrast, states like **Bihar**, **Uttar Pradesh**, and **West Bengal** show a higher dependence on traditional fuel types like **Petrol** and **Diesel**, with comparatively lower electric vehicle penetration. This indicates the need for further development of charging infrastructure and policy incentives in these regions to foster EV adoption. States with a higher reliance on **CNG** and **Petrol/CNG** combinations, such as **Delhi** and **Gujarat**, also indicate a gradual transition towards cleaner energy but have room for further growth in electric mobility.

Overall, the chart highlights that while urbanized states with strong infrastructure development are adopting EVs at a faster rate, other regions still depend heavily on traditional fuels. To bridge this gap, state-specific strategies that focus on expanding the EV charging network and raising awareness of the benefits of EV ownership are essential to increase adoption rates across the country.



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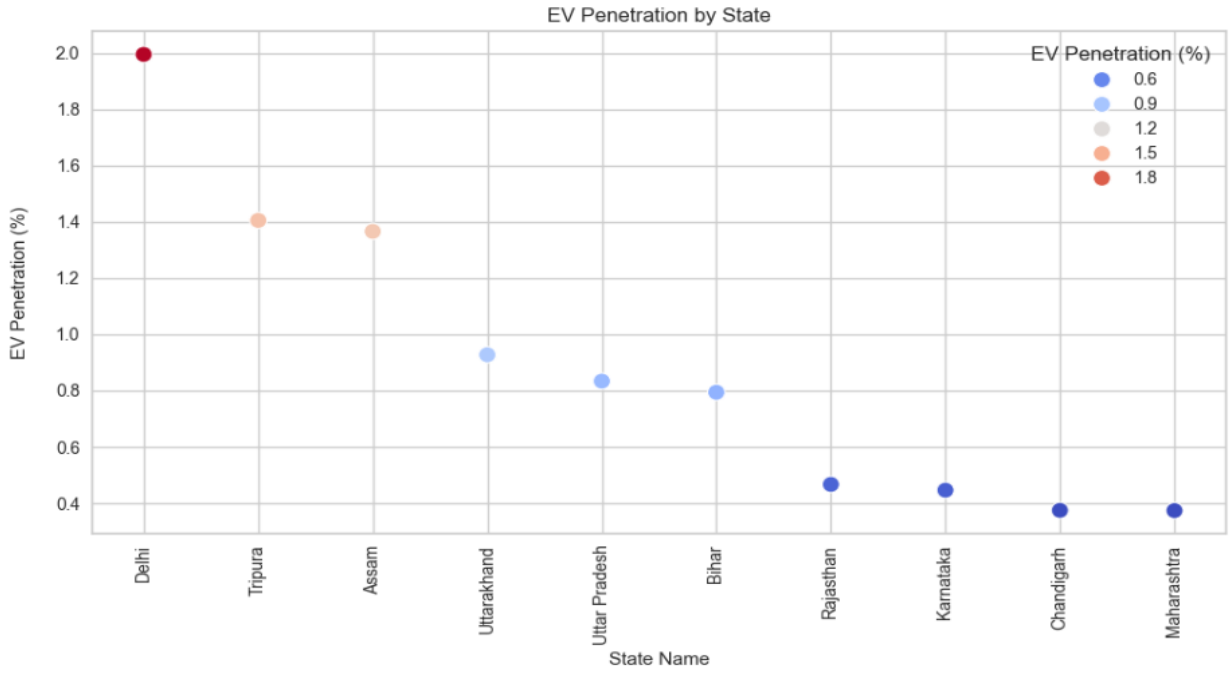
Top 5 States with Most Charging Stations:

	State Name	total-charging-stations
16	Maharashtra	265.0
26	Tamil Nadu	183.0
6	Delhi	179.0
13	Karnataka	134.0
14	Kerala	94.0



8. Data Pre-processing

The data preparation phase of this project involved a systematic approach utilizing Python libraries such as numpy, pandas, matplotlib, , and seaborn. The initial task was to consolidate the sales data, which was initially spread across 10 separate Excel sheets. By leveraging pandas, the data was merged into a unified dataset, laying the foundation for subsequent analysis. A key focus was placed on ensuring the accuracy of electric vehicle manufacturer names through meticulous data cleansing operations.

Following the data consolidation, essential aggregation operations were performed on the electric two-wheeler sales data. This step provided a detailed perspective on market trends. The next phase centered on data preparation for market segmentation. Customer reviews and responses were integrated with corresponding electric vehicle technical specifications. To maintain data integrity, null values were handled using specific logical values, ensuring a complete dataset.

Sentiment analysis of customer reviews was conducted using the natural language processing capabilities of nltk. This analysis provided valuable qualitative insights into customer sentiments. Subsequently, behavioral variables such as Visual Appeal, Reliability, Performance, Service Experience, Extra Features, Comfort, Maintenance Cost, and Value for Money were isolated and carefully prepared. These variables were fundamental in laying the groundwork for the market segmentation analysis, providing a nuanced understanding of customer preferences and attitudes toward electric vehicles.

9. Segment Extraction

9.1 Using Sales Data

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

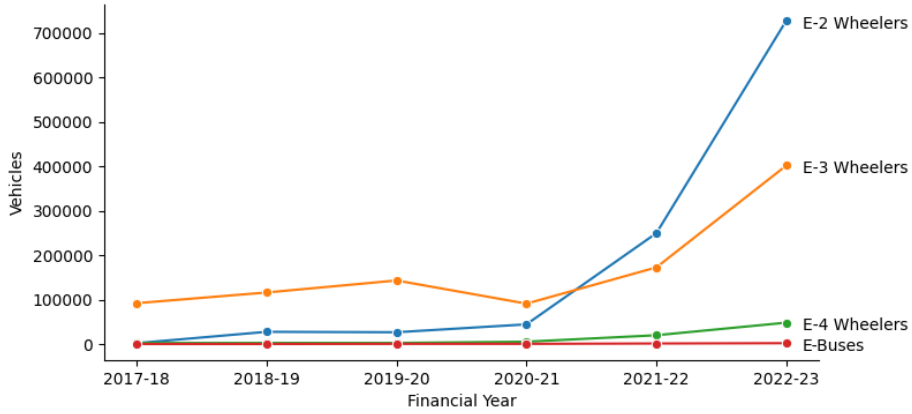


Figure 5.1 India's electric vehicle market

Figure 5.1 showcased the remarkable growth trajectory of India's two-wheeler market in 2023, underscoring its leading position within the industry.

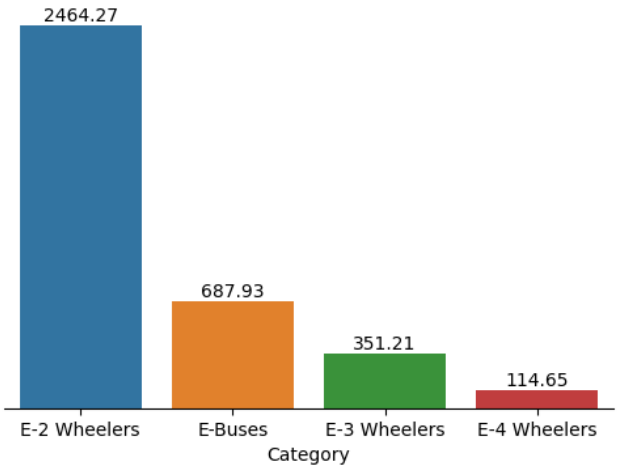


Figure 5.2 India's electric vehicle industry in crores

Figure 5.2 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.

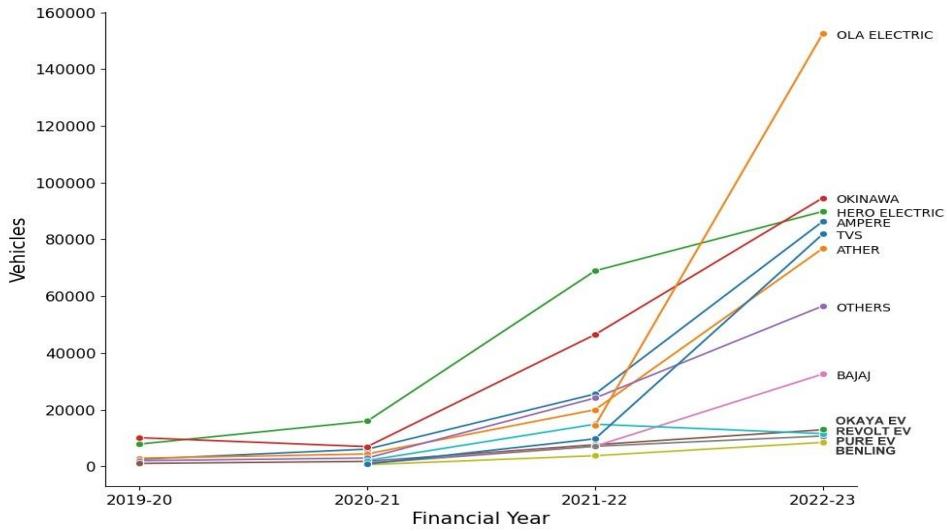
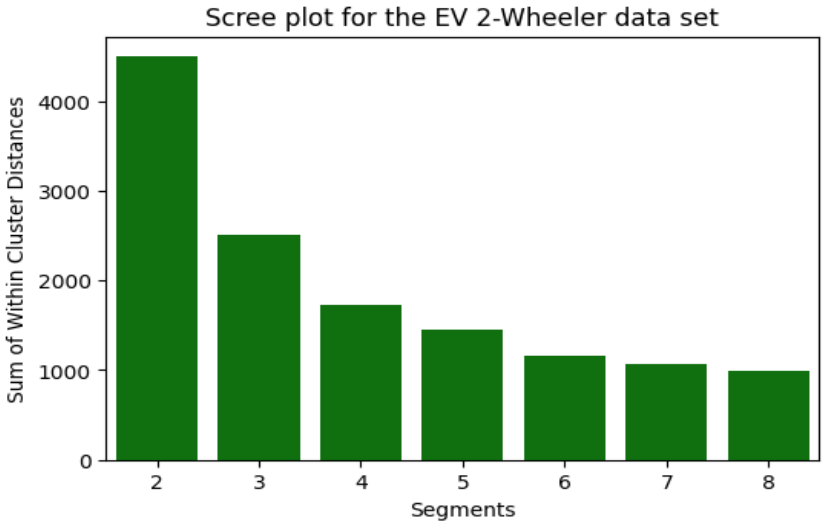


Figure 5.3 Top electric two-wheeler companies

In 2023, Ola Electric emerged as the market leader among specific electric two-wheeler companies, showcasing industry leadership and competitiveness. The electric two-wheeler segment was identified as the most promising area for detailed study due to robust growth, revenue dominance, and market leadership. Using the k-means algorithm, market segmentation possibilities within electric two-wheeler customer reviews data were



explored. The scree plot Figure 5. 4 indicated a distinct elbow at four segments, guiding the decision-making process towards the optimal number of segments for analysis. By incorporating insights from these analyses, focus remained on the electric two-wheeler segment, ensuring precision and relevance in market segmentation.

Figure 5.4 Scree plot for the electric vehicle data set

9.2 Selection of Target Segment

Our strategic target segments for the electric vehicle market are Segment 1 and Segment 2, which make up 39% and 33% of consumers, respectively. Segment 1 has diverse perceptions and preferences, presenting opportunities to understand and address their specific demands for improved customer satisfaction and loyalty. Segment 2 values visual appeal, reliability, service experience, and comfort, offering insights for customizing our electric vehicles to cater to their expectations and create resonance within this group. Addressing Segment 1's dissatisfaction points and enhancing Segment 2's positive perceptions will help refine our offerings and ensure a competitive edge. By aligning with the unique needs of these segments, our strategy aims to enhance existing features, address dissatisfaction, and amplify positive elements to drive sustained market growth and customer loyalty.

10. Profiling and Describing Segmentation

10.1 Profiling Segments

This section provides a detailed analysis of consumer segments outlined in Figure 6. 1. Segment 0 (15%) values electric two-wheelers for visual appeal, reliability, performance, service, and comfort. Segment 1 (39%) is the largest but least satisfied group. Segment 2 (33%) appreciates visual appeal, reliability, service, comfort, and sees value for money. Segment 3 (13%) values visual appeal, reliability, performance, service, features, and maintenance cost, displaying unique perspectives on features and costs.

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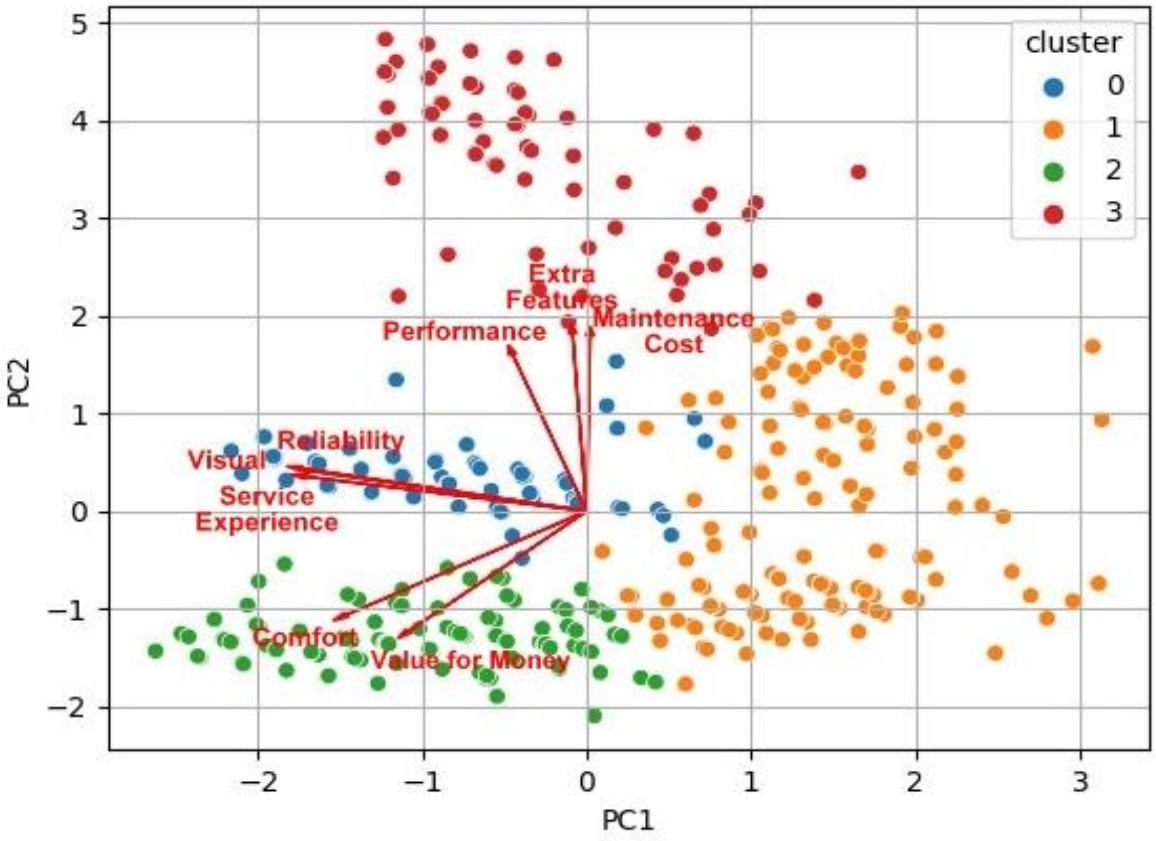

Figure : Highlights differences in segments using principal components. Despite Segment 1's size, they lack specific opinions, setting them apart in satisfaction levels. These insights shape our strategy, aligning our electric vehicles with varied values and priorities accurately.

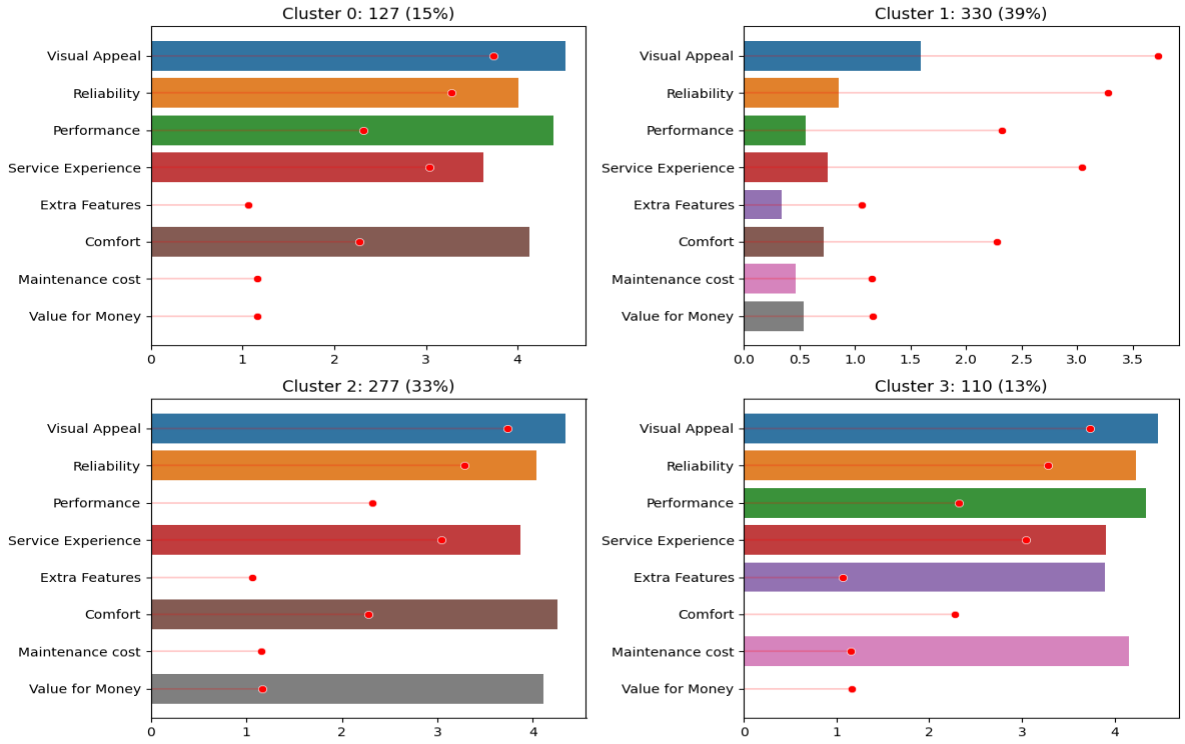

Figure : Segment profile plot for the four-segment solution

11. Potential Early Market Customer Base

In our electric vehicle market strategy, customization is key to targeting Segment 1 and Segment 2. We plan to tailor product features to address specific desires within each segment, focusing on performance and service for Segment 1, and visual appeal and value for money for Segment 2. Diverse offerings cater to varied tastes and budgets.

Price customization involves setting competitive prices, with affordable options for Segment 1 and slightly higher prices for value-added features in Segment 2. Promotions will be tailored to emphasize reliability and service for Segment 1, and aesthetics and affordability for Segment 2. Distribution channels will be established in urban areas for Segment 1 and suburban/semi-urban regions for Segment 2, with a strong online presence for seamless purchasing and customer support.

Training customer service representatives to address segment-specific concerns empathetically is essential for People and Process customization. Efficient processes for customization requests and service appointments enhance customer satisfaction and

loyalty. This approach ensures that our electric vehicles meet the distinct needs of Segment 1 and Segment 2, driving market relevance and customer preference.

Segment 1, with 330 members (39% of consumers), and Segment 2, with 277 members (33% of consumers), represent the primary target segments in the early market. Target price ranges have been determined for each segment, guiding potential sales and profits. Segment 1 shows a larger market share and customer base, with a calculated potential profit of ₹39. 60 crores, while Segment 2 has a potential profit of ₹30. 47 crores.

Strategic Analysis:

- I**nfrastructure Development**: Prioritize regions with high EV adoption but low charging infrastructure.
- **Policy and Incentives**: Tailor government incentives to increase EV adoption and support infrastructure.
- **Public Awareness**: Promote education and awareness around the benefits of EVs and the availability of incentives and infrastructure.
- **Private Partnerships**: Engage private companies to co-invest in charging stations and other infrastructure needs.

Market Fixing for Electric Vehicle (EV) Growth and Charging Infrastructure

To accelerate the **electric vehicle (EV) market** and ensure long-term sustainability, a comprehensive **market fixing strategy** is necessary. This strategy should address the market gaps, barriers to entry, and consumer adoption challenges identified through the dataset analysis. Here are some key areas of focus:

1. **Address the Supply and Demand Mismatch**
    - **Market Gap**: In certain states, there's a mismatch between the **demand for EVs** and the availability of **charging infrastructure**.
    - **Fix**: Invest in a **targeted expansion of charging networks** in high-demand areas. Introduce **incentive programs** for businesses (e.g., shopping malls, gas stations) to install charging stations to meet consumer needs. Encourage **public-private partnerships** to build more charging stations, especially in rural and underserved areas.

2. **Government Subsidies and Incentives**

- **Market Gap**: EVs may have a higher upfront cost compared to traditional vehicles, and adoption in certain states may be slow.
- **Fix**: Provide **tax credits**, **subsidies**, and **low-interest loans** to encourage the purchase of EVs. Offer **grants for installing EV infrastructure** for businesses and residential buildings. Introduce **state-specific policies** to address regional disparities in EV adoption.

3. **Price Optimization for EVs**

- **Market Gap**: Pricing can be a barrier to adoption, especially for middle and low-income consumers.
- **Fix**: Work with manufacturers to optimize **price points for EV models** based on regional demand. Encourage the development of **affordable EV models**, including two-wheelers and compact cars, to appeal to a broader market.

4. **Enhance Consumer Awareness and Education**

- **Market Gap**: Lack of awareness about the long-term savings and benefits of EV ownership.
- **Fix**: Launch **consumer education campaigns** to highlight the **cost-saving benefits** (e.g., lower fuel and maintenance costs) and **environmental benefits** of EVs. Promote **EV test drive events** and educational outreach in regions where adoption is slow. Utilize **social media and digital platforms** to raise awareness about government subsidies and charging station availability.
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5. **Regulatory and Policy Support**

- **Market Gap**: Policy uncertainty in some states may discourage investment and consumer adoption.

Fix: Implement **clear and consistent regulations** that support EV infrastructure development and long-term market stability. Mandate **EV-friendly policies** (e.g., emission reduction targets, green transportation goals) at both state and federal levels to encourage automakers and consumers to invest in electric vehicles. Set **clear deadlines for phasing out gasoline-powered vehicles**, especially in states with high pollution levels.

6. **Support Research and Development (R&D)**

- **Market Gap**: Innovation is needed to improve battery technology and charging speed, making EVs more attractive.
- **Fix**: Support R&D for **long-range battery technology** and **faster charging solutions**. Encourage innovation in **renewable energy integration**, such as solar-powered charging stations and vehicle-to-grid (V2G) technologies. Collaborate with universities, research institutions, and private companies to develop **next-generation EVs** and **smart grids** for EV charging.

7. **Private Sector Engagement**

- **Market Gap**: The private sector may be hesitant to invest in EV infrastructure due to perceived market risks.
- **Fix**: Create **financial incentives** and **guarantees** to encourage private-sector investment in **charging networks**, especially in less profitable rural and suburban areas. Encourage **auto manufacturers** to expand their EV model offerings and support EV infrastructure. Engage **utility companies** to invest in building **smart charging stations** that can handle future growth in EV usage

Contributors

This project was a team effort, and we acknowledge the contributions of all members.

You can explore their work on GitHub:

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Conclusion:

After a comprehensive analysis of India's electric vehicle (EV) market, several strategic insights have emerged that inform the company's focus and approach in manufacturing and selling EVs.

Market Opportunities

1. Targeting Promising Segments: Segment 1, representing 39% of the consumer base, stands out as the most promising target. By customizing electric two-wheeler specifications to meet this segment's preferences, the company can tap into a significant market opportunity. This focus on a specific segment is grounded in a deep understanding of market segmentation and consumer behavior, guiding product development and marketing strategies for a successful market entry.

2. Categories of Vehicles: The analysis indicates strong demand for both personal and shared vehicles in the mainstream market, particularly 2-wheelers and 4-wheelers. Given the significant representation in Cluster 1, the company should prioritize these vehicle types. Additionally, there is potential in niche markets such as buses and goods vehicles, which may offer less competition and unique opportunities for growth.

Table : Technical specification of electric vehicle two-wheeler for segment 1

Specifications for EV-2W	**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

Specifications for EV-4W	**Recommended Range (in INR)**
Price	10,00,000– 25,00,000
Riding range	320 - 560 kms on WLTP cycle

Target Markets for Sales

3. Geographic Focus: The company should concentrate its efforts on states with the highest EV uptake, such as Maharashtra, Karnataka, Tamil Nadu, and Rajasthan. These regions demonstrate significant acceptance and usage rates for EVs, making them prime targets for sales strategies.

4. Diverse Market Segmentation: Selling to both consumer (personal use) and commercial segments (shared use and goods transportation) allows the company to diversify its market base. This diversification can enhance resilience against market fluctuations, providing a broader platform for growth and stability.

Economic Dynamics and Price Segmentation

5. Understanding Price Perception: The analysis of customer buying behavior in the internal combustion engine (ICE) vehicle segment reveals that the premium market (₹10 lakh to ₹25 lakh) attracts the most buyers. However, in the EV market, economic dynamics shift the price perception. EVs are generally priced 30% higher than their ICE counterparts due to factors like battery technology costs and economies of scale. Thus, what is seen as a premium segment in ICE vehicles becomes the "affordable" segment for EVs, typically ranging from ₹10 lakh to ₹30 lakh.

6. Strategic Focus on Affordable EVs: For a start-up aiming to enter the 4-wheeler EV category, targeting the ₹10 lakh to ₹30 lakh range aligns with current market expectations for affordable electric vehicles. This strategic positioning is essential as it meets the growing demand from consumers transitioning from traditional ICE vehicles to EVs. By focusing on this price segment, the start-up can attract mainstream consumers seeking affordability, performance, and advanced features in electric vehicles.

In conclusion, the company's strategic focus should be on electric two-wheelers and four-wheelers, particularly in the ₹10 lakh to ₹30 lakh price range. By targeting states with high EV acceptance and addressing both consumer and commercial markets, the company is well-positioned to succeed in India's dynamic electric vehicle landscape. This approach leverages insights from market segmentation and consumer preferences, ensuring a solid foundation for growth and competitive advantage in the burgeoning EV sector.