REPORT

EV MARKET SEGMENTION ON DIFFERENT INDIAN MARKET FACTORS

TEAM PIYUSH

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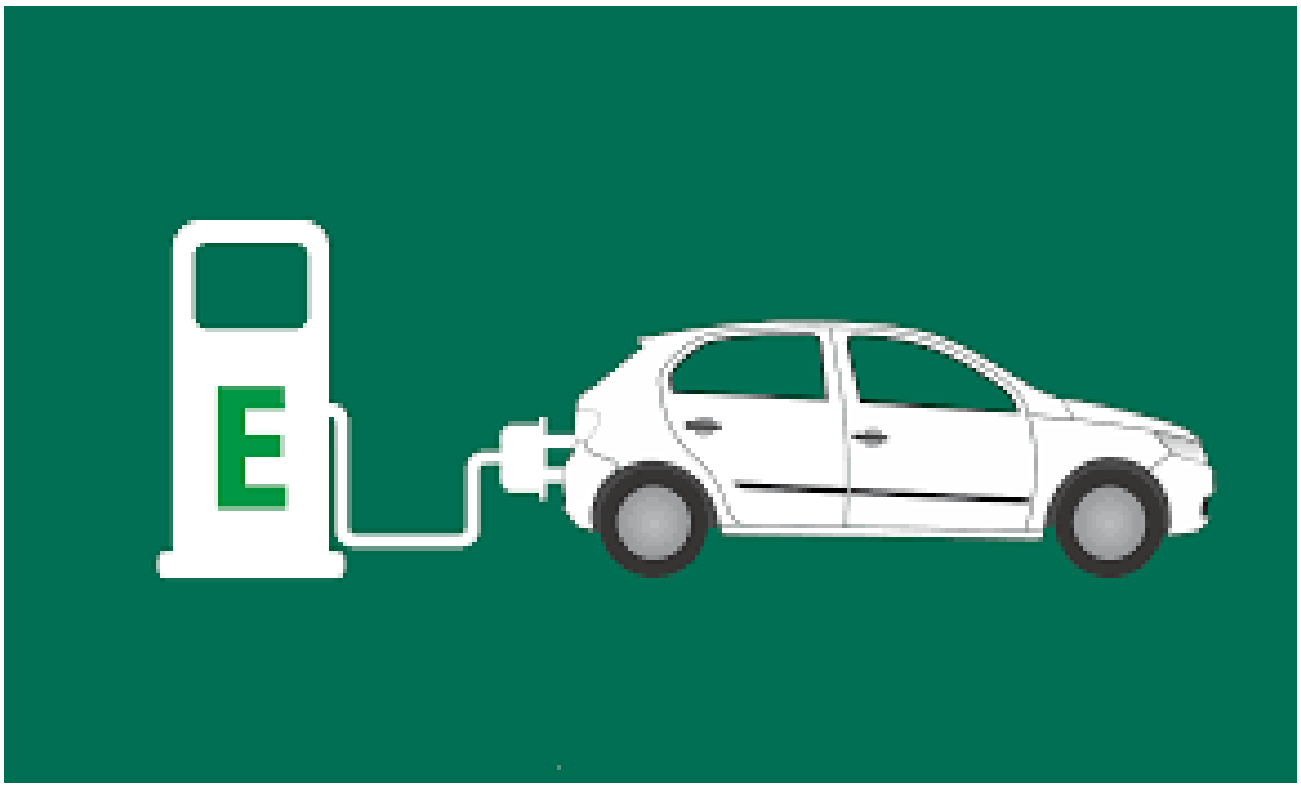


1. Team Members

i. Piyush Chandra : https://github.com/piyushchandra357/MarketSegP2
ii. Shivang Vyas : https://colab.research.google.com/drive/18ZhQB4BRrQ2FqnlhqY2yqosT39yrt3IA?usp=sharing
iii. Nizamol F : https://github.com/Nizamol/Feynn_Labs-Internship/tree/main/Electric_Vehicle_Segmentation
iv. Prerana Sharma: https://github.com/preranasharma15/EV/tree/main

2. Data Sources

i. https://www.kaggle.com/datasets/divyanshusingh18/ev-cars-india-2023
ii. https://tn.data.gov.in/resource/stateuts-wise-current-sales-electric-vehicles-ev-country-various-segments-reply-unstarred
iii. https://www.kaggle.com/datasets/saketpradhan/electric-vehicle-charging-stations-in-india
iv. Bikewala.com
v. Some data was scrapped off government websites like Vahan etc.
vi. https://www.data.gov.in/keywords/Electric
vii. https://data.mendeley.com/datasets/9c4brbnms3/1

3. Data Pre-processing

Pre-processing was performed on each dataset using the following libraries: Pandas, NumPy, Matplotlib, Sklearn.

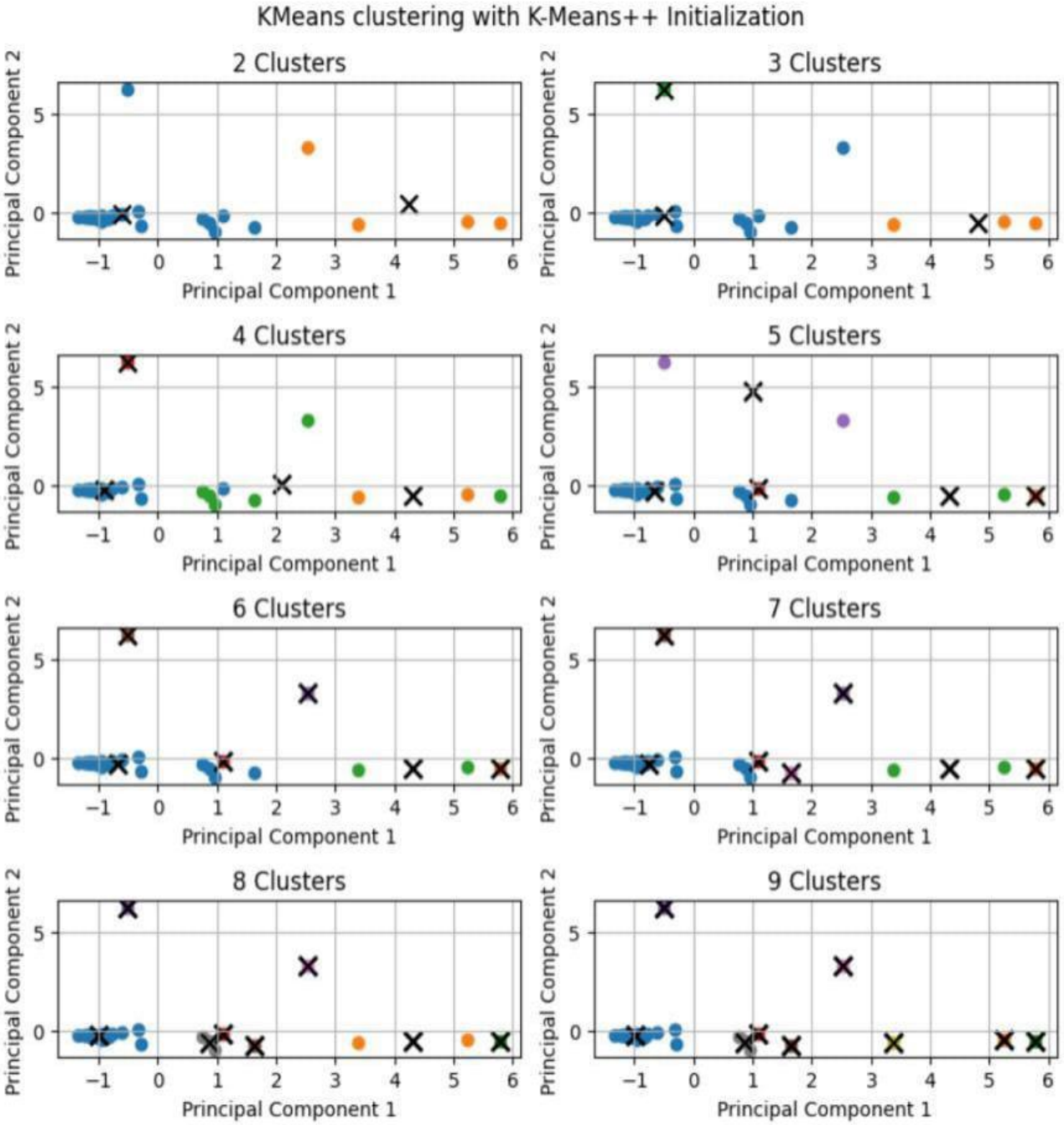
4. Segment Extraction and Profiling

PART – I : GEOGRAPHICAL MARKET SEGMENTATION OF THE ELECTRIC VEHICLE MARKET

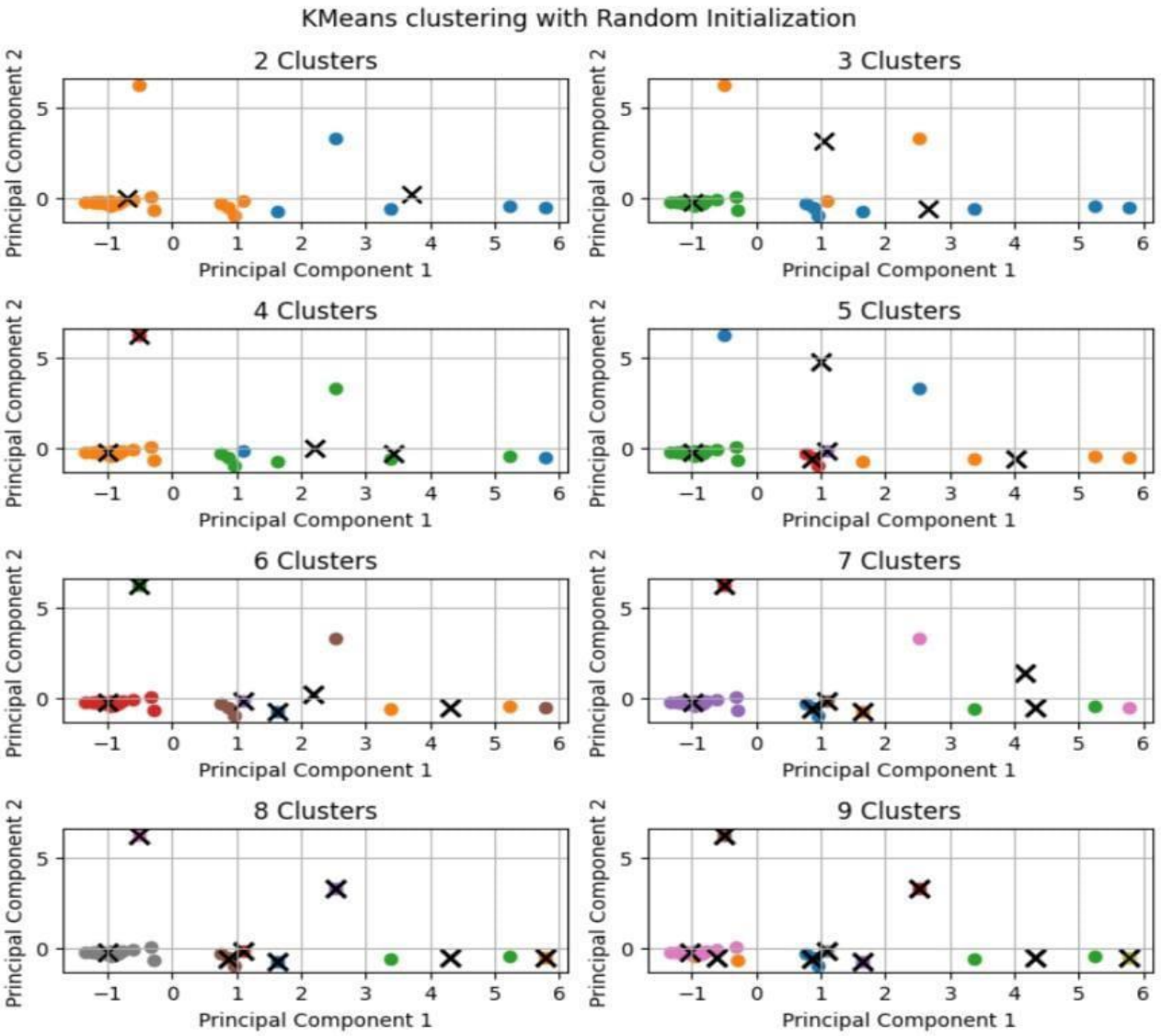
Comprehensive analysis of the geographical segmentation of the Electric Vehicle market, aimed at understanding the regional dynamics that influence EV adoption and sales. By analysing sales data across different areas, we can identify key trends and patterns that influence the growth and demand of EVs in specific region. This segmentation allows us to understand the unique characteristics of each market, from densely populated urban centers with established charging networks to emerging markets with untapped potential.

Based on the visualization below (fig.1 and fig.2) with varying cluster numbers, it appears that selecting 3 clusters yields the most reasonable segmentation of the data. Both the silhouette score and global stability plot indicate that clusters 7 and 5 effectively capture the underlying structure of the data but upon visualization after applying k-means that doesn't seem to be the case.

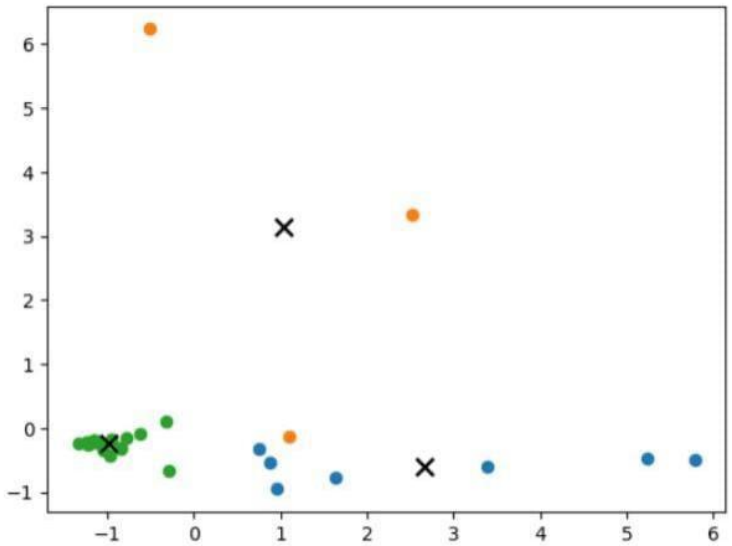
Additionally, the segmentation achieved with Random initialization appears to be more effective than that with KMeans++ initialization. This observation suggests that the choice of centroid initialization method plays a significant role in the clustering outcome. Overall, the analysis suggests



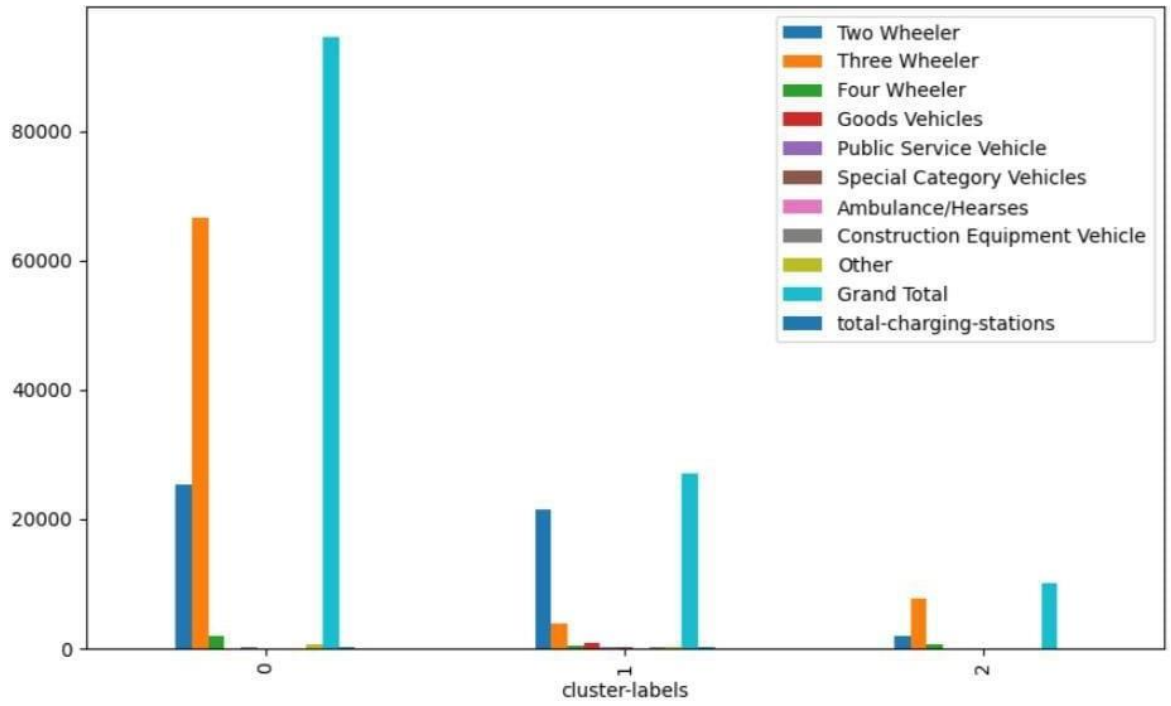
that opting for 3 clusters with random initialization would likely provide the most meaningful segmentation of the data compared to other cluster numbers and initialization methods considered.



Profiling and Describing Segments



Final clusters were obtained from K-Means clustering, with n_clusters =3 and init='random'.



On inspecting the means after grouping the features by cluster labels (as depicted in the aboveimage), 3 clear clusters emerged.

Cluster 0: Dominant Two-Wheeler and Three-Wheeler Market

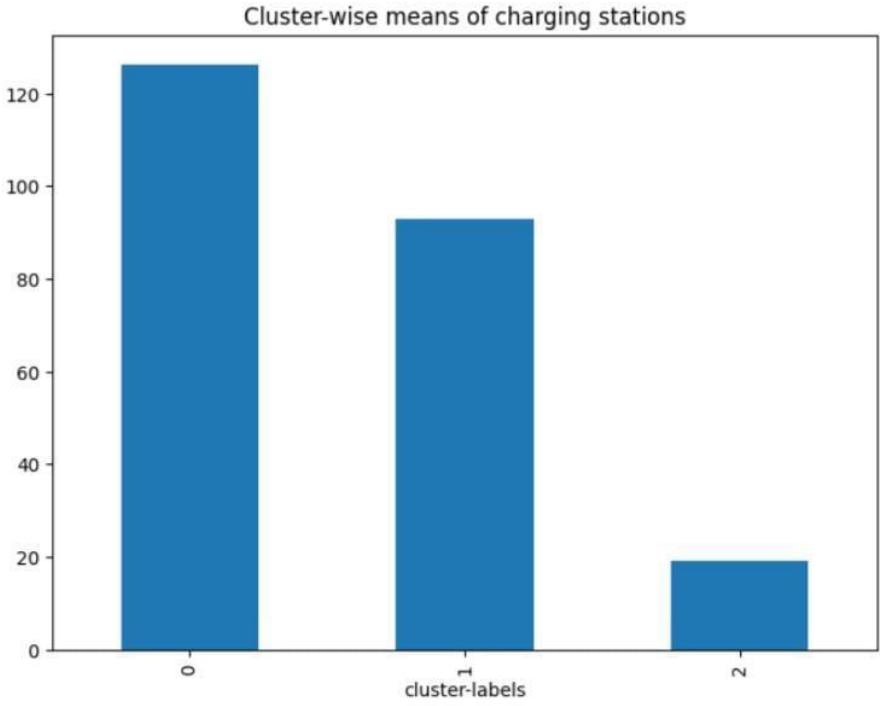
1. Represents the highest values across all vehicle categories, indicating a marketdominated by two-wheelers and three-wheelers.
2. More three-wheelers than two-wheelers, with a significant number of both vehicle typespresent.
3. Noteworthy presence of four-wheelers alongside two-wheelers and three-wheelers, suggesting a diverse mix of vehicles.

Cluster 1: Diverse Market with Balanced Vehicle Distribution

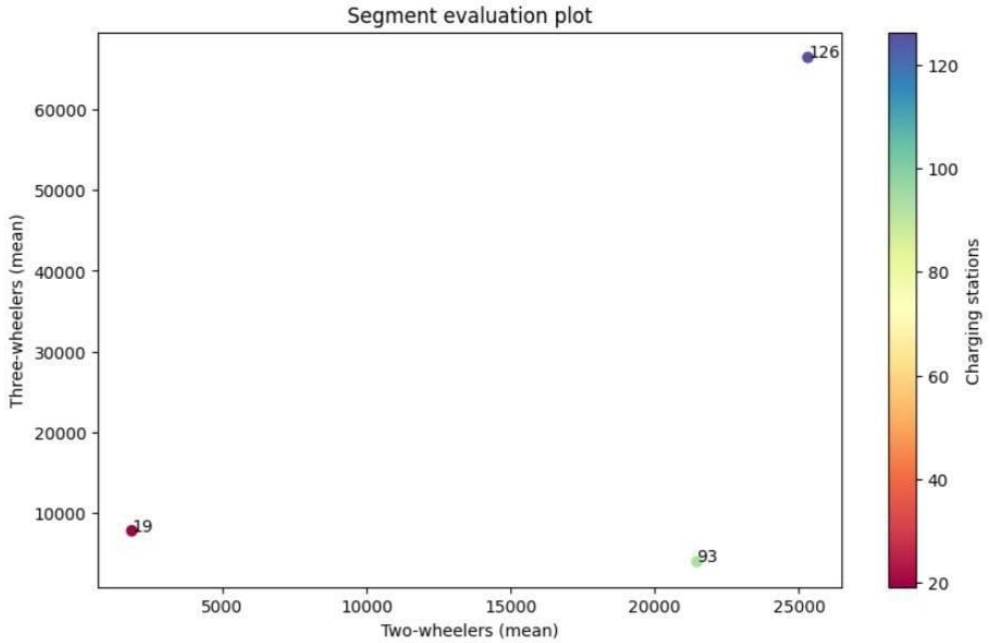
1. Characterised by a balanced distribution of two-wheelers and three-wheelers, with ahigher presence of two-wheelers.
2. Mean values fall between those of the other clusters, indicating moderate usage levelsacross vehicle categories.
3. Notable presence of goods vehicles alongside two-wheelers and three-wheelers,reflecting a diverse market composition.

Cluster 2: Small-Scale Market with Focus on Three-Wheelers

1. Characterized by the lowest values across all vehicle categories, indicating a smaller-scale market compared to other clusters.
2. More three-wheelers than two-wheelers, with relatively fewer vehicles overallcompared to other clusters.



The charging station availability varies across the clusters, with Cluster 1 representing a moderate range, while Cluster 0 and Cluster 2 are positioned at the extremes, with the highest and lowest values, respectively.



Selecting Target Segment

In order to establish a strong foothold in the market and ensure lasting impact while minimizing competition and leveraging available resources, Cluster 1 emerges as the most promising choice. Here's why:

1. *Balanced Market Opportunity*: Cluster 1 represents a balanced market with a mix of two-wheelers, three-wheelers, and a small presence of goods vehicles. This diversity indicates potential opportunities for introducing new types of vehicles, such as electricscooters or electric three-wheelers, catering to various consumer preferences.

2. *Moderate Competition*: States falling under Cluster 1 have a moderate level of vehicleusage across different categories, which is favorable compared to other clusters with higher concentrations of specific vehicle types. This allows for easier market entry andreduces the intensity of competition, enabling our startup to gain a stronger foothold.

3. *Abundance of Resources*: Upon inspection of states within Cluster 1, such as Chhattisgarh and Tamil Nadu, ample resources are available to support transportation infrastructure, including charging stations and maintenance facilities. This infrastructure facilitates the adoption of electric vehicles and provides our startup withthe necessary support for success.

By targeting Cluster 1, we can tap into a diverse market with growth potential while minimizing competition and capitalizing on available resources. Chhattisgarh and Tamil Nadu stand out among other states for several reasons:

- Both states have growing economies with large consumer bases, providing a fertile ground for market expansion.
- Governments in these states are committed to promoting clean energy and sustainable transportation, offering incentives, subsidies, and supportive policies for EVmanufacturers.
- Infrastructure development initiatives, including the establishment of charging stationsand road networks, encourage consumers to switch to electric vehicles and support widespread adoption.
- The thriving industrial ecosystem in Chhattisgarh and Tamil Nadu, with a strong presence of automotive manufacturers, ensures access to skilled labor, networks with existing supply chains, and opportunities for collaboration.

In summary, targeting Cluster 1, particularly in states like Chhattisgarh and Tamil Nadu, positions our startup for success by capitalizing on market diversity, minimizing competition,leveraging available resources, and aligning with supportive government policies and infrastructure development initiatives.

PART – II : GROWTH OF EV MARKET IN INDIA

Rapid Growth of the Automobile Industry in India

India's automobile industry is experiencing remarkable growth, positioning itself as a significant player in the global market. With robust support from government policies and a thriving domestic demand, the industry is on a trajectory of rapid expansion, contributing significantly to the national economy.

Growth Prospects

The Indian automotive industry is projected to reach a staggering value of US$ 300 billion by 2026. This impressive growth is underpinned by strong policy support from the Indian government, which has introduced various initiatives to bolster the sector. Additionally, India presents a substantial growth opportunity in the passenger vehicle segment. With a car penetration ratio of just 24 per 1,000 people,

India ranks as the third lowest among the top 13 global markets. In comparison, the global average stands at 314 per 1,000, highlighting the vast potential for expansion within the Indian market.

India's Position as the Third-Largest Automobile Market

India's prominence as a major automobile market is further evidenced by the significant sales figures recorded in January 2024, where total passenger vehicle sales reached an impressive 393,074 units. This represents a 14% increase compared to January 2023, marking the highest ever sales for the month of January. The automobile sector's contribution to the national GDP has grown substantially, rising from 2.77% in 1992-1993 to approximately 7.1% today. The industry also plays a crucial role in employment, directly and indirectly supporting around 19 million jobs. The presence of established domestic and international Original Equipment Manufacturers (OEMs) further solidifies India's position as a key player in the global automobile industry.

A Segmented and Diverse Market

The Indian automobile sector is segmented into four main categories: two-wheelers, three-wheelers, passenger vehicles, and commercial vehicles, each dominated by a few market leaders. In the fiscal year 2023, two-wheelers and passenger cars commanded a significant market share of 75% and 18%, respectively. Notably, India has emerged as the largest manufacturer of electric two-wheelers (E2W) and electric three-wheelers (E3W) globally. In January 2024 alone, 1,495,183 two-wheeler units were sold, showcasing the strong demand for this segment.

India's Advantages in the Automobile Industry

India's automobile industry is poised for substantial growth, driven by a combination of demographic trends, government initiatives, and strategic investments. The country's unique advantages are positioning it as a global leader in automotive manufacturing and exports.

Demographic and Economic Growth

India's rising middle-class income and a predominantly young population are key factors contributing to the robust growth of the automobile industry. The increase in disposable income among the middle class is expected to fuel demand for vehicles, further accelerating the industry's expansion. Additionally, the Indian automotive sector has set ambitious targets to increase vehicle exports fivefold between 2016 and 2026, indicating a strong focus on capturing a larger share of the global market.

In January 2024 alone, the total production of passenger vehicles, three-wheelers, two-wheelers, and quadricycles reached an impressive 2,328,329 units. In the fiscal year 2023, India exported 4,761,487 vehicles, underscoring its growing presence in the global automotive market. As the global electric vehicle (EV) market continues to expand, with projections of growth from US$ 250 billion in 2021 to US$ 1,318 billion by 2028, India is well-positioned to capitalize on this trend.

Growing Demand for Electric Vehicles

The demand for electric vehicles in India is on the rise, driven by a shift towards reducing emissions and promoting sustainable mobility. The Indian government is committed to transforming the country into a hub for automotive research and development (R&D), which will further enhance its capabilities in the EV sector. By 2030, India aims to be a leader in shared mobility, creating opportunities for the adoption of electric and autonomous vehicles.

The EV industry in India is expected to generate approximately 50 million jobs by 2030, reflecting the sector's potential to significantly impact employment. Moreover, the Indian government has pledged that 30% of all new vehicle sales by 2030 will be electric, demonstrating a strong commitment to promoting eco-friendly transportation.

Opportunities and Cost Advantages

India offers significant cost advantages in the automobile sector, with firms saving between 10-25% on operations compared to Europe and Latin America. This cost efficiency is a key driver for international companies to invest in India. Between April 2000 and December 2023, the automobile sector attracted a cumulative equity Foreign Direct Investment (FDI) inflow of approximately US$ 35.65 billion, highlighting the confidence of global investors in India's automotive market.

India is on track to become the largest EV market by 2030, with an investment opportunity exceeding US$ 200 billion over the next 8-10 years. This potential for growth is supported by various government initiatives aimed at fostering the industry's development.

Rising Investments and Government Initiatives

The Automotive Mission Plan 2016-26 is a collaborative effort between the Government of India and the Indian automotive industry to chart a roadmap for the sector's growth. The plan outlines strategies to develop India into a global manufacturing center for automobiles, enhancing the country's competitiveness on the world stage.

In addition, the government has extended the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) Scheme for an additional two years, up to March 31, 2024. This extension reflects the government's ongoing commitment to supporting the EV sector and encouraging the adoption of electric vehicles.

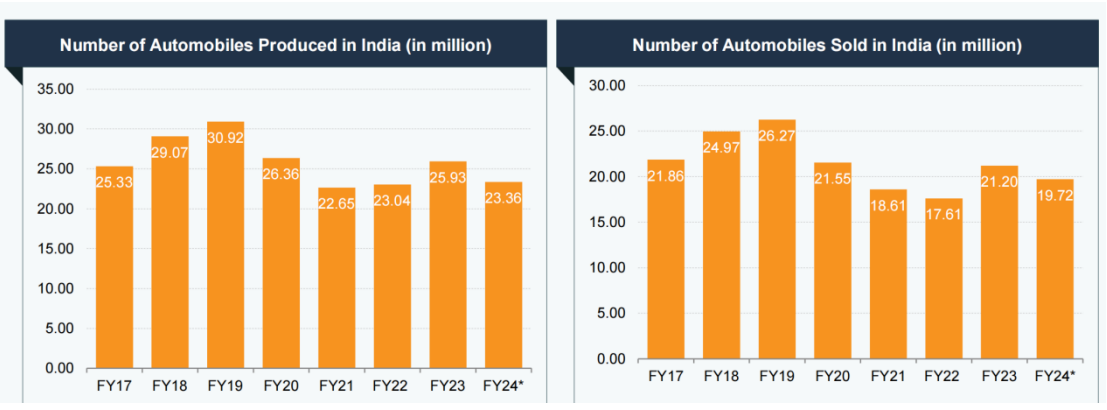
Growth of India's Automotive Manufacturing Industry

The automotive manufacturing industry in India encompasses the production of commercial vehicles, passenger vehicles, three-wheelers, and two-wheelers. During the period of April to January in FY24, the total production across these segments, including quadricycles, reached 23.36 million units. This robust production volume reflects the industry's strong performance in the current fiscal year.

India achieved a significant milestone in the electric vehicle (EV) sector, with the sale of 1,325,112 EVs in FY24 (up to January 2024). This achievement underscores the country's growing emphasis on sustainable mobility and the increasing adoption of electric vehicles.

The calendar year 2023 marked a satisfactory recovery for the Indian automobile sector, as it rebounded from the challenges posed by the COVID-19 pandemic. The industry recorded single-digit growth in the passenger vehicle, commercial vehicle, and two-wheeler segments, while the three-wheeler segment experienced a notable recovery, bolstered by supportive government schemes. The Indian automotive industry is optimistic about sustaining this growth momentum in FY24.

According to a report by the India Energy Storage Alliance, the EV market in India is projected to grow at a compound annual growth rate (CAGR) of 36% until 2026. Additionally, the EV battery market is expected to expand at a CAGR of 30% during the same period, highlighting the significant potential for growth in India's electric vehicle ecosystem.



ELECTRIC VEHICLE MARKET

Growth and Prospects of the Global and Indian Electric Vehicle Market

In 2023, the global electric vehicle (EV) market was valued at approximately US$ 255.54 billion. It is projected to experience substantial growth, reaching an estimated value of US$ 2,108.80 billion by 2033, with a significant compound annual growth rate (CAGR) of 23.42% from 2024 to 2033. This remarkable expansion reflects the increasing global shift towards sustainable transportation solutions.

India's electric vehicle sector is undergoing rapid development, driven by government incentives, rising environmental awareness, and technological advancements. The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, among other initiatives, underscores the government's commitment to boosting EV adoption and transforming the nation's transportation landscape towards greater sustainability and innovation.

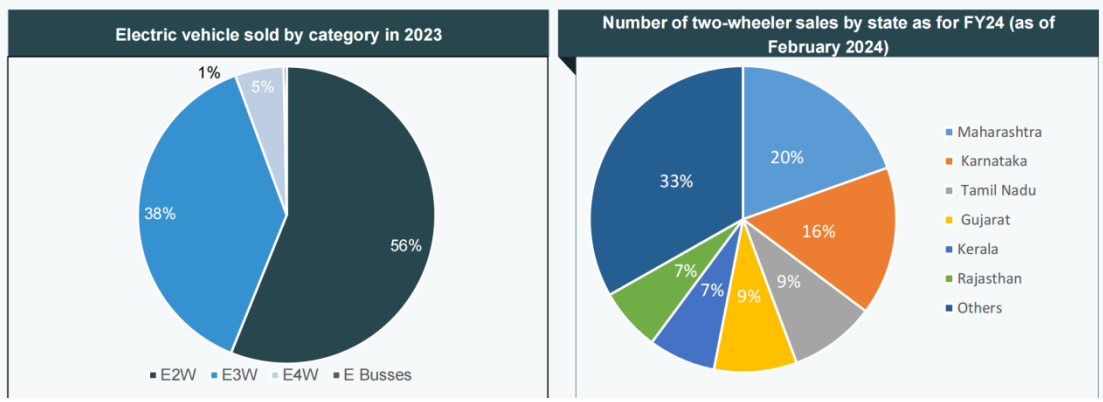
According to Fortune Business Insights, the Indian EV market is expected to grow from US$ 3.21 billion in 2022 to US$ 113.99 billion by 2029, with a staggering CAGR of 66.52%. In 2023 alone, electric vehicle sales in India surged by 49.25%, reaching 1.52 million units, signaling the growing acceptance and demand for electric mobility.

India has set ambitious targets for the adoption of electric vehicles, aiming to achieve 30% EV penetration in private cars, 70% in commercial vehicles, 40% in buses, and 80% in two-wheelers and three-wheelers by 2030. This translates to an estimated 80 million EVs on Indian roads by 2030, according to the Confederation of Indian Industry (CII).

The Indian EV battery market is also poised for significant growth, with projections indicating an increase from US$ 16.77 billion in 2023 to US$ 27.70 billion by 2028. A key focus in this expansion is the development of a robust and reliable infrastructure, particularly in ensuring that home charging is both accessible and affordable.

In a further push towards sustainable development, the Indian Army, in February 2024, proposed the gradual introduction of a select number of electric vehicles at 'Peace Stations' across the country. This initiative aims to embrace technological advancements, promote green energy, and reduce dependence on fossil fuels.

These developments highlight India's proactive approach to becoming a global leader in the electric vehicle sector, fostering innovation, environmental sustainability, and energy independence.



Key Developments in the Electric Vehicle Sector in India

Electric Car Growth in Mumbai:

- As of June 2024, the number of electric cars in Mumbai surpassed 10,000.
- These vehicles represent 33% of all electric cars in Maharashtra.

Electric Two-Wheeler (E2W) Market:

- In 2023, electric two-wheelers (E2Ws) constituted the largest share of total electric vehicle sales by volume, accounting for 56%.
- E2W sales are projected to surpass one million units in 2024, driven by increasing demand, enhanced manufacturing capabilities, and cost-effectiveness.

Expansion of Original Equipment Manufacturers (OEMs):

- Numerous OEMs are expanding their reach into rural regions, broadening the market for electric vehicles.

Maharashtra's Leadership in Electric Two-Wheeler Sales:

- As of February 2024, Maharashtra leads in electric two-wheeler sales for FY24.
- This growth is attributed to rising income levels and favorable government regulations.
- Maharashtra has set a target for electric vehicles to account for 10% of all new vehicle registrations by December 2025.

Karnataka's Electrification Goals:

- Karnataka aims to achieve 100% electrification of three and four-wheeler cargo vehicles by December 2030.

Overview and Data Preparation of State/UT-wise Operational Public EV Charging Stations as of 31st March 2024

Dataset Description:
The dataset in question provides comprehensive information on the number of operational public electric vehicle (EV) charging stations (PCS) across various States and Union Territories (UTs) in India as of 31st March 2024. This dataset is crucial for understanding the distribution and availability of EV charging infrastructure across the country, which is a key factor in promoting the adoption of electric vehicles.

Data Cleansing Process:
To ensure the accuracy and reliability of the dataset, a meticulous data cleansing process was undertaken. Utilizing Python libraries such as Pandas and NumPy, the data was thoroughly examined for inconsistencies, missing values, and any anomalies that could affect subsequent analyses. The process involved:

Identification and Handling of Missing Values: Missing data points were identified and handled appropriately, either through imputation techniques or by excluding certain records to maintain data integrity.

Standardization and Normalization: The dataset was standardized to ensure uniformity in data representation across all records, making it easier to compare data points from different States/UTs.

Automated Exploratory Data Analysis (EDA): Advanced visualization techniques and automated EDA were performed using tools like dataprep. This helped in uncovering patterns, trends, and insights within the data, facilitating a better understanding of the distribution of EV charging stations.

Outcome:
Through these processes, the dataset was transformed into a clean, structured, and highly informative resource. It is now ready for in-depth analysis and reporting, which can be used to inform policy decisions, identify gaps in EV infrastructure, and support the ongoing development of a robust electric vehicle ecosystem in India.

Overview and Data Processing of State/UT-wise Electric Vehicle Registrations (2020-2023)

Dataset Description:
The dataset under review provides detailed information on the number of electric vehicles (EVs) registered across various States and Union Territories (UTs) in India from 2020 to 2023. This dataset is pivotal for analyzing trends in EV adoption, understanding regional variations in registration numbers, and assessing the impact of government policies on EV growth over the specified period.

Data Cleansing Process:
To ensure the dataset's accuracy and readiness for analysis, a comprehensive data cleansing process was conducted. Using Python libraries such as Pandas and NumPy, the dataset underwent a series of steps to rectify any inconsistencies and enhance its reliability. The process included:

Identification and Correction of Data Anomalies: The dataset was carefully examined for anomalies, such as outliers, duplicate entries, and erroneous data points. These were either corrected or removed to ensure the integrity of the dataset.

Handling of Missing Values: Missing data entries were identified and addressed using appropriate methods, such as imputation or exclusion, to maintain the consistency and completeness of the dataset.

Normalization and Standardization: Data normalization and standardization techniques were applied to ensure uniformity across the dataset, making it easier to compare and analyze EV registrations across different regions and time periods.

Automated Exploratory Data Analysis (EDA):
After the data cleansing process, an automated exploratory data analysis (EDA) was performed using the datapreplibrary. This step involved generating a variety of visualizations and statistical summaries to uncover key insights and trends within the dataset. The EDA provided a comprehensive overview of the distribution of EV registrations across States/UTs, highlighting significant patterns and correlations that can inform policy decisions and strategic planning for the promotion of electric vehicles in India.

Outcome:
Through meticulous data cleansing and insightful EDA, the dataset was refined into a valuable analytical resource. It is now well-prepared for in-depth analysis, supporting stakeholders in understanding the dynamics of EV adoption and facilitating data-driven decision-making to foster the growth of electric mobility in India.

Analysis and Prediction of Electric and Non-Electric Vehicle Distribution in India (As of 03-08-2023)

Dataset Description:
The third dataset provides a comprehensive overview of the distribution of electric and non-electric vehicles across various States and Union Territories (UTs) in India as of 3rd August 2023. This dataset is critical for understanding the current landscape of vehicle adoption in the country, offering insights into regional preferences for electric versus non-electric vehicles. Such data is instrumental in informing policy decisions, infrastructure development, and market strategies aimed at accelerating the transition to electric mobility.

Data Cleansing and Exploratory Data Analysis (EDA):
To prepare the dataset for analysis, a thorough data cleansing process was undertaken using Python libraries like Pandas and NumPy. This process involved:

Identification and Correction of Data Inconsistencies: The dataset was carefully examined to identify and rectify any inconsistencies, such as incorrect entries, duplicate records, or outliers that could skew the analysis.

Handling Missing Values: Missing data points were systematically addressed through appropriate methods, such as imputation or exclusion, ensuring the dataset's completeness and reliability.

Standardization and Normalization: The data was standardized and normalized to ensure uniformity, facilitating accurate comparisons across different regions and vehicle types.

Following data cleansing, an automated exploratory data analysis (EDA) was performed using advanced visualization tools, such as Matplotlib and Seaborn, to uncover trends and patterns within the dataset. This step provided valuable insights into the distribution of electric and non-electric vehicles, highlighting key factors influencing vehicle adoption in different States/UTs.

Predictive Modeling Using Linear Regression:
To predict future trends in vehicle distribution, a linear regression algorithm was chosen as the appropriate predictive model. The process involved:

Data Splitting: The dataset was split into training and testing sets using the train_test_split function from Scikit-learn, ensuring the model's accuracy and generalizability.

Model Training: A linear regression model was trained on the dataset to establish a relationship between the independent variables (such as region, vehicle type, and other relevant factors) and the dependent variable (the number of vehicles).

Model Evaluation: The performance of the model was evaluated using metrics like Mean Squared Error (MSE) and R-squared (R^2) to assess its predictive accuracy. The results indicated a strong correlation between the predictors and the outcome, validating the model's effectiveness in forecasting vehicle distribution trends.

Outcome:
The linear regression model provided meaningful predictions regarding the distribution of electric and non-electric vehicles across India. The insights gained from this analysis can be leveraged by policymakers and industry stakeholders to make informed decisions about infrastructure development, resource allocation, and strategies to promote the adoption of electric vehicles in the country.

PART – III : CONSUMER KNOWLEDGE ATTITUDE PRACTISE MARKET SEGMENTATION

Dataset Descriptions

df_ev_details (Electric Vehicle Details):

This dataset offers insights into the current electric vehicles available in India, highlighting critical attributes such as price, battery capacity, driving range, power, and charge times. This information is essential for understanding the value proposition of various EV models and aligning them with consumer needs.

df_ev_category (Vehicle Category Details):

This dataset reflects the distribution of electric vehicle types across Indian states, providing a geographical perspective on market penetration. It helps in identifying regions with high concentrations of specific vehicle types, which could guide regional marketing efforts and product placement strategies.

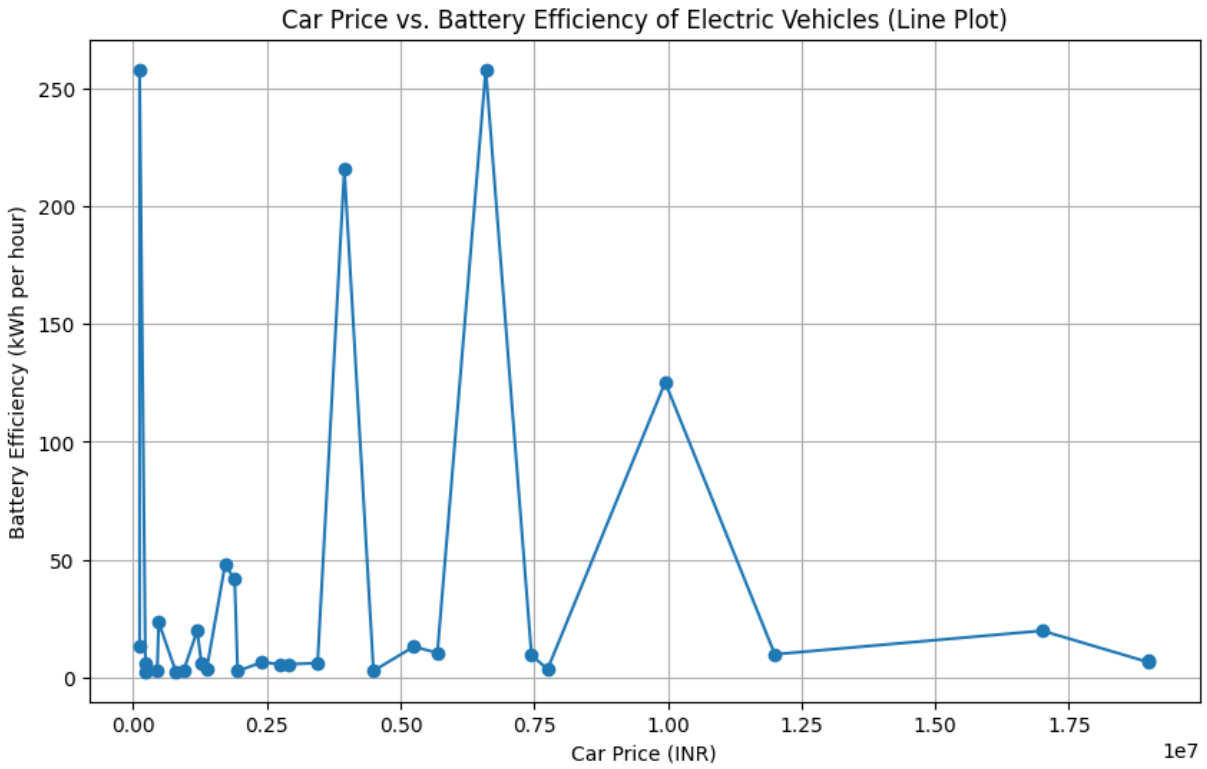
df_survey (Consumer Survey on EV Adoption):

The survey data reveals consumers' awareness, attitudes, and practices regarding electric vehicles. This is vital for market segmentation as it identifies different consumer groups based on their knowledge of EVs, their willingness to adopt EV technology, and their behaviors toward electric vehicles. This information will be key in segmenting the market into adopters, potential adopters, and those resistant to adoption.

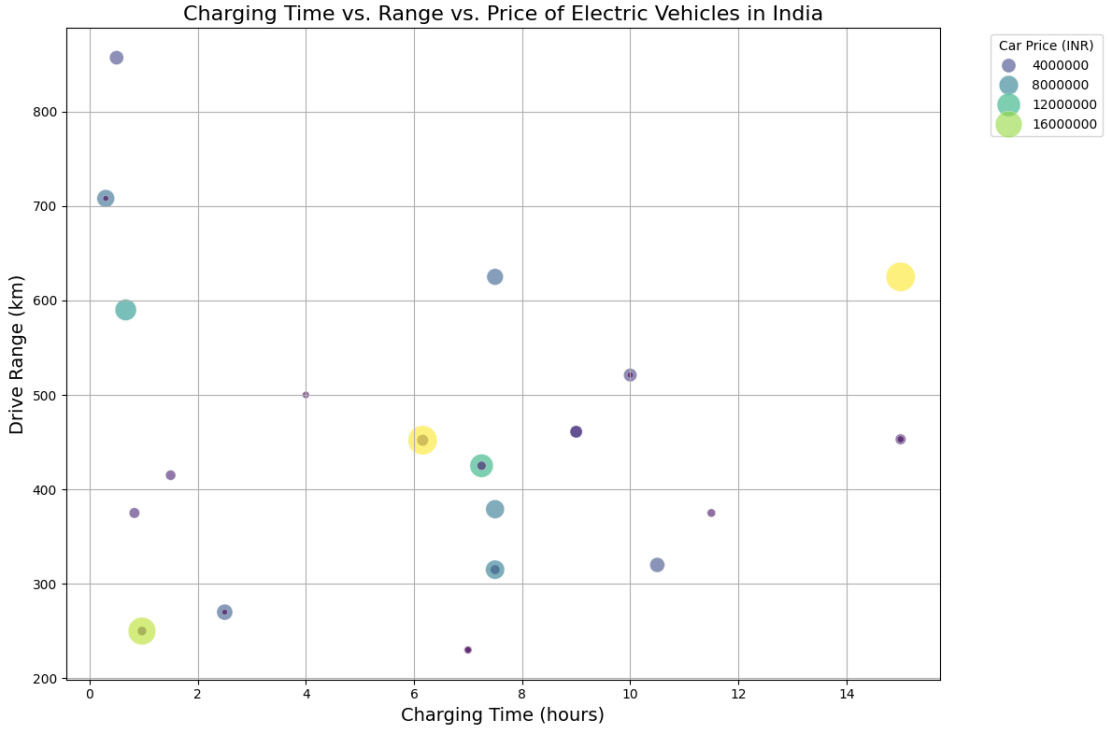
Insights from Initial Visualizations:

- **Price vs. Battery Efficiency:** EVs in the market show a broad range in price and battery efficiency. Vehicles that are priced lower tend to have lower battery efficiency, while higher-priced vehicles generally offer better performance. This suggests a clear segmentation between

premium and budget-conscious customers, with premium customers likely prioritizing range and performance over cost.



- **Charging Time vs. Range vs Price**:
    - As charging time increases (moving right along the x-axis), there's a general trend of drive range increasing (up the y-axis).
    - However, it's not a strict linear relationship. Some outliers defy the trend.
    - Longer charging times seem to correlate with longer drive ranges, but it's not a perfect match.
    - Higher-priced vehicles (those with larger points) tend to offer longer drive ranges.
    - Interestingly, they don't necessarily require significantly longer charging times.

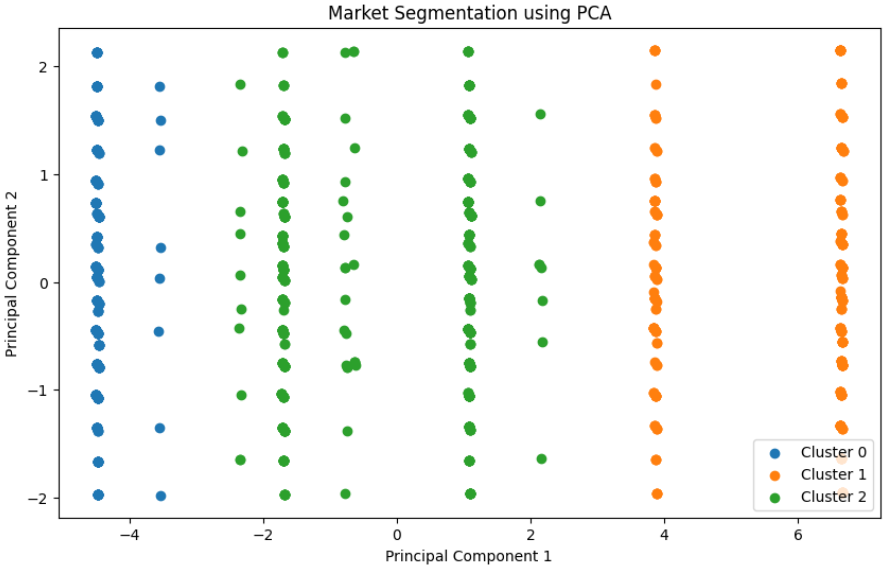


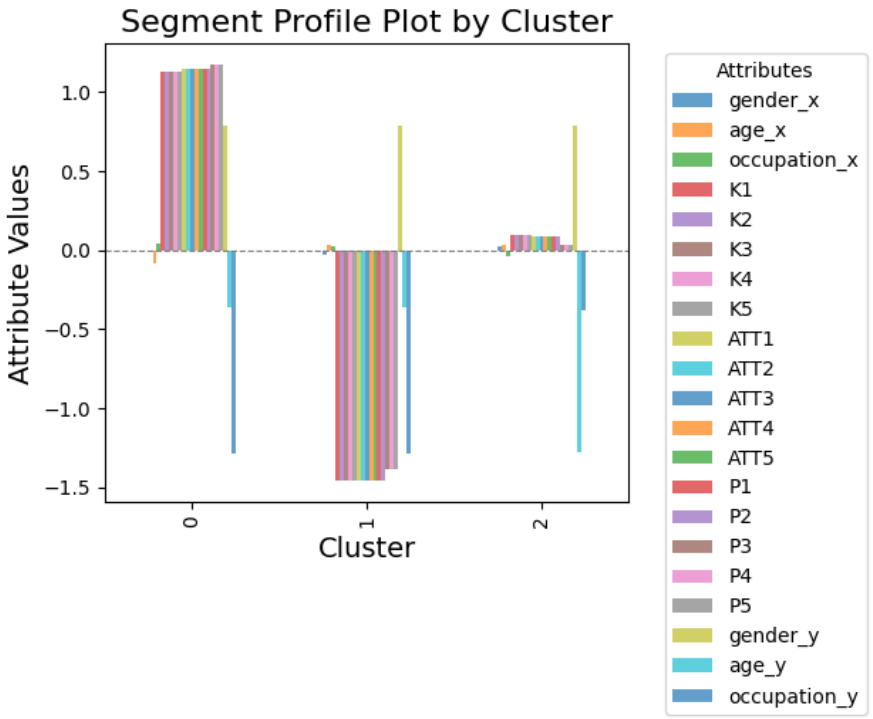
For the company, this implies a two-pronged strategy: target high-income, performance-conscious consumers with premium EVs, and simultaneously develop an entry-level segment strategy focused on younger, budget-conscious buyers

Market Segmentation (Inference)

Based on the output provided from the K-Means clustering analysis, we can define and profile the segments identified in the dataset. Each segment represents a unique group of respondents characterized by their responses to the survey questions related to knowledge (K1-K5), attitudes (ATT1-ATT5), and practices (P1-P5), along with demographic information such as gender, age, and occupation.

Segment Definitions and Profiles





Segment 0: Low Knowledge and Low Attitude

- **Cluster**: 0+
- **Gender**: Predominantly male
- **Age**: Slightly younger than average
- **Occupation**: Varied, but generally less engaged in the subject matter
- **Knowledge Scores (K1-K5)**: All scores are significantly below average (around -1.46), indicating low knowledge levels.
- **Attitude Scores (ATT1-ATT5)**: Low (around -1.46), suggesting a negative or indifferent attitude towards the subject.
- **Practice Scores (P1-P5)**: Low practice scores indicate minimal engagement or application of knowledge.

Segment 1: Moderate Knowledge and Positive Attitude

- **Cluster**: 1
- **Gender**: Balanced, with a slight male majority
- **Age**: Slightly older than Segment 0
- **Occupation**: More engaged individuals, possibly professionals
- **Knowledge Scores (K1-K5)**: Moderate scores (around 1.13), indicating some knowledge of the subject.
- **Attitude Scores (ATT1-ATT5)**: Positive attitudes (around 1.15), suggesting a favourable view of the subject matter.
- **Practice Scores (P1-P5)**: Higher practice scores indicate active engagement with the subject.

Segment 2: Average Knowledge and Attitude

- **Cluster**: 2
- **Gender**: Balanced representation
- **Age**: Slightly older than Segment 1
- **Occupation**: Mixed occupations, including both engaged and less engaged individuals
- **Knowledge Scores (K1-K5)**: Close to average (around 0.1), indicating moderate knowledge.
- **Attitude Scores (ATT1-ATT5)**: Slightly positive (around 0.09), suggesting a neutral to positive attitude.
- **Practice Scores (P1-P5)**: Moderate practice scores, indicating some application of knowledge but not consistently.

Insights Derived from the Data

1. **Knowledge and Attitude Correlation**

The analysis shows a clear correlation between knowledge levels and attitudes. Segments with higher knowledge scores (like Segment 1) also exhibit more positive attitudes towards the subject. This suggests that increasing knowledge through educational programs could enhance attitudes.

2. **Targeted Educational Interventions**

- **Segment 0**: Requires foundational educational initiatives to improve knowledge and attitudes. Awareness campaigns could be beneficial here.

- **Segment 1**: This group is already engaged and has a positive attitude, making them ideal candidates for advanced training or specialized content.
- **Segment 2**: This segment may benefit from tailored educational resources that bridge the gap between their moderate knowledge and practice levels.

3. **Demographic Insights**

Understanding the demographics of each segment can help tailor communication strategies. For example, younger individuals in Segment 0 may respond better to digital outreach, while older individuals in Segment 1 might prefer traditional methods.

4. **Resource Allocation**

Organizations can allocate resources more effectively by focusing on segments that need the most support (e.g., Segment 0) while also nurturing those that are already engaged (e.g., Segment 1).

5. **Behavioural Insights**

The profiling reveals behavioural patterns that can inform marketing strategies. For instance, targeting Segment 1 with advanced products or services could be effective, while Segment 0 may require introductory materials.

Conclusion

The segmentation and profiling of the KAP dataset provide valuable insights into the characteristics of different respondent groups. By understanding these segments, organizations can develop targeted interventions, educational programs, and marketing strategies tailored to the unique attributes of each group. This approach enhances the potential for effective engagement and positive outcomes in addressing knowledge, attitudes, and practices within the population.

e. Potential Customer Base and Early Market Profit Estimation:

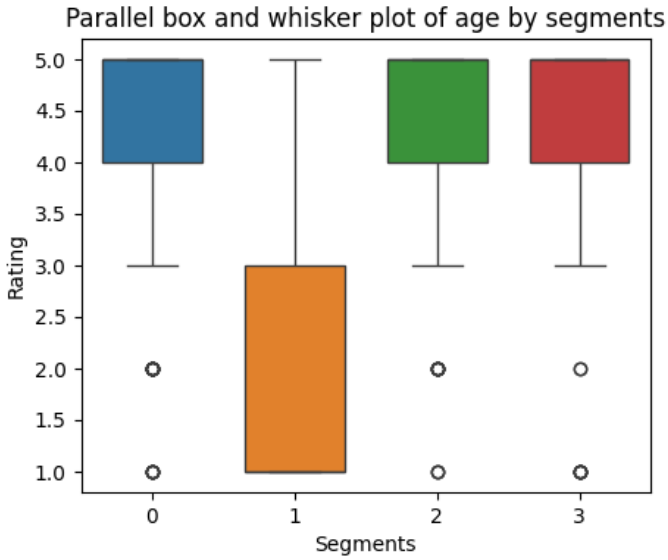
- We estimate the potential customer base by analyzing the size of the selected segment from the survey data. For example, if the segment represents 25% of the survey respondents, and this can be scaled to represent a sizable portion of the Indian market, we estimate the potential early market size.
- **Calculation Example:**
    - Potential Customer Base: Assume 25% of survey respondents represent a target population of 500,000 potential buyers.
    - Target Price Range: ₹1,500,000 (Mid-range EV)
    - Potential Profit: ₹1,500,000 * 500,000 = ₹750 billion
- **Inference: By focusing on the early adopter segment, we can project a significant profit potential, assuming successful conversion efforts through targeted marketing.**

PART – IV : REPORT ON EV MARKET ANALYSIS

This project mainly focuses on the Indian EV Market and its market segmentation which is derived from their sales data, production data, reviews and specifications.

1. **Data Sources (Data Collection)**
    - *Details*:
        - **Source 1**: All the dataset used is collected from KAGGLE except the bikewala.com dataset.
        - **Source 2**: Bikewala.com dataset.

2. **Data Pre-processing (Steps and Libraries Used)**
   - *Summary*: Data pre-processing involved cleaning, normalization, and transformation to make the data suitable for analysis.
   - *Details*:
     - **Libraries Used**: Pandas, NumPy, Scikit-Learn.
3. **Segment Extraction (ML Techniques Used)**
   - *Summary*: Machine learning techniques were applied to identify different market segments.
   - *Details*:
     - **Clustering Techniques**: K-means clustering was used to categorize customers into different segments based on behaviour and demographic data.
     - **Dimensionality Reduction**: PCA (Principal Component Analysis) to reduce the number of features while preserving variance.
     - **Tools/Libraries Used**: Scikit-Learn, Matplotlib for visualization.
     -



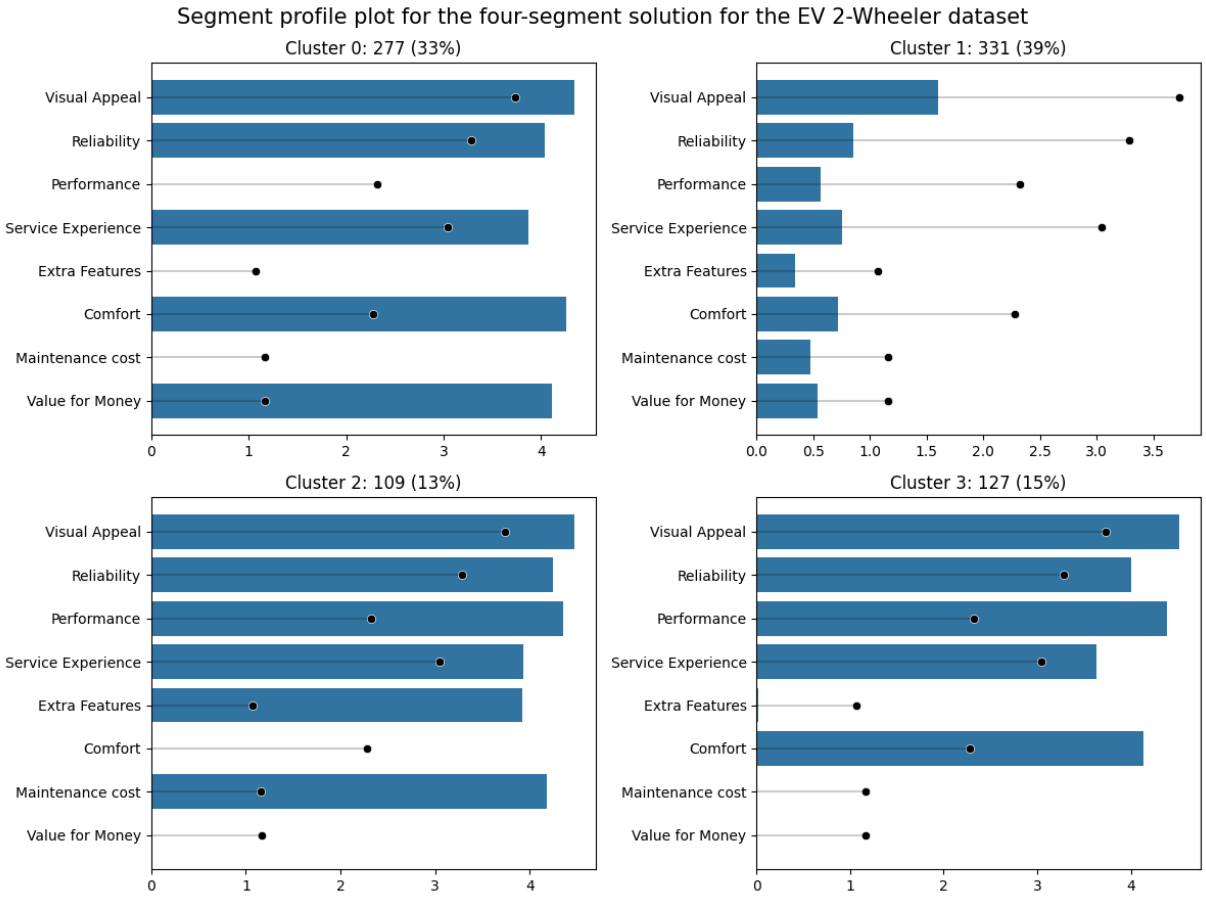
4. **Profiling and Describing Potential Segments**
   - *Summary*: Each segment was analysed to understand its unique characteristics.
   - *Details*:
     - **Segment 1**: Visual Appeal, Reliability, Comfort, Value for money are the characteristics that customers in Segment 1 values. It caters 33% of the customers.
     - **Segment 2**: This Segment is mostly displeased and dissatisfied with all the options available in the market. Total of 39% of population lies in this Segment.
     - **Segment 3:** It mainly focuses on Visual Appeal, Performance, Reliability, Service Experience, Extra Features, Maintenance cost.
     - **Segment 4:** The main focus of this segment is comfort and performance.

5. **Selection of Target Segment**
   - *Summary*: Based on profiling, the most promising segments were chosen for targeted marketing i.e., Segment 1 and Segment 2
   - *Details*: The target segment was chosen due to high profitability, low competition, etc.

6. **Potential Customer Base in the Early Market (Business Markets)**
   - *Summary*: The potential customer base was calculated to estimate early market profit.
   - *Details*:
     - **Potential Customer Base**: Segment 1 and Segment 2 customers.
     - **Target Price Range**: 70k – 1.3L

7. Optimal Market Segments to Enter

- *Summary*: The most optimal market segments were identified based on a combination of factors, including potential growth, profit margins, and competition.
- *Details*: Segment 1, comprising 39% of consumers, is identified as the optimal market for electric two-wheelers. With a balanced blend of price and technical specs, it offers substantial potential. Recommended specifications include a price range of ₹70,688 to ₹1,29,063, riding range of 89 to 180 km, top speed of 58 to 116 kmph, weight of 76 to 120 kg, 3 to 5 hours



charging time, and 1200 to 5500 W power, aligning with market preferences.