

Market Segmentation Analysis of Electric Vehicles Market in India

Date: 7th May, 2024

ELECTRIC CAR IN INDIA



Problem Statement

Task is to analyze the Electric Vehicles Market in India using *Segmentation* analysis and come up with a feasible strategy to enter the market, targeting the segments most likely to use their product in terms of Geographic, Demographic, Psychographic, and Behavioral.

In this report we analyze the Electric Vehicles Market in India using segments such as region, price, charging facility, type of vehicles (e.g., 2 wheelers, 3 wheelers, 4 wheelers etc.), retail outlets, manufacturers, body type (e.g., Hatchback, Sedan, SUV, Autorickshaw etc.), safety, plug types and much more.

Fermi Estimation

Geographic Segmentation :- India has a population of around 1.3 billion people. Major urban areas where EV adoption is high constitute about 30% of the population, so around 390 million people.

Demographic Segmentation :- Let's say around 25% of the urban population falls in the age group of 25-40, which is approximately 97.5 million people. Considering about 20% of them have middle to high income, around 19.5 million people.

Psychographic Segmentation :- Assuming around 15% of the target group is environmentally conscious and seeks innovation, approximately 2.9 million people.

Behavioral Segmentation :- Assuming around 10% of environmentally conscious people are early technology adopters, around 290,000 people. About 30% of this group might be interested in cost-effective, low-maintenance transportation, around 87,000 people.

So, approximately 87,000 people in India could be early adopters of EVs who are environmentally conscious and seek cost-effective transportation solutions. This is a simplified estimation, but it gives us a ballpark figure of the potential market size for targeted EVs in India.

Data Collection

Data was extracted from the website mentioned below for EV market segmentation.

Link for data extraction:

- <https://electricvehicles.in/electric-vehicles-sales-report-in-india-2018/>

Raw data generated:

- https://github.com/ramdhan9604/Fynn_Labs_internship_project_2_market_segmentation

Columns explanations:

1. 'Brand' and tells the manufacturers of electric vehicles.
2. 'model' tells the various of electric vehicles.
3. 'AccelSec', 'Top Speed', 'Power Train' tells specification about the vehicles.
4. 'Range_km', 'Fast_Charge', 'Plug_type' and 'Bodystyle' tells us about range of vehicle per full charge, fast charging is provided or not, type of charging plug and body style of vehicle respectively.
5. 'Seats' and 'Price' tells about the number of seats available on vehicle and their price.
6. 'Region' and 'State/UT' tells about the states of India.
7. 'EV Charging Facility' and 'Chargers' tells about the facility of charging in the respective states.
8. '2W', '3W', '4W', 'Bus' tells about the type of vehicles in the market.

Data Preprocessing

Steps taken to preprocess the scraped raw data:

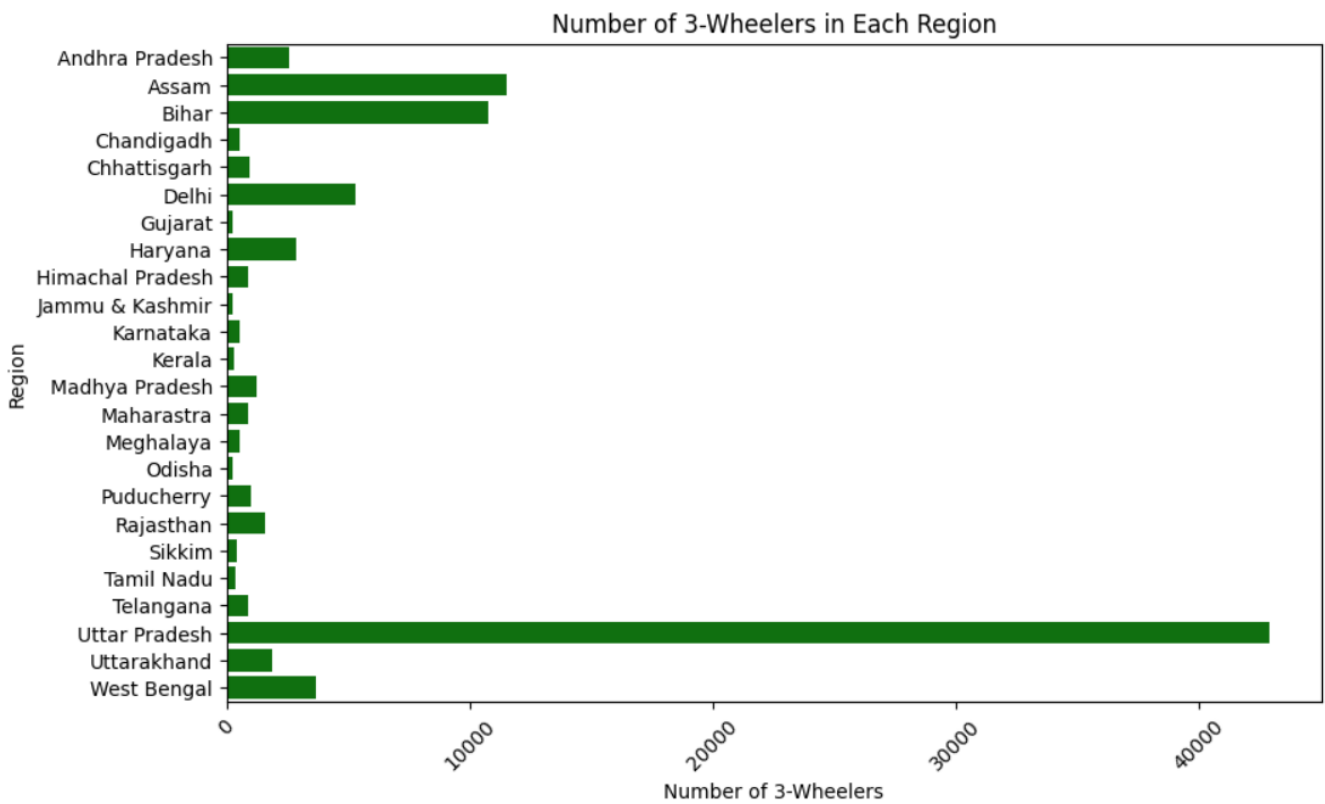
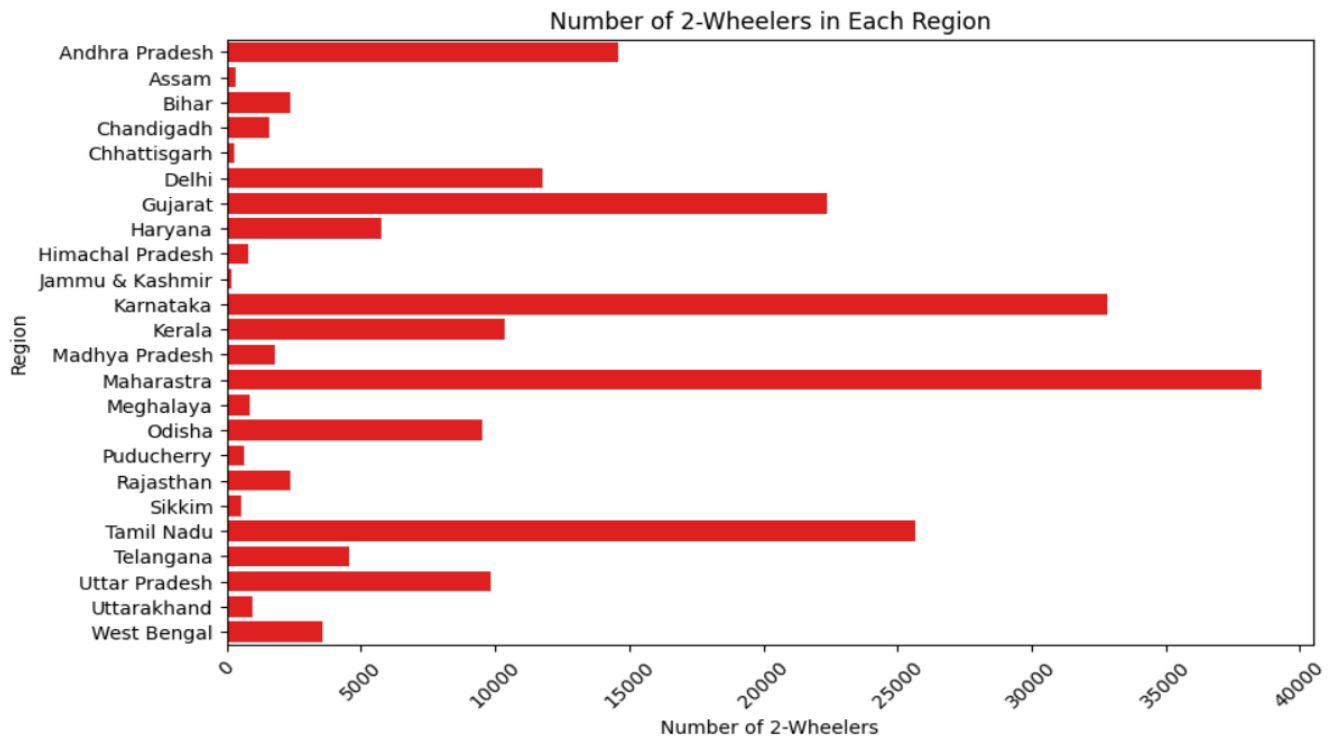
1. Ordinal encoded 'PowerTrain'
2. Label encoded 'RapidCharge'
3. Used Label Encoder and Standard Scaler package for preprocessing of the dataset.

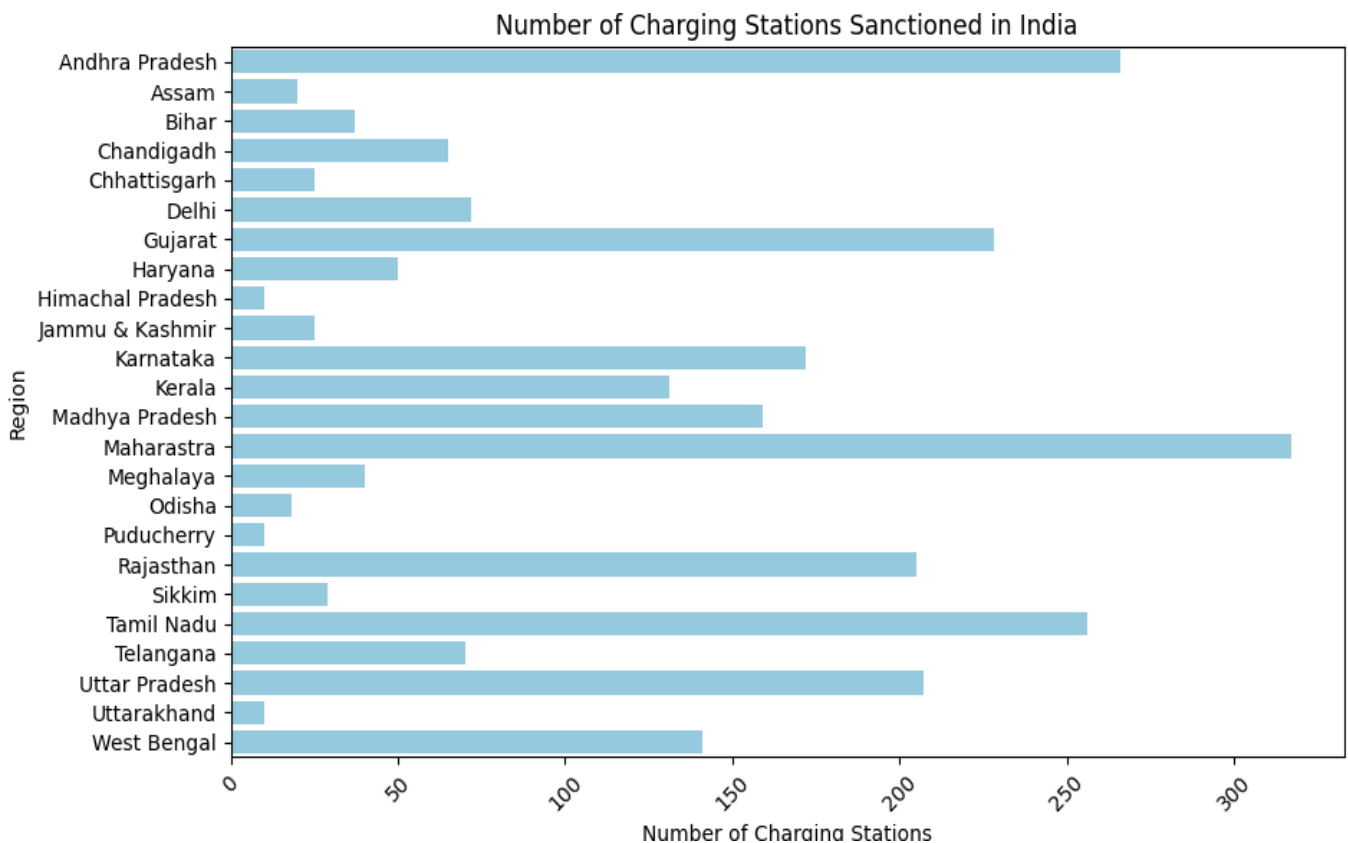
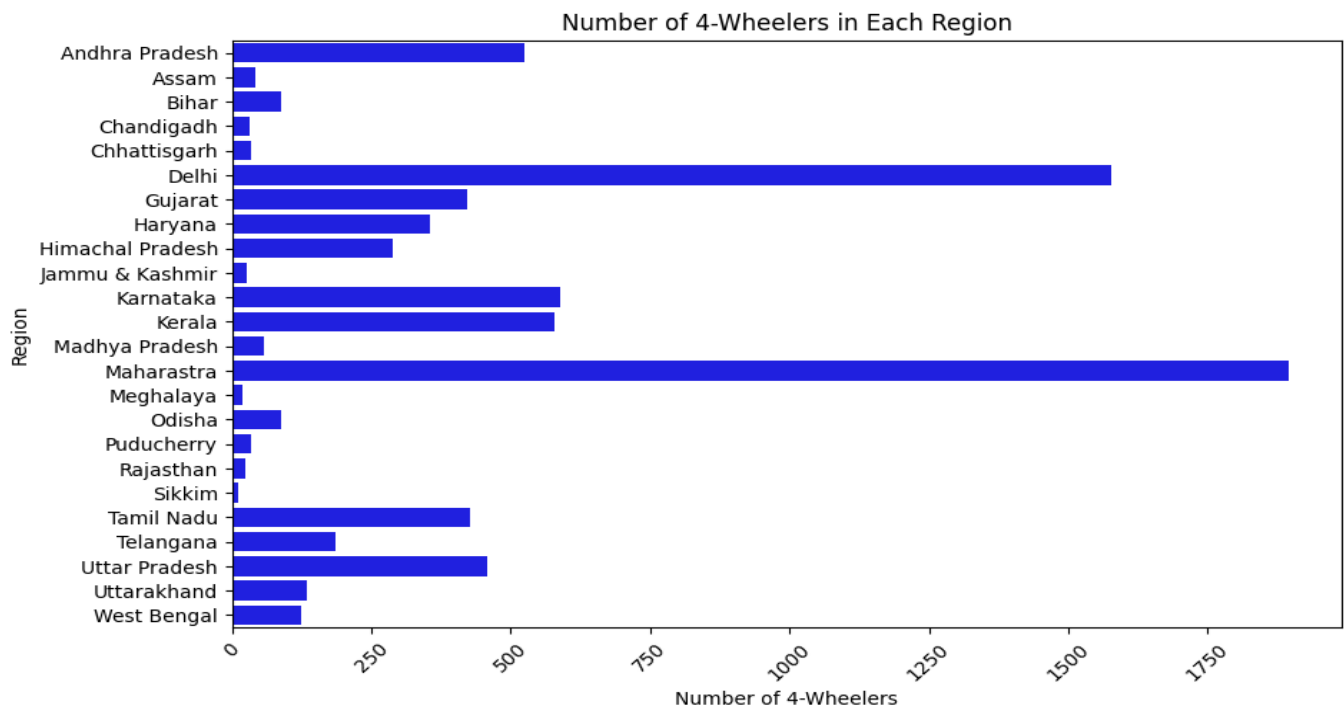
Exploratory Data Analysis

An Exploratory Data Analysis or EDA is a thorough examination meant to uncover the underlying structure of a data set and is important for a company because it exposes trends, patterns, and relationships that are not readily apparent.

We analyzed our dataset using *univariate* (analyze data over a single variable/column from a dataset), *bivariate* (analyze data by taking two variables/columns into consideration from a dataset) and *multivariate* (analyze data by taking more than two variables/columns into consideration from a dataset) analysis.

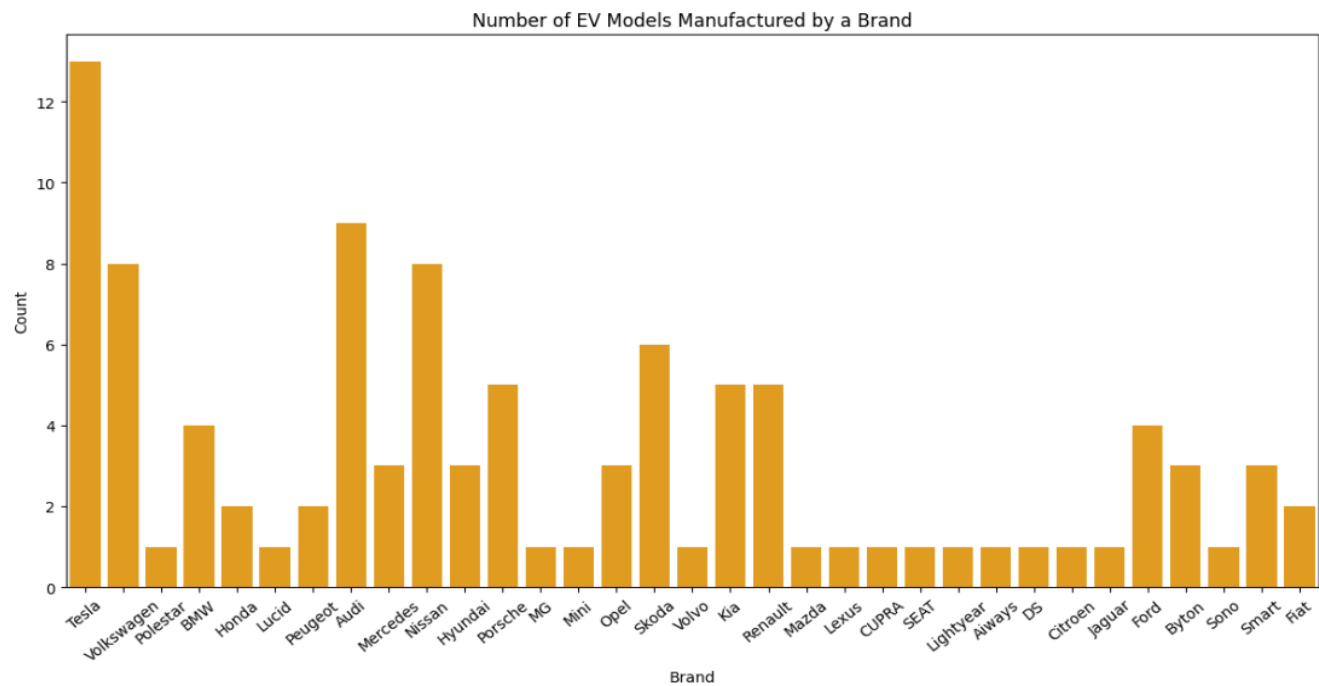
The bar graph below shows the diversity of the data geographically. We can see that we have the maximum amount of data of states *Karnataka* and *Maharashtra*; and minimum amount of data for *Sikkim*, *Meghalaya*, *Lakshadweep*, *Ladakh*, and *Dadra and Nagar Haveli and Daman and Diu*. There are a total of 1536 rows of data distributed among the cities shown in the graph.



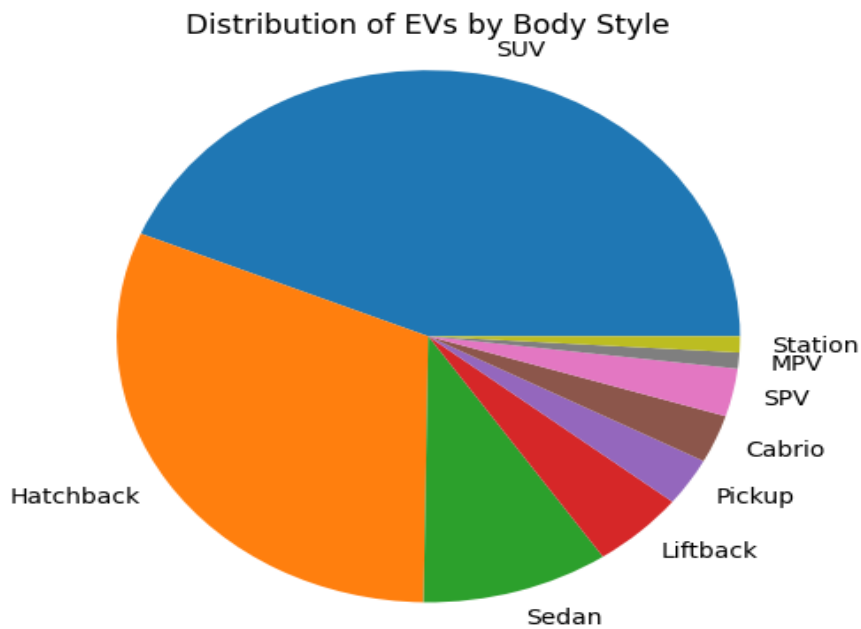


This Bar Chart shows the type of vehicles used in various states from the dataset after removing meaningless outliers. It also shows the Number of Charging Stations sanctioned in India state wise. Quick look at the graphs tells us that *Maharashtra, Karnataka, Andhra Pradesh, Tamilnadu* and *Gujrat*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

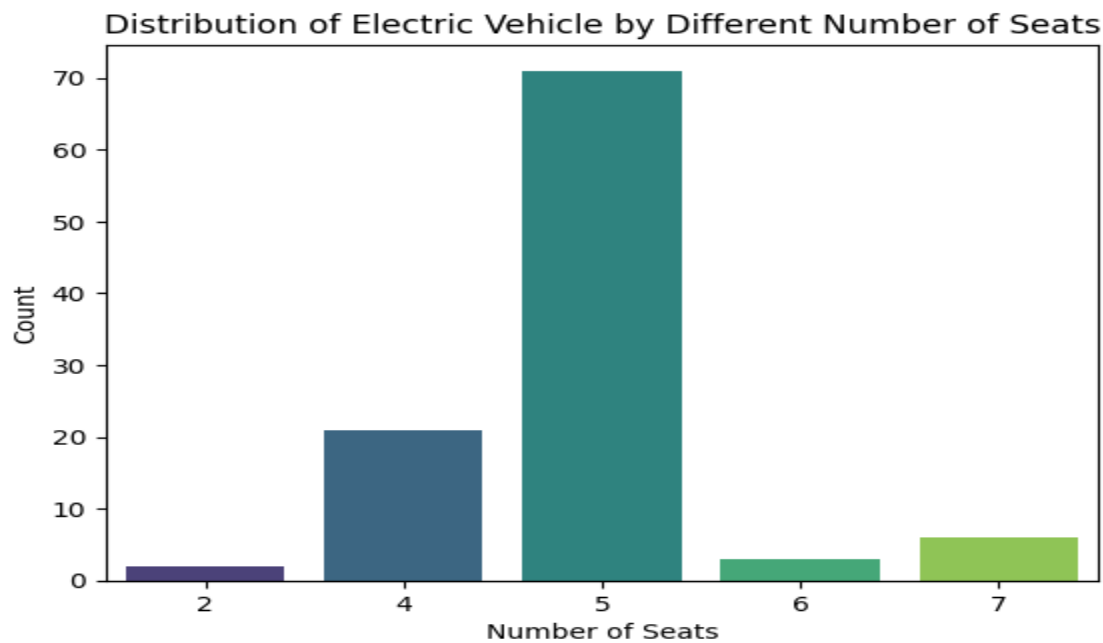
This bar graphs shows the manufacturers of Electric Vehicles.



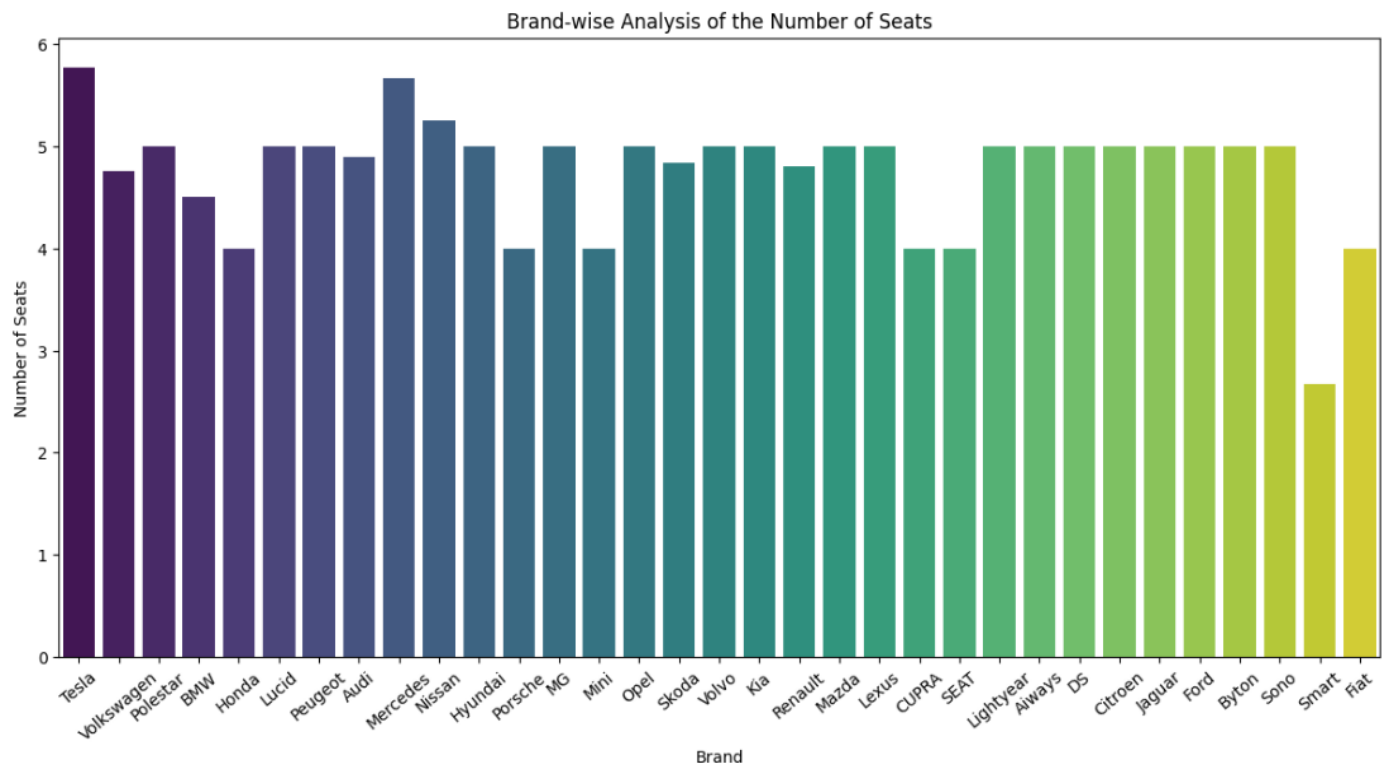
This pie chart shows the different types of Electric Vehicles



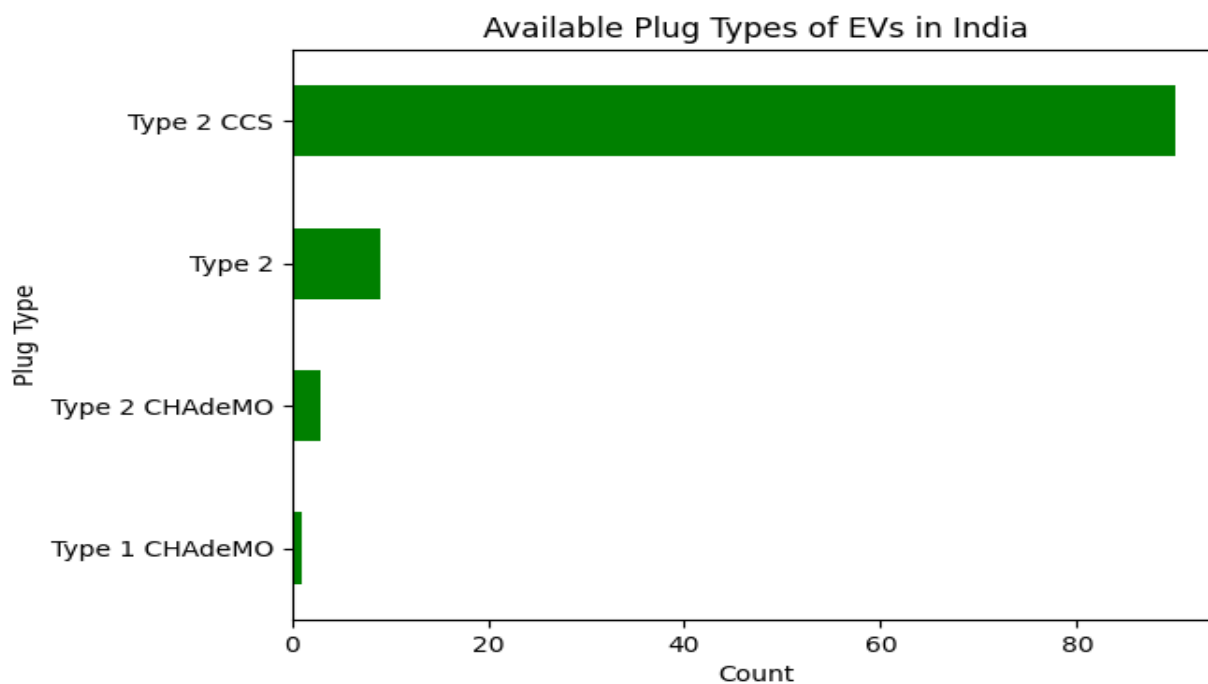
This bar graph shows the number of seats available in Electric Vehicles.



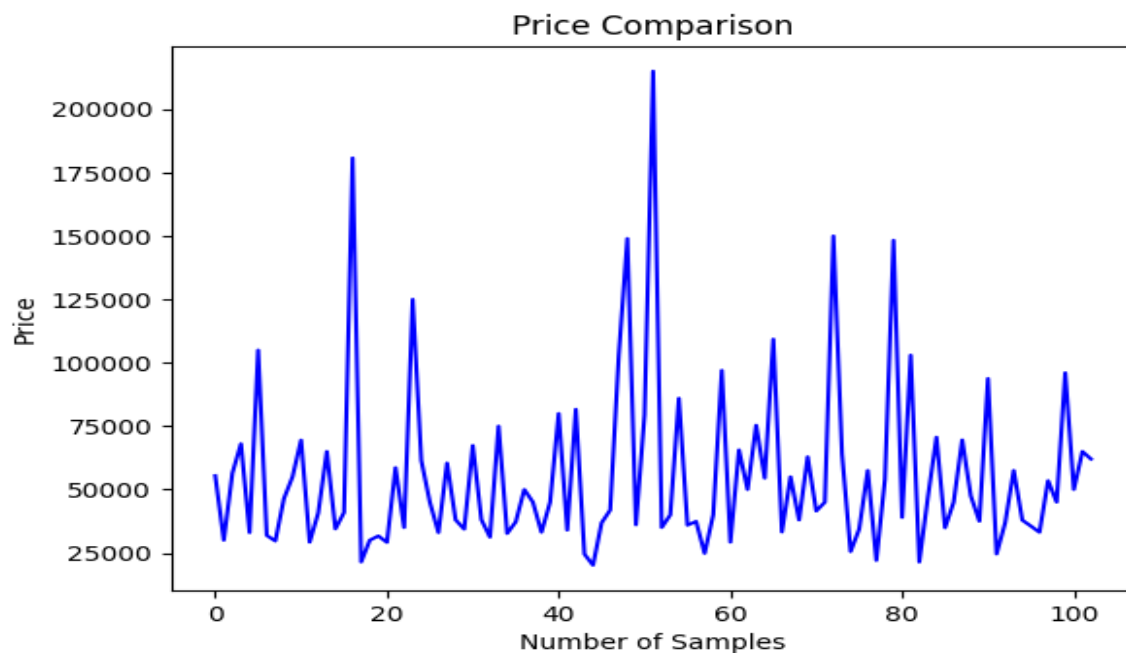
This bar graph shows the number of seats available in Electric Vehicles available in India.



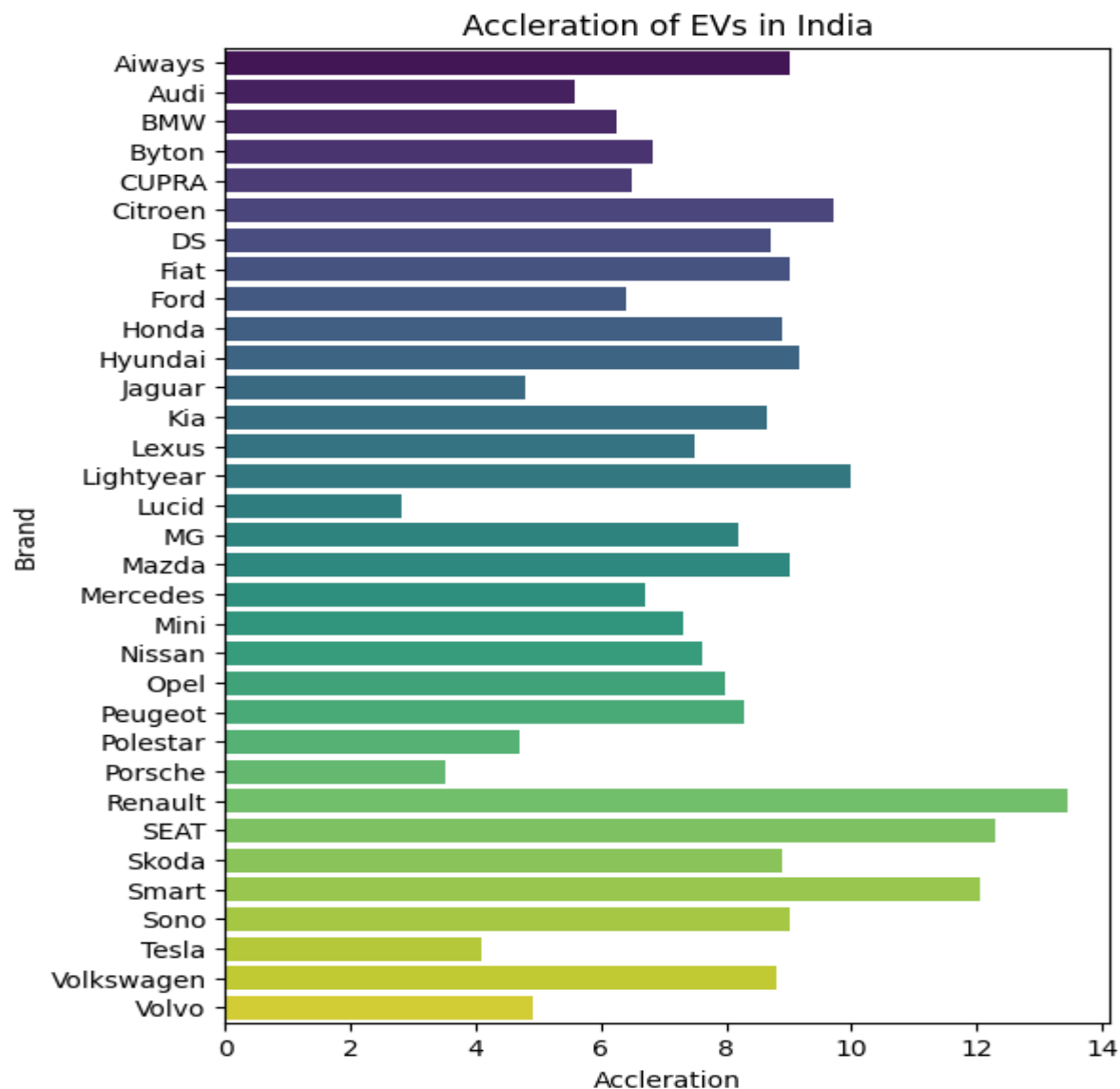
This bar graph shows the available plug types in Electric Vehicles.



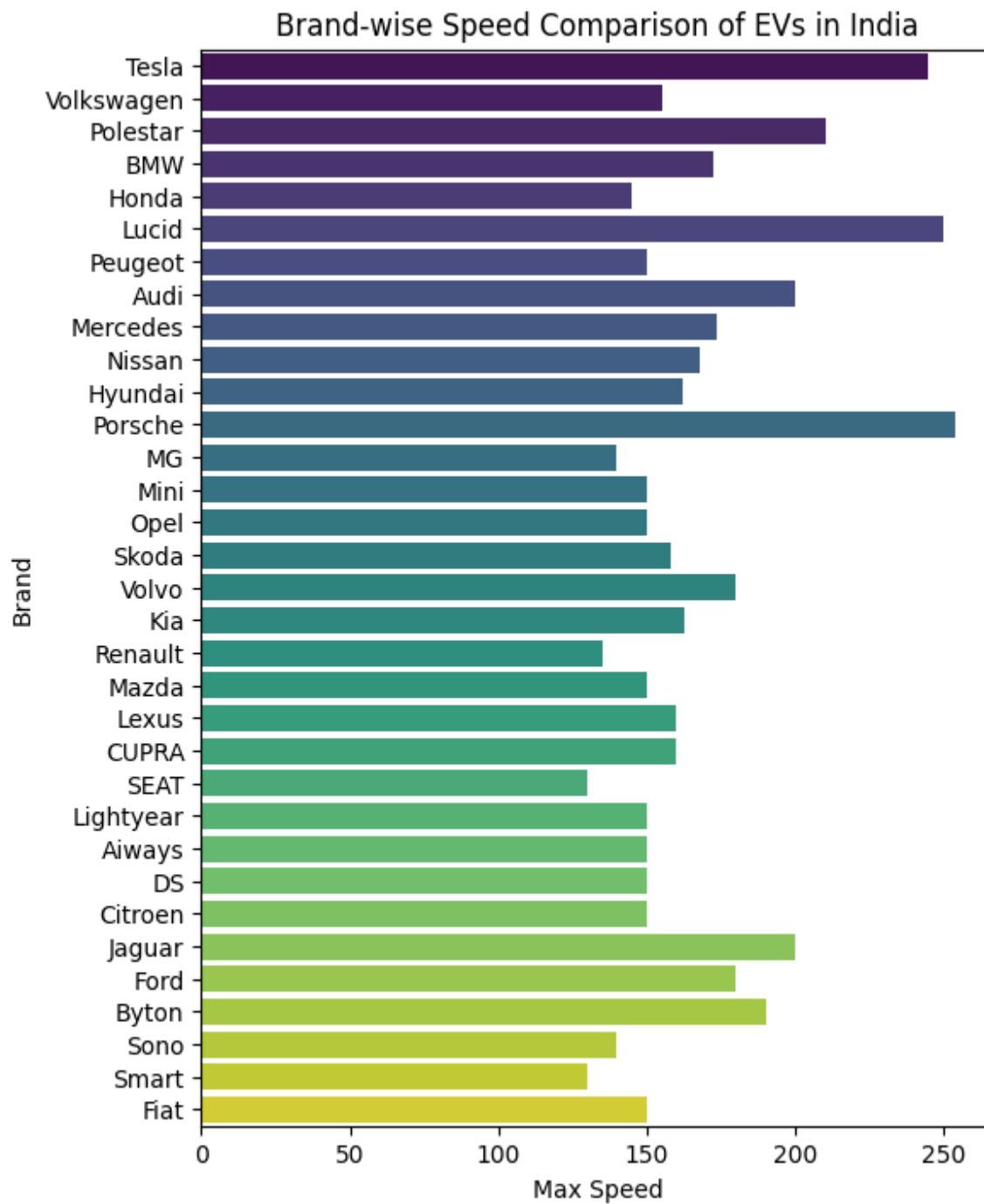
This line graph shows the price comparisons in Electric Vehicles.



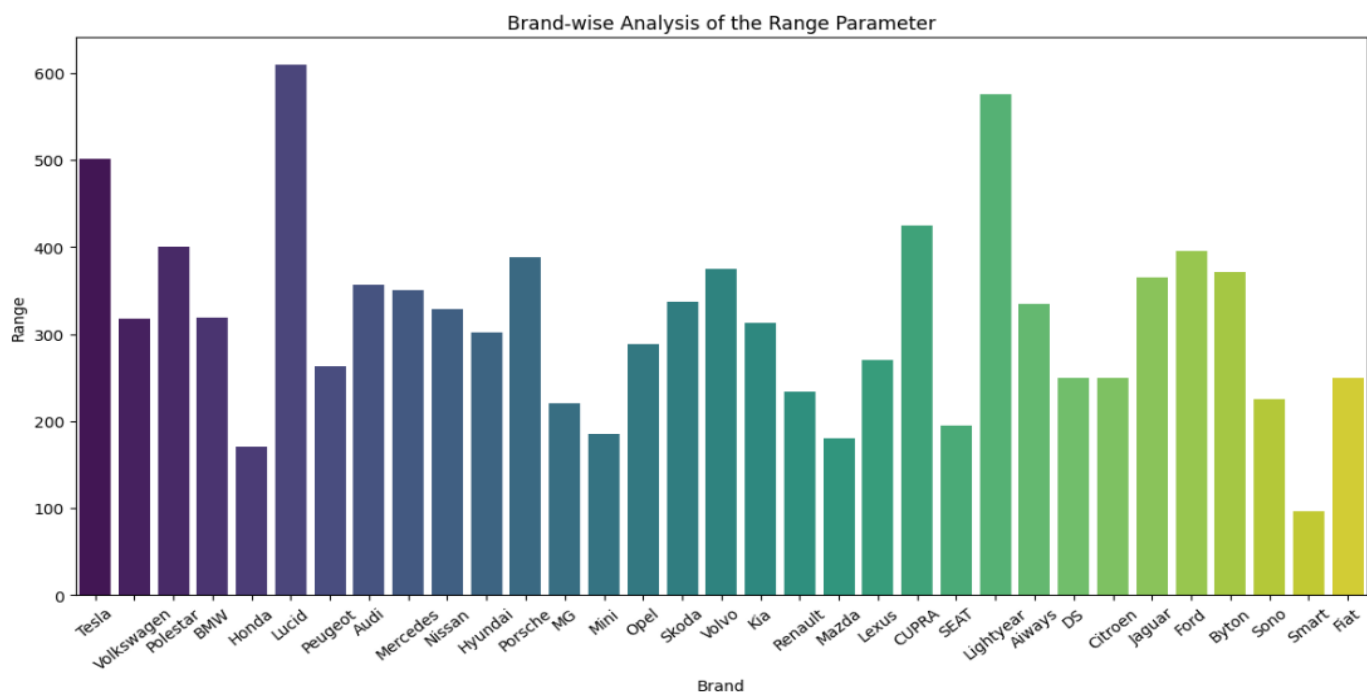
This bar graph shows the Electric Vehicles based on Acceleration.



This bar graph shows the Brand-wise Speed Comparison of EVs.



This bar graph shows the Brand-wise Analysis of the Range Parameter.



Correlation matrix for the features in one of the dataset used.

Correlation Matrix							
AccelSec	1.00	-0.79	-0.68	-0.38	-0.73	-0.18	-0.63
TopSpeed_KmH	-0.79	1.00	0.75	0.36	0.79	0.13	0.83
Range_Km	-0.68	0.75	1.00	0.31	0.72	0.30	0.67
Efficiency_WhKm	-0.38	0.36	0.31	1.00	0.32	0.30	0.40
FastCharge_KmH	-0.73	0.79	0.72	0.32	1.00	0.19	0.67
Seats	-0.18	0.13	0.30	0.30	0.19	1.00	0.02
PriceEuro	-0.63	0.83	0.67	0.40	0.67	0.02	1.00
	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	Seats	PriceEuro

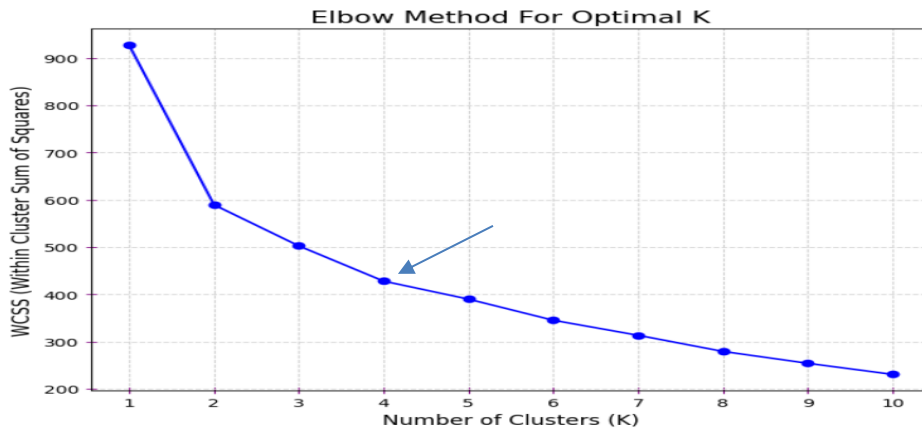
Segment Extraction

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.

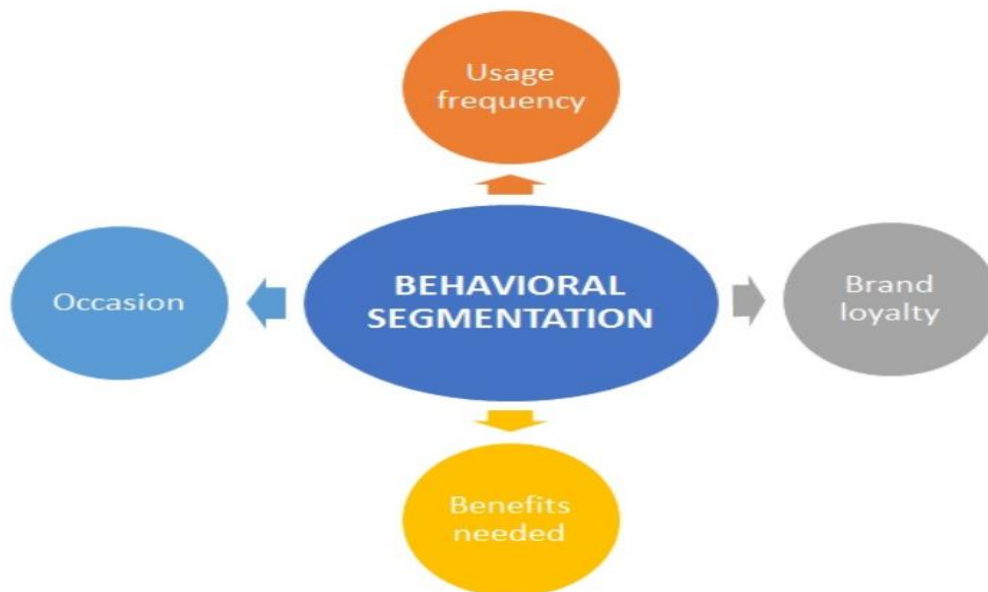
In the Elbow method, we are actually varying the number of clusters (K) from 1 – 10. For each value of K, we are calculating WCSS (Within-Cluster Sum of Square). WCSS is the sum of squared distance between each point and the centroid in a cluster. When we plot the WCSS with the K value, the plot looks 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.

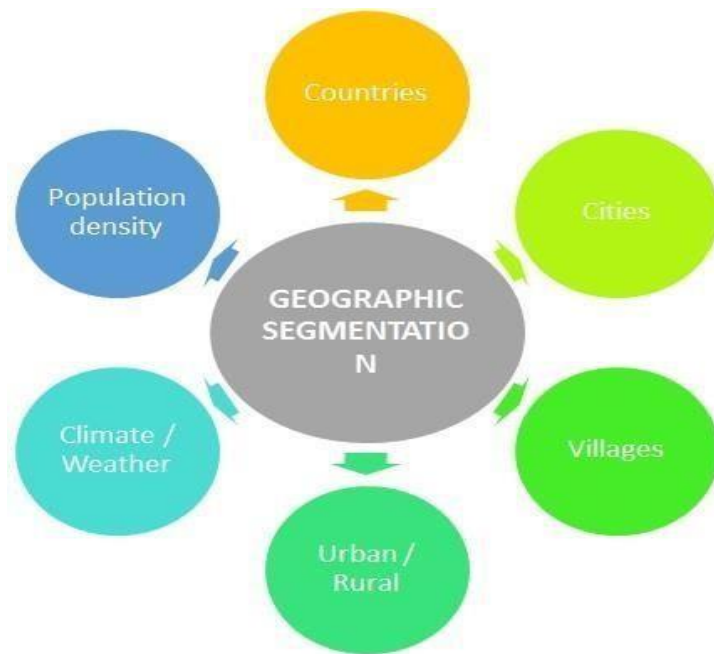


Profiling Potential Segments

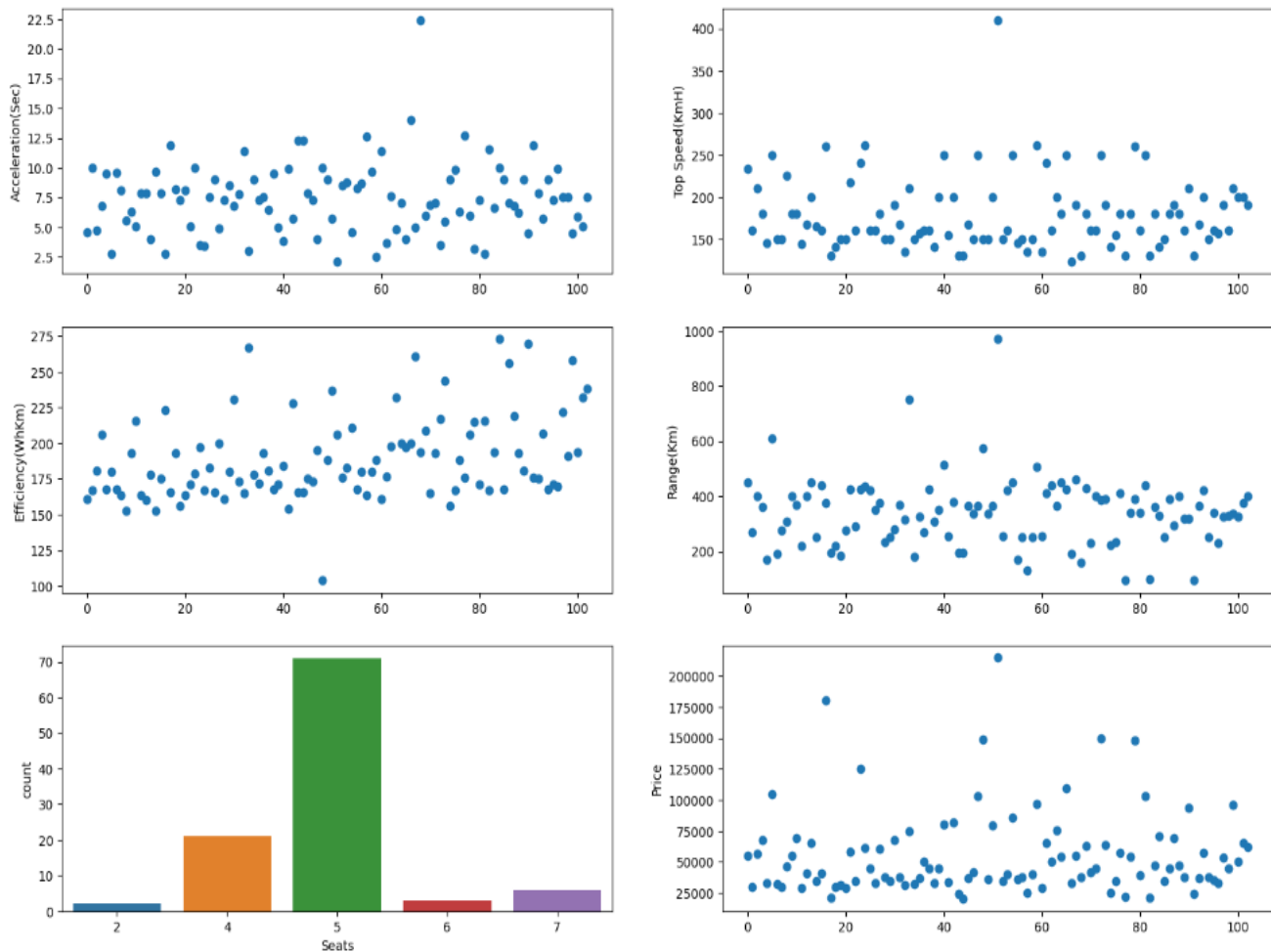
Behavioral Segmentation: Segmenting the market based on customer behavior aspects such as what price range customers usually buy in, what kind of specifications customers look for in their cars, etc.



Geographic Segmentation: Segmenting the market based on geography. This mainly includes characteristics of the market based on the location.



Behavioral Factors

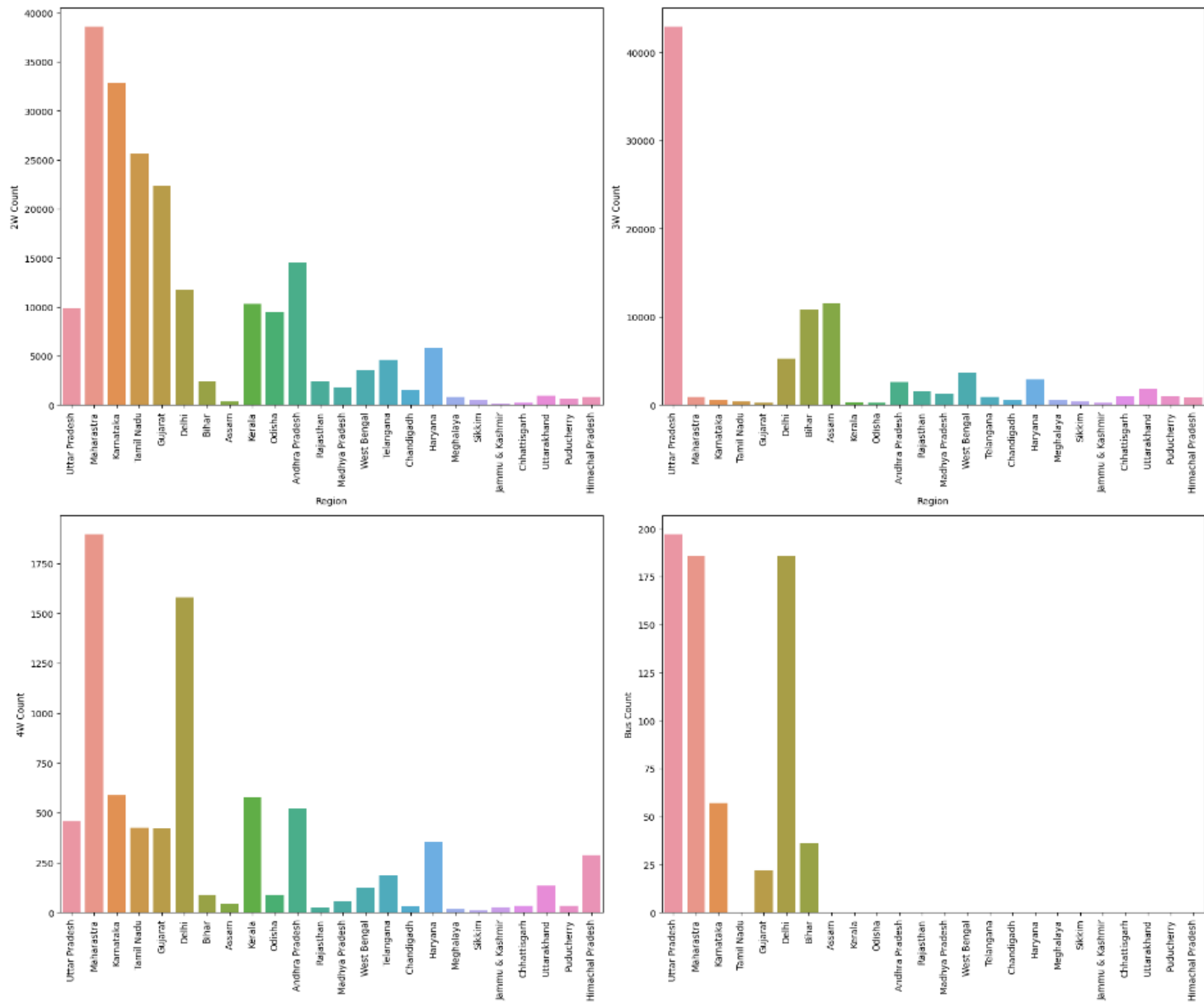


Inferring from the graphs, most of the EVs belong to the 5-seater category. An average price range of 20-30 Lakhs and an Efficiency-high vehicle would do well in the market. Acceleration seems to matter more than the top speed of the vehicle.

Major behavioral factors to consider – Price, Efficiency, Acceleration

Geographic Factors

The following graph shows the number of different type of EVs in different states.



The geographical analysis indicates that Uttar Pradesh and Maharashtra have the highest overall vehicle counts, with Uttar Pradesh showing particularly high numbers in three-wheelers, buses, and chargers, while Maharashtra has a strong presence across all vehicle types. Conversely, states like Assam and Jammu & Kashmir have notably lower vehicle counts overall, with a majority of vehicles being three-wheelers.

Target Segments

Based on the analysis, the target segment can be narrowed down to EVs having:

- **Behavioral factors** such as good Acceleration and high efficiency with average Price range
- **Geographic factors** such as States like Maharashtra, Uttar Pradesh, and Karnataka, with significant numbers across all vehicle types, suggest a broad target demographic including urban commuters, businesses, and public transportation needs.

In conclusion, the target segment should comprise of EVs having **Acceleration** of 7.5-10 sec, have a **Price** range of 20-30 Lakhs, and be focused mainly on **States** such as Maharashtra, Karnataka, Tamil Nadu and Rajasthan.

Customizing the market mix

The marketing mix helps enable the growth of the business in the automotive industry. A company's marketing mix or 4Ps (Product, Place, Promotion, and Price) specify the approaches and strategies that address the target market, based on the details of the marketing plan.

Product Mix

- Assess the demand for different types of vehicles in each region.
- Introduce models tailored to the specific needs and preferences of each region. For example, focus on electric two-wheelers in regions with high urban density and traffic congestion.
- Offer a variety of vehicle sizes and types to cater to diverse consumer preferences across regions

Prices and Pricing Strategies

- Adjust pricing strategies based on regional affordability and demand. For instance, consider offering lower-priced models in states with lower average incomes.
- Implement promotional pricing or discounts to stimulate demand in regions where vehicle adoption is low.

Place/Distribution

- Optimize distribution channels to ensure easy accessibility of products in high-demand regions. This could involve expanding dealership networks or partnering with local distributors.
- Prioritize regions with high potential for growth, such as urban centers or areas with increasing infrastructure development.

Promotional Mix

- Advertising and promotional campaigns to resonate with the local culture and preferences of each region.
- Highlight features of vehicles that align with the specific needs and challenges faced by consumers in different regions. For example, emphasize the fuel efficiency of vehicles in states with limited access to charging infrastructure.
- Utilize digital marketing channels to reach a wider audience and engage with potential customers in regions with high internet penetration.

Potential Sales in Early Market

Purchasing a vehicle is one of those life accomplishments that top nearly everyone's bucket list. The majority of the customers have a family. For such folks there are a variety of reasons, including market and schooling. Whether you prefer a modernized urban loft or a sprawling suburban home with a white picket fence, most of us hope to find a vehicle that feels like it was made specifically for our family. Here is where our insights come in to assist such people to find a best vehicle at the best-fixed price according to the area and several other factors.

Some of the key points required to focus for the development of EV in India are:

1. **Retrofitting Public Transport:** Converting public buses, taxis, and auto rickshaws to electric hybrids can significantly reduce emissions and lessen infrastructure demands.
2. **Government Incentives:** Subsidies that bridge the price gap between conventional and electric vehicles, along with tax and registration benefits, will encourage adoption.
3. **Charging Infrastructure:** Expanding charging options with grid-connected stations, promoting renewable energy-powered stations, and integrating charging facilities at petrol pumps and public spaces are crucial.
4. **Developing a Domestic EV Ecosystem:** India needs to establish domestic manufacturing of Electric Propulsion Systems (EPS) and batteries. Initiatives to support research, development, and recycling are essential. Battery swapping stations could also be a viable option.
5. **Skilled Workforce Development:** Training certified technicians to handle the complexities of EVs is vital for safety and maintenance.
6. **Raising Awareness:** Extensive public awareness campaigns highlighting the environmental and economic benefits of EVs across various media platforms can drive consumer interest.

Most Optimal Market Segment

To determine the most optimal market segment, we need to consider various factors such as customer preferences, market trends, and potential profitability. Here's how we can approach it:

Customer Preferences: Analyze which market segment shows the highest interest and demand for electric vehicles (EVs) based on factors like demographics, lifestyle, and preferences.

Market Trends: Consider market trends and growth potential in different segments. Look for segments that are rapidly growing or have untapped potential.

Profitability: Evaluate the profitability of each segment by assessing factors such as potential sales volume, pricing strategy, and competition.

Government Incentives: Take into account government incentives and policies that may favor certain market segments for EV adoption.

In the conclusion, electric vehicles are the future hence - ***“Go Green Go Electric”***.