Market Segmentation Analysis of the Electric Vehicles Market in India

A report submitted for the Data Science Internship

Submitted By

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Chapter 1

PROBLEM STATEMENT

The objective is to analyze the Electric Vehicles (EV) Market in India through segmentation analysis to devise a feasible market entry strategy. The analysis will focus on targeting segments based on geographic, demographic, psychographic, and behavioral factors. The report covers various segments such as region, price, charging facility, vehicle type (e.g., 2-wheelers, 3-wheelers, 4-wheelers), retail outlets, manufacturers, body type (e.g., Hatchback, Sedan, SUV, Autorickshaw), safety, plug types, and more.

1.1 FERMI ESTIMATION:

Wild Guess: Around 8-10% people will have electric vehicles by the end of 2023 in India. Educated Guess: Employment rate = it is the ratio of number of available labor force to the population of People in the working age. We think there are about 1.5 billion Indians in the world. Let's assume the only people over18 and under 60 works, assuming that they account for around 65% of the population then that would make 0.9 billion Indians in the working class. Out of the 0.9 billion people not all are employed, assuming only 2023 had 40%employment rate that would bring the number around 405 million. Since, not everyone can afford an electric vehicle, let's assume only people above middle class can afford an electric vehicle, that would be 40 million. Not everyone buysan electric vehicle. Let's assume out of these 40 million only 10 million are willing to buy an electric vehicle.

1.2 FORMULA

Variables and Formulas: Let E(x) be the employment rate of the year x (in %).Let P(x) be the population of the year x. Let A(x) be the number of available Labor in the year x. Let r be the ratio of Indians between the age of 18 and 60 to the total population of India. E(x) = (A(x)*100)/(P(x)*r) This formula will formulate the Employment ratio for the year x.

1.3 DATA COLLECTION:

Data was sourced from various websites and scraped using tools like Google play scraper, resulting in datasets in CSV, Excel, and PDF formats.

Columns Explanation

Brand: Manufacturers of EVs

Model: Various models of EVs

Specifications: 'AccelSec', 'Top Speed', 'Power Train'

Vehicle Details: 'Range_km', 'Fast_Charge', 'Plug_type', 'Bodystyle'

Other Details: 'Seats', 'Price', 'Region', 'State/UT', 'EV Charging Facility', 'Chargers', 'Vehicle Types (2V, 3V, 4V, Bus)'

1.4 DATA PREPROCESSING

Steps taken to preprocess the scraped raw data:

1. Ordinal encoded 'PowerTrain'

2. Label encoded 'RapidCharge'

3. Used Label Encoder and Standard Scaler package for preprocessing of the dataset.

Chapter 2

EXPLORATORY DATA ANALYSIS

Exploratory Data Analysis (EDA) is a comprehensive investigation designed to reveal the underlying structure of a dataset. It is crucial for companies as it highlights trends, patterns, and relationships that may not be immediately obvious.
In our analysis, we utilized univariate, bivariate, and multivariate methods: Univariate Analysis: Examines data within a single variable/column. Bivariate Analysis: Investigates data considering two variables/columns. Multivariate Analysis: Explores data considering more than two variables/columns.

This Bar Chart shows the type of vehicles used in various states from the dataset after removing meaningless outliers. It also shows the Number of Charging Stations sanctioned in India state wise. Quick look at the graphs tells us that Maharashtra, Karnataka, Andhra Pradesh, Tamilnadu and Gujrat have the most number of electric vehicles and least number of electric vehicles are from Sikkim, Meghalaya, Lakshadweep, Ladakh, and Assam states.

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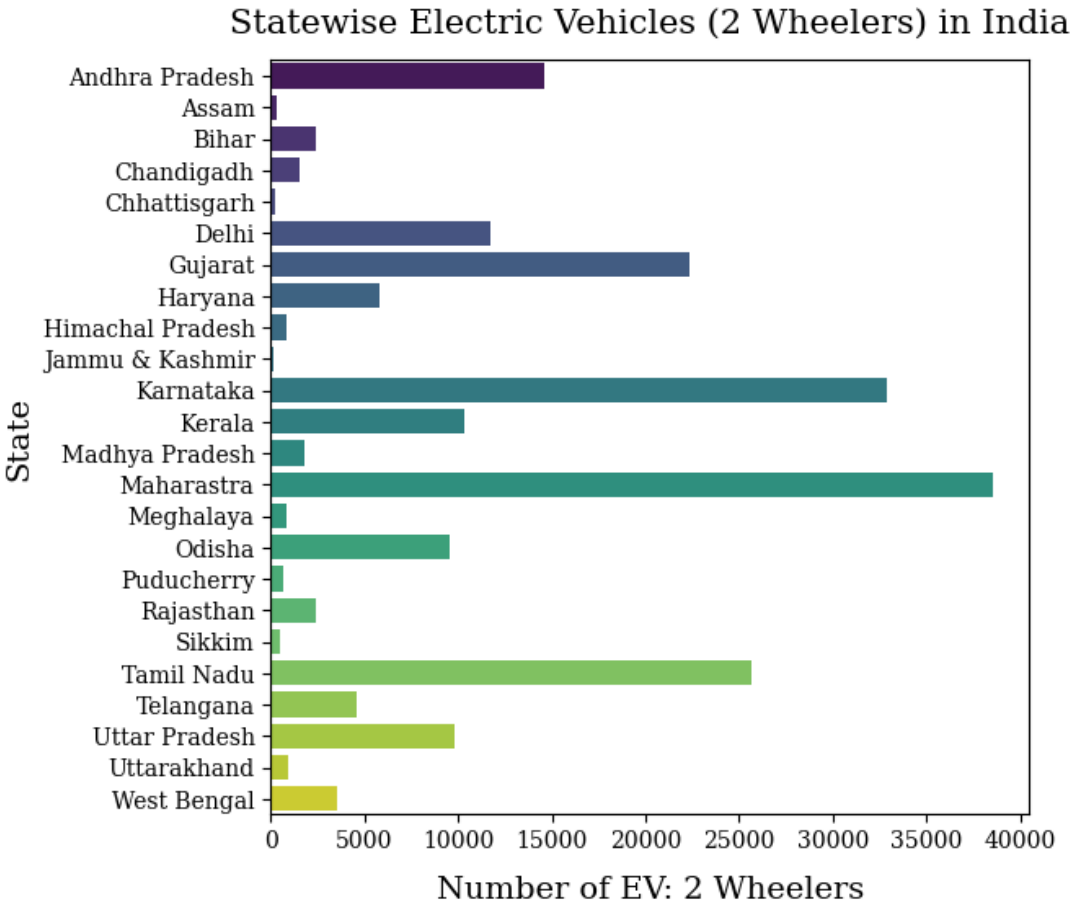

Figure 2.1: State Wise Data 1

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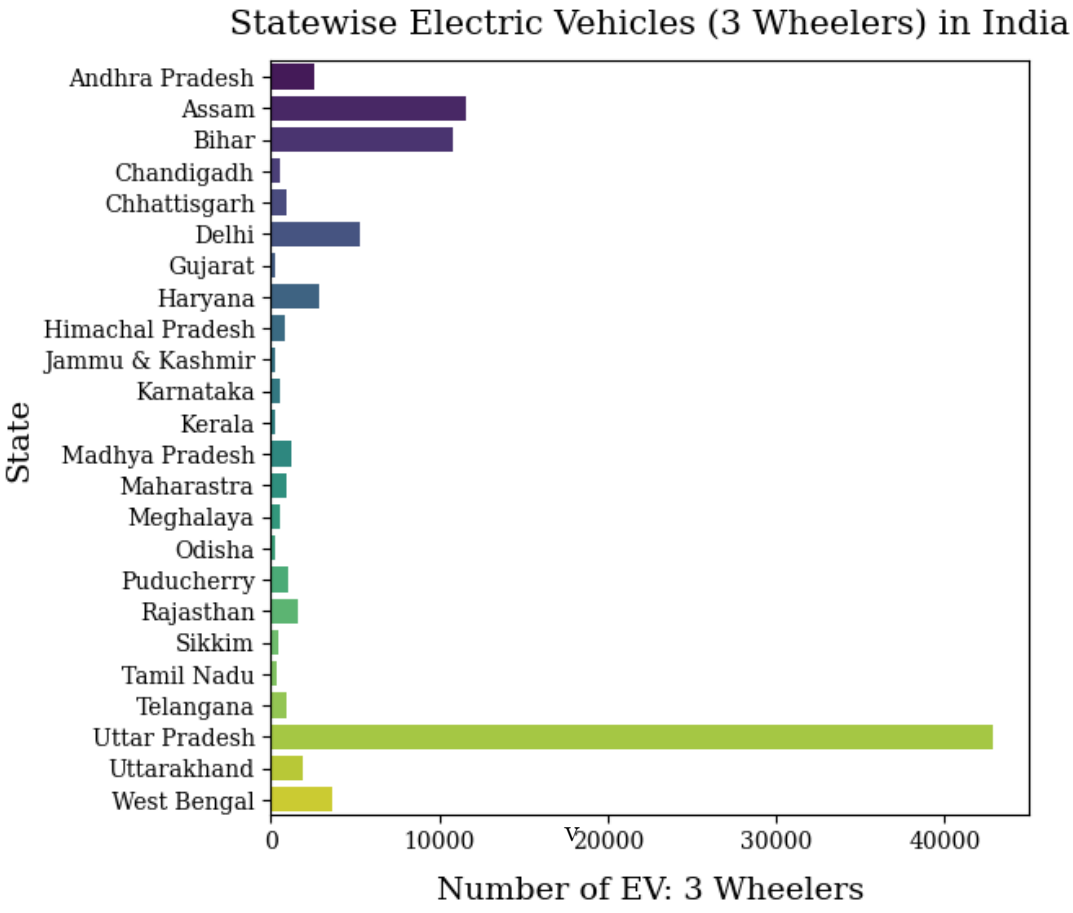

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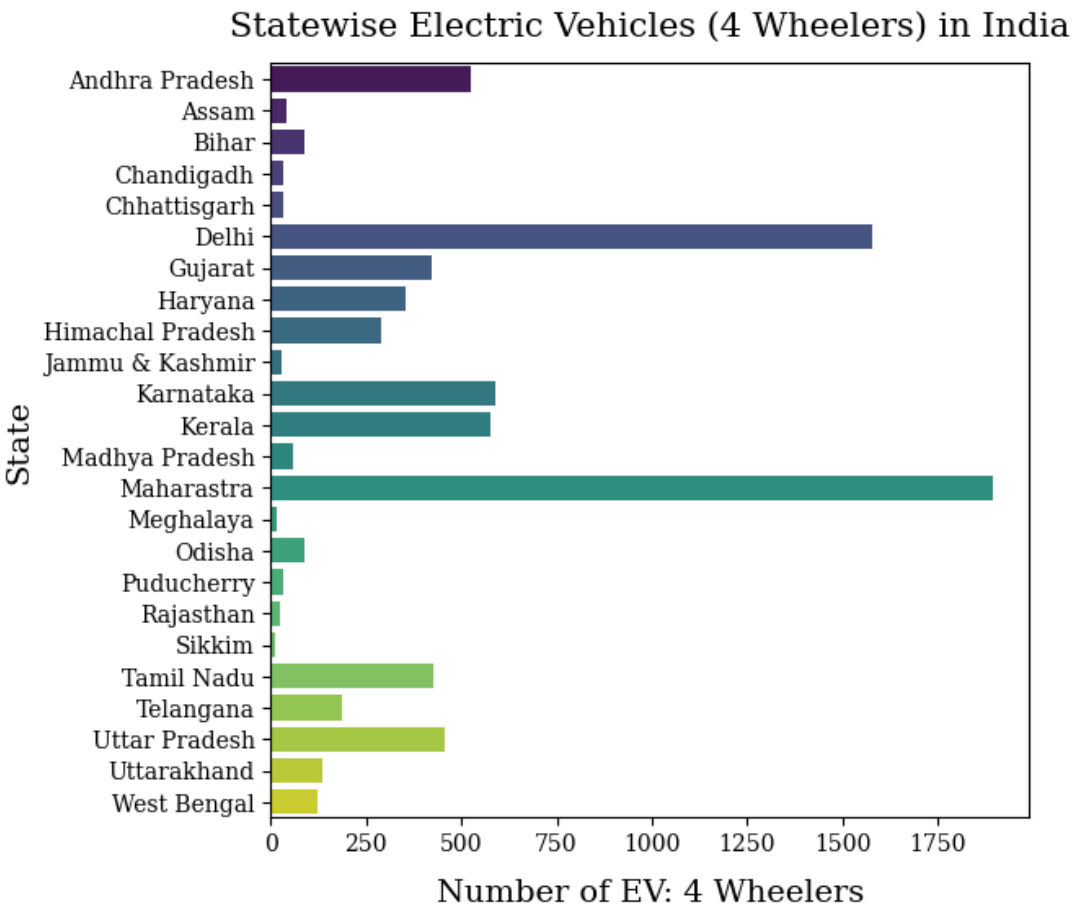

Figure 2.4: State Wise Data 4

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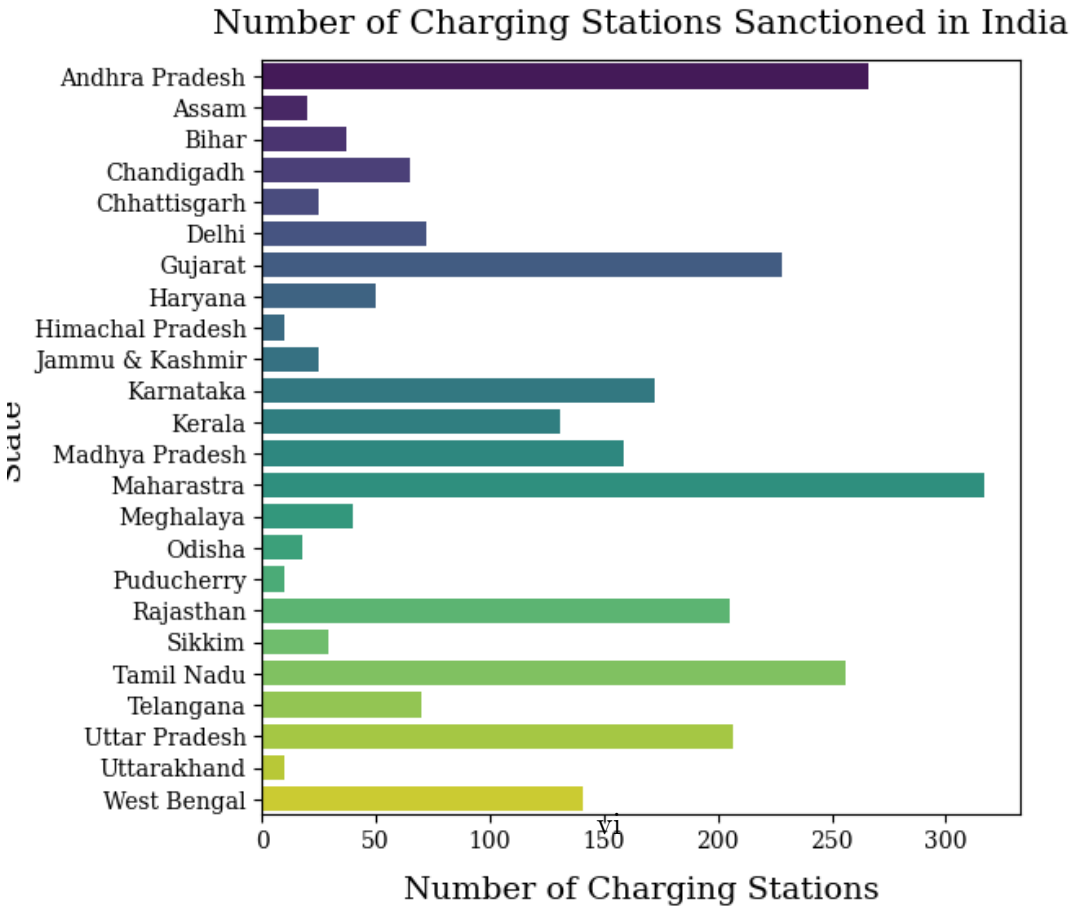

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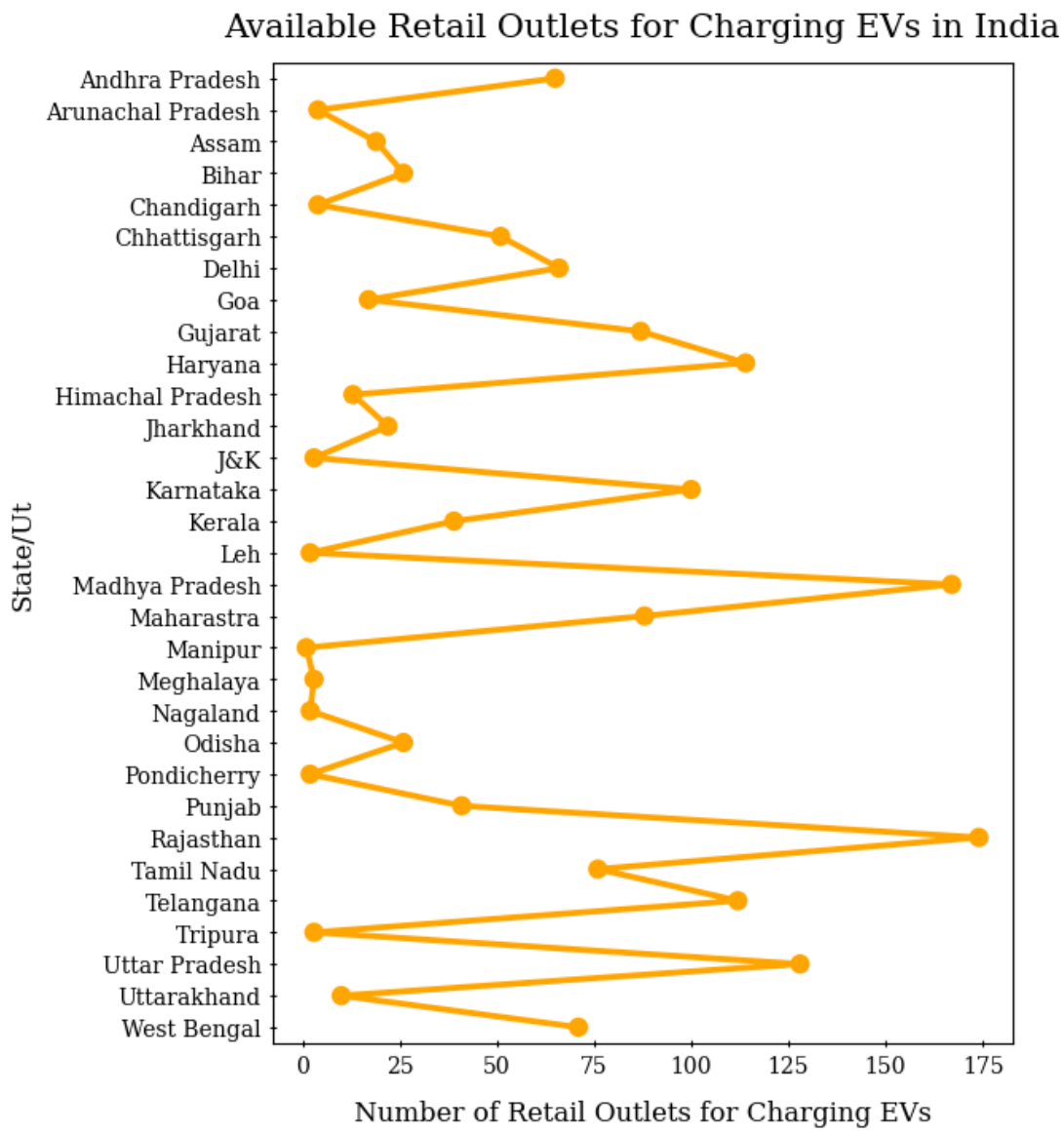

Figure 2.7: State Wise Data 4

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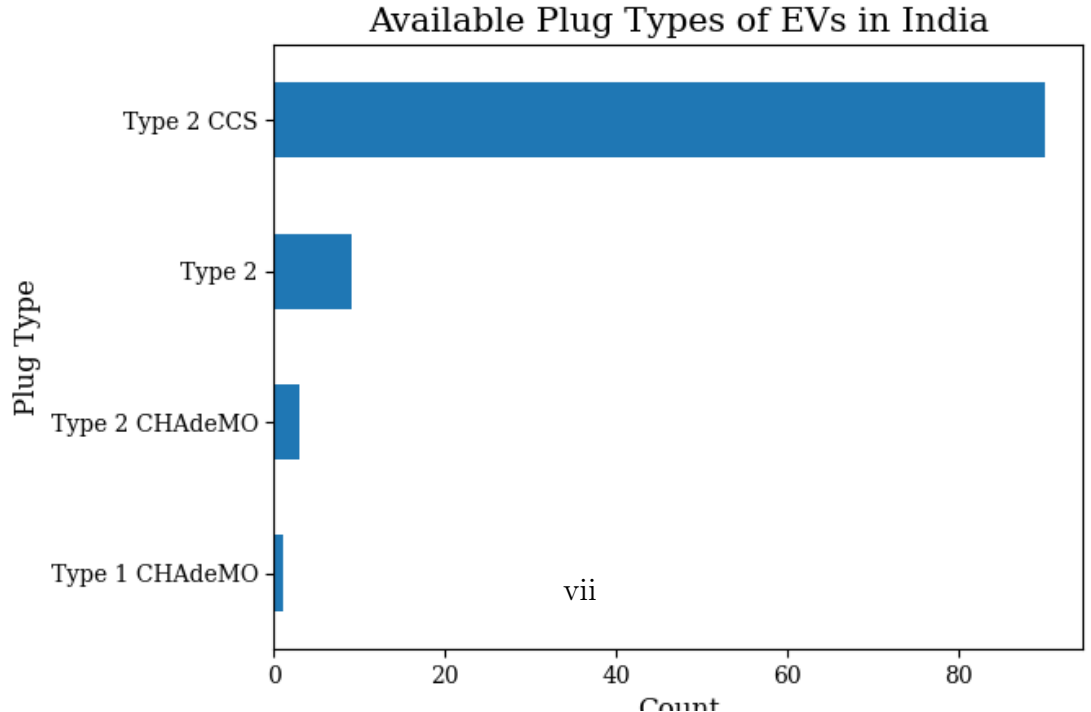

APPROACH

2.1 SEGMENTATION

Segment Extraction K-Means Clustering is one of the most popular Unsupervised Machine Learning Algorithms Used for Solving Classification Problems. K Means segregates the unlabeled data into various groups, called clusters, based on having similar features, common patterns. Suppose we have N number of Unlabeled Multivariate Datasets of various features like water- availability, price, city etc. from our dataset. The technique to segregate Datasets into various groups, on the basis of having similar features and characteristics, is called Clustering. The groups being Formed are known as Clusters. Clustering is being used in Unsupervised Learning Algorithms in Machine Learning as it can segregate multivariate data into various groups, without any supervisor, on the basis of a common pattern hidden inside the datasets. In the Elbow method, we are actually varying the number of clusters (K) from 1 – 10. For each value of K, we are calculating WCSS (Within-Cluster Sum of Square). WCSS is the sum of squared distance between each point and the centroid in a cluster. When we plot the WCSS with the K value, the plot looks like an Elbow.

As the number of clusters increases, the WCSS value will start to decrease. WCSS value is largest when K = 1. When we analyze the graph, we can see that the graph will rapidly change at a point and thus creating an elbow shape. From this point, the graph starts to move almost parallel to the X-axis. The K value corresponding to this point is the optimal K value or an optimal number of clusters.

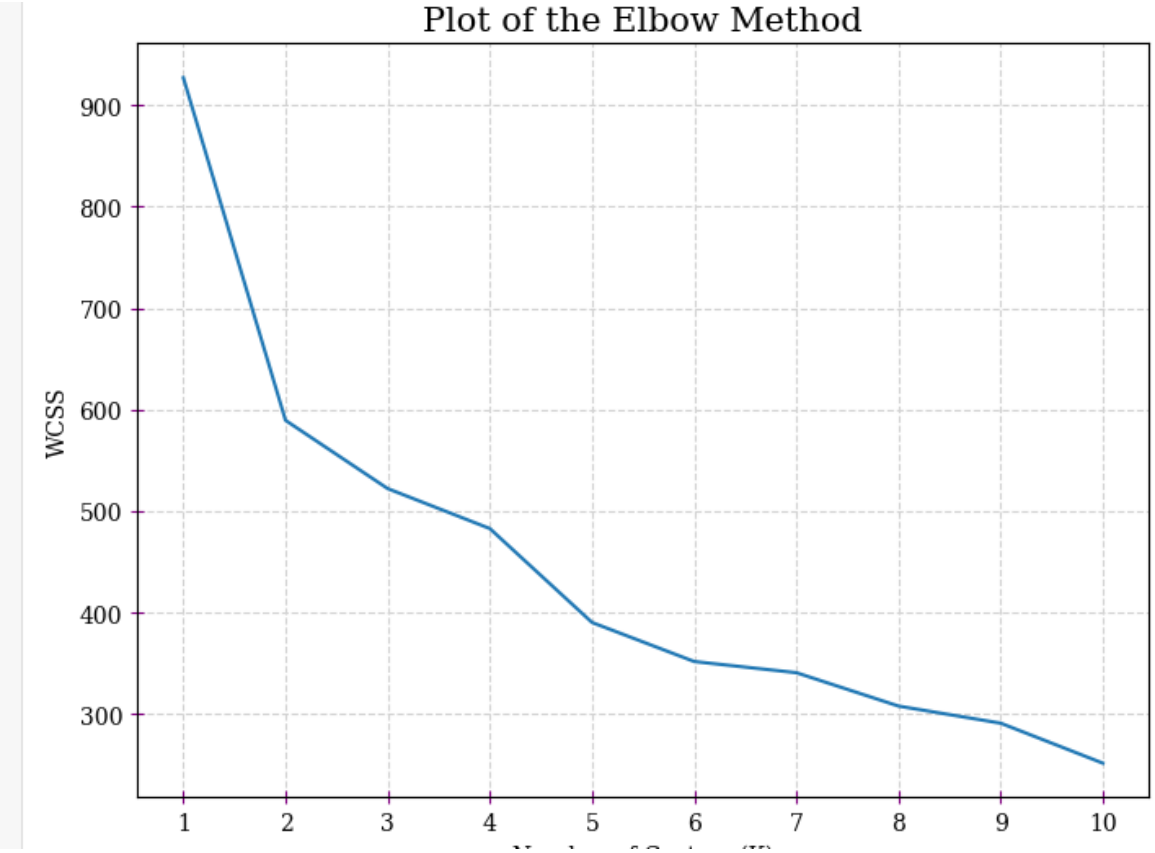

Figure 2.10: Elbow method

2.2 CLUSTERING RESULT

The figure shown below desribe the clustering result of market segmentation

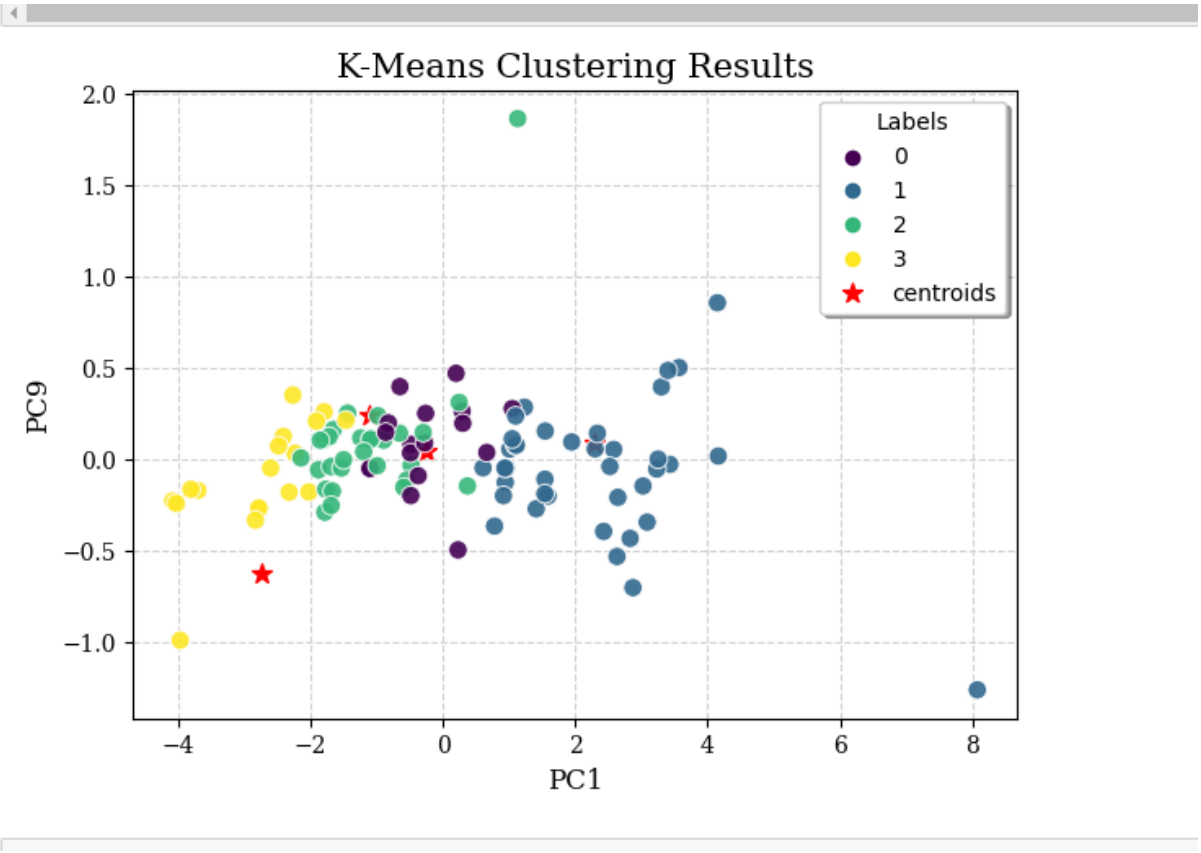

Figure 2.11: clustring

Chapter 3

CONCLUSION

Potential Sales in Early Market Purchasing a vehicle is a significant milestone that many people aspire to achieve. Most customers have families, and their preferences are influenced by various factors such as market conditions and schooling options. Whether one prefers a modern urban loft or a spacious suburban home with a white picket fence, the goal is often to find a vehicle that seems tailor-made for their family. Our insights aim to help individuals find the best vehicle at the best-fixed price based on their location and other relevant factors.

Key Focus Areas for EV Development in India Retrofitting Public Transport: Converting public transport buses, taxis, and three-wheelers (autos) to plug-in hybrid electric vehicles (PHEVs) is essential for sustainable transportation. This will not only help balance emissions but also reduce the infrastructure burden.

Government Incentives: Identifying strategic incentives is crucial for the electric vehicle (EV) market. Incentives can increase the adoption rate and address the primary price barrier for customers. Examples include subsidies that bridge the cost gap between conventional and electric vehicles, discounts on VAT, registration, and tolls to encourage EV sales.

Charging Infrastructure: The development of charging infrastructure should parallel the growth of the EV market. This can be facilitated by creating grid-connected charging stations with moderate tariffs, promoting standalone renewable charging stations, adding charging facilities at petrol pumps and bus stops, and supporting the development of private renewable charging stations.

Electrical Propulsion System (EPS): Currently, no Indian manufacturer produces EPS domestically. Support and a positive atmosphere for manufacturers are critical. Policies should be developed to support the supply, manufacturing, and recycling of propulsion systems. While power electronics converters and motor technology can be developed in India, cost-effective Li-ion battery technology is challenging due to the global lithium supply being concentrated in China and the USA. Battery replacement and swapping could be viable options.

Development of Skilled Manpower: Given the safety considerations and advanced technology involved, it is essential to develop certified skilled technicians and professionals.

Awareness: Promoting the benefits of EVs and government initiatives can significantly aid development. This can be achieved through extensive advertising at airports, bus stations, cinemas, government offices, and public places using banners and hoardings. Utilizing print media, digital media, radio, TV shows, expert talks, and providing microfunding for projects in schools and colleges, as well as RD grants, can also help.

Promotional Highlights for Consumers a. Environmental Benefits: EVs emit lower levels of air pollutants, such as nitrogen oxides, particulate matter, and greenhouse gases, compared to conventional petrol and diesel vehicles.

b. Cost-Effectiveness: Electricity is cheaper than petrol or diesel, making EVs less expensive to run.

c. Lower Life Cycle Cost

d. Urban Suitability: Reduced pollution and noise levels make EVs ideal for urban areas.

e. Smooth Operation: EVs offer smooth acceleration and deceleration due to the characteristics of electric motors.

f. Quieter Operation: EVs are quieter than conventional vehicles, operating almost silently except for tire noise.

g. Proven Technology: There is a significant rise in the global EV market, demonstrating the viability of this technology.

Optimal Market Segment Several EV manufacturing companies operate in India, including Hero Electric, Tata Motors, Ather Energy, Ashok Leyland, and Hyundai Kona Electric. With Tesla's entry into the market, demand is expected to increase significantly. However, the EV industry in India is still recovering from the impact of the COVID-19 pandemic and will require time to fully establish itself.

Key Insights The electric vehicle industry has struggled due to the COVID-19 pandemic but is expected to grow significantly in the coming years. EVs will be transformative in terms of environmental benefits, reducing air and noise pollution, and offering post-electric advantages. Companies should plan to establish local operations in India, either through partnerships with local firms or by setting up their own manufacturing units, potentially combined with importing specific components. Growth in India is expected to be driven by the commercial fleet market for two-wheelers and three-wheelers, particularly for last-mile delivery and urban freight services. Opportunities exist across the supply chain in battery, EV components, and charging infrastructure segments, including the machinery and equipment needed for manufacturing plants, training, and skilled workforce provision. Companies should initially focus on metro cities and gradually expand to other cities within the same state. This approach allows for easier expansion based on prior business knowledge and an established supply chain network.