Electric Vehicle Market in India

Market Segmentation

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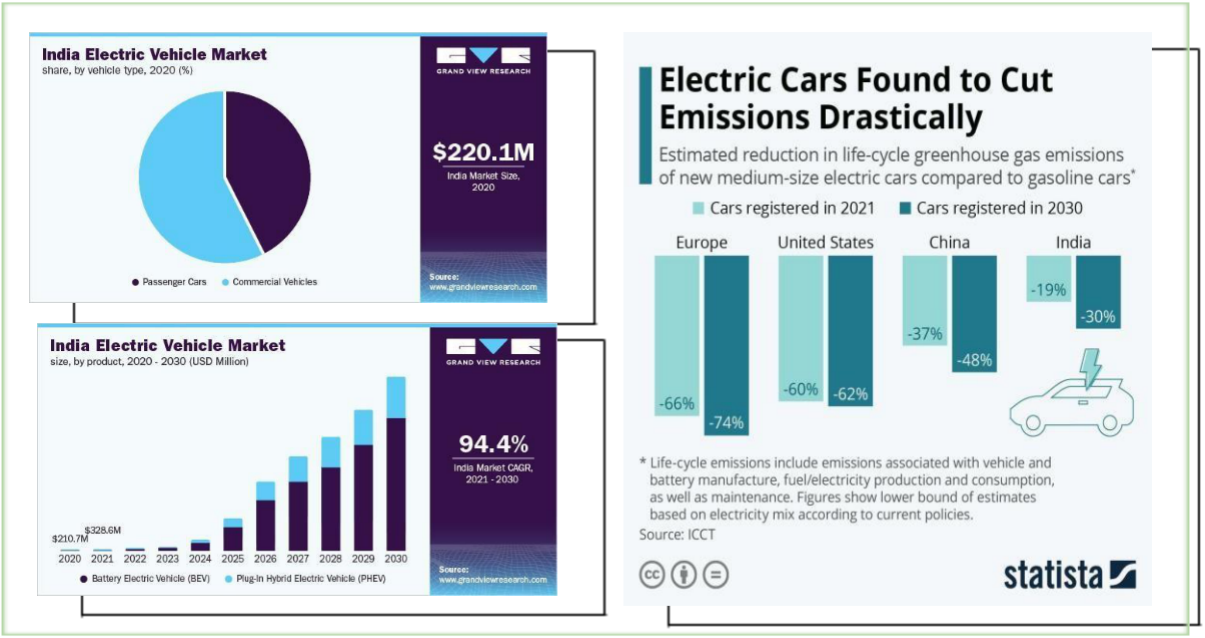
source:5paisa.com

Abstract

The electric vehicle (EV) market in India is rapidly growing, with the Indian government promoting the adoption of EVs through various initiatives and policies. In recent years, the Indian EV market has seen significant growth in both the number of electric vehicles sold and the number of charging infrastructure facilities established. Start-ups operating in various segments of the EV industry value chain, such as manufacturing, retail, battery swapping, and software services, are disrupting the traditional structure of the automotive industry. Additionally, these startups are incorporating emerging technologies like artificial intelligence, analytics, and machine learning, giving them a technological edge over their traditional petrol or diesel counterparts.

One of the primary drivers of EV growth in India is the government's Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) program, which aims to increase the adoption of electric vehicles and reduce carbon emissions. Under this program, the government provides incentives for the purchase of electric vehicles and the establishment of charging infrastructure. Another significant development in the Indian EV market is the emergence of several domestic EV manufacturers, such as Tata Motors, Mahindra Electric, and Hero Electric. These companies are developing affordable and efficient electric vehicles to cater to the needs of the Indian market. In addition to passenger vehicles, the Indian EV market is also seeing growth in the commercial vehicle segment, with many logistics and delivery companies adopting electric vehicles for their operations. The government has also encouraged the adoption of electric two-wheelers, which are a popular mode of transportation in India.

The following infographics shows the progress of EV market in India



Problem Statement

This report aims to conduct a comprehensive analysis of the Electric Vehicles Market in India by employing segmentation analysis. The objective is to identify the most promising segments of the market, based on geographic, demographic, psychographic, and behavioral factors, and to devise a feasible market entry strategy accordingly. The study will focus on various 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 features, plug types, and more. Through this analysis, we hope to provide valuable insights to businesses looking to enter the Indian Electric Vehicles Market and help them make informed decisions about their market entry strategy.

Fermi Estimation

Wild Guess: The EV market in India will grow by 50% in the next five
years. Educated Guess:
There are approximately 1.3 billion people in India. Let's assume that only 50% of them are in the target market for EVs, which would make it around 650 million. Out of this target market, let's assume that only 20% of people will be interested in buying an EV, which would make it around 130 million.
The average cost of an EV in India is around 10 lakhs. Let's assume that only 10% of people in the target market can afford to buy an EV, which would make it around 13 million people.
Let's also assume that the EV market in India is currently growing at a rate of 10% per year. In five years, it would grow by approximately 60%. However, considering the challenges in infrastructure and the cost of EVs, let's assume that growth will be slower, at 50% over the next five years.
Variables and Formulas:
Let p be the population of India.
Let *tm* be the target market for EVs.
Let *i* be the interested population for EVs.
Let *a* be the affordable population for EVs.
Let *c* be the average cost of an EV in
India. Let *g* be the growth rate of the EV
market. *tm* = *p* * 0.5
i = *tm* * 0.2
a = *tm* *
0.1 *g* = 0.5
Conclusion: By this analysis, we conclude that the EV market in India will grow by 50% in the next five years, and around 13 million people will be able to afford EVs.

Data Collection

The data has been collected manually, and the sources used for this process are listed below :

https://www.kaggle.com/datasets
https://datasetsearch.research.google.com
/
https://www.india-briefing.com/news/indias-ev-manufacturing-capacity-and-market-preferences-progress-25840.html/
https://pib.gov.in/PressReleasePage.aspx?PRID=1842704
https://pib.gov.in/PressReleasePage.aspx?PRID=1910392#:~:text=The%20Ministry%20has%20sanctioned%202%2C877,cities%20across%2025%20states%2FUTs

Data Pre-processing:

Libraries/packages used in

python:

- Pandas
- Numpy
- Matplotlib, seaborn
- Scikit-lea

rn Steps

involved:

- Data manipulation
- Custom functions for plots
- Drop irrelevant columns
- Reformatting columns to appropriate datatype

Reading the Data

```
df2 = pd.read_excel('EV_charging_station_dataset.xlsx', sheet_name='Table 2', header=1)
df2.head()
```

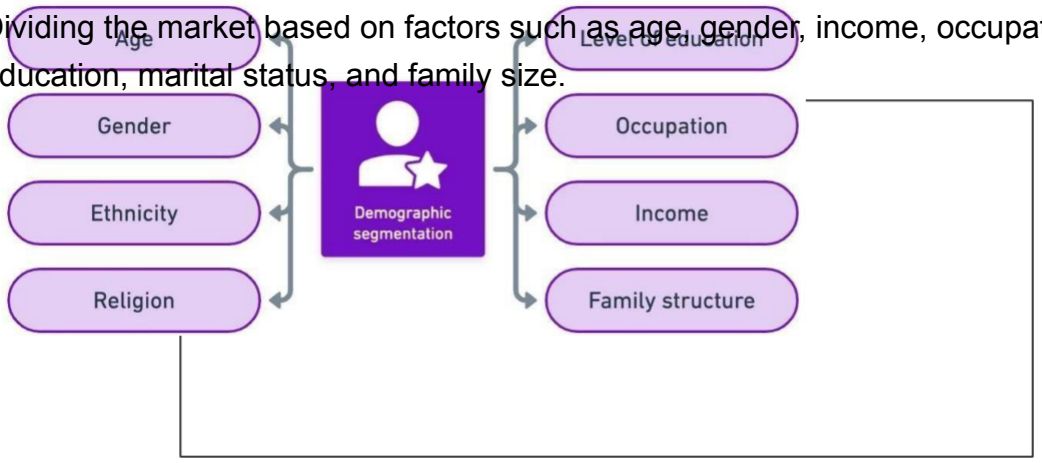
	State	No. of EV chargers sanctioned
0	Maharashtra	317
1	Andhra Pradesh	266
2	Tamil Nadu	281
3	Gujarat	278
4	Uttar Pradesh	207

Market Segmentation

Market segmentation is the process of dividing customers into subgroups based on their characteristics. There are two approaches to market segmentation - a-priori and post-hoc. The a-priori approach uses predefined characteristics to create segments, while the post-hoc approach identifies segments based on the relationship among measured variables. This study uses an a-priori approach to segment potential EV customers. The study suggests that using a blend of psychographic and socioeconomic attributes is useful in formulating sub-market strategies that satisfy specific consumer preferences. The study also recommends using perceived-benefit characteristics guided by blended psychographic and socio-economic aspects for segmenting the consumer market. Previous research has shown that psychographic characteristics are more useful than socio-demographic and economic ones in explaining environmentally-conscious consumer behavior.

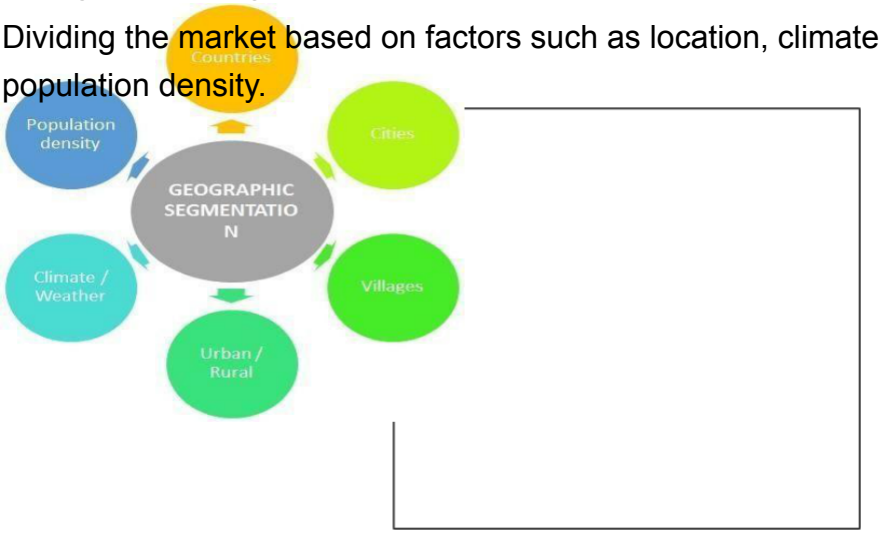
Demographic / Behavioral segmentation

Dividing the market based on factors such as age, gender, income, occupation, education, marital status, and family size.



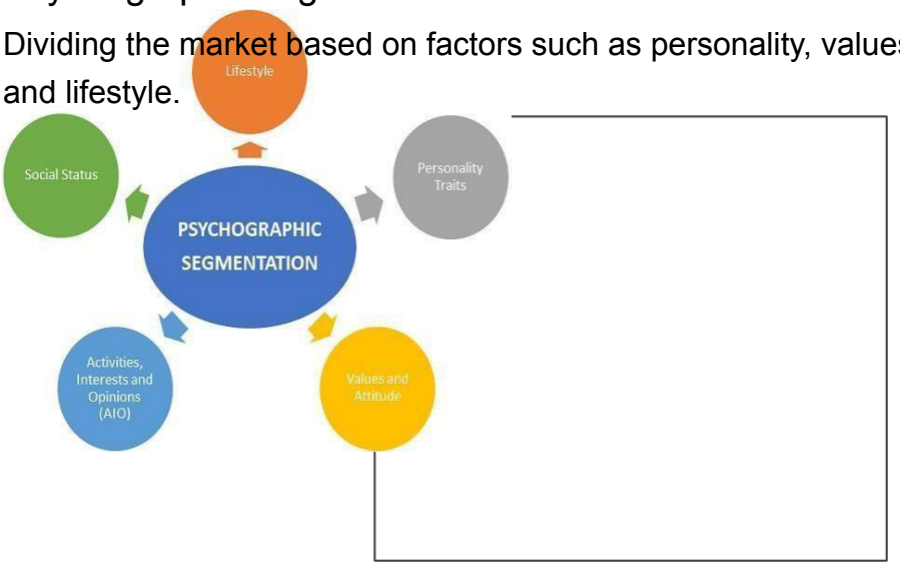
Geographic segmentation

Dividing the market based on factors such as location, climate, region, and population density.



Psychographic segmentation

Dividing the market based on factors such as personality, values, interests, attitudes, and lifestyle.



Product-based segmentation

Dividing the market based on product attributes such as features, design, quality, size, and price.

EDA and clustering

Geographical dataset

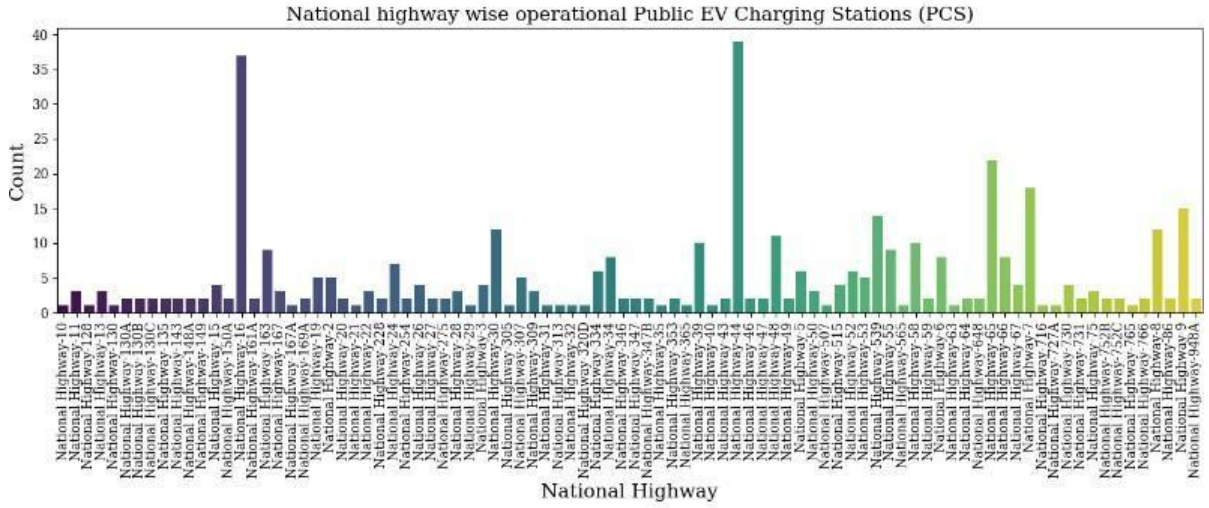
- Conducting data manipulation to extract relevant fields from the dataset.
- Creating custom functions for generating plots that group data based on specific features and provide insights.
- Eliminating features from the dataset that have little or no relevance to electric vehicles.
- Cleaning numerical data by converting string values to floating-point values.
- Combining relevant data frames to generate a visualization of electric vehicle market insights on a map of India.

Behavioral Dataset

- Consumer characteristics, namely Age, Profession, Marital Status, Education, No. of Dependents, Car Loan, Total Salary (Combined salary in case married) are compared to the price of the purchased Electrical Vehicle.
- Clusters are formed based on inferences drawn from analysis.
- Categorical value count is compared with EV price
- Inference is drawn on clusters formed.

Geographical Segmentation: Visualization and insights

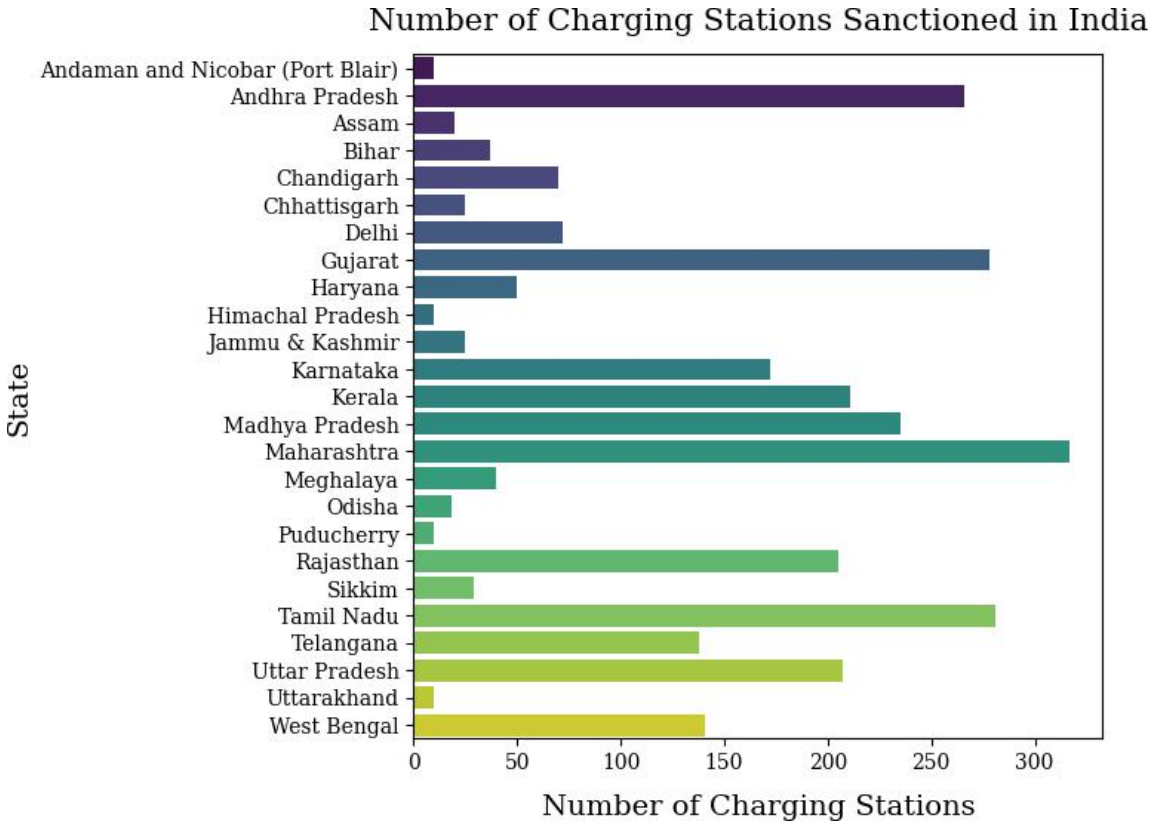
Charging stations on Indian Highways



Based on the above plot, the following states consisting the important highways could serve as baseline targets when it comes to geographic segmentation.

- Maharashtra.
- Delhi.
- West Bengal.
- Karnataka.
- Gujarat

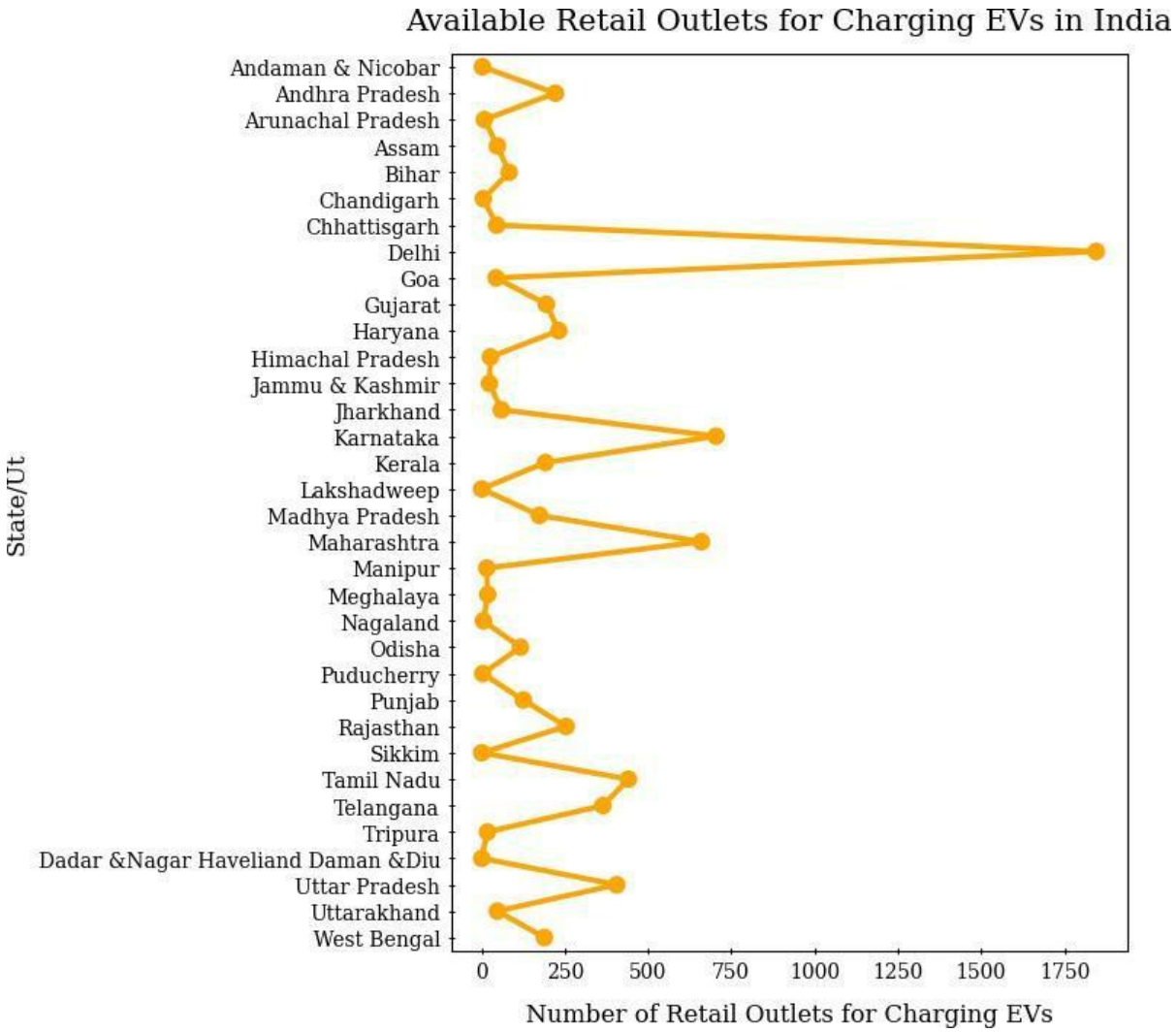
Sanctioned Charging Stations State-wise



States to target based on charging stations sanctioned:

- Maharashtra
- Andhra Pradesh
- Tamil Nadu
- Gujarat
- Uttar Pradesh
- Rajasthan
- Karnataka

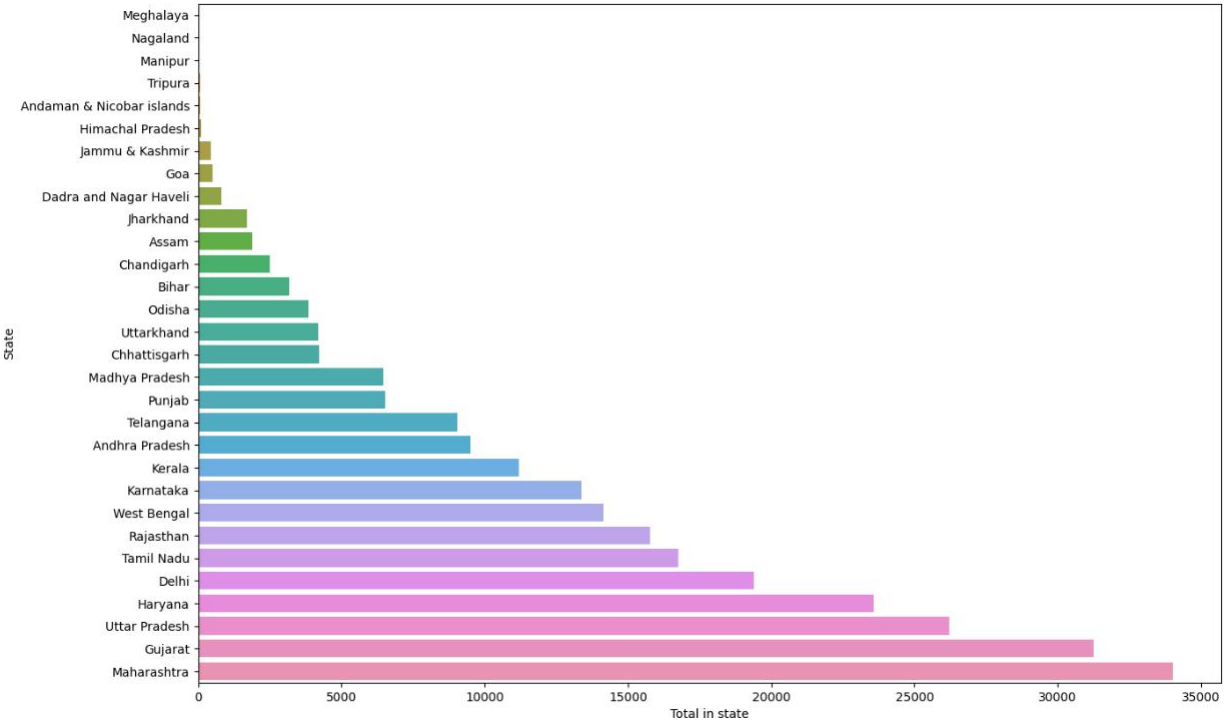
Available Retail Outlets for Charging EVs in India:



States to target based on charging stations sanctioned:

- Maharashtra
- Karnataka
- Tamil Nadu
- Delhi
- Uttar Pradesh

Vehicle data state-wise



After conducting analysis of the number of charging stations in various states and highways, we have identified the most promising states to enter the EV market. This aligns with our earlier baseline states that we had established.

Observations -

From the above graph we can see that Maharashtra has the highest count of customers for electric vehicles.

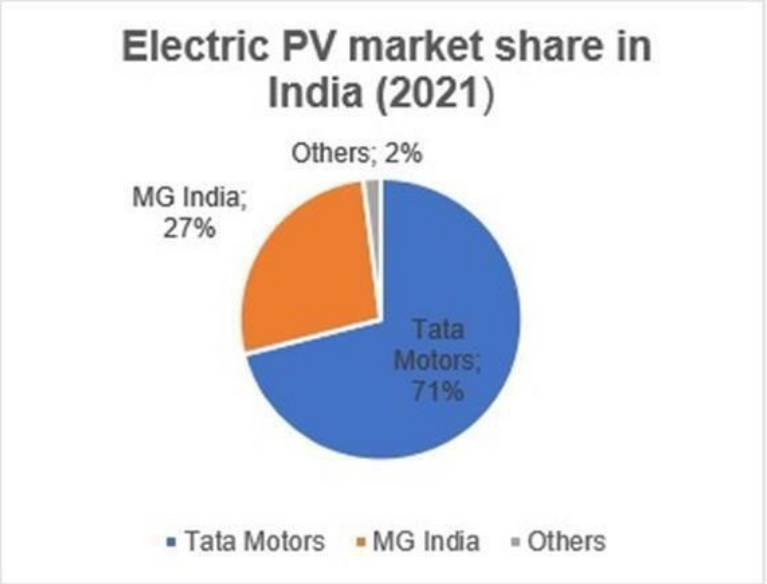
Meghalaya has the least customer count for EVs.

At last the takeaway from this analysis is that the focus for our marketing should be Maharashtra, Gujarat, UP, Haryana.

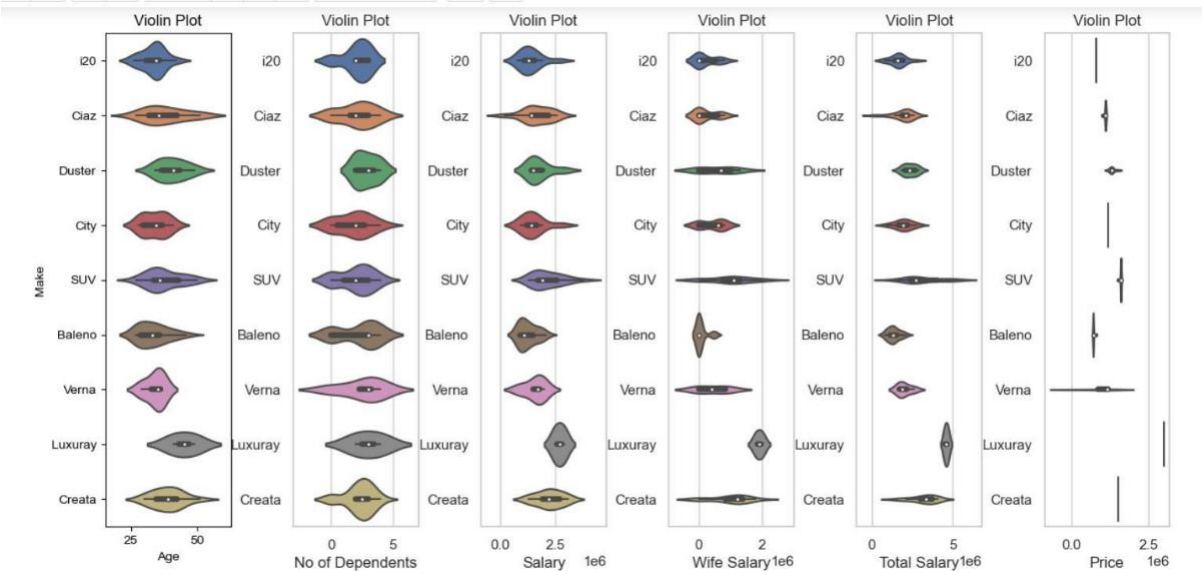
From the above plot we can see that Uttar Pradesh and Maharashtra has highest target customers.

DEMOGRAPHIC ANALYSIS

Motors dominates the electric vehicle segment in the passenger car segment with market share of 71%, led by two flagship models, the Nexon and the Tigor EV. MG Motors India finished in second, with the most electric vehicles on the market (the MG EZS has a range of 39 kilometers on a single charge). Other Indian manufacturers have also revealed their models, which will be released in the near future.



We will visualize the dataset to gain knowledge on customer preferences.

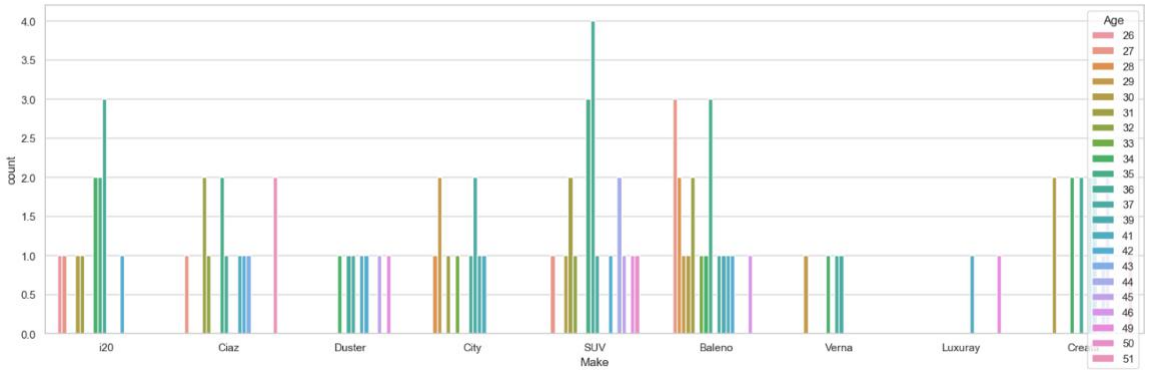


Observations:

- Age: Younger consumers buy cheaper cars.
- Number of dependents: More dependents make consumers buy cars with more seats, so they prefer SUVs.
- Salary: If you fit the normal salary chart with the price chart, you'll notice that the average violin salary chart corresponds to the price of the car, which is a very direct relationship.

Plot of the relationship between the ages of buyers and the vehicles they buy.

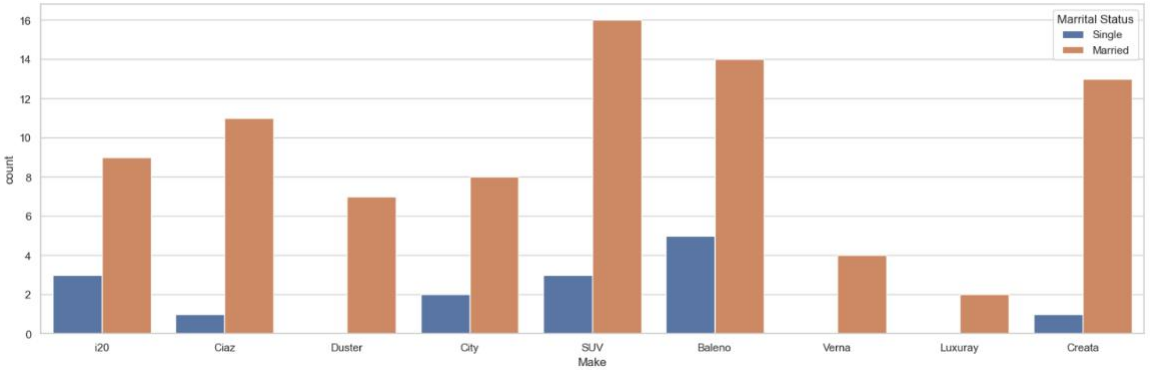
```
<AxesSubplot:xlabel='Make', ylabel='count'>
```



Observation: People in their 30s including early 40s and late 20s tend to buyelectric vehicle comparatively than others.

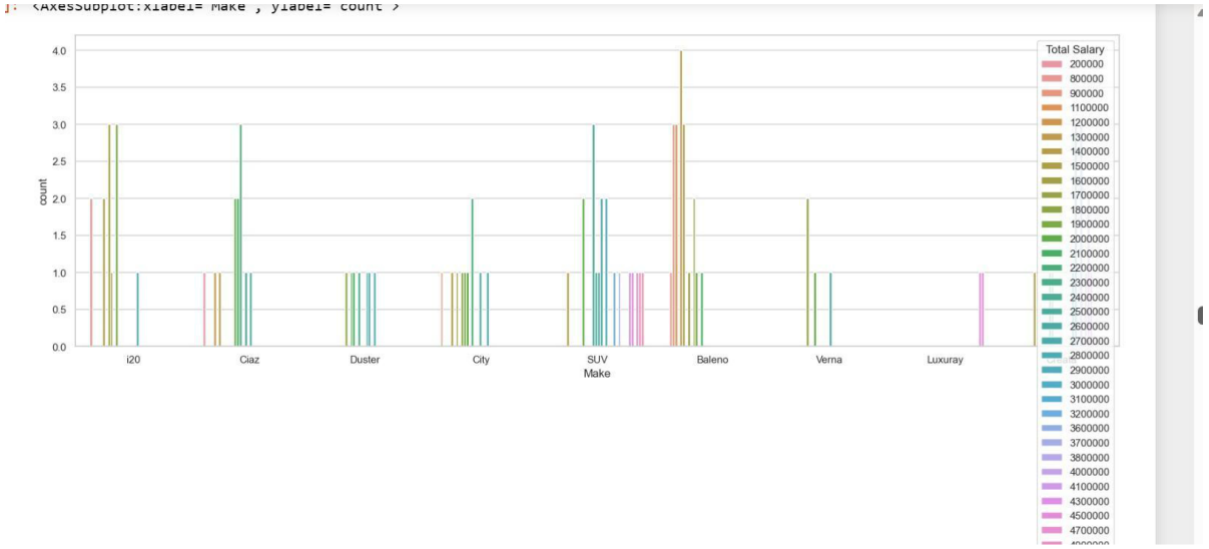
Plot for the relationship between consumer marital status and car purchases.

```
<AxesSubplot:xlabel='Make', ylabel='count'>
```



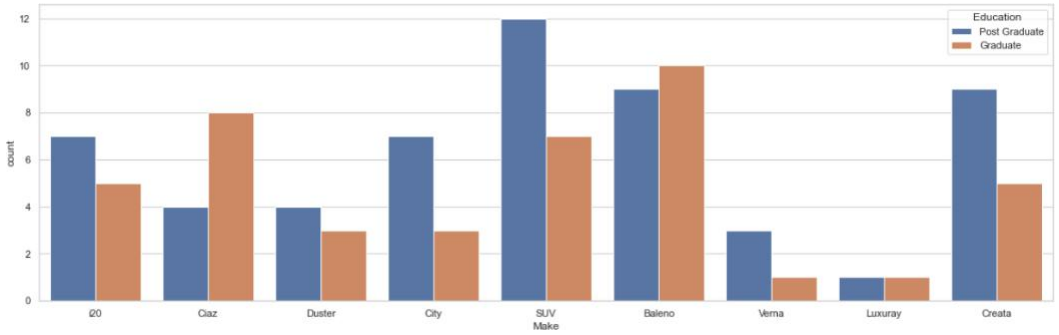
Observation: From the above plot it is clearly notable that married persons are more likely to purchase an electric vehicle when compared to a single person.

Plot for Relation between consumer’s total salary and the vehicles they purchase.



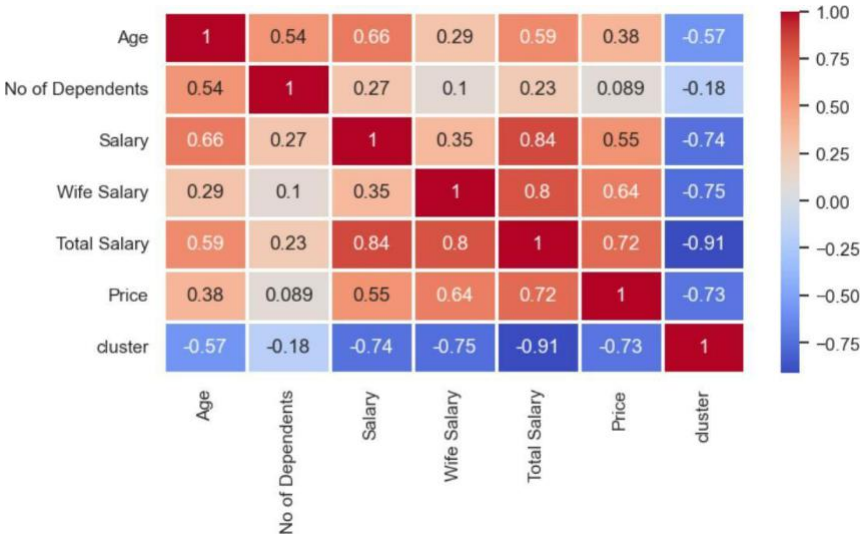
Observation: From the above plot we can analyze that salary is directlyproportional to type of Electric vehicle a person tends to buy.

Plot for Relation between consumer's education and the vehicles they purchase.



Observation: In this plot both graduate and undergraduate have equal probability of buying an e vehicle.

CORRELATION PLOT

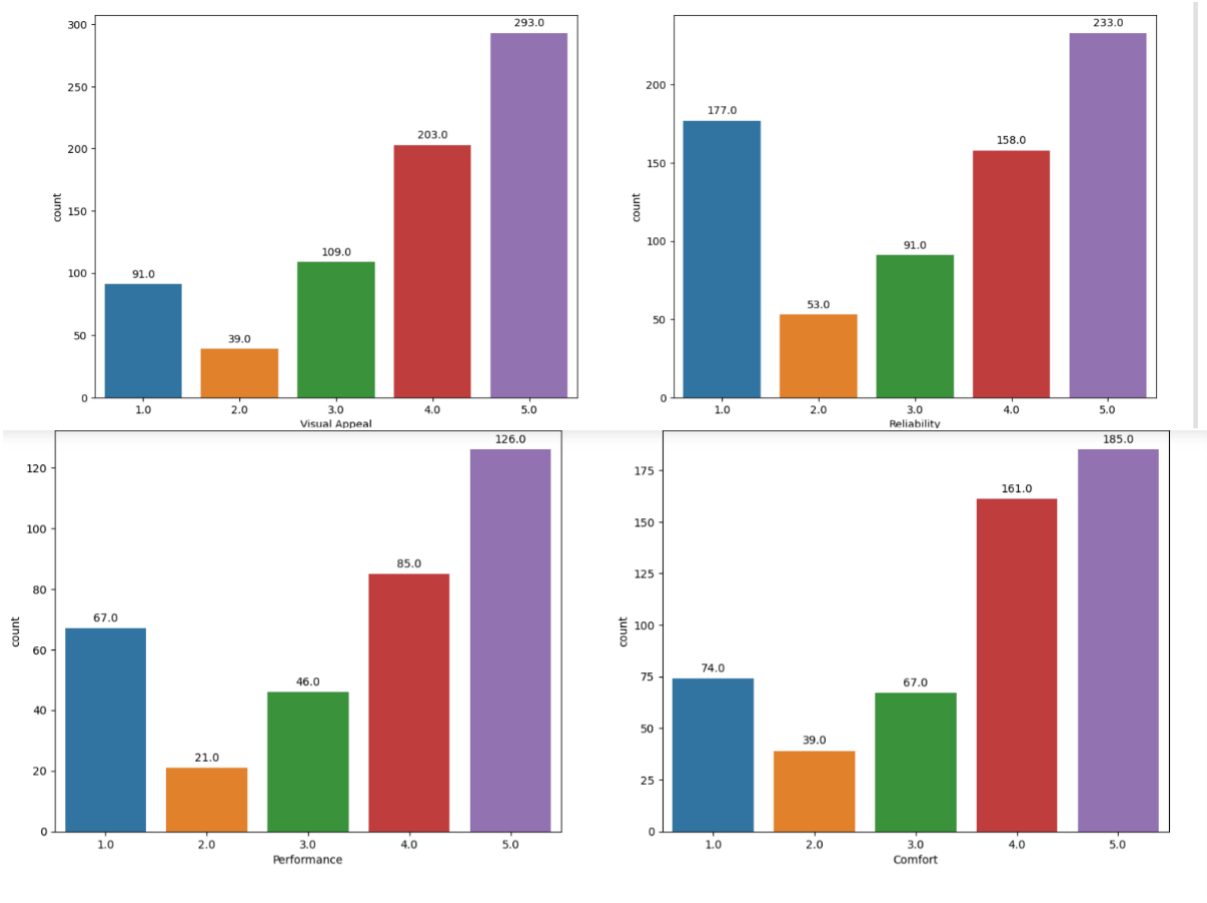


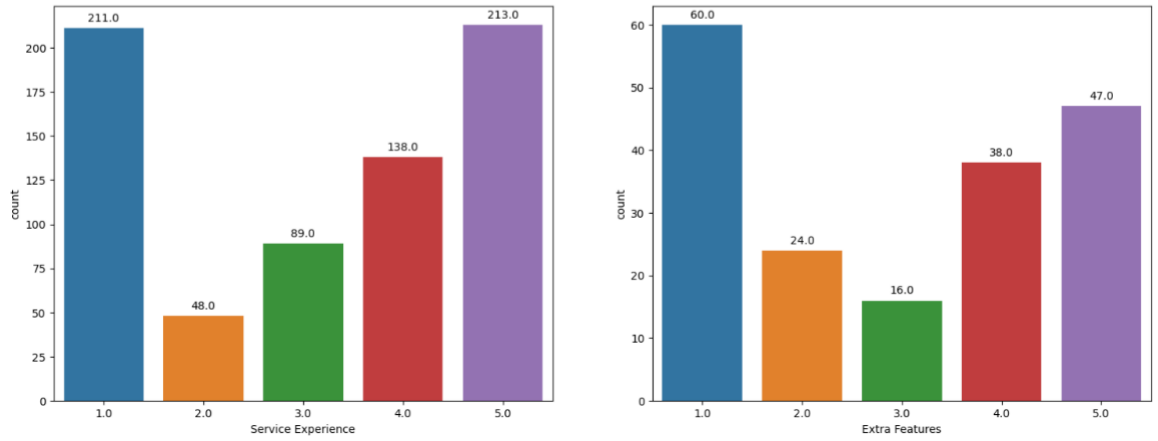
This correlation plot can clearly convey the attributes that affects the buying preference of any person.

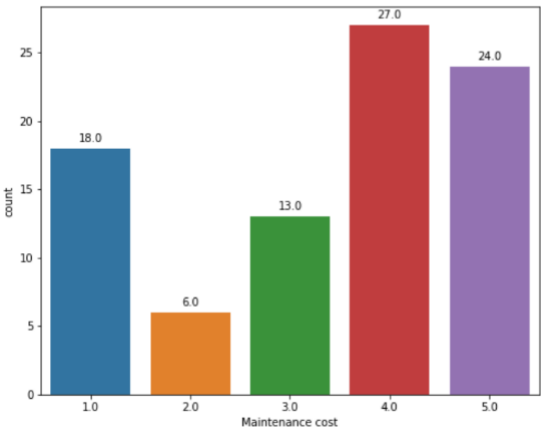
PSYCHOGRAPHIC ANALYSIS

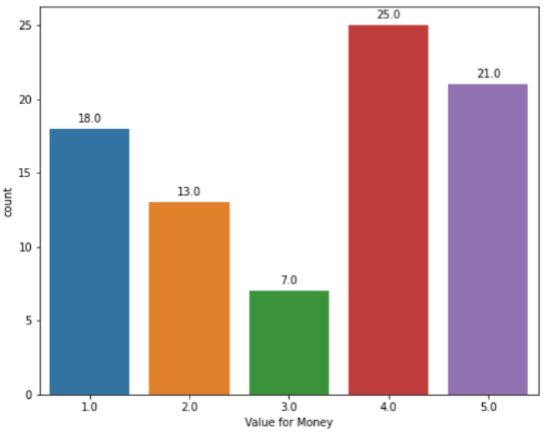
Here we can analyse all the preferences and reviews of the customers on various aspects.

For **E2Ws**:

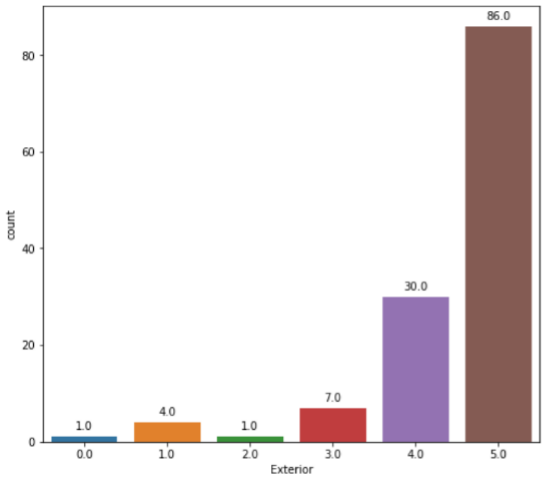


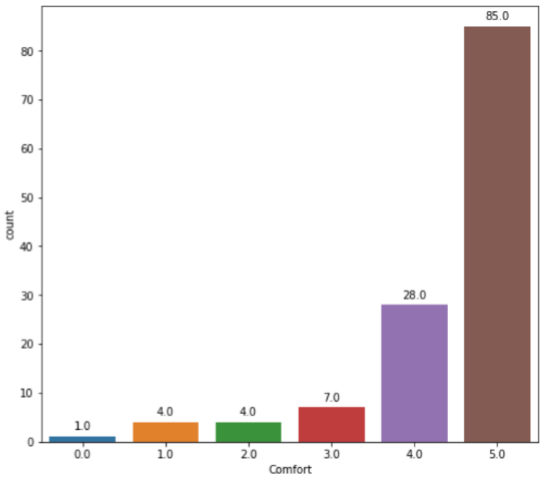


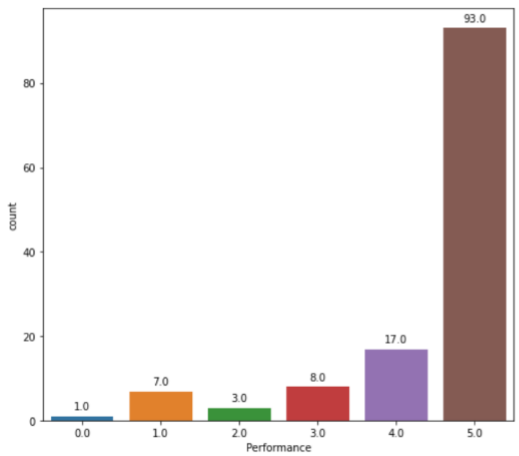

count
Maintenance cost
18.0
6.0
13.0
27.0
24.0

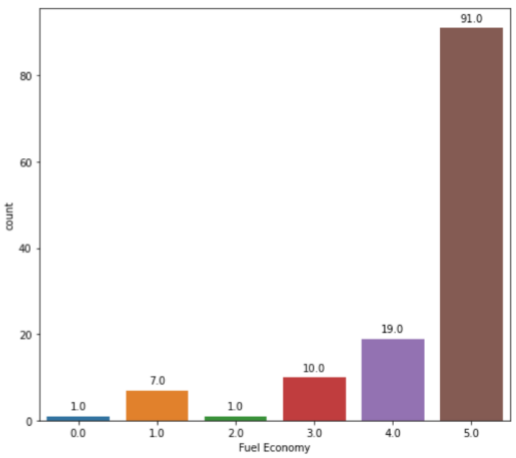

count
Value for Money
18.0
13.0
7.0
25.0
21.0

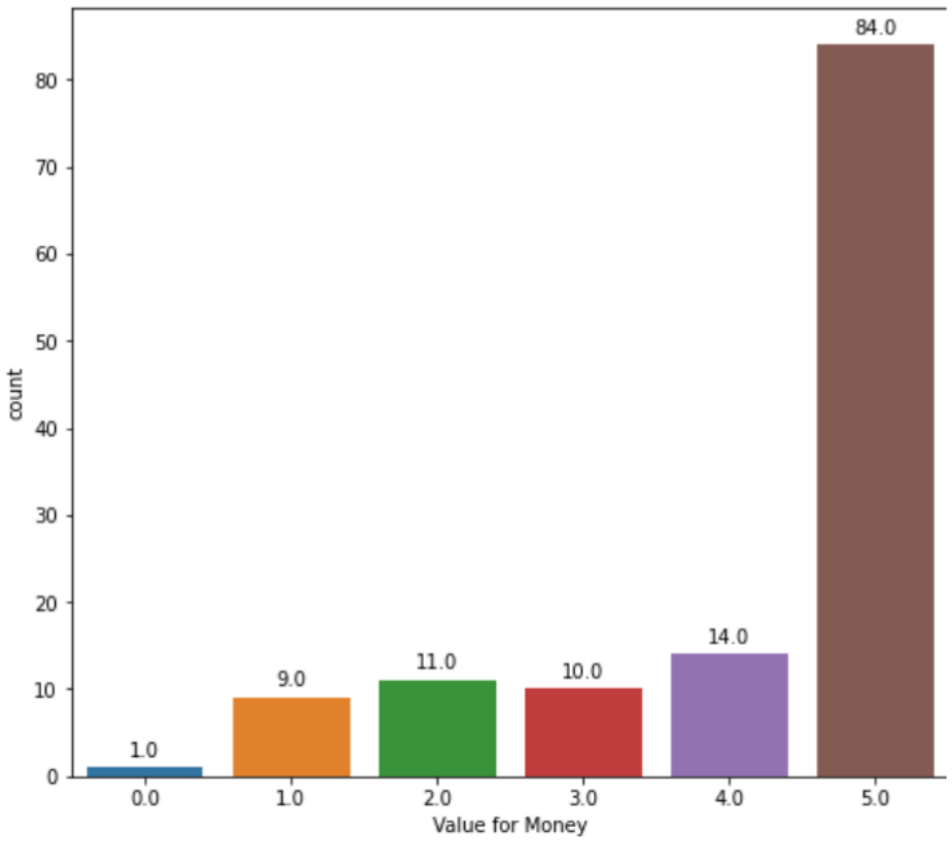
For **E4Ws**:


count
Exterior
1.0
4.0
1.0
7.0
30.0
86.0


count
Comfort
1.0
4.0
4.0
7.0
28.0
85.0


count
Performance
1.0
7.0
3.0
8.0
17.0
93.0

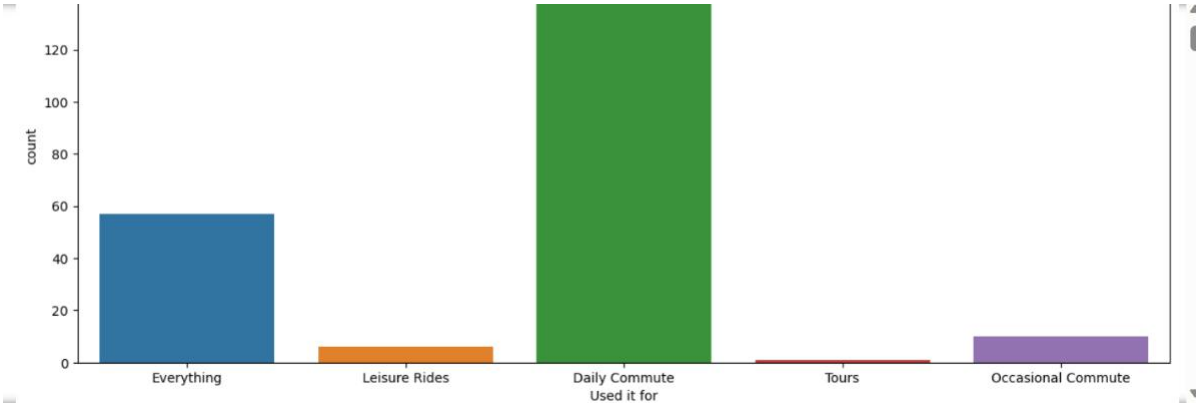

count
Fuel Economy
1.0
7.0
1.0
10.0
19.0
91.0

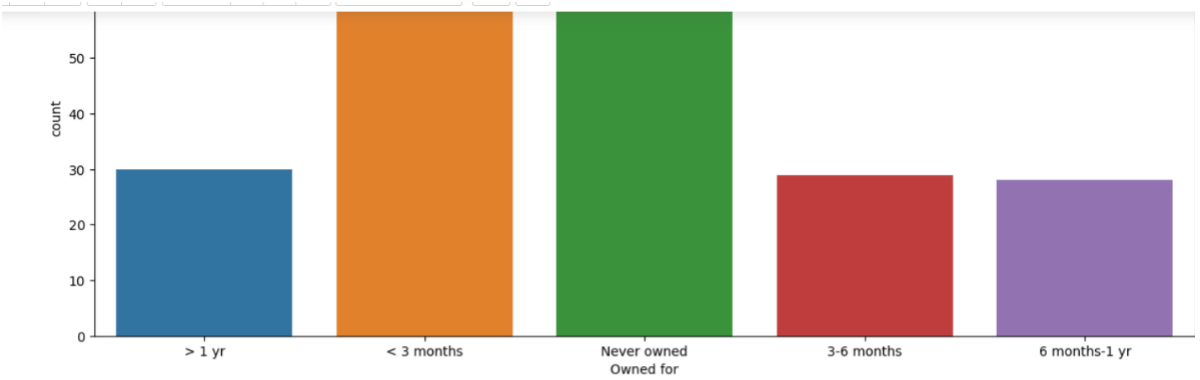


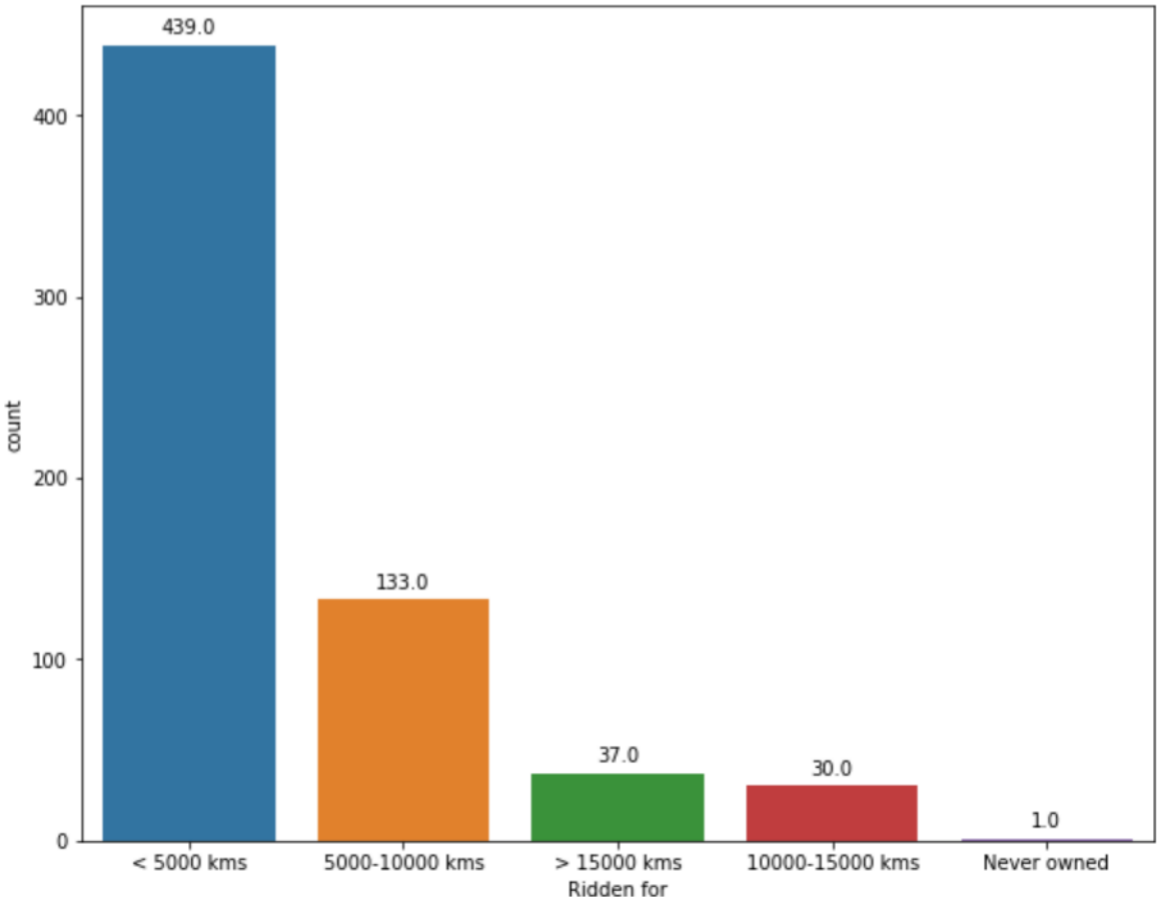
BEHAVIORAL ANALYSIS :

We can look into the behavioral aspect of users.

For **E2Ws**:

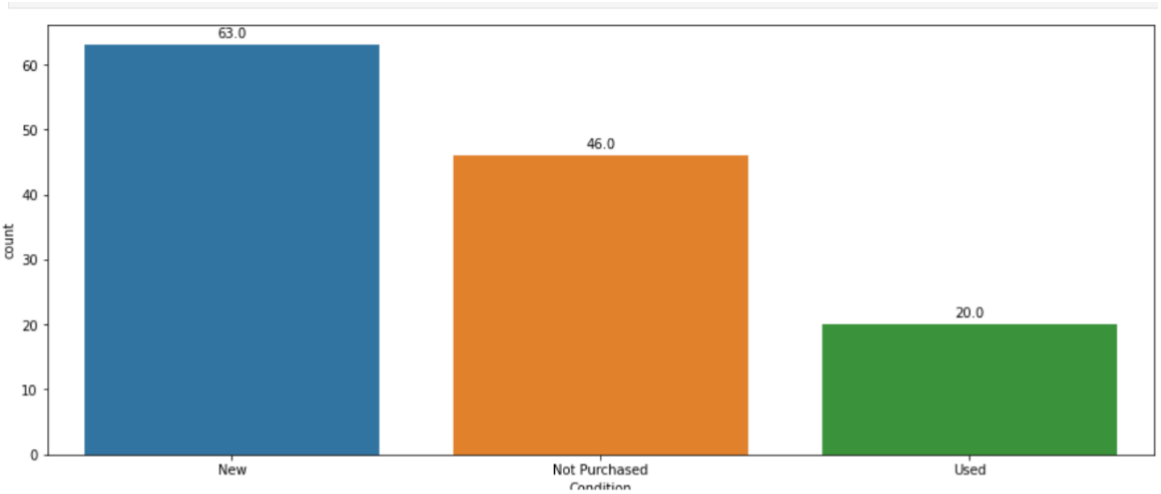


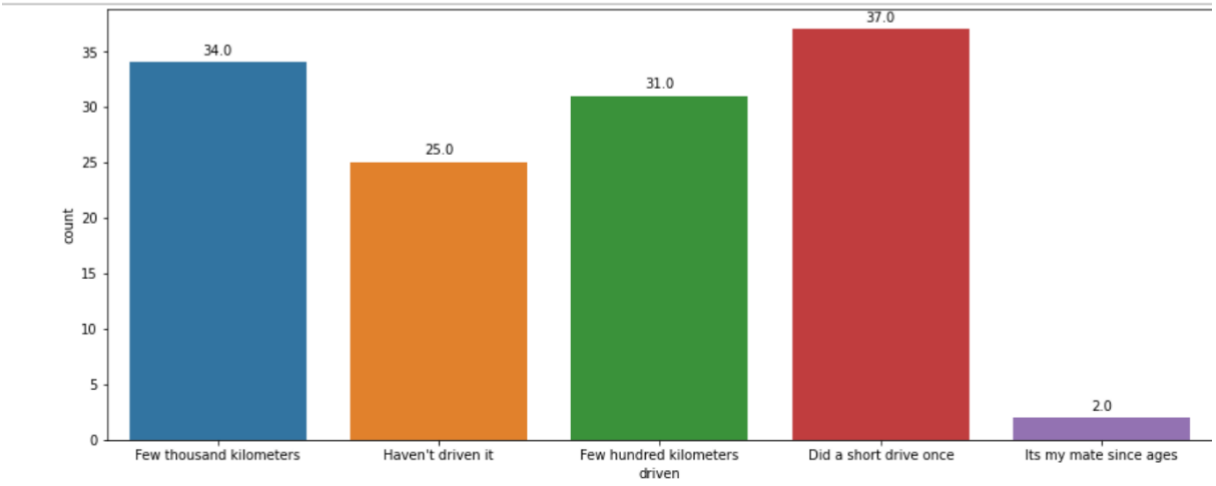




We can see that most users use E2Ws for daily commute only and many people who haven't owned an E2W also posted reviews, shows the interest of people towards EVs.

For **E4Ws**:





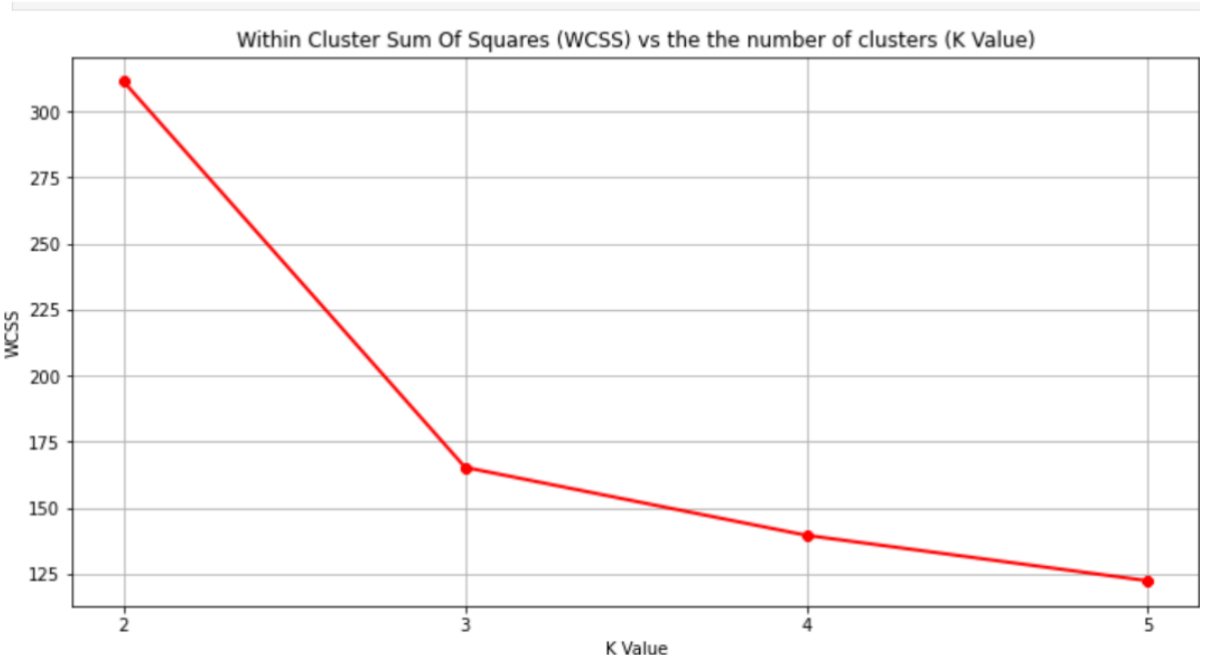
For E4W's, most people own a new EV and most of them have driven for short distances only, so no long-term review is available.

SEGEMENTATION

USING K MEANS

- For **E4Ws**:

Using Elbow method to find the optimum K value

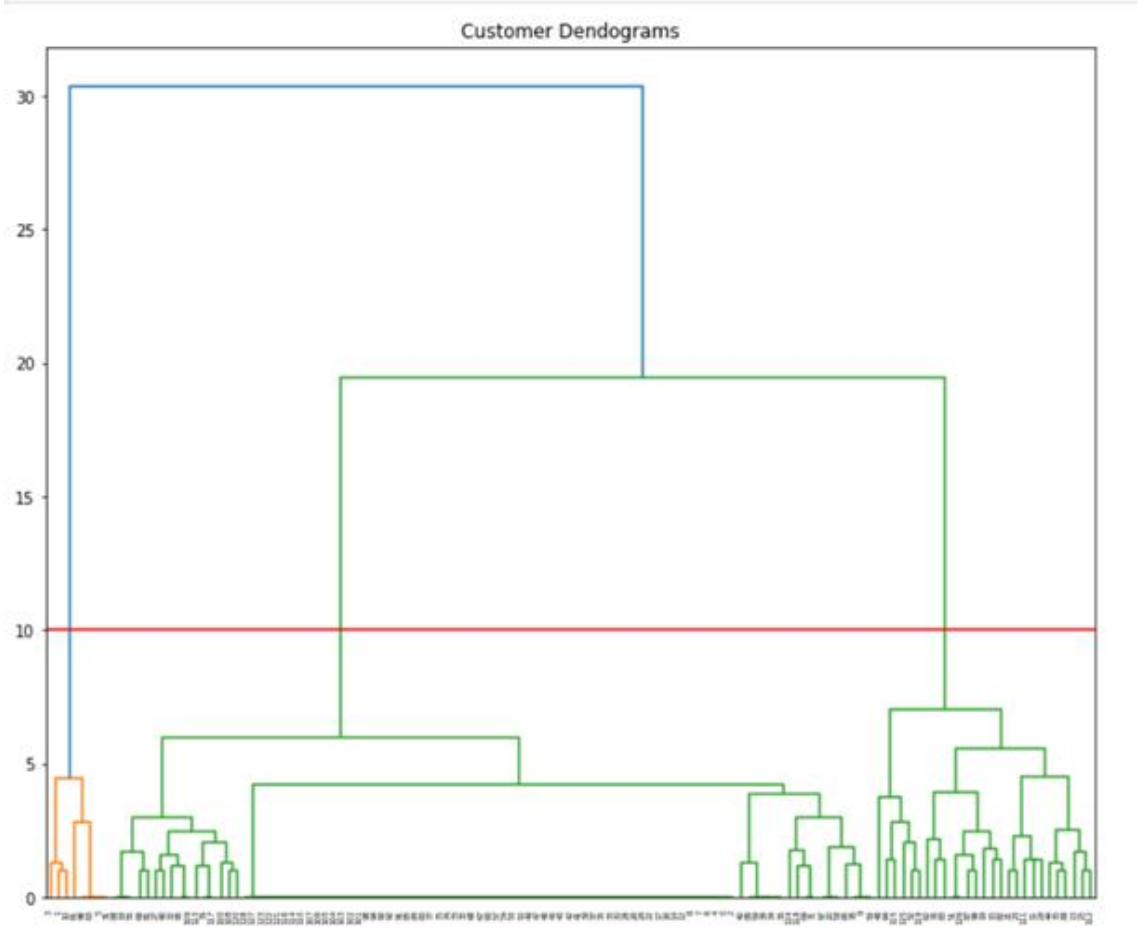


We clearly observe an elbow at k=3.

```
For n_clusters = 2 The average silhouette_score is : 0.7219919432326541
For n_clusters = 3 The average silhouette_score is : 0.6315470424676867
For n_clusters = 4 The average silhouette_score is : 0.5479325325802188
For n_clusters = 5 The average silhouette_score is : 0.5192618534553939
```

Silhouette Score also gives optimal clusters as 3.

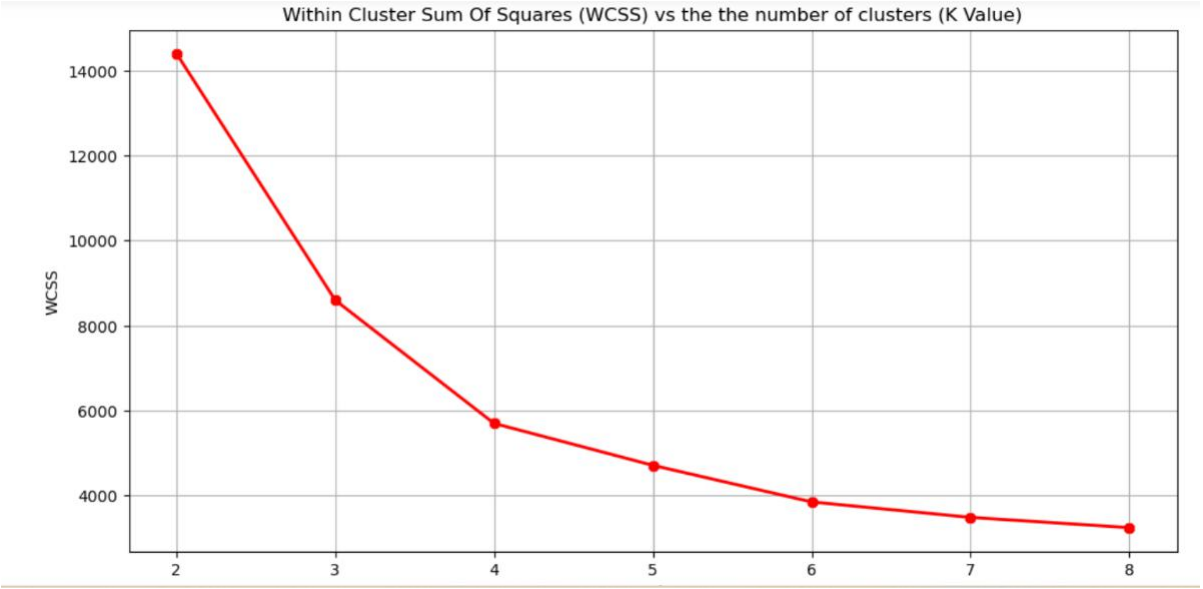
Using Dendograms:



This also gives optimal clusters as 3.

For E2Ws:

Using Elbow method to find the optimum K value.



We clearly observe an elbow at k=4.

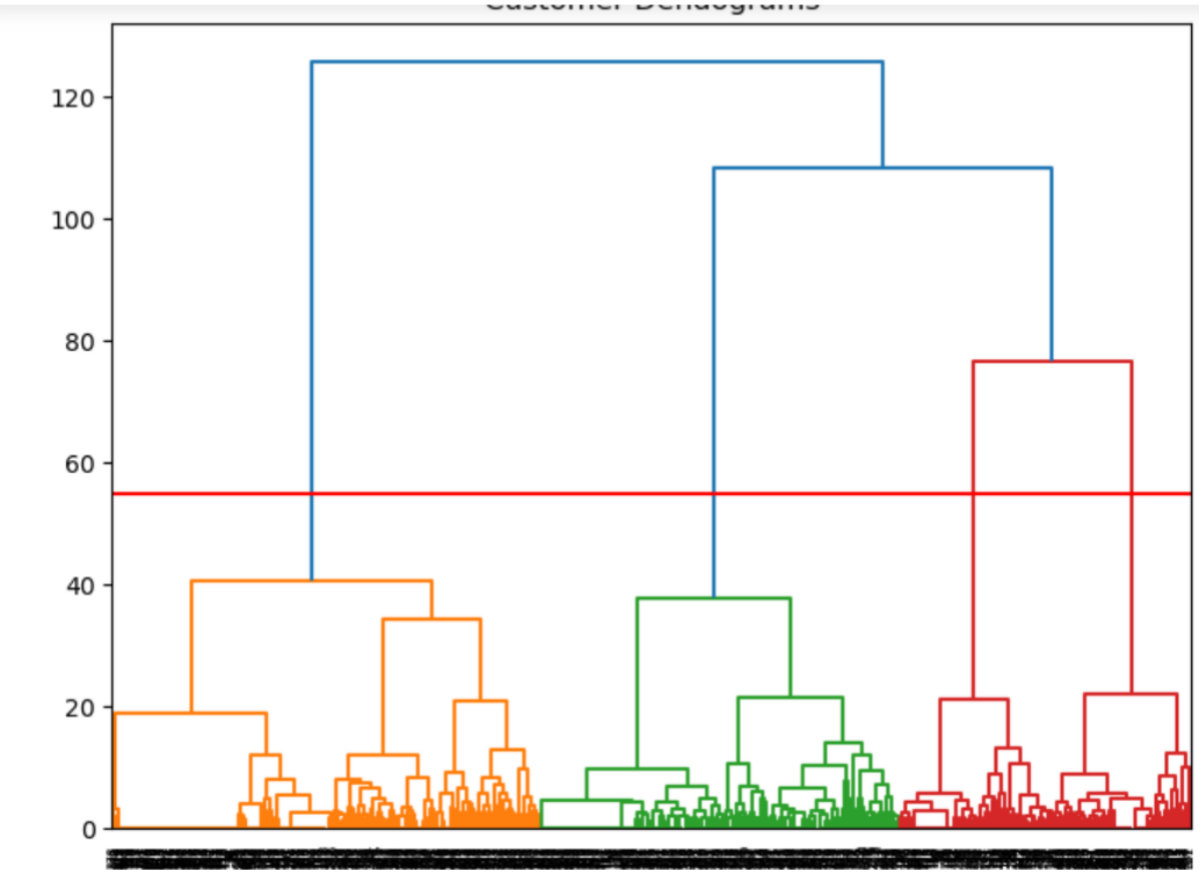
Using Silhouette Score

```
For n_clusters = 2 The average silhouette_score is : 0.3655582570314462
For n_clusters = 3 The average silhouette_score is : 0.46645212221643917
For n_clusters = 4 The average silhouette_score is : 0.5236812643763783
For n_clusters = 5 The average silhouette_score is : 0.4646784836687874
For n_clusters = 6 The average silhouette_score is : 0.4747358246318907
For n_clusters = 7 The average silhouette_score is : 0.43596922714158387
For n_clusters = 8 The average silhouette_score is : 0.41406771031700124
```

Silhouette Score also gives optimal clusters as 4.

Using Dendrograms

This also gives optimal clusters as 4



Marketing Mix

The marketing mix comprises a series of tactics used by a company to promote its brand or product in the market. It typically consists of four elements, commonly referred to as the 4Ps: Price, Product, Place, and Promotion. Each of these factors plays a crucial role in the success of a company's marketing strategy.

- **Price** refers to the monetary value assigned to a product, which depends on various factors such as the targeted market segment, the company's financial ability, the customers' purchasing power, and supply-demand dynamics.
- **Product** pertains to the actual service or product being offered and its ability to meet a minimum level of performance required to satisfy customers.
- **Place** involves the point of sale, which aims to capture customers' attention and make it convenient for them to purchase the product. A well-planned distribution strategy can greatly influence the success of a retail business, as location is often key.
- **Promotion** encompasses all activities undertaken to create awareness and generate interest in the product or service. This can include advertising, word of mouth, press coverage, incentives, trade awards, consumer schemes, direct marketing, and contests.

The four elements of the marketing mix are interrelated and impact one another. An effective marketing plan requires a thorough understanding of the market, extensive research, and consultation with various stakeholders such as customers, trade partners, and manufacturers. When executed well, the marketing mix can propel a company to great success.

Customizing the Marketing Mix

Product:

The EV market in India is dominated by compact SUVs and hatchbacks. However, there are also electric sedans and premium SUVs available in the market. Companies like Hyundai, Tata Motors, and MG Motor offer various EV models with different features, such as fast charging, connected car technology, and advanced safety features. For example, the Hyundai Kona Electric comes with a range of 452 km, fast charging capability, and advanced safety features. With the market diversified demand for different preferences, our startup needs to have a set of

products to serve all types of customers. Based on our research, existing vehicles using EV (BOV), target these vehicle spaces:

E-Rickshaw
motor-Cycl
e Moped
Car with 5 seaters or more*(data is insufficient)*

Place:

In India, the EV market is still at a nascent stage, and the infrastructure for EV charging is not yet well developed. Companies like Tata Motors and MG Motor have partnered with various entities to set up charging stations across the country. Moreover, they are also setting up their dealerships in various cities to provide a better buying experience for customers. For example, Tata Motors has partnered with Tata Power to set up a wide network of charging stations, and MG Motor has partnered with Fortum Charge & Drive India to set up 5 superfast charging stations in five cities.

For our product, we have to be informed about Government guidelines related to EV rules and regulations state-wise. We have to target states where charging stations are more/ or Govt and other entities collaborate to establish more convenient infrastructure.

From our research, based on the Number of sanctioned charging stations, people are more likely to opt for EV vehicles due to its convenience. States to focus are: Maharashtra, Andhra Pradesh, Tamil Nadu, Gujarat,Uttar Pradesh, Rajasthan, Karnataka.

Based on the average number of EV present in India, and charging stations in highways, States to focus are:

Uttar Pradesh, Maharashtra, Karnataka, Gujarat, Tamil Nadu, Bihar.

The common names from both the insights are important to target sales of our EV. They are:

Uttar Pradesh, Delhi*(It's the capital; viable to enter here too)****,***
Maharashtra, Karnataka, Rajasthan, Gujarat, Tamil Nadu

It is evident that states having lower temperatures are less likely to adopt EVs compared to above mentioned states.

Price:

A company's price strategy is influenced by factors such as competition, segment, geography, and demand. A flexible pricing strategy can be used to adjust to changes in market conditions and competitors. Two common pricing strategies are

- market-oriented pricing and
- value-based pricing.

Market-oriented pricing sets prices based on the prevailing market rates, while value-based pricing sets prices based on the perceived or actual value of the product. Companies may use value-based pricing for high-end or more expensive

products. Additionally, offering financing options at low-interest rates can help companies increase sales and profitability. From our research,

- Most EV cars are purchased by individuals aged between 30 and 40.
- Families with four members are less interested in buying cars.
- Individuals with a moderate salary level are more likely to buy EV cars.
- EV cars with medium price range are popular among buyers.

The startup needs to focus only on market-oriented pricing strategy where a certain group of customers get attracted.

Promotion:

To promote their EVs, companies in India use various marketing channels, such as advertising, social media, events, and sponsorships. For example, Tata Motors launched the Nexon EV with a TV commercial campaign featuring actor Milind Soman. Similarly, MG Motor launched the ZS EV with an online booking campaign and tied up with various celebrities to promote the brand. Moreover, companies also participate in events like Auto Expo to showcase their products and create buzz in the market.

A company like Toyota utilises various promotional tactics to market their products. They make use of traditional media platforms like newspapers, billboards, and television, as well as digital platforms like social media and websites.

Toyota also employs personal selling, where sales personnel directly promote products to potential buyers, and they use celebrities as brand ambassadors to create brand recall for customers. Additionally, they have implemented initiatives to reduce greenhouse gas emissions, which they promote to the public to enhance their public relations. Toyota's promotional strategy encompasses activities like personal selling, advertising, public relations, sales promotion, and direct selling. We have to focus on:

- Also, the sentiment of the population towards EV vehicles. For instance, the EV vehicle when it comes to personal usage is not bound to social status. But for Rickshaw to be made electric, proper communications need to be made to the public as auto drivers aren't economically independent, and are reluctant to adopt new means of transport because of fear of their current vehicle being obsolete. Some steps include:
- With coordination from government and support to those segments can be fruitful in introducing the rickshaw to the market.
- Creating awareness state-wise through celebrities like cricket players, artists to the public about EV vehicle advantages.

Github Link:

https://github.com/SatyaTheG/EV_Market_Segmentation

- Satyanarayan Sahoo
- Madhavi Parashar
- Akash Valluri
- Siddhant Pahade