EV Startup Market Segmentation

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Abstract: This project utilizes machine learning to segment the electric vehicle (EV) market for a startup. By applying clustering and predictive modeling techniques to diverse data sources including demographics, geography, and behaviour, distinct customer segments are identified. Emphasizing interpretability, the approach provides actionable insights for tailored marketing campaigns and product strategies. This enables the startup to effectively target and retain customers in the competitive EV market.

By Nirmal:

1. Introduction

The electric vehicle (EV) market is changing dramatically as the world becomes more aware of climate change and environmental issues. Electric vehicles (EVs), which run on electricity rather than traditional fossil fuels such as gasoline or diesel, are viewed as a cleaner and more sustainable way to cut carbon emissions. With breakthroughs in battery technology and government initiatives that promote greener transportation, global demand for electric vehicles has increased. Major automakers, both established brands and startups, are increasingly focusing on building a diverse range of EVs that serve to a variety of market groups, from low-cost models to luxury electric vehicles. In addition, charging infrastructure is fast developing, making it easier for consumers to embrace EVs.

In India, the EV market is beginning to grow as people become more concerned about air pollution, particularly in major cities. The government is playing an important role in encouraging more electric vehicles through initiatives such as the Faster Adoption and Manufacturing of Electric Vehicles (FAME) program. Indian automakers are also starting to create more electric vehicles, and EV charging stations are being built to make it easier for consumers to use them.

The increase in the number of electric vehicles in India has the potential to have far-reaching consequences for both the environment and the economy. By reducing its reliance on imported crude oil, India can save money on energy and minimize its exposure to global oil price changes. Furthermore, the EV industry has the potential to generate new jobs in manufacturing, R&D, battery technology, and infrastructure. As more Indian consumers become aware of the advantages of electric vehicles, such as cheaper operating costs, government incentives, and environmental benefits, the EV industry is likely to expand rapidly in the next years, influencing the country's transportation landscape.

This report aims to provide a comprehensive analysis of market segmentation within India's electric vehicle sector, identifying the most suitable type of EV to ensure the success of a new startup in this rapidly evolving market.

2. Problem Statement

The electric vehicle (EV) market in India is growing fast, and many companies are attempting to figure out how to penetrate this market. Our startup is looking for the perfect type of electric vehicle to create. To accomplish so, we need to understand the various elements that individuals consider when purchasing an EV. Price, battery capacity, driving range, charging time, and vehicle type are all important considerations. By extensively examining these features, we can determine which form of EV will appeal most to Indian consumers.

In our analysis, we focus on different sorts of electric vehicles (EVs), such as 2-wheelers, 3-wheelers, 4-wheelers and bus, to see which would be the most profitable for the organization to create. The goal is to evaluate how different vehicle types perform in terms of sales and market trends in order to make an informed judgment about which EV sector has the most potential for growth. This research will also focus on essential criteria like as price, battery capacity, drive range, power, charge time, top speed, body type, and category, allowing us to adequately analyse each type of EV to make a rigid decision.

This research is critical for developing a strategy that will maximize the startup's success. By focusing on the most profitable EV type, the business may enter the market with a product that not only meets demand but also allows the company to develop and compete more effectively. This data-driven approach ensures that resources are allocated efficiently and that the firm meets its financial and business objectives.

3. Sales Report

The sales report was created to analyse the performance of various electric cars (EVs) in the Indian market from 2017 to 2024. The report examines sales patterns for two-wheelers, three-wheelers, four-wheelers, and electric buses across time. This analysis is crucial for determining which category of EVs has experienced the highest growth and may be the most profitable for the firm to invest in.

The 2-wheeler segment has consistently dominated the market (Fig 1), accounting for more than 2 million sales and being the largest by volume. This suggests that two-wheelers are in high demand in India due to their low cost and convenience for urban commuting. In contrast, the 4-wheeler segment, although growing steadily, shows lower sales figures, with around 209,000 units sold. This reflects the relatively higher price point and different consumer base for electric cars compared to 2-wheelers.

The report also shows significant growth in the 3-wheeler market, with sales approaching 2 million units, owing mostly to commercial and last-mile transportation demands. Buses, although being the smallest category, have had a consistent growth in sales, indicating a growing interest in electrifying public transit. This extensive sales study will help the organization decide on the most profitable EV type to create and market.

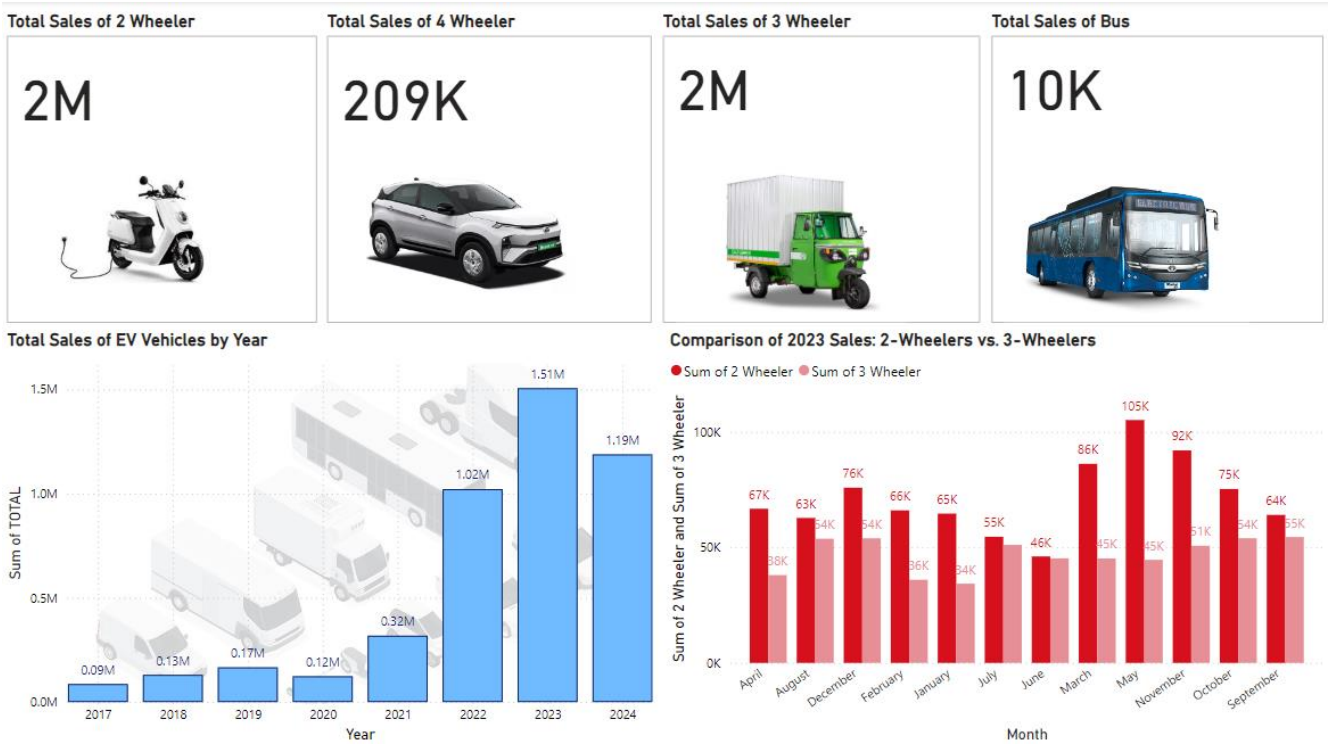


Fig 1. Total units sold until August 2024

There was a consistent increase in the sales from 2017 but declined steadily by 2020. However, there was a significant growth afterwards, with year 2023 recording the highest sales across all the years.

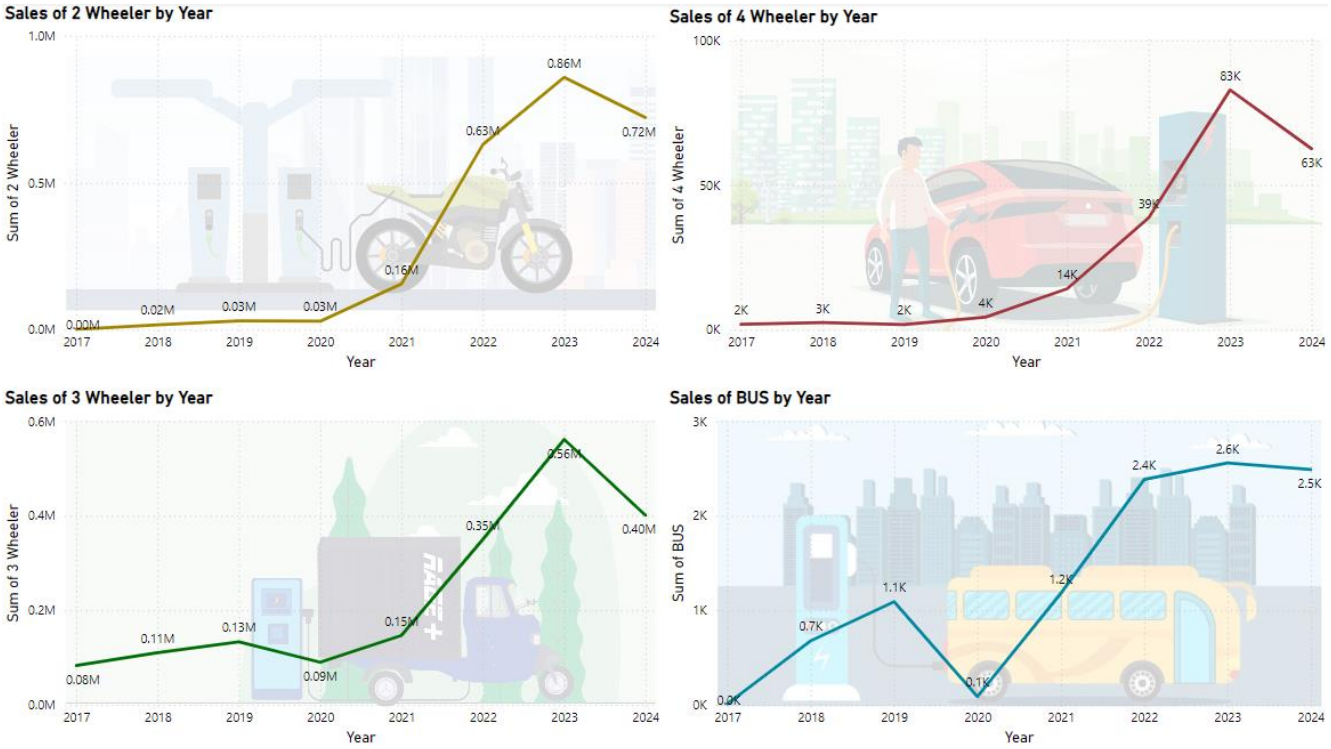


Fig 2. Sales of each electric vehicle by year

From Fig 2, we observe detailed sales trends for different electric vehicle types—2-wheelers, 4-wheelers, 3-wheelers, and buses—by year, providing significant insights into the Indian EV market.

2-Wheeler Sales: The figure shows a substantial increase in 2-wheeler sales beginning in 2020 and peaking in 2023 at 860000 units. This upward trend indicates rising demand for affordable and efficient modes of transportation, particularly in cities.

4-Wheeler Sales: The 4-wheeler segment had consistent development, with sales rising from 2,000 units in 2017 to a high of 83,000 in 2023. This suggests an expanding but still specialized sector in which electric vehicles are gaining traction at a slower rate than two-wheelers.

3-Wheeler Sales: Sales of electric 3-wheelers have increased significantly, particularly since 2021, peaking at 560000 units in 2023. This growth demonstrates the appeal of three-wheelers for business purposes, particularly in logistics and urban transportation.

Bus Sales: While still the smallest market, electric buses have showed consistent growth, reaching 2.6 thousand units in 2023. This points to a sluggish but steady adoption of electric buses for public transportation systems.

From overall report, it can be understood where the highest demand lies. With these figures, startups will now get a small glimpse into which EV type has the greatest market potential. In the further analysis, we will determine the optimal specifications that the vehicle's features should possess, supporting startups business goals effectively.

4. Vehicle Segmentation

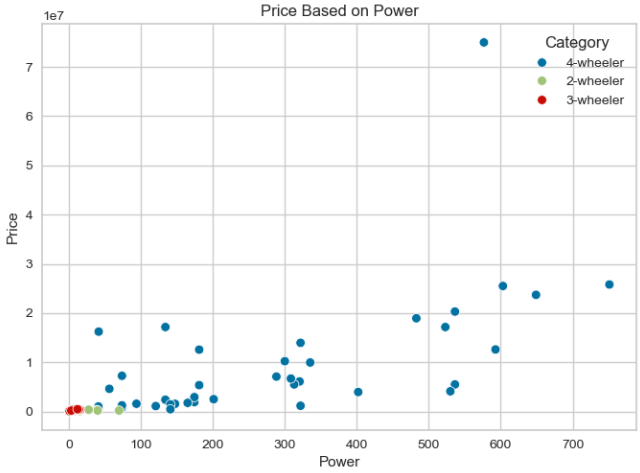
In this section, we will derive insights into sensible specifications that a startup company can consider to achieve their desired goals. This analysis was conducted using Scatterplots, Principal Component Analysis (PCA) and K-Means clustering algorithm. Furthermore, we analysed customer feedback to learn about their disappointments and find areas for improvement. This method will help us solve these difficulties and improve the products, resulting in more profitable outcomes.

Our dataset has 118 observations and includes variables such as Model Name, Price, Battery Capacity, Drive Range, Power, Charge Time, Top Speed, Body Type, and Category. It focuses primarily on two-, three-, and four-wheelers, eliminating electric buses because they are unprofitable, as seen by continually low sales since 2017 (Fig 2). Bus production requires a high level of investment, making it a less viable option for entrepreneurs.

4.1. Exploratory Data Analysis

Key attributes such drive range, power, battery capacity, and charge time were taken into account, and a scatter plot was generated to assess their relationship to car prices. Many 4-wheelers are typically very expensive, ranging from 10 lakhs to 70 lakhs, as compared to other 2 categories (Fig 3) and have a greater driving range, power, battery capacity, and longer charge times.


Price Based on Drive Range
1e7
Category
4-wheeler
2-wheeler
3-wheeler
Price
Drive Range
0
1
2
3
4
5
6
7
100
200
300
400
500
600
700
800


Price Based on Power
1e7
Category
4-wheeler
2-wheeler
3-wheeler
Price
Power
0
1
2
3
4
5
6
7
0
100
200
300
400
500
600
700

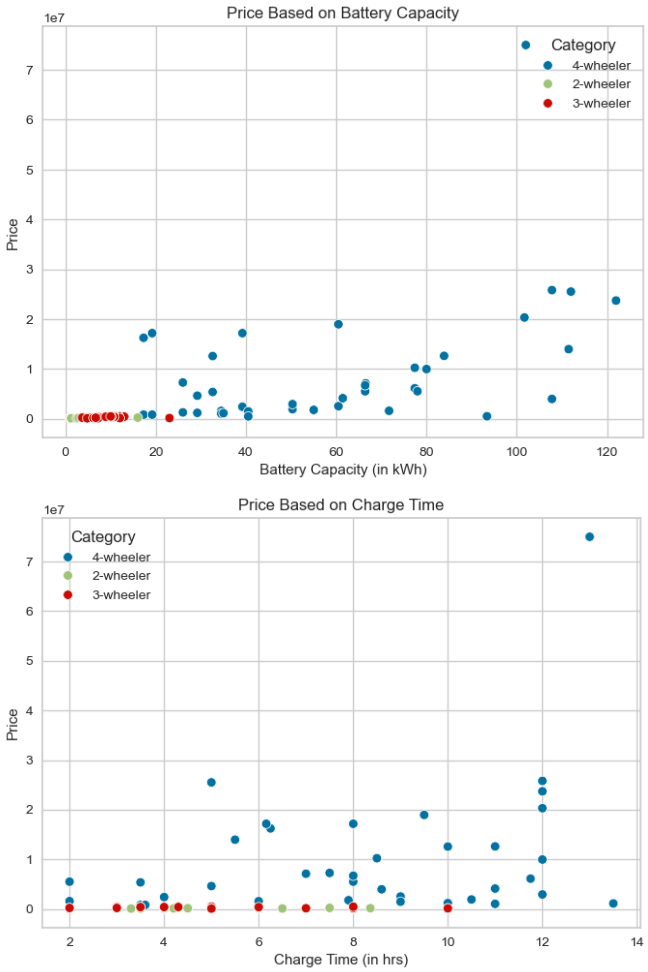


Fig 3. Relationship between price and other specific features based on EV categories

2-wheelers and 3-wheelers are clustered at the lower end of price and other attributes except for charge time. This indicates that they have generally lower driving range below 300 km and lower price than 4-wheelers, under 1 million, which is 10 lakhs. The average price of a 4-wheeler is Rs. 94,55,940 in India. 2-wheelers are the cheapest with average price being Rs. 1,09,853 while 3-wheelers being marginally higher at Rs. 2,61,250. There are a few vehicles from 3-wheeler and 2-wheeler categories that require longer time for charging as seen in the 4th graph.

4.2. Principal Component Analysis

In this, we have removed certain irrelevant features because they play no role in deciding the optimal specifications we target for. A subset of features we chose for PCA are Price, Battery Capacity, Drive Range, Power, Charge Time, and Top Speed.

We apply PCA after preprocessing the data using StandardScaler which is used to scale the features on a common range, from 0 to 1. The final output is given in Fig 4.

	Standard deviation	Proportion of Variance	Cumulative Proportion
PC1	2.24	0.71	0.71
PC2	0.83	0.10	0.81
PC3	0.78	0.09	0.90
PC4	0.62	0.05	0.95
PC5	0.38	0.02	0.97
PC6	0.35	0.02	0.99
PC7	0.30	0.01	1.00

Fig 4. PCA results

Results from principal components analysis indicate that the first three components capture 90% of the variance in the data. The loadings indicate how the original variables are combined to form principal components. Loadings guide the interpretation of principal components. In our example, the two segmentation variables with the highest loadings (in absolute terms) for principal component 3 are Charge time and Price (Fig 5).

	PC1	PC2	PC3	PC4	PC5	PC6	PC7
feature							
Price	0.33	0.46	0.64	0.41	0.17	-0.24	-0.15
Battery_Capacity	0.41	-0.09	0.12	-0.41	-0.07	-0.45	0.66
Drive_Range	0.41	-0.21	-0.11	-0.43	0.35	-0.22	-0.65
Power (in bhp)	0.41	0.11	0.17	-0.24	-0.69	0.47	-0.18
Charge_Time (in hrs)	0.29	0.67	-0.67	0.07	0.07	0.01	0.08
Top_Speed	0.41	-0.26	0.03	0.18	0.50	0.63	0.29
Category	-0.36	0.46	0.29	-0.62	0.33	0.29	0.07

Fig 5. Factor loadings

Charge Time and Price are two important attributes that influence the overall composition of EV features. Specifically, these two features show strong associations in the data, indicating that they are critical for determining the market direction. EVs with competitive pricing and short charging times may have a great market appeal in the company's future product plan. These data can help guide product development, ensuring that the chosen EV type is in line with industry trends and maximizes profit potential.

4.3. K-means Clustering

In K-means clustering, we generally plot clusters based on 2 criteria, Elbow method and Silhouette analysis to determine optimal number of clusters. Applying both techniques relatively indicate that 3 clusters are appropriate.

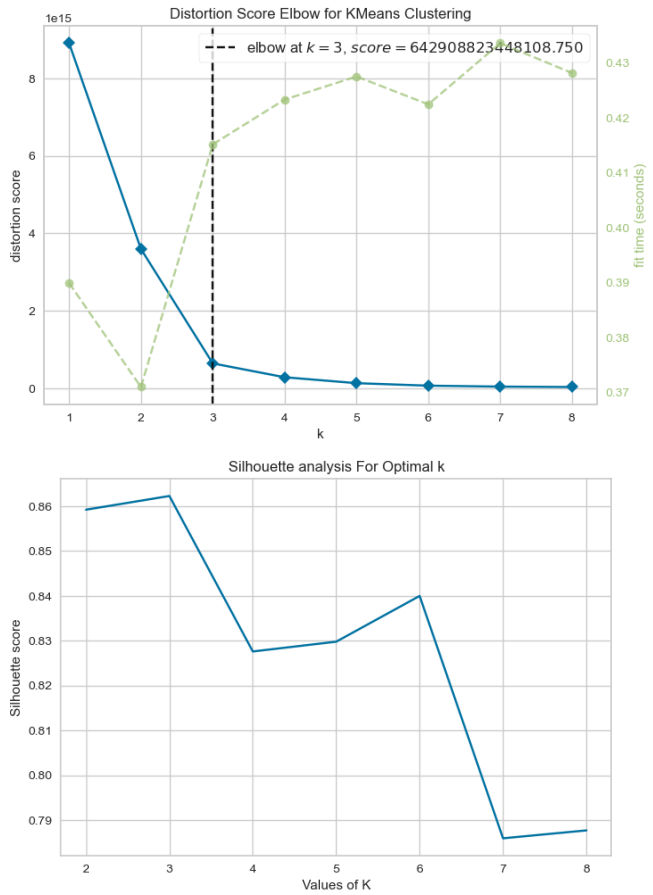
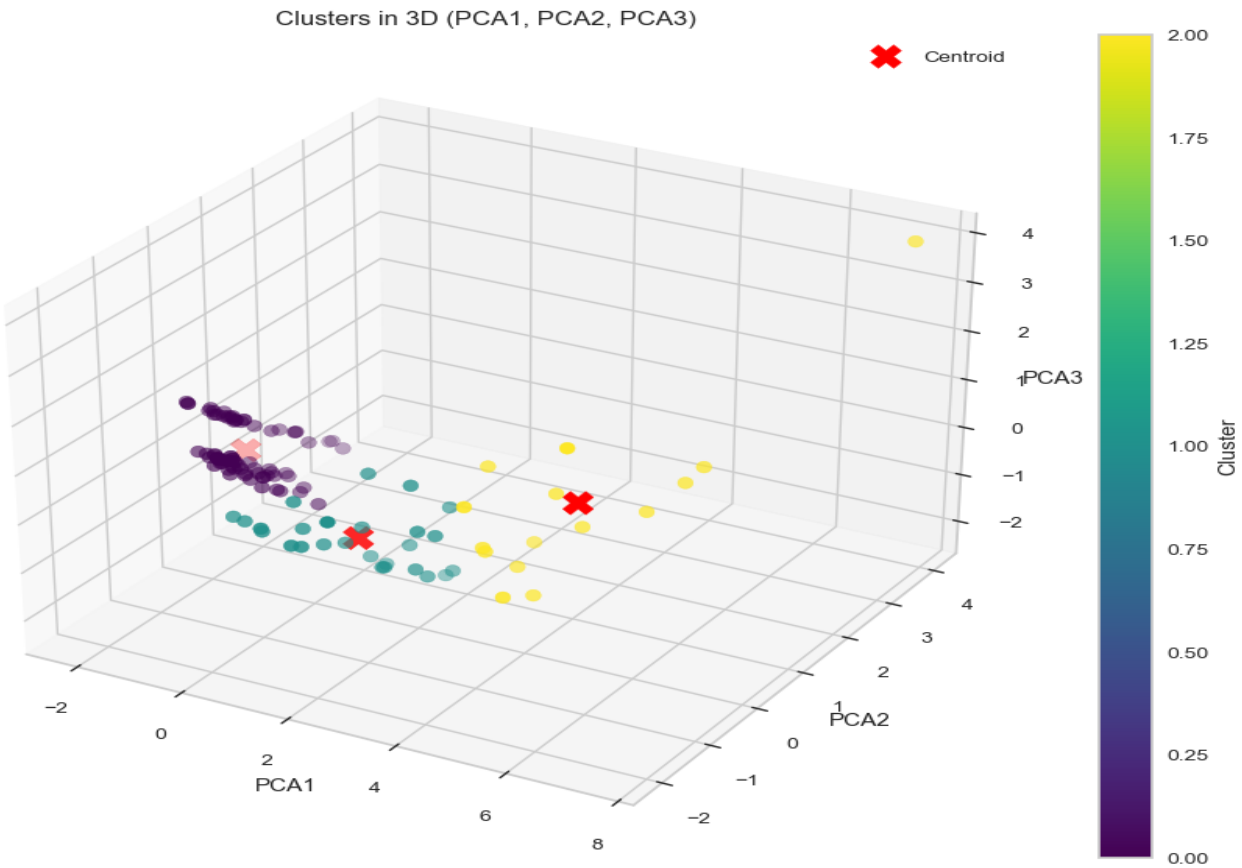


Fig 6. Cluster validation techniques

In our case (Fig 6), the distortion score was really high, therefore we decided to do a silhouette analysis to determine whether employing three clusters is adequate. Silhouette score is very high for k= 3, suggesting that the data points are well-clustered. Therefore, we choose 3 clusters in the end.



Cluster	Price	Battery_Capacity	Drive_Range	Power (in bhp)	Charge_Time (in hrs)	Top_Speed	Category
0	167668	5	119	6	5	55	2
1	4064654	42	378	143	7	160	1
2	18183776	87	577	497	10	223	1

Fig 7. Cluster analysis using K-means

As we can see the summary of our analysis in Fig 7, all clusters are distinct. However, clusters 1 and 2 provide data for 4-wheeler but other specifications vary between the two clusters. Cluster 0 entails data about specifications for 2-wheeler.

From our summary, it is obvious that 4-wheelers are more expensive than 2-wheelers with higher specifications. While 2-wheelers tend to be more affordable. Based on the factor loadings shown in Fig 5, Charge Time and Price are the most important aspects to consider. As a result, we can choose two-wheeler that is reasonably priced and has a shorter charge time as compared to 4-wheeler that is highly priced and has longer charge times. The initial price for 2-wheeler is set at Rs. 1,67,668, which seems to be fair and reasonable and the charging time for a full charge is 5 hours as observed in Fig 7.

In conclusion, startups should prioritize manufacturing 2-wheelers over 4-wheelers. Because two-wheelers are becoming increasingly popular in many regions due to their low cost, fuel efficiency, and convenience of use in urban areas. In addition to that, they are also ideal for city commuting, which might be a substantial market niche.

5. Sentiment Analysis

We've now determined the type of car that entrepreneurs should focus on developing. Moving onto next step which is analysis of past customer feedback, generally called as Sentiment Analysis. By evaluating previous customer feedback, we could identify weaker areas and make improvements to ensure startups give high-quality service to their clients. We used mosaic plots and bar charts to delve deeper into features people were dissatisfied with. More importantly, we leveraged word cloud to gain insights into the concepts that faced the most criticism.

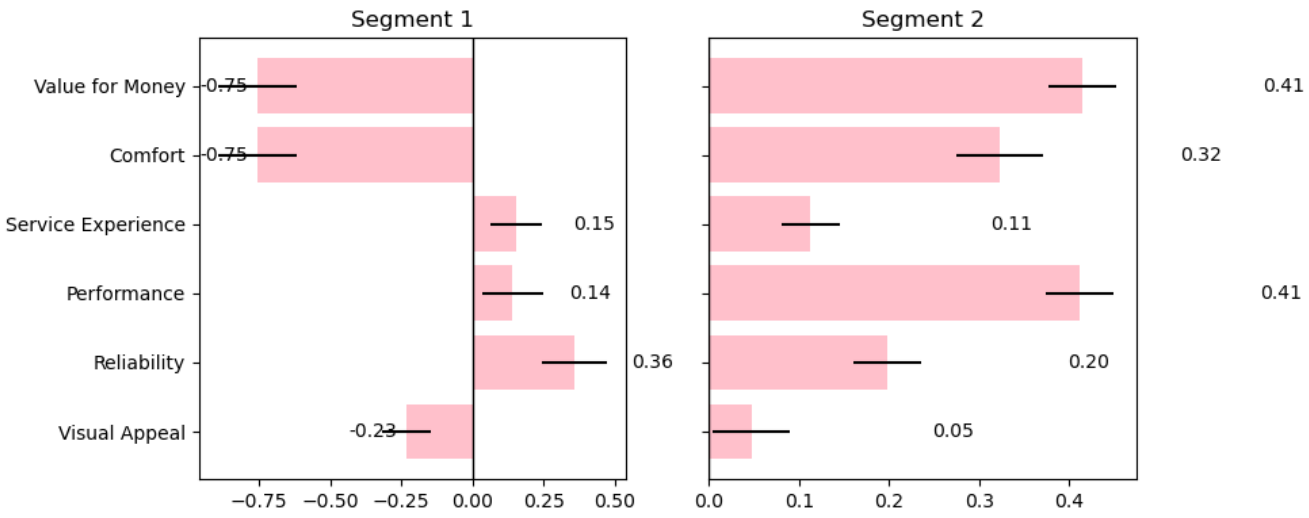


Fig 8. Regression coefficients of the two-segment mixture of linear regression models for 2-wheeler dataset

From Fig 8, Members of Segment 1 favored 2-wheeler for its service experience, performance, and reliability, but they are less impressed by aspects such as value for money, comfort, and visual appeal. In contrast, members of Segment 2 value 2-wheeler for their value for money, comfort, service experience, performance, reliability, and visual appeal.

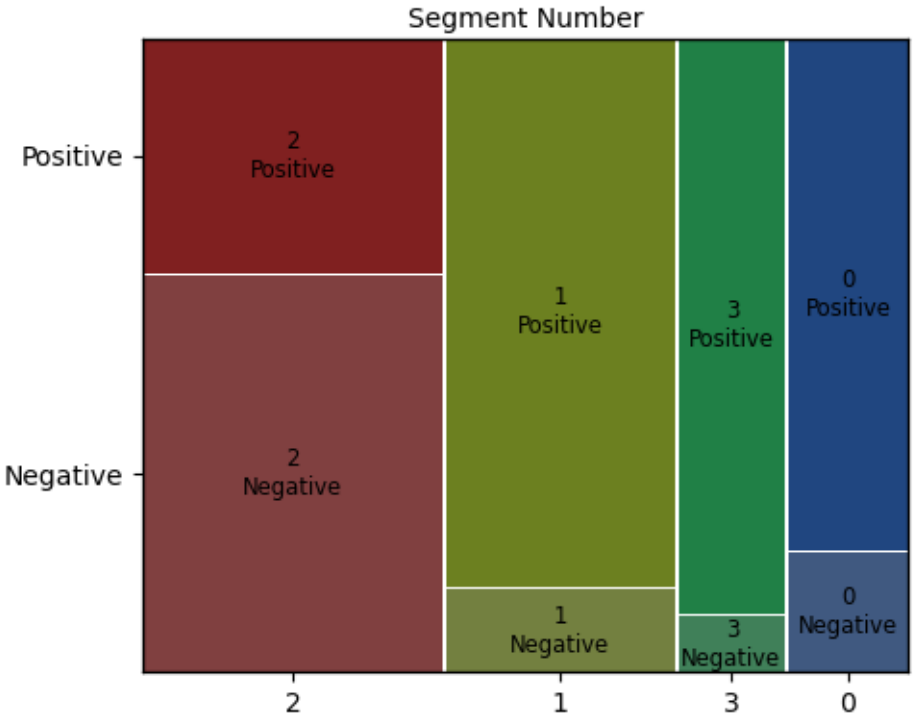
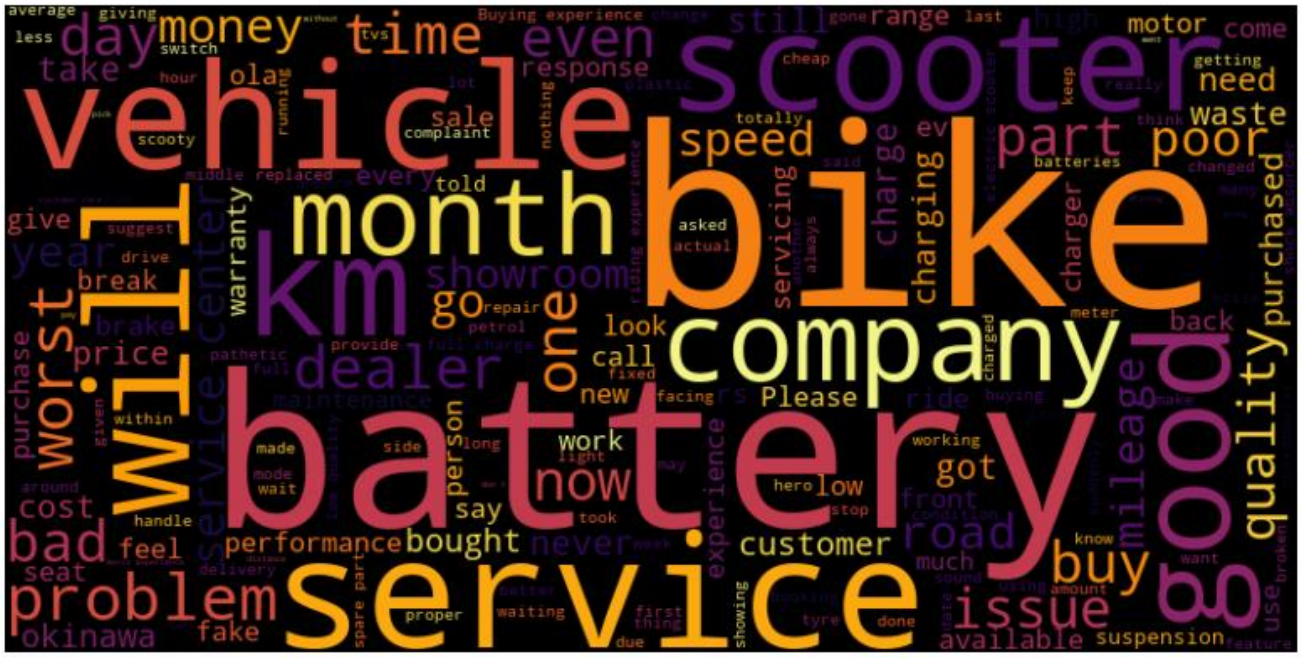


Fig 9. Positive/Negative Comments based on segment number

Most members of segment 2 have negative reaction towards their purchase of 2-wheeler as seen in Fig 9. They might not have liked the quality, performance or other factors. Understanding people's preferences, behaviour, and interests is critical for maintaining efficient business operations.



This word cloud has been created over negative reviews solely. From the visual, we can make out that majority of the people were dissatisfied with service of their dealers, followed by battery, company and vehicle itself. To guarantee seamless business operations for startups, it is crucial to emphasize improving dealer relationships and providing adequate customer support. Furthermore, addressing concerns about battery performance and vehicle quality will help build confidence and consumer loyalty, resulting in long-term market success.

6. Marketing Mix

The Marketing Mix, also known as the 4Ps (Product, Price, Place, and Promotion), is a key framework used by businesses to develop and implement efficient marketing strategies. These components are critical in determining how a product fits customer wants, reaches its target market, and provides value for the business.

This section of the report on marketing mix analysis for the electric vehicle industry focuses on how each of the four Ps can be customized for various market segments. We divided the market into segments according to vehicle characteristics using K-means clustering. With this strategy, we will be able to match the marketing mix to the most promising customer groups, which will direct company's strategic choices about product development, price, and market placement.

6.1 Product

The product should be 2-wheeler, as this segment shows low cost and might be suitable for urban commuting. Key features include:

- Charge time: Aim for a charging time of 4-5 hours to ensure convenience.
- Drive Range: Offer a more satisfying drive range of 119 km per charge, meeting weekly needs of urban consumers.
- Power: Offer 6 bhp which is ideal for lightweight vehicles like scooters or bikes designed for urban commuting.
- Top Speed: A top speed of 55 km/h is more reasonable for city driving.
- Battery Capacity: Battery capacity of 5 kWh best aligns with the characteristics of a budget-friendly 2-wheeler, focusing on energy efficiency and cost-effectiveness.

6.2 Price

The price is significantly lower around Rs. 1,67,668 than in the other clusters, which reflects the focus on affordability. This pricing strategy is essential for breaking into the mass market, particularly in developing nations like India where people are on a budget and searching for less expensive mobility options.

6.3 Place

The distribution strategy (Place) for these two-wheelers might target urban areas, small towns, and locations with a high demand for low-cost electric cars. A focus on places with existing EV infrastructure, like as charging stations, would be beneficial, particularly in densely populated cities where commuting is common.

6.4 Promotion

Promotion methods should emphasize the low cost of ownership, environmental friendliness, and practical benefits of electric two-wheelers, such as ease of usage in congested urban settings. Key promotional strategies include:

- Paid advertising
- Content marketing
- Sponsorships
- Referral marketing

- Coupons and deals

7. Conclusion

In conclusion, the rapidly expanding electric vehicle (EV) industry in India represents a big opportunity for startup firms. After doing a thorough review of sales statistics, customer sentiment, and marketing methods, we determined that 2-wheelers are the most promising industry for their organization to focus on.

The sales data reveals 2-wheelers have the biggest number of sales in the market, demonstrating significant demand due to their low cost and convenience for urban transportation. Despite the increasing expansion of three- and four-wheelers, two-wheelers remain the most lucrative alternative due to their low cost and great demand. Our marketing mix strategy suggests promoting two-wheelers as economical, efficient, and environmentally friendly alternatives suitable for urban contexts. Startups can efficiently reach their target market and enhance their success by focusing on places with current EV infrastructure and implementing a variety of promotional strategies.

Overall, focusing on 2-wheelers with the recommended features and price strategy will allow startup companies to enter the market with a competitive product that fits consumer needs and is consistent with their company objectives.

By Anjali:

PROBLEM STATEMENT

Question :

Based on Markey Analysis, the entire segmentation problem boils down to Two main Questions :

1. What type of EV the company will produce?

2. Who are the target customer?

In this case I am specifically looking into the 2 wheeler EV market as it is much bigger and more dynamic market comparatively. Thus, I look for What type of EV 2 Wheelers a EV 2 Wheeler company should focus it's resources on.

Approach :

Task is to analyse 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 Behavioural. In this report I have analysed the 2 Wheeler Electric Vehicles Market in India using segmentation analysis and tried to answer some of the crucial questions. Along with that, I have also performed Segmentation on customers and their Income Data. The Segmentation is Done using PCA and K-Means clustering and Hierarchical Clustering is also shown. At the end the possible segments to choose for such an EV company, are evaluated based of selected features.

DATA COLLECTION :

Both the Demographic dataset and EV bikes dataset are collected from https://www.kaggle.com/

The bikes dataset needed to be modified to add some missing values like products from Popular brands.

In this part I show the methods taken to do a demographic segmentation on the Dataset. But first some Exploratory Data Analysis is performed. 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.

BEHAVIOURAL SEGMENTATION :

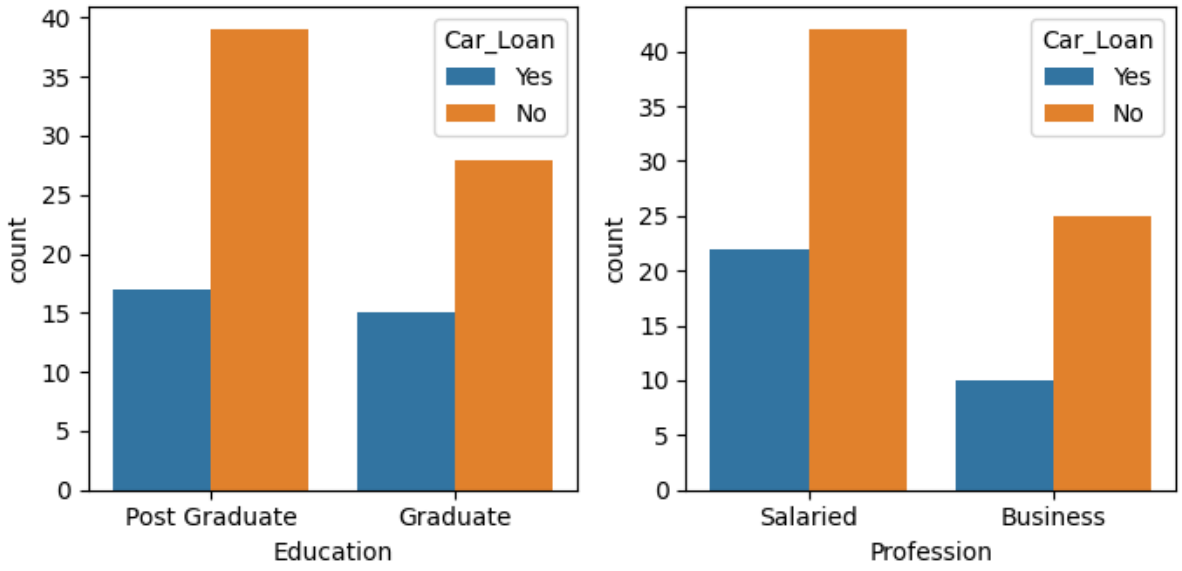
In this part I show the methods taken to do a demographic segmentation on the Dataset. But first some Exploratory Data Analysis is performed. An Exploratory Data Analysis or EDA is a thorough examination meant to uncover the underlying structure of a data set and is important

for a company because it exposes trends, patterns, and relationships that are not readily apparent. Exploratory Data Analysis.

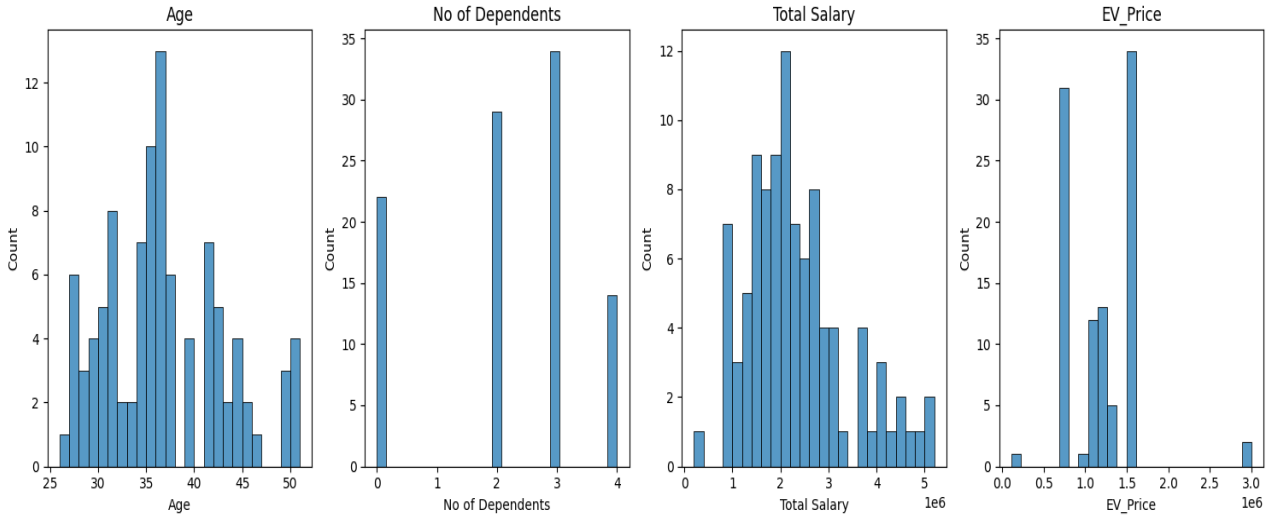
The Dataset –

	Age	Profession	Marrital Status	Education	No of Dependents	Car_Loan	Total Salary	EV_Price
0	27	Salaried	Single	Post Graduate	0	Yes	800000	800000
1	35	Salaried	Married	Post Graduate	2	Yes	2000000	1000000
2	45	Business	Married	Graduate	4	Yes	1800000	1200000
3	41	Business	Married	Post Graduate	3	No	2200000	1200000
4	31	Salaried	Married	Post Graduate	2	Yes	2600000	1600000

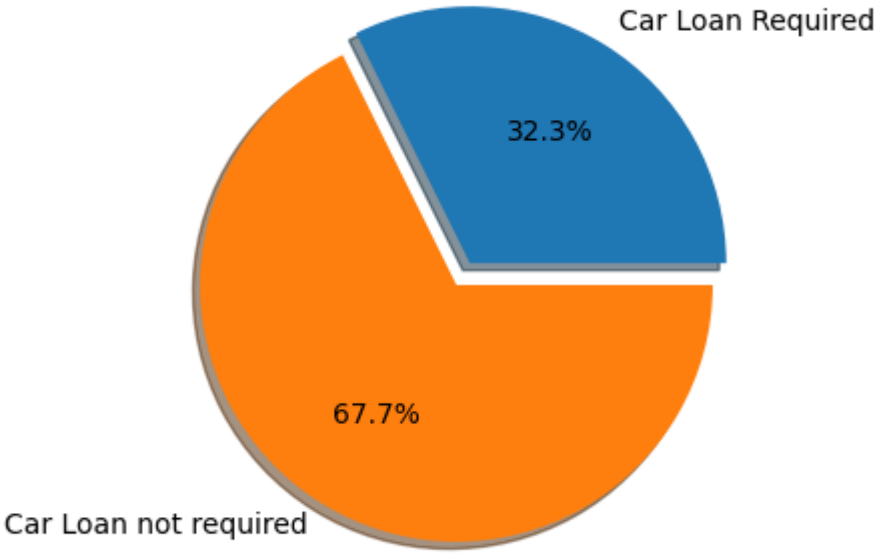
Count plots are used to show categorical features like Profession, Education, etc. and how many of them take Loan to buy EV.



Several Count plots are used to do Univariate Analysis on numerical data.



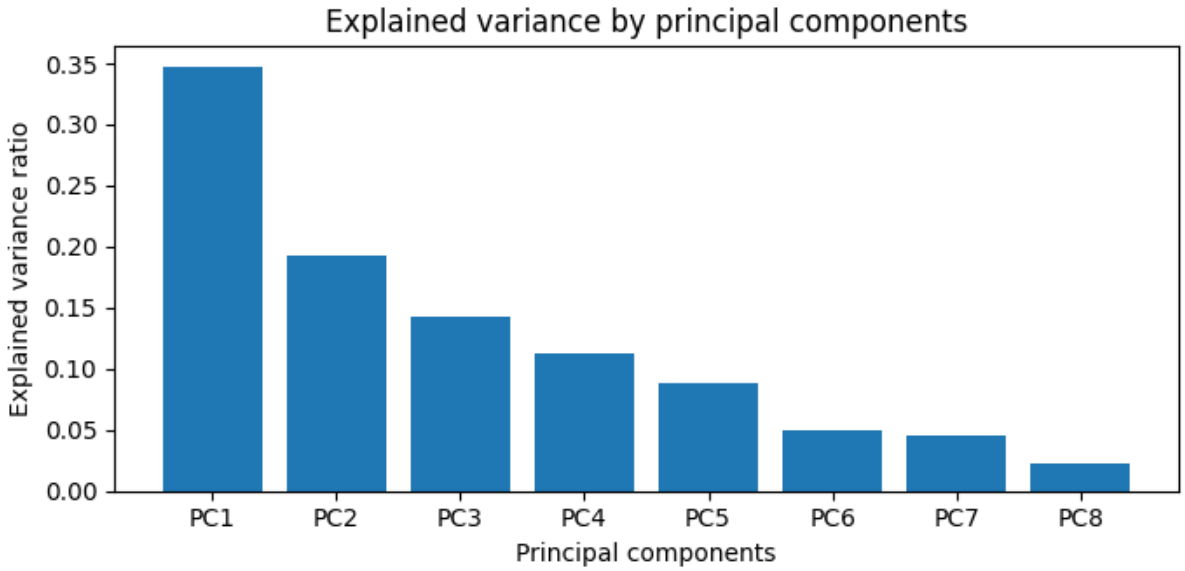
A data to show percentage of candidates taking loan, which might be useful for purchase options using EMI and other options given by the company.

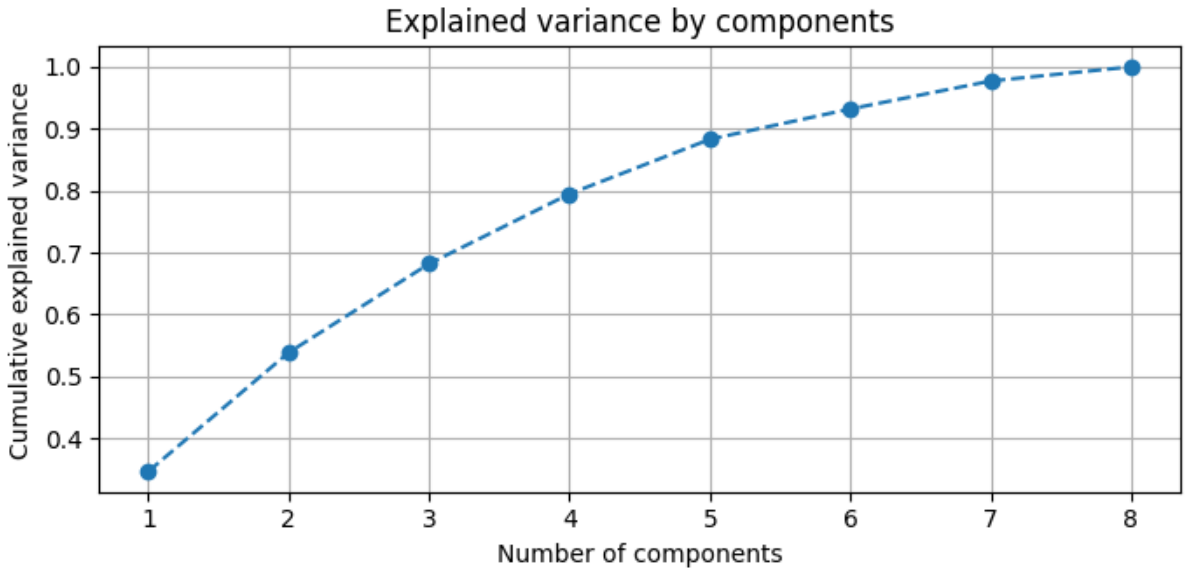


Principal Component Analysis :

Before Clustering the datapoints I have shown the correlation matrix where the dataset showing interdependency between features.

The data are preprocessed using Standard Scalar class in ScikitLearn and I proceed for PCA to extract the independent components and less than the number of features for which most of the information is intact i.e the explained variance.

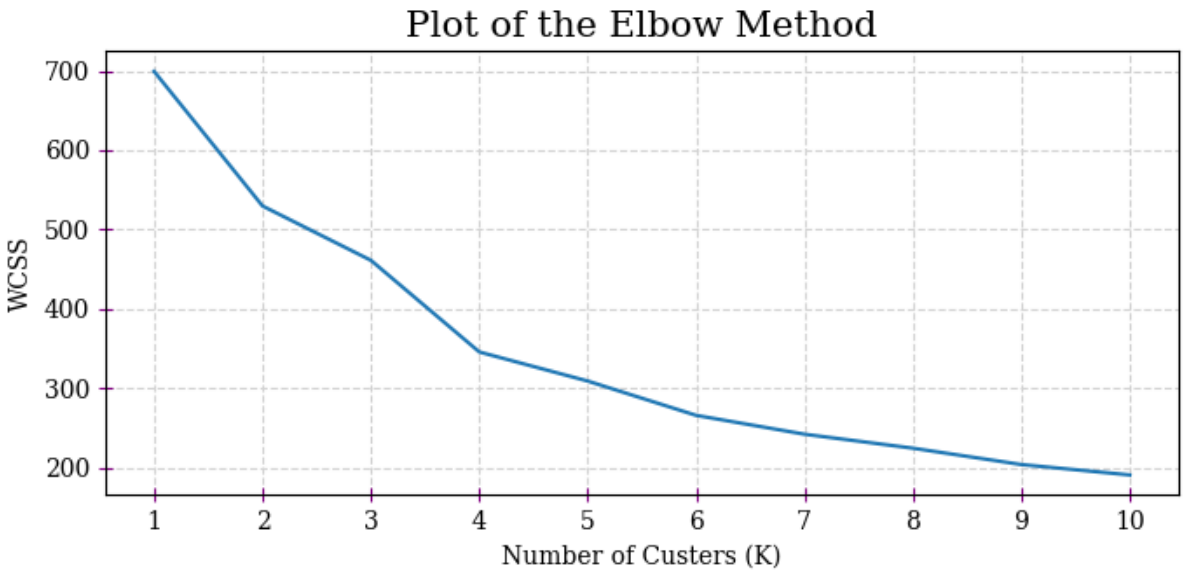




It is obvious from the PCA analysis by taking all the features that only 5 components explain more than 90% of the variance.

K-Means Clustering :

Now I performed K-means clustering for different number of clusters and plot the Elbow curve to determine the number of clusters, as the algorithm needs the number of clusters to be given as an input. One point to note that I have used “k-means++”. Only difference from normal one is that it initialises the clusters smartly rather than randomly in normal k-means.



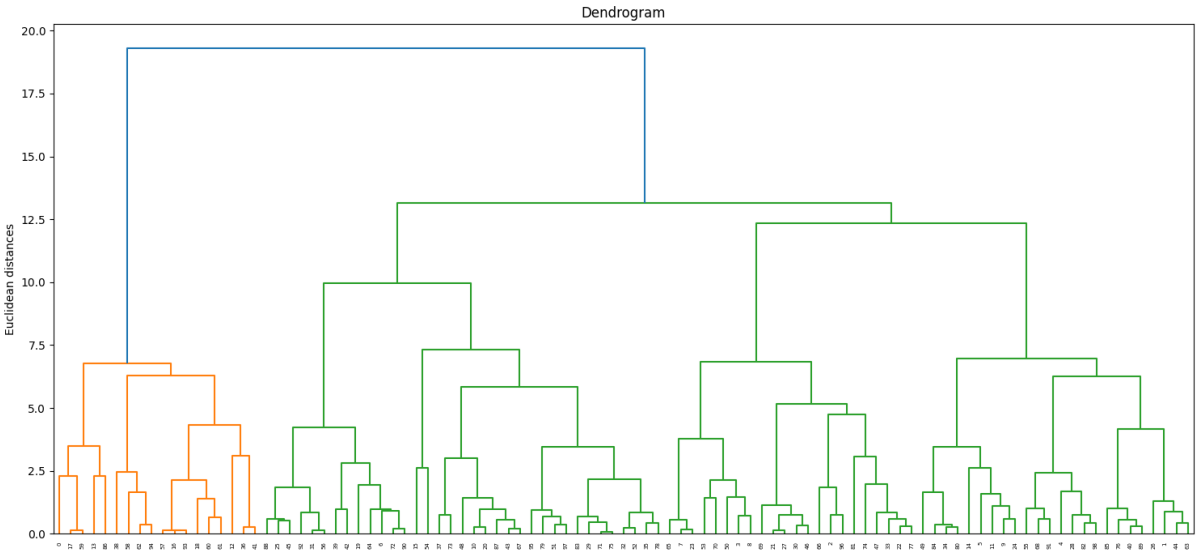
According to the Elbow curve I have chosen 4 clusters to preform K-Means. The clusters are shown in the plot(First vs Last principal components).

The standard deviations and rotations for each principal components are shown below.

```
Standard deviations:
[1.7 1.2 1.1 1.  0.8]
Rotation matrix:
                      PC1  PC2  PC3  PC4  PC5
Age                   0.5  0.1  0.0  0.1  0.2
Profession           -0.1  0.3  0.7  0.4  0.5
Marrital Status       0.4  0.3  0.0  0.0 -0.4
Education             0.1 -0.2 -0.6  0.8  0.1
No of Dependents      0.4  0.5 -0.0  0.2 -0.2
Car_Loan             -0.1  0.5 -0.4 -0.3  0.6
Total Salary          0.5 -0.3 -0.0 -0.2  0.3
EV_Price              0.4 -0.5  0.2 -0.1  0.3
```

Hierarchical Clustering :

A similar hierarchical clustering is also performed which shows 2 different components, shown in the Dendrogram.



Making Predictions :

In this subsection I try to answer the questions that posed initially, by selecting target clusters which to the 2 wheeler EV company wants to cater to. The top 5 variables on which the segment can be targeted are- “Age”, “Total Salary”, “Profession”, “Education” and “Car_Loan”. The target variables and chosen cluster can depend on the company policies and their goal. Some possible target clusters are chosen here. The feature values for different clusters are shown here.

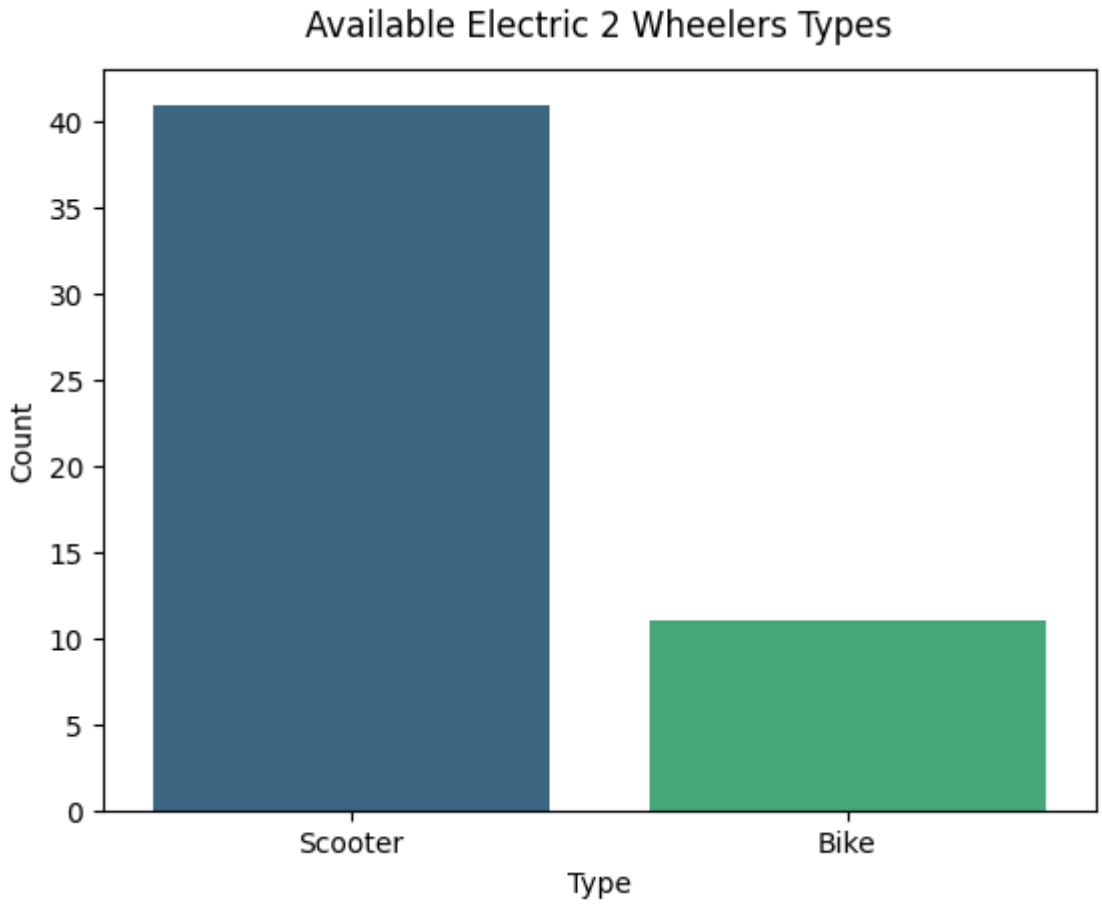
VEHICLE SEGMENTATION :

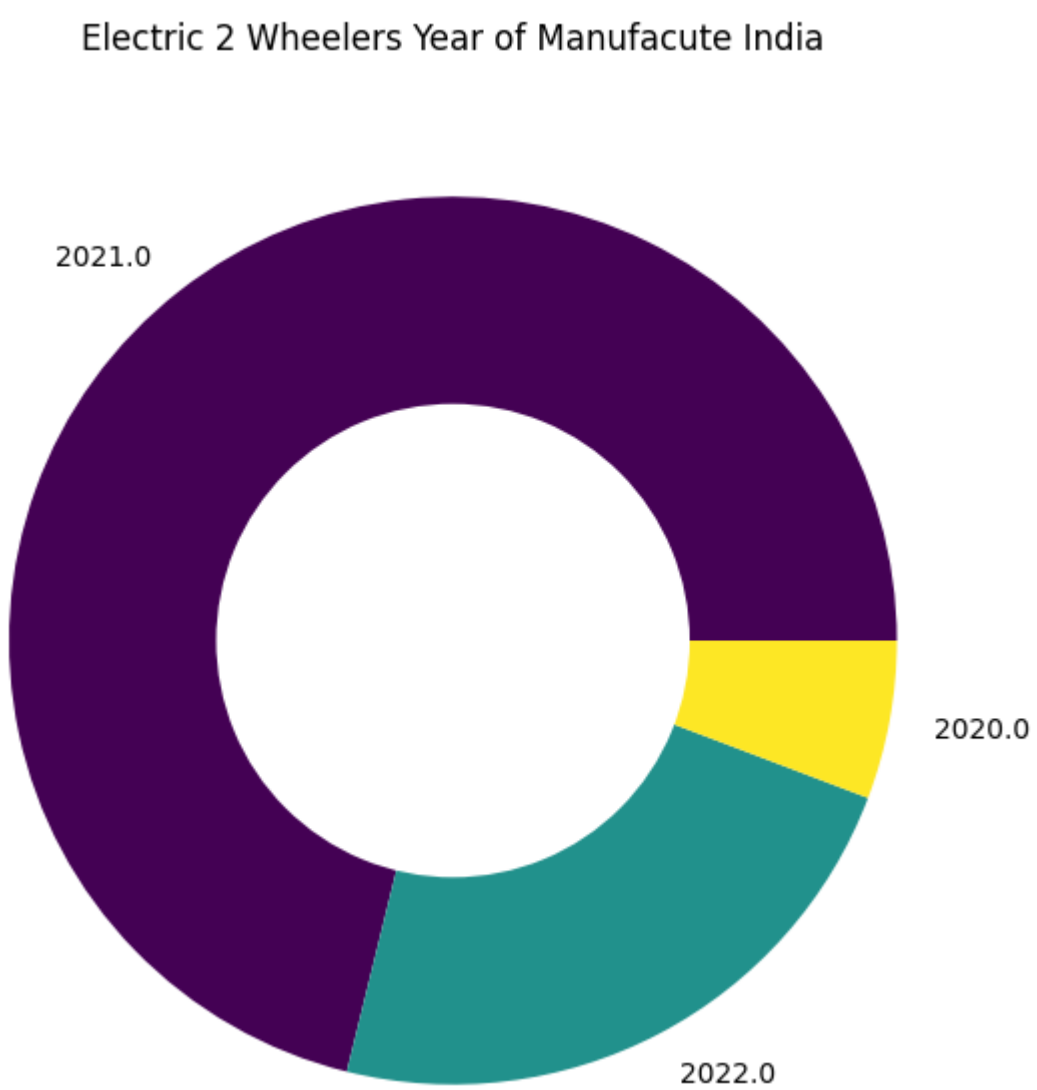
Here I perform a segmentation analysis on the possible segment to target depending on the product(2 wheelers) features during product development. Let’s explore the data through Exploratory Data Analysis.

Exploratory Data Analysis :

	Model	Manufacturer	Vehicle Type	Battery Capacity (kWh)	Range per Charge (km)	Charging Time	Price	Power (HP or kW)	Top Speed (km/h)	Year of Manufacture
0	Ola Electric S1	Ola	Scooter	2.98	181	5.0	85099.0	4.5	116.0	2021.0
1	Ola Electric S1 Pro	Ola	Scooter	4.00	181	6.5	120149.0	11.0	116.0	2021.0
2	TVS iQube	TVS	Scooter	3.40	75	6.5	117630.0	4.4	78.0	2020.0
3	Aura 300 Plus	Ather Energy	Scooter	2.90	116	4.5	129000.0	6.0	80.0	2021.0
4	Pure EV Epluto 7G	Pure EV	Scooter	2.70	120	3.0	109000.0	5.0	80.0	2021.0

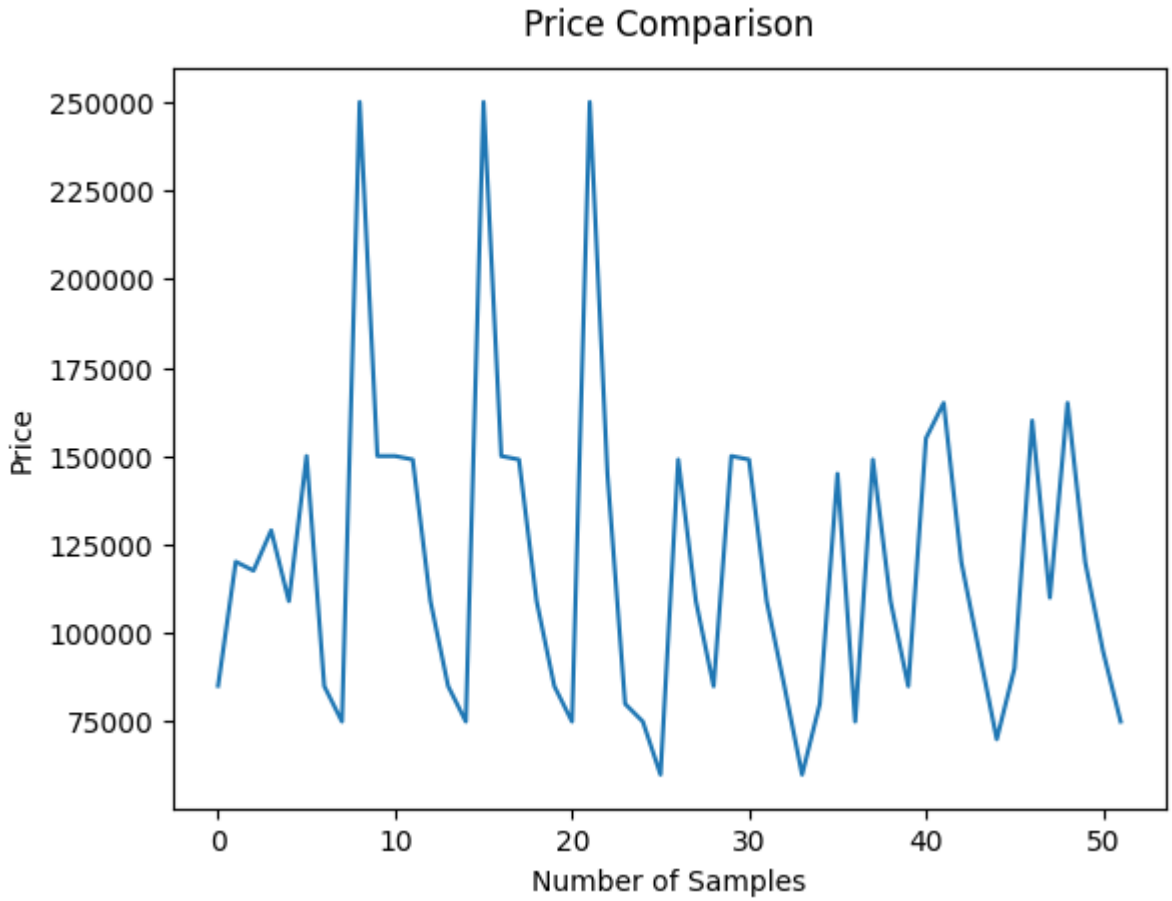
There exists two Types of 2 wheelers: Bikes and Scooters, their counts along with the year of manufacture of the 2 wheelers in the dataset :





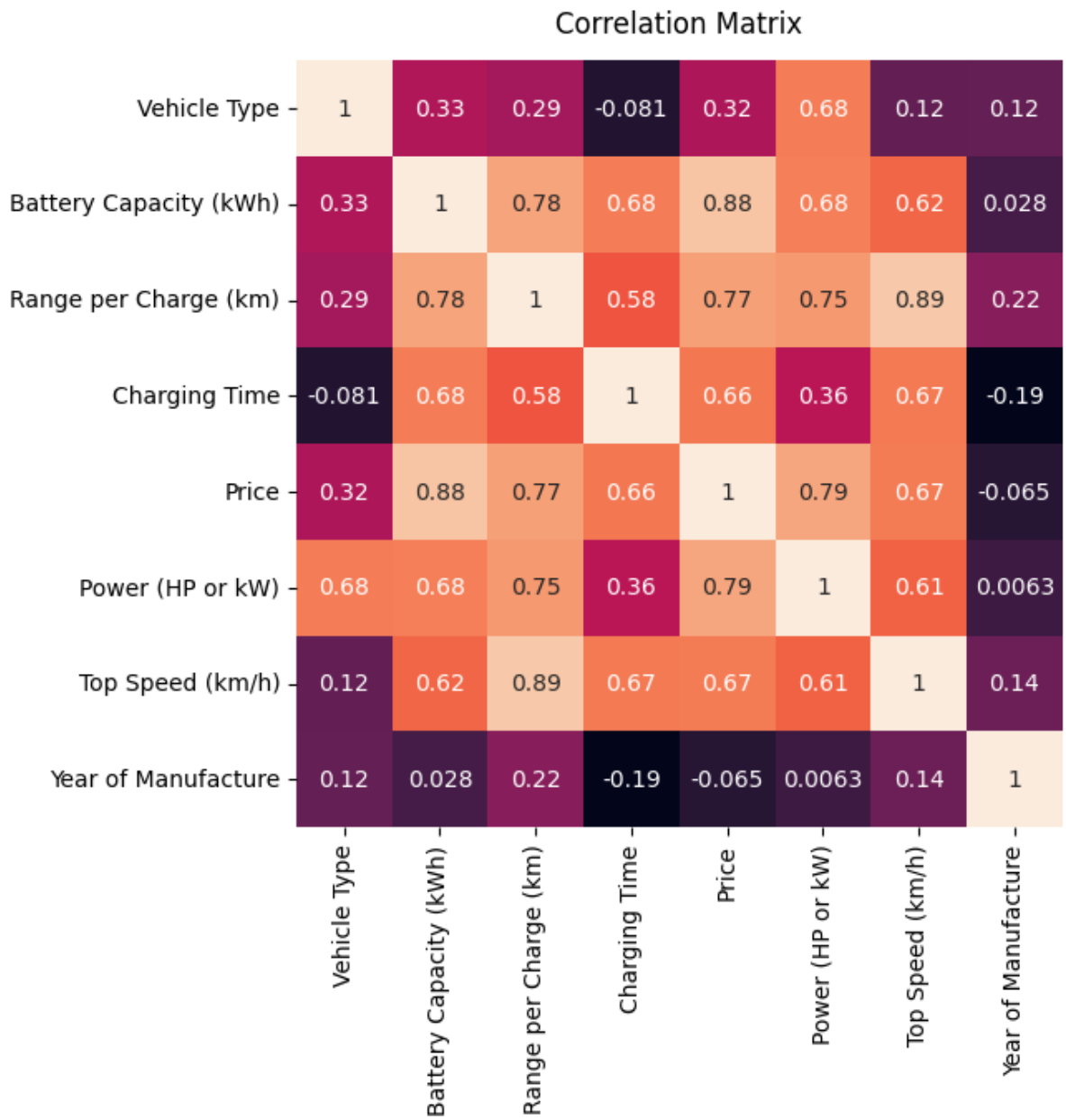
The most important features that the buyer might look for in an EV are Range, Battery Size and probably the Top Speed. This information help the buyer to choose a product. These features are plotted in bar plot.

The buying decisions also depends on the price of the product. The price values from the dataset:



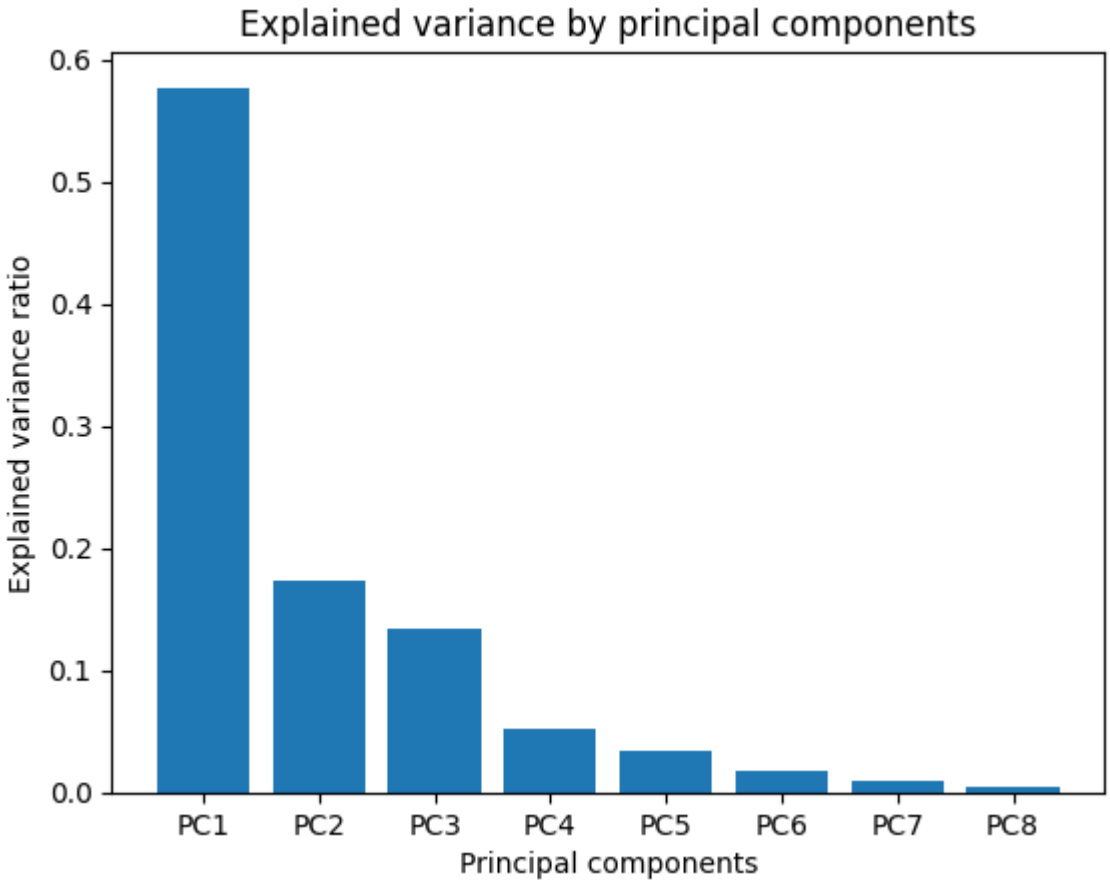
Principal Component Analysis :

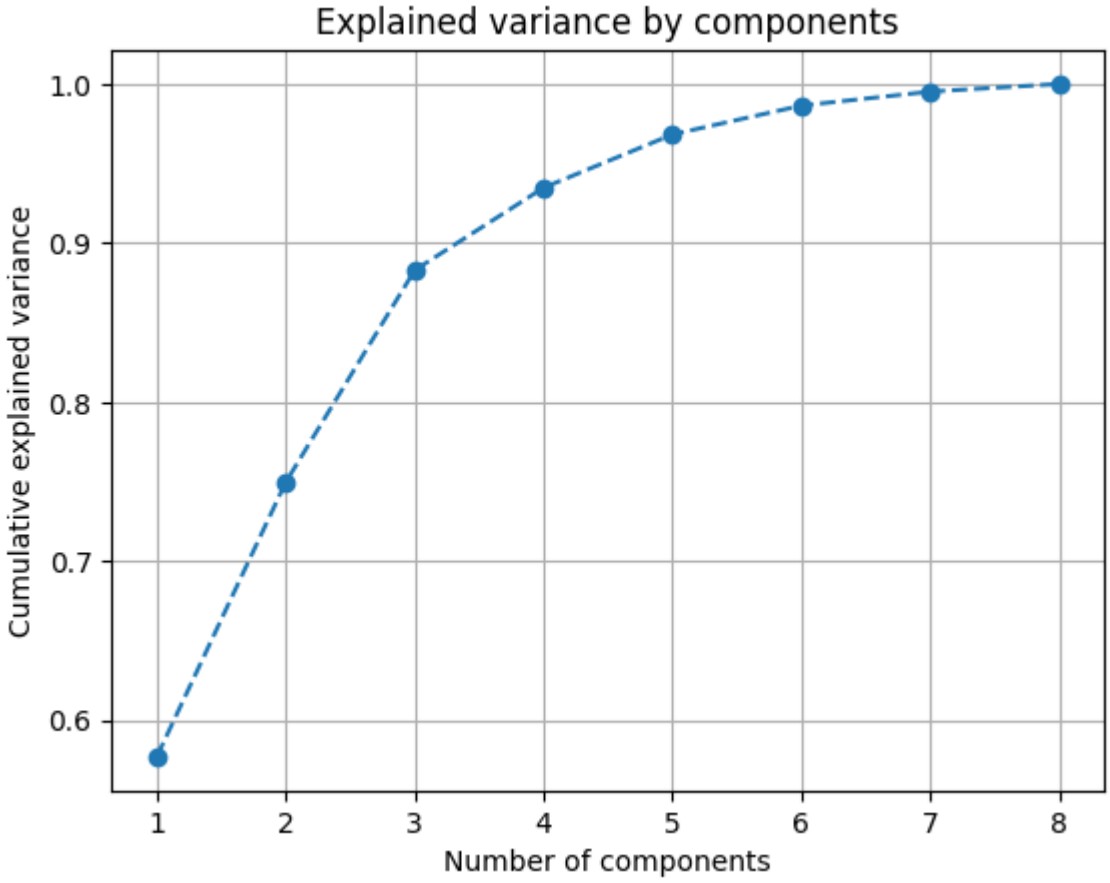
I have performed correlation analysis among the features and they had significant correlation.



Therefore, it is necessary to preform PCA to extract independent principal components and only those which have significant information of the entire dataset.

We first scale the data to perform PCA. Taking all the features to do PCA we get the explained variance as :


Explained variance by principal components
Explained variance ratio
0.0
0.1
0.2
0.3
0.4
0.5
0.6
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PC8
Principal components

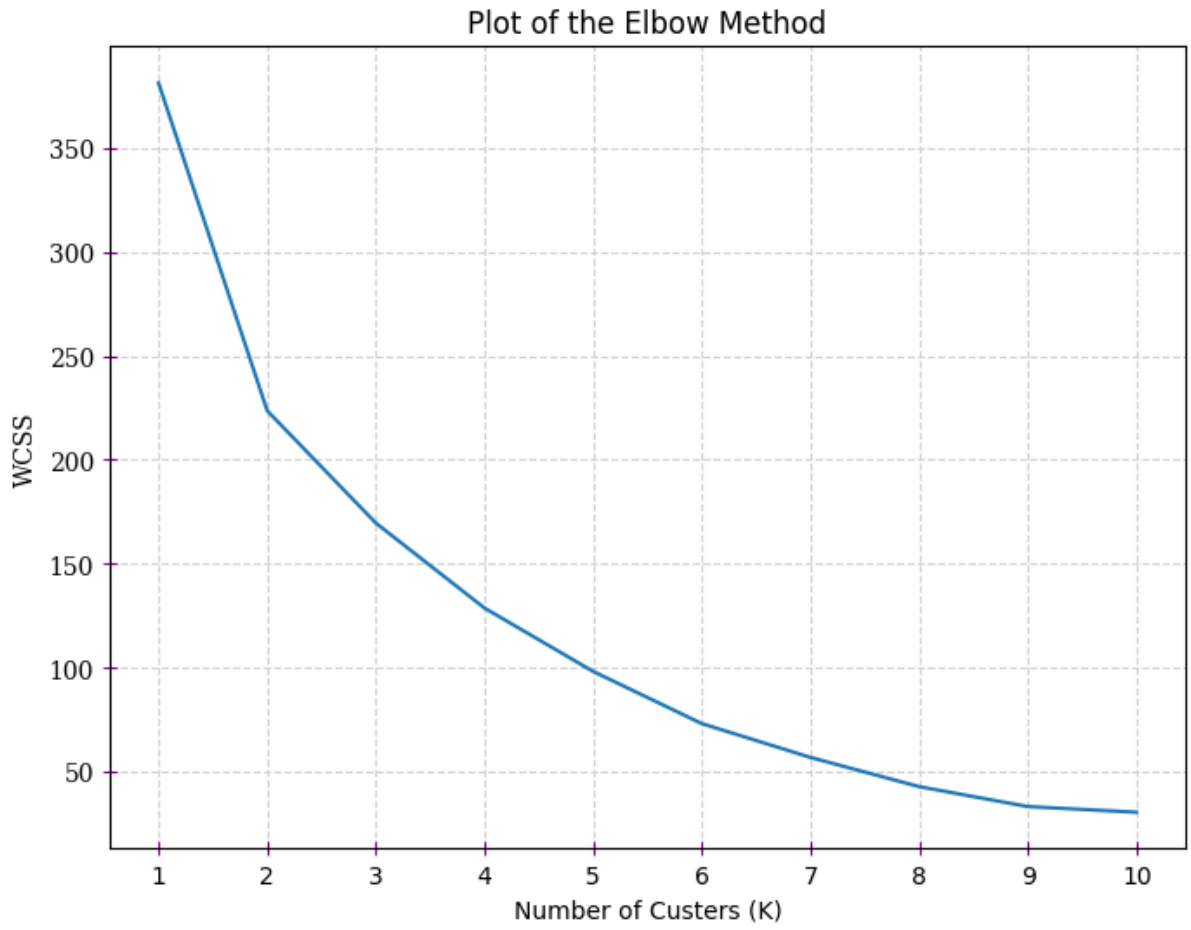

Explained variance by components
Cumulative explained variance
0.6
0.7
0.8
0.9
1.0
1
2
3
4
5
6
7
8
Number of components

I have taken 4 Principal Components as it is enough for more than 90% of explained variance. The principal components along with the weightage of each feature with the components are :

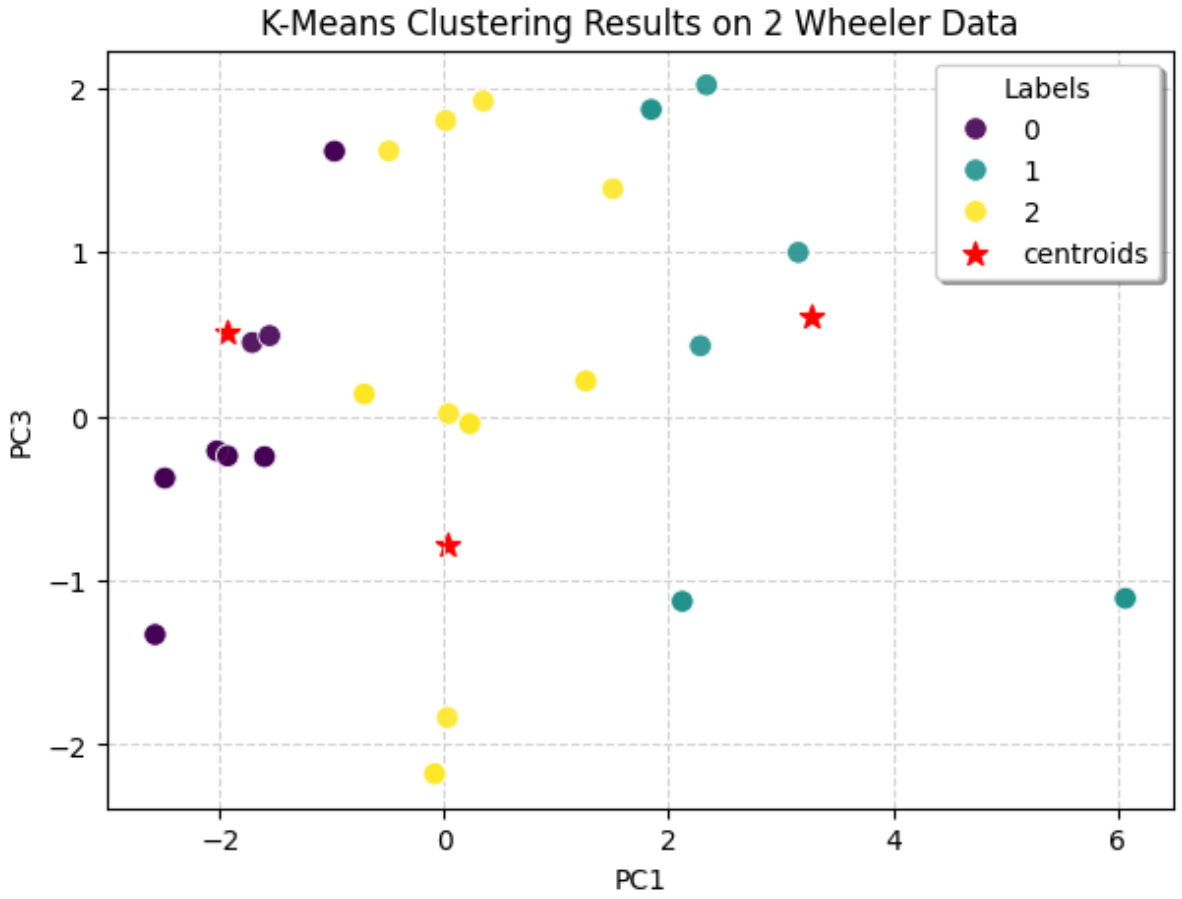
	PC1	PC2	PC3	PC4
0	1.503078	-1.388905	1.384091	2.192278
1	3.154668	-1.876417	0.996621	1.296237
2	0.027291	-2.739152	-1.835036	-0.281784
3	0.038391	-0.851359	0.014584	0.209208
4	-0.712720	-0.165038	0.134792	0.754506

K-Means Clustering :

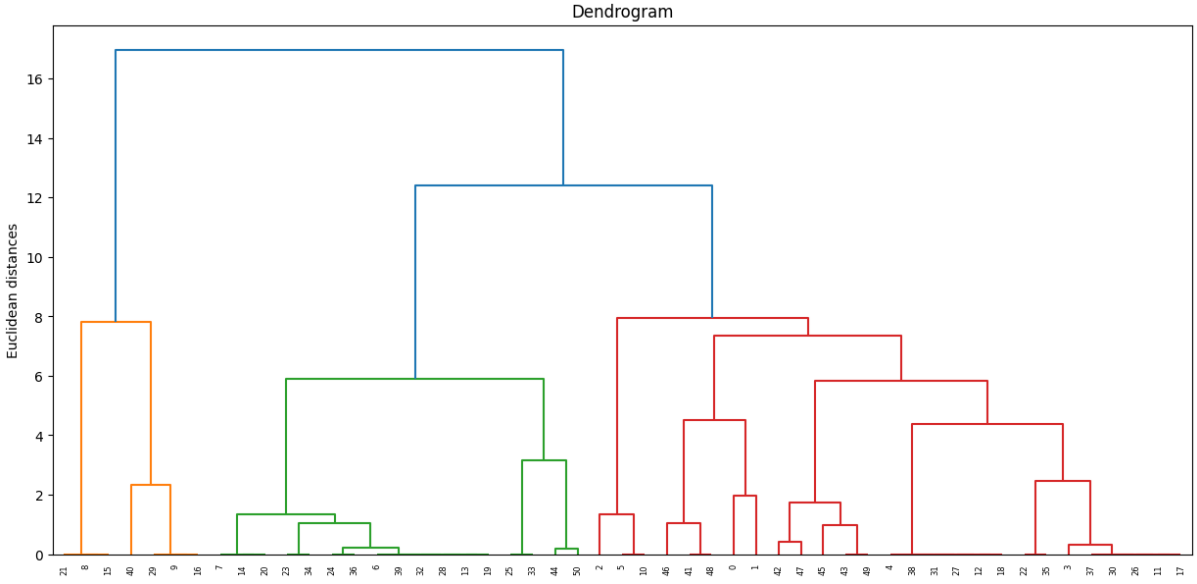
K-means takes number of clusters as an input as it itself can't determine number of clusters. To do that I rum k-means for various number of clusters and choose the optimal one. One point to note that I have used "k-means++". Only difference from normal one is that it initialises the clusters smartly rather than randomly in normal k-means. The elbow plot :



K - Means Clustering :



Hierarchical Clustering :



The EV Manufacturer Company might choose the 1st Segment having feature values-

• Manufacture EV Scooter

• Price Point of 85k-95k

• Top Speed having 50-70 km/h

• Range Having between 80-120 km,

• Battery Capacity of 2.2-3 kWh

• Charging Time of 2.5-2.5 Hrs

• Already Present Manufacturers in the Segment are Hero, Okinawa, Ampere, etc.

```
[Manufacturer
 Okinawa Autotech        8
 Electric Vehicle Co.    5
 Hero Motocorp           3
 Ampere Vehicles         2
 Joy E-Bike              1
 Name: count, dtype: int64,
 Manufacturer
 Revolt Motors    4
 Tork Motors      3
 Ather Energy     2
 Ola              1
 Bajaj Auto       1
 Name: count, dtype: int64,
 Manufacturer
 Pure EV         7
 Ather Energy    6
 Bajaj Auto      4
 TVS             1
 Ola             1
 Name: count, dtype: int64]
```

```
[Charging Time
3.0   13
2.5    4
3.5    2
Name: count, dtype: int64,
Charging Time
5.0   5
4.0   4
6.5   1
6.0   1
Name: count, dtype: int64,
Charging Time
4.5   6
3.0   6
5.0   3
4.0   2
5.5   2
Name: count, dtype: int64]
```

Another Possible Segment :

to target is 3rd Segment with features as-

• Manufacture EV Scooter

• Price Point of 85k-149k

• Top Speed having 80-116 km/h

• Range Having between 95-181 km,

• Battery Capacity of 2.7-4 kWh

• Charging Time of 3-5.5 Hrs

• Already Present Manufacturers in the Segment are Ola, Aether, Bajaj , TVS, etc.

MARKET MIX :

The four main points of a marketing mix called 4P's- Product, Place, Promotion, and Price. They specify the approaches and strategies that address the target market, based on the details of the marketing plan. Product Each product line represents a group of outputs or products. The set of all the product lines is called the product mix. The company can have different Kind of Products, Models of EV. They might offer-

• Automobiles

• Automobile parts

• Commercial vehicles

• Financial services

Pricing Strategies :

The Company should have a strategy for the pricing of it's products depending on the segments the company targeting. Both Premium and Affordable strategies are necessary e.g-

• Market-oriented pricing strategy

• Premium pricing strategy

Promotion :

One of the most important task for the Company is to tell the customer about the product they have produced in a convincing way. The activities are-

• Advertising (Primary Method)

• Direct marketing

• Personal selling

• Sales promotion

• Public relations

Place :

In this aspect, the virtual or physical locations of transactions are considered. Such locations are significant because they enable the company to reach target customers in specific markets.

The places can be-

• Official websites

• Dealerships

• Automotive shows and exhibits

CONCLUSION :

There are many 2 wheeler EV manufacturing companies in the country like Ola Electric, Hero Electric, Aether Energy, TVS, Bajaj, Okinawa, etc. 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 even though we have already started to see them spreading throughout the country. Such a segmentation analysis on EV Product, Demographic Segmentation, etc. proves to be invaluable resource to New EV Brands as well as already

established brands to better understand the market and predict the dynamics of such and early market especially where investments are happening.

By Asna:

This dataset contains information about electric vehicle (EV) adoption across various States and Union Territories (UTs) in India. Here's a summary of key insights:

1. Proportion of Electric Vehicles :

The percentage of EVs varies significantly, with Delhi having one of the highest at 2.71% , followed by Tripura (2.02%) and Assam (2.16%). In contrast, many regions like Arunachal Pradesh and Nagaland have meager EV adoption rates, around 0.01% .

2. FinTech Hubs :

Major fintech hubs like Bengaluru (447 FinTech companies), Mumbai and Pune (525), Gurugram (128), and Noida (77) are highlighted as key cities where fintech companies are concentrated, suggesting a correlation between these cities' urban infrastructure and higher EV adoption.

3. EV Subsidies and Incentives :

Several states offer incentives to promote EV adoption:

Assam , Meghalaya , Rajasthan , Odisha , and Uttar Pradesh provide direct incentives for E2W, E3W, and E4W (electric two, three, and fourwheelers), typically ranging from INR 10,000 to 30,000 per kWh or a percentage of the vehicle's cost.

Delhi , Goa , and Haryana also offer incentives, with some states providing additional subsidies such as scrapping incentives or early bird discounts.

4. Charging Infrastructure :

Charging station availability varies widely. Karnataka leads with 5,130 stations, followed by Maharashtra (3,083), Delhi (1,886), and Tamil Nadu (643). This indicates that states with more urban development and larger populations tend to have more charging infrastructure, which supports EV adoption.

5. Clusters and EV Adoption :

States like Delhi , Tripura , and Assam are identified as having a relatively higher proportion of EV adoption and are grouped in Cluster 2 along with some other states.

Cluster 0 , which contains most of the states, generally shows lower EV adoption, fewer incentives, and less developed charging infrastructure.

6. FinTech & Urban Influence :

There is a noticeable concentration of fintech companies in states with higher EV adoption rates, such as Bengaluru , Mumbai , Pune , Ahmedabad , and Gurugram , possibly highlighting an association between modern infrastructure, economic development, and EV adoption.

7. Variation in Subsidy Policies :

States like Chhattisgarh and Kerala offer additional incentives such as interest subvention, scrapping incentives, or other unique policies, while many states (e.g., Bihar , Jharkhand , and West Bengal) do not provide specific details on subsidies for EVs.

This data provides a snapshot of how various regions in India are progressing towards EV adoption, influenced by infrastructure development, government policies, and fintech growth.

New Categories Added :

- **Charging Station Category:** Classifies the density of charging stations in each state or UT as *Low*, *Medium*, *High*, or *Very High*.
- **EV Adoption Category:** Classifies EV adoption rates as *Low*, *Medium*, *High*, or *Very High*, which provides an easier way to interpret the proportion of electric vehicles.
- **FinTech Category:** Classifies the number of fintech companies into levels like *Low*, *Medium*, and *Very High*. This was missing in the previous dataset.
- **Geographical Segment:** New classification of states/UTs into *Rural*, *SemiUrban*, and *Urban* segments, offering insights into the level of urbanization.

Interpretation of the New Dataset:

1. Charging Stations:

- **Delhi**, **Karnataka**, and **Maharashtra** maintain their leadership with a *Very High* density of charging stations, which likely correlates with their higher EV adoption rates.
- Several regions like **Andaman & Nicobar Island**, **Ladakh**, **Nagaland**, and **UT of DNH & DD** have very low numbers of charging stations, categorized as *Low*, which aligns with their lower levels of EV adoption.

2. Proportion of Electric Vehicles (EV Adoption):

- The dataset highlights states with *Very High* EV adoption, including **Delhi**, **Assam**, **Tripura**, and **Uttar Pradesh**. These regions are progressing well in the transition to electric vehicles.
- Many states, such as **Arunachal Pradesh**, **Nagaland**, and **Sikkim**, show *Low* adoption of EVs, reflecting infrastructure or policy challenges in rural and remote areas.

3. Number of FinTechs:

- The presence of fintech companies is concentrated in **Karnataka**, **Maharashtra**, and **Tamil Nadu**, which are categorized as *Very High* fintech hubs, showing the states' strong tech ecosystems.

- Several states like **Andaman & Nicobar**, **Arunachal Pradesh**, **Himachal Pradesh**, and **Manipur** are categorized as having *No* or *Low* fintech presence, suggesting a lack of financial technology infrastructure in these rural or less developed regions.

4. Geographical Segment:

- Most of the *Urban* regions, such as **Karnataka**, **Maharashtra**, and **Tamil Nadu**, tend to have high levels of fintech activity and charging infrastructure. These regions also have a medium to high EV adoption rate, indicating that urbanization plays a role in supporting EV growth.
- In contrast, **Rural** regions like **Ladakh**, **Mizoram**, **Nagaland**, and **Sikkim** are categorized as having low fintech activity, fewer charging stations, and lower EV adoption, illustrating the gap in development between urban and rural areas.

5. Segmentation of EV, FinTech, and Charging Stations:

- **Urban states** like **Delhi**, **Karnataka**, and **Maharashtra** score high in fintech presence, charging station availability, and EV adoption. These regions benefit from better infrastructure, government policies, and urbanization.
- **Semiurban regions** such as **Bihar**, **Chhattisgarh**, and **Punjab** show medium levels of EV adoption and infrastructure, indicating developing markets.
- **Rural states** like **Manipur**, **Nagaland**, and **Arunachal Pradesh** struggle with low fintech presence, EV adoption, and charging infrastructure, highlighting the challenges these regions face in transitioning to EVs.

KMeans Clustering Process:

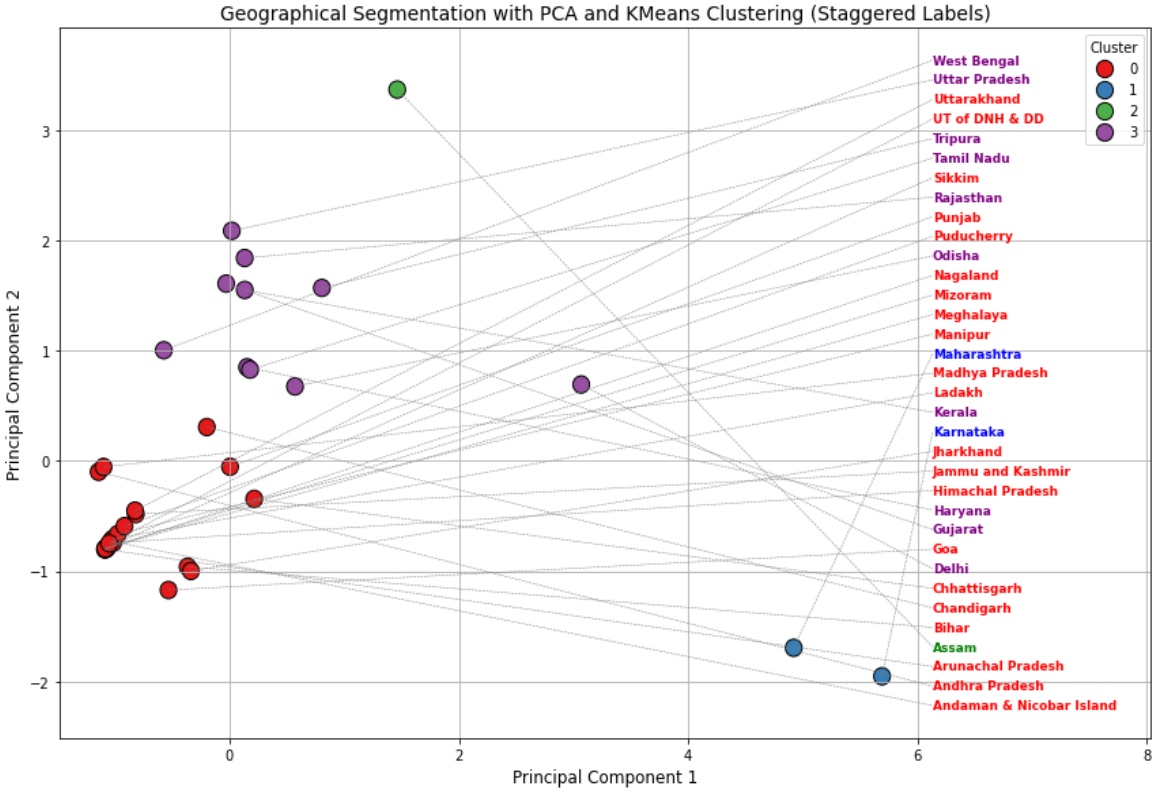
1. **Encoding Categorical Variables**:
   Since KMeans clustering works with numerical data, categorical features like "Charging Station Category," "EV Adoption Category," and "FinTech Category" have been label encoded. This means that the categories are converted to numerical representations, which allow them to be used in the KMeans algorithm.
2. **Standardization**:
   The features, including the numeric ones (charging stations, proportion of EVs, fintech numbers) and the encoded categorical variables, were standardized. This step is essential in clustering algorithms like KMeans because features with different scales can disproportionately affect the clustering result. Standardization ensures that each feature contributes equally to the distance calculations.
3. **PCA for Dimensionality Reduction**:
   - PCA reduces the dimensionality of the dataset by transforming the original feature space into two principal components (PC1 and PC2) while retaining most of the variance. This step is crucial because it simplifies the data and allows us to visualize it in 2D.
   - Although PCA reduces the complexity, it still captures the most significant patterns in the data, making it easier to visualize the clusters.

4. **KMeans Clustering**:

   - After applying PCA, KMeans clustering is used to group the data points into **four clusters** (k=4) based on their similarity.
   - The algorithm assigns each state/UT to one of these clusters by minimizing the withincluster sum of squares (variance) and maximizing the separation between clusters.
   - This plot represents the PCA (Principal Component Analysis) applied to the dataset along with KMeans clustering to segment the states/UTs based on EV adoption, fintech presence, and charging infrastructure. The points represent different states/UTs, and the axes (PC1 and PC2) are the two principal components that capture the maximum variance in the data. The states are grouped into four clusters, with color coding as follows:
   -
   - Cluster 0 (Red): Multiple states are grouped in this cluster.
   - Cluster 1 (Blue): Contains Karnataka and Maharashtra.
   - Cluster 2 (Green): Contains Assam.
   - Cluster 3 (Purple): Includes states such as Uttar Pradesh, Delhi, and Tamil Nadu.
   - Clusterwise Interpretation:
   - Cluster 0 (Red):
   - This cluster includes several states/UTs, such as Madhya Pradesh, Goa, Chhattisgarh, Punjab, Uttarakhand, Puducherry, and others.
   - These states are likely characterized by lowtomoderate levels of EV adoption, moderatetolow fintech presence, and relatively underdeveloped charging infrastructure.
   - These states appear to be more clustered toward the bottomleft of the plot, indicating similarities in their lower levels of development in the key factors considered (fintech, EV, and infrastructure).
   - Cluster 1 (Blue) – Karnataka and Maharashtra:
   - Karnataka and Maharashtra are the only states in this cluster. Both of these states are highly urbanized and technologically advanced, with strong fintech ecosystems.
   - This positioning indicates that these states have high fintech activity, good charging infrastructure, and likely higherthanaverage EV adoption. The separation of these two states from the other clusters suggests they are leading in these areas.
   - Maharashtra and Karnataka are likely more mature in terms of infrastructure and EV ecosystem compared to states in other clusters.
   - Cluster 2 (Green) – Assam:
   - Assam is the sole state in this cluster, and its positioning indicates that it has a unique combination of characteristics compared to other states.

- Assam has a relatively high EV adoption rate but differs in terms of fintech presence and charging infrastructure from other states, which places it in its own cluster.
- This uniqueness could stem from the fact that although Assam is making strides in EV adoption, its fintech ecosystem or infrastructure might not be as developed as states in other clusters.
- Cluster 3 (Purple):
- This cluster includes states such as Uttar Pradesh, Delhi, West Bengal, Tamil Nadu, Odisha, Kerala, Rajasthan, and Tripura.
- These states are likely moderatetohigh performers in terms of EV adoption, fintech presence, and charging infrastructure.
- The states in this cluster are more spread out, with some closer to the highly developed states and others closer to the lowerperforming states. This suggests that while they share certain characteristics, they may differ in specific areas such as the number of charging stations or fintech activity.
- Delhi, for instance, stands slightly apart from other states in this cluster, indicating that it may have a unique combination of characteristics (possibly high fintech activity and EV adoption but with certain limitations in infrastructure).
- Insights from the Plot:
- Highly Developed States (Cluster 1 Blue):
-
- Maharashtra and Karnataka lead the way in fintech and EV development. Their separation from other clusters suggests they are significantly more advanced in terms of EV ecosystem readiness, which could be driven by their urbanization and techdriven economies.
- Isolated High Performer (Cluster 2 Green):
-
- Assam stands alone, indicating that it has a distinctive EV adoption rate but likely lacks the same fintech presence or infrastructure development as states like Karnataka or Maharashtra. Its unique characteristics could stem from regional policies or specific market conditions that have encouraged EV adoption independently of other factors.
- Moderate Performers (Cluster 3 Purple):
-
- States like Uttar Pradesh, Tamil Nadu, Delhi, and West Bengal fall into the middle category. They likely have a balanced mix of fintech presence, EV adoption, and infrastructure development, but not as advanced as Maharashtra and Karnataka.
- Delhi, positioned slightly away from the bulk of Cluster 3, could be seen as progressing faster in fintech and EV adoption, but it may still have limitations in other areas, such as charging infrastructure.
- LowtoModerate Performers (Cluster 0 Red):

-
- States like Madhya Pradesh, Goa, Chhattisgarh, and Uttarakhand fall into this cluster, likely indicating they are in earlier stages of development concerning EV adoption and infrastructure.
- These states may have less developed fintech ecosystems, fewer charging stations, and lower EV adoption rates compared to the other clusters.
- Conclusion:
- Maharashtra and Karnataka (Cluster 1) stand out as the leaders in fintech and EV infrastructure, while Assam (Cluster 2) has a unique position driven by higher EV adoption but lacks in other areas.
- Cluster 3 consists of a mixture of states that are steadily progressing but have not yet reached the development levels of the leaders.
- Cluster 0 represents states that are lagging behind in both fintech development and EV adoption.
- This analysis provides a clear view of the regional differences in EV adoption, fintech presence, and infrastructure readiness across India.



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- **Cluster 3 (Purple)**: Includes states such as **Uttar Pradesh**, **Delhi**, and **Tamil Nadu**.

Clusterwise Interpretation:

Cluster 0 (Red):

- This cluster includes several states/UTs, such as **Madhya Pradesh**, **Goa**, **Chhattisgarh**, **Punjab**, **Uttarakhand**, **Puducherry**, and others.
- These states are likely characterized by **lowtomoderate levels of EV adoption**, **moderatetolow fintech presence**, and relatively underdeveloped charging infrastructure.
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- This positioning indicates that these states have **high fintech activity**, **good charging infrastructure**, and likely **higherthanaverage EV adoption**. The separation of these two states from the other clusters suggests they are leading in these areas.
- **Maharashtra** and **Karnataka** are likely more mature in terms of infrastructure and EV ecosystem compared to states in other clusters.

Cluster 2 (Green) – Assam:

- **Assam** is the sole state in this cluster, and its positioning indicates that it has a unique combination of characteristics compared to other states.
- Assam has a **relatively high EV adoption rate** but differs in terms of fintech presence and charging infrastructure from other states, which places it in its own cluster.
- This uniqueness could stem from the fact that although Assam is making strides in EV adoption, its fintech ecosystem or infrastructure might not be as developed as states in other clusters.

Cluster 3 (Purple):

- This cluster includes states such as **Uttar Pradesh**, **Delhi**, **West Bengal**, **Tamil Nadu**, **Odisha**, **Kerala**, **Rajasthan**, and **Tripura**.
- These states are likely **moderatetohigh performers** in terms of EV adoption, fintech presence, and charging infrastructure.
- The states in this cluster are more spread out, with some closer to the highly developed states and others closer to the lowerperforming states. This suggests that while they share certain characteristics, they may differ in specific areas such as the number of charging stations or fintech activity.
- **Delhi**, for instance, stands slightly apart from other states in this cluster, indicating that it may have a unique combination of characteristics (possibly high fintech activity and EV adoption but with certain limitations in infrastructure).

Insights from the Plot:

1. **Highly Developed States (Cluster 1 Blue)**:
    - **Maharashtra** and **Karnataka** lead the way in fintech and EV development. Their separation from other clusters suggests they are significantly more advanced in terms of EV ecosystem readiness, which could be driven by their urbanization and techdriven economies.
2. **Isolated High Performer (Cluster 2 Green)**:
    - **Assam** stands alone, indicating that it has a distinctive EV adoption rate but likely lacks the same fintech presence or infrastructure development as states like Karnataka or Maharashtra. Its unique characteristics could stem from regional policies or specific market conditions that have encouraged EV adoption independently of other factors.
3. **Moderate Performers (Cluster 3 Purple)**:
    - States like **Uttar Pradesh**, **Tamil Nadu**, **Delhi**, and **West Bengal** fall into a middle category. They likely have a balanced mix of fintech presence, EV adoption, and infrastructure development, but not as advanced as **Maharashtra** and **Karnataka**.
    - **Delhi**, positioned slightly away from the bulk of Cluster 3, could be seen as progressing faster in fintech and EV adoption, but it may still have limitations in other areas, such as charging infrastructure.
4. **LowtoModerate Performers (Cluster 0 Red)**:
    - States like **Madhya Pradesh**, **Goa**, **Chhattisgarh**, and **Uttarakhand** fall into this cluster, likely indicating they are in earlier stages of development concerning EV adoption and infrastructure.
    - These states may have less developed fintech ecosystems, fewer charging stations, and lower EV adoption rates compared to the other clusters.

Conclusion:

- **Maharashtra** and **Karnataka** (Cluster 1) stand out as the leaders in fintech and EV infrastructure, while **Assam** (Cluster 2) has a unique position driven by higher EV adoption but lacks in other areas.
- **Cluster 3** consists of a mixture of states that are steadily progressing but have not yet reached the development levels of the leaders.
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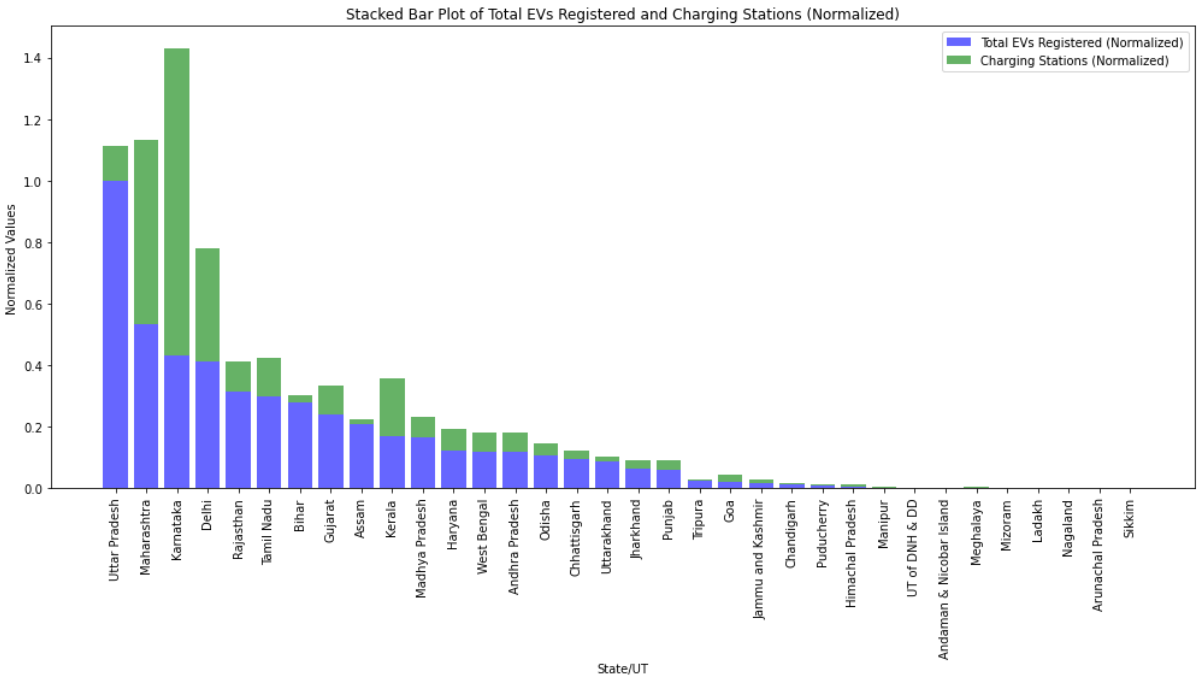
This analysis provides a clear view of the regional differences in EV adoption, fintech presence, and infrastructure readiness across India.



This plot visually represents the comparison between Total EVs Registered and Charging Stations across different states/UTs, with both values normalized. Normalization scales the data between 0 and 1, making it easier to compare states/UTs that may differ significantly in absolute numbers.

1. Xaxis (State/UT):

The xaxis shows different states and union territories (UTs) in India. The data is sorted by the total number of EVs registered, from highest to lowest.

Each bar represents one state or UT.

2. Yaxis (Normalized Values):

The yaxis shows the normalized values for both the total number of EVs registered and the number of charging stations. The values have been normalized so that both EVs registered and charging stations fall between 0 and 1, making them comparable across different states.

3. Stacked Bars:

Blue Segment: Represents the normalized number of total EVs registered in each state/UT. States with taller blue segments have registered a higher proportion of EVs relative to the highest Registered state.

Green Segment: Represents the normalized number of charging stations in each state/UT. States with taller green segments have a greater density of charging stations relative to the state with the most charging stations.

The height of the combined stacked bars represents the sum of both metrics (total EV registrations and charging stations), indicating how developed each state's EV ecosystem is relative to others.

1. Leading States (High EV Registration and Charging Infrastructure):

Some states, like the first few on the left, have large blue and green sections, indicating they not only have a high number of EV registrations but also a significant number of charging stations.

For example, the first state in the plot has high levels of both EV adoption and charging stations (likely states like Karnataka or Maharashtra).

2. States with Disparity (High EV Registrations but Low Charging Infrastructure):

In certain states, you might observe a large blue section with a much smaller green section. This indicates that while the state has a high number of EV registrations, its charging infrastructure is lagging.

These states might need to invest more in charging infrastructure to support further EV adoption.

3. States with More Charging Stations but Fewer EVs:

In some cases, you might see a larger green section with a smaller blue section, suggesting that the state has developed its charging infrastructure but hasn't seen a high level of EV adoption yet. These states might be preparing for future EV adoption but haven't yet caught up in terms of registrations.

4. Less Developed States (Low EV Registrations and Charging Stations):

Toward the right of the plot, the bars are much smaller for both blue and green segments. These states have low EV registration and low charging infrastructure development, meaning they are lagging behind in terms of EV adoption and infrastructure.

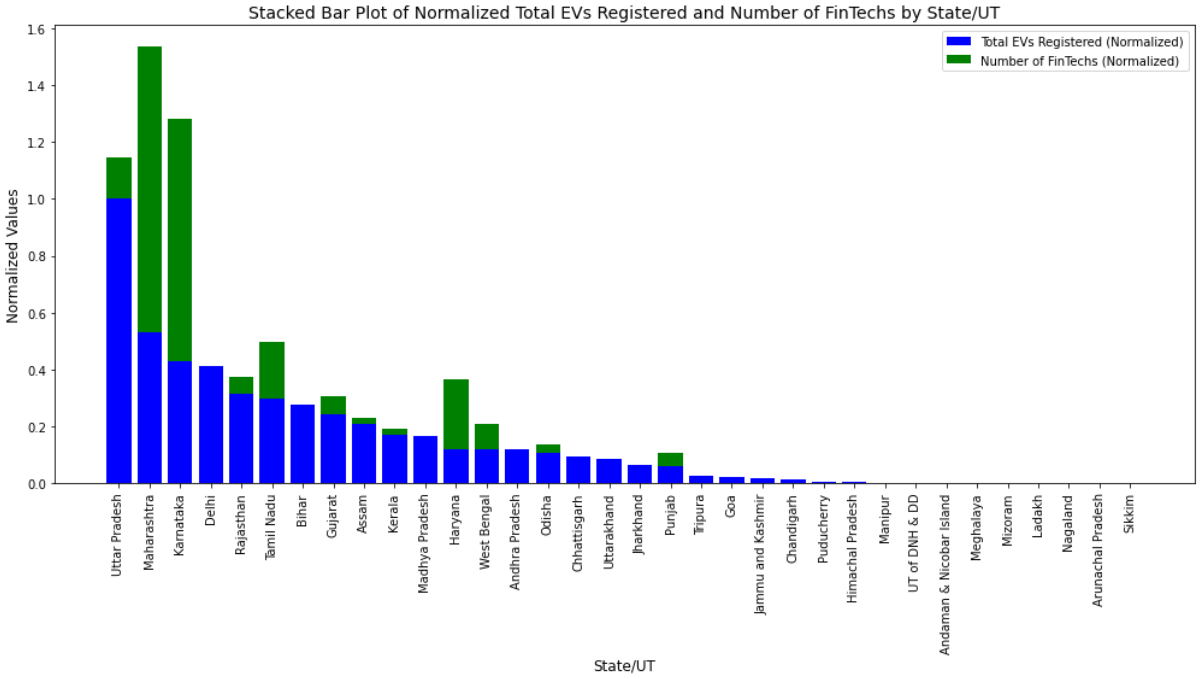
Overall Summary:

The plot helps to visually identify states that are doing well in both EV adoption and charging infrastructure (with tall bars representing both segments).

It also highlights the disparities in certain states where either EV adoption is outpacing infrastructure development or vice versa.

Finally, it shows which states are falling behind in both EV adoption and charging station deployment, indicating potential areas where policy interventions might be necessary to accelerate growth.

This type of visualization allows policymakers and businesses to focus on areas needing more development and investment in EV infrastructure or promotion of EV adoption.



This plot represents the **normalized values** for **Total EVs Registered** and the **Number of FinTechs** across different states and union territories (UTs). Both values have been normalized to make them comparable on the same scale.

Key Components:

1. **Xaxis (State/UT)**:
    - The states/UTs are displayed along the x-axis. Each bar represents one state or UT, and the data is sorted based on the total number of EVs registered.
2. **Yaxis (Normalized Values)**:
    - The y-axis shows the **normalized values**, which scale the raw data between 0 and 1. This means that the highest value for EV registrations or fintech presence is represented as 1, and other values are scaled accordingly.
3. **Stacked Bars**:
    - **Blue Segment**: Represents the **normalized number of total EVs registered** for each state/UT. Taller blue sections indicate states with a higher proportion of EV registrations relative to other states.
    - **Green Segment**: Represents the **normalized number of fintech companies** in each state/UT. Taller green sections indicate a higher concentration of fintech companies.
    - Together, the total height of the stacked bars reflects the combined performance of each state in terms of both EV adoption and fintech presence.

Key Observations:

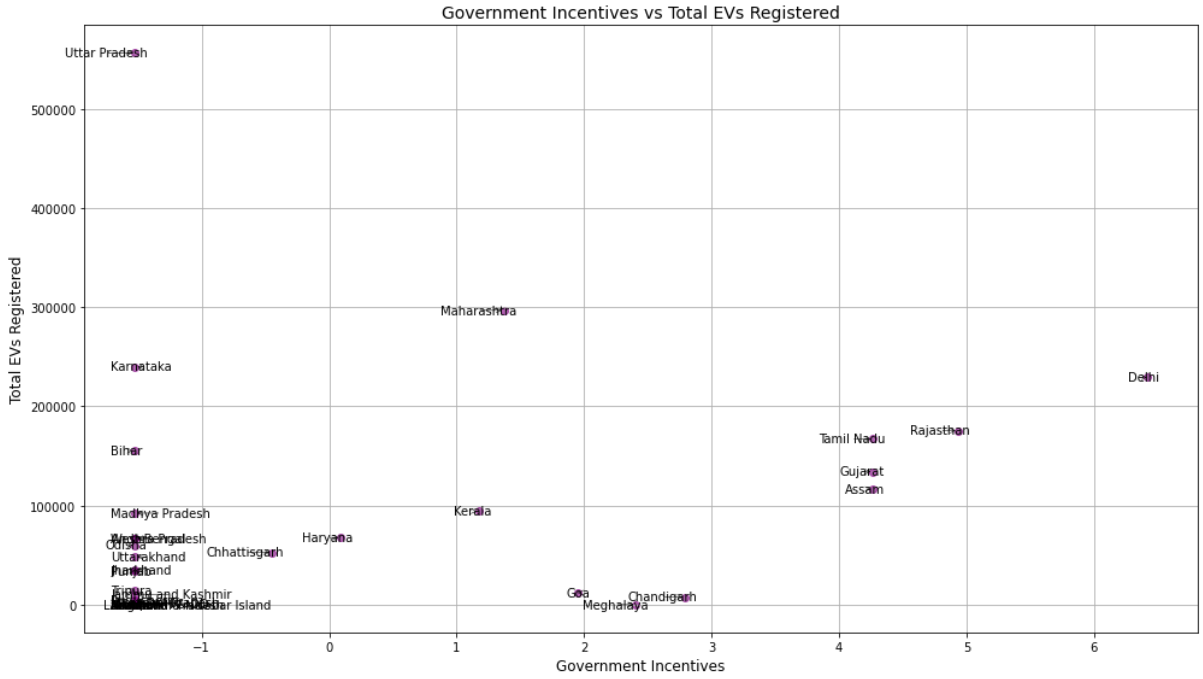
1. **States Leading in Both EV Adoption and FinTech Presence**:

- The states with **large blue and green sections** are likely to be the ones leading in both EV adoption and fintech presence. These states likely have developed ecosystems for both EV infrastructure and financial technology.
- For example, the first few states on the left have large bars, indicating they have both a significant number of EV registrations and a thriving fintech environment (likely states like **Karnataka** or **Maharashtra**).

2. **States with High FinTech Presence but Lower EV Registrations**:
   - States with **large green segments** but relatively smaller blue segments indicate a strong fintech presence but lower EV adoption. This could imply that these states have financial technology hubs but haven't yet seen large-scale EV adoption.
   - These states might have strong urban infrastructure that supports fintech, but the EV ecosystem may be in earlier stages of development.
3. **States with High EV Registrations but Lower FinTech Presence**:
   - States with **large blue segments** and **small or absent green segments** indicate regions where EV adoption is growing, but the fintech sector is still underdeveloped. These states may have implemented policies promoting EVs, but they haven't seen corresponding growth in the fintech sector.
   - This suggests potential areas of improvement for fintech-related initiatives in these states.
4. **States with Low EV Registrations and FinTech Presence**:
   - Toward the right of the plot, the bars are relatively smaller for both blue and green sections, indicating that these states are lagging in both EV adoption and fintech development. These regions may require further investment and support to develop in these sectors.

Overall Summary:

- The plot provides a visual comparison of states/UTs in terms of both **EV adoption** and **fintech presence**. It highlights the states that are leaders in both areas and those that excel in one but lag in the other.
- **Leading states** have tall stacked bars (large blue and green segments), representing strong ecosystems for both EVs and fintech.
- **Disparities** between EV adoption and fintech development can be seen in certain states where one is high but the other is low, indicating potential opportunities for growth in the underdeveloped sector.
- Finally, the **less developed states** have small bars, showing they are still in the early stages of both EV and fintech development.



This plot is useful for policymakers and investors to identify regions with growth potential in both electric vehicles and fintech, as well as regions that may need targeted efforts to boost either sector.

In this scatter plot, the x-axis represents the Government Incentives provided by various states, and the y-axis represents the Total EVs Registered in those states. The labels on the points indicate the respective states/UTs.

1. General Trend:

High Incentives, High EV Registrations: States like Delhi, Tamil Nadu, Rajasthan, and Maharashtra offer relatively higher incentives and correspondingly have high EV registrations. This suggests a positive relationship between government incentives and the adoption of electric vehicles in these regions.

Low Incentives, Low EV Registrations: Several states, such as Meghalaya, Chandigarh, and Ladakh, offer lower incentives, and consequently, the EV registrations are also lower. This again highlights the impact of government support on EV adoption.

2. Outliers:

Delhi stands out with a high level of EV registrations relative to its incentives. This may indicate that factors other than incentives, such as infrastructure or policy support, are also driving EV adoption.

Uttar Pradesh and Karnataka have high EV registrations, but their incentives might not be as significant as those provided by states like Delhi. This could suggest that local demand or other market dynamics are stronger drivers of EV adoption in these regions.

3. Cluster of Low EV Registrations and Low Incentives:

Many states are clustered toward the lower left corner of the plot, such as Madhya Pradesh, Bihar, and Haryana. These regions show lower EV registrations, and their government incentives are also limited or not fully captured. This points to areas where both incentives and adoption may need to be improved.

By Harsh:

Introduction

The electric vehicle (EV) market is undergoing significant transformation as global awareness of climate change and environmental issues rises. EVs, which operate on electricity instead of conventional fossil fuels like gasoline or diesel, are increasingly recognized as a cleaner and more sustainable alternative for reducing carbon emissions. Advances in battery technology and supportive government policies are driving a surge in global demand for EVs. Major automotive manufacturers, including both established companies and startups, are focusing on creating a wide array of EV models that cater to various market segments, from budget-friendly options to high-end luxury vehicles. Additionally, the development of charging infrastructure is rapidly progressing, facilitating consumer adoption of EVs.

In India, the EV market is beginning to gain momentum as public concern over air pollution, especially in urban areas, grows. The government is actively promoting the adoption of electric vehicles through initiatives like the Faster Adoption and Manufacturing of Electric Vehicles (FAME) program. Indian automakers are increasingly producing electric vehicles, and the establishment of EV charging stations is being prioritized to enhance accessibility for consumers.

The rise in electric vehicle adoption in India could have significant implications for both the environment and the economy. By decreasing dependence on imported crude oil, India can save on energy costs and reduce vulnerability to fluctuations in global oil prices. Furthermore, the EV sector has the potential to create numerous jobs in manufacturing, research and development, battery technology, and infrastructure. As awareness of the benefits of electric vehicles—such as lower operating costs, government incentives, and environmental advantages—grows among Indian consumers, the EV industry is poised for rapid expansion in the coming years, reshaping the nation's transportation landscape.

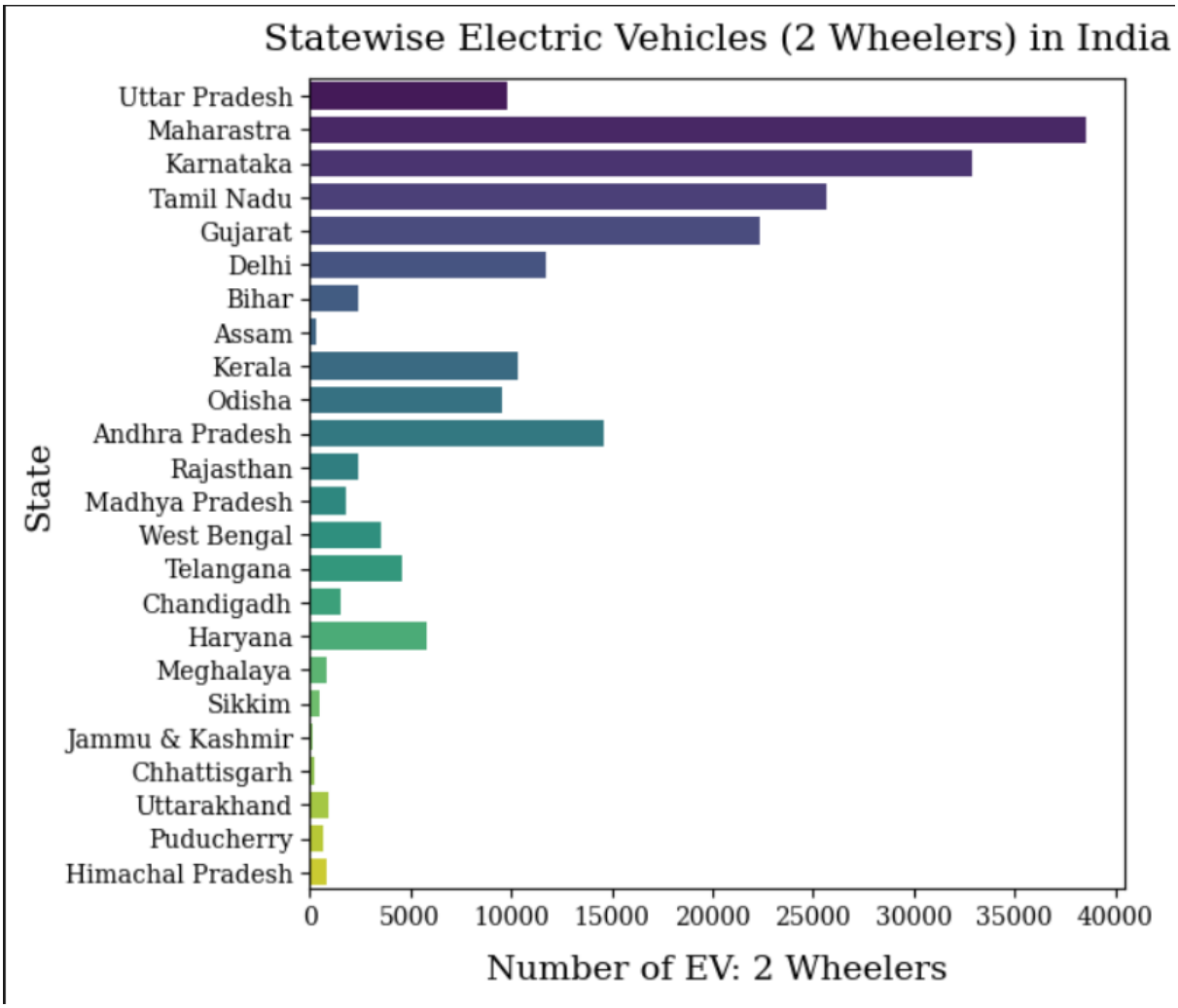
This report aims to deliver an in-depth analysis of market segmentation within India's electric vehicle sector, identifying the most promising types of EVs that could ensure the success of a new startup in this dynamic market.

Problem Statement

The Indian electric vehicle (EV) market is experiencing rapid growth, with sales expected to increase significantly in the coming years. As our startup seeks to identify the optimal type of electric vehicle to develop, it is essential to understand the various factors that influence consumer purchasing decisions. Key considerations include price, battery capacity, driving range, charging time, and vehicle type. Our analysis will focus on different categories of electric vehicles, such as two-wheelers, three-wheelers, four-wheelers, and buses, to determine which segment holds the most potential for profitability. By evaluating sales performance and market trends across these vehicle types, we aim to make an informed decision about which EV sector to target for growth. This research will also examine critical criteria such as pricing, battery capacity, driving range, power, charging time, top speed, body type, and category, allowing for a thorough analysis of each EV type. This comprehensive

approach is vital for developing a strategy that maximizes our startup's success. By concentrating on the most lucrative EV type, we can introduce a product that meets market demand while positioning ourselves for competitive growth. Ultimately, this data-driven strategy will ensure efficient resource allocation and help the company achieve its financial and business objectives.

GRAPHS



The graph presents the state-wise distribution of electric two-wheelers (EVs) in India, emphasizing how different states are adopting EVs at varying rates.

Key Observations:

Top States in EV Adoption:

- Uttar Pradesh: Leads with close to 40,000 EVs, showing significant penetration of electric two-wheelers.
- Maharashtra: Follows closely behind with over 35,000 EVs, making it one of the top states in EV adoption.
- Karnataka: Has around 30,000 EVs, indicating strong growth in this sector.

Mid-range States:

- Tamil Nadu: Comes next with around 25,000 EVs.
- Gujarat and Delhi also show substantial numbers, with over 20,000 and 15,000 EVs respectively, suggesting active EV policies and infrastructure.

States with Moderate Numbers:

- Andhra Pradesh, Odisha, Kerala, and Assam: These states have between 10,000 to 20,000 EVs, showing moderate adoption but still significant compared to others.
- Bihar, Assam, and Rajasthan show EV numbers ranging between 5,000 to 10,000.

Low EV Adoption States:

- States like Himachal Pradesh, Puducherry, Uttarakhand, and Chhattisgarh show very low adoption, with numbers less than 5,000. These regions might face challenges in EV infrastructure, awareness, or policies.

Smaller States and UTs:

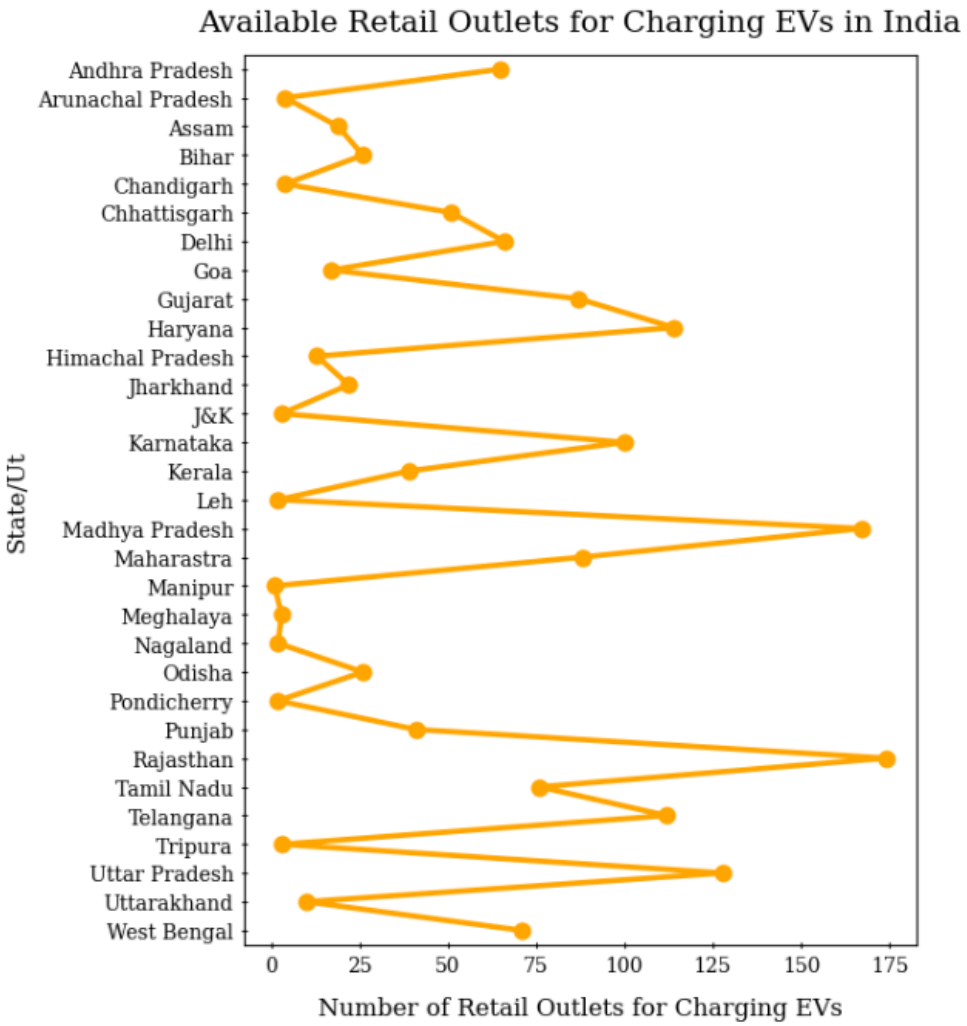
- Sikkim, Meghalaya, Jammu & Kashmir, and Chandigarh: These smaller states and Union Territories show comparatively lower numbers, likely due to their smaller populations or lesser focus on EV infrastructure.

Insights:

Geographical and Policy Impact: Larger and more industrialized states like Uttar Pradesh, Maharashtra, and Karnataka are leading in EV adoption, likely due to stronger policy initiatives, urban demand, and better infrastructure.

Lower Adoption in Smaller/Remote States: States in the northeast and hilly regions (e.g., Sikkim, Meghalaya, Himachal Pradesh) show less adoption, which could be due to geographical challenges and lesser infrastructure for EV charging.

The graph illustrates the growing importance of electric two-wheelers in India's transportation system and highlights the regional disparities in adoption rates.



The line chart illustrates the number of available retail outlets for charging electric vehicles (EVs) across various states and Union Territories (UTs) in India.

Key Features:

The x-axis represents the number of retail outlets available for charging EVs, ranging from 0 to 175.

The y-axis lists the states and UTs in India.

Observations:

Top States in EV Charging Outlets:

- Tamil Nadu and Uttar Pradesh have the highest number of retail outlets for EV charging, exceeding 150 outlets.
- Maharashtra, Gujarat, and Karnataka are also among the top states, with outlets ranging between 100 to 150.

States with Moderate Availability:

- States like Delhi, Kerala, Telangana, Punjab, and Rajasthan have between 75 to 100 charging outlets.
- Goa, Bihar, Odisha, and Haryana display moderate infrastructure, with around 50 to 75 outlets.

States with Low Availability:

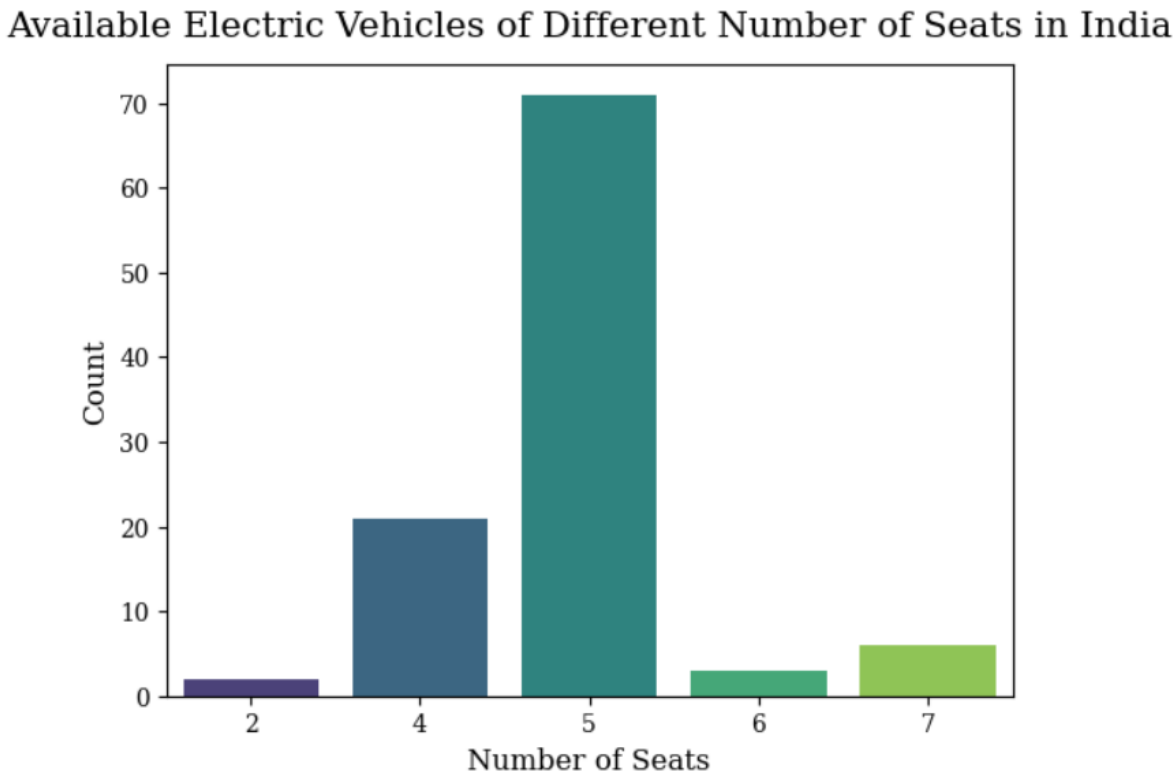
- States like Meghalaya, Nagaland, Sikkim, Tripura, and Arunachal Pradesh have very few outlets, below 25, reflecting the challenges in developing EV infrastructure in these regions.

Outliers:

- Some states and UTs like Pondicherry, Manipur, and Leh show relatively few outlets, which could be attributed to their small size or limited population.

Insights:

This chart highlights the uneven distribution of EV charging infrastructure across India. Larger and more industrialized states have more robust infrastructure, whereas smaller or more remote regions have fewer outlets. The data suggests that the development of EV infrastructure is still concentrated in more urbanized or economically developed areas.



The bar graph shows the distribution of available electric vehicles (EVs) in India based on the number of seats.

Key Features:

The x-axis represents the number of seats in the EVs (ranging from 2 to 7 seats).

The y-axis shows the count of available EVs for each seating capacity.

Observations:

5-Seater EVs Dominate:

The majority of available EVs in India have 5 seats, with a count of around 70, making this the most common EV seating configuration.

Moderate Availability for 4 and 7 Seaters:

EVs with 4 seats have a count of around 20.

EVs with 7 seats have a smaller count, around 5 to 10, indicating lesser availability but still notable.

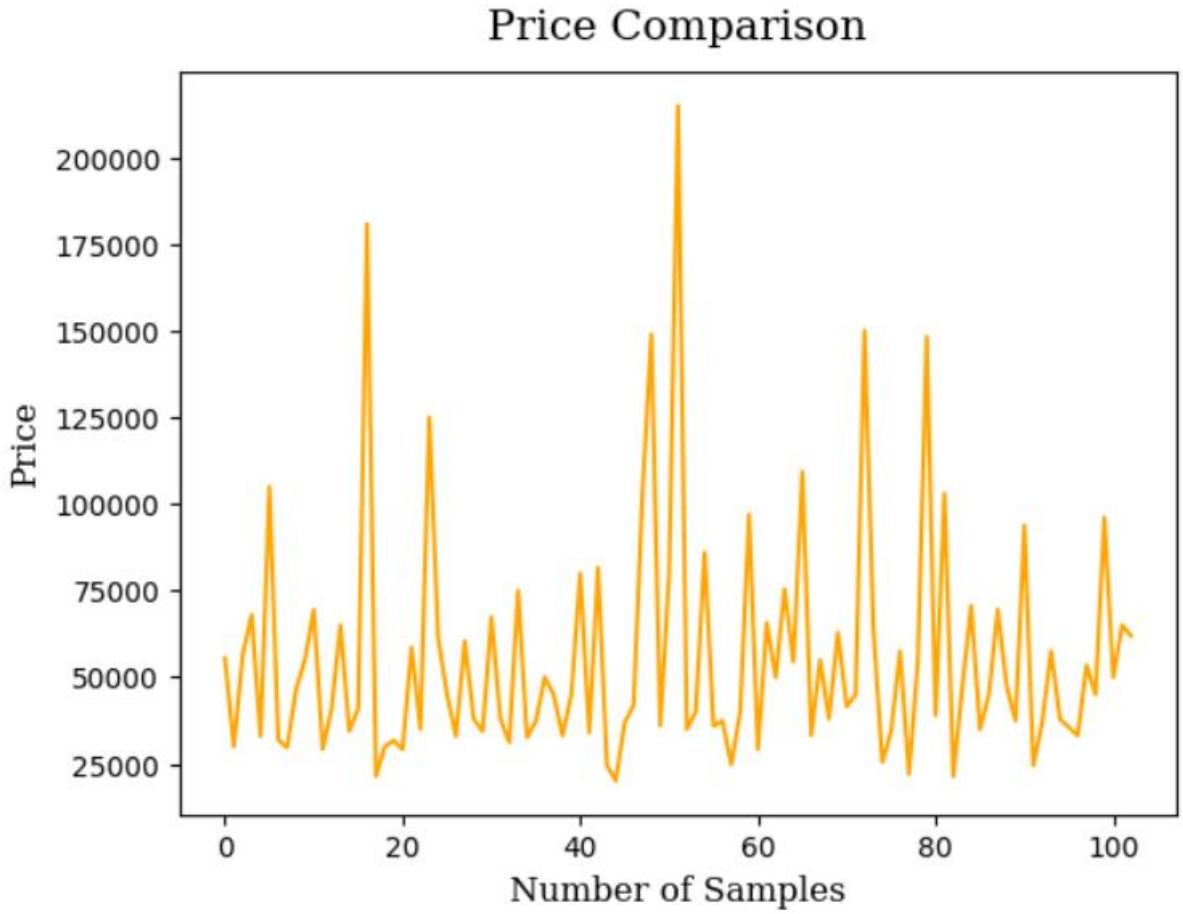
Minimal Availability for 2 and 6 Seaters:

Vehicles with 2 seats and 6 seats are the least available, with only a few models on the market.

Insights:

The chart shows that 5-seater electric vehicles are the most popular and widely available in India, likely due to their suitability for family and general urban use.

EVs with 4 and 7 seats also see some demand, whereas 2-seaters and 6-seaters remain niche or specialized categories.



The graph illustrates the fluctuation of price in relation to the number of samples over time, showcasing a pattern of alternating periods of price increases and declines.

Key Features:

Price Fluctuation:

The graph displays periods of rapid price increases, followed by subsequent declines, indicating that the price is highly variable rather than following a steady trend.

Influence of External Factors:

The price changes appear to be influenced by external factors beyond just the number of samples, such as market trends, supply and demand dynamics, or competition. These external elements likely drive the fluctuations observed in the graph.

Price Sensitivity:

Even with a small number of samples, the price shows significant variation. This indicates that the price is sensitive to changes in the underlying data, where even minor variations can have a noticeable impact.

Insights:

The graph suggests that the relationship between price and the number of samples is complex and affected by a combination of factors, not solely dependent on the number of samples.

The high variability even with a relatively small sample size implies that prices can shift rapidly, likely due to the interaction of multiple market forces.

Overall, the graph offers a visual understanding of the intricate relationship between price and sample numbers, revealing the impact of various influencing factors.

Github links:

NIRMAL: https://github.com/NirmalKoshy/EV-Market-Segmentation

ASNA: https://github.com/ASNAJAMS/electric-vehicle-market-segmentataion-in-india

ANJALI: https://github.com/anjali202377/Feyyn-Labs-Project-EV-Market-Segmentation-Analysis

HARSH: https://github.com/harshsinghrana/EV-Market-Segmentation