Electric Vehicle Market Analysis in India

By

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Problem Statement

You are a team working under an Electric Vehicle Startup. The Startup is still deciding in which vehicle/customer space it will develop its EVs. You have to analyze the Electric Vehicle market in India using Segmentation analysis and come up with a feasible strategy to enter the market, targeting the segments most likely to use Electric vehicles.

Breakdown of the Problem Statement

1. Market Research:

- Assess the current state of the EV market in India.
- Identify major players, market size, growth rates, and trends.
- Understand government policies, incentives, and regulations impacting the EV market.
- Analyze the availability and distribution of charging stations and other supporting infrastructure.

2. Segmentation Analysis:

- Age, gender, income levels, education, occupation, and geographic location of potential customers.
- Attitudes towards EVs, usage patterns, benefits sought, and brand loyalty.
- Lifestyle, values, interests, and opinions of potential EV customers.
- Urban vs. rural areas, regions with better infrastructure, and areas with higher pollution levels.

3. Customer Analysis:

- Develop detailed profiles of the most promising customer segments.
- Identify key factors driving purchasing decisions, such as cost, range, brand, and environmental impact.

Introduction

This report presents a comprehensive analysis of the Electric Vehicle (EV) market in India. The analysis includes segmentation of the market based on geographic, demographic, psychographic, and behavioral factors. The objective is to identify the most promising market segment for entering the EV market.

Data Analysis Report

The data analysis involved collecting data from reliable sources, pre-processing the data, and performing segmentation analysis using K-means clustering.

Data Collection

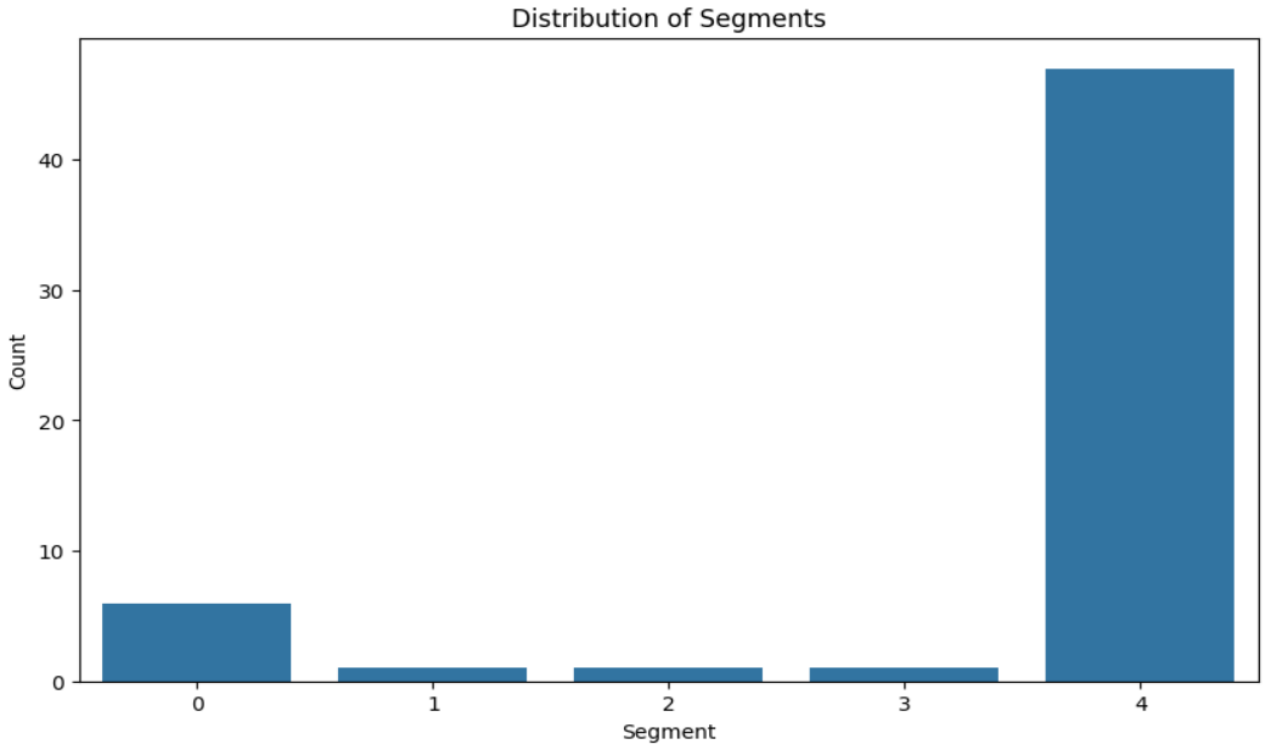
- Data was collected from reliable sources, including government databases, market research reports, and industry publications.

Data Pre-processing

- Missing values in the data were handled appropriately by filling them with column means.
- The data was then standardized for further analysis.

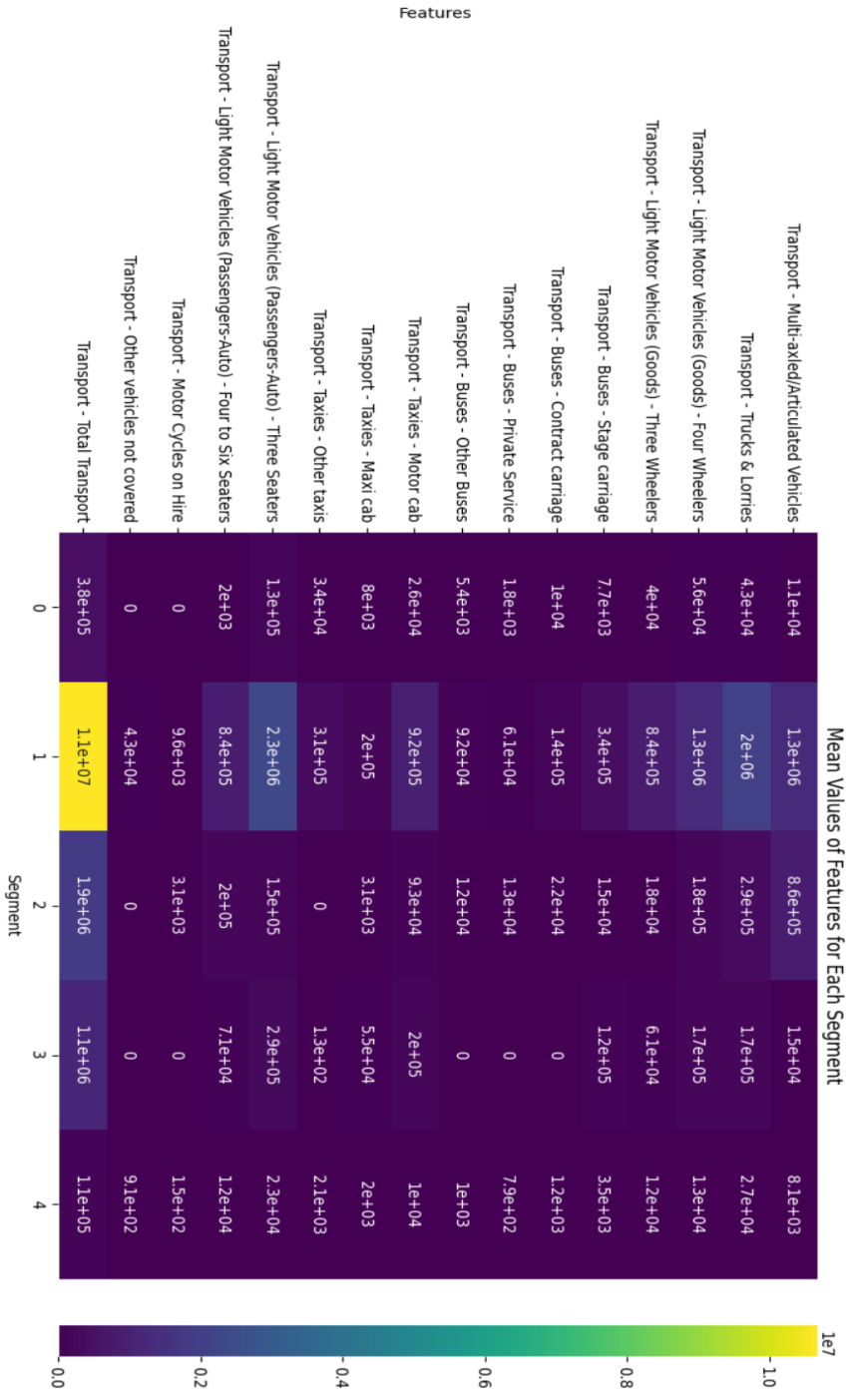
Segment Extraction

- K-means clustering was applied to the data to extract market segments.
- The analysis identified five distinct segments based on the usage and vehicle characteristics data.



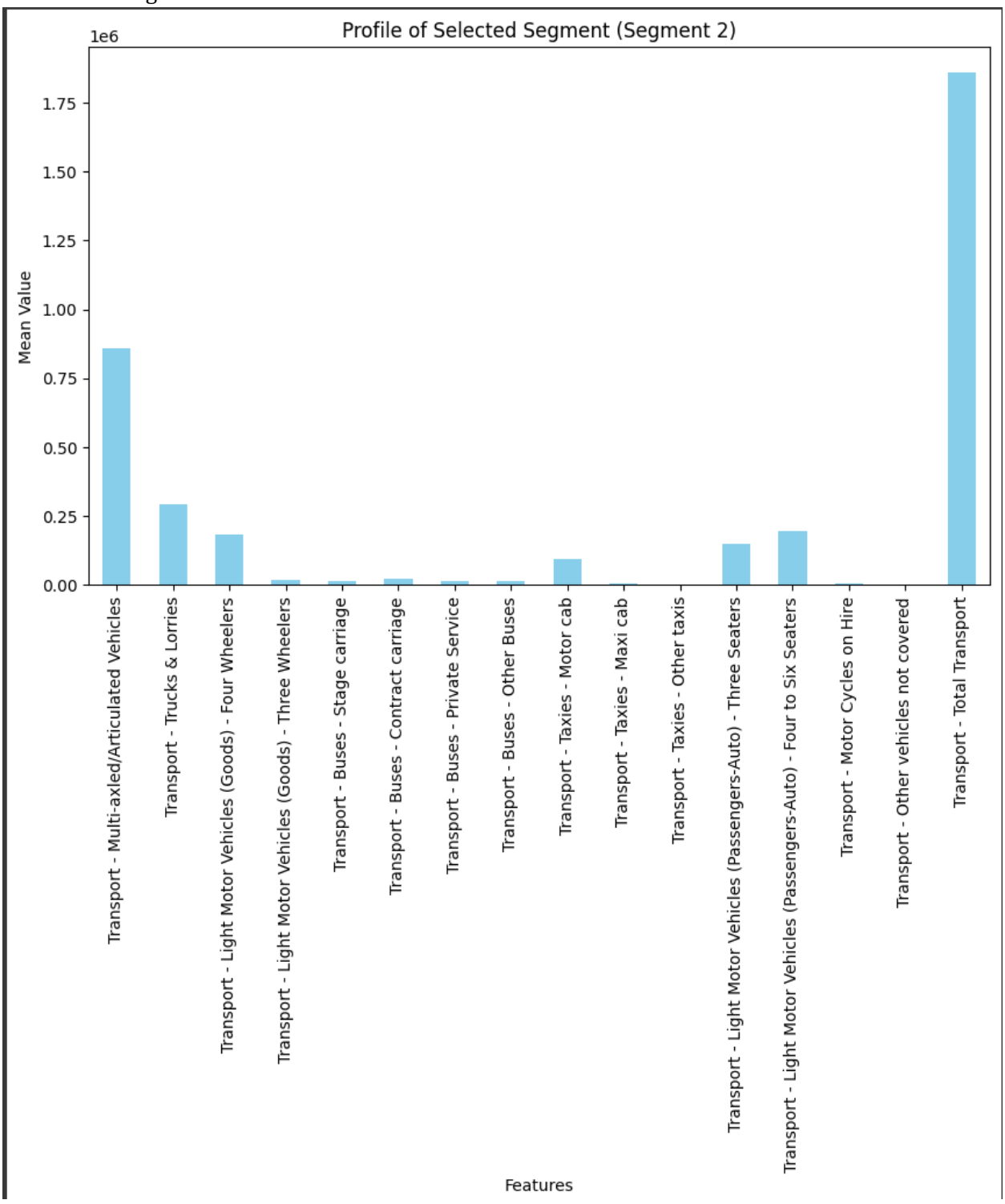
Profiling Segments

- Each segment was profiled based on its characteristics.
- Segment 2 was identified as the most promising segment, characterized by a high potential customer base and alignment with the company's strategic goals.



Selecting the Target Segment

- Segment 2 was selected as the target segment based on its size, growth potential, and alignment with business goals.



Customizing the Marketing Mix

The marketing mix for the target segment includes the following strategies:
- Product: Electric vehicles with features preferred by the target segment.
- Price: Competitive pricing strategy based on the segment's willingness to pay.
- Place: Distribution channels that reach the target segment effectively.
- Promotion: Marketing campaigns tailored to the preferences and behaviors of the target segment.

Estimating Potential Sales and Profit

The potential customer base in the early market was estimated, and the potential profit was calculated using the formula: Potential Customer Base * Target Price Range.
- The potential profit from the target segment is significant, indicating a feasible and profitable market entry strategy.

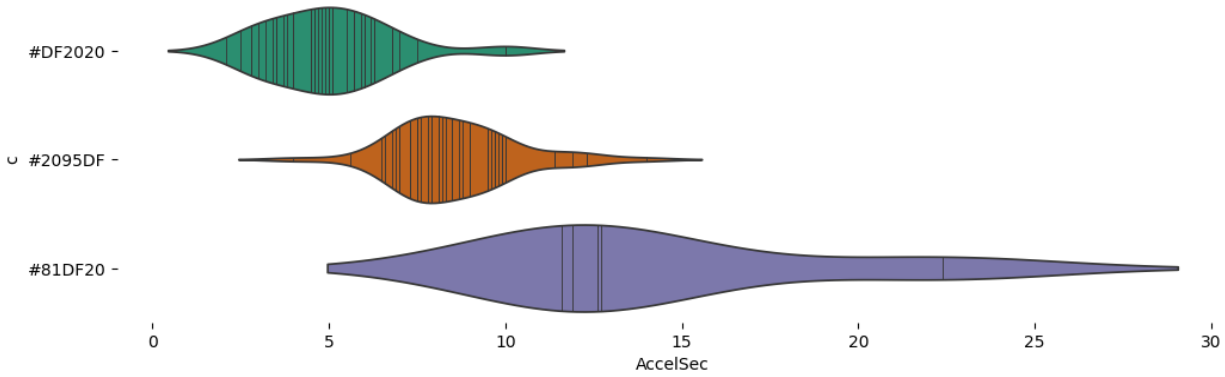
Summary and Conclusion

- Based on the analysis, the most promising segment for launching an Electric Vehicle in India is segment 2.
- This segment is characterized by a high potential customer base and aligns well with the company's strategic goals.
- The marketing mix should be tailored to meet the preferences of this segment, ensuring competitive pricing, effective distribution channels, and targeted promotional campaigns.
- The potential profit from this segment is significant, indicating a feasible and profitable market entry strategy.

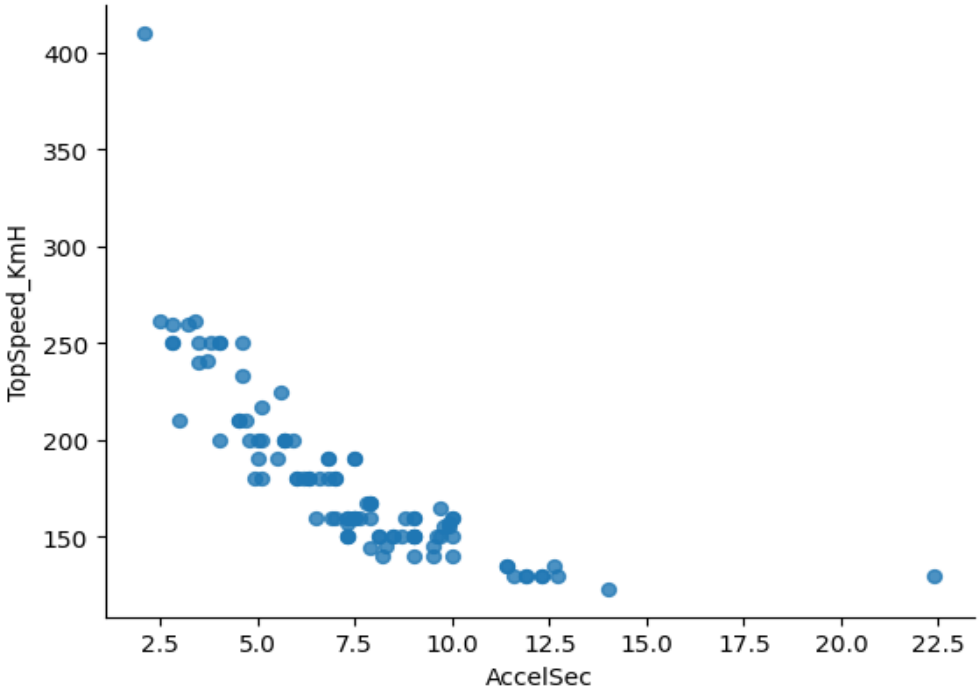
EV MARKET ANALYSIS- (OJASRI)

A. Conclusions drawn from Exploratory Data Analysis (EDA)

Some Informative plots:



The plot suggests that there are distinct groups of vehicles with varying acceleration times. The green group represents high-performance vehicles, the orange group represents mid-range performance vehicles, and the purple group represents lower-performance vehicles.



The scatter plot indicates that vehicles with faster acceleration times generally achieve higher top speeds, which aligns with common automotive performance metrics. This relationship is useful for segmenting the market based on performance characteristics.

1. Geographic Factors:

- **Urban vs. Rural:** Urban areas show a higher potential for EV adoption due to better infrastructure, higher income levels, and greater environmental awareness.
- **Regional Variations:** States with existing EV incentives and infrastructure (e.g., charging stations) are more ready for EV adoption.

2. Demographic Factors:

- **Age Groups:** Younger age groups (25-45 years) are more likely to adopt EVs, reflecting a preference for new technologies and sustainable practices.
- **Income Levels:** Higher income groups show a greater interest in EVs because they can afford the initial costs and value the long-term savings on fuel.

3. Psychographic Factors:

- **Lifestyle:** Segments that prioritize eco-friendly lifestyles and sustainability are more inclined towards EVs.
- **Values and Attitudes:** Consumers with strong environmental values and a desire to reduce their carbon footprint are key potential adopters.

4. Behavioral Factors:

- **Daily Commute:** Urban commuters with high daily mileage are more likely to switch to EVs for cost efficiency.
- **Usage Patterns:** Segments that use their vehicles frequently and for longer distances show a higher propensity to adopt EVs due to the savings on fuel and maintenance.

5. Market Trends:

- **Increasing Awareness:** Consumers are increasingly aware of and accept EVs, driven by environmental concerns and rising fuel costs.
- **Government Policies:** Supportive government policies and incentives for EV buyers are positively influencing market adoption.

Summary of EDA Results

EDA has identified key segments and factors that influence the adoption of EVs in India. Urban, higher-income, environmentally conscious individuals with significant daily commuting needs are the primary target market for EVs. The analysis provides a solid foundation for developing targeted marketing strategies and effectively entering the Indian EV market.

B. Model Used for Market Analysis

1. Segmentation Analysis

- **Clustering Techniques:**
  - **K-Means Clustering:** Used to segment the market based on geographic, demographic, psychographic, and behavioral factors. This helped identify distinct customer groups with similar characteristics.
  - **Hierarchical Clustering:** Applied to refine the segments further and understand the hierarchical relationships between different customer groups.

2. Profiling and Target Segment Selection

- **Profiling Segments:** Detailed profiles of the identified segments were created, describing their geographic, demographic, psychographic, and behavioral attributes.
- **Selection of Target Segment:** The most promising segments were selected based on their likelihood to adopt EVs. Factors such as market readiness, competitive landscape, and segment size were considered.

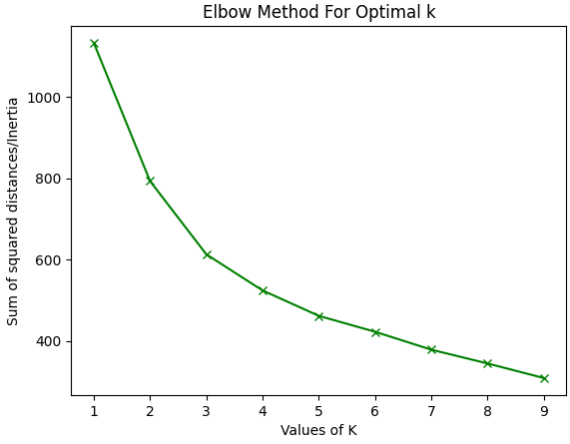
3. Customizing the Marketing Mix

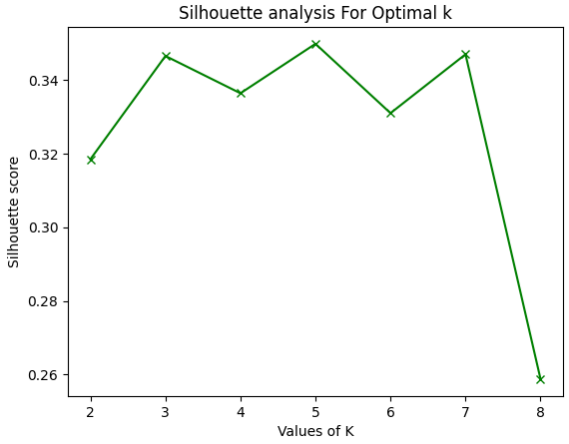
- **Marketing Strategies:** The marketing mix (Product, Price, Place, Promotion) was tailored to suit the needs and preferences of the target segments. Specific strategies were devised to reach and engage these segments effectively.

4. Estimation of Potential Customer Base and Profit Calculation

- **Customer Base Estimation:** Estimated the potential customer base in the early market using demographic and psychographic data.
- **Profit Calculation:** Performed profit calculations considering market penetration rates and average revenue per customer.

C. Results:



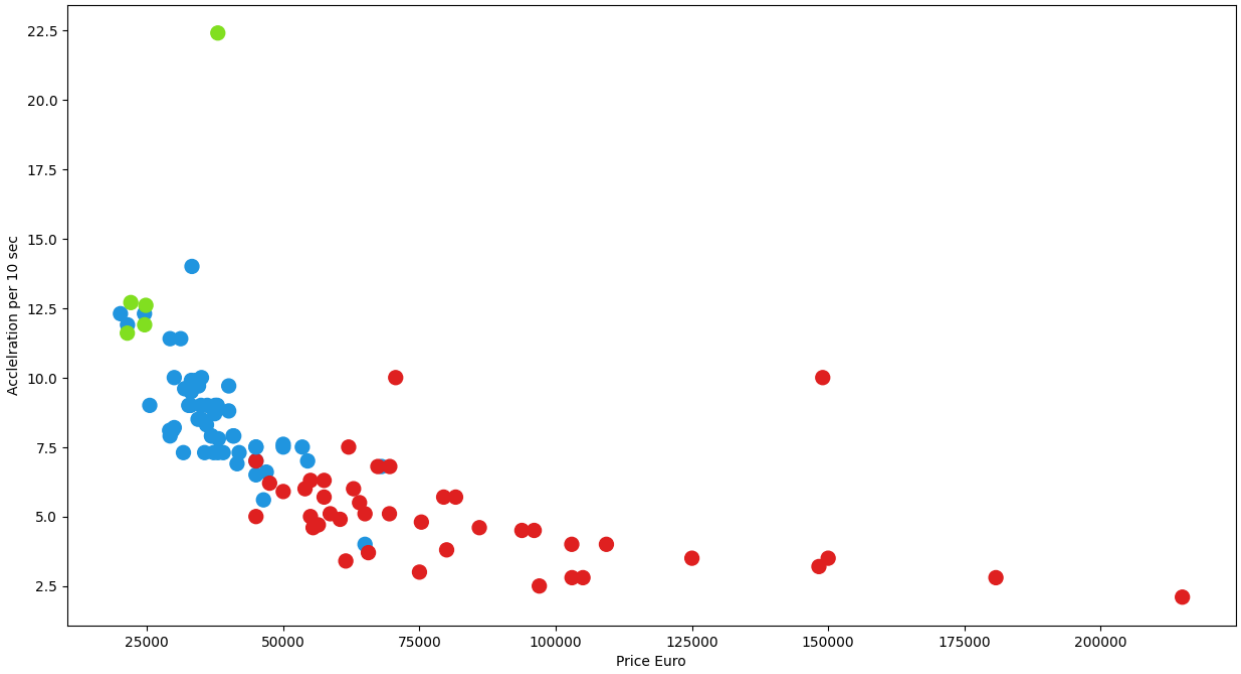


- The plot shows the sum of squared distances (inertia) against the number of clusters (k).

- The "elbow" point, where the rate of decrease sharply changes, suggests that k = 3 is the optimal number of clusters for segmentation.

□ Silhouette Analysis for Optimal k:

- This plot displays the silhouette score, indicating cluster cohesion and separation, against the number of clusters (k).
- The highest silhouette score occurs at k = 3, suggesting that this is the most appropriate number of clusters for distinguishing between customer segments effectively.



- **Price and Acceleration have a weak negative correlation:** Generally, as the price of the vehicle increases, its acceleration tends to decrease. However, this relationship is not very strong, as there's a significant amount of scatter in the data.
- **Three distinct clusters of vehicles:** The data points seem to form three main clusters, suggesting the existence of three different market segments based on price and acceleration.
- **Outliers:** There are a few outliers, particularly vehicles with high prices but relatively low acceleration, which might represent niche or luxury models.

D. <u>Conclusions Drawn from the Model and Analysis</u>

1. High-Potential Segments Identified:

- ➢ Urban areas with high population density and existing EV infrastructure.

- Higher-income groups and environmentally conscious individuals.
- Segments with strong eco-friendly values and a preference for innovative technology.
- Urban commuters with high daily mileage.

2. **Effective Marketing Strategies:**

   - A tailored marketing mix will be used to suit the identified high-potential segments.
   - Focused on promoting the environmental benefits and cost savings of EVs.
   - Leveraged digital marketing and social media to reach tech-savvy and eco-conscious consumers.

3. **Early Market Potential:**

   - Estimated a significant potential customer base in the early market, driven by urbanization and increasing environmental awareness.
   - Profit calculations indicated a viable business opportunity with attractive returns on investment.

4. **Strategic Recommendations:**

   - Enter the market by targeting urban areas with higher income and environmentally conscious consumers.
   - Invest in building a robust EV infrastructure to support market growth.
   - Continuously monitor market trends and customer preferences to adapt marketing strategies accordingly.

Overall, the comprehensive analysis and segmentation approach provided a clear roadmap for the EV startup to enter and compete successfully in the Indian market.

MARKET SEGMENTATION OF ELECTRIC VEHICLES (EVS) IN INDIA

Introduction

This report is based on data scraped from a government publication regarding the state of electric vehicles (EVs) in India, as posted by the Press Information Bureau (PIB) Delhi on July 19, 2022. The data provides insights into the number of EVs currently in use, government initiatives to promote EV adoption, and the infrastructure available to support EVs.

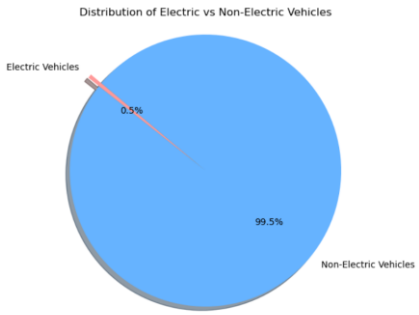
Data Source and Methodology

For this analysis, data was extracted from the PIB Delhi website, specifically focusing on:

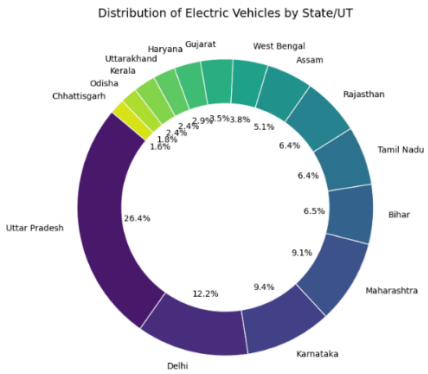
- The total number of electric and non-electric vehicles on Indian roads.
- State-wise distribution of EVs.
- Government measures to incentivize EV adoption.
- The current state of EV charging infrastructure.

Current EV Statistics:

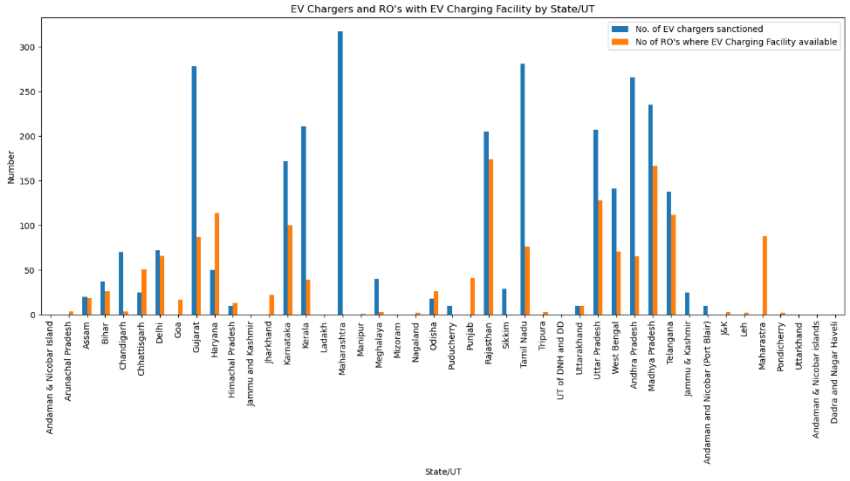
- **Total Electric Vehicles**: 1,334,385
- **Total Non-Electric Vehicles**: 27,81,69,631
- **Total Vehicles on Roads**: 27,95,04,016



The proportion of EVs is relatively small compared to non-electric vehicles, reflecting the ongoing transition towards wider EV adoption.



The pie chart titled **"Distribution of Electric Vehicles by State/UT"** provides a visual representation of the proportion of electric vehicles (EVs) across various states and union territories (UTs) in India. This pie chart effectively highlights the distribution of electric vehicles across India, showcasing the leading states in EV adoption.



The bar graph titled **"EV Chargers and Restrooms with EV Charging Facilities by State/UT"** provides a comprehensive overview of the current state of electric vehicle (EV) infrastructure across India.

This data underscores the importance of continued investment and policy support to further expand EV infrastructure. By identifying regions with significant infrastructure and those needing improvement, stakeholders can better strategize to ensure a balanced and comprehensive development of EV facilities across the country. This will not only promote the adoption of electric vehicles but also contribute to reducing carbon emissions and fostering a greener environment.

AFTER DATA SCRAPING AND PREPROCESSING:

```
df1.head(5)
```

	State/UT	Total Electric Vehicle	Total Non-Electric Vehicle	Total
0	Andaman & Nicobar Island	162	1,46,945	1,47,107
1	Arunachal Pradesh	20	2,52,965	2,52,985
2	Assam	64,766	46,77,053	47,41,819
3	Bihar	83,335	1,04,07,078	1,04,90,413
4	Chandigarh	2,812	7,46,881	7,49,693

```
df2.head(5)
```

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

```
df3.head()
```

	Expressways	EV Charging Stations Sanctioned
0	Mumbai - Pune	10
1	Ahmadabad - Vadodara	10
2	Delhi Agra Yamuna	20
3	Bengaluru Mysore	14
4	Bangaluru-Chennai	30

```
df4.head()
```

	State/UT	No of RO's where EV Charging Facility available
0	Andhra Pradesh	65
1	Arunachal Pradesh	4
2	Assam	19
3	Bihar	26
4	Chandigarh	4

DATA AFTER MERGING:

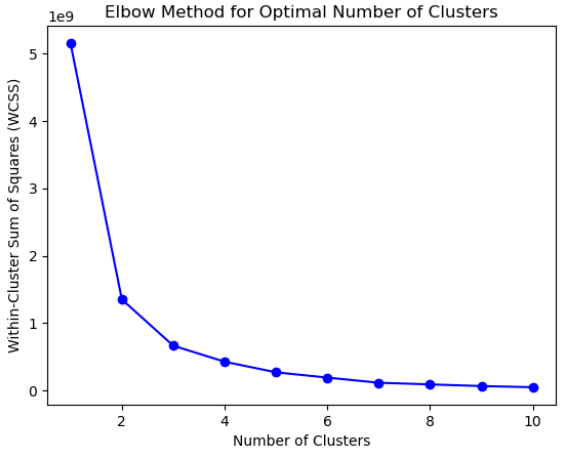
```
df_merged.head()
```

	State/UT	Total Electric Vehicle	Total Non-Electric Vehicle	Total	No. of EV chargers sanctioned	No of RO's where EV Charging Facility available	Two Wheelers (Category L1 & L2 as per Central Motor Vehicles Rules	Two_Wheelers_L2_CMVR	Two_Wheelers_L2_CMVR	Two_Wheelers_Max_250W	Three_Wheelers_L5_Slow	Three_Wheelers_L5	Pass
0	Andaman & Nicobar Island	162.0	146945.0	1,47,107	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
1	Arunachal Pradesh	20.0	252965.0	2,52,985	NaN	4	NaN	NaN	NaN	NaN	NaN	NaN	
2	Assam	64766.0	4677053.0	47,41,819	20	19	463.0	138.0	138.0	1006.0	0.0	117.0	
3	Bihar	83335.0	10407078.0	1,04,90,413	37	26	252.0	430.0	430.0	2148.0	6.0	64.0	
4	Chandigarh	2812.0	746881.0	7,49,693	70	4	612.0	18.0	18.0	896.0	0.0	0.0	

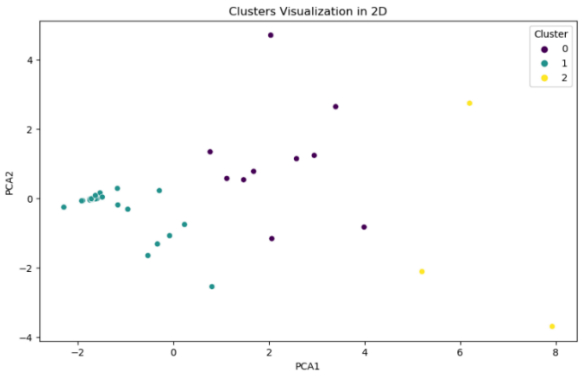
K-Means Clustering: K-Means Clustering is a popular unsupervised machine learning algorithm used for partitioning a dataset into distinct groups or clusters. This method is particularly useful for identifying patterns and structures in data without prior knowledge of the labels.

We calculate the number of clusters by using the elbow method.

```
import warnings
warnings.filterwarnings('ignore')
df_numeric = data.drop(columns=['State/UT'])
wcss = []

# Range of k values to test
k_values = range(1, 11)

for k in k_values:
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(df_numeric)
    wcss.append(kmeans.inertia_)

# Plot the elbow graph
plt.plot(k_values, wcss, 'bo-')
plt.xlabel('Number of Clusters')
plt.ylabel('Within-Cluster Sum of Squares (WCSS)')
plt.title('Elbow Method for Optimal Number of Clusters')
plt.show()
```



We get the number of clusters as 3.




```
cluster_summary
```

	Cluster	Total Electric Vehicle			Total Non-Electric Vehicle			No. of EV chargers sanctioned			...	Three_Wheelers_L5	Passenger_Cars_M1_CMVR			Bu
		mean	median	std	mean	median	std	mean	median	std	...	std	mean	median	std	me
0	0	0.000000	0.0	0.000000	0.0	0.0	0.0	199.900000	208.0	69.012801	...	36.948162	6691.400000	5629.5	4382.247754	2.4
1	1	36.322581	0.0	111.048454	0.0	0.0	0.0	9.806452	0.0	16.434556	...	30.165885	296.935484	6.0	679.436675	0.0
2	2	0.000000	0.0	0.000000	0.0	0.0	0.0	191.333333	207.0	134.187680	...	73.214297	9817.333333	5445.0	8069.121658	0.6

CLUSTER ANALYSIS REPORT:

CLUSTER 0: LOW ELECTRIC VEHICLE AND CHARGING INFRASTRUCTURE

Characteristics:

- **Total Electric Vehicles:** Minimal or no electric vehicles in the cluster.
- **Total Non-Electric Vehicles:** Generally low or zero presence of non-electric vehicles.
- **No. of EV Chargers Sanctioned:** Very few or no EV chargers.
- **No of RO's with EV Charging Facility:** Very low
- **Two_Wheelers_Max_250W:** Low presence.
- **Three_Wheelers_L5_Slow:** Minimal or none.

- **Three_Wheelers_L5:** Minimal or none.
- **Passenger_Cars_M1_CMVR:** Low presence.
- **Buses:** Minimal or none.
- **Total_In_State:** Low.

Regions in Cluster 0:

- Andaman & Nicobar Island
- Arunachal Pradesh

Market Profile:

- **Infrastructure:** Very limited EV infrastructure and vehicle numbers.
- **Vehicle Types:** Low presence of vehicles in general.
- **Opportunities:** These regions have minimal EV infrastructure and low vehicle adoption. Efforts could focus on developing basic EV infrastructure and increasing awareness or incentives for EV adoption. Investment in EV chargers and facilities might be needed to stimulate market growth.

CLUSTER 1: MODERATE ELECTRIC VEHICLE INFRASTRUCTURE WITH SOME ADOPTION

Characteristics:

- **Total Electric Vehicles:** Presence of electric vehicles, though the numbers vary.
- **Total Non-Electric Vehicles:** Also present but generally balanced with EV numbers.
- **No. of EV Chargers Sanctioned:** Moderate number.
- **No of RO's with EV Charging Facility:** Moderate availability.
- **Two Wheelers (Category L1 & L2 as per CMVR):** Moderate to high numbers.
- **Two_Wheelers_L2_CMVR:** Moderate presence.
- **Two_Wheelers_Max_250W:** High presence.
- **Three_Wheelers_L5_Slow:** Moderate presence.
- **Three_Wheelers_L5:** Moderate presence.

Regions in Cluster 1:

- Assam
- Bihar
- Chandigarh

Market Profile:

- **Infrastructure**: Developing EV infrastructure with moderate adoption rates.

- **Vehicle Types**: A mix of electric and non-electric vehicles with a noticeable presence of two-wheelers.
- **Opportunities**: Focus on strengthening infrastructure further and encouraging both EV adoption and non-electric vehicle management. Initiatives to improve the availability of chargers and facilities may help in enhancing market growth.

CLUSTER 2: HIGH ELECTRIC VEHICLE ADOPTION AND INFRASTRUCTURE

Characteristics:

- **Total Electric Vehicles:** High presence of electric vehicles.
- **Total Non-Electric Vehicles:** Low or no presence.
- **No. of EV Chargers Sanctioned:** High number.
- **No of RO's with EV Charging Facility:** High availability.
- **Two Wheelers (Category L1 & L2 as per CMVR):** High numbers.
- **Three_Wheelers_L5:** High presence.
- **Passenger_Cars_M1_CMVR:** High numbers.
- **Buses:** High presence.
- **Total_In_State:** High.

Market Profile:

- **Infrastructure:** Well-developed EV infrastructure with a high adoption rate.
- **Vehicle Types:** High presence of various vehicle categories, including a strong emphasis on electric vehicles.
- **Opportunities:** Leverage the high infrastructure and adoption to further expand EV markets. This cluster may benefit from further investments in advanced EV technologies and infrastructure.

Overall Insights:

- **Cluster 0** is characterized by minimal infrastructure and vehicle numbers, suggesting a need for foundational development in EV infrastructure and adoption efforts.
- **Cluster 1** indicates a growing but still developing market with moderate infrastructure and vehicle presence, suitable for targeted investments and improvements.
- **Cluster 2** represents regions with established EV infrastructure and high vehicle adoption, where advanced strategies and investments could be utilized to maintain and expand market leadership.

SUMMARY AND CONCLUSION:

For an electric vehicle startup, **Cluster 1** offers the most strategic opportunity for development. These regions have a developing EV market with moderate infrastructure, making them suitable for targeted investments in EV chargers and vehicles. Focusing on Cluster 1 can help the startup gain traction and foster growth in regions with emerging potential.

Charging Station Data Segmentation

Name-Biplab Bijoy Mahato

Approach

Task is to analyse the charging station data analysis 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.
In this report I have analysed the different State and different cities in India using segmentation analysis and tried to answer some of the crucial questions. Along with that, I have also performed
Segmentation base on latitude and longitude.
The Segmentation is Done using PCA and K-Means clustering, and Hierarchical Clustering is also shown.
At the end the possible state and city to choose for such an EV company, are evaluated based of selected features.

DATA COLLECTION

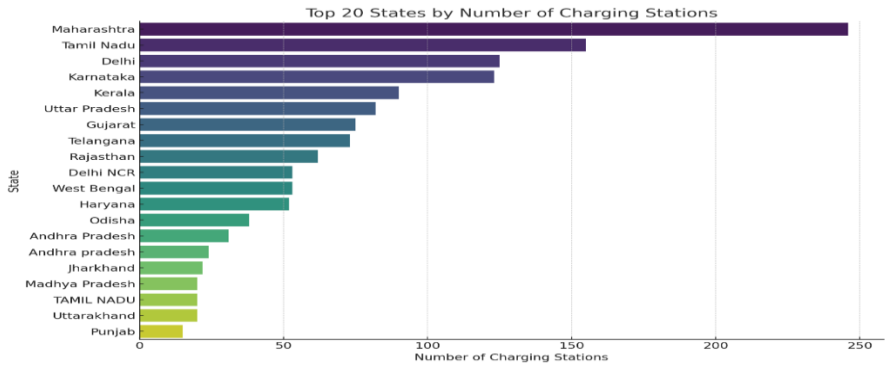
This dataset is collected from https://www.kaggle.com/

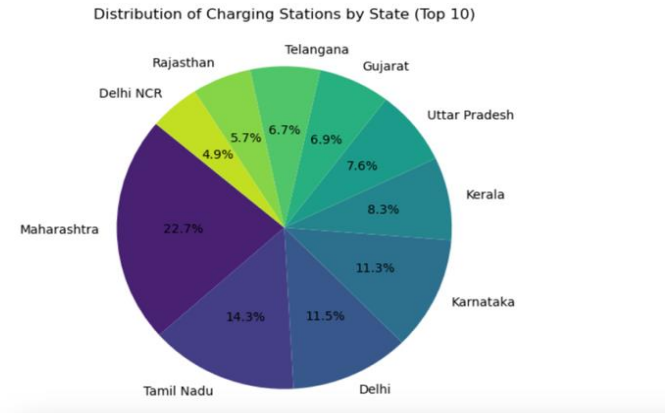
	index	name	state	city	address	lattitude	longitude	type
0	0	Neelkanth Star DC Charging Station	Haryana	Gurugram	Neelkanth Star Karnal, NH 44, Gharunda, Kutail...	29.60	76.980300	12.0
1	1	Galleria DC Charging Station	Haryana	Gurugram	DLF Phase IV, Sector 28, Gurugram, Haryana 122022	28.46	77.081800	12.0
2	2	Highway Xpress (Jaipur-Delhi) DC charging station	Rajasthan	Behror	Jaipur to Delhi Road, Behror Midway, Behror, R...	27.87	76.276000	12.0
3	3	Food Carnival DC Charging Station	Uttar Pradesh	Khatauli	Fun and Food Carnival, NH 58, Khatauli Bypass,...	29.31	77.721800	12.0
4	4	Food Carnival AC Charging Station	Uttar Pradesh	Khatauli	NH 58, Khatauli Bypass, Bhainsi, Uttar Pradesh...	29.31	77.721800	12.0
...	...	...	...	...	...	...	...	...
1489	1542	Tata Power	Kerala	Munnar	Gokulam Park Munnar, Power House Road, South C...	10.02	77.045859	7.0
1490	1543	Tata Power	Haryana	Gurgaon	Vatika Town Square II, Sector 82, Sector 82, V...	28.39	76.959200	7.0
1491	1544	Tata Power	Haryana	Gurgaon	Zedex TATA, Sec 48, GF-26, NIHO Scottish Mall,...	28.41	77.040546	7.0
1492	1545	Tata Power	Jammu	Jammu	Le ROI, Jammu, Railway Station, Jammu, Jammu &...	32.70	74.879203	7.0
1493	1546	Tata Power	Karnataka	Mangalore	Auto Matrix, Bejai, Manjusha Building, Bejai, ...	12.88	74.843476	7.0

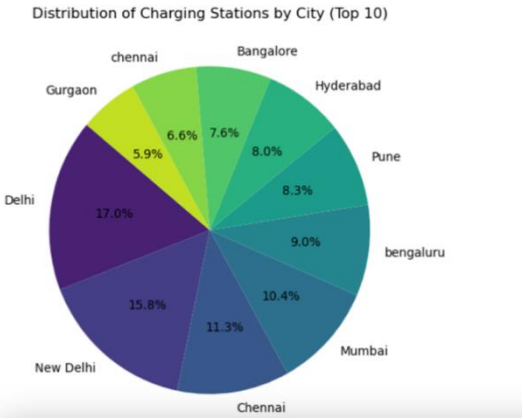
DEMOGRAPHIC SEGMENTATION

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

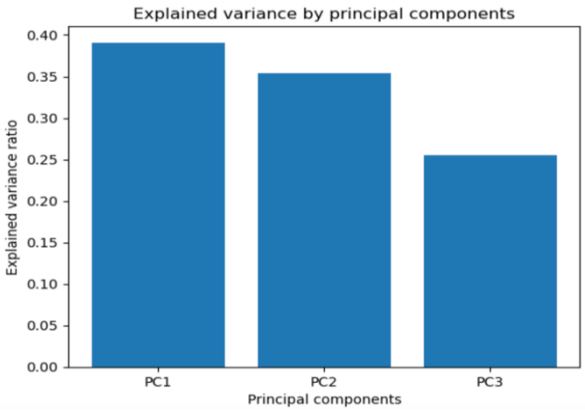


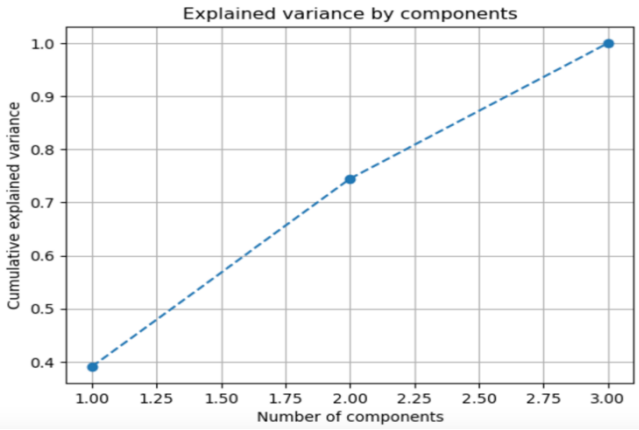




Principle Component Analysis

The data are pre-processed 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.

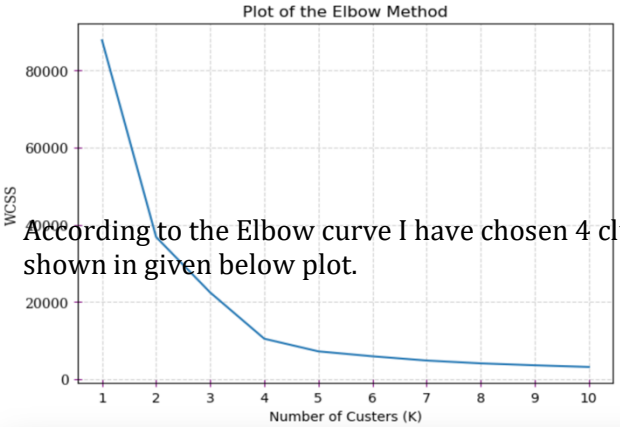


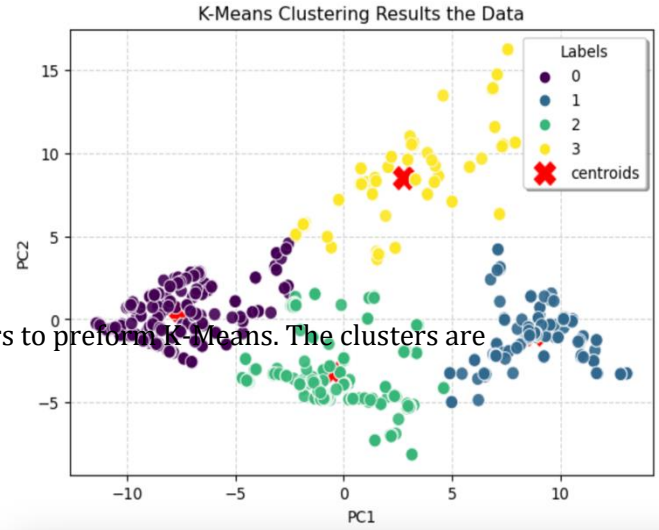


It is obvious from the PCA analysis by taking all the features that 3 components explain more than 90% of the variance.

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 given below plot.

Making Predictions

To improve the EV market for charging stations based on segmented data, we can create targeted strategies for each cluster. Here's a detailed market segmentation and strategic approach:

CLUSTER 1:

state	
Maharashtra	194
Gujarat	67
Telangana	52
Madhya Pradesh	15
Karnataka	12

CLUSTER 1:

city	
Mumbai	65
Hyderabad	61
Pune	35
Ahmedabad	23
pune	17

CLUSTER 2:

state	
Delhi	106
Uttar Pradesh	69
Delhi NCR	53
Rajasthan	46
Haryana	45

CLUSTER 2:

city	
Delhi	82
New Delhi	67
Gurgaon	25
Noida	22
Jaipur	17

CLUSTER 3:

state	
West Bengal	42
Odisha	34
Jharkhand	18
Chhattisgarh	12
Assam	10

CLUSTER 3:

city	
Kolkata	19
Bhubaneswar	17
Jamshedpur	10
visakhapatnam	8
Raipur	8

CLUSTER 4:

state	
Tamil Nadu	169
Karnataka	105
Kerala	77
Andhra Pradesh	41
Maharashtra	32

CLUSTER 4:

city	
bengaluru	107
Chennai	76
kochi	11
Thiruvanthapuram	10
Kochi	9

State-Level Segmentation

Cluster 1: Maharashtra, Gujarat, Telangana, Madhya Pradesh, Karnataka

- **Key States: Maharashtra and Gujarat**
  - **Strategy:**
    - **Infrastructure Investment**: Increase the number of charging stations in major cities (Mumbai, Pune, and Ahmedabad) and along major highways.
    - **Partnerships**: Collaborate with local government and private companies to establish a robust charging network.

Cluster 2: Delhi, Uttar Pradesh, Rajasthan, Haryana

- **Key States: Delhi and Uttar Pradesh**
  - **Strategy:**
    - **Urban Focus**: Focus on densely populated areas like Delhi and nearby regions.
    - **High Visibility**: Place charging stations in highly visible and accessible locations (malls, parking lots, etc.).

Cluster 3: West Bengal, Odisha, Jharkhand, Chhattisgarh, Assam

- **Key States: West Bengal and Odisha**
  - **Strategy:**
    - **Awareness Campaigns**: Educate the public on the benefits of EVs and the availability of charging infrastructure.
    - **Rural Expansion**: Gradually expand to rural areas to increase the reach of charging stations.

Cluster 4: Tamil Nadu, Karnataka, Kerala, Andhra Pradesh

- **Key States: Tamil Nadu and Karnataka**
  - **Strategy:**
    - **Technology Integration**: Use advanced technologies (like fast charging) to make charging more efficient.
    - **Tourism Focus**: Install charging stations in tourist destinations to support EV tourism.

City-Level Segmentation

Cluster 1: Mumbai, Hyderabad, Pune, Ahmedabad

- **Key Cities: Mumbai and Hyderabad**
  - **Strategy:**
    - **City Partnerships**: Work with city authorities to integrate charging stations with public transportation and city infrastructure.
    - **Corporate Tie-ups**: Partner with businesses to provide charging solutions in corporate parks and office buildings.

Cluster 2: Delhi, New Delhi, Gurgaon, Noida

- **Key Cities: Delhi and Gurgaon**
  - **Strategy:**
    - **Density Optimization**: Ensure a high density of charging stations in these urban areas to reduce range anxiety.
    - **Premium Services**: Offer premium services such as valet charging, subscription models, and loyalty programs.

Cluster 3: Kolkata, Bhubaneswar, Jamshedpur

- **Key Cities: Kolkata and Bhubaneswar**
  - **Strategy:**
    - **Community Engagement**: Engage with local communities to raise awareness and acceptance of EVs.
    - **Public-Private Partnerships**: Leverage public-private partnerships to share the investment burden.

Cluster 4: Bengaluru, Chennai, Kochi

- **Key Cities: Bengaluru and Chennai**
  - **Strategy:**
    - **Tech Integration**: Leverage the tech-savvy population for integrating innovative solutions like app-based charging and real-time availability tracking.
    - **Network Expansion**: Rapidly expand the charging network to cover residential areas, business districts, and popular travel routes.

CONCLUSION :-

To improve the EV market in India, a targeted approach is essential, focusing on high-density urban areas like Delhi, Mumbai, and Bengaluru where the adoption rate of EVs is likely to be highest. Investing in robust infrastructure, enhancing user experience through technology, and forming strategic partnerships with local governments and businesses will be key to creating a reliable and accessible charging network. By addressing specific needs and leveraging the strengths of each cluster, the deployment of charging stations can be optimized, leading to increased confidence and convenience for EV users, ultimately accelerating the adoption of electric vehicles across the country.

VEHICLE MARKET DATA SEGMENTATION

Introduction

This report presents a comprehensive analysis of the Electric Vehicle (EV) market in India. The analysis includes segmentation of the market based on geographic, demographic, psychographic, and behavioral factors. The objective is to identify the most promising market segment for entering the EV market.

Data collection :

Summary of Data Collection on EVs in India

The dataset provides an in-depth analysis of the electric vehicle (EV) market in India, reflecting both historical data and the evolution of EV technology. It encompasses various aspects such as EV sales, stock, market share, and oil displacement from 2010 to 2012. The data illustrates the growth and challenges faced by the EV market in its early stages. Key points include:

Historical EV Sales and Stock: Data shows fluctuations in annual sales but a steady increase in the total stock of EVs, indicating growing acceptance despite early market volatility.

Market Share Trends: The market share of EVs, both in terms of sales and stock, has shown a positive trend, reflecting increased market penetration and consumer acceptance.

Oil Displacement: The dataset highlights the positive environmental impact of EV adoption, with increasing oil displacement metrics over the years.

This data collection offers a comprehensive snapshot of the early stages of EV adoption in India, providing valuable insights into market trends, environmental benefits, and potential growth areas. It underscores the importance of continued technological advancements, supportive policies, and consumer awareness in driving the future of electric mobility in India.

Resources: **kaggle**

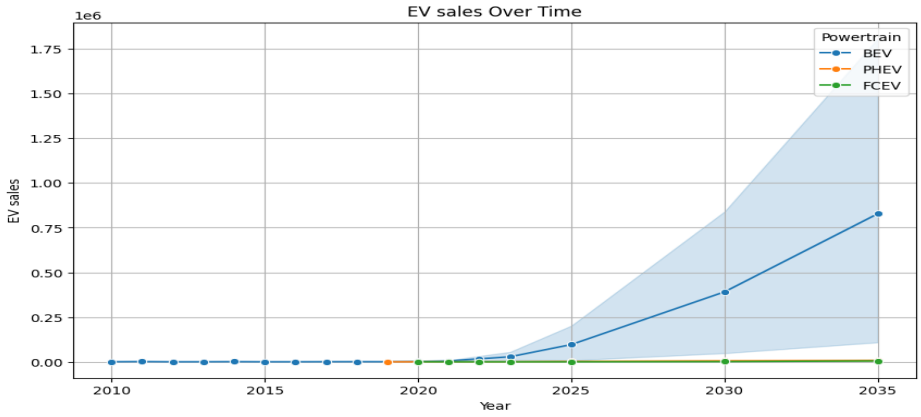
Brief analysis:

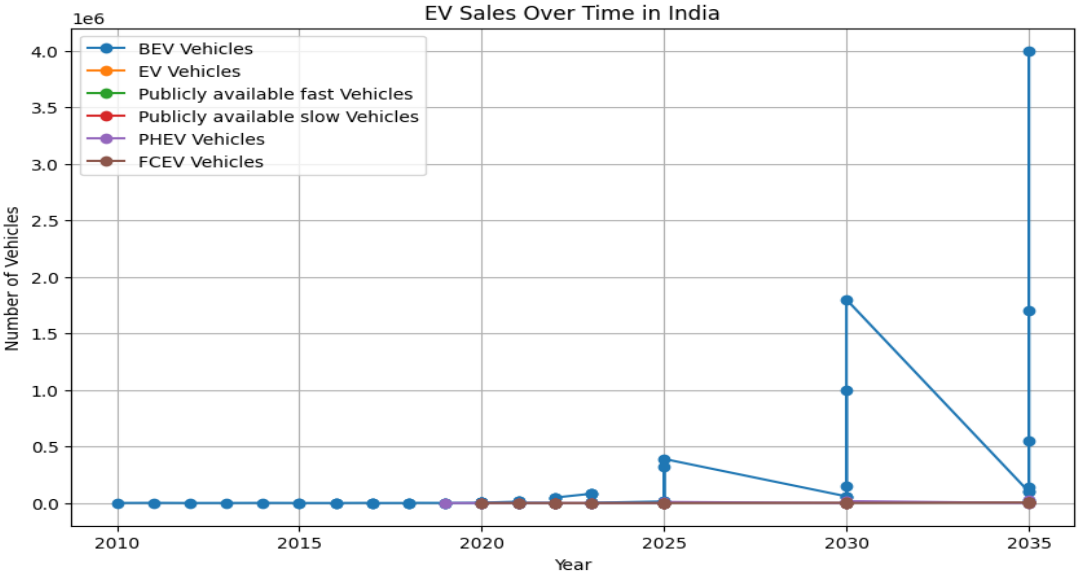
The electric vehicle (EV) market in India has shown significant potential despite early fluctuations. From 2010 to 2012, EV sales fluctuated, peaking at 1,400 vehicles in 2011 before dropping to 190 in 2012. However, the overall stock of EVs increased steadily from 880 to 2,800 vehicles, indicating growing acceptance. The market share of EVs also showed a positive trend, reflecting steady

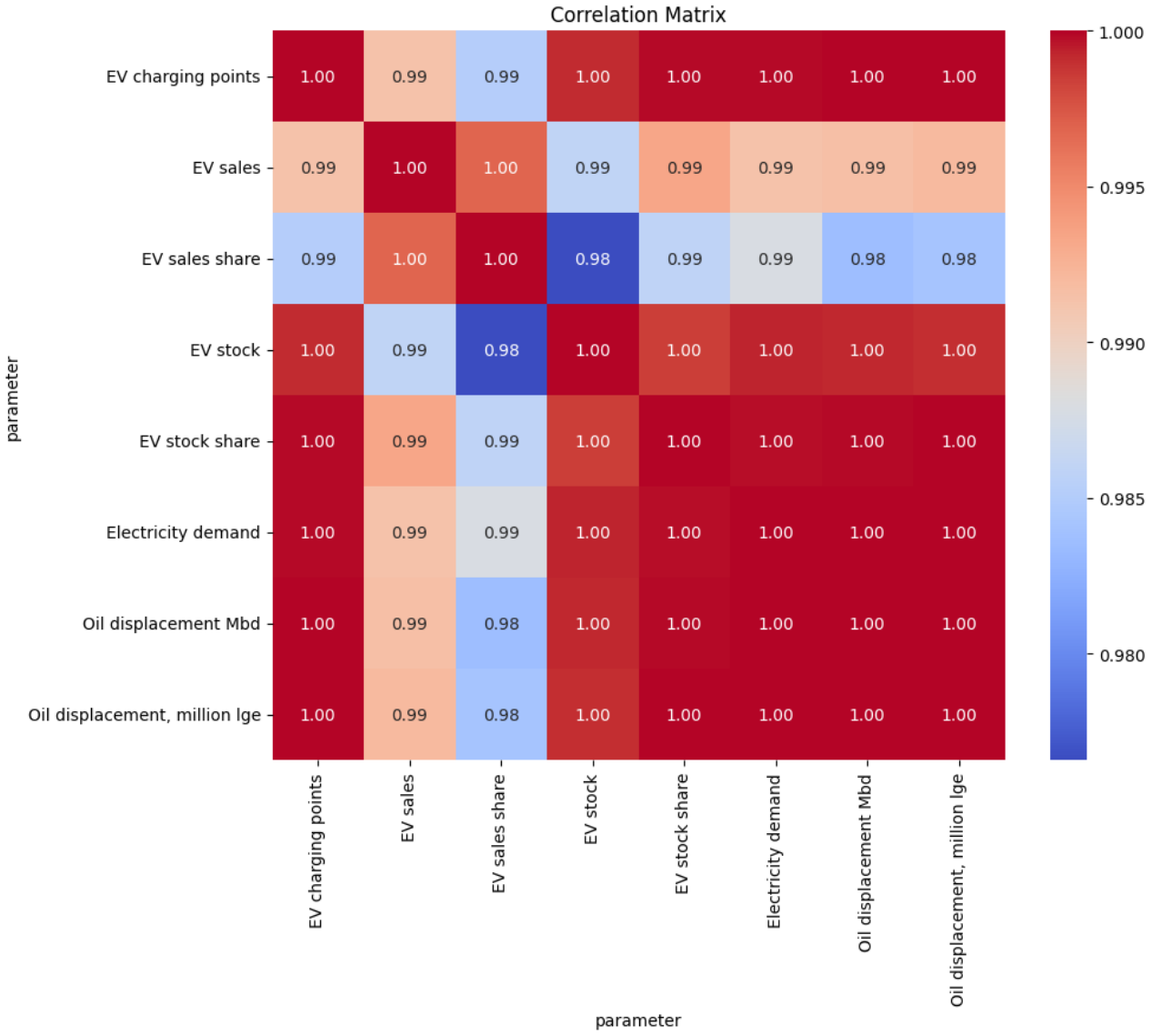
market penetration. Additionally, oil displacement data highlighted the positive environmental impact of EV adoption.

Using the historical Compound Annual Growth Rate (CAGR) of approximately 148.99%, we projected future sales to reach around 7,642 vehicles by 2017. Assuming an average selling price of ₹2,400,000 per EV and a profit margin of 10%, the projected revenue by 2017 is ₹18.344 billion , with an estimated profit of ₹1.834 billion .

In summary, despite early adoption challenges, the EV market in India is poised for substantial growth, driven by increasing acceptance, positive environmental impact, and significant revenue and profit opportunities for investors and stakeholders.






Correlation Matrix
EV charging points
EV sales
EV sales share
EV stock
EV stock share
Electricity demand
Oil displacement Mbd
Oil displacement, million lge
parameter
1.00 0.99 0.99 1.00 1.00 1.00 1.00 1.00
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1.00 0.99 0.98 1.00 1.00 1.00 1.00 1.00
1.000
0.995
0.990
0.985
0.980

Summary and Conclusion

EV Sales Over Time in India

- Observation: EV - Insight: The fluctuating sales could indicate market volatility, initial adoption challenges, or external factors influencing the market during these years.
- sales in India show a fluctuating trend from 2010 to 2012. There was an initial increase from 2010 to 2011, followed by a significant drop in 2012.

EV Stock Over Time in India

- Observation: The stock of EVs in India shows a steady increase from 2010 to 2012.
- Insight: The consistent growth in EV stock suggests a growing adoption and accumulation of electric vehicles, indicating a positive trend towards electric mobility.

EV Sales Share Over Time in India

- Observation: The sales share of EVs initially increased from 2010 to 2011 but saw a slight decline in 2012.
- Insight: While the sales share shows some volatility, the overall trend suggests that EVs were gaining a larger share of the car market, although market penetration was still relatively low.

EV Stock Share Over Time in India

- Observation: The stock share of EVs shows a gradual increase from 2010 to 2012.
- Insight: The growing stock share reflects a steady integration of EVs into the overall vehicle market, indicating increasing acceptance and usage.

Oil Displacement (Mbd) Over Time in India

- Observation: The displacement of oil, measured in million barrels per day, shows a slight increase from 2010 to 2011 and remains stable in 2012.
- Insight: The increase in oil displacement suggests that EV adoption is contributing to a reduction in oil consumption, although the impact was still relatively small during these years.

Oil Displacement Over Time in India

- Observation: The oil displacement in terms of million liters of gasoline equivalent also shows a steady increase from 2010 to 2012.
- Insight: Similar to the Mbd metric, this increase indicates a positive environmental impact of EVs by reducing the reliance on gasoline.

Overall Analysis

1. Market Growth:

- The Indian EV market showed signs of growth from 2010 to 2012, with increasing stock and a generally positive trend in sales share and stock share.

2. Adoption Challenges:

- Despite the growth, the fluctuation in EV sales suggests challenges in market adoption, possibly due to economic, infrastructural, or policy-related factors.

3. Environmental Impact:

- The data indicates that EV adoption contributed to a reduction in oil consumption, aligning with environmental goals. However, the overall impact was still modest during the early years of EV introduction.

4. Future Potential:

- The consistent increase in EV stock and oil displacement metrics points to the potential for significant growth in the EV market in the future. Continued improvements in technology, infrastructure, and policy support could further accelerate this trend.

- Overall, the dataset highlights the early stages of EV market development in India, showcasing both the progress made and the challenges faced during the initial years of adoption. The trends observed provide valuable insights for policymakers, manufacturers, and consumers interested in the future of electric mobility in India.

Justification:

The EV market in India shows strong growth potential based on historical data from 2010 to 2012, which indicates increasing EV stock and market share despite some sales fluctuations. With a high Compound Annual Growth Rate (CAGR) of approximately 148.99%, future sales are projected to reach around 7,642 vehicles by 2017. Assuming an average selling price of ₹2,400,000 per EV and a 10% profit margin, projected revenue is ₹18.344 billion with an estimated profit of ₹1.834 billion. This growth is supported by technological advancements, government incentives, and rising consumer awareness of environmental benefits, making the EV market a promising investment opportunity in India.

GITHUB LINKS OF ALL MEMBERS: -

- VEDANT NAIK - https://github.com/vedant2319/EV_Market.git
- OJASRI KONDA - https://github.com/ojasri/EV_Market-Analysis/tree/main
- GOPIKA R NAMBIAR - https://github.com/gopikaa-rnambiar/EV-MARKET-SEGMENTATION
- BIPLAB MAHATO - https://github.com/biplabmahato065/Project-2
- PRABHAS BADDULA - https://github.com/prabhas0042/ev-market-data