

EV MARKET SEGMENTATION ANALYSIS REPORT



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Problem Statement

You are a team working under an Electric Vehicle Startup. The Startup is still deciding in which vehicle/customer space it will develop its EVs.

You have to analyze the Electric Vehicle market in India using Segmentation analysis and come up with a feasible strategy to enter the market, targeting the segments most likely to use Electric vehicles.

Fermi Estimation: Breakdown of the Problem Statement

- Problem: The startup must decide which vehicle/customer space to develop its EVs.
- Estimate: The startup could segment the Indian EV market into the following categories:
- Geographic: Urban, rural, etc.
- Demographic: Age, income, gender, etc.
- Psychographic: Lifestyle, values, etc.
- Behavioral: Purchase intent, usage patterns, etc.
- Data: The startup may not have access to all of this data, so it will need to do some research to collect available data.
- Strategy: The startup could target the segments most likely to use electric vehicles. For example, it could target urban consumers concerned about the environment.
- Estimate: The startup could estimate the market size for each segment by using data from other markets or by conducting its research.

The startup could use this information to develop a feasible strategy to enter the Indian EV market.

Here are some additional considerations for the Fermi estimation:

- The size of the Indian EV market is expected to grow significantly in the coming years.
- The government of India is providing incentives to promote the adoption of electric vehicles.
- The availability of charging infrastructure is improving in India.

Overall, the Indian EV market is a promising market for startups. Using Fermi estimation, the startup can better understand the market and develop a feasible strategy to enter the market.

Now, we try to apply Fermi's estimation in a very simple way to guess how many people in India will be using EVs by 2024:

Assumptions:

- The current population of India is 1.4 billion people.
- The current number of EVs in India is 1 million.
- The growth rate of the EV market in India is 25% per year.

Estimation:

- The number of EVs in India in 2024 would be $1 \text{ million} \times (1 + 0.25)^7 = 5.3 \text{ million}$
- The number of people using EVs in India in 2024 would be $5.3 \text{ million} / 2 = 2.65 \text{ million}$.

This is just a Fermi estimation, so it is not exact. However, it gives us a rough idea of how many people in India could use EVs by 2024.

Source Code

The source code for the segment extraction, data preprocessing, and analytical study of target segments was done using Python notebooks. All of these are uploaded on GitHub that can be found below:

<https://github.com/aishS007/Feynn-Labs-T-1-R>

Data Collection

Data was taken from the most popular platform Kaggle for market segmentation. The first two datasets are recent and seem the best fit for analysis.

The sources are mentioned below:

<https://www.kaggle.com/datasets/kkhandekar/electric-vehicles-india>

<https://www.kaggle.com/datasets/saketpradhan/electric-vehicle-charging-stations-in-india>

<https://www.ibef.org/blogs/electric-vehicles-market-in-india>

<https://evreporter.com/indias-region-wise-ev-market-jan-may-2022/>

Some datasets were also web-scraped data collected using available libraries in Python and available on websites for public use.

Data Preprocessing

Python libraries like Pandas and NumPy were used to load the datasets, preview them and perform initial review and cleaning. Data preprocessing also involved dropping unnecessary columns, replacing long column/feature names with shorter ones, and choosing datasets with more refined data quality.

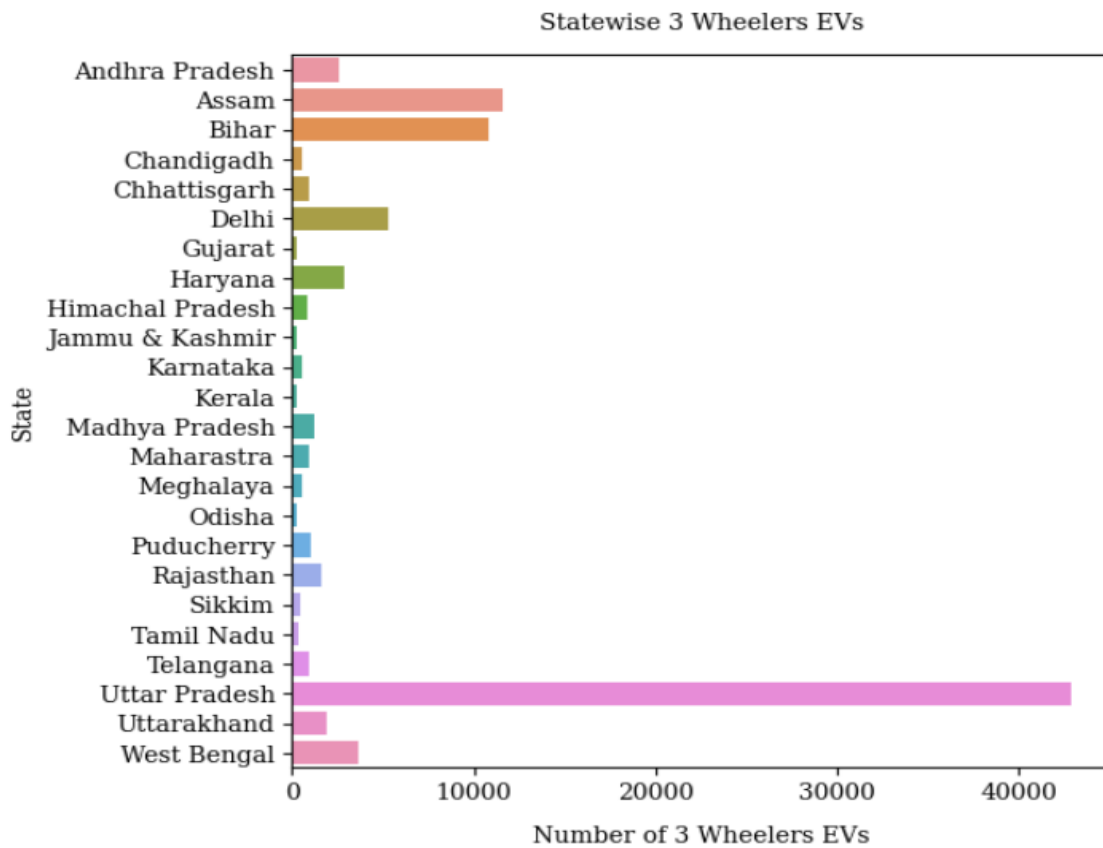
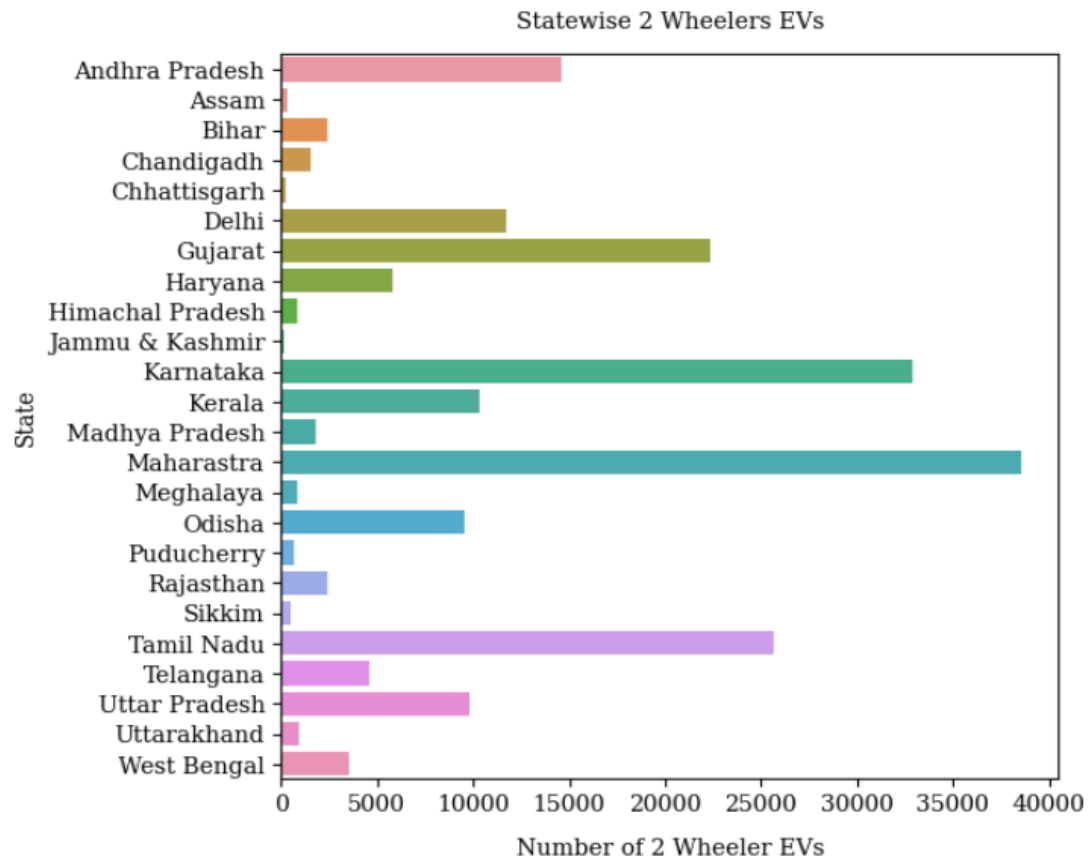
EDA

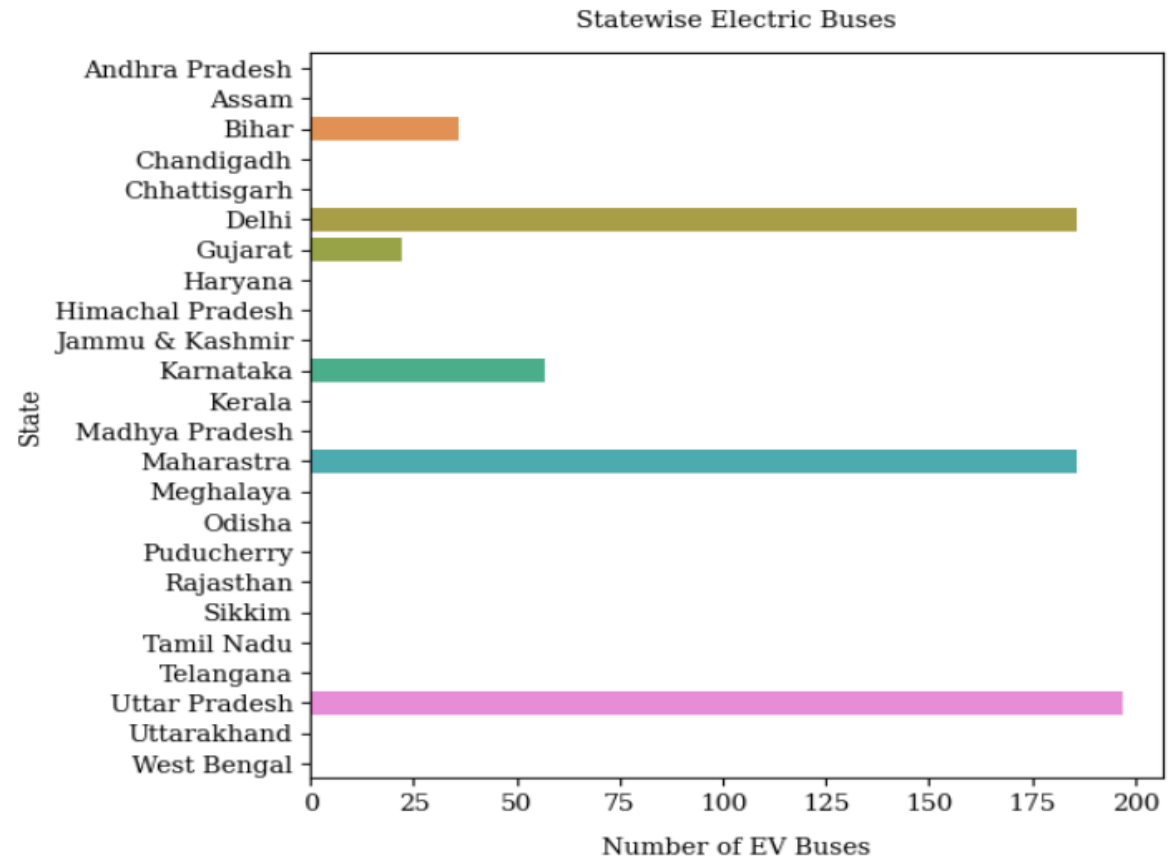
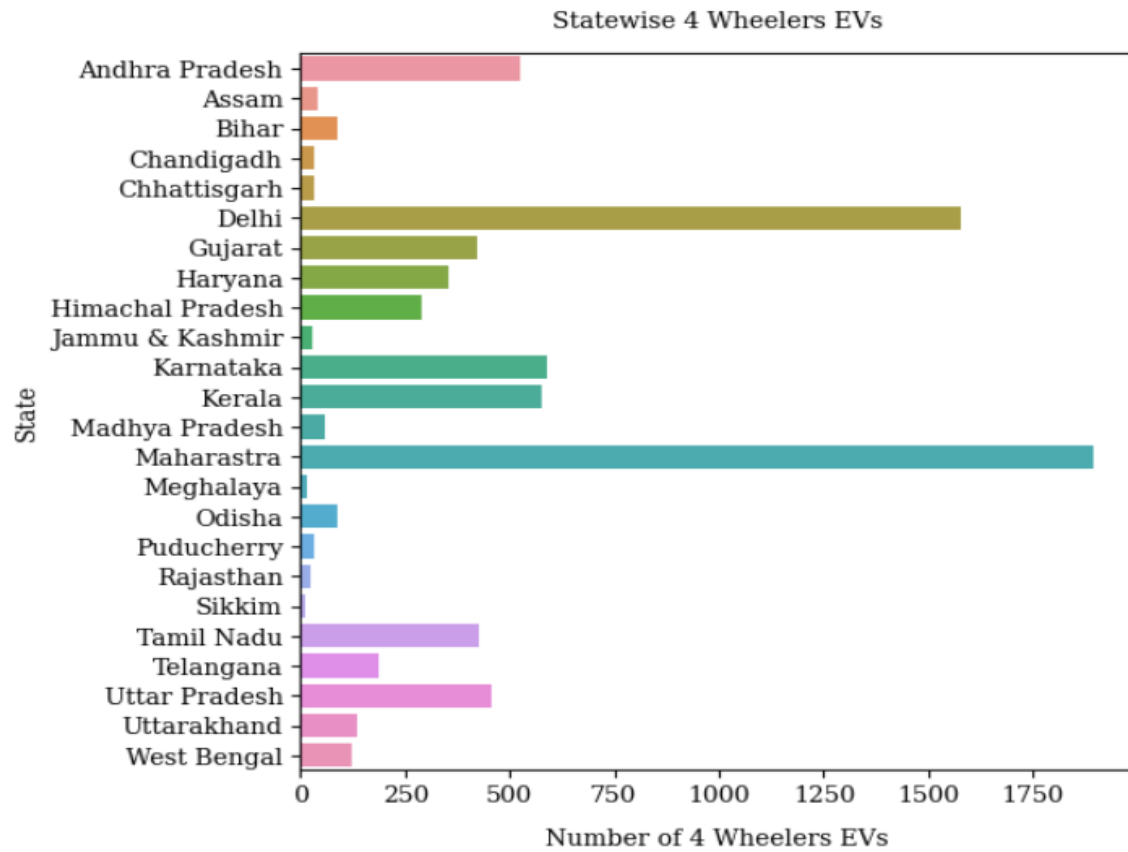
Exploratory data analysis (EDA) is an approach to analyzing data sets to summarize their main characteristics, often using statistical graphics and other data visualization methods. It is a process of inspecting a data set to summarize its main features, often with visual methods, for example, plotting and correlation matrices.

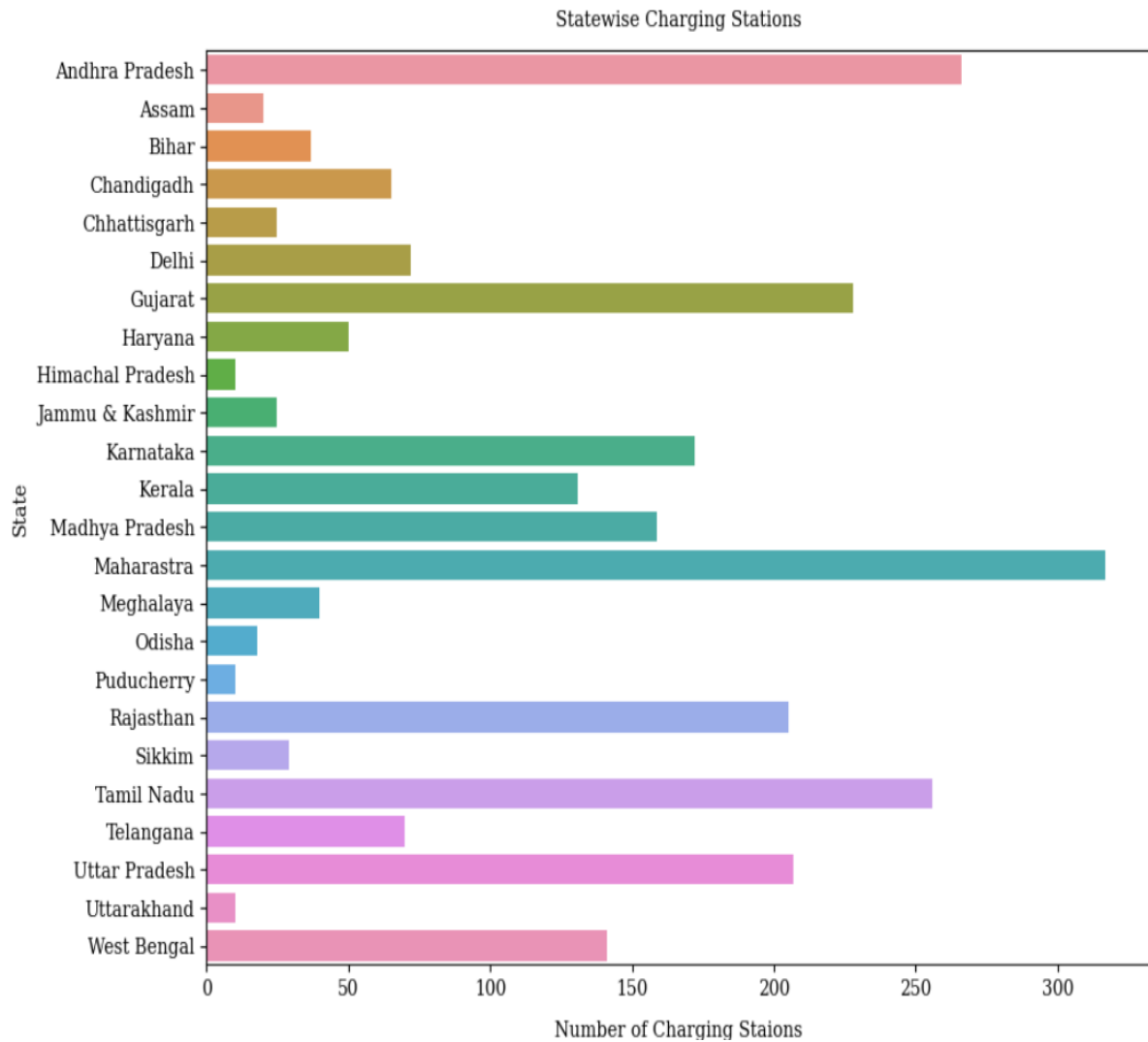
Data scientists use EDA to understand the data and to identify patterns and trends. This information can then be used to develop models or to make predictions. EDA is a non-parametric approach to data analysis, meaning it does not make any assumptions about the data distribution. This makes it a versatile tool that can be used on various data sets.

An attempt was made to analyze the information provided by the datasets using single columns (univariate), two columns (bivariate), and multiple columns (multivariate) to gain a better understanding of the trends.

Data were analyzed for each type of EV used in the major Indian states. It can be observed that the conditions that are using more EVs on their roads are Maharashtra, Delhi, Karnataka, Tamil Nadu, and Uttar Pradesh. Of course, the EV type's popularity differs from state to state. But this information paves a path for possibilities of early models to be launched by the start-up. However, further research might be required for the most accurate numbers.



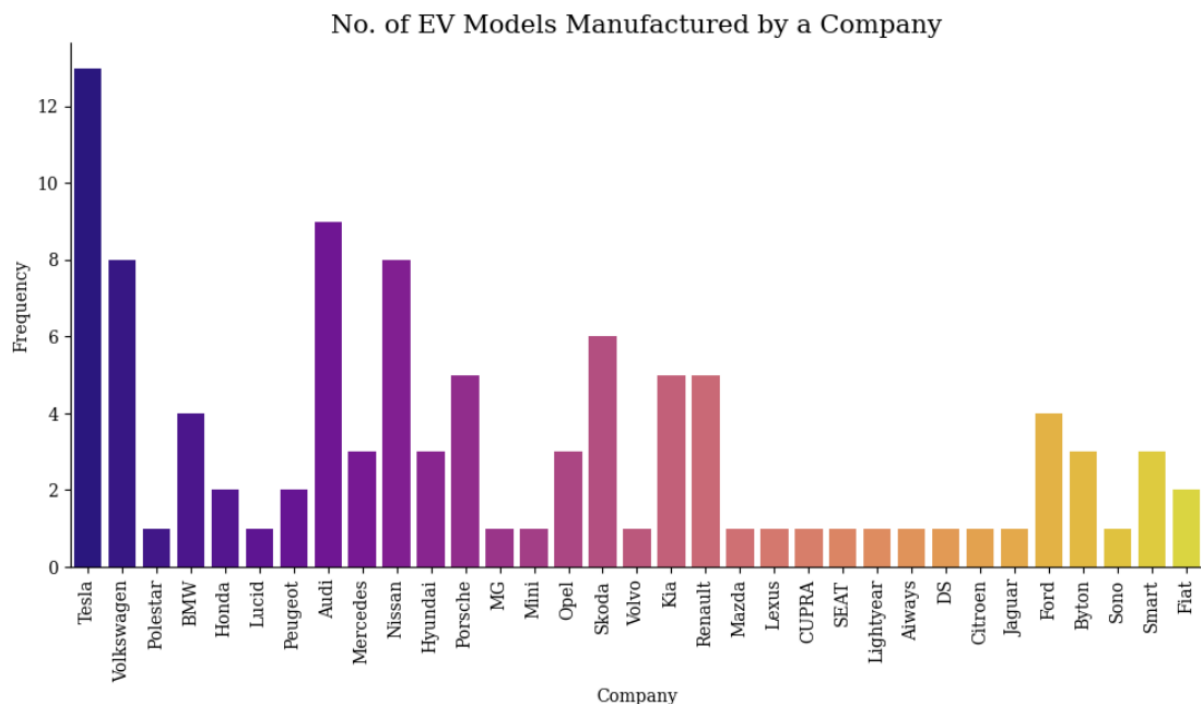




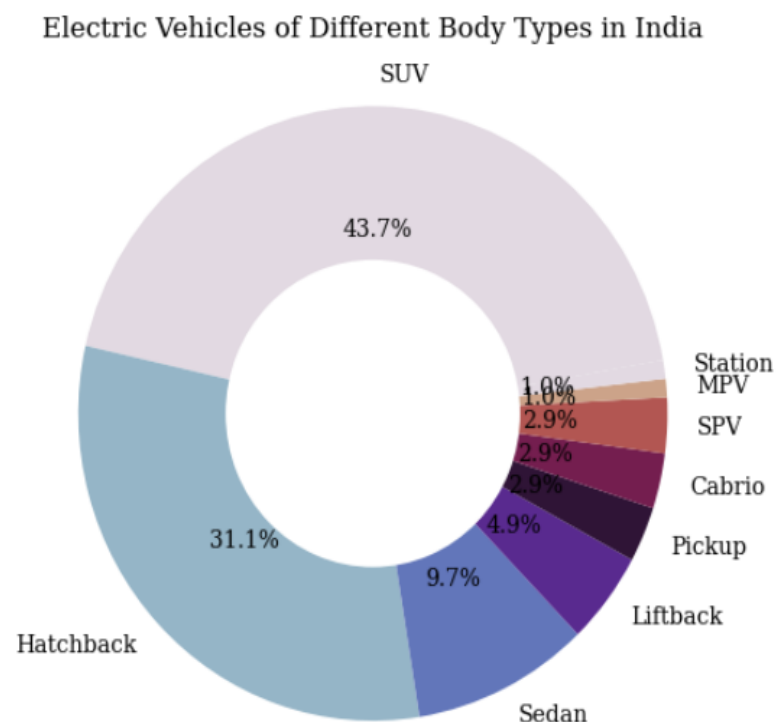
This bar plot graph shows the number of charging stations functioning in India. It can be safely inferred from the graph that the number of charging stations is directly related to the demand for EVs in daily use in those states. The above chart tells us that states like Maharashtra, Andhra Pradesh, Tamil Nadu, Gujarat, Karnataka, and Uttar Pradesh are ideal states for Indian customers to buy and adopt EVs for their use.

However, states like Assam, Chhattisgarh, Himachal Pradesh, Puducherry, and Sikkim are the least in numbers for all the graphs above. The reasons might be geographic limitations or smaller populations than other bigger states.

Now, we will observe trends in the manufacturing of EVs by the companies present in the market already. This might help us understand what vehicles are more feasible to manufacture and most bought in the Indian markets.

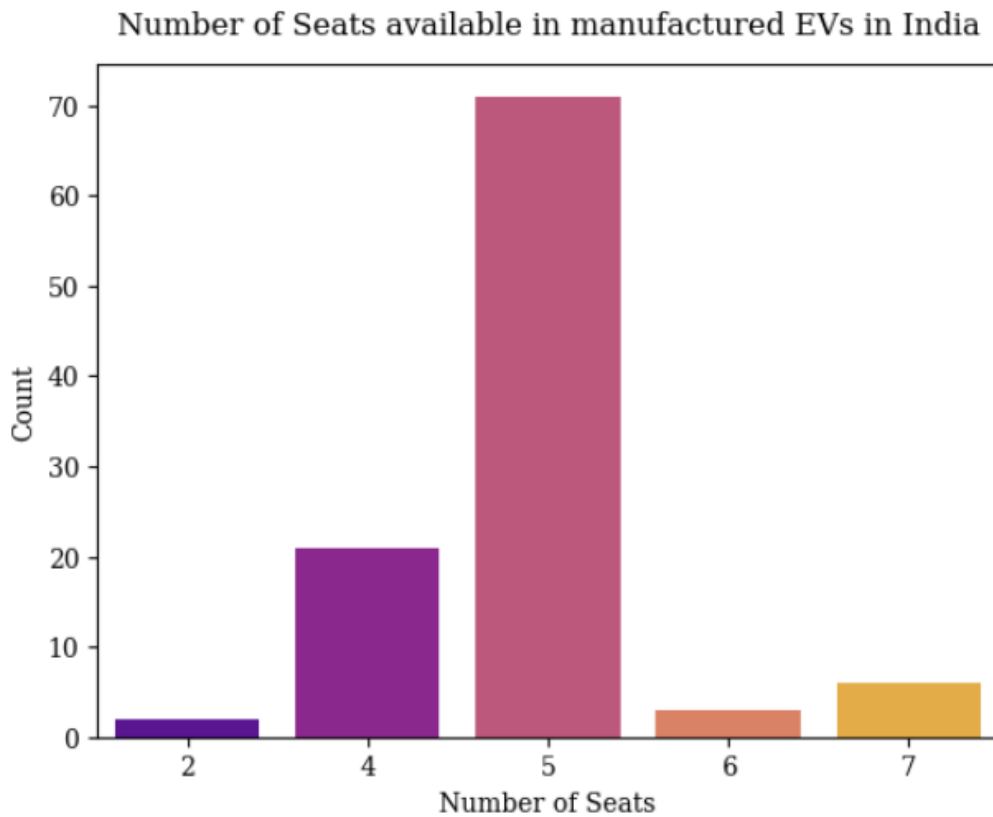


The above graph uses a dataset for the global market of EVs since there was limited data on Indian companies manufacturing EVs. The chart says that Tesla, Audi, Volkswagen, Nissan & Skoda manufacture more EV models. We could look into structural designs and take inspiration after discussing their publicly available information. This also presents us with the leading companies to be approached for future collaborations with our startup.

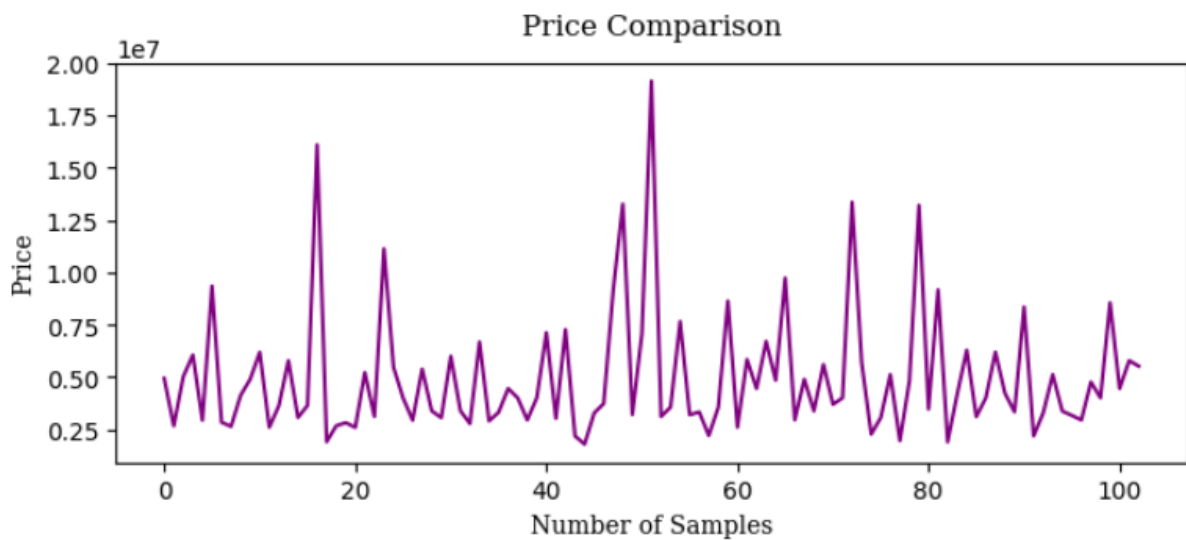


The pie chart on the left shows popular body types for 4-wheeler electric vehicles in the Indian market. They also include hybrid EVs since SUVs primarily run on diesel in India.

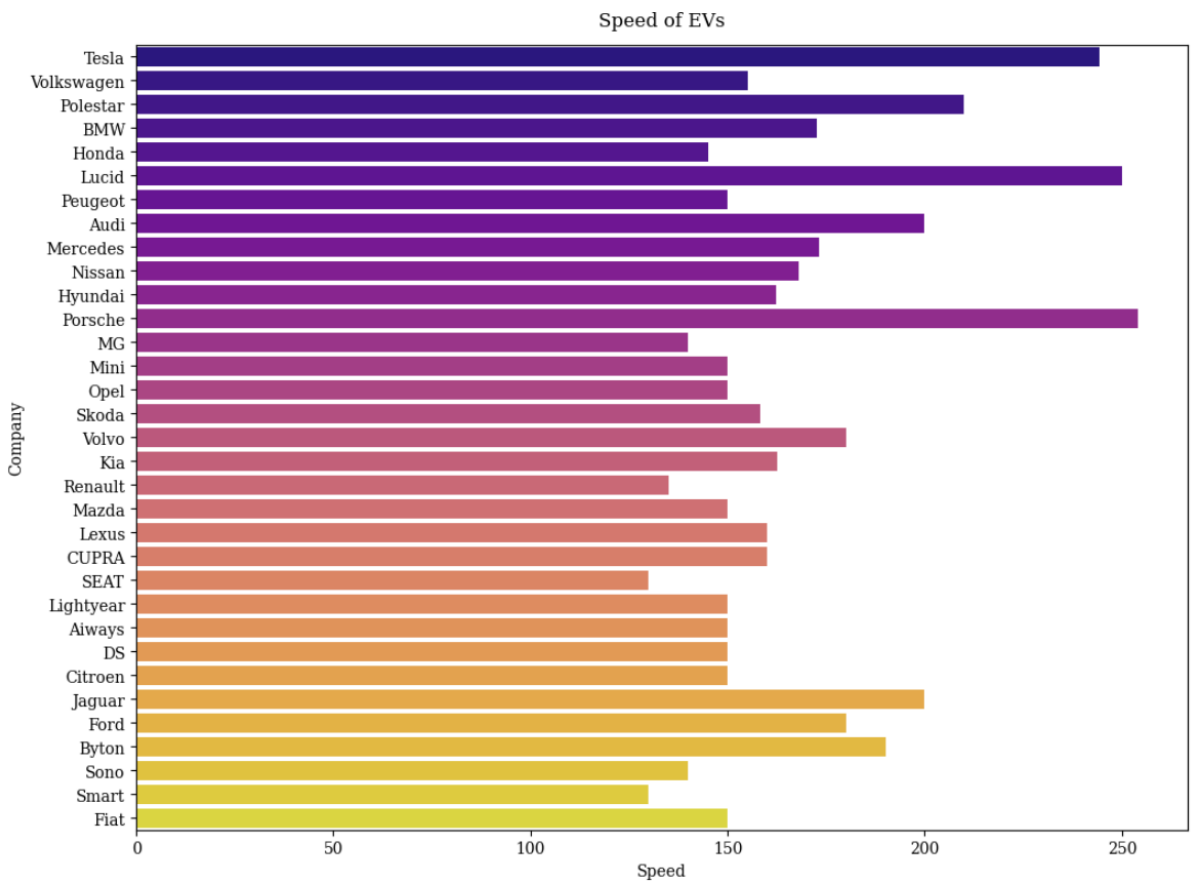
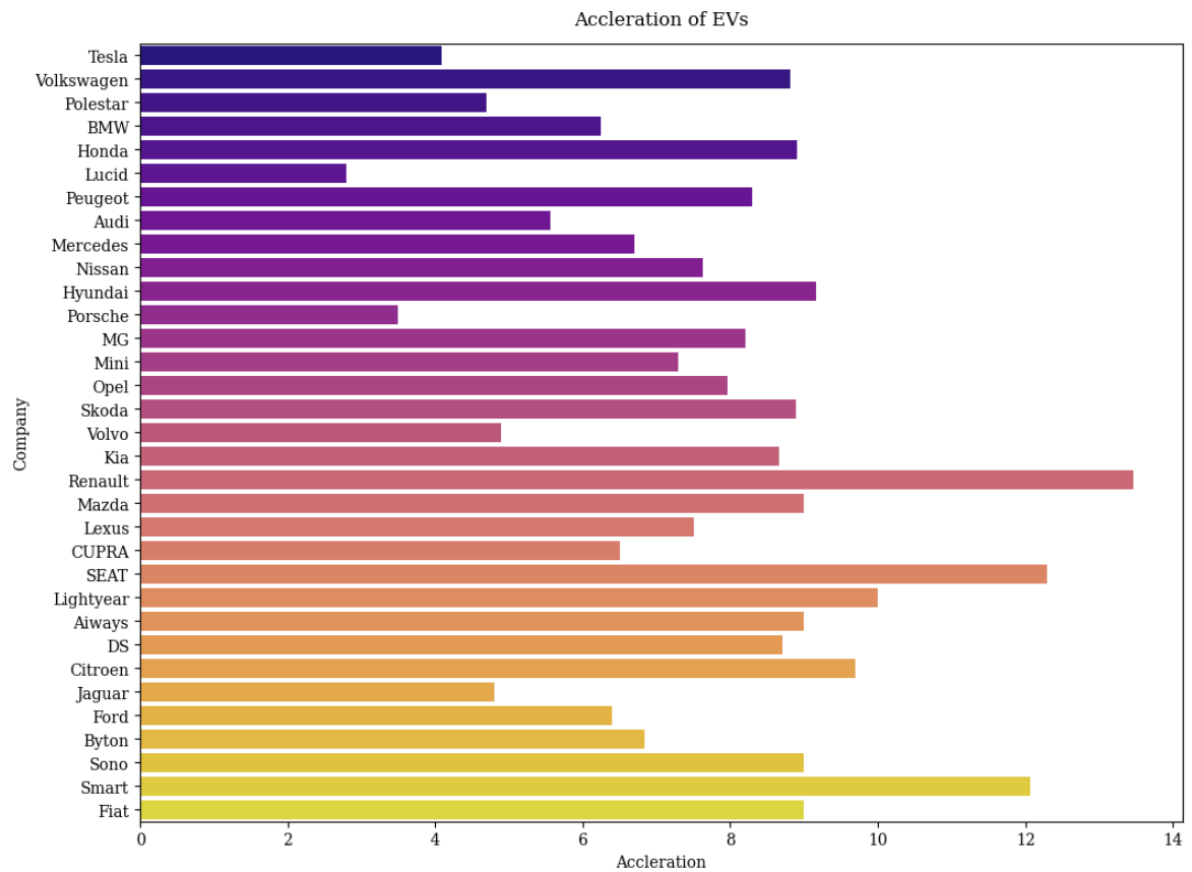
The chart depicts the popularity of SUVs, Hatchbacks, and Sedans regarding body types, while others are less popular and manufactured.

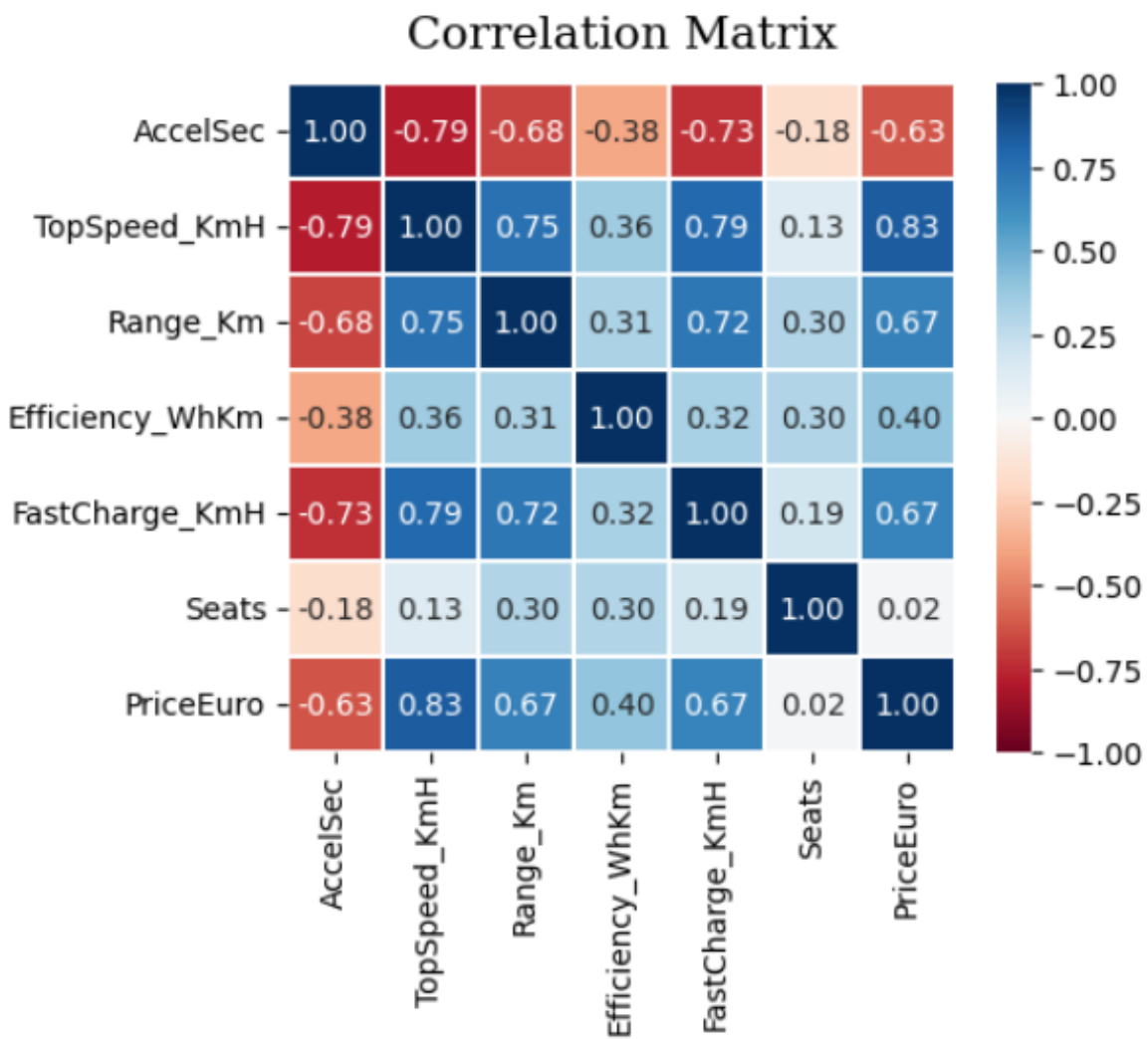
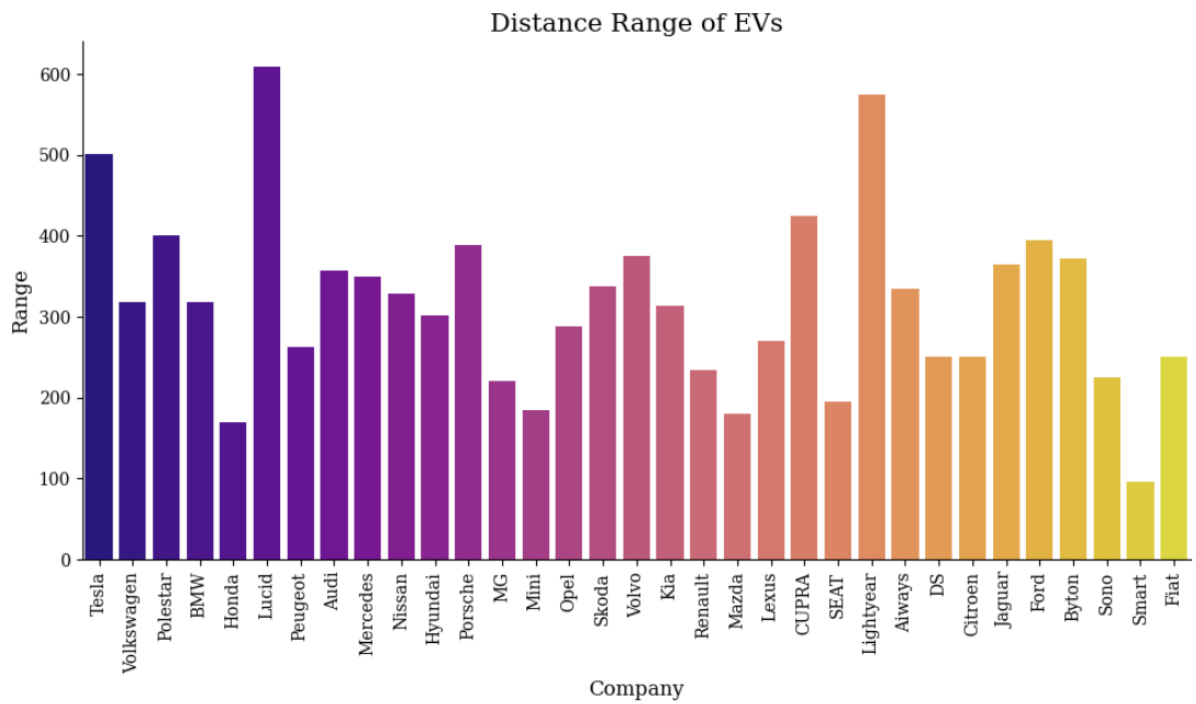


The above chart displays that maximum EVs of 4-wheeler type have five to four seats, which is the size of an average modern Indian family.



The chart displays the price range in INR converted from the dataset that has prices in EURO. The average cost for 4-wheeler EVs in India falls from 20 lacs to 35 lacs. This is only affordable to upper-middle-class to high-class customers in India.





Extraction of Target Segments

Before applying any ML algorithm, there is a need to analyze and reduce the redundant features from the dataset. One popular technique to achieve that is Principal Component Analysis (PCA). Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into values of linearly uncorrelated variables called principal components. This transformation is defined so that the first principal component has the largest possible variance (that is, it accounts for as much of the variability in the data as possible). Each succeeding component has the highest variance possible under the constraint that it is orthogonal to (i.e., uncorrelated with) the preceding components.

PCA is a widely used dimensionality reduction technique for data analysis. It can reduce the number of features in a dataset while preserving as much information as possible. This can help make the data easier to visualize and analyze and improve the performance of machine learning algorithms.

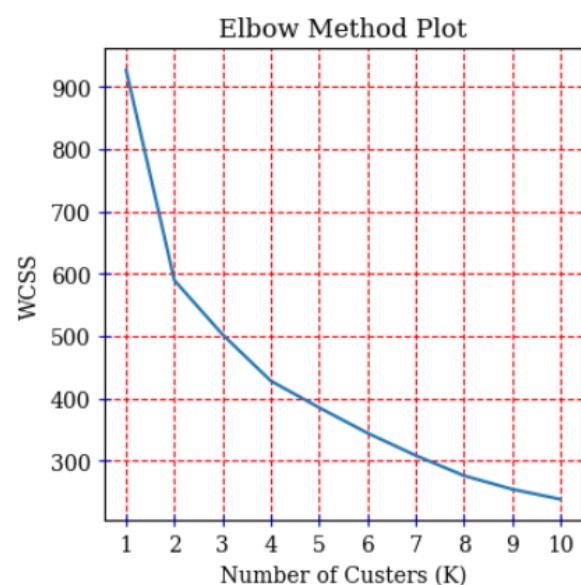
There are a few reasons why we use PCA before clustering techniques.

- To reduce the dimensionality of the data. This can be helpful if the data has many features, as it can make the clustering algorithm more efficient.
- To identify the most important features. PCA can identify the features that explain the most variance in the data. This can help understand the data and select the most relevant features for clustering.
- To improve the clustering results. In some cases, PCA can help to improve the clustering results by making the clusters more distinct. This is because PCA can help to remove noise from the data and to identify the underlying patterns.

After achieving an ideal number of features, we use them for the dataset that goes into an unsupervised machine learning technique called K-Means Clustering. K-means clustering is a type of unsupervised learning algorithm that is used to group data points into clusters. The algorithm works by iteratively assigning data points to the cluster with the closest mean (the centroid). The mean of a cluster is the average of all the data points in that cluster. The algorithm repeats this process until the data points no longer move between clusters.

K-means clustering is a popular algorithm because it is relatively simple to understand and implement. It is also very efficient, making it suitable for large datasets. This segregates an unlabeled multivariate dataset into various groups without any guiding supervision. It tries to find common patterns hidden inside the datasets and accordingly forms the groups. The clusters are calculated, and a WCSS value (within-cluster sum of squares) is calculated accordingly. Plotting the graph between both cluster and WCSS looks like this:

The WCSS value is indirectly proportional to the number of clusters. As the number of clusters increases, the value of WCSS decreases. But we also cannot have more clusters, so choosing an optimal number of clusters (K) is necessary. The graph plotted depicts the most optimal value of $K = 4$, i.e., where there is an elbow-shaped curve.



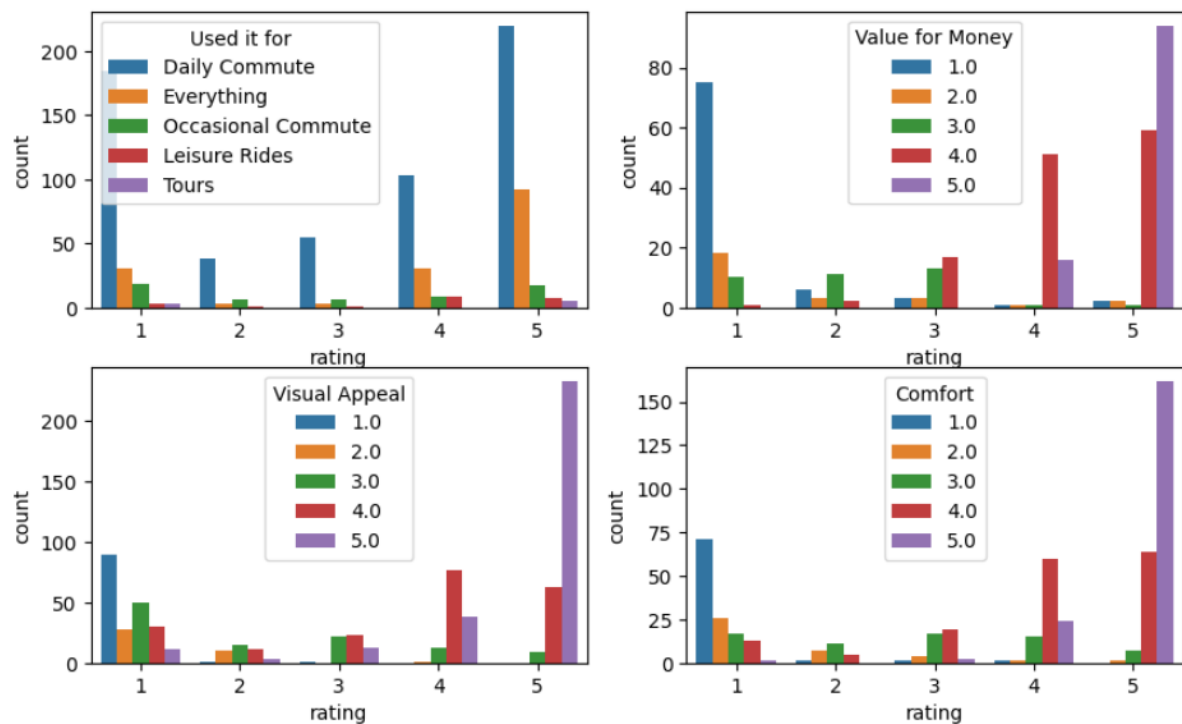
Profiling and Describing Potential Segments

Geographic Segmentation is the process of dividing a market into groups based on their location. This can be done using factors such as country, region, city, or postal code. Geographic segmentation is a common way to segment markets because it is easy to understand and can be used to target marketing campaigns as per locations where customers reside. For example, a company that sells snow skis might want to target its marketing campaigns to people who live in cold climates.

The above charts created during the study show that states like Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Rajasthan, and Delhi have favorable geographic locations rather than states located in mountainous terrains.

Psychographic Segmentation is a marketing strategy that divides customers into groups based on their psychological characteristics. This can be done using personality, lifestyle, values, and attitudes. Psychographic segmentation is a powerful tool for marketers because it can help them to understand their customers' needs and wants and target their marketing campaigns more effectively. Though this is subjective, it always helps marketers learn about customers' psychological preferences while buying a product.

Our study considered psychological factors like value for money, the purpose of use, visual appeal, and comfort during data collection. The results are shown below:

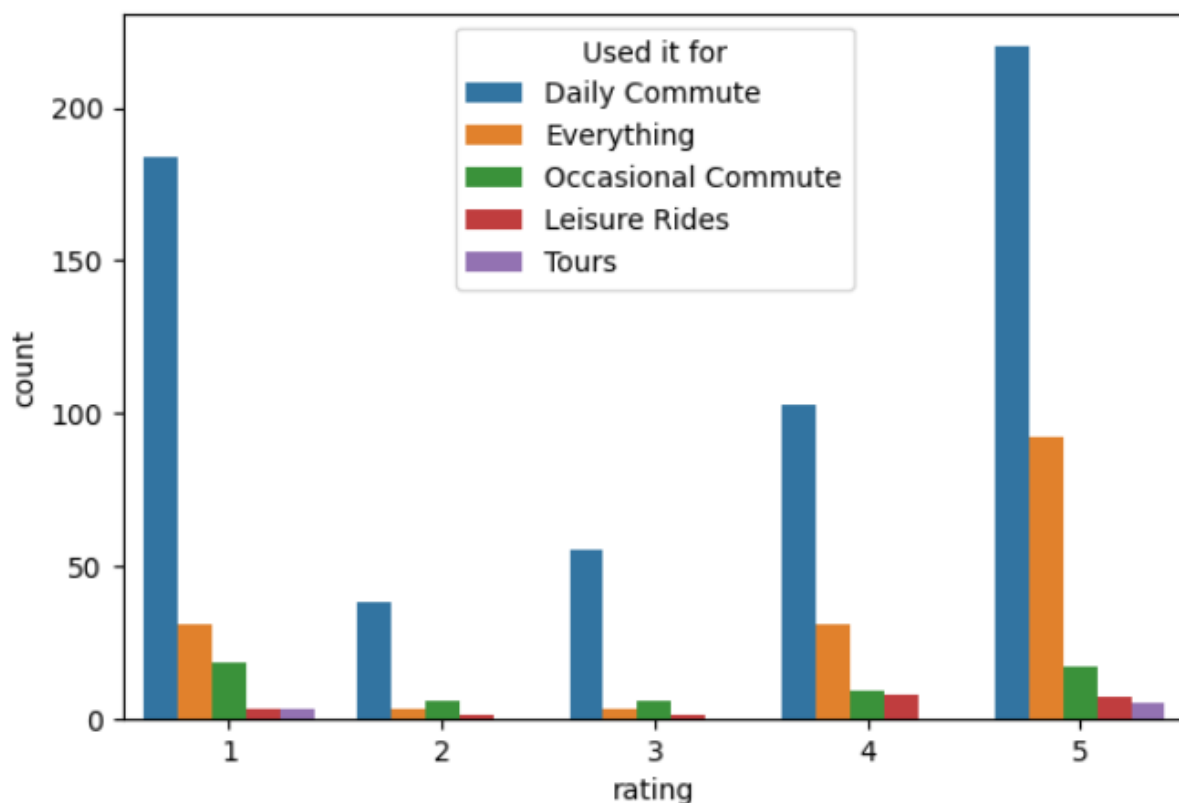


Value for Money	1.00	0.74	0.78	0.87
Visual Appeal	0.74	1.00	0.79	0.77
Comfort	0.78	0.79	1.00	0.83
rating	0.87	0.77	0.83	1.00
	Value for Money	Visual Appeal	Comfort	rating

Behavioral Segmentation is a marketing strategy that divides customers into groups based on their behavior. This can be done using daily activities, purchase history, website activity, or social media engagement. Behavioral segmentation is a powerful tool for marketers because it can help them to understand their customers' needs and wants and target their marketing campaigns more effectively.

This also holds power because daily needs drive humans' desires to make our lives more comfortable and smoother, especially when a significant number of the human population is involved in jobs that involve some form of physical interaction with the surroundings, like commuting to work, an update on social apps, buying daily needs, etc.

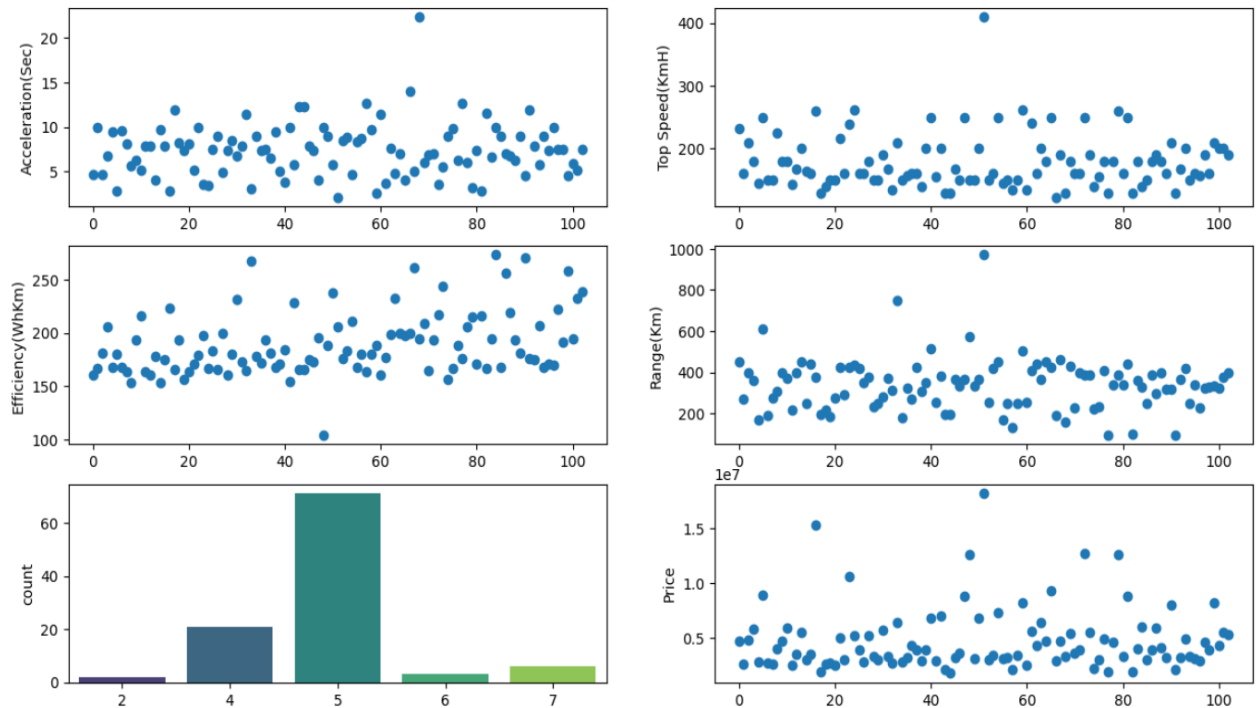
For our study in the EV market, the key behavior is using vehicles for transportation. The dataset collected for psychographic segmentation also has information on the need for EVs defined by the customers. Below is the chart that depicts the major purpose of using EVs by Indian customers:



It shows that EVs are popularly used for daily commutes by Indians. This can help us decide the design and specifications of the model we manufacture and market in India.

PRODUCT-BASED SEGMENTATION is a type of market segmentation that focuses on studying various features or characteristics of existing products in the market. It divides customers into groups based on the products they use or are interested in. This can be done using product features, price, brand, or usage factors.

Product-based segmentation is a useful tool for marketers because it can help them to understand their customers' needs and wants and target their marketing campaigns more effectively. For example, we have included features of an EV product like acceleration, speed, fuel efficiency, distance range covered, seat count, and price range.



Selection of Target Segments

Concluding from the graphs above, it can be safely decided that most of them have five seats, their cost ranges between 20-30 Lakhs, and they possess high efficiency in fuel consumed per unit distance.

[Note that acceleration is more important than speed when comparing vehicles. This is because acceleration is how quickly a car can change its speed. Acceleration can be more important than top speed in some situations, such as passing on the highway or merging onto a busy road.]

Therefore, the four target segments were decided upon after the segmentation analysis of the datasets. The ideal EV product must have the following:

- **Geographic factors:** States that are more open-minded and have higher availability of EVs due to easier topological features and more population.
- **Psychographic factors:** Comfort and value for money are the most chosen features that Indian customers go for while buying an EV.
- **Behavioral factors:** Most EVs are used for daily commutes so an ideal EV would be 2- or 3-wheelers for early manufacturing stages.
- **Product-based factors:** Most EVs must have good acceleration, moderate price, and high fuel efficiency.

To put down specific numbers, the startup should target manufacturing EVs that have *7.5 to 10 units*, cost between *20 to 30 lakh rupees*, provide *comfort and value for money*, and market them in states such as *Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, and Rajasthan*.

Customizing Market Mix

This is the final stage of the process. It is where we take the insights gained from the segmentation analysis done before and use them to tailor the marketing mix to the specific needs of the target segments. The marketing mix comprises the **four Ps: product, price, place, and promotion**.



How the target segment decision affects marketing mix development

We will also need to consider the following factors:

- The needs and wants of the target segments
- The competitive landscape
- The company's resources and capabilities

Considering these factors, we decide how to modify the four Ps to meet the target segments' needs. For example, the marketer may need to develop new products, change prices, modify distribution channels, or create new promotional campaigns.

Customizing the market mix aims to create a marketing mix tailored to the target segments' specific needs, which will help the company achieve its marketing objectives.

Since we are a start-up trying to enter the market, it would be favorable for us to fulfill the needs stated by the target segments we chose in our segment extraction. We need to tailor our product in such a way that it checks all the optimal numbers found in our target segmentation. The four Ps of our marketing mix is adjusted accordingly:

- **Product:** The product is a business's good or service sold by them. When customizing the market mix, it is important to consider the product's features, benefits, and pricing. For the products we plan to manufacture and market, we will focus on features like good acceleration, high fuel efficiency, comfortable interiors, etc. We will also focus on manufacturing different models and body types that cater to the needs of the Indian population that mostly use EVs for daily commutes.
- **Price:** The price is the amount customers pay for the product. It is important to consider the target market's willingness to pay when setting the price. Since most EVs are 2-wheelers and 3-wheelers, we will start our business by focusing on these types of EVs. The prices for such models would average in the ranges of 0.5 to 1 lakh and 0.6 to 5.6 lakhs. We will transition to marketing high-end 4-wheelers that will cost in the range of 20 to 30 lakhs. Now, we can also estimate the potential profit for our business market. Given that our ideal target cities are Mumbai, Bangalore, Mysore, and Pune, we can calculate early profit approximately.

Let's say that the potential customer base in Mumbai is 20 million people, and our target price range is INR 100,000-200,000 (for 3-wheelers). The potential sale (profit) in Mumbai would be:

20 million * INR 100,000 = INR 2 billion

20 million * INR 200,000 = INR 4 billion

Similarly, we can estimate profit in other target cities as below:

City	Potential Customer Base	Target Price Range	Potential Sale (Profit)
Mumbai	20 million	INR 100,000-200,000	INR 2-4 billion
Bangalore	15 million	INR 100,000-200,000	INR 1.5-3 billion
Mysore	5 million	INR 100,000-200,000	INR 0.5-1 billion
Pune	10 million	INR 100,000-200,000	INR 1-2 billion

- **Place:** The place where the product is sold. When customizing the market mix, it is important to consider the distribution channels and retail outlets. Statistics resulting from our analysis have shown that the ideal states for our product launch and sales would be Maharashtra, Karnataka, Tamil Nadu, Uttar Pradesh, and Rajasthan.
- **Promotion:** Promotion is how businesses communicate their product's value to the target market. Considering the different promotional channels and tactics when customizing the market mix is important. We can adopt online and social media advertising and arrange event advertising through free test drives, launch parties, and educational seminars.

FINAL STRATEGY

1. **Ideal Location for the early market:** We will start with the launch of EVs in Maharashtra and Karnataka during the early months of business. The sales and feedback will be closely observed and considered immediately during this early stage of the startup.

The reason for choosing these two states is because they house a large population that is educated, open to ideas, and earns livelihood on a stable basis. As per the Innovation Adoption Life Cycle –

“

...the first group of people to use a new product is called "innovators," followed by "early adopters." Next, come the early majority and late majority, and the last group to eventually adopt a product are called "Laggards" or "phobics."

“

Maharashtra and Karnataka also have cities booming with technology and education. So, people have already adapted to newer technologies and lifestyles earlier than in some other states. It would benefit the startup to target the “early adopters” and “early majority” customers by focusing on the factors stated below:

- **Demographic:** Customers belonging to Mumbai, Pune, Mysore, and Bengaluru cities that are in the age ranges of 25 to 45 years. They are mostly working class and are expected to be aware of technology, traffic problems, and the environment's cleanliness. We will also look for good distributors to reach more customers in the local areas.
- **Behavioral:** Most datasets point out that the main use of EVs is for daily commutes. In the urban cities mentioned before, traffic is a major problem. 2-wheeler bikes and 3-wheeler taxis autos would be ideal for people who commute to their offices and also for the delivery services that are very popular in these cities.
- **Psychographic:** Since Indian customers prefer comfort and value for money more than visual appeal, extra effort will be made to incorporate enough space and strength in structural design. High fuel efficiency will also be provided to provide good ROI. The startup will reward early customers with free servicing for a month or two and consider adding other benefits if necessary.
- **Economic:** The startup will collaborate with good financial institutions to provide low-income customers with financial support for purchasing. We will include some experts on the team that can provide financial and technological advice to improve our products in the market. We will also tie up with the government to help reach the masses better.

Following these plans ensures a well-organized path to the launch and growth of the company in the early business phases. However, extensive research and an active feedback loop are always necessary to quickly address issues, enhance product quality and be aware of customer experiences.

The EV market is growing rapidly. In 2022, global EV sales reached 6.6 million units, and the Indian EV market was worth **USD 3.21 billion** by this year. The Indian government has also understood the importance of environmental safety and has set a target of **having 30% of all new vehicles sold** in India be electric by 2030.

This is a significant increase from just a few years ago. Several factors, including government incentives, technological advances, and consumer demand, are driving the growth of the EV market. **As the EV market grows, it will create new opportunities for our startup.** EV startups have the potential to disrupt the traditional automotive industry. They can develop new products and services that meet the needs of EV drivers. They can also **partner with existing businesses** to help them transition to a **more sustainable future**.

The future of transportation is electric. EV startups have the opportunity to be a part of this transformation. By developing innovative products and services, our startup can help make EVs more affordable, efficient, and accessible to Indians. This will help to accelerate the adoption of EVs and **create a cleaner, healthier future for everyone in India.**