ELECTRIC VEHICLE MARKET SEGMENTATION ANALYSIS

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EV SALES MARKET SEGMENTATION - Aiswarya Sudhir

1. Introduction

In this project, I've undertaken a comprehensive analysis of India's electric vehicle market, with a keen focus on customer segmentation derived from electric vehicle sales spanning from 2020 to 2024 across various states in India. The study delved into both behavioral and geographic segmentation, considering factors such as the states and vehicle categories preferred by customers.

One of the notable findings of the analysis is the robust growth trajectory observed in India's three-wheeler market and the sales of M-cycle/M-scooters. These insights shed light on the evolving dynamics and preferences within the electric vehicle market in India. To deepen our understanding further, I employed behavioral variables from past purchases to conduct a rigorous market segmentation analysis, utilizing the standard k-means algorithm. This analytical approach effectively partitioned the market into two distinct segments, revealing clear differences in customer preferences and behaviors.

By segmenting the market, I gained valuable insights that can inform strategic decision-making for businesses operating in the electric vehicle industry. Understanding the distinct needs and preferences of each segment allows for tailored product offerings and targeted marketing strategies, ultimately driving growth and competitiveness in India's electric vehicle market.

2. Fermi Estimation

2.1 Problem Statement

India's transportation landscape is undergoing a remarkable transformation, primarily fueled by the widespread adoption of Electric Vehicles (EVs). These vehicles are revolutionizing India's mobility narrative by providing a sustainable answer to the pressing challenges of pollution and greenhouse gas emissions.

To tackle the Electric Vehicle Market, we're leveraging data-driven insights derived from comprehensive sales data, encompassing both behavioral and geographical information, alongside technical specifications of electric vehicles. Our objective is to harness these insights to segment the market and identify optimal target segments for our electric vehicles.

By analyzing sales data enriched with behavioral and geographical insights, we aim to uncover patterns and preferences among consumers. Understanding these dynamics will enable us to effectively tailor our offerings to meet the diverse needs of different market segments. Ultimately, our goal is to leverage data-driven decision-making to carve out a strategic position in the Indian electric vehicle market. By identifying and prioritizing target segments based on comprehensive insights, we can maximize our impact and drive sustainable growth for our Electric Vehicle Startup.

In our approach to Fermi Estimation for market segmentation and strategy formulation, we follow a systematic process aimed at leveraging data-driven insights to inform decision-making and maximize market potential for our Electric Vehicle Startup:

2.2.1 Data Collection and Assessment
- Gather Comprehensive Data: Collect sales data, electric vehicle customer reviews, and technical specifications.
- Assess Data Reliability: Evaluate the reliability and comprehensiveness of the collected data to ensure its suitability for analysis.

2.2.2 Segmentation Using Behavioral Variables
- Identify Patterns and Segments: Utilize behavioral data to identify patterns and segments within the customer base.
- Estimate Segment Characteristics: Employ data-driven techniques to estimate the size and characteristics of each segment.

2.2.3 Analysis of Psychographic Data
- Understand Customer Preferences: Analyze psychographic data within each behavioral segment to understand customer preferences and motivations.
- Estimate Psychographic Traits: Estimate the psychographic traits and preferences of customers within each segment.

2.2.4 Technical Specification and Price Analysis
- Evaluate Technical Specifications: Assess the technical specifications of electric vehicles within identified segments.
- Impact Analysis: Estimate the impact of technical features on customer preferences and purchasing decisions.

2.2.5 Target Segment Selection
- Thorough Analysis: Select target segments based on a comprehensive analysis of behavioral, psychographic, and technical factors.

2.2.6 Customization of Marketing Mix
- Tailored Marketing Mix: Develop a customized marketing mix tailored specifically for the selected target segments.
- Effectiveness Estimation: Estimate the effectiveness of various marketing strategies within the selected target segments, aligning them with customer preferences.

2.2.7 Segment Recommendation
- Finalize Recommendations: Combine segment analysis results and marketing mix customization findings to finalize segment recommendations.

- Market Potential Assessment: Recommend target segments with the highest estimated market potential, ensuring a focused and targeted market entry strategy.

By rigorously following these steps and employing Fermi estimation techniques at each stage, our Electric Vehicle Startup aims to make informed decisions, precisely target market segments, and tailor our marketing approach. This strategic approach will enable us to ensure a successful market entry and sustain growth in the competitive electric vehicle market.

3. **Data Sources**

3.1 https://cleanmobilityshift.com/ev-dashboard/
The data has been downloaded from EV Sales - Statewise

4. **Data Pre-processing**

Libraries Used:
- Pandas
- Numpy
- Seaborn
- Matplotlib
- Scikit Learn`

Data cleaning was done using pandas functions . unnecessary columns not required for segmentation purposes were removed and the data was further reduced from the year 2020 to 2024 for better analysis results. . To maintain data integrity, null values and duplicate values were handled using specific logical values, ensuring a complete dataset.

	Year	Month_name	Date	State	Vehicle Class	Vehicle Category	Vehicle Type	ELECTRIC(BOV)	Total
12	2022	nov	11/1/2022	Andaman & Nicobar Island	M-CYCLE/SCOOTER	2-Wheelers	2W_Personal	1	386
15	2022	nov	11/1/2022	Andaman & Nicobar Island	MOTOR CAR	4-Wheelers	4W_Personal	1	156
16	2022	nov	11/1/2022	Andaman & Nicobar Island	MOTOR CYCLE/SCOOTER-USED FOR HIRE	2-Wheelers	2W_Shared	5	15
274	2022	dec	12/1/2022	Andaman & Nicobar Island	MOTOR CAB	4-Wheelers	4W_Shared	3	8
276	2022	dec	12/1/2022	Andaman & Nicobar Island	MOTOR CYCLE/SCOOTER-USED FOR HIRE	2-Wheelers	2W_Shared	10	15

Here we can see the number of electric vehicles sold with date and in which state grouped by vehicle category and vehicle class.

5. **Segment Extraction**

A detailed exploratory data analysis was conducted with the sales data with respect to different states, type of vehicle, category of vehicle and how the sales have increased throughout the years.
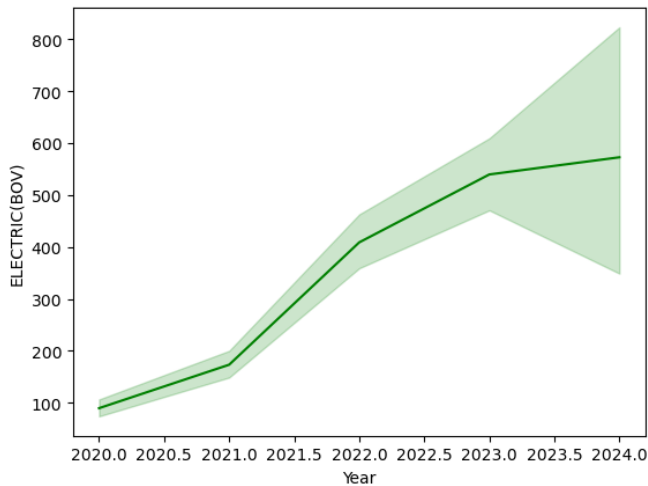
Fig 5.1 : India's Electric Vehicle Market

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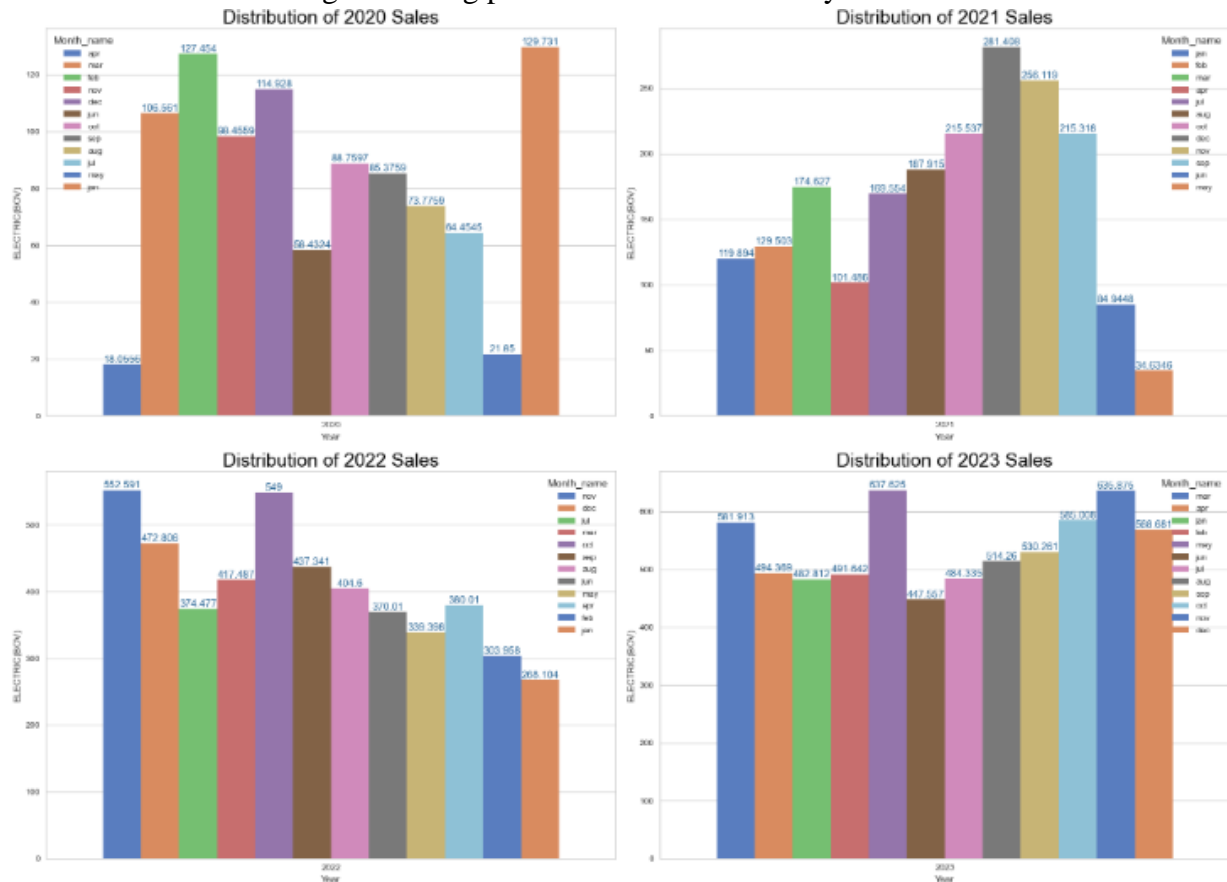

Fig 5.2 : Sales distribution from 2020 to 2023

From the above figure we can see that the number of electric vehicles sold fluctuates from January to December each year and does not remain stable even though the overall sales has increased.
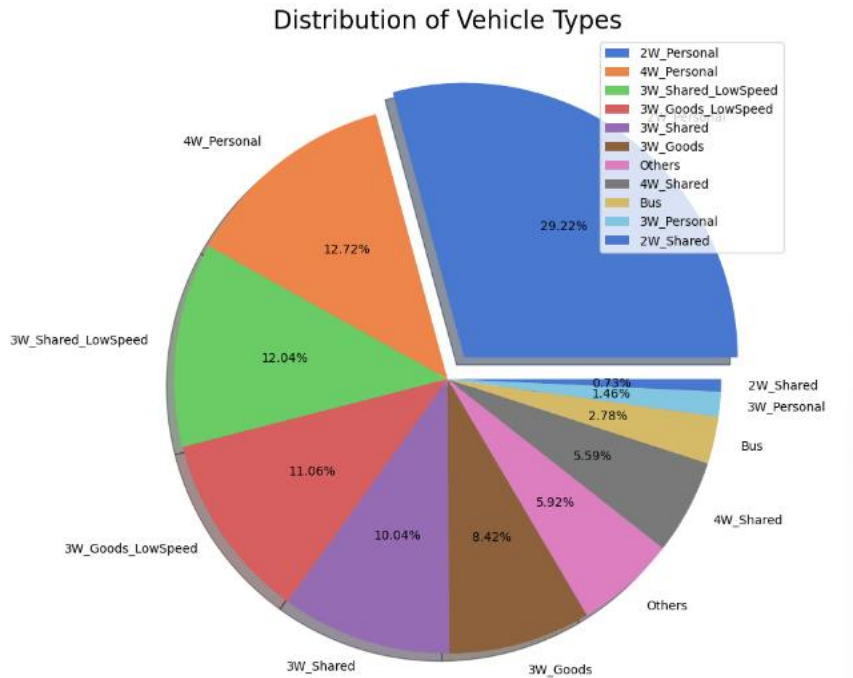
Fig 5.3 : Distribution of Vehicle Types

From the pie chart in fig 5.3 , we can observe that the 2w_Personal is the highest sold vehicle type from 2020 to 2023 followed by 12% of 4W_Personal.
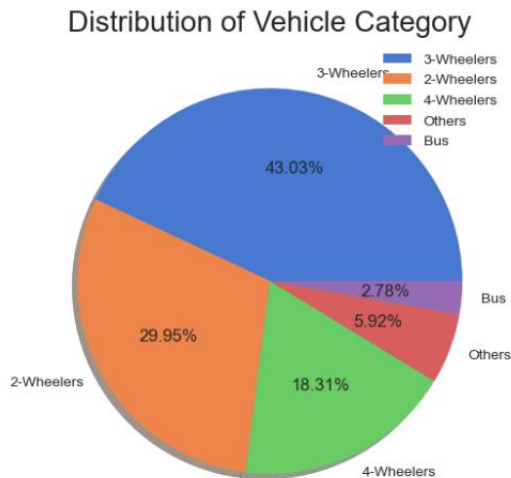

Fig 5.4 : Distribution of Vehicle Category

Fig 5.4, shows that around 43% of the electric vehicles sold were 3-wheelers which was followed by 29% of 2-wheelers.
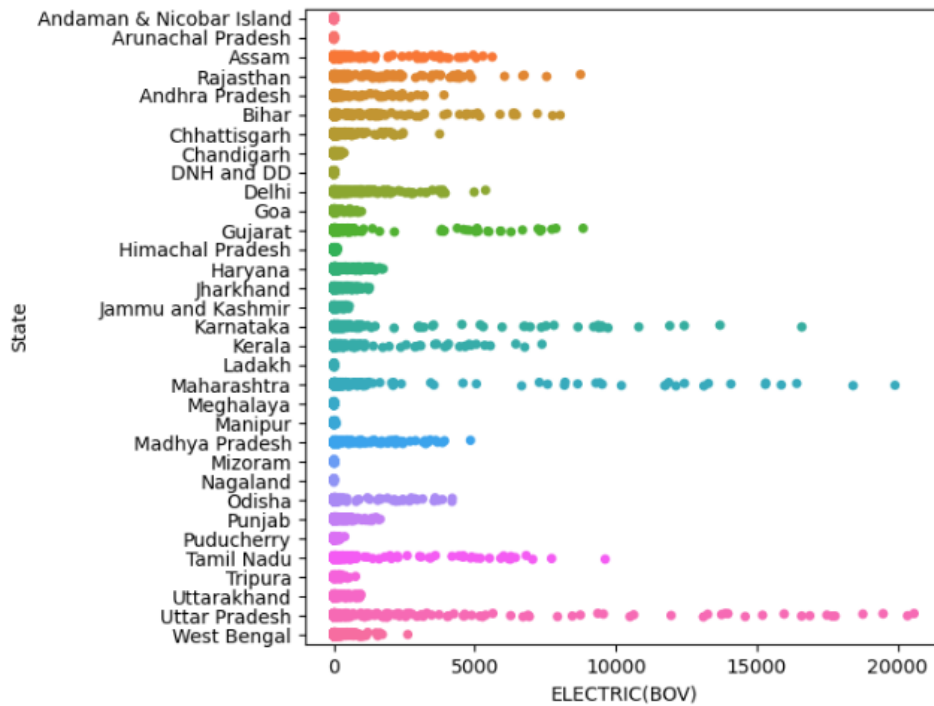
6. Profiling Segments

Fig 6.1 : EV sale distribution across states

The highest sales of Electric vehicles were from customers in Uttar Pradesh , which was followed by Maharashtra, Bihar , Karnataka , Tamil Nadu and Delhi as seen from Fig 6.1. Geographic segmentation can be performed using this variable to target effective markets.
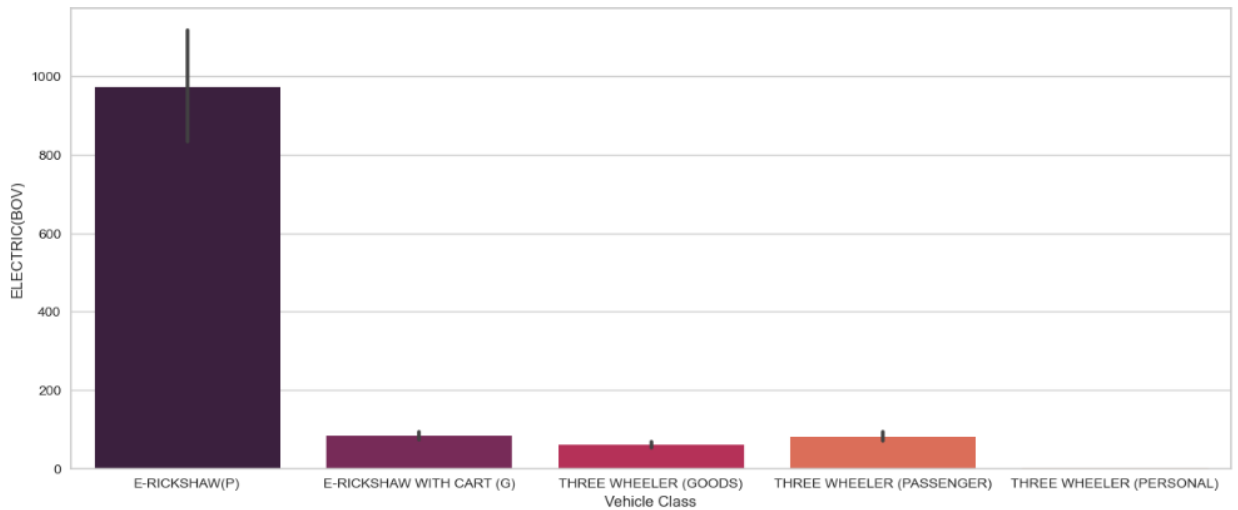

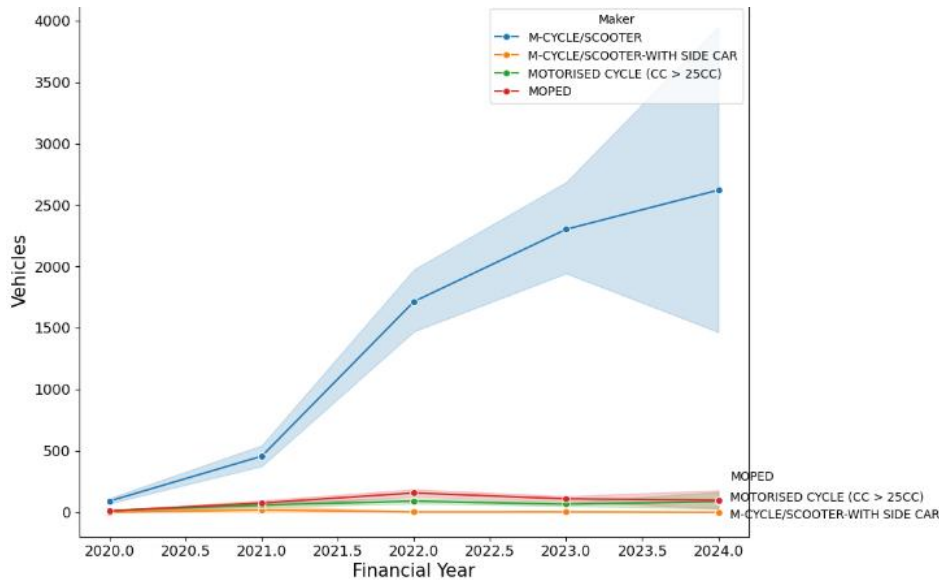**Fig 6.2 : EV sales of 3-wheelers by vehicle class**

Fig 6.3 : EV sales of 2W_Personal by vehicle class

3-wheelers were the most sold vehicle category as we saw from the pie chart. Among three wheelers , E-rickshaw had the highest sales and was the most preferred by customers as shown in fig 6.2 , hence both vehicle category and vehicle class are important segmentation variables. Similarly 2W_Personal occupied the top position for the most preferred vehicle type and on further analysis we can see from the line plot in fig 6.3 that when the vehicle type is 2W_Personal, motorcycle/scooter had the highest sales throughout that period.
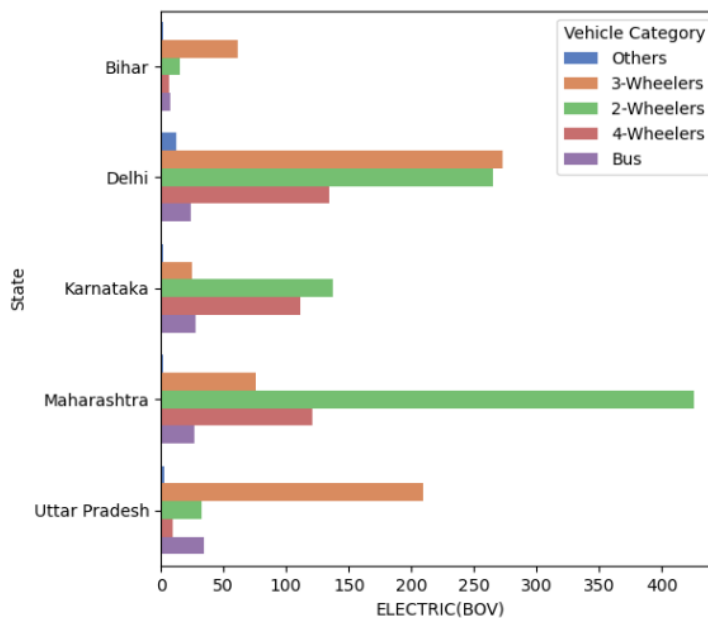

Fig 6.4 : EV sales in states grouped by vehicle category

In this subsequent analysis, the standard k-means algorithm was applied to explore market segmentation possibilities within the electric vehicle sales data. Solutions were systematically tested for two to four market segments. The decision-making process was significantly guided by the elbow method plot, revealing a distinct elbow at four segments. This marked point indicated a substantial reduction in distances, signifying the optimal number of segments for our analysis. By incorporating

insights from these analyses, our focus remained finely tuned on the three-wheeler segment, ensuring precision and relevance in our market segmentation approach

The bar graph in figure 6.4 depicts the top 5 states with the highest sales which are grouped by vehicle category. As we can observe , 3-wheelers and 2-wheelers are the most purchased electric vehicles overall in all states, with 3-wheelers sales leading in Delhi and 2-wheeler sales leading in Maharashtra.
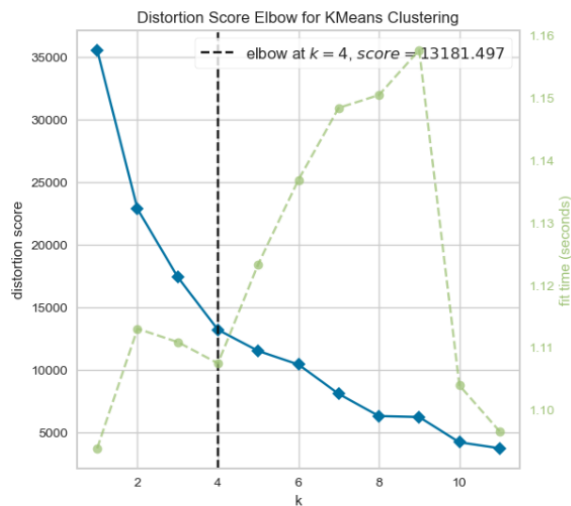

Fig 6.4 : Elbow Method for finding optimal number of clusters

The elbow method graph shows us that the optimal number of clusters required for market segmentation of electric vehicles in India is 4.

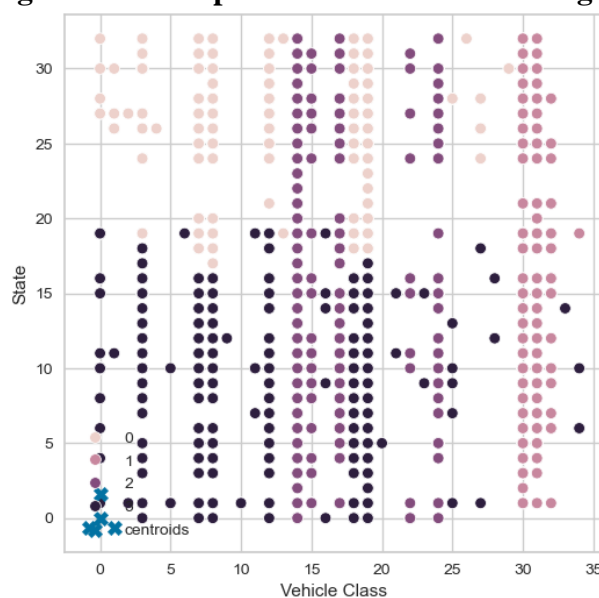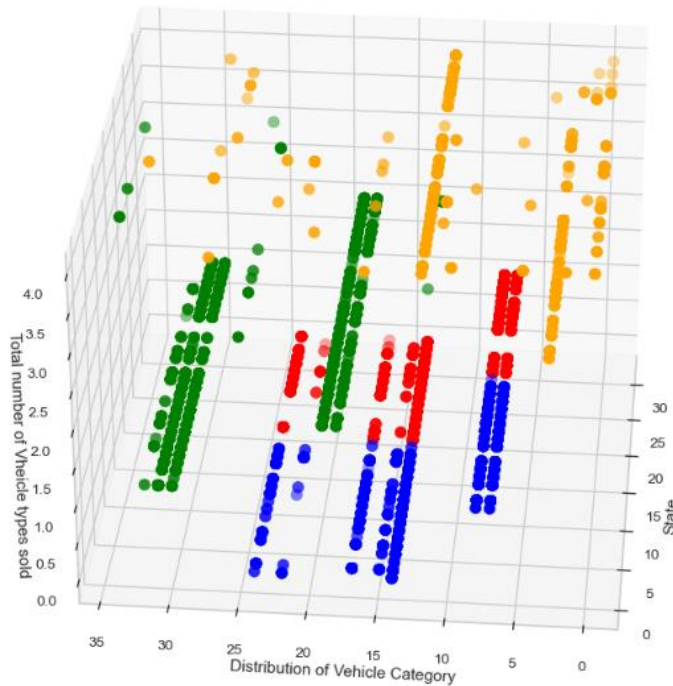**Fig 6.5 : Scatter plot for K-Means clustering**

Fig 6.6 : Scatter Plot showing correlation between segmentation variables

We have used K-means clustering for segmentation and the scatter plots shows the further emphasizes these differences and correlation between the 4 segments, these detailed insights play a pivotal role in shaping our strategy, ensuring our electric vehicles align precisely with the diverse values and priorities of each segment, thus informing our market offerings accurately.

This section presents a detailed analysis of our consumer segments, as illustrated in Figure 6.7. The graph visually captures the diverse perceptions among different segments. Segment 0, representing 21% of consumers, values the electric vehicle sales with correlation to which state it belongs,its vehicle type, vehicle category, vehicle class. Conversely, Segment 1 (20% of consumers) , the smallest segment,expresses a strong value for vehicle class but expresses dissatisfaction across all other aspects, marking them as the largest but least satisfied group. Segment 2 (30% of consumers) appreciates only geographical location and vehicle class, marking them as the largest segment. Lastly, Segment 3 (29% of consumers)maintains a constant value for vehicle type, vehicle category, vehicle class and state showcasing distinct perceptions, particularly on class and type.
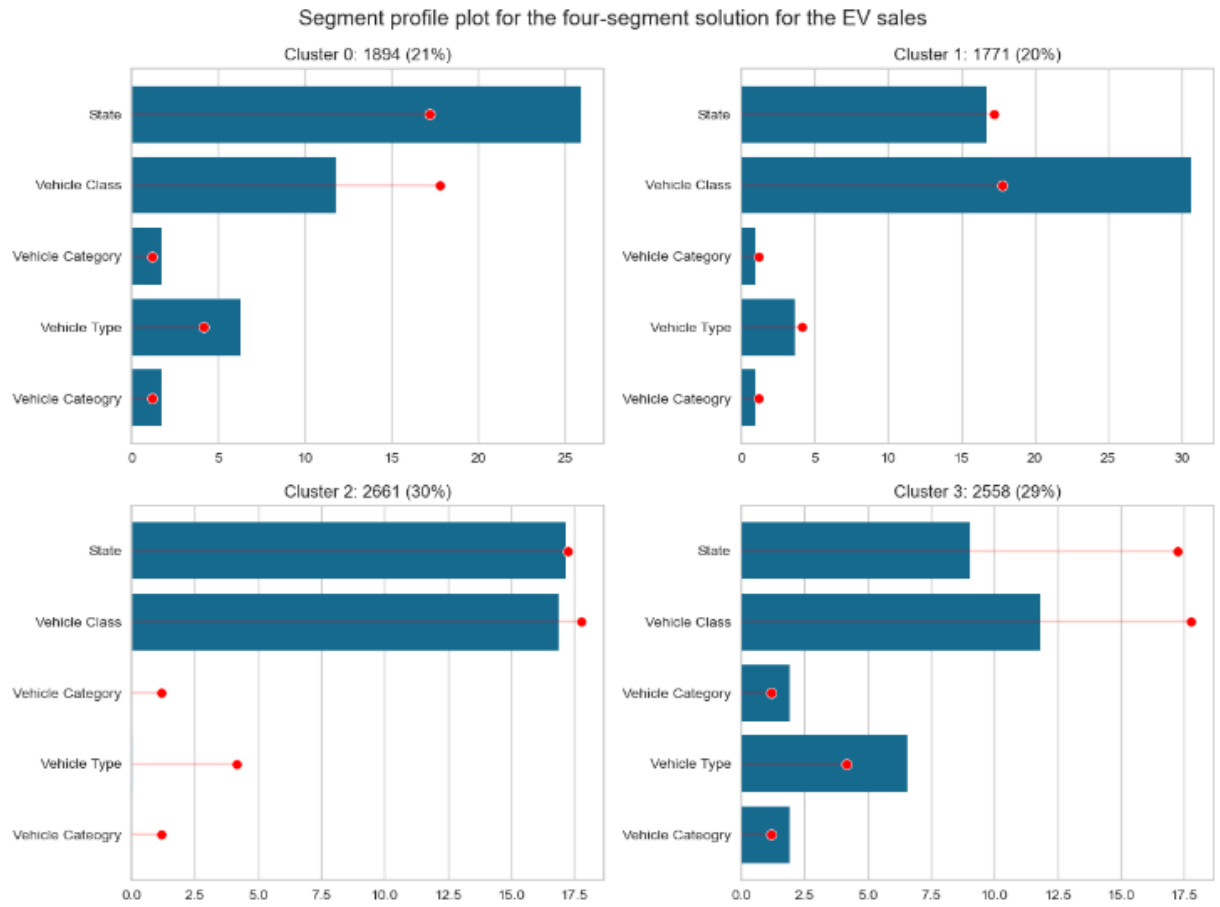
Fig 6.7 : Segment Profiling
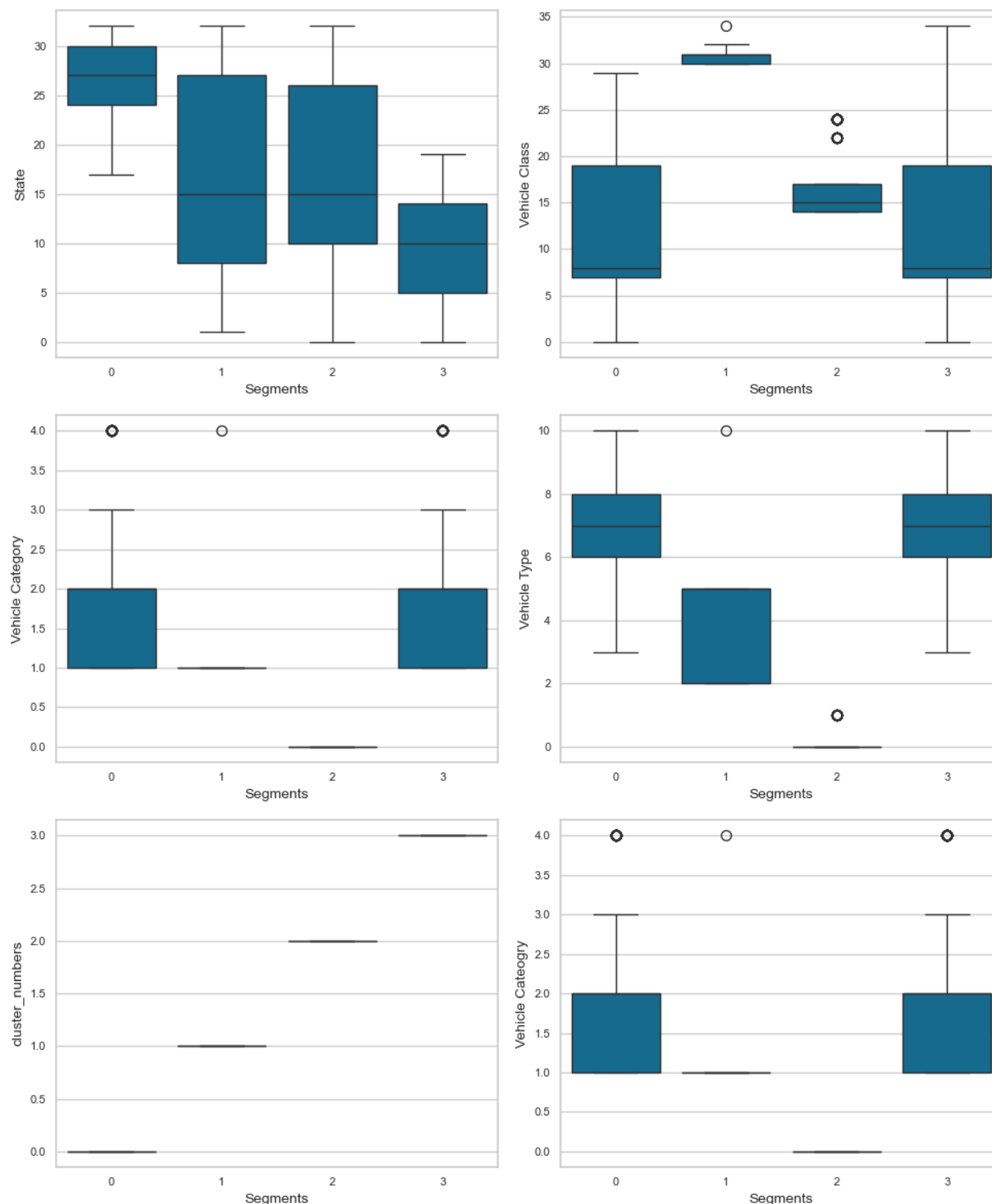
Fig 6.8: Describing Segments

In analyzing the technical specifications of electric vehicles across segments, distinct patterns emerge. Segment 0 showcases a major vehicle class, emphasizing a preference for vehicle category within this group. Conversely, Segment 1 exhibits a low vehicle category, indicating a focus on vehicle type and states. Segment 2 and Segment 3 also emphasize on state, albeit with large differences. These findings align with consumer preferences, highlighting varied considerations within the market. Moving to vehicle type, Segment 0 and 3 stands out with a higher average,

suggesting a preference for electric vehicles with specific class and category. Segment 1 and Segment 3 also focus on moderate ranges for vehicle classes. While Segment 0 and Segment 2 prioritize vehicle class suitable for consumers. Segment 1 and Segment 2 lean less towards vehicle class, accommodating diverse user preferences. Lastly, the states have a stable distribution in all segments with slightly higher levels towards segment 1 and 2. These technical specifications, visually represented in respective figures, underscore the nuanced preferences and priorities of each segment, shaping the landscape of the electric vehicle market in India.

7. Target Segment

In the strategic selection of our target segment for the electric vehicle market, Segment 0 and Segment 3 stands out as potential focal points. Segment 0, encompassing 21% of consumers, represents a vast market base with diverse perceptions and preferences. This segment's varying sentiments, as revealed through our analysis, signify their specific behavior and priorities. Understanding their unique perceptions, such as dissatisfaction across multiple aspects, presents an opportunity. Addressing these concerns directly can lead to improved customer satisfaction and brand loyalty within this significant market share.

Segment 3, comprising 29% of consumers, presents another enticing opportunity. Their distinct perceptions will shape customer expectations. This segment's sales analysis provides invaluable insights, aiding in the customization. By catering to these sales trends, such as states, preferred vehicle type ,class and category we can create a strong resonance within this consumer group.

Upon careful analysis, both segments offer a unique challenge and opportunity. Understanding Segment 0 and 1's positive perceptions provides a foundation for enhancing these features further, ensuring a positive customer experience and reinforcing brand loyalty.Incorporating these perceptions within the respective segments, our strategy will focus on Sales in particular states, production of more preferred vehicles, and enhancing positive vehicle types.By aligning our electric vehicles with distinct expectations we can ensure a competitive edge and sustained market growth.

8. Customizing the Market Mix

Vehicle type Customization involves introducing more enhanced features in the less preferred categories for electric vehicles and improved productions and flexible pricing structures. Category Customization demands targeted advertising, focusing on reliability and improvements for Segment 0 and 3 , and producing more 2 wheelers and 3 wheelers with more efficiency to further engage these segments effectively.

In terms of Location Customization, we'll establish accessible distribution channels in states with fewer electric vehicles purchased for Segment 0 and 3. 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. This tailored approach ensures our electric vehicles resonate with the distinct needs of Segment 0 and Segment , fostering market relevance and customer preference.

9. **Optimal Market segments**

In the context of selecting the most optimal market segment for our electric vehicle sales, thorough analysis and evaluation have pointed to Segment 3 as the ideal choice. Representing 29% 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 vehicle specifications and geographic location, positions it as the most promising market segment for our electric vehicles.

The recommended technical specification range for Segment 3, presented in Table 9.1

SPECIFICATION	RECOMMENDATION
State	Uttar Pradesh, Maharashtra, Karnataka, Delhi, Bihar
Vehicle Type	2W_Personal, 4W_Personal
Vehicle Class	E-Richshaw , motorcycle/motor scooter
Vehicle Category	2-wheelers, 3 wheelers

10. **Conclusion**

In this comprehensive analysis of India's electric vehicle market, we've pinpointed Segment 3 as the prime target for our Electric Vehicle Startup. With a substantial 29% consumer base, this segment presents a lucrative market opportunity for us. By aligning our electric vehicle sales with the preferences of Segment 3, we can effectively cater to the demands of a sizable customer base.

This strategic decision is rooted in a deep understanding of market segmentation, consumer behavior, and technical specifications. By leveraging these insights, we're able to make informed choices that ensure our products resonate strongly with the needs and preferences of our target audience.

Moving forward, this focused approach guides our market entry strategy, emphasizing precision and relevance in both product development and marketing initiatives. By staying attuned to the evolving landscape of India's electric vehicle market, we're poised to establish a solid foothold and drive sustainable growth for our Electric Vehicle Startup.

11. **Github**

Puja Rajput

EV Market Segmentation

-Puja Rajput

Introduction: The automotive industry in India has long been dominated by non-electric vehicles. The popularity of fossil fuel-based vehicles is attributed to their affordability, low maintenance costs, and the widespread availability of petrol and diesel infrastructure. However, electric vehicles (EVs) are now gaining traction in India. Major automotive brands like TATA, Mahindra, and international companies are introducing unique EV products. Our research and analysis have led us to develop a specific range of products for our startup, allowing us to compete with established automotive companies and provide affordable EV options to the Indian public.

Market Info:

a) **General Usage Info:** The Indian EV market varies significantly by state, depending on factors including demographics, income levels, regulatory landscape and urbanization. The state of Uttar Pradesh, for instance, with one of the lowest urbanization rates, has seen a significant uptake of electric two-wheelers.

・Challenges Ahead: Despite its potential, the Indian EV market faces challenges such as affordability, charging infrastructure expansion, and addressing consumer concerns like range anxiety. These issues require ongoing attention and innovative solutions.

· Promising Trajectory: The electric vehicle market in India is on a promising trajectory, with robust government support, increasing consumer awareness, and a growing infrastructure. This sector is poised for substantial growth in the coming years

b) **Battery Info:**

 Lead-acid batteries currently dominate the market but demand for Lithium-ion battery models is expected to grow rapidly under government incentives and demand from bike and scooters. Current and desired driving range of different EV categories in India set by the Government of India is presented in the following table.

Category	Battery Capacity (KWH)	Energy Consumption(kwh/km)

E-bike	1.2	0.016
2 WLS	2.2	0.025
2 WCS	3.0	0.030
2 WHP	4.6	0.035

Electric Cars	40	0.157

Electrode Materials: The choice of electrode materials significantly impacts the battery's longevity. Different materials exhibit varying levels of stability and durability over time.

Charge and Discharge Cycles: The number of charge and discharge cycles a battery undergoes affects its overall lifespan. Frequent cycling can lead to gradual degradation.

Charging Speed: The rate at which the battery is charged also matters. Rapid charging generates more heat and stress, potentially accelerating wear and tear.

Operating Temperature: The temperature during operation plays a crucial role. Extreme temperatures (both high and low) can harm the battery chemistry and reduce its effectiveness.

Reducing Greenhouse Gas Emissions: By handling retired EV batteries appropriately, we can minimize their environmental impact throughout their life cycle. This includes responsible disposal, recycling, or repurposing to prevent harmful emissions.

Maximizing Economic Value: Efficiently managing retired batteries ensures that their economic value is optimized. This can involve repurposing them for secondary applications (such as stationary energy storage) or recycling valuable materials like lithium, cobalt, and nickel.

This strategy aligns with the Government of India's target of installing 175 GW of renewable energy capacity by 2022. It is estimated that these batteries can serve as energy banks until they deteriorate to 60% of their initial capacity35 and this extends their economic life by another 10 years.

Market Analysis - Indian electric vehicle (EV) market is one of the fastest growing in the world. It is expected to grow at a compound annual growth rate (CAGR) of 94.4% from 2021 to 2030.

· The Indian government is offering several incentives to promote the adoption of EVs, including tax breaks, subsidies, and access to restricted lanes

· The government has set a target of achieving 30% electrification of the country's vehicle fleet by 2030. The EV market in India is expected to be worth around USD 152.21 billion by 2030.

· The government has also announced a production-linked incentive (PLI) scheme for manufacturing electric vehicles and components. The PLI scheme is expected to attract investments of around INR 45 billion (USD 570 million) and create over 75,000 jobs in the EV sector

Geographic and Demographic Research
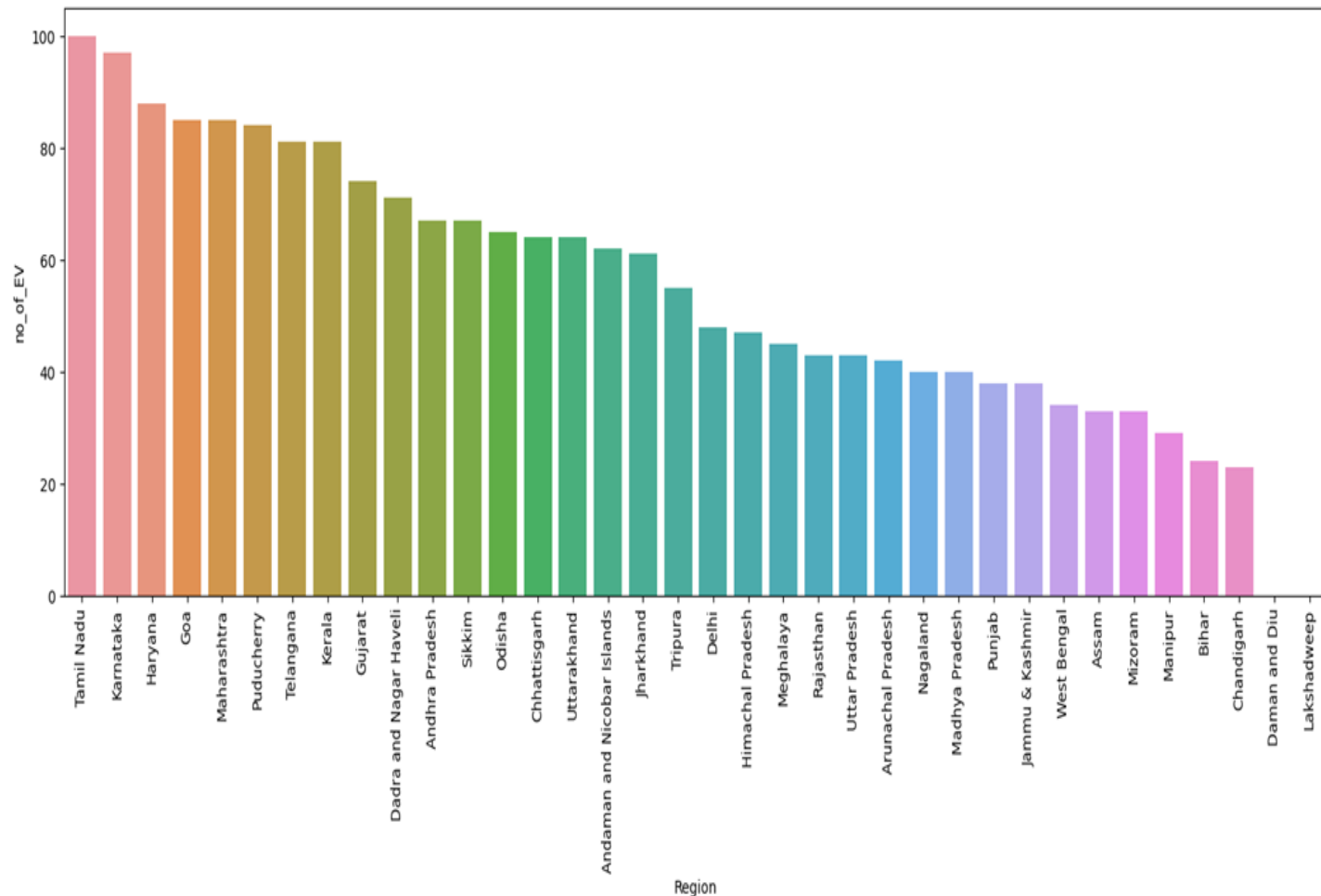
· South India being a Tech Hub is a backbone of EV demands.

· We analyzed those south Indian states that have a good number of charging stations available.

· Delhi has the highest number of charging stations but still EV popularity is relatively low.

· Other states and regions especially West, East and North and Central India have balanced   numbers and competitive demands.

· We did not get any survey information in Daman and Diu and Lakshadweep, so these two regions are not analyzed properly.

On availability of charging stations, we observed:
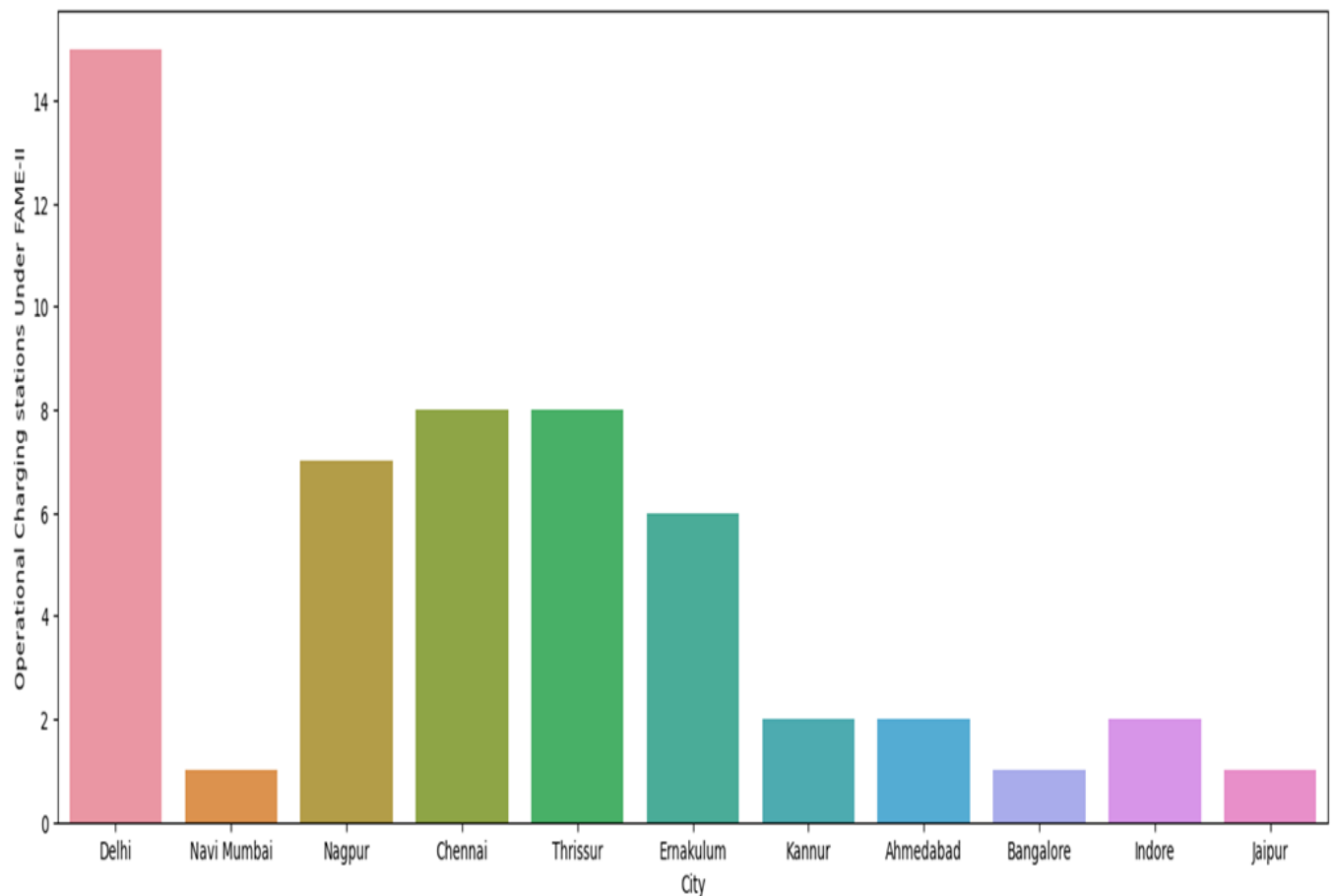

· First observation, only a limited number of charging stations are available in India as of 2023.

· Delhi has a greater number of charging stations compared to other metro cities.

· South Indian metro cities have a balanced number, but still many cities are missing from south India.

· Mumbai being the economic capital of India has only 1 charging station in Navi Mumbai.

Total Market Share of Electric Vehicles [State Wise]:

Here we can see most of the electrical vehicles used in Delhi and Mizoram have the least EV used.
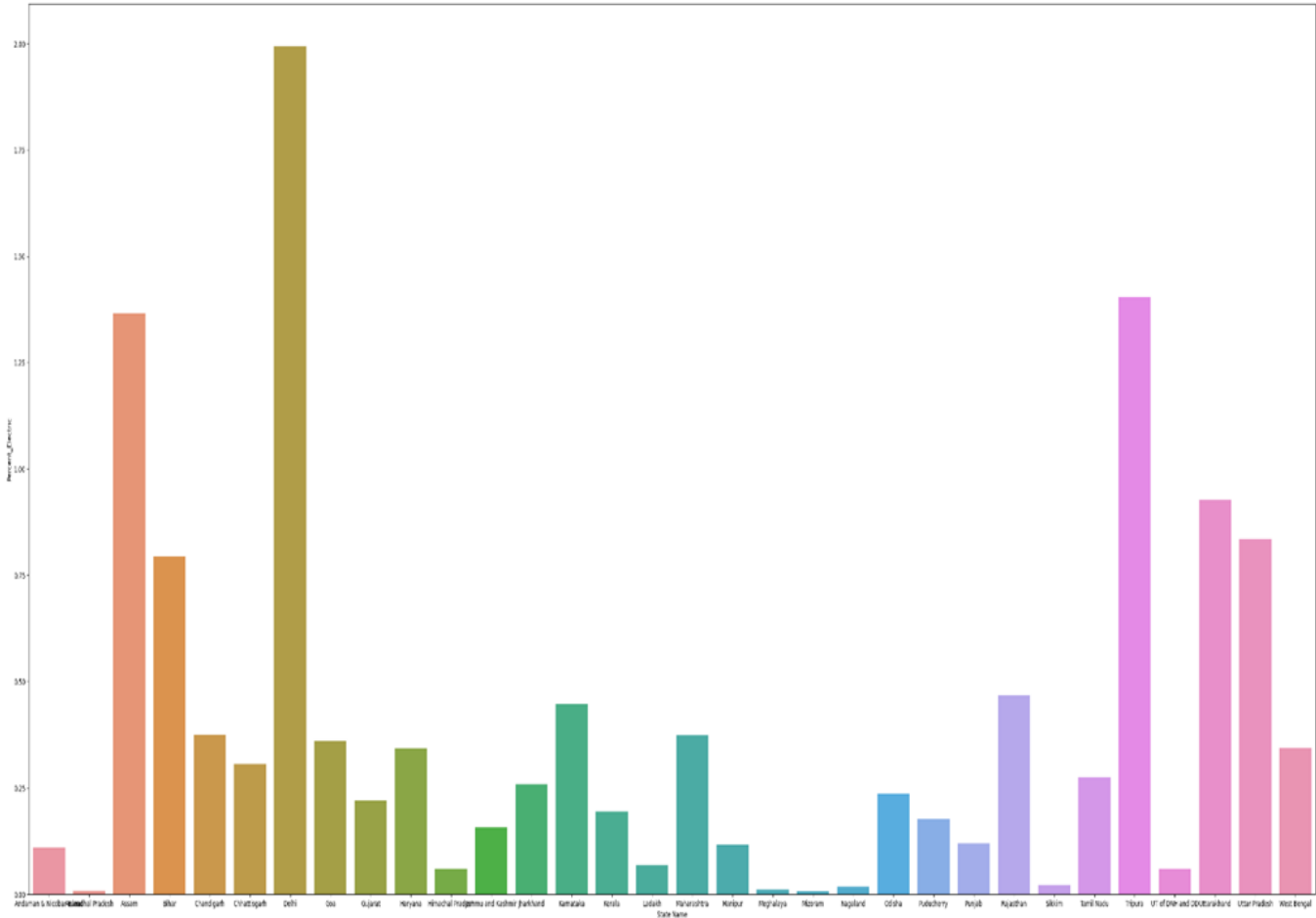
Biggest Untouched Markets:
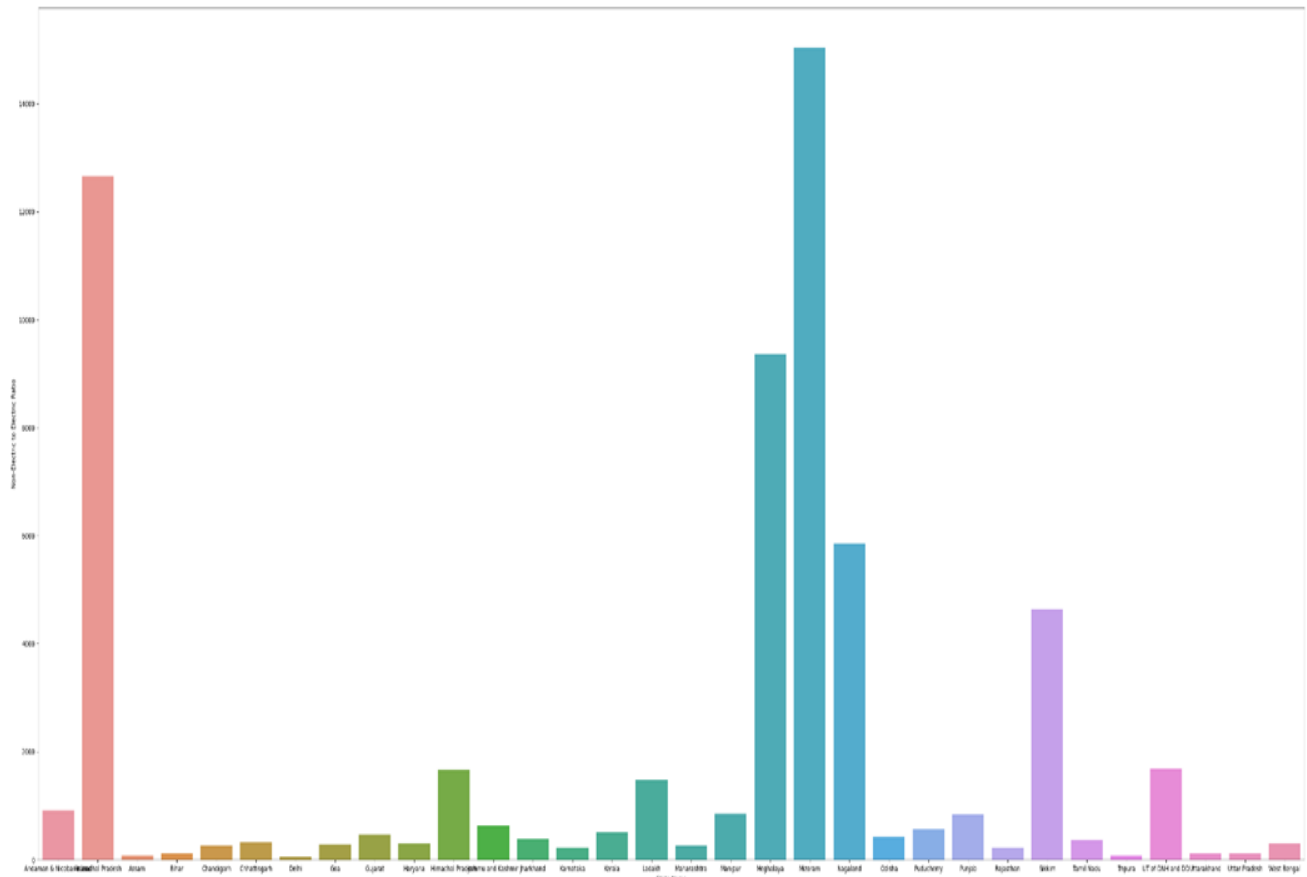
Conclusion:

· The Indian EV market is growing rapidly. The market size was estimated to be USD 1.45 billion in 2021 and is projected to reach USD 113.99 billion by 2029, growing at a CAGR of 66.52% during the forecast period.

· We analyzed that the south India region is more technologically advanced with good availability of charging infrastructure and Electric vehicles becoming more popular. Big Brands who already launched

their products and have their manufacturing plants in south India. It is possible that we can create space for our EVs, but it will be very difficult.

· Northeastern states have growing popularity, especially Sikkim, this is a good place for us to create space for our EVs.

· Once our EV popularity grows up, we can target East Indian states and central Indian states.

· North Indian states are not recommended right now because of the analysis results. People are not buying EVs despite having lots of charging infrastructure.

· In 2021, India sold over 300,000 electric vehicles. The state of Uttar Pradesh is the leading market for electric vehicles in India.

 Github Link

https://github.com/poojarajput2/EV_India-market-

EV Market /Segment Analysis
Vedant Aryan

Introduction

An EV, short for electric vehicle, operates either partially or entirely on electric power. These vehicles boast reduced running costs due to fewer moving parts, and they offer significant environmental benefits by minimizing or eliminating the use of fossil fuels like petrol or diesel. While some EVs previously utilized lead-acid or nickel-metal hydride batteries, modern battery electric vehicles predominantly rely on lithium-ion batteries. These batteries are preferred for their extended lifespan and exceptional energy retention, boasting a mere 5% self-discharge rate per month. Despite advancements, challenges persist, notably concerning thermal runaway in lithium-ion batteries, which has led to incidents like fires or explosions in models such as the Tesla Model S. Nonetheless, strides have been taken to enhance the safety of these batteries.

Problem Statement

The aim of this project is to conduct Exploratory Data Analysis (EDA) on a dataset concerning Electric Vehicles (EVs) in order to extract valuable insights and reveal significant patterns. The dataset encompasses a wide array of attributes related to electric vehicles, encompassing:
• Various types of EVs
• Utilization patterns across different states of India
• Price ranges of different EV models
• Battery capacity and performance metrics
• Charging infrastructure availability and charging times
This comprehensive dataset offers a rich source of information for uncovering trends and understanding the landscape of electric vehicle usage and characteristics.

Results

• Scalability of EV in recent years compared to that in 2020 and 2021
• Charging Stations in Different States of India
• Charging time as per the Range of the Vehicle
• Heatmap of various attributes
• Efficiency of Top Speed with there respective Battery Capacity
• Charging Time pf Vehicles according to there price
• Price of Electric Vehicles according to there Range
Conclusion
Conclusion

The adoption of electric vehicles (EVs) in India has witnessed a significant increase over the past five years, primarily due to their enhanced efficiency. Moreover, rising fuel prices have

further contributed to a substantial surge in the adoption of EVs, driven largely by their extended range and efficiency.

The global Electric Vehicle Market is anticipated to expand from 8,151 thousand units in 2022 to 39,208 thousand units by 2030, with a compound annual growth rate (CAGR) of 21.7%. This growth is propelled by factors such as the escalating demand for low-emission transportation and government initiatives supporting the use of long-range, zero-emission vehicles through subsidies and tax incentives, compelling manufacturers worldwide to offer electric vehicles.

Governments worldwide are increasing investments to develop EV charging infrastructure and hydrogen fueling stations, alongside offering incentives to buyers. These initiatives create opportunities for Original Equipment Manufacturers (OEMs) to broaden their revenue streams and geographical footprint.

Through segmentation analysis, various consumer segments are identified to influence purchasing decisions. Geographic segmentation considers factors such as the availability of charging stations in different regions, impacting market sales. For instance, consumers residing in areas with more accessible charging infrastructure are more likely to purchase EVs compared to those in regions with limited charging stations. Demographic segmentation focuses on variables like education level, family size, occupation, and income, reflecting how consumers utilize products and services and their willingness to pay. The decision to purchase EVs may vary based on factors such as consumer education, financial status, and the intended use of the vehicle. For example, consumers intending to transport goods across cities or states may prioritize factors like cargo space and maximum range. Lastly, psychological segmentation acknowledges that some consumers prioritize satisfaction when selecting a product, while others prioritize cost-effectiveness alongside other considerations.

Github Link

https://github.com/vedyan/FeynnLabs_ML_Intern

ELECTRIC VEHICLE MARKET SEGMENTATION ANALYSIS
[GAJANAN PURUD]

Market Segmentation of Electronic Vehicles in India Of Brands and Charging stations with Statewise analysis

Dataset Details: **EV_cars_India 2023 Brands , Charging stations , EV Stats**

1. ## Introduction

Electric vehicles (EVs) are becoming an increasingly popular mode of transportation worldwide due to their potential to reduce carbon emissions and dependence on fossil fuels. In India, the EV market has been gaining momentum over the past few years as the government and industry stakeholders take significant steps to promote sustainable mobility. Here is an overview of the current state of electric vehicles in India in 2023-24:

Government Initiatives and Policies

The Indian government has been proactive in promoting electric mobility through various policies and initiatives. The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, introduced in 2015, aims to increase the adoption of electric vehicles by providing incentives for EV purchases and developing charging infrastructure. The FAME II scheme, launched in 2019, has a budget of INR 10,000 crore (approximately $1.36 billion) and focuses on electrifying public transportation, including buses, three-wheelers, and two-wheelers.

Charging Stations and Infrastructure

One of the key challenges to the widespread adoption of EVs in India is the availability of charging infrastructure. However, significant progress has been made in recent years:

- **Public Charging Stations**: The government has set a target to establish charging stations every 25 km in urban areas and every 100 km on highways. Many companies are investing in charging infrastructure, and public-private partnerships are being formed to expand the network.
- **Home Charging**: Many EV owners install home charging stations to ensure convenient and easy access to charging. Manufacturers offer portable chargers with their vehicles, enabling users to charge their EVs at home.
- **Charging Network Expansion**: Various energy companies, oil corporations, and private enterprises are actively expanding the charging network across the country.

EV Stats and Market Overview

- **Vehicle Sales**: The adoption of electric vehicles in India has been steadily increasing, with sales of electric two-wheelers and three-wheelers leading the market. Electric four-wheelers are also gaining popularity, particularly in the premium and luxury segments.
- **Manufacturers**: Domestic and international automakers are investing in the Indian EV market. Companies such as Tata Motors, Mahindra & Mahindra, and Bajaj Auto have launched electric vehicles, while global brands like Tesla, Hyundai, and MG Motors are also making significant strides in the market.

Battery Technology: Advancements in battery technology, particularly in lithium-ion batteries, are driving the efficiency and performance of EVs. Indian manufacturers are also exploring local battery production to reduce dependency on im EV Stats and Market Overview

2}Fermi Estimation

2.1 Problem Statement

In 2023-24 , the market for electric vehicles (EVs) in India is experiencing rapid growth due to increased environmental awareness and government incentives. However, there is a lack of comprehensive understanding of the diverse market segments within the EV industry and the current state of charging infrastructure across the country. This knowledge gap presents challenges to automakers, energy companies, and policymakers who aim to effectively address the needs of different consumer groups and optimize charging station placement.

Key Challenges

1. Market Segmentation: The Indian EV market encompasses a wide range of consumer segments, including private car owners, commercial fleets, public transport operators, and delivery services. Understanding the unique needs and preferences of each segment is crucial for tailoring EV offerings and marketing strategies.

2. Charging Infrastructure: The availability and accessibility of charging stations vary across urban, suburban, and rural areas. An optimal distribution of charging infrastructure is essential to encourage EV adoption and address range anxiety among potential buyers.

3. Data Availability: There is a lack of detailed, up-to-date data on EV ownership trends, usage patterns, and charging station utilization rates. This data is necessary for making informed decisions about product development, market entry strategies, and infrastructure investments.

4. Regulatory Framework: Policymakers need to balance the interests of various stakeholders, including automakers, energy providers, and consumers, to create a supportive regulatory environment that encourages EV adoption and infrastructure development.

Objectives

- Identify Market Segments: Conduct market research to segment the EV market based on factors such as vehicle type, usage patterns, income levels, and geographic location.

- Analyze Charging Infrastructure: Assess the current state of charging stations across different regions and evaluate the coverage, availability, and accessibility of these stations for various market segments.

- Data Collection and Analysis: Gather data on EV ownership, usage, and charging habits from multiple sources, including surveys, industry reports, and public records. Analyze the data to identify trends and patterns.

- Strategic Recommendations: Based on the findings, provide recommendations for automakers, energy companies, and policymakers to tailor EV offerings, expand charging infrastructure, and develop supportive policies.

Expected Outcomes

- A comprehensive understanding of the different market segments within the Indian EV market in 2023, including their needs, preferences, and usage patterns.

- A detailed analysis of the current charging infrastructure, including gaps and opportunities for expansion.

- Strategic recommendations for industry players and policymakers to improve EV adoption and optimize charging station placement.

- Insights that guide future investments in EV products and infrastructure, fostering sustainable growth in the Indian EV mark

In our approach to Fermi Estimation for market segmentation and strategy formulation, we follow a systematic process aimed at leveraging data-driven insights to inform decision-making and maximize market potential for our Electric Vehicle Startup:

2.Data Sources
   The data has been downloaded from Kaggle
   https://www.kaggle.com/datasets/divyanshusingh18/ev-cars-india-2023

   Data Pre-processing

        Libraries Used:
        ● Pandas
        ● Numpy
        ● Seaborn
   ● Matplotlib
        ● Scikit Learn`

RESULTS

❊ Analysis of 2 Wheeler EVs

UttarPradesh, Gujrat, Haryana are among the top states with the majority of EV 2Wvehicles, while the remaining states have less number .
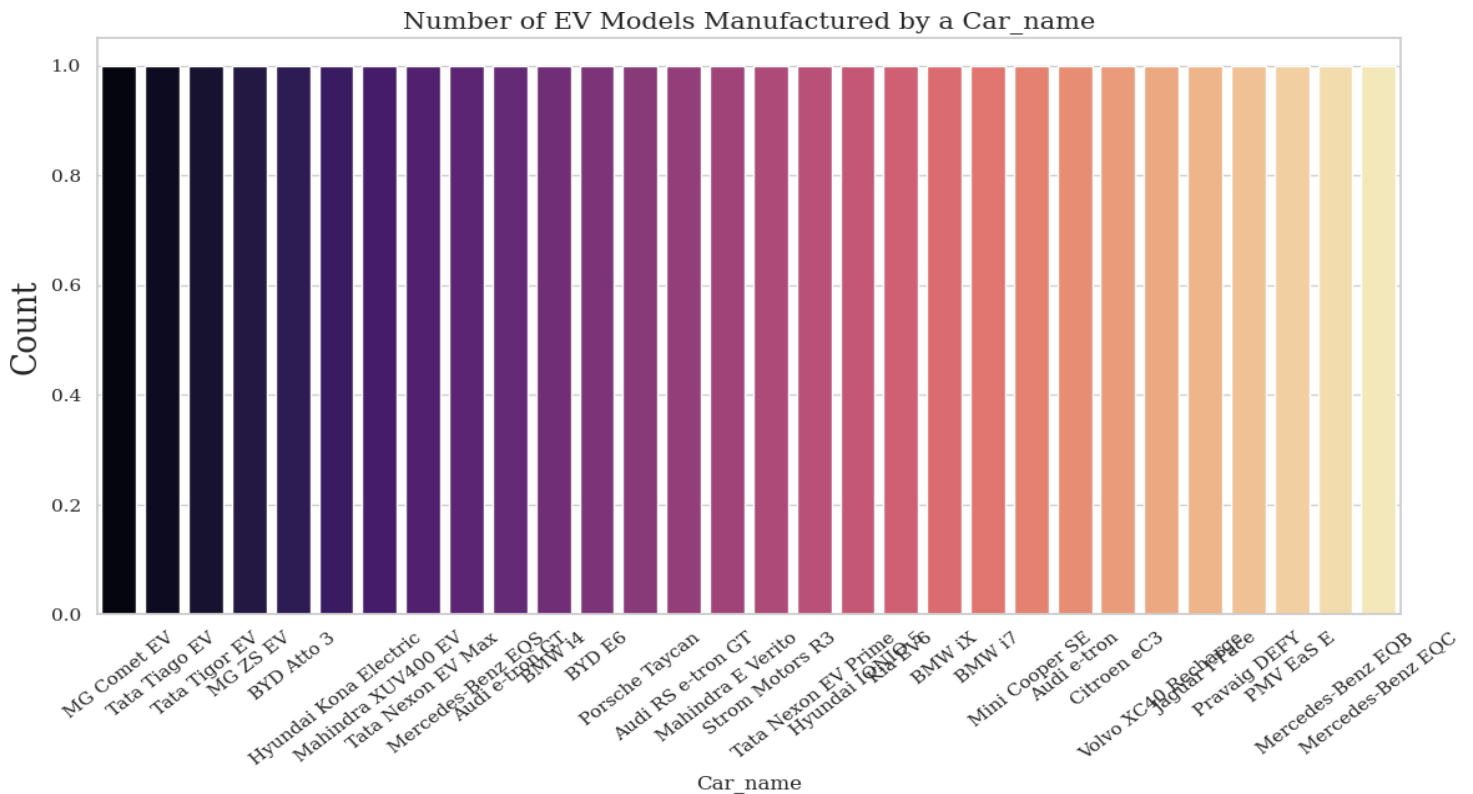

Total Number of Two-Wheeler Vehicles in Each State (Sum of Categories)
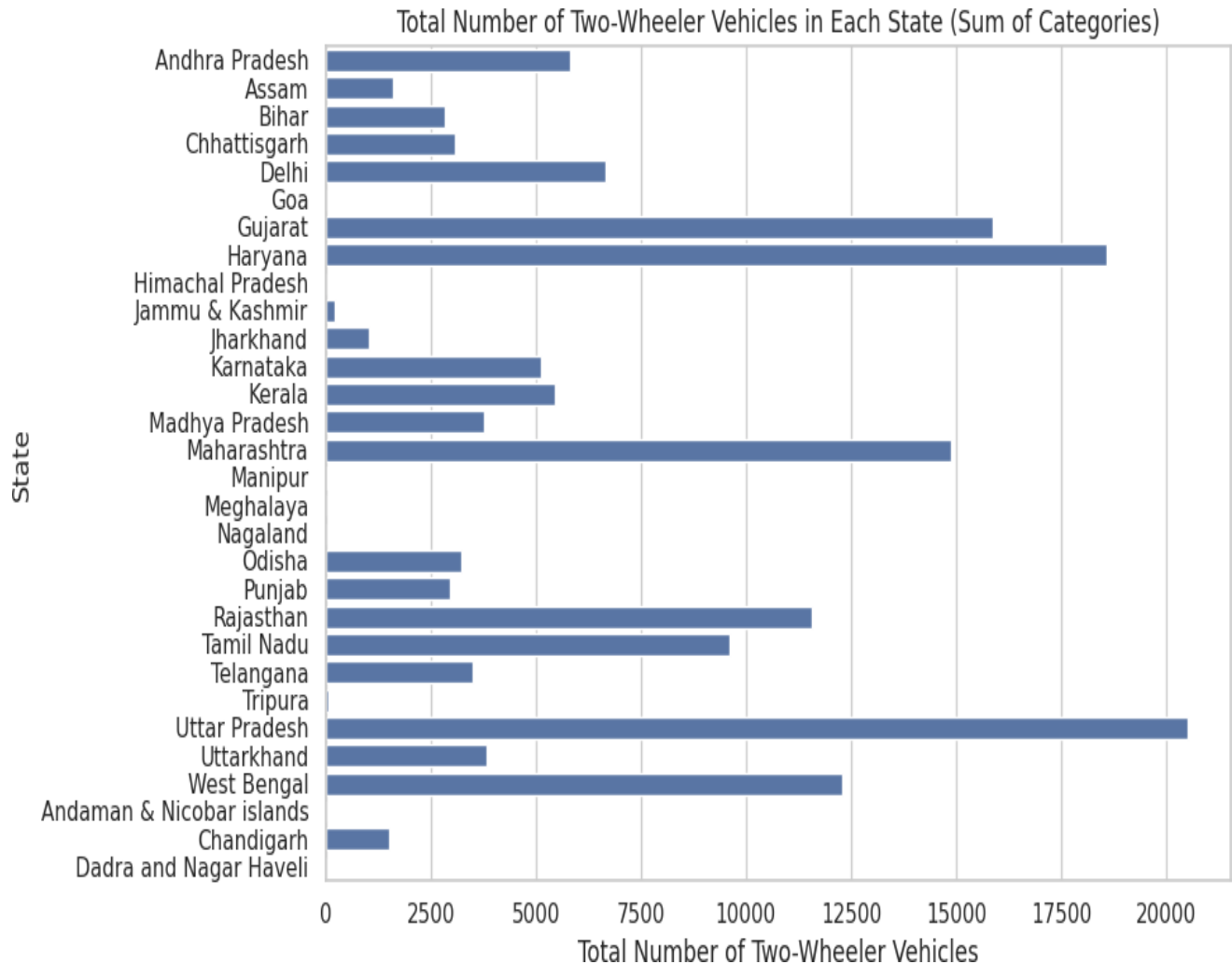
❊ Analysis of 3 wheeler EV

Uttar Pradesh, Chattisgarh, Haryana are among the top states with the majority of EV 3W vehicles, while the remaining states have less number.
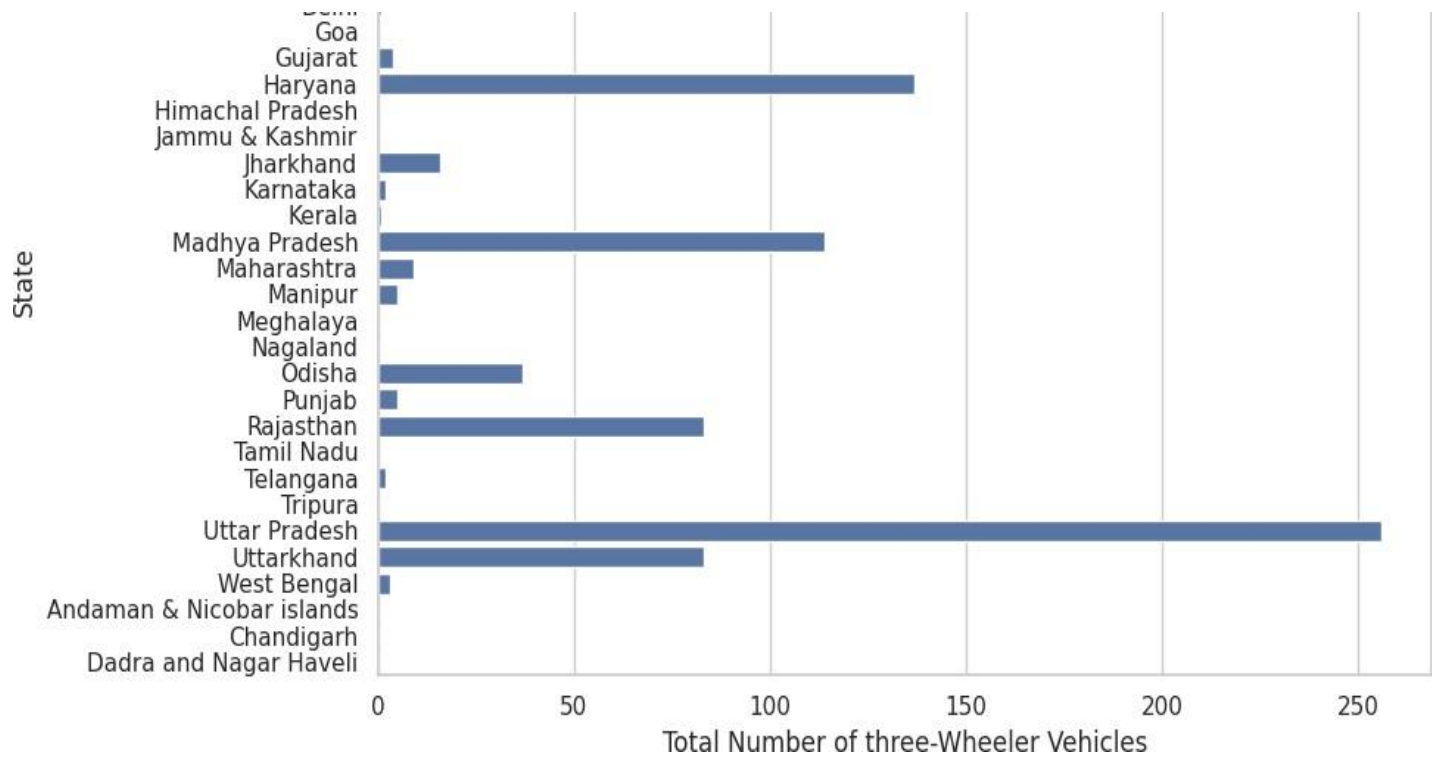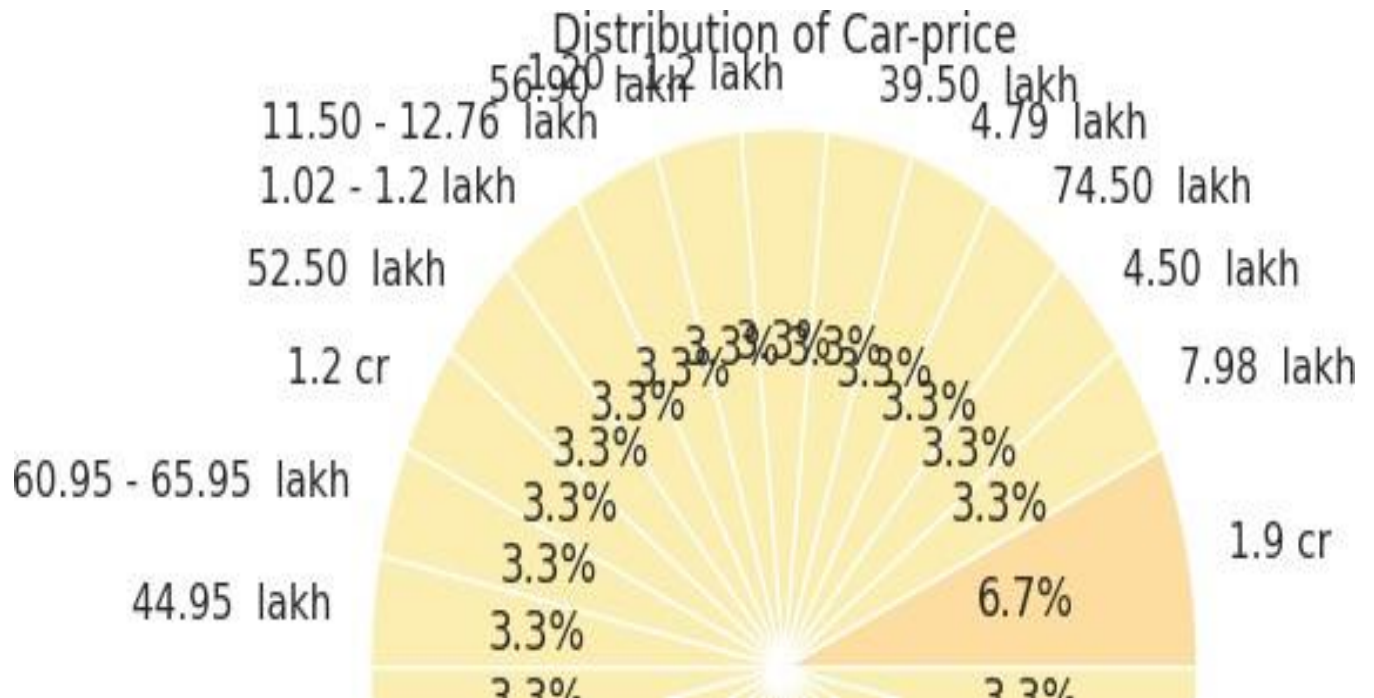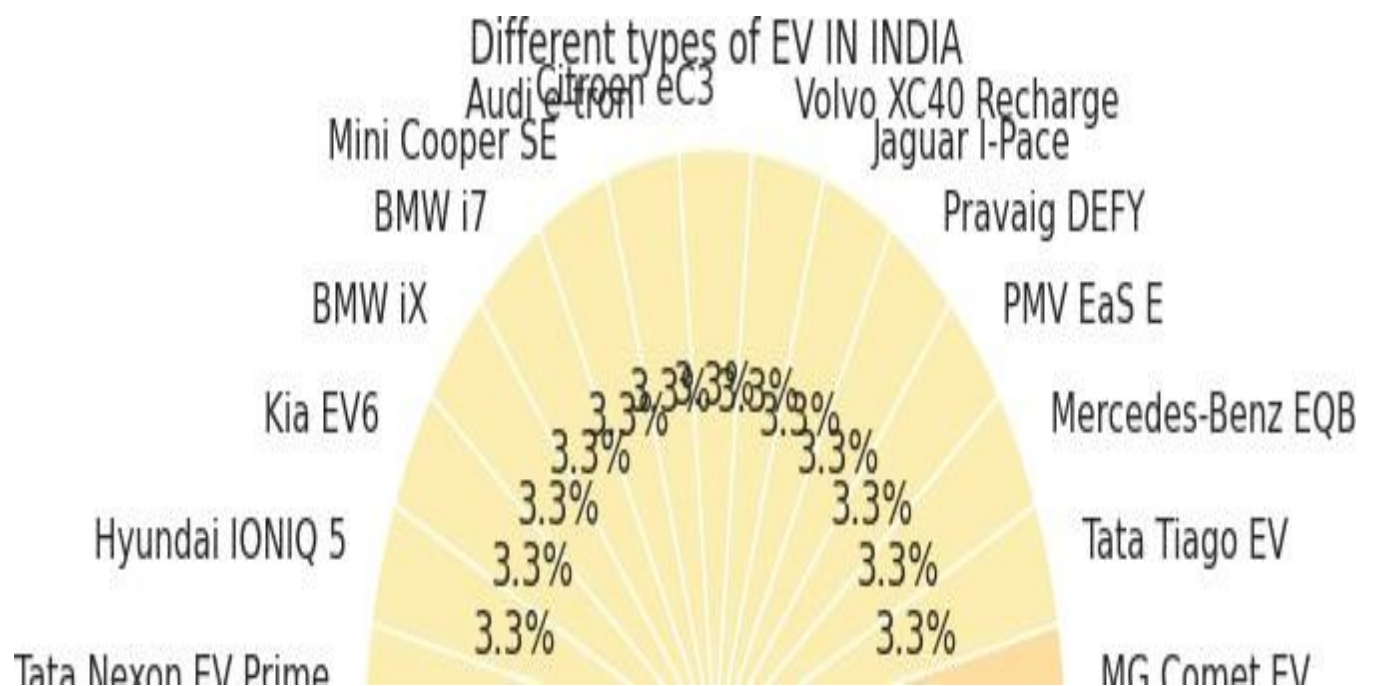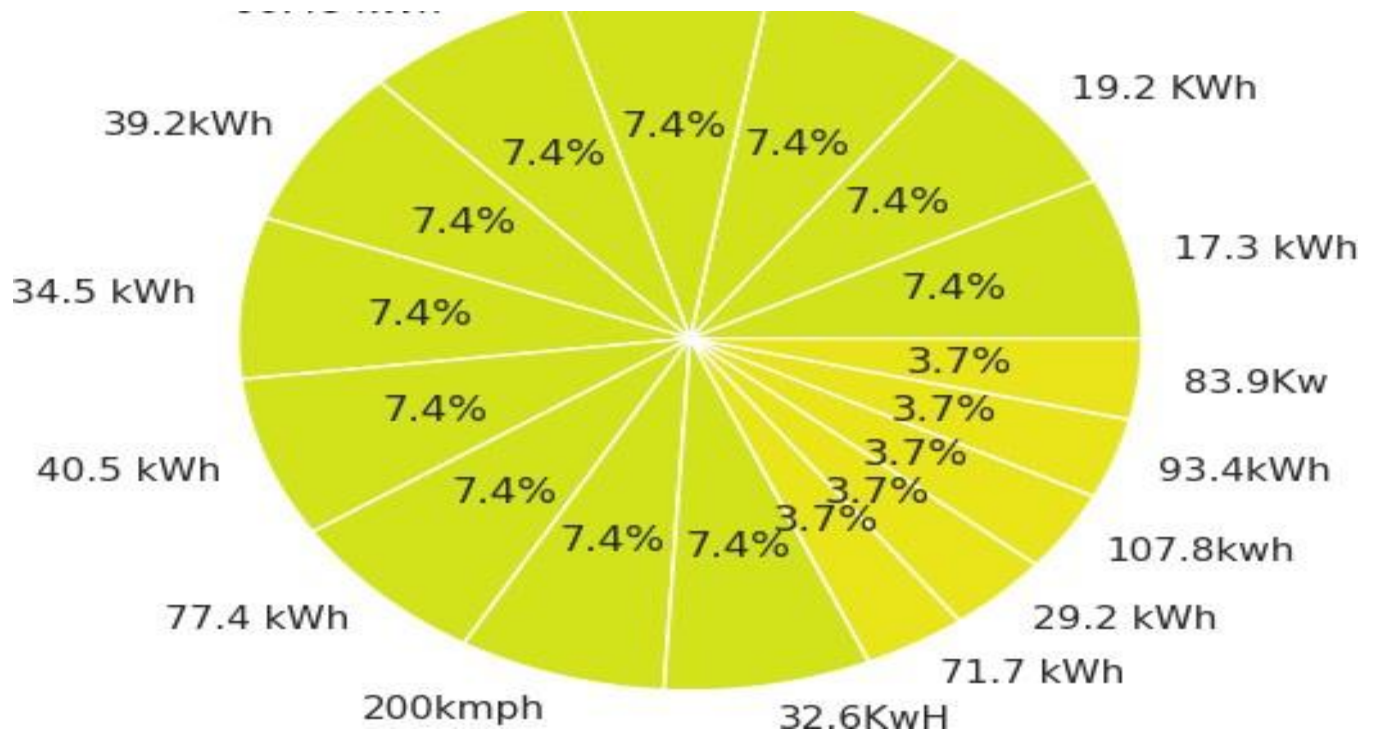
2. **Segment Extraction**

✻ **Brand wise EV analysis**

* ANALYSIS OF DISTRIBUTION OF DIFFERNT CAR PRICE IN EV

Distribution of Car-price

56.90 lakh 1.2 lakh 39.50 lakh

11.50 - 12.76 lakh 4.79 lakh

1.02 - 1.2 lakh 74.50 lakh

52.50 lakh 4.50 lakh

1.2 cr 7.98 lakh

3.3% 3.3% 3.3% 3.3% 3.3% 3.3% 3.3%
3.3% 3.3%
3.3% 3.3%

60.95 - 65.95 lakh 3.3% 3.3% 1.9 cr

44.95 lakh 3.3% 6.7%

3.3% 3.3%

* EV available in india

Different types of EV IN INDIA

Audi e-tron Citroen eC3 Volvo XC40 Recharge

Mini Cooper SE Jaguar I-Pace

BMW i7 Pravaig DEFY

BMW iX PMV EaS E

Kia EV6 Mercedes-Benz EQB

3.3% 3.3% 3.3% 3.3% 3.3% 3.3% 3.3%
3.3% 3.3%
3.3% 3.3%

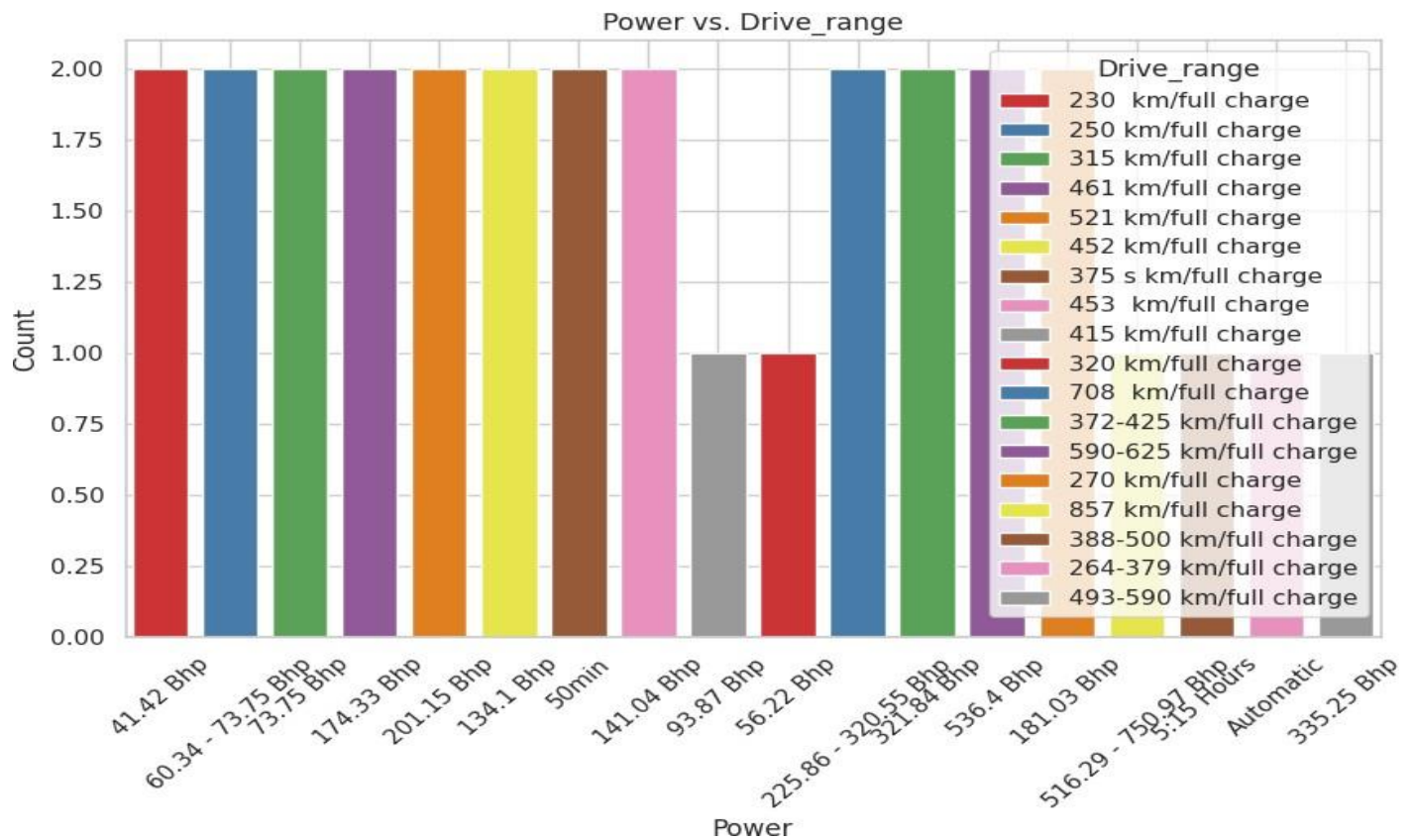Hyundai IONIQ 5 3.3% 3.3% Tata Tiago EV
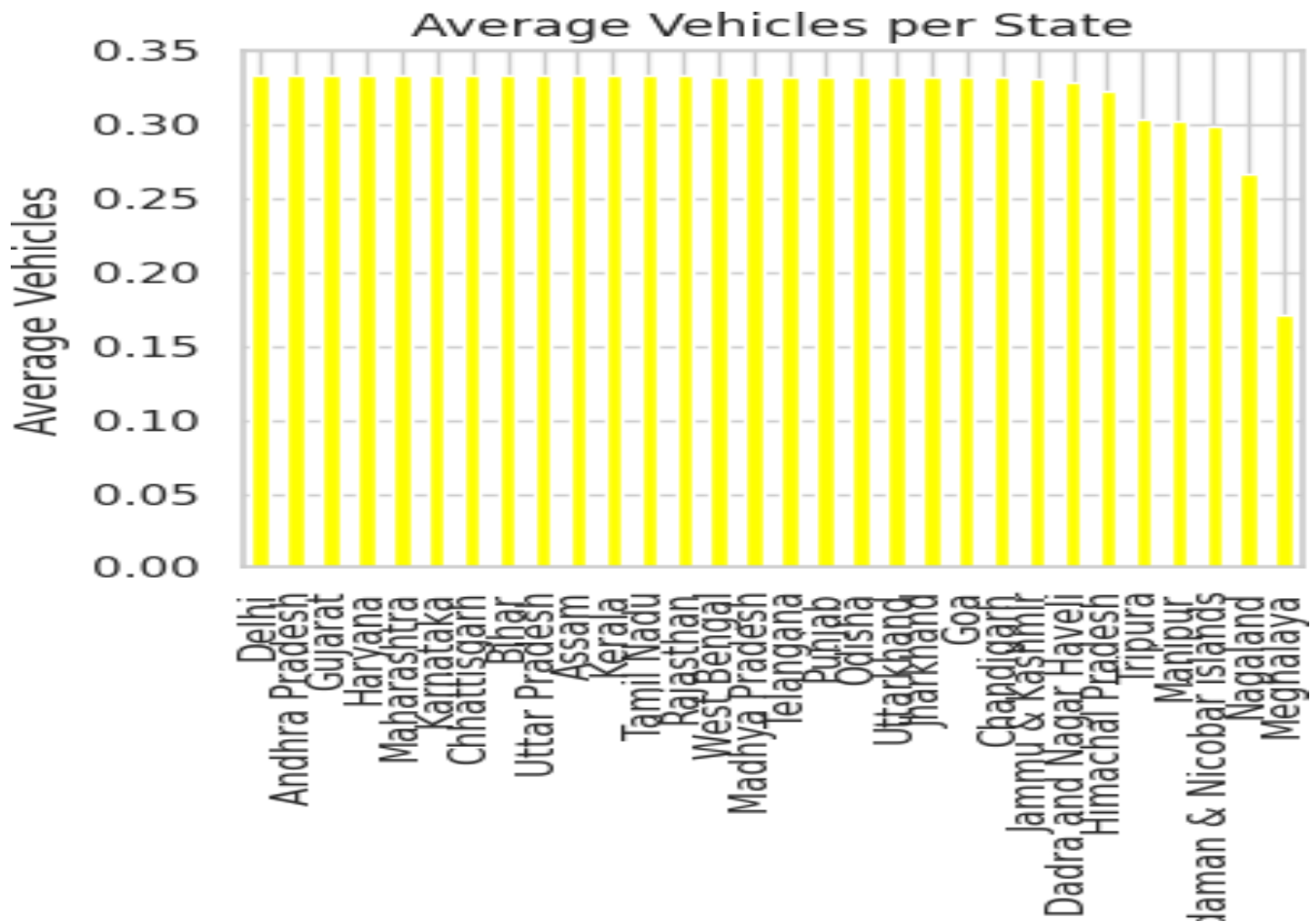
3.3% 3.3%

Tata Nexon EV Prime MG Comet EV

❊ Electric Vehicles of Different Battery Capacity in India

❊ Power vs. Drive_range

Bar plot for average vehicles per state
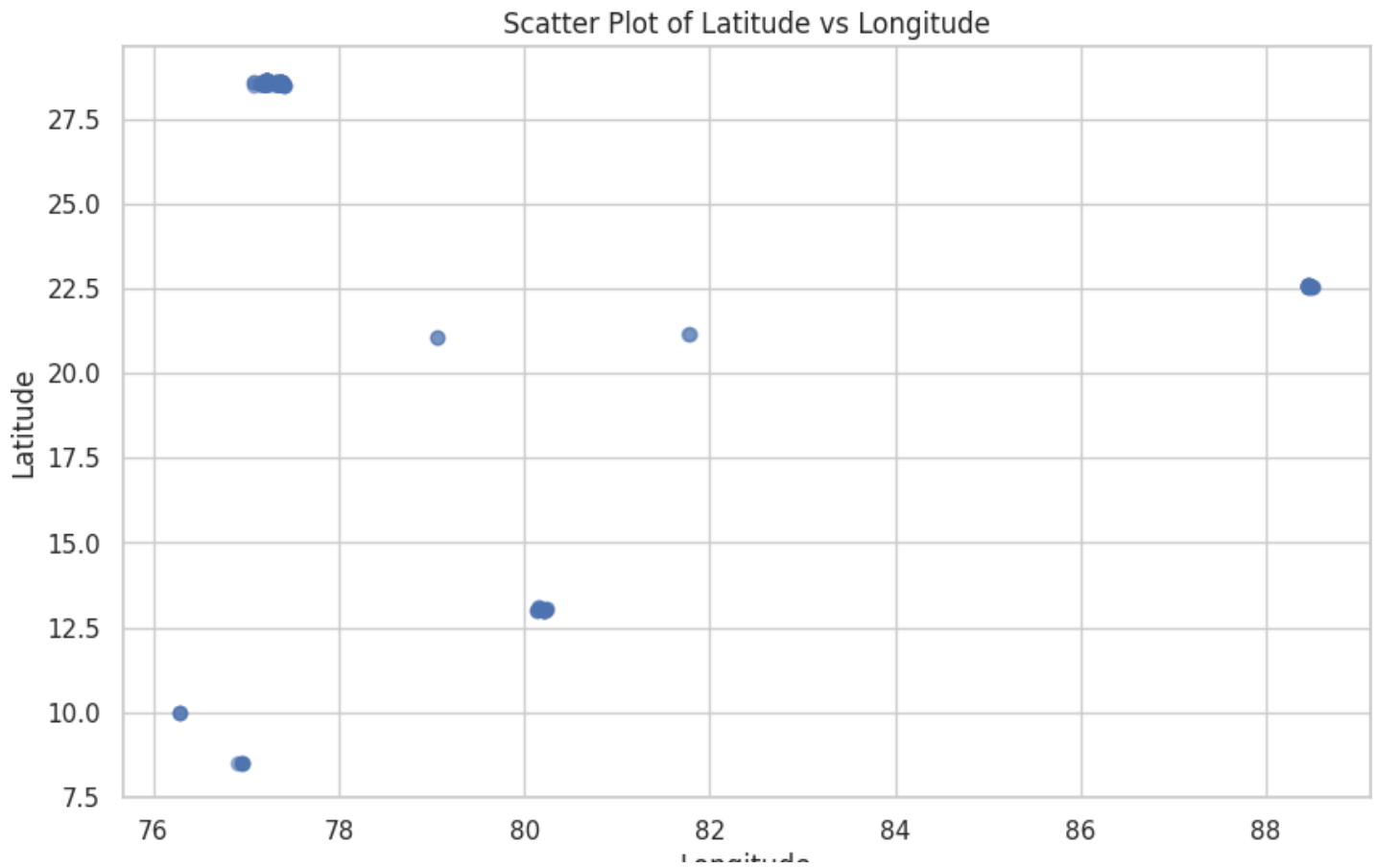

Average Vehicles per State

Strategies for EV Brands

- Customization: Tailor EV offerings to the specific needs of each market segment, such as different range options and price points.

- Brand Partnerships: Collaborate with charging station operators and energy providers to expand infrastructure and offer bundled services.

By targeting these optimal market segments and focusing on high-potential states, EV brands can capitalize on India's growing demand for electric vehicles while ensuring that consumers have access to a reliable and convenient charging infrastructure.

3. **Profiling Segments**

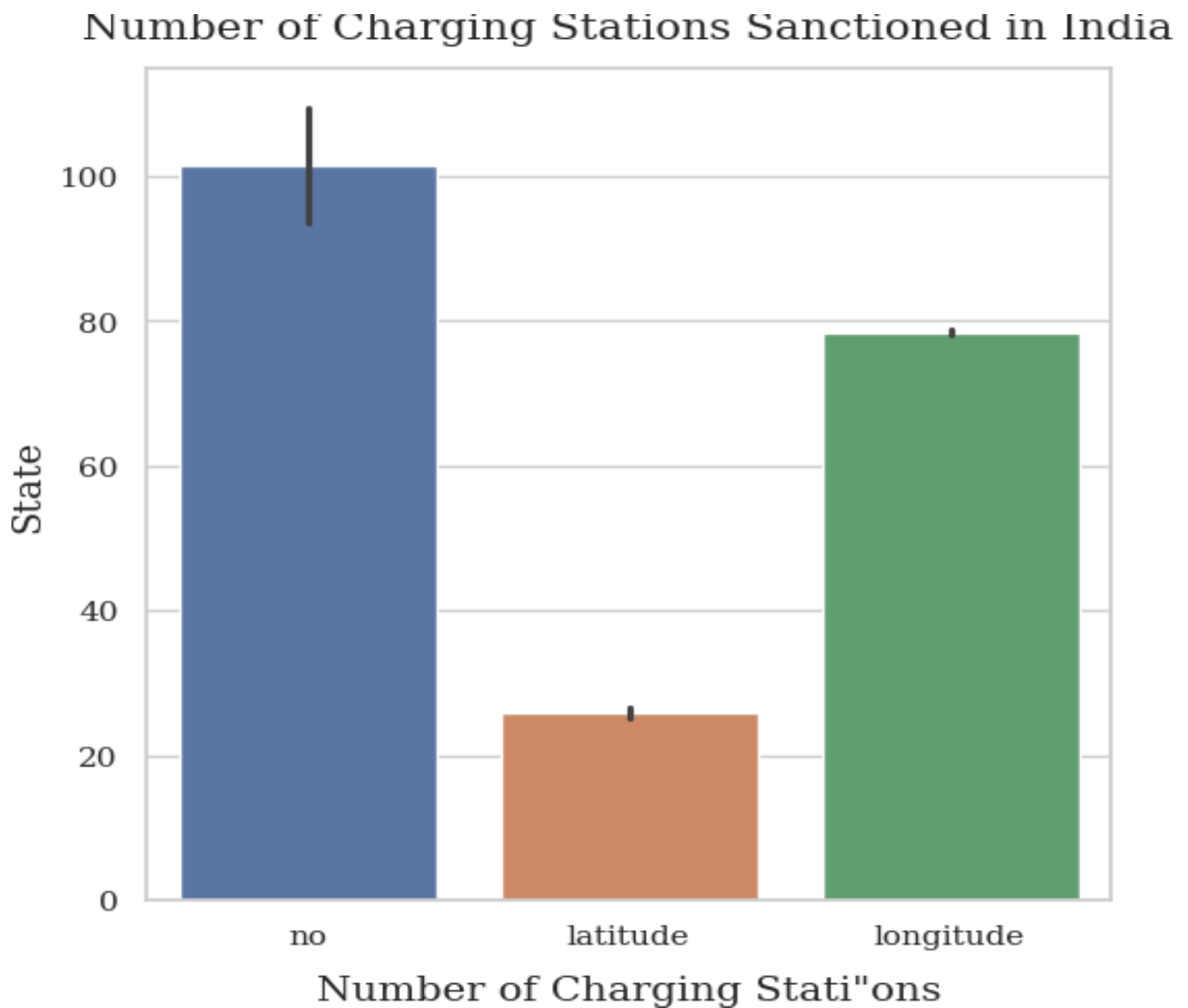## Scatter plot for Latitude and Longitude Charging Station in INDIA

Scatter Plot of Latitude vs Longitude

Total Vehicles per State
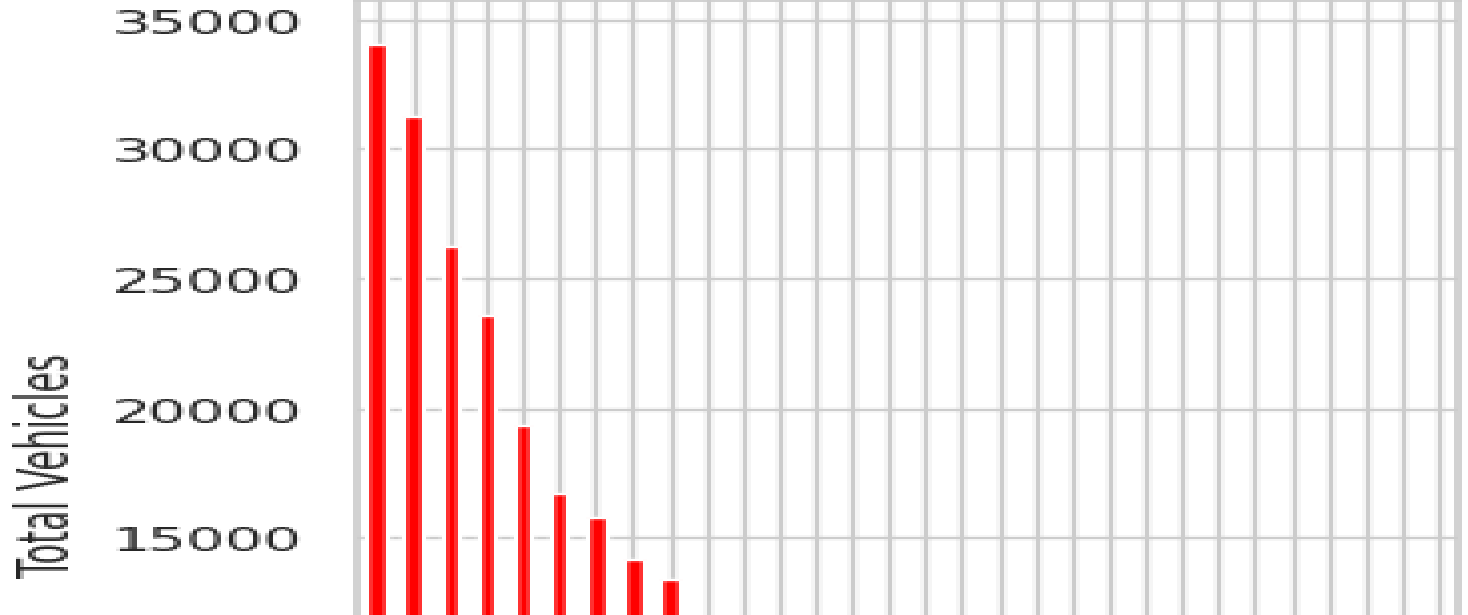
Charging stations sanctioned visualization from dataset

## Number of Charging Stations Sanctioned in India

OBSERVATION

Observation: Maharashtra, Gujarat, Karnataka, Kerala, Uttar Pradesh, Rajasthan, and Andhra Pradhesh are among the top states with the majority of EV charging stations sanctioned while the remaining states have less number of the same.

Retail outlets visualization from dataset

Available Retail Outlets for Charging EVs in India

Number of Retail Outlets for Charging EVs
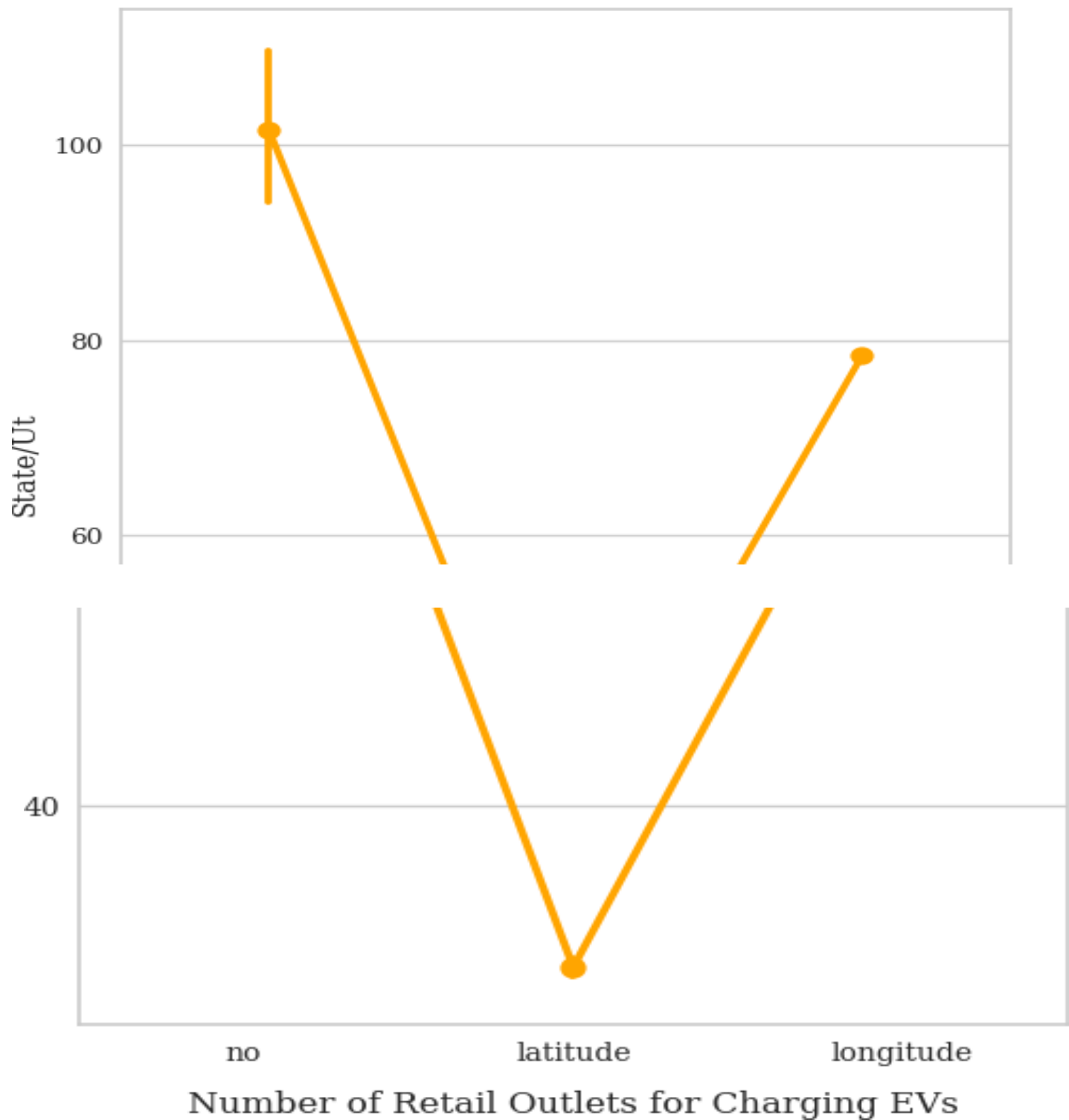
4. <u>Target Segment</u>

In India, electric vehicle (EV) brands and charging station operators target specific market segments and focus on certain states to maximize their impact and achieve greater market penetration. Here's a brief overview of the target segments and states for EV brands and charging stations:

<u>Target Segments for EV Brands</u>

1. **Two-Wheelers**:
   o **Urban Commuters**: EV brands target individuals who use two-wheelers for short-distance daily commutes in cities and towns.
   o **Younger Consumers**: Brands focus on younger consumers who are more open to adopting new technologies and sustainable transportation options.

2. **Three-Wheelers**:
   o **Commercial Operators**: Brands target autorickshaw and other three-wheeler operators for passenger and cargo transport, offering lower operating costs and government incentives.
   o **Fleet Owners**: Larger fleet operators looking to transition to electric three-wheelers for cost savings and environmental compliance.

3. **Four-Wheelers**:
   o **Middle- to High-Income Urban Residents**: EV brands focus on offering premium electric cars to individuals and families seeking modern, sustainable, and stylish vehicles.
   o **Corporate Fleet Buyers**: Businesses and institutions looking to adopt EVs for corporate fleets to reduce operational costs and demonstrate corporate social responsibility.

5. **Customizing the Market Mix**

Customizing the market mix for electric vehicle (EV) brands in India in 2023 involves tailoring the product, price, place, and promotion aspects of the marketing strategy to meet the unique needs and preferences of different market segments and geographic areas. Here's a brief overview:

Product

- Vehicle Types: Offer a variety of EV types such as two-wheelers, three-wheelers, and four-wheelers to cater to different market segments.

Price

- Competitive Pricing: Set prices competitively to make EVs accessible to a broader range of consumers, considering government incentives and subsidies.

- Flexible Financing: Offer financing options, such as leasing and loan schemes, to lower the barrier to entry for potential buyers.

Place

- Distribution Channels: Establish a strong network of dealerships and service centers in high-demand areas, particularly in major cities and urban centers.

- Charging Infrastructure: Collaborate with charging station operators to ensure adequate coverage and access to charging facilities in key markets.

Promotion

- Targeted Marketing: Use localized advertising campaigns to raise awareness and promote EVs to specific consumer segments.

- Partnerships: Collaborate with local businesses and institutions to offer promotions and special deals to employees and customers.

By customizing the market mix in this way, EV brands can effectively address the diverse needs of the Indian market, driving greater adoption and satisfaction among consumers.

6. <u>**Optimal Market segments**</u>

Identifying the optimal market segments for electric vehicle (EV) brands in India in 2023 involves considering factors such as consumer preferences, vehicle types, and geographic locations, along with the distribution and availability of charging stations. Here's an overview of the optimal market segments and geographic focus for EV brands in India in 2023:

Optimal Market Segments

1.Two-Wheelers:

2. Three-Wheelers:

3. Four-Wheelers:

In brief, the optimal market segment for electric vehicles (EVs) and charging stations in India in 2023 is urban residents and commercial operators. This includes:

- Urban Residents: Middle- to high-income individuals and families living in major cities who are open to adopting electric two-wheelers, three-wheelers, and four-wheelers for their daily commutes.

- Commercial Operators: Fleet owners and drivers of three-wheelers and four-wheelers, such as autorickshaws and taxis, who are looking for lower operational costs and compliance with environmental regulations.

Focusing on these segments allows EV brands and charging station operators to capitalize on the growing demand for sustainable transportation in urban areas, where the population density and shorter commutes make EVs a practical choice.

7. <u>**Conclusion**</u>

Based on the above analysis and visualizations, it would be really helpful for any company which is looking to open up an EV startup in India . In this report the analysis of diferent

datasets related to EV have been done on

1] Brands and models of EVs in India with their attributes

2] State wise distribution of 2,3,4 wheeler EV s and passenger cars in India

3] Electric Vehicle Charging Stations In INDIA Analysis.

-The study concludes that understanding the different segments in the Indian EV market is crucial for EV manufactures and marketers to effectively target their customers and promote adoption of EV in India. We have came up with conclusions are as follows related to EV

- Uttar Pradesh, Gujrat, Haryana are among the top states with the majority of EV 2W vehicles, while the remaining states haveless number
- Uttar Pradesh, Chattisgarh, Haryana are among the top states with the majority of EV 3W vehicles, while the remaining stateshave less number
- Delhi, Goa, Maharashtra, Kerela and Karnataka are among the only states with EV buses in India .
- Maharashtra, Gujarat, Karnataka, Kerala, Uttar Pradesh, Rajasthan, and Andhra Pradesh are among the top states with themajority of EV charging stations sanctioned while the remaining states have less number of the same.

8. **Github**

https://github.com/GAJANAN07/EV-Vehicle-market-segmentation

https://github.com/GAJANAN07/EV-Vehicle-market-segmentation

Jada Sunil

https://github.com/sunilyadav2713/electronic_analysis