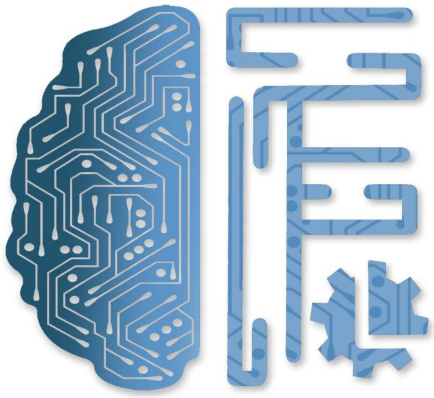

FeyNN LABS

Machine Learning Internship

Task 2.1

A Market Segmentation Case Study Report by:

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Abstract

With the current depletion of fossil fuels and its price hike, there is a need for another energy resource to run the vehicle. The automobile sector is considering Electric Vehicle as a solution to the industry and environment in India. However, the current market penetration of EV is relatively low despite governments implementing EV policies. Through this report we will analyse the potential scope of Electric vehicle in India and the potential market segments and suitable locations that new emerging Electric Vehicles Start-ups should target in their early market stages.

This project addresses market segmentation challenges within the electric vehicle (EV) industry in India, using a holistic approach that integrates geographic, economic and demographic factors. The research focuses on understanding the geography of electric vehicle adoption across Indian states, taking into account variables such as state-wise distribution, economic indicators, payment infrastructure, demographics is derived from the net GDP of the state. This project uses spatial data analysis techniques and a collection of algorithms, including hierarchical clustering, to identify natural patterns and patterns within datasets. By combining regional information with economic and demographic characteristics, the aim is to provide actionable recommendations for market segmentation, helping stakeholders including policy makers, electric vehicle manufacturers and provides the resources, to effectively implement strategies and interventions.

The research process includes data collection, cleaning, analytic data analysis, and cluster analysis, focusing on creating a vision that improves the interpretation of classification results. The ultimate goal is to contribute to the sustainable growth of the electric vehicle market in India by aligning marketing efforts with the diverse needs of different regions and demographic segments.

Objective

The main objective of this report is to improve and expand the understanding of the Electric Vehicle (EV) Market of India by addressing certain objectives:

1. To study and understand the concerns and attitudes of Indian consumers regarding electric vehicles. Analyse factors influencing adoption, identified barriers, and preferences to provide a detailed overview of customer segments.

2. Use segmentation and aggregation analysis techniques to create a comprehensive segmentation of the Indian electric vehicle market. Identify different segments of customers based on demographics, behaviours and activities. This analysis will inform the development of a targeted marketing strategy that will be implemented for the electric vehicle launch.

3. Conduct a feasibility study to identify states/locations in India suitable for launching new electric vehicles. Consider factors such as state distribution, economic indicators, charging infrastructure, and demographic indicators to identify areas with high potential for early market penetration.

In order to achieve these goals, the report seeks to provide valuable insights and strategic plans for electric vehicle start-ups to succeed in the Indian market, tailoring its approach to meet the unique needs and interests of different segments. differences of consumers and geographical areas.

Fermi Estimation

Let's estimate that approximately **75%** of people of driving age in India are interested in owning a vehicle. This gives us **852 million * 0.75 = 639 million**.

Percentage of People Open to Electric Vehicles:
Considering factors such as environmental concerns and government incentives, let's estimate that around **15%** of potential vehicle owners in India are open to considering electric vehicles. This gives us **639 million * 0.15 = 95.85 million**.

Average Number of Vehicles per Household:
Assuming an average of **1.2 vehicles per household** in India, we have **95.85 million / 1.2 = 79.875 million** households potentially interested in electric vehicles.

Percentage of New Vehicle Purchases:
Assuming that electric vehicles constitute approximately **5%** of new vehicle purchases in India, we have **79.875 million * 0.05 = 3.99375 million** households potentially purchasing electric vehicles.

This Fermi estimate suggests that there are roughly **3.99375 million households in India** that might be part of the electric vehicle market.

Government Support: Initiatives and policies

There are many government initiatives and policies that promote electric vehicle adoption around the world. Here are some examples:

- The National Electric Mobility Mission Plan (NEMMP) launched in 2013 is a governmental mission providing a roadmap for the faster adoption of electric vehicles in the nation and their manufacturing in the country to achieve national fuel security. The plan is projected to save 9500 million litres of crude oil which is equal to INR 62,000 crores.

- The FAME India (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India) scheme was launched in 2015 under the NEMMP to provide financial incentives for the purchase of electric and hybrid vehicles. The scheme was extended in 2019 as FAME II with a budget of INR 10,000 crores for three years. FAME II aims to support the deployment of 10 lakh electric two-wheelers, 5 lakh electric three-wheelers, 55,000 electric four-wheelers and 7,000 electric buses.

- The Production Linked Incentive (PLI) scheme was approved in 2020 to boost domestic manufacturing and attract large investments in the sectors of advanced chemistry cell (ACC) battery, electronic/technology products, automobiles and auto components. The scheme has an outlay of INR 18,100 crores for ACC battery manufacturing and INR 57,042 crores for automobiles and auto components. The scheme is expected to increase the production of electric vehicles and reduce their cost by promoting localization of battery and other components.

- The Vehicle Scrappage Policy was launched in 2021 to phase out old and unfit vehicles that cause pollution and increase fuel consumption. The policy aims to create an eco-system for scrapping of end-of-life vehicles and encourage the replacement of old vehicles with new and energy-efficient ones. The policy offers incentives such as scrap value, registration fee waiver, road tax rebate and GST concession for the purchase of new vehicles after scrapping old ones.

- Along with the central government, many state governments have also announced their own EV policies to provide additional benefits and support for the adoption of electric vehicles. Some of the states that have EV policies are Delhi, Gujarat, Maharashtra, Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Telangana, Uttar Pradesh and Bihar. The state policies offer various incentives such as subsidy, exemption from road tax and registration fee, preferential parking, charging infrastructure development and demand creation for electric vehicles.

Incentive Programs

There are various incentives available for electric vehicle purchases in India, both at the national and state levels. Some of the incentives are:

- Tax deductions on loan for EVs: Under section 80EEB of the Income Tax Act, individuals can claim a tax deduction of up to Rs 1.5 lakh on the interest paid on loans taken to buy electric vehicles. This deduction is applicable for both four-wheeler and two-wheeler electric vehicles. The loan should be taken from a financial institution or a non-banking financial company (NBFC) between April 1, 2019, and March 31, 2023.

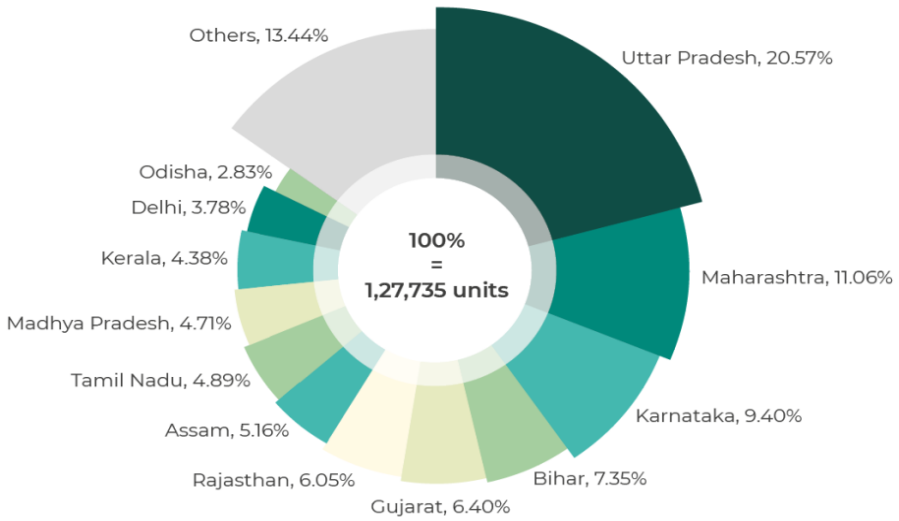
- Purchase incentives under FAME II: The central government provides direct subsidies to the buyers of electric vehicles under the FAME II scheme. The subsidy amount depends on the battery capacity of the vehicle and is capped at a certain percentage of the vehicle cost. The subsidy rates and caps are as follows:

Vehicle Type	Subsidy Rate	Subsidy Cap
Two-wheeler	Rs 15,000 per kWh	40% of cost
Three-wheeler	Rs 10,000 per kWh	-
Four-wheeler	Rs 10,000 per kWh	-
E-bus	Rs 20,000 per kWh	-

- State-level incentives: Many states have also announced their own EV policies to provide additional benefits and support for the adoption of electric vehicles. Some of the state-level incentives are:

State	Incentive Type	Incentive Amount
Delhi	Subsidy	Up to Rs 1.5 lakh for four-wheelers, Rs 30,000 for two-wheelers and Rs 30,000 for three-wheelers
Gujarat	Subsidy	Up to Rs 1.5 lakh for four-wheelers, Rs 20,000 for two-wheelers and Rs 50,000 for three-wheelers
Maharashtra	Subsidy	Up to Rs 2.5 lakh for four-wheelers, Rs 25,000 for two-wheelers and Rs 12,500 for three-wheelers
Karnataka	Road tax exemption	100% exemption for all EVs
Tamil Nadu	Registration fee exemption	100% exemption for all EVs

State-wise Registered EV Sales in September 2023



The Indian automobile industry is the fifth largest in the world and is expected to become the third largest by 2030. As per India Energy Storage Alliance (IESA), the Indian EV industry is expected to expand at a CAGR of 36%. As population rises and demand for vehicles grow, dependence on conventional energy resources is not a sustainable option as India imports close to 80% of its crude oil requirements. NITI Aayog aims to achieve EV sales penetration of 70% for all commercial cars, 30% for private cars, 40% for buses and 80% for two and three-wheelers by 2030. This is in line with the goal to achieve net zero carbon emission by 2070. Over the last three years, 0.52 million EVs were registered in India, according to the Ministry of Heavy Industries. EVs recorded robust growth in 2021, supported by the implementation of favourable policies and programmes by the government. In India, Uttar Pradesh held the highest share in EV sales in 2021, with the number of units sold across all segments reaching 66,704, followed by Karnataka with 33,302 units and Tamil Nadu with 30,036 units. Uttar Pradesh dominated the three-wheeler segment, while Karnataka and Maharashtra led the two-wheeler segment and four-wheeler segment, respectively.

DATASETS:

DATASET 1

DATASET 2

DATASET 3

DATASET 4

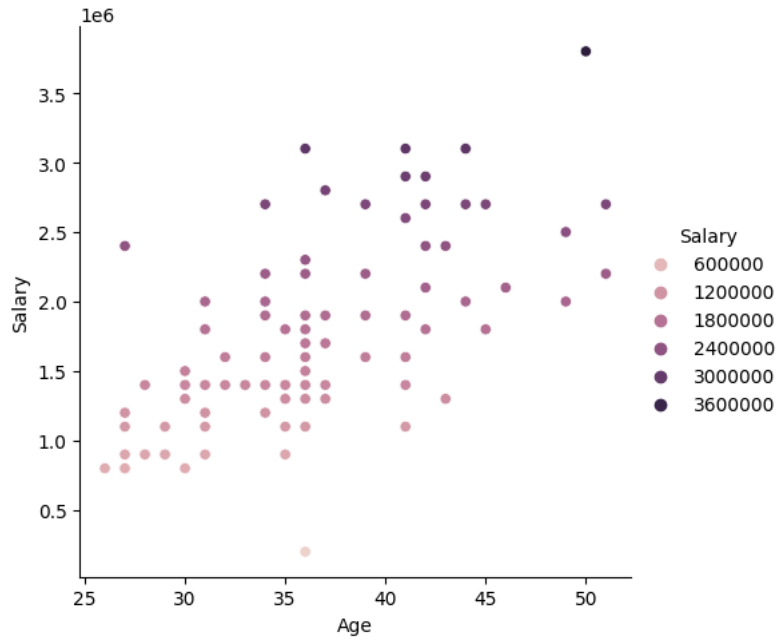
DATASET 5

DATASET 6

DATASET 7

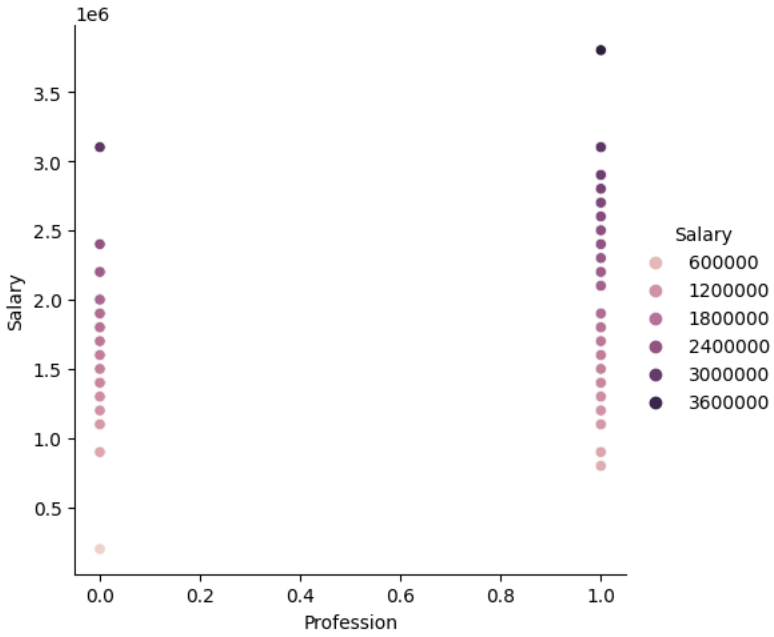
Exploratory Data Analysis and Market Segmentation

Exploratory Data Analysis (EDA) is a crucial phase in understanding the intricate dynamics of the Indian electric vehicle (EV) market, laying the foundation for insightful market segmentation and strategic decision-making. The EDA process involves a comprehensive investigation into various facets of the dataset, shedding light on patterns, trends, and potential customer segments.

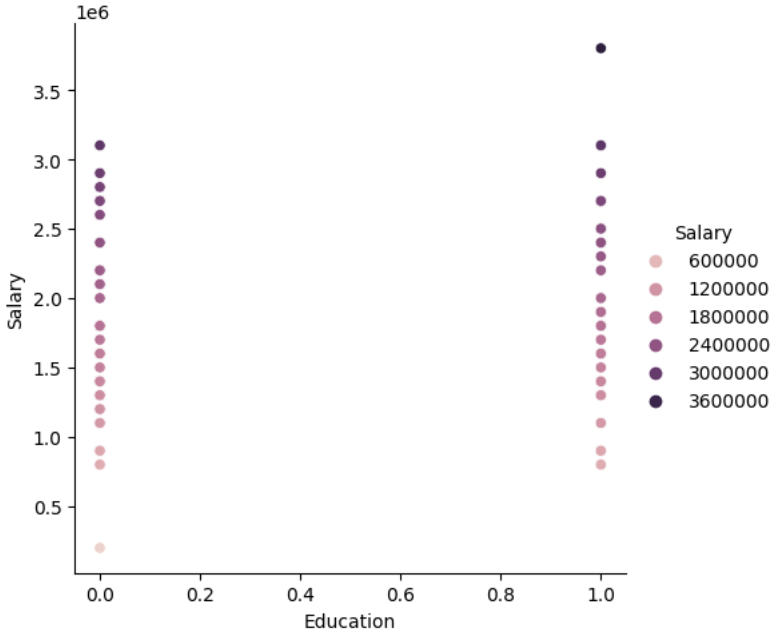


The above scatterplot describes an important relation between the age and salaries of the citizens. This helps us understand that the salary of the people tends to increase with their age .i.e. work experience. Thus plotting relations like these help us identify our target audience.

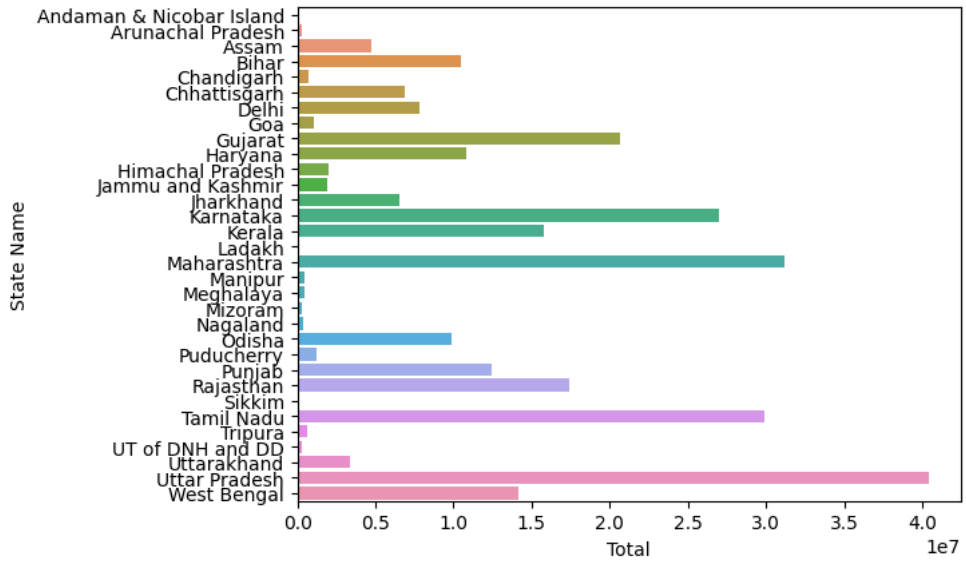
Thus, this gives us a good idea about the target audience, for example if we observe the plot, we can see that people at and after 30 years of age tend to earn well enough. Thus, we can easily rule out that our primary target audience is decided by the willingness to buy that comes with the ability to afford the expenditure of that kind. Thus the citizens in our target audience can have their ages in the range of 30-50 years old, or more than 30 years old.



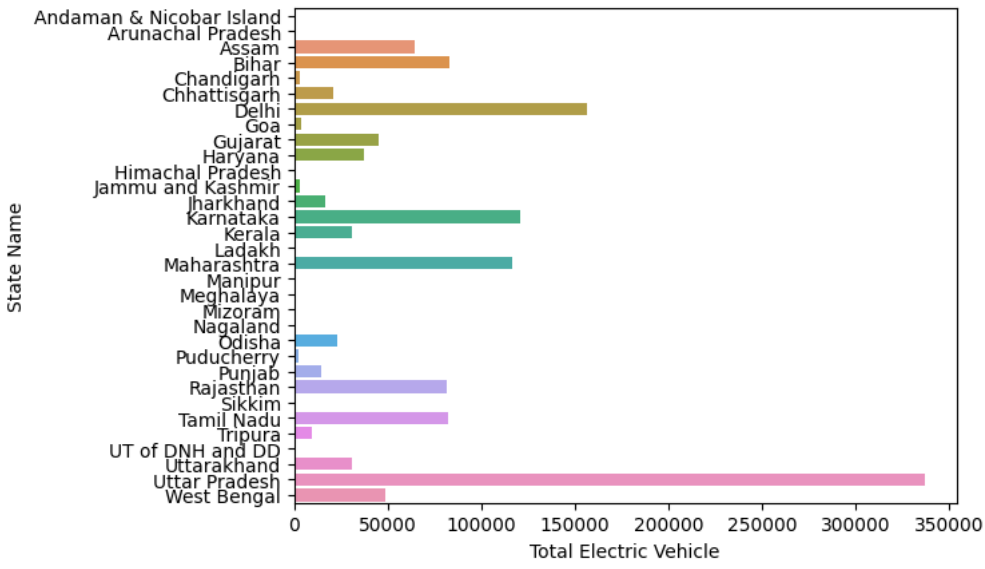
The above plot gives us the relation between salaries and professions of the citizens. As we can see, the professions were encoded into binary form thus the digit '1' signifies that the citizen is into service sector .i.e. a 'job'. On the other hand, the digit '0' signifies the citizen's profession corresponding to that of a businessman, i.e., the main revenue/income generated by the client is through a business. In the above plot, we can see that the salaries range from as low as Rs.6,00,000 to as high as Rs.36,00,000 and more. The below plot gives us a similar relation between salary and educational background (highest level of education received) of the citizens. '1' signifies Post Graduate whereas '0' signifies Graduate level education.



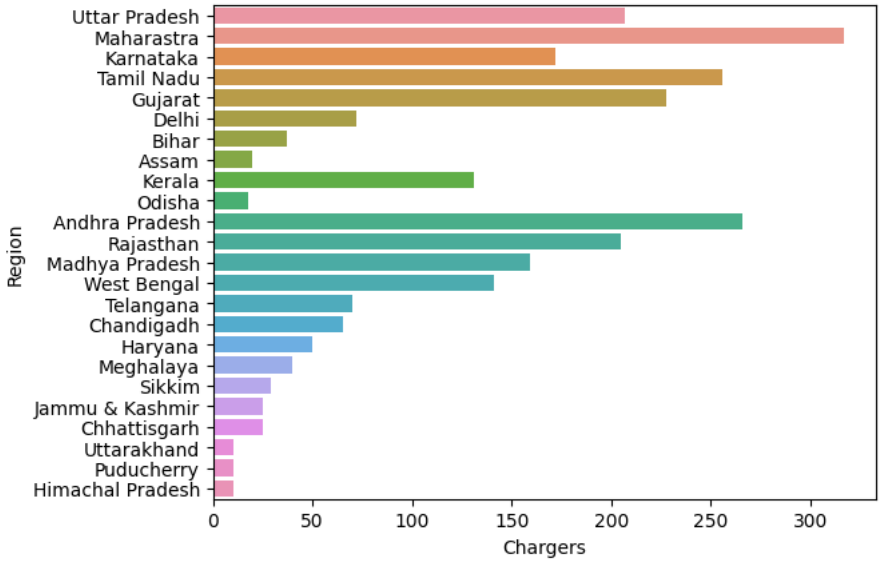
Now that we have enough information on the population in order to identify the buying or purchasing patterns, we can move on to the state- wise distribution of electric vehicles in Indian market. For this, we analyse the distributions of vehicles, electric vehicles and officially sanctioned charging stations/retail stores officially allowing charging of electric vehicles etc. through various plots. This means that we have attained the basic demographic information we can finally move on to the basic context/case-specific information.



This plot gives us an idea about the total numbers of vehicles being used throughout different states in India. As we can see, Uttar Pradesh has the highest number of vehicles being used. This is followed by Maharashtra, Tamil Nadu and Karnataka etc. Now, Let us check the number of electric vehicles being used in each of the states of our nation.



Now we can see the states like Uttar Pradesh, Delhi etc are the leading states when it comes to use of electric vehicles. Hence, it means that these states are already occupied by too much of competition in the market.



As we can see, the number of charging facilities sanctioned by the government in each state give us a good idea of why people do or do not opt for electric vehicles in that state. As we know, more the number of charging stations, more convenient it gets for the citizens in that region to utilise electric vehicles without having to worry about running out of power.

Now that we have information on the data for each state in the country, let's shed some light on the economy of these states in order to understand the mindset of the citizens in order to make them purchase a product that ranges anywhere between 10-30 lakh rupees.

State Name	NSDP Per Capita (Nominal)2019-20	
0	Arunachal Pradesh	1,69,742
1	Assam	86,801
2	Bihar	46,292
3	Chhattisgarh	1,04,989
4	Goa	4,35,959
5	Gujarat	2,13,936
6	Haryana	2,47,628
7	Himachal Pradesh	1,83,407
8	Jammu and Kashmir	1,04,889
9	Jharkhand	75,739
10	Karnataka	2,23,175
11	Kerala	2,21,904
12	Madhya Pradesh	98,418

13	Maharashtra	2,02,130
14	Manipur	84,746
15	Meghalaya	82,182
16	Mizoram	1,87,327
17	Nagaland	1,20,518
18	Punjab	1,51,491
19	Rajasthan	1,16,492
20	Sikkim	4,03,376
21	Tamil Nadu	2,13,396
22	Telangana	2,33,325
23	Tripura	1,29,675
24	Uttar Pradesh	65,431
25	Uttarakhand	2,02,895
26	West Bengal	1,21,463
27	Odisha	1,09,730
28	Andhra Pradesh	1,68,480

The above table gives us the NET STATE DOMESTIC PRODUCT(NSDP) for the year 2019-20. Using this data we can observe the percentage increase in the net state product per capita. This helps us break down the problem and help us understand consumer behaviour. As we know, states with a lower per capita income mean that the citizens are not generating enough revenue and thus cannot be trusted with buying such expensive products.

Thus if we segment the audience in proper ways we can rule out that a state having it's per capita income between 1.4 to 4 lakhs would probably be the ideal place to enter the market.

Thus, the ideal market mix would be a state with a moderate amount of electric vehicles and charging facilities where per capita income is above 1.4 lakhs and the audience is well educated salaried and majority is between 30-50 years old.

Clustering

Clustering is a technique used in machine learning and data analysis to group similar data points together based on certain characteristics or features. The goal is to partition a dataset into distinct groups or clusters in a way that data points within the same cluster are more similar to each other than to those in other clusters.

In the context of market segmentation:

Clustering is used to group similar entities or observations within a dataset. In market segmentation, these entities could be customers, regions, or products. Clustering helps identify patterns and structures within data. By grouping together entities that share common characteristics, businesses can identify segments of their market that exhibit similar behaviours or preferences. Once clusters are identified, businesses can tailor their marketing strategies to target each segment differently. For example, if certain customer segments show a preference for specific product features, marketing messages or product offerings can be customized accordingly.

Clustering aids in enhancing the understanding of customer behaviour and preferences. It goes beyond demographic information and allows businesses to identify patterns that might not be immediately apparent. By understanding the distinct characteristics of each cluster, businesses can allocate resources more efficiently. This includes optimizing marketing budgets, product development efforts, and other resources based on the needs and preferences of each segment. Clustering helps businesses position their products effectively within the market. By understanding the specific needs and preferences of different clusters, businesses can ensure that their products align with the expectations of each segment.

Clustering provides a foundation for strategic decision-making. It helps businesses identify market opportunities, focus on high-potential segments, and tailor their overall business strategy to align with the diverse needs of their customer base. Popular clustering algorithms include K-Means clustering, hierarchical clustering, and DBSCAN, among others. These algorithms use mathematical techniques to group data points based on their similarities and

dissimilarities. The insights derived from clustering contribute significantly to effective market segmentation and targeted marketing strategies.

Hierarchical clustering is a clustering algorithm used in data analysis and machine learning to group similar data points into nested structures or hierarchies. The algorithm builds a tree-like structure, known as a dendrogram, where each node represents a cluster of data points. The hierarchy is constructed by iteratively merging or splitting clusters based on their similarity.

In the context of the provided case study on market segmentation for electric vehicles (EVs) in India, hierarchical clustering is considered ideal for several reasons:

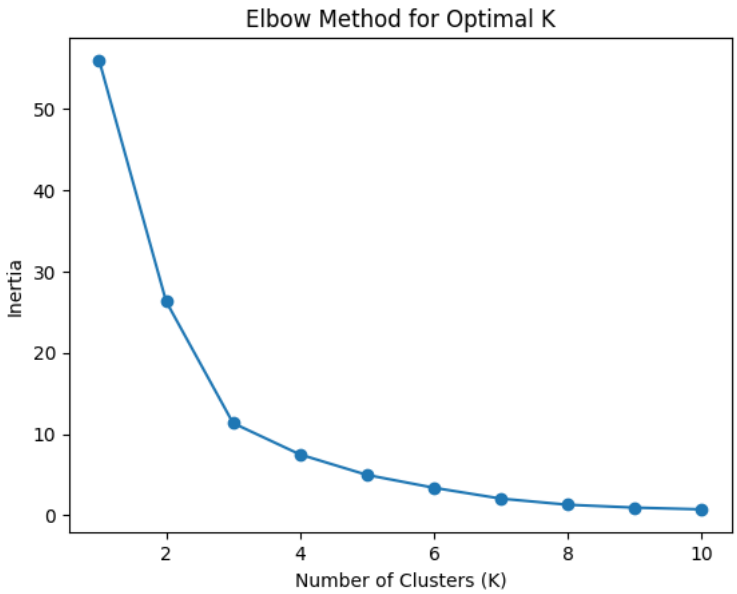
India, with its diverse geography, demographics, and economic variations across states, may exhibit hierarchical relationships in the adoption of electric vehicles. Hierarchical clustering is well-suited to capture nested structures within the data, making it an effective tool for understanding the potential subsegments and their relationships. Unlike some other clustering methods (e.g., K-Means, which requires specifying the number of clusters beforehand), hierarchical clustering does not require the pre-definition of the number of clusters. The dendrogram allows for an intuitive visual inspection, enabling the identification of an optimal number of clusters based on the structure of the data.

Given the geographic nature of the data, hierarchical clustering can provide valuable spatial insights. It helps identify regions with similar characteristics in terms of EV adoption, economic indicators, and other relevant factors. This geographic perspective is crucial for a market segmentation study that considers the feasibility of setting up operations in different states. The dendrogram produced by hierarchical clustering is a powerful visualization tool. It allows stakeholders to visually interpret the relationships between clusters and gain insights into the hierarchical structure of the market. This can aid in developing a nuanced understanding of how various factors contribute to the segmentation of the EV market in India.

Hierarchical clustering produces results that are often more interpretable than some other clustering methods. The hierarchical structure provides a clear representation of the relationships between different segments, making it easier for stakeholders to understand and interpret the results.Hierarchical clustering can handle datasets with multivariate factors,

considering various features simultaneously. This is important in the case study where factors such as state-wise distribution, economic indicators, and charging infrastructure need to be collectively considered for market segmentation. Hierarchical clustering tends to be more robust to outliers compared to certain other clustering techniques. In a diverse market like India, where states may exhibit unique characteristics, the robustness to outliers can be advantageous. In summary, hierarchical clustering is ideal for the case study on market segmentation for EVs in India due to its ability to capture hierarchical relationships, flexibility in determining the number of clusters, spatial insights, visual interpretability, and consideration of multivariate factors. The algorithm aligns well with the complexity and diversity inherent in the Indian market.

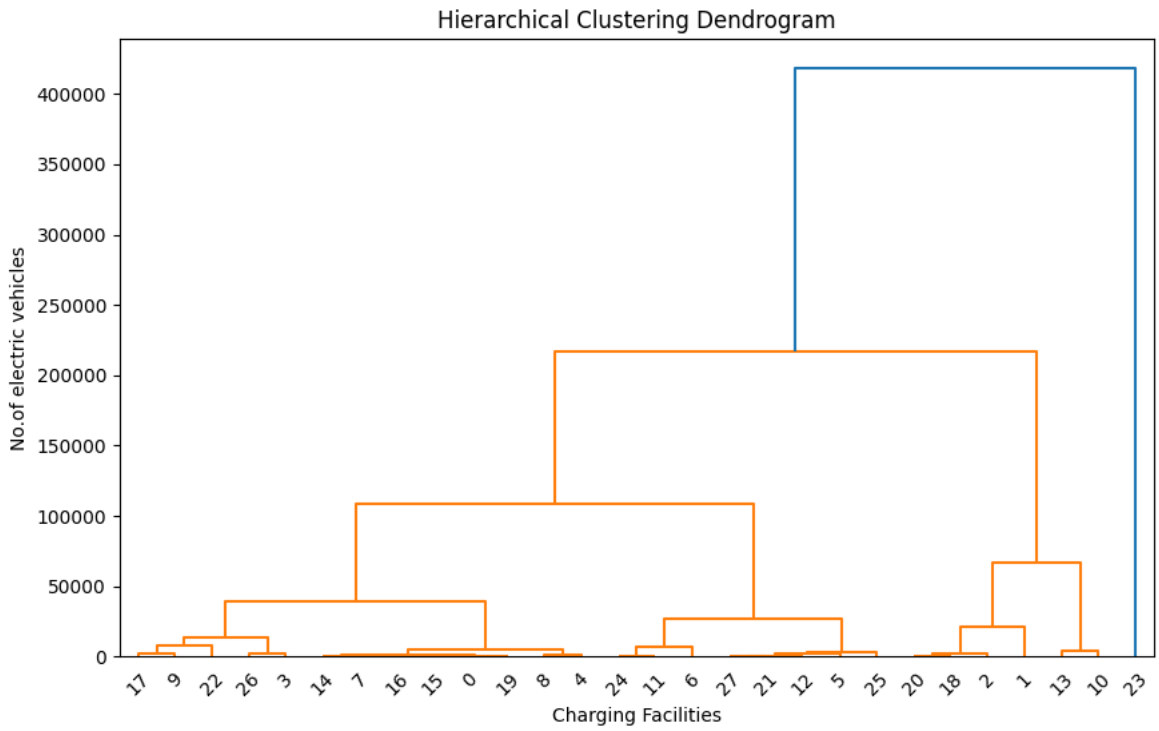
The elbow method is a technique used to determine the optimal number of clusters (k) in a dataset for clustering algorithms, such as K-Means. The idea is to run the clustering algorithm with different values of k and plot the sum of squared distances (or inertia) of data points to their assigned cluster centroids. The "elbow" of the resulting curve is considered the optimal k, as it indicates the point at which adding more clusters does not significantly reduce the sum of squared distances.



Elbow point: 3

Thus we make 3 clusters.

Dendogram:



Cocnclusion:

In conclusion, the exploration of the Indian electric vehicle (EV) market through a comprehensive approach, including exploratory data analysis (EDA) and hierarchical clustering, has yielded valuable insights. The state-wise distribution analysis revealed diverse geographical patterns in EV adoption, while hierarchical clustering identified natural market segments with unique characteristics. Consumer profiling based on demographic and psychographic factors enhanced our understanding of the diverse EV market. Feasibility analysis pinpointed strategic locations for an EV start-up's early operations. These findings have critical implications for targeted marketing strategies, operational optimization, and informed policy and investment decisions. While acknowledging study limitations, this research provides a solid foundation for stakeholders, policymakers, and businesses to navigate the complexities of the evolving EV landscape in India, paving the way for sustainable growth and market leadership.