Market Segmentation Analysis of Electric Vehicles Market in India

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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.

Data Collection

Data was extracted from the various websites mentioned below for EV market segmentation.
Link for data extraction:

- https://pib.gov.in/PressReleasePage.aspx?PRID=1842704
- https://www.ibef.org/blogs/electric-vehicles-market-in-india
- https://evreporter.com/indias-region-wise-ev-market-jan-may-2022/
- https://www.india-briefing.com/news/indias-ev-manufacturing-capacity-and-market-preferences- progress-25840.html/

Data from those links are extracted by Google play scraper available on libraries package. There are multiple datasets extracted from those websites in CSV and Excel formats. There are some pdfs also which contain valuable information regarding the EV market. We have extracted data from those pdfs as well.

Raw data generated:

- https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/DATASETS/1_ev_charger_dataset.csv
- https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/DATASETS/2_ev_charging_station_dataset.xlsx
- https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/DATASETS/3_ev_market_india_dataset.xlsx

Columns explanations:

1. 'Brand' and tell the manufacturers of electric vehicles.
2. 'Model' tells the various electric vehicles.
3. 'AccelSec', 'Top Speed', 'PowerTrain' tell the 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.
5. 'Seats' and 'Price' tells about the number of seats available on a vehicle and their price.
6. 'Region' and 'State/UT' talk about the states of India.
7. 'EV Charging Facility' and 'Chargers' tell about the facility of charging in the respective states.
8. '2V', '3V', '4V', 'Bus' tells about the type of vehicles in the market.

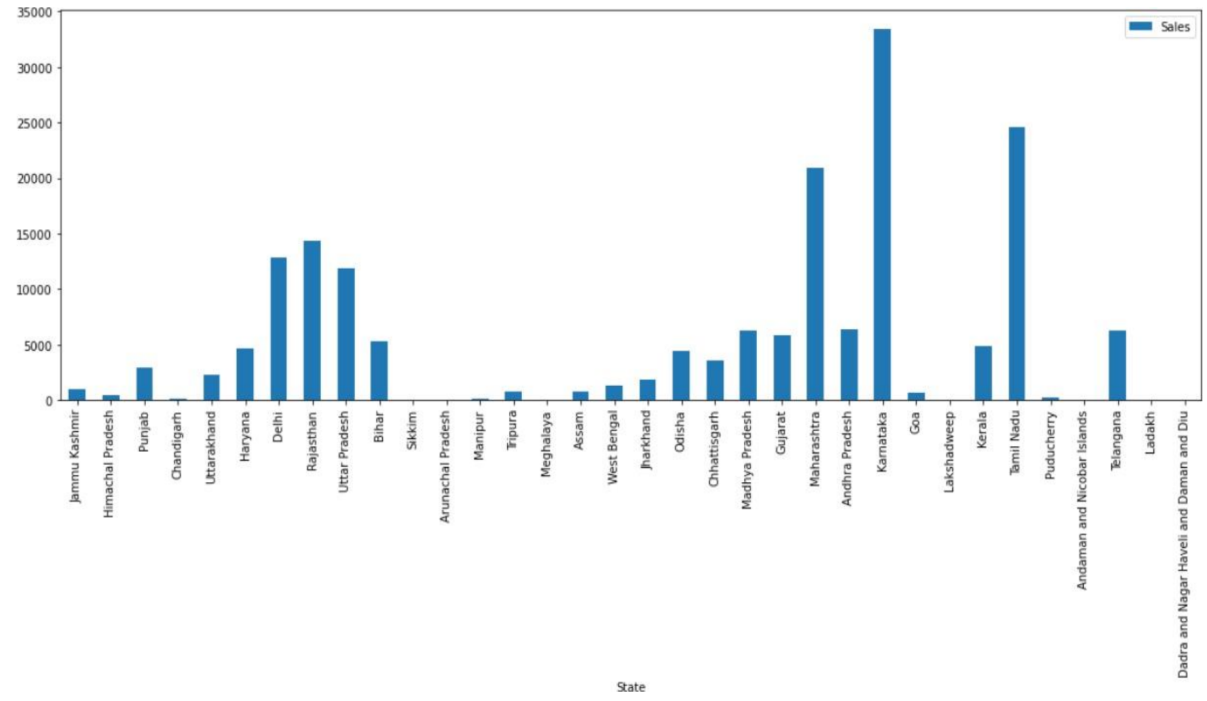
Data Preprocessing

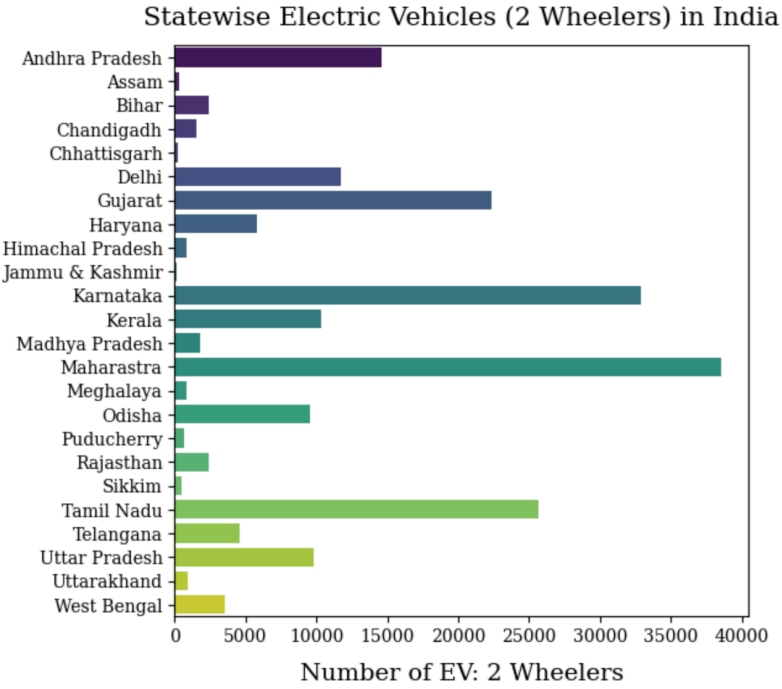
Steps taken to preprocess the scraped raw data:
1. Ordinal encoded 'PowerTrain'
2. Label encoded 'RapidCharge'
3. Used Label Encoder and Standard Scaler package for preprocessing of the dataset.

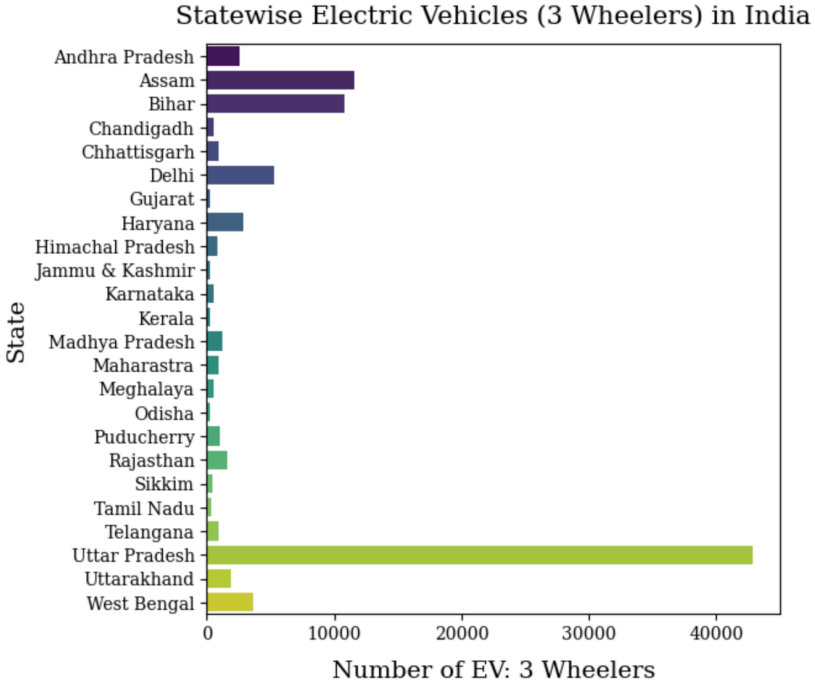
Exploratory Data Analysis

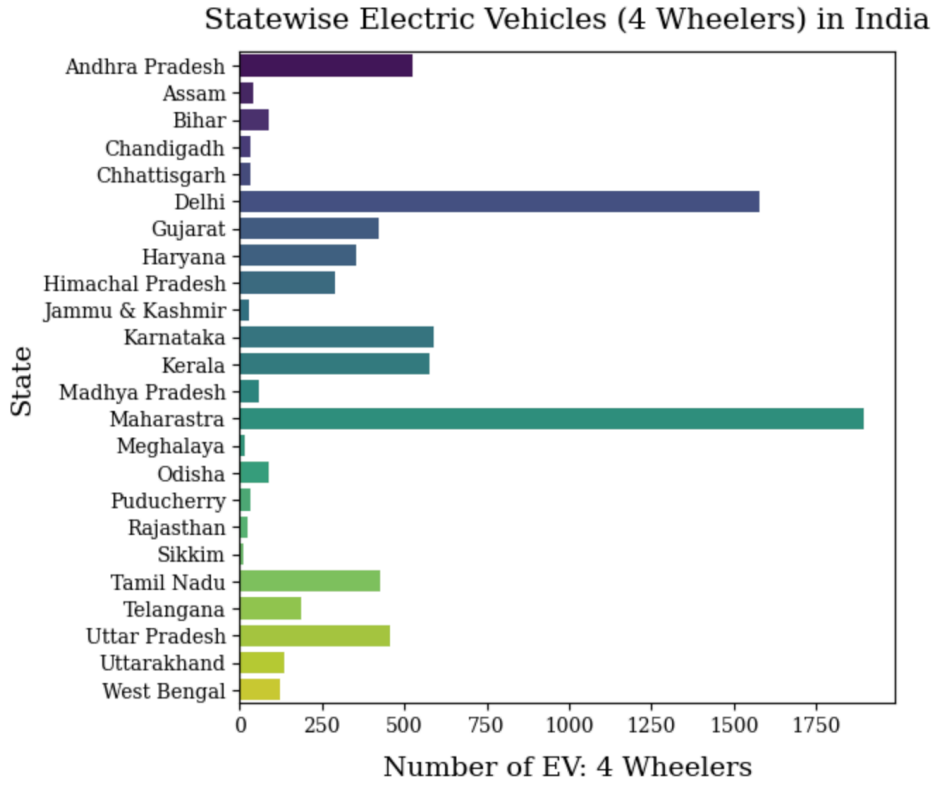
An Exploratory Data Analysis or EDA is a thorough examination meant to uncover the underlying structure of a data set and is important for a company because it exposes trends, patterns, and relationships that are not readily apparent.

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.

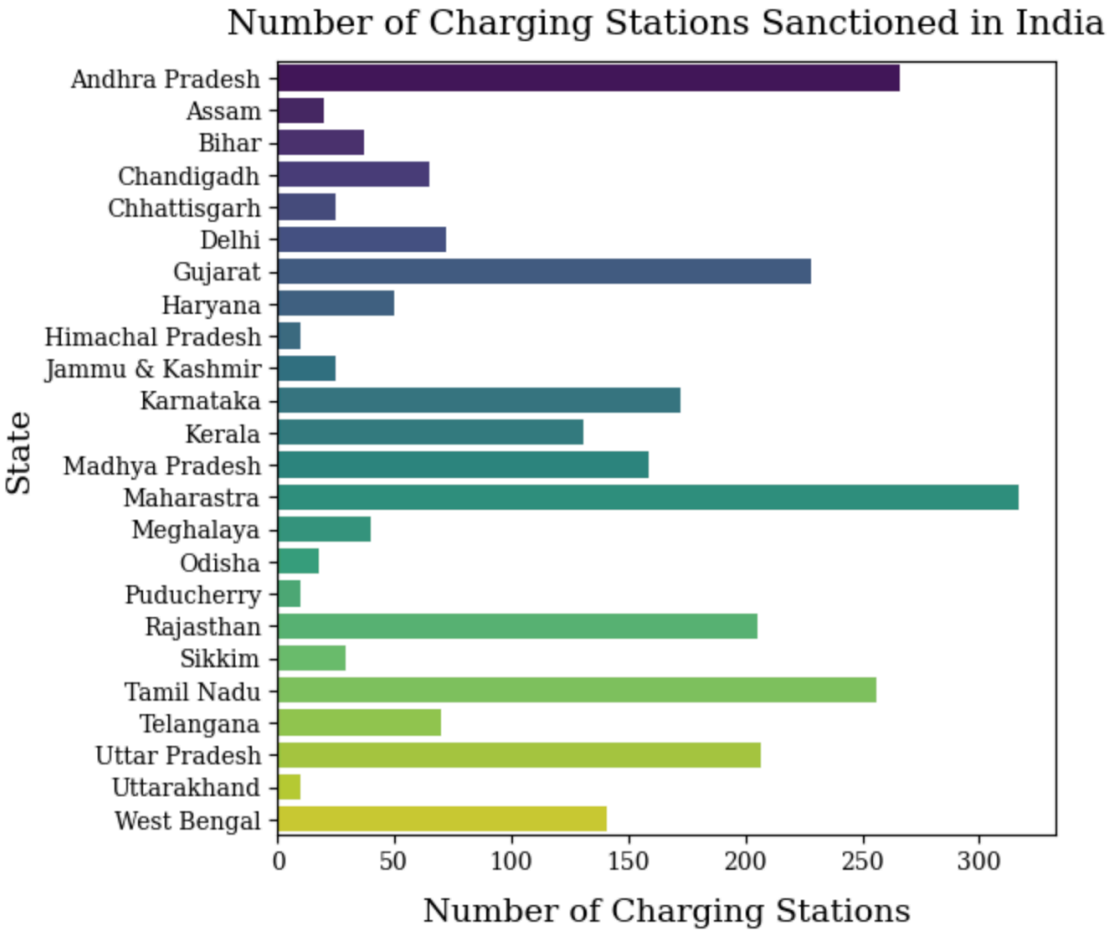



Statewise Electric Vehicles (2 Wheelers) in India
Andhra Pradesh
Assam
Bihar
Chandigadh
Chhattisgarh
Delhi
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Karnataka
Kerala
Madhya Pradesh
Maharastra
Meghalaya
Odisha
Puducherry
Rajasthan
Sikkim
Tamil Nadu
Telangana
Uttar Pradesh
Uttarakhand
West Bengal
0
5000
10000
15000
20000
25000
30000
35000
40000
Number of EV: 2 Wheelers

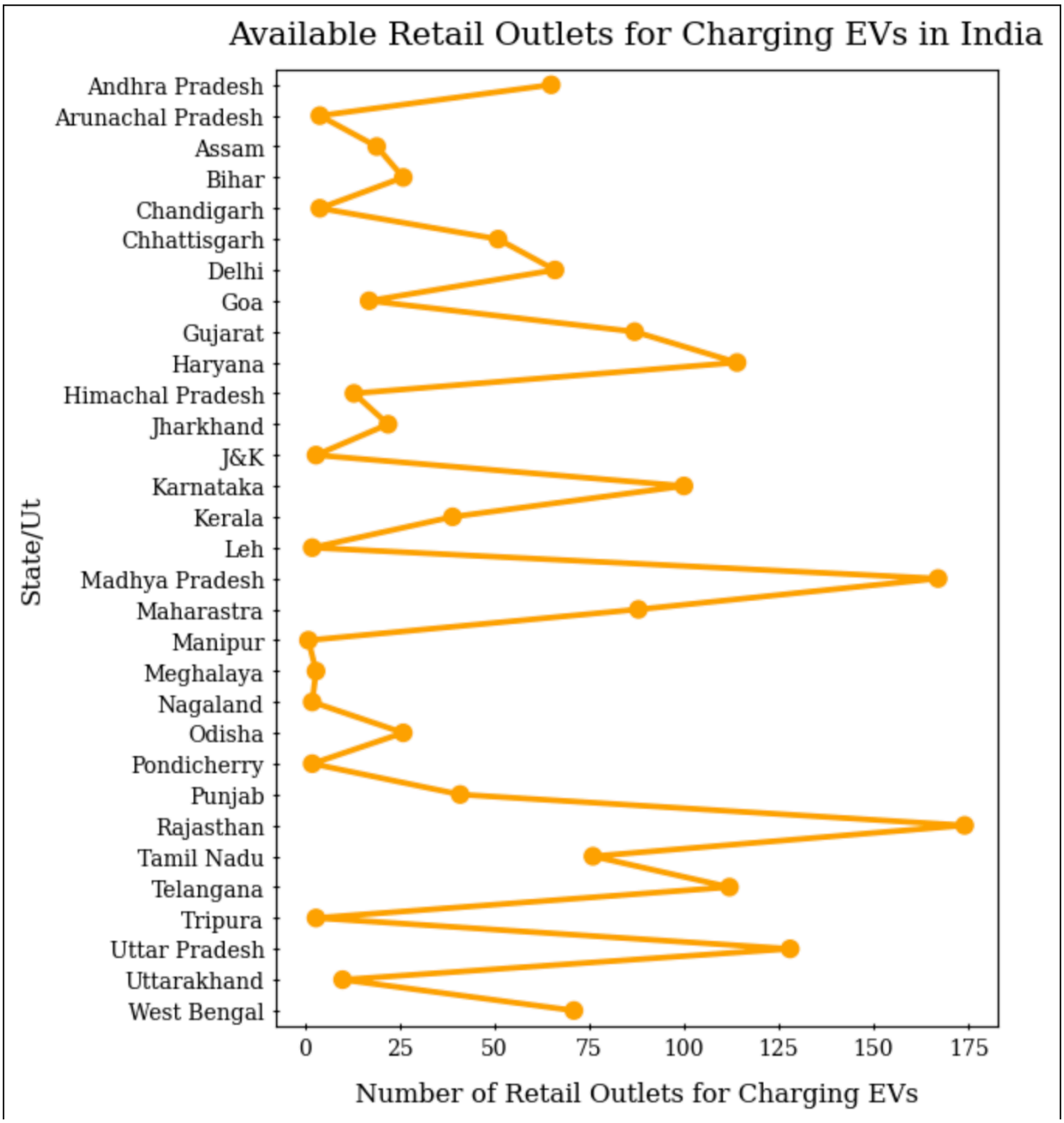

Statewise Electric Vehicles (3 Wheelers) in India
State
Andhra Pradesh
Assam
Bihar
Chandigadh
Chhattisgarh
Delhi
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Karnataka
Kerala
Madhya Pradesh
Maharastra
Meghalaya
Odisha
Puducherry
Rajasthan
Sikkim
Tamil Nadu
Telangana
Uttar Pradesh
Uttarakhand
West Bengal
0
10000
20000
30000
40000
Number of EV: 3 Wheelers


Statewise Electric Vehicles (4 Wheelers) in India
State
Andhra Pradesh
Assam
Bihar
Chandigadh
Chhattisgarh
Delhi
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Karnataka
Kerala
Madhya Pradesh
Maharastra
Meghalaya
Odisha
Puducherry
Rajasthan
Sikkim
Tamil Nadu
Telangana
Uttar Pradesh
Uttarakhand
West Bengal
0
250
500
750
1000
1250
1500
1750
Number of EV: 4 Wheelers

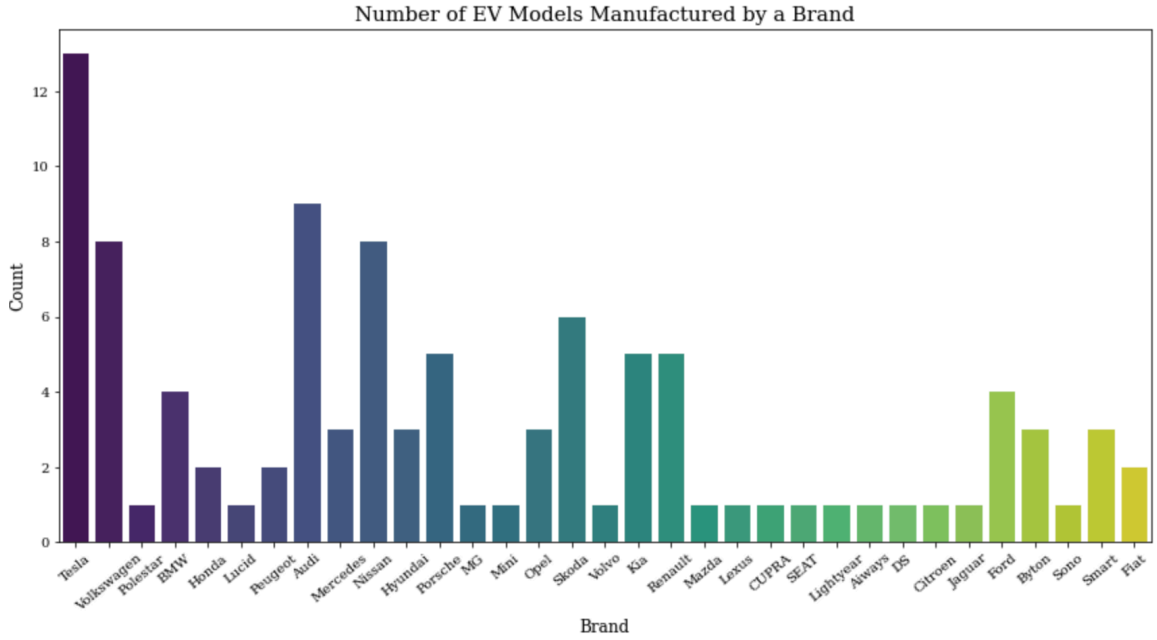
This Bar Chart shows the type of vehicles used in various states from the dataset after removing meaningless outliers. It also shows the Number of Charging Stations sanctioned in India state wise.
Quick look at the graphs tells us that *Maharashtra, Karnataka, Andhra Pradesh, Tamilnadu* and *Gujrat*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



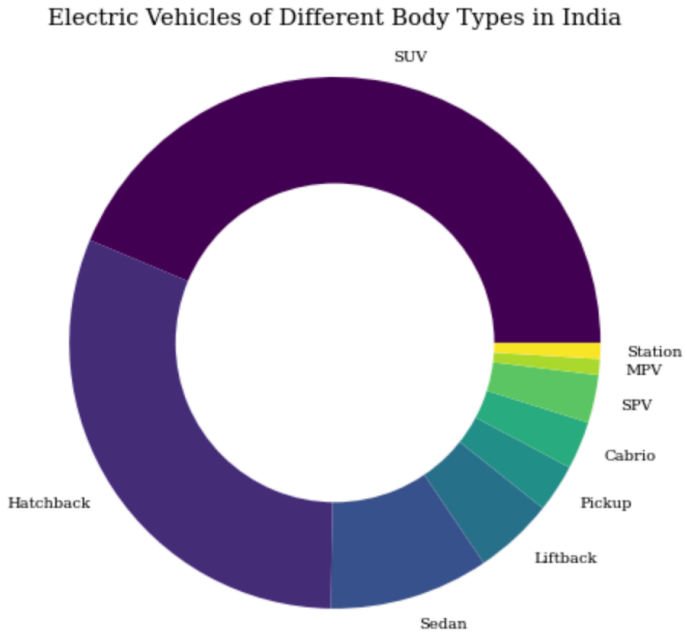
This point plot shows the number of retail outlets for charging EVs in various states from the dataset. Graphs shows us that Maharashtra, Karnataka, Andhra Pradesh, Tamilnadu and Gujrat have the most number of retail outlets for charging EVs and least number of retail outlets for charging EVs are from Sikkim, Meghalaya, Lakshadweep, Ladakh, and Assam states. (From dataset 2)



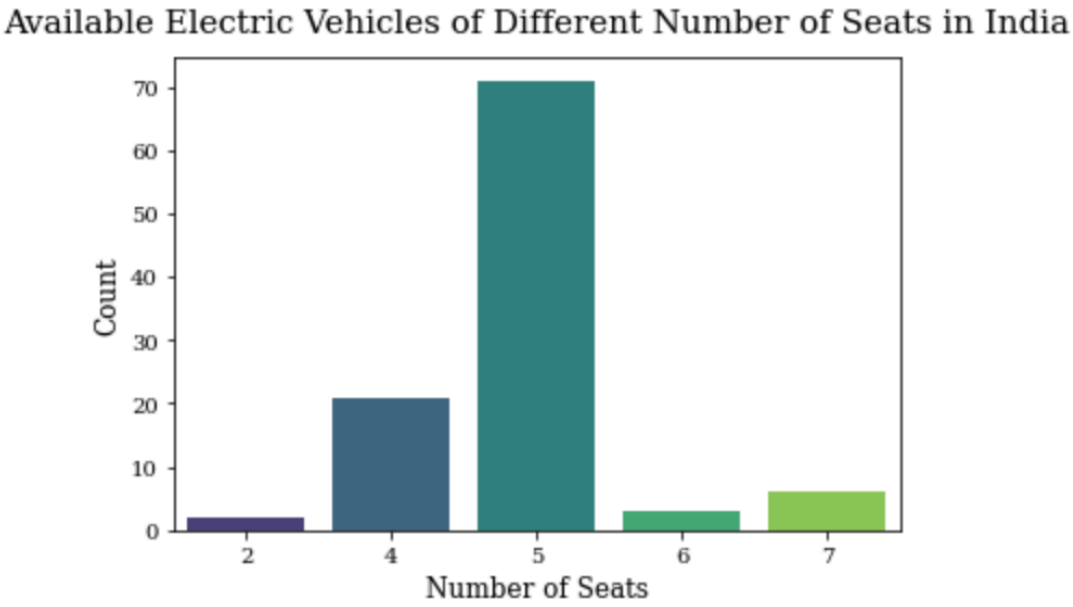
This bar graphs shows the manufacturers of Electric Vehicles.



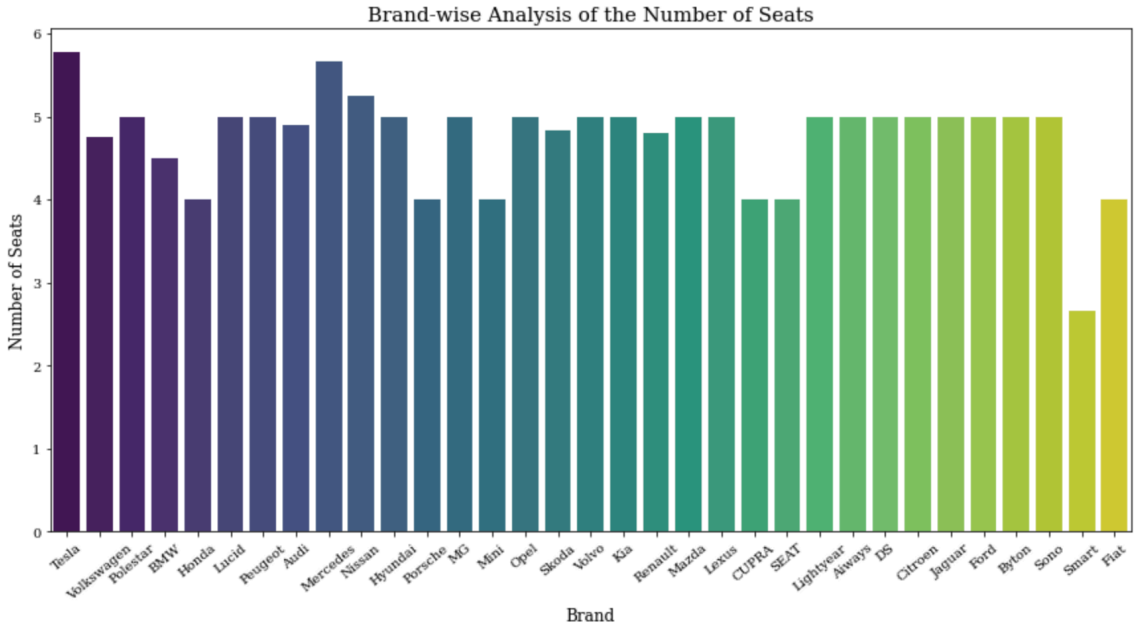
This pie chart shows the different types of Electric Vehicles.



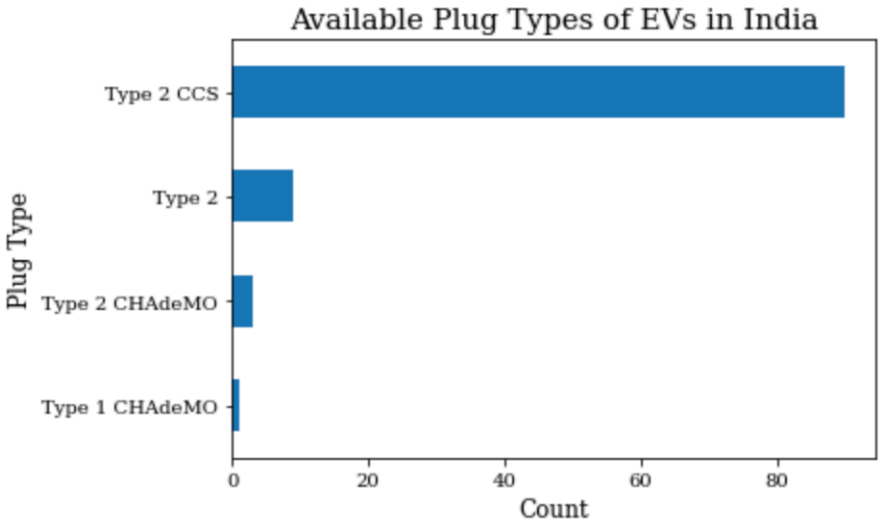
This bar graph shows the number of seats available in Electric Vehicles.



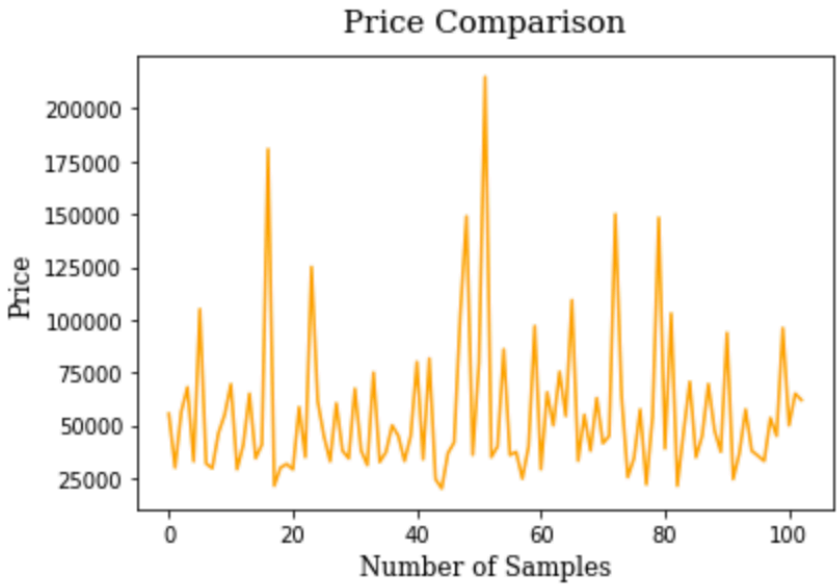
This bar graph shows the number of seats available in Electric Vehicles available in India.

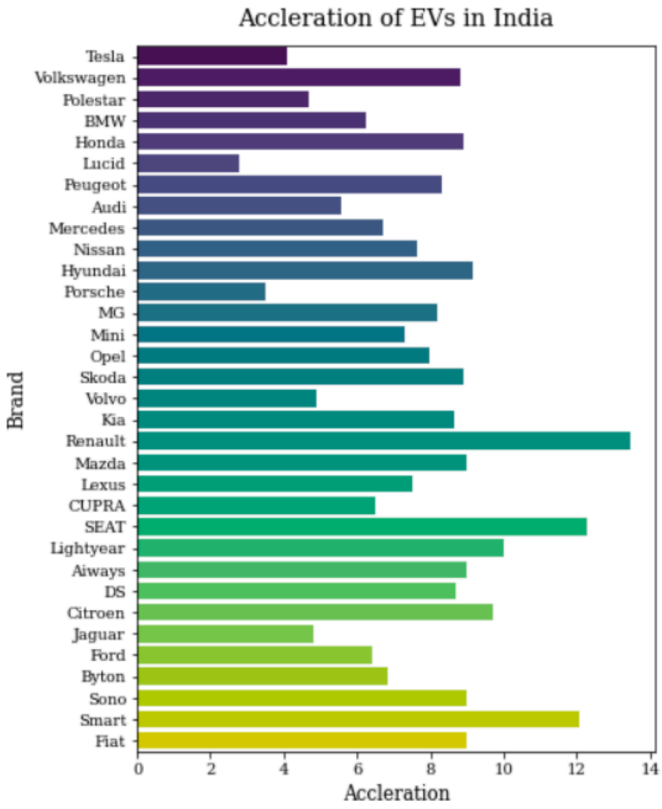


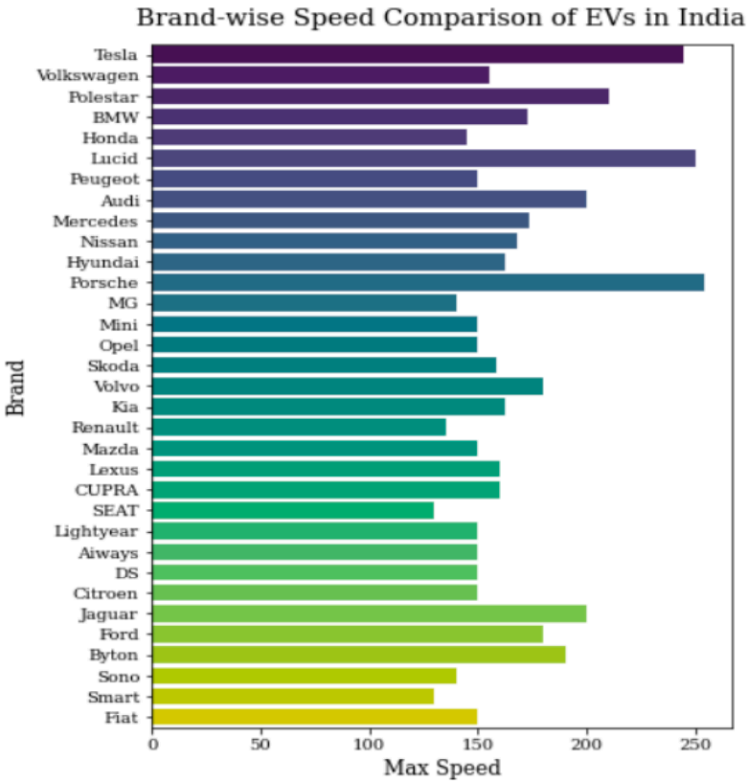
This bar graph shows the available plug types in Electric Vehicles.



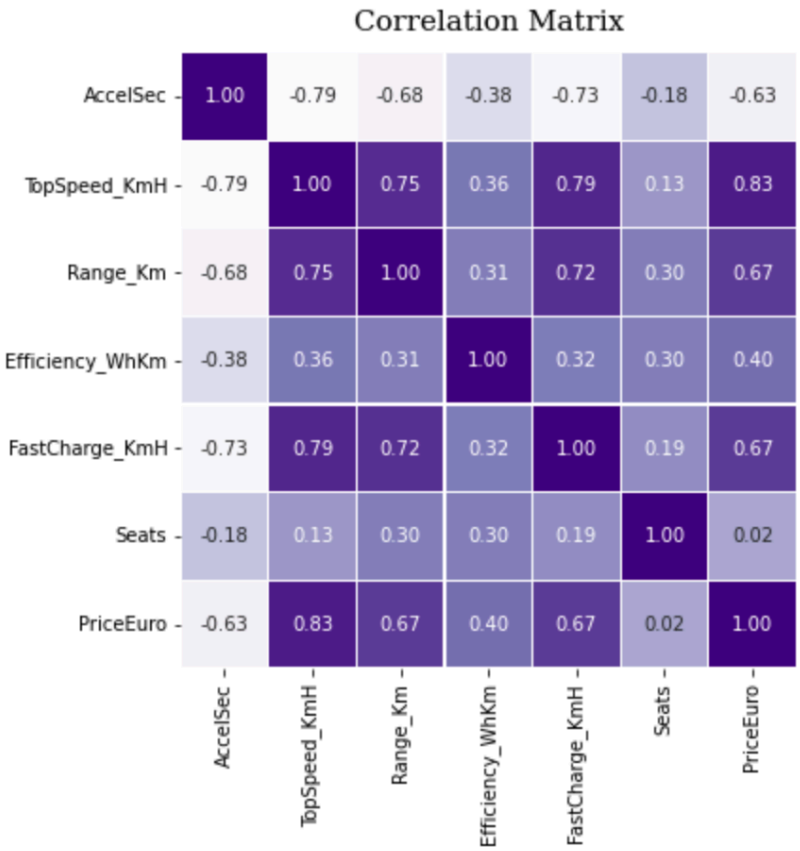
This line graph shows the price comparisons in Electric Vehicles.







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

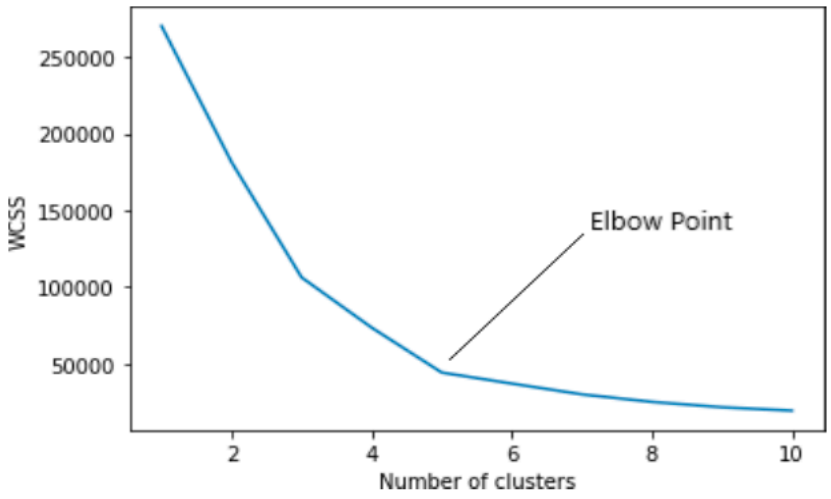


Segment Extraction

K-Means Clustering is one of the most popular Unsupervised Machine Learning Algorithms Used for Solving Classification Problems. K Means segregates the un labeled data into various groups, called clusters, based on having similar features, common patterns.
Suppose we have N number of Un labeled 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.



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. The company's aim is to maximize sales and improve market presence. With a strong position in the market,

The automotive market has various opportunities for the growth, such as opportunities for products that integrate advanced computing technologies. However, the company faces threats in its business environment. Managers can use the SWOT Analysis to determine appropriate adjustments in the marketing mix or 4Ps to deal with these threats and opportunities.

Product Mix

This aspect of the marketing mix pertains to the outputs of the business. Each product line represents a group of outputs or products. The set of all the product lines is called the product mix. the product mix shows limited business diversification. Nonetheless, the company offers a wide variety of products, such as different brands, types, and models of automobiles.

1. Automobiles
2. Automobile parts
3. Commercial vehicles
4. Financial services

Prices and Pricing Strategies

The setting of price points and price ranges for the company's products is the main concern in this aspect of the marketing mix. Pricing affects the perceived value of brands and products, and influences sales in price-sensitive markets. the pricing strategies for its automotive products are as follows:

1. Market-oriented pricing strategy
2. Premium pricing strategy

Most Optimal Market Segment

There are many EV manufacturing companies in the country like Hero Electric, Tata Motors, Ather Energy, Ashok Leyland, Hyundai Kona Electric, etc. Tesla has also arrived; the demand will get higher & higher since it is automotive so the investments and policies and all that would be bigger but it will take some time to perfectly settle in India. The following are the key insights of the project:

- The electric vehicle industry has not done that much good due to the devastating hit of the Covid outbreak but it will take a huge jump in upcoming years.
- The use of EVs will be game-changing in terms of environment, air, noise pollution-free, post-electric, and much more.
- The company should plan to establish local operations in India either by partnering with a local company or by setting up its own manufacturing/ development unit, potentially combined with imports of specific components.
- The company would expect to further grow in India, underpinned by a growing commercial fleet market for two-wheelers and three-wheelers especially for last km delivery/urban freight services. The company must see opportunities across the supply chain in the battery, EV component and charging infrastructure segments including the machinery and equipment needed for establishing manufacturing plants, training and provision of skilled workforce etc.
- The company should start their business from Metro Cities in India and then after considerable business expand to other cities of the same state of the Metro Cities. This will help the company to expand easily as they will be having a prior knowledge of business from Metro Cities and Network of Supply chain will be easy for the company as the time goes in business.

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

Github links:

1) For datasets
   - https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/DATASETS/1_ev_charger_dataset.csv
   - https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/DATASETS/2_ev_charging_station_dataset.xlsx
   - https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/DATASETS/3_ev_market_india_dataset.xlsx

2) For Implemented codes:
   - https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/codes/dataset%201%20working%20.ipynb
   - https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/codes/dataset%202%20working%20.ipynb
   - https://github.com/Manassaluja/feynn-lab-internship/blob/main/Task%201-R/codes/dataset%203%20working%20.ipynb