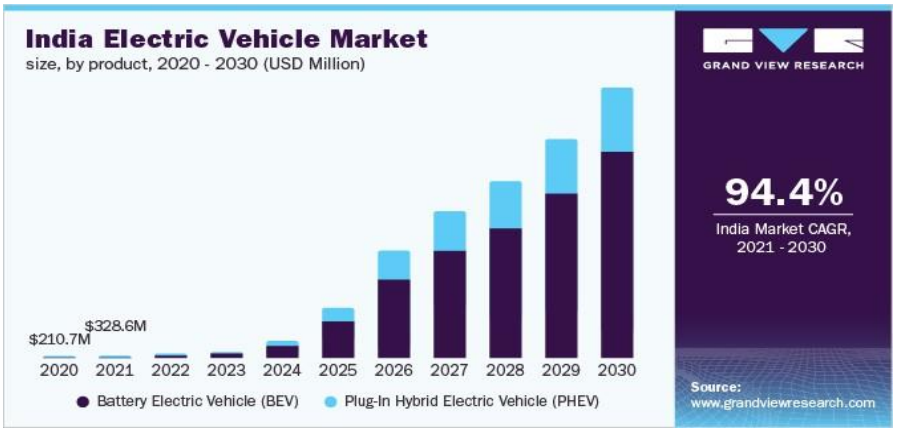
FEYNN LABS: PROJECT T-1-R

Market Segment Analysis of Electronic Vehicle in India



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GitHub Link:

Sindhu Priya: https://github.com/KancharlaSindhupriya/FEYNN-LABS-EV-MARKET-ANYALSIS

Shreyas Gosavi: https://github.com/ShreyasG482/Feynn_Labs_Projects.git

AkshayLanjewar: https://github.com/akshaylanjewar0872/EV-Market-Analysis/

Sanchit Singla: https://github.com/sa-1-2/Feynn-Labs-EV-Market-Segmentation

Hiya Nachnani: https://github.com/Hiyanachnani/EV_Market_Segmentation_Analysis

Market Segmentation Analysis of India's Electric Vehicle Market

GitHub Link: https://github.com/KancharlaSindhupriya/FEYNN-LABS-EV-MARKET-ANYALSIS

I. Problem Statement:

The rapid growth of India's electric vehicle market presents both opportunities and challenges for stakeholders, policymakers, and industry players. However, amidst increasing environmental concerns, technological advancements, and changing consumer preferences, there exists a pressing need to understand the current dynamics, segmentation trends, regulatory landscape, and competitive factors shaping the EV market in India. This Market analysis seeks to identify key market segments derived from sales data, customer reviews, and technical specifications, assess market trends, evaluate regulatory frameworks, analyze competitive dynamics, and provide insights and recommendations to navigate the complexities and capitalize on the opportunities within India's evolving electric vehicle ecosystem.

II. Data Collection:

Sales data: What timeframe does the sales data cover? What types of vehicles are included (two-wheelers, three-wheelers, four-wheelers, etc.)? Are there any regional breakdowns?

Customer reviews: From what platforms were the reviews collected? Are they online reviews, surveys, or social media comments? Is there any information about the reviewer demographics (age, location, income)?

Technical specifications: What specific technical aspects are considered (range, battery capacity, charging speed, etc.)? Is there data on price and brand?

➢ Raw data generated:

Sales Data: **https://github.com/KancharlaSindhupriya/FEYNN-LABS-EV-MARKET-ANYALSIS/blob/main/smev_data.xlsx**

Customer Reviews: **https://github.com/KancharlaSindhupriya/FEYNN-LABS-EV-MARKET-ANYALSIS/blob/main/ev2_bikewale.csv**

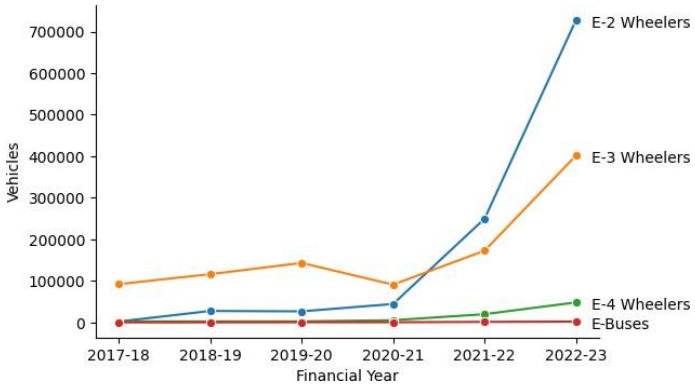
Technical Specifications: **https://github.com/KancharlaSindhupriya/FEYNN-LABS-EV-MARKET-ANYALSIS/blob/main/ev_model_spec.csv**

III. Sales Data Analysis:

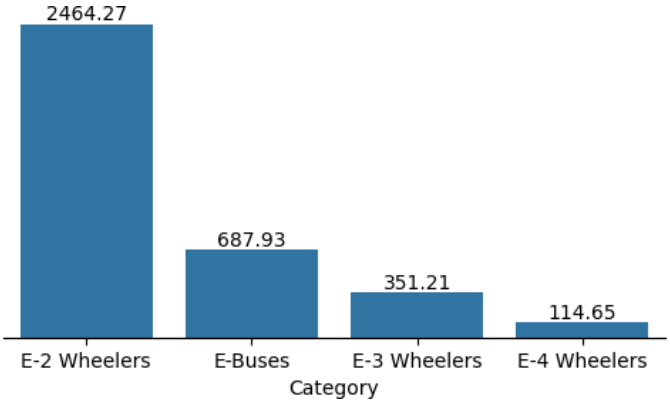
```
data_smev = pd.read_excel("smev_data.xlsx", sheet_name=None)

data_smev.keys()
```

- This subsection focuses on analyzing sales data obtained from various sources, such as industry reports, market research firms, and manufacturer data.

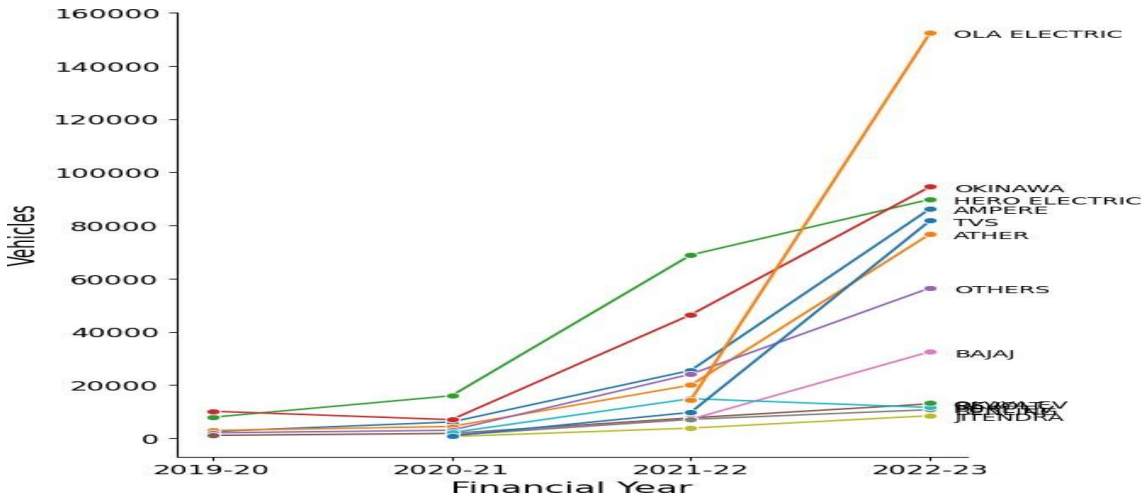
- Key metrics examined include total sales volume, market share of different electric vehicle types (e.g., electric cars, electric two-wheelers, electric buses), regional distribution of sales, and trends over time.
- The analysis may also delve into factors influencing sales performance, such as pricing strategies, consumer preferences, government incentives, and competition from conventional vehicles.
- Statistical techniques like trend analysis, regression modeling, and market segmentation may be utilized to identify patterns, growth drivers, and market segments with significant sales potential.



Above Figure showcased the **remarkable growth trajectory of India's two-wheeler** market in 2023 reflects a convergence of favorable factors, including government support, technological advancements, shifting consumer preferences, and market competition. As electric two-wheelers continue to gain momentum, they are poised to play a significant role in shaping the future of urban mobility and sustainable transportation in India.



Above Figure **delved into the market's financial perspective**, representation of the industry's total value in crores, with two-wheelers emerging as the primary revenue generators, offers valuable insights into the market's financial landscape and underscores the economic significance of electric two-wheelers within India's electric vehicle industry.



Above Figure **honed in on specific electric two-wheeler companies**, Ola Electric's emergence as the market leader in 2023 the electric two-wheeler segment highlights its industry leadership, market competitiveness, and strategic positioning within India's electric vehicle market. As Ola Electric continues to innovate, expand, and drive market growth, its leadership position is likely to shape the trajectory of the electric two-wheeler industry in the years to come.

IV. EV Market Segmentation

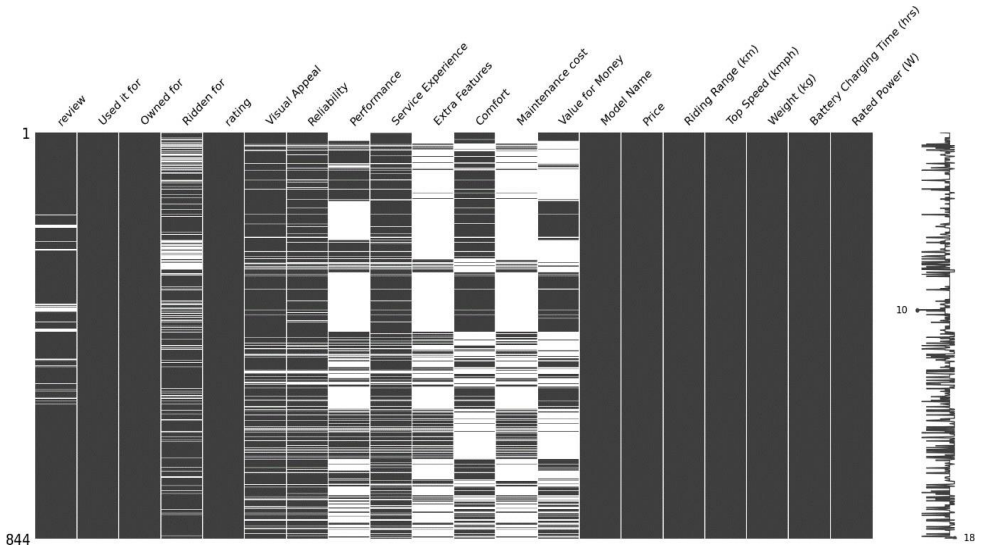
- **Customer Reviews Analysis:**
    - This subsection entails analyzing customer reviews and feedback from various online platforms, forums, and social media channels.
    - Natural language processing (NLP) techniques, sentiment analysis, and topic modeling may be employed to extract insights from customer reviews.
    - Key aspects assessed include overall satisfaction levels, likes and dislikes regarding specific electric vehicle models, performance feedback, user experiences with charging infrastructure, reliability, and after-sales service.
    - The analysis aims to identify common themes, sentiments, and areas for improvement based on customer feedback, which can inform product development, marketing strategies, and customer engagement initiatives.
- **Technical Specifications Analysis:**
    - This subsection involves a detailed examination of technical specifications provided by electric vehicle manufacturers.
    - Key parameters analyzed include battery capacity, range per charge, charging time, vehicle performance (e.g., acceleration, top speed), safety features, and onboard technology.
    - Comparative analysis may be conducted to benchmark electric vehicles against each other and against conventional vehicles in terms of performance, efficiency, and features.
    - The analysis aims to identify trends in technological advancements, areas of innovation, and consumer preferences for specific technical specifications.

- Insights derived from technical specifications analysis can guide manufacturers in product development, pricing strategies, and positioning within the competitive landscape.

```
data_bw = pd.read_csv("ev2_bikewale.csv")
data_model = pd.read_csv("ev_model_spec.csv")
```

The dataset used for the market segmentation analysis, extracted from bikewale.com, comprises electric two-wheeler customer reviews, offering vital behavioral and psychographic insights.

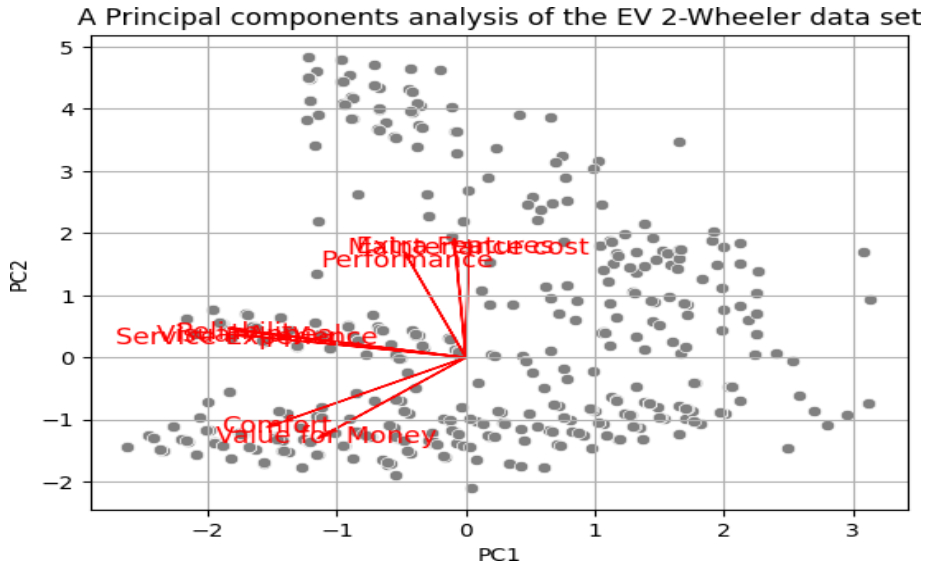
It also presents detailed technical specifications and pricing information of electric two-wheelers. This data allowed us to assess the technical feasibility and price points crucial for our market segmentation strategy



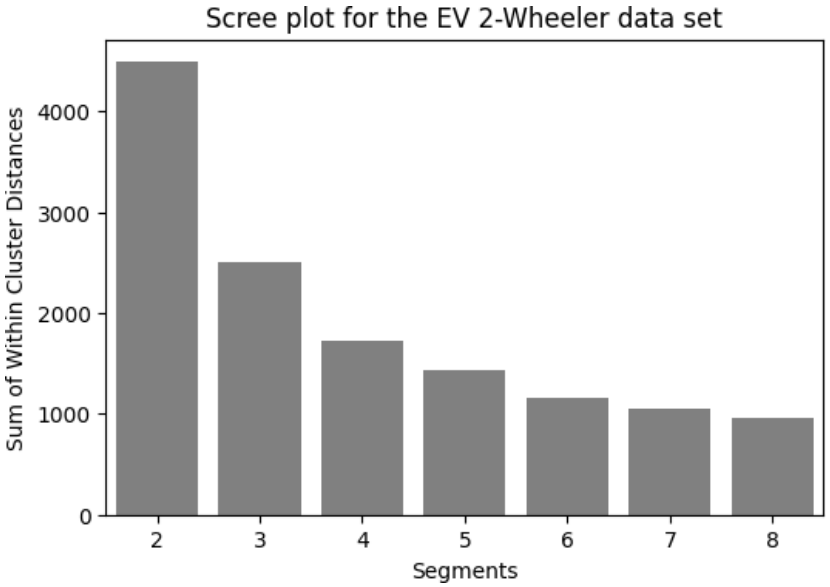
In the EV market context, **the missingness matrix provides insights** into the completeness and quality of the dataset used for analysis. By visualizing missing data patterns, researchers can identify areas of concern and take appropriate steps to address data gaps and ensure the reliability and validity of their analysis results. Understanding missingness patterns is essential for making informed decisions and drawing accurate conclusions regarding market trends, consumer behavior, and technological advancements within the EV industry.

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Visual Appeal	-0.480170	0.117814	0.063320	-0.730598	0.247014	0.105903	0.375474	0.067539
Reliability	-0.494758	0.124910	-0.002776	0.152447	-0.819319	0.060484	0.117211	0.166384
Performance	-0.128721	0.459145	0.574833	-0.005549	-0.019902	-0.025704	-0.288468	-0.598232
Service Experience	-0.486499	0.100691	-0.054176	0.653781	0.470391	0.052432	0.311210	-0.044129
Extra Features	-0.024373	0.519633	-0.364578	-0.023208	0.116821	0.559390	-0.456829	0.246323
Comfort	-0.418255	-0.304266	0.249807	-0.020111	0.172621	-0.296656	-0.623271	0.404238
Maintenance cost	0.005912	0.513208	-0.386495	-0.054822	0.020302	-0.762039	-0.003360	0.055435
Value for Money	-0.309572	-0.351548	-0.563840	-0.107598	-0.046688	0.009572	-0.260855	-0.617065

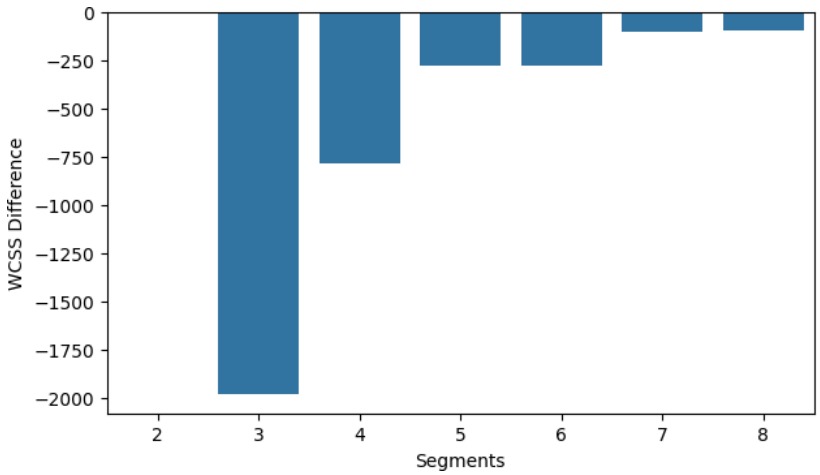
In the context of the **electric vehicle (EV) market analysis**, the factor loadings obtained from PCA can provide valuable insights into the underlying structure and relationships among the variables (features) in the dataset. By examining the factor loadings, analysts can identify which variables contribute most significantly to each principal component and understand the patterns and trends driving variation within the data.



Facilitates a deeper understanding of the relationships and patterns within the EV 2-Wheeler dataset, enabling stakeholders to make informed decisions regarding market segmentation, product development, and strategic planning in the electric vehicle market.



The Scree plot serves as a valuable tool for determining the optimal number of clusters in K-means clustering and facilitates the identification of meaningful segments within the EV 2-Wheeler dataset, contributing to more effective market segmentation and strategic decision-making in the electric vehicle market.



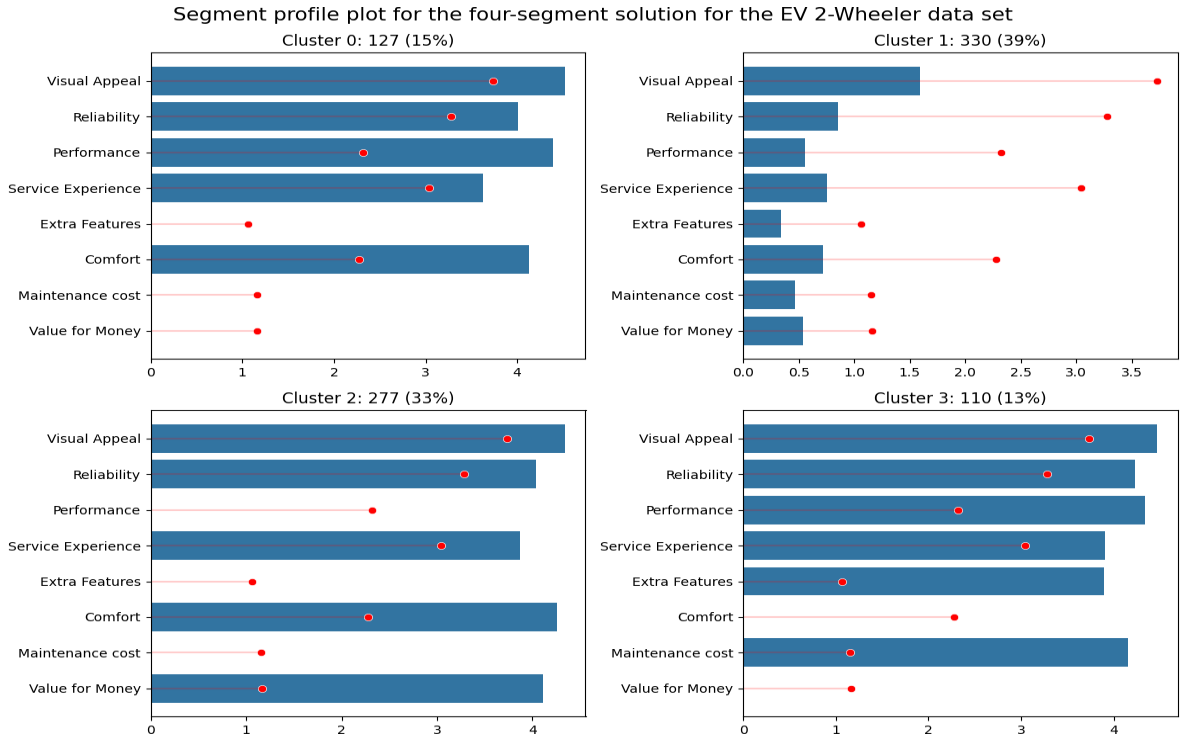
The decision-making process was significantly guided by the scree plot above, revealing a distinct elbow at four segments. This marked point indicated a substantial reduction in distances, signifying the optimal number of segments for our analysis.

Using K-means

K-means clustering is a powerful tool for segmentation in the electric vehicle market, enabling businesses and researchers to uncover meaningful patterns and insights within complex datasets. By leveraging K-means clustering, stakeholders can make informed decisions and strategies to address the diverse needs and preferences of consumers in the evolving EV market landscape.

K-means clustering is a valuable tool for segmentation in the EV market, enabling businesses to gain actionable insights, enhance customer engagement, and drive competitive advantage in a rapidly evolving industry landscape. By leveraging the capabilities of K-means clustering, businesses can effectively navigate market complexities and capitalize on emerging opportunities in the dynamic EV market ecosystem.

V. Profiling Segments



Above **graph visually captures the diverse perceptions** among different segments. Segment 0, representing 15% of consumers, values the electric two-wheeler vehicle for its visual appeal, reliability, performance, service experience, and comfort. Conversely, Segment 1 (39% of consumers) expresses dissatisfaction across all aspects, marking them as the largest but least satisfied group. Segment 2 (33% of consumers) appreciates visual appeal, reliability, service experience, comfort, and notably, perceives a strong value for money. Lastly, Segment 3 (13% of consumers), the smallest segment, values visual appeal, reliability, performance, service

experience, extra features, and maintenance cost, showcasing distinct perceptions, particularly on features and costs.

Segment 0 (15% of consumers):

1. **Values:** Visual appeal, reliability, performance, service experience, and comfort.
2. **Perception:** Positive across various aspects, indicating high satisfaction levels within this segment.
3. **Potential Marketing Approach:** Emphasize product design, reliability, performance, and customer service to maintain and enhance satisfaction levels.

Segment 1 (39% of consumers):

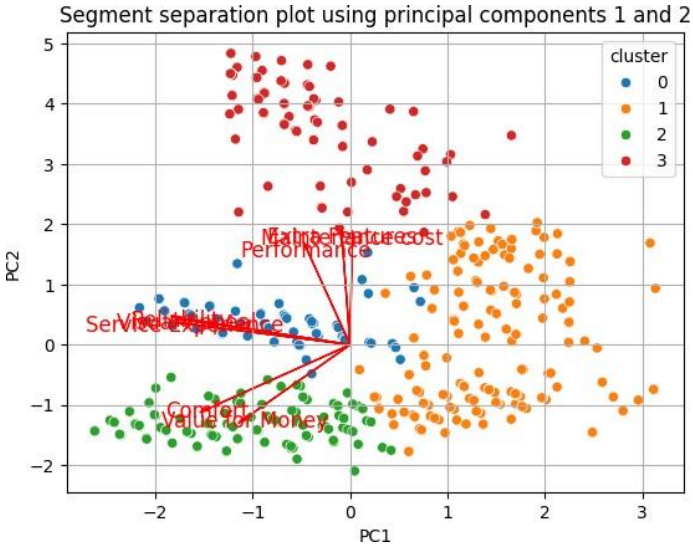
1. **Values:** Not explicitly mentioned, but expresses dissatisfaction across all aspects.
2. **Perception**: Represents the largest but least satisfied group, highlighting significant opportunities for improvement.
3. **Potential Marketing Approach**: Address pain points, gather feedback, and implement changes to enhance product quality, service experience, and overall satisfaction.

Segment 2 (33% of consumers):

1. **Values:** Visual appeal, reliability, service experience, comfort, and perceives strong value for money.
2. **Perception:** Generally positive, particularly in terms of value for money, indicating a favorable perception of the product's cost-effectiveness.
3. **Potential Marketing Approach:** Highlight affordability, emphasize reliability, service quality, and overall value proposition to attract and retain customers in this segment.

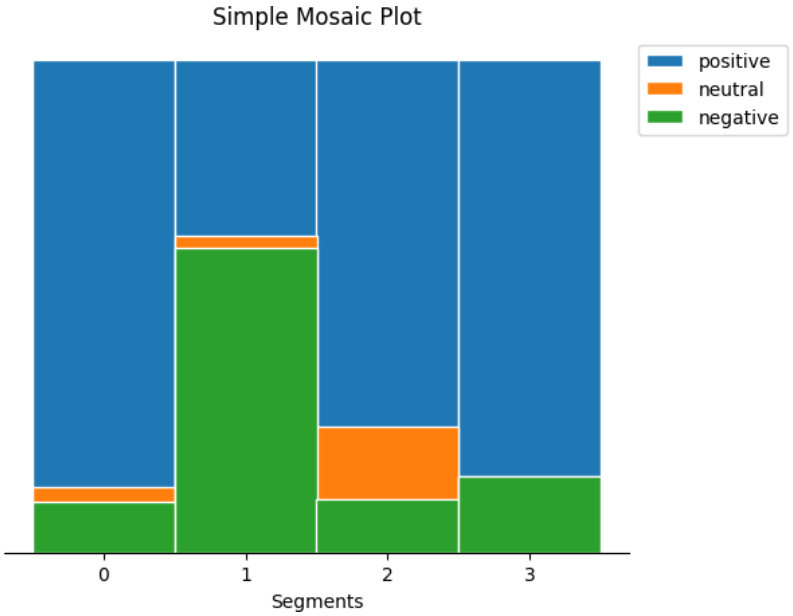
Segment 3 (13% of consumers):

1. **Values:** Visual appeal, reliability, performance, service experience, extra features, and maintenance cost.
2. **Perception:** Positive perceptions across various aspects, particularly on features and maintenance costs.
3. **Potential Marketing Approach:** Focus on product differentiation, highlight premium features, emphasize reliability, and offer competitive maintenance packages to cater to the specific preferences of this segment.



Above **Figure, utilizing principal components**, further emphasizes the differences among segments. Notably, Segment 1, despite being the largest segment, lacks specific opinions, making them unique in their lack of satisfaction.

VI. Describing Segments



Above mosaic plot, explores consumer sentiments, revealing that all segments, except Segment 1, exhibit positive sentiments. Segment 1 consumers stand out with negative sentiments, indicating dissatisfaction across various aspects.

1. **Consumer Sentiments Analysis:**

The mosaic plot visually represents consumer sentiments, with each segment categorized based on positive or negative sentiments.

Positive sentiments indicate satisfaction or positive perceptions, while negative sentiments reflect dissatisfaction or negative perceptions.

Understanding consumer sentiments is crucial for identifying areas of strength and improvement within each segment and guiding targeted marketing and product enhancement strategies.

2. **Segment Comparison:**

Segments 0, 2, and 3 exhibit predominantly positive sentiments, indicating overall satisfaction or positive perceptions among consumers within these segments.

Consumers in these segments likely appreciate various aspects of electric vehicles, such as visual appeal, reliability, performance, service experience, and value for money.

Their positive sentiments suggest that these segments may represent loyal customers or enthusiasts who are generally satisfied with their electric vehicles.

3. **Segment 1 Dissatisfaction:**

Segment 1 stands out with negative sentiments, indicating dissatisfaction across various aspects of electric vehicles.

Consumers in this segment express negative perceptions or experiences, highlighting areas of concern and potential dissatisfaction within the electric vehicle market.

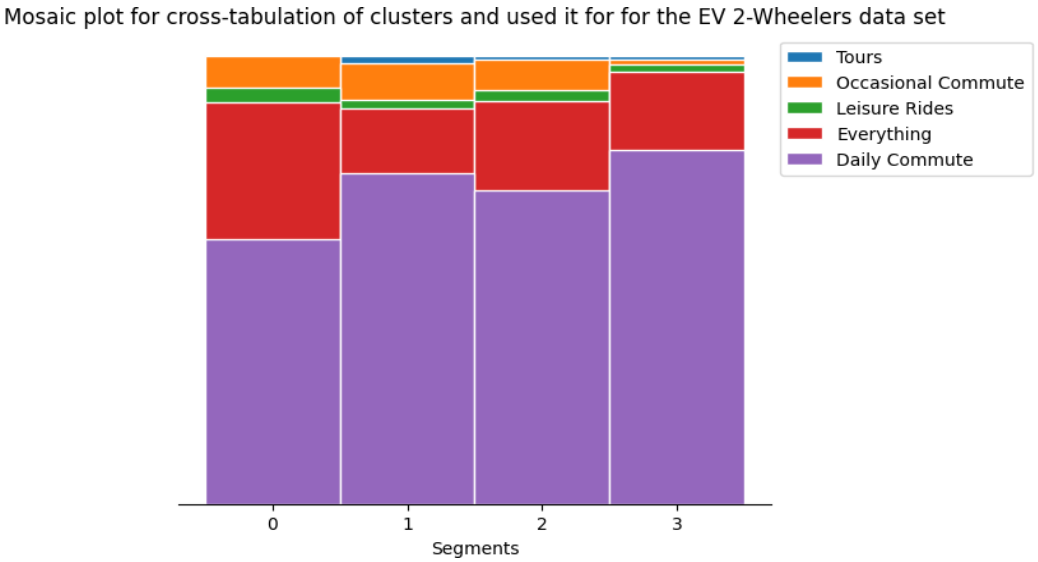
Their negative sentiments may stem from issues related to product quality, service experience, pricing, or other factors that fail to meet their expectations or requirements.

4. **Implications for Market Strategies:**

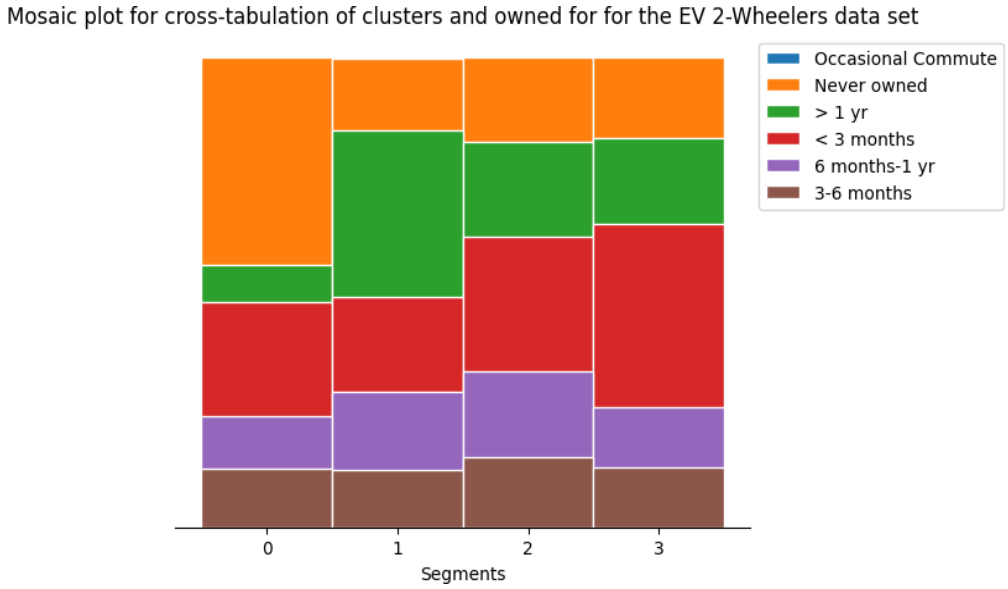
The mosaic plot underscores the importance of addressing dissatisfaction within Segment 1 to improve overall customer satisfaction and loyalty in the electric vehicle market.

Businesses should prioritize understanding the underlying reasons for dissatisfaction within Segment 1 and take proactive measures to address consumer concerns and improve product offerings and service quality.

Targeted marketing campaigns, product enhancements, customer support initiatives, and pricing strategies may be necessary to effectively address the needs and preferences of consumers within Segment 1 and enhance their overall satisfaction levels.



Above mosaic plot illustrates that all segments predominantly use electric vehicles for daily commuting, with limited usage for tours, occasional commuting, and leisure rides.



Above mosaic plot delineates the ownership duration of electric vehicles among segments. Segment 1 stands out, owning electric vehicles for more than a year, while Segment 0 has no prior ownership experience. Segment 2 members moderately own vehicles ranging from less than 3 months to over a year, and Segment 3 consumers have owned electric vehicles for a few days to less than 3 months.

1. **Segment 1 Ownership Duration**:

Segment 1 stands out for owning electric vehicles for more than a year.

This indicates a longer-term commitment to electric vehicle ownership among consumers in Segment 1, suggesting potential loyalty or satisfaction with electric vehicles over time.

2. **Segment 0 Ownership Experience:**

Segment 0, in contrast, has no prior ownership experience with electric vehicles.

This suggests that consumers in Segment 0 may represent potential new adopters or individuals exploring electric vehicle ownership for the first time.

3. **Segment 2 Ownership Duration**

Members of Segment 2 exhibit moderate ownership durations, ranging from less than 3 months to over a year.

This indicates a range of experiences and tenure among consumers in Segment 2, with some being relatively new owners and others having more established ownership histories.

4. **Segment 3 Ownership Duration:**

Consumers in Segment 3 have owned electric vehicles for a relatively short duration, ranging from a few days to less than 3 months.

This suggests that Segment 3 represents a group of recent adopters or individuals who have recently transitioned to electric vehicle ownership.

5. **Implications for Market Understanding:**

Understanding ownership duration patterns provides insights into consumer behavior, satisfaction levels, and brand loyalty within the electric vehicle market.

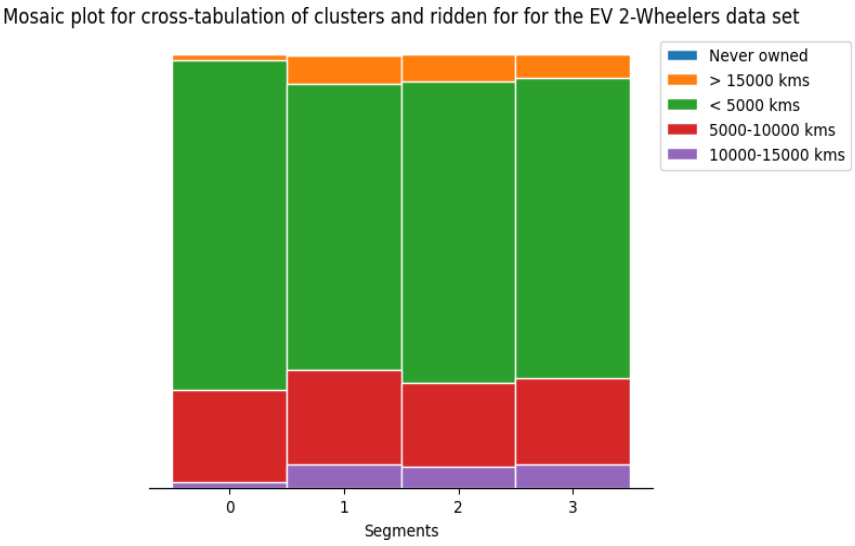
Businesses can tailor their marketing strategies, customer engagement initiatives, and product offerings based on the unique needs and preferences of each segment.

6. **Opportunities for Engagement:**

Segment 0 presents opportunities for education, outreach, and incentives to encourage new adopters to explore electric vehicle ownership.

Segment 1 represents an opportunity for retention and loyalty-building efforts to maintain satisfaction and engagement among long-term owners.

Segments 2 and 3 may benefit from targeted messaging, support services, and product enhancements tailored to their specific ownership durations and experiences.



Above mosaic plot delves into the distances covered by consumers, indicating that all segments predominantly use electric vehicles for commuting, with most users covering distances below 5000 kms. A small portion falls in the 5000 to 10000 kms range, aligning with their commuting needs.

1. **Distance Coverage Patterns:**

The majority of users in all segments cover distances **below 5000 kilometers.**

This suggests that most electric vehicle users typically engage in short to moderate-distance commuting, which aligns with urban and suburban travel patterns.

2. **Moderate Distance Range:**

A small portion of users across segments falls **within the 5000 to 10000 kilometers range**.This moderate distance range likely corresponds to longer commutes or occasional travel needs, further emphasizing the practicality and versatility of electric vehicles for various commuting distances.

3. **Implications for Market Understanding**:

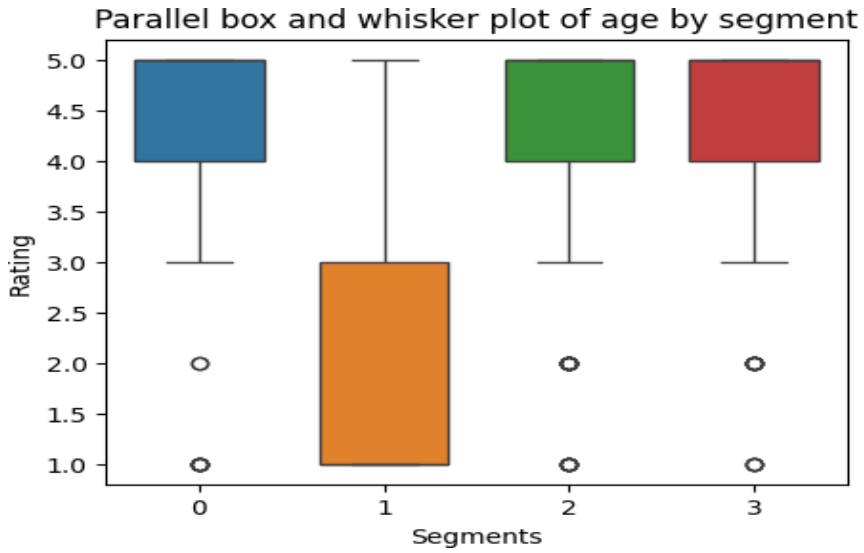
Understanding the distances covered by consumers provides valuable insights into usage patterns, travel behaviors, and preferences within the electric vehicle market.

Businesses can leverage this information to optimize electric vehicle features, range capabilities, charging infrastructure, and marketing messages to meet the diverse commuting needs of consumers.

4. **Market Opportunities**:

The predominance of commuting as the primary usage pattern presents opportunities for businesses to innovate and differentiate their electric vehicle offerings.

Strategies to enhance range, efficiency, comfort, and convenience for commuting purposes can drive market adoption and customer satisfaction in the electric vehicle market.



Above parallel box and whisker plot, emphasizes significant differences in average ratings among segments. Specifically, Segment 1 consumers express dissatisfaction across all perceptions, leading to lower overall ratings.

1. **Segment 1 Dissatisfaction:**

Segment 1 stands out for expressing dissatisfaction across all perceptions.

This indicates that consumers within Segment 1 consistently rate electric vehicles lower across various aspects, highlighting significant areas of dissatisfaction or discontentment with the product or service experience.

2. **Lower Overall Ratings:**

The consistent expression of dissatisfaction among Segment 1 consumers contributes to lower overall ratings for this segment.

Lower overall ratings may impact brand perception, customer loyalty, and market competitiveness, emphasizing the importance of addressing consumer concerns and improving satisfaction levels within Segment 1.

3. **Implications for Market Understanding:**

Understanding the factors contributing to dissatisfaction within Segment 1 is crucial for market understanding and strategic decision-making.

Businesses need to identify and address underlying issues related to product quality, service experience, pricing, or other factors that contribute to lower ratings and dissatisfaction among Segment 1 consumers.

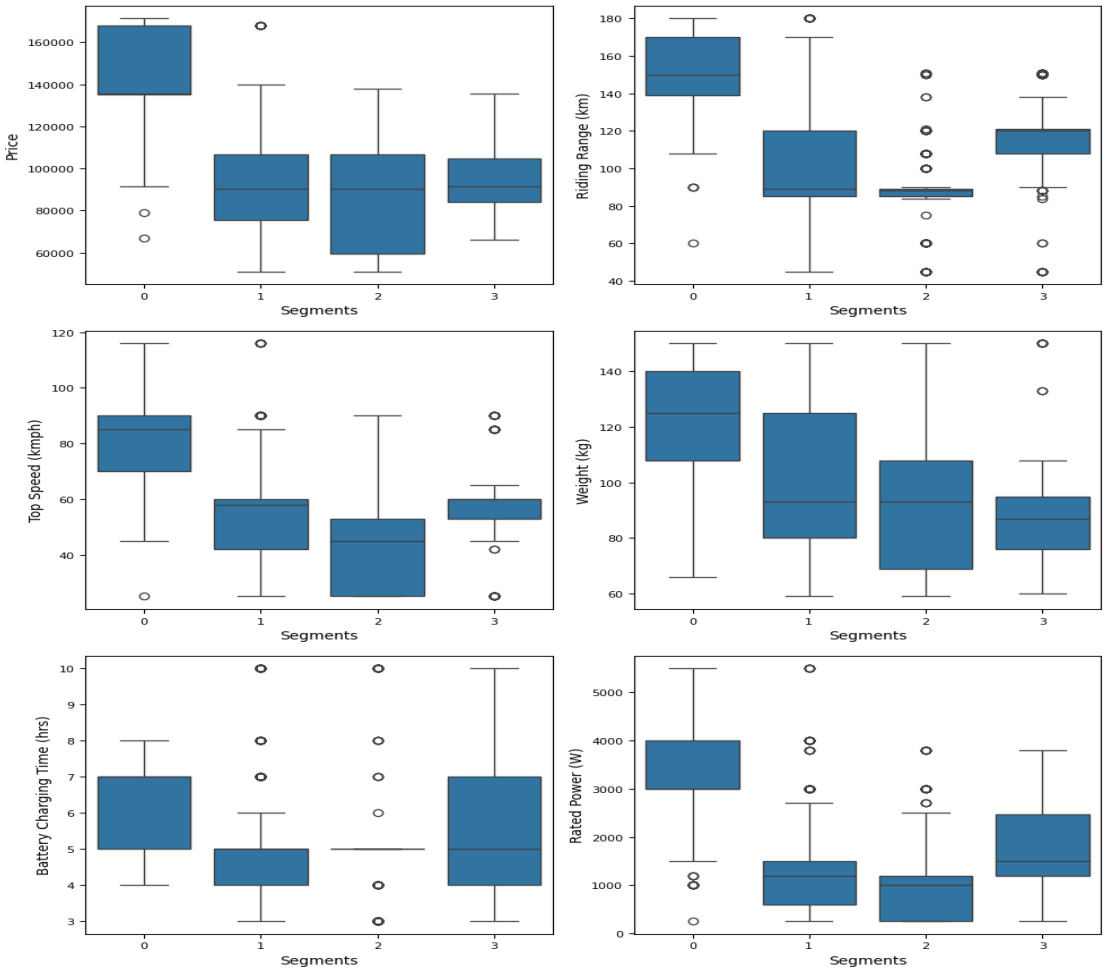
4. **Opportunities for Improvement:**

Segment 1 dissatisfaction presents opportunities for improvement and intervention to enhance customer satisfaction and loyalty.Strategies such as product enhancements, service quality improvements, customer engagement initiatives, and targeted marketing campaigns can help address consumer concerns and improve overall ratings within Segment 1.

5. **Competitive Advantage:**

Addressing consumer dissatisfaction within Segment 1 can lead to competitive advantage and differentiation within the electric vehicle market.

By prioritizing customer satisfaction and addressing pain points, businesses can enhance brand reputation, customer loyalty, and market share in the competitive landscape.



In analyzing technical specification of electric vehicles across different segments, distinct patterns emerge. Segment 0 prefers premium EVs with a higher price range and extended riding range, emphasizing consumer preference for luxury and long-distance travel. Segment 1 focuses on budget-friendly options with lower prices and moderate riding ranges, suitable for daily commuting. Segment 2 and Segment 3 prioritize affordability, with slight differences in riding range and speed preferences. Weight preferences vary, with Segment 0 and Segment 1 favoring heavier vehicles, while Segment 2 and Segment 3 prefer lighter options. Charging time also differs, with Segment 0 and Segment 3 opting for longer durations for overnight charging, while Segment 1 and Segment 2 prioritize faster charging for quick turnaround times. These nuanced preferences shape the electric vehicle market in India.

1. **Segment 0 Preferences:**

Preference for Premium EVs: Segment 0 shows a preference for premium electric vehicles characterized by higher price ranges and extended riding ranges.

Emphasis on Luxury and Long-Distance Travel: Consumers in Segment 0 prioritize luxury features and longer riding ranges, indicating a preference for high-end electric vehicles suitable for long-distance travel and premium experiences.

2. **Segment 1 Preferences:**

Focus on Budget-Friendly Options: Segment 1 consumers prioritize budget-friendly electric vehicles with lower prices and moderate riding ranges.

Suitability for Daily Commuting: Electric vehicles in Segment 1 are tailored to meet the needs of daily commuters, offering affordable options with practical riding ranges for everyday transportation.

3. **Segment 2 and Segment 3 Preferences:**

Priority on Affordability: Both Segment 2 and Segment 3 prioritize affordability in electric vehicles, with slight differences in riding range and speed preferences.

Varied Weight Preferences: While Segment 0 and Segment 1 favor heavier vehicles, Segment 2 and Segment 3 prefer lighter options, reflecting diverse consumer preferences and usage scenarios.

4. **Charging Time Preferences:**

Segment 0 and Segment 3 opt for longer charging durations suitable for overnight charging, reflecting a preference for convenience and flexibility in charging schedules.

Segment 1 and Segment 2 prioritize faster charging capabilities for quick turnaround times, indicating a need for efficient charging solutions tailored to daily commuting patterns and urban lifestyles.

5. **Market Implications:**

Nuanced Consumer Preferences: The nuanced preferences observed across different segments shape the electric vehicle market landscape in India, influencing product development, pricing strategies, and marketing approaches.

Opportunity for Segmented Offerings: Understanding consumer preferences allows manufacturers and stakeholders to develop segmented offerings tailored to specific market segments, enhancing competitiveness and market penetration.

VII. Selection of Target Segment

The strategic target segments for the electric vehicle market are identified as Segment 1 (39% of consumers) and Segment 2 (33% of consumers). Segment 1's diverse preferences and dissatisfaction points present an opportunity for improving customer satisfaction and loyalty by directly addressing their specific demands. Segment 2 values visual appeal, reliability, service experience, and comfort, offering a chance to customize electric vehicles to meet these expectations and emphasize value for money. The strategy involves addressing dissatisfaction points in Segment 1 and enhancing positive elements in Segment 2, aligning electric vehicles with the distinct expectations of each segment to ensure competitive advantage and sustained market growth.

VIII. Customizing the Marketing Mix

In our electric vehicle market strategy, customization of the marketing mix is crucial for appealing to Segment 1 and Segment 2, our target segments.

Product customization involves enhancing features based on specific desires, addressing dissatisfaction points for Segment 1, and emphasizing visual appeal and value for money for Segment 2. Diverse offerings cater to varied tastes and budgets within each segment.

Price customization includes competitive pricing for Segment 1 and a slightly higher price point for value-added features in Segment 2.

Promotion customization focuses on targeted advertising and tailored promotional events for each segment's preferences.

Place customization establishes accessible distribution channels in urban areas for Segment 1 and suburban/semi-urban regions for Segment 2, with a strong emphasis on online presence and customer support.

People and Process Customization involves training customer service representatives to address segment-specific concerns and ensuring efficient processes for customization requests and service appointments. This tailored approach ensures our electric vehicles align with the distinct needs of Segment 1 and Segment 2, enhancing market relevance and customer preference.

IX. Potential Early Market Customer Base

1. Segment Identification:

Segment 1: Consists of 330 members, representing 39% of consumers.

Segment 2: Comprises 277 members, accounting for 33% of consumers.

2. Target Price Range:

Segment 1: Target price range falls between ₹51,094 and ₹1,67,844.

Segment 2: Target price range ranges from ₹51,094 to ₹1,37,890.

3. Potential Profits Calculation:

For Segment 1:

Assuming a target price of ₹1,20,000, the potential profit can be calculated by multiplying the number of potential customers (330 members) by the target price.

Potential profit = 330 members * ₹1,20,000 = ₹39.60 crores.

For Segment 2:

Considering a target price of ₹1,10,000, the potential profit is determined by multiplying the number of potential customers (277 members) by the target price.

Potential profit = 277 members * ₹1,10,000 = ₹30.47 crores.

4. **Market Penetration Focus:**

Segment 1 is identified as the primary focus for early market penetration efforts due to its larger potential market share and higher profit opportunity.

With a significant number of potential customers and a broader price range, Segment 1 offers substantial profit potential for early market penetration initiatives.

5. **Strategic Implications:**

Targeting Segment 1 allows businesses to capitalize on the significant profit opportunity and establish a strong foothold in the market.

Strategies such as targeted marketing campaigns, product enhancements, and customer engagement initiatives can be tailored to meet the specific needs and preferences of Segment 1 consumers, driving market penetration and revenue growth.

X. Most Optimal Market Segments

1. **Segment 1 Selection:**

Constitutes 39% of consumers: Segment 1 represents a sizable portion of the target market, offering significant market potential and opportunities for growth.

Balanced blend of specifications and price range: Segment 1's characteristics align well with the target market's preferences, providing a balance between technical specifications and affordability.

2. **Recommended Technical Specifications for Segment 1:**

Price Range: ₹70,688 to ₹1,29,063: The recommended price range ensures affordability while offering a range of options to cater to different budget preferences within Segment 1.

Riding Range: 89 to 180 km: A moderate riding range addresses the commuting needs of consumers while providing flexibility for longer trips.

Top Speed: 58 to 116 kmph: A varied range of top speeds accommodates different usage scenarios and preferences among consumers.

Weight: 76 to 120 kg: Optimal weight ensures maneuverability, ease of handling, and efficiency in urban and suburban environments.

Battery Charging Time: 3 to 5 hours: Efficient charging times cater to the convenience and practicality needs of consumers, facilitating daily usage without significant downtime.

Rated Power: 1200 to 5500 W: Varied power ratings offer options for consumers with different performance requirements and preferences.

3. **Targeted Approach and Market Alignment:**

Tailoring technical specifications to meet the diverse needs and preferences of Segment 1 consumers ensures market alignment and enhances the likelihood of success in the electric vehicle market.

The targeted approach focuses on delivering value, performance, and affordability, key factors that influence consumer purchasing decisions in the electric two-wheeler segment.

4. **Foundation for Success:**

The selection of Segment 1 as the optimal market segment, coupled with the recommended technical specifications, lays a solid foundation for a successful and sustainable venture into the electric vehicle market.

By aligning products with consumer preferences and market dynamics, businesses can capitalize on opportunities, drive adoption, and establish a competitive edge in the evolving electric two-wheeler market landscape.

XI. Conclusion

In Conclusion, depth analysis of India's electric vehicle market led us to identify Segment 1 as the optimal target. With a significant 39% consumer base, this segment represents a substantial market opportunity. By tailoring our electric two-wheeler specifications to meet the preferences of this segment, we ensure our products align seamlessly with the demands of a large customer base. This strategic decision is grounded in a thorough understanding of market segmentation, consumer behavior, and technical specifications. These insights provide a clear direction for our market entry, emphasizing precision and relevance in both product development and marketing strategies. Moving forward, this approach equips us with a solid foundation, ensuring our offerings resonate effectively within India's evolving electric vehicle landscape.

MARKET SEGMENTATION ANALYSIS OF ELECTRIC VEHICLES MARKET IN INDIA

Shreyas Gosavi

1 Problem Statement

Our goal is to analyze market segment for an Electric Vehicle based startup to decide which vehicle/customer space is suitable for developing its EVs..

In this report we analyze the Electric Vehicles Market in India using segments such as region, price, charging facility, type of vehicles (e.g., 2 wheelers, 3 wheelers, 4 wheelers etc.), body type (e.g., Hatchback, Sedan, SUV, Autorickshaw etc.), safety, plug types and much more.

2 Fermi Estimation

Around 4.52 million electric vehicles are estimated to be sold in India in the year 2024 out of which 75% of the market will be occupied by public transport. gives us a rough idea of how many people in India could use EVs by 2024. The Indian EV market in 2024 could reach between Rs. 63,700 crores and Rs. 161,500 crores, depending on the pace of EV adoption. Moderate estimates suggest a 3% adoption rate and a slight price decrease, leading to a market size of Rs. 102,300 crores. However, optimistic scenarios with 5% adoption and continued government support could push the market towards Rs. 161,500 crores. These are the rough estimations which gives us a rough idea of how many people in India could use EVs by 2024.

3 Data Collection

Data was collected from one of the most popular data science platforms which is Kaggle and public datasets to extract meaningful insights. We'll be using these datasets for our market segmentation analysis.

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

https://www.india-briefing.com/news/indias-ev-manufacturing-capacity-and-market-preferences-progress-25840.html/

4 Data Preprocessing

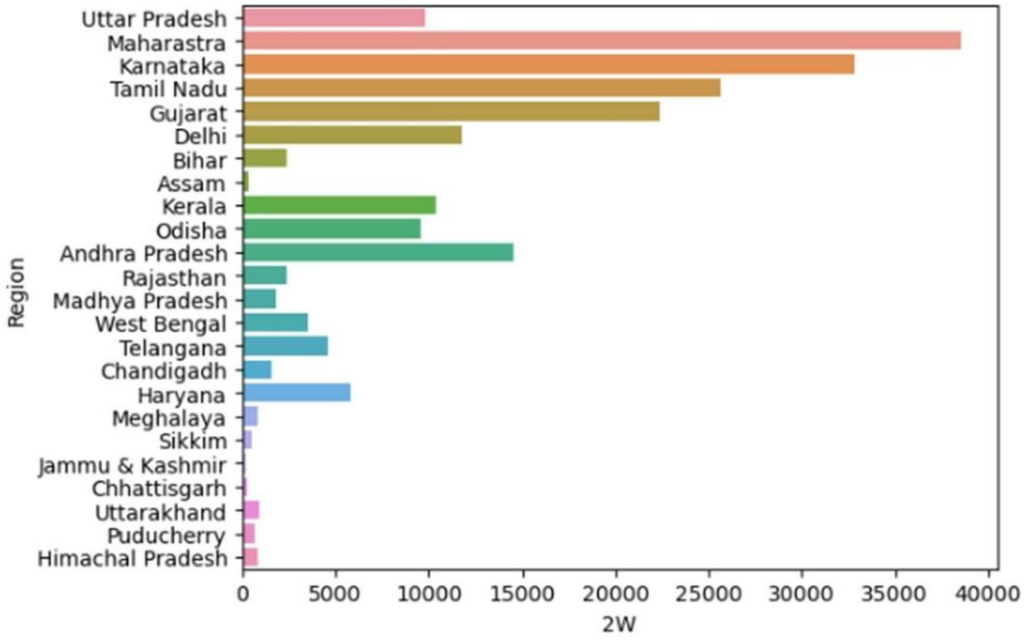
Using Python libraries such as NumPy and Pandas, the data was loaded into the notebook and preprocessed. The preprocessing involved encoding of categorical variables, extraction of

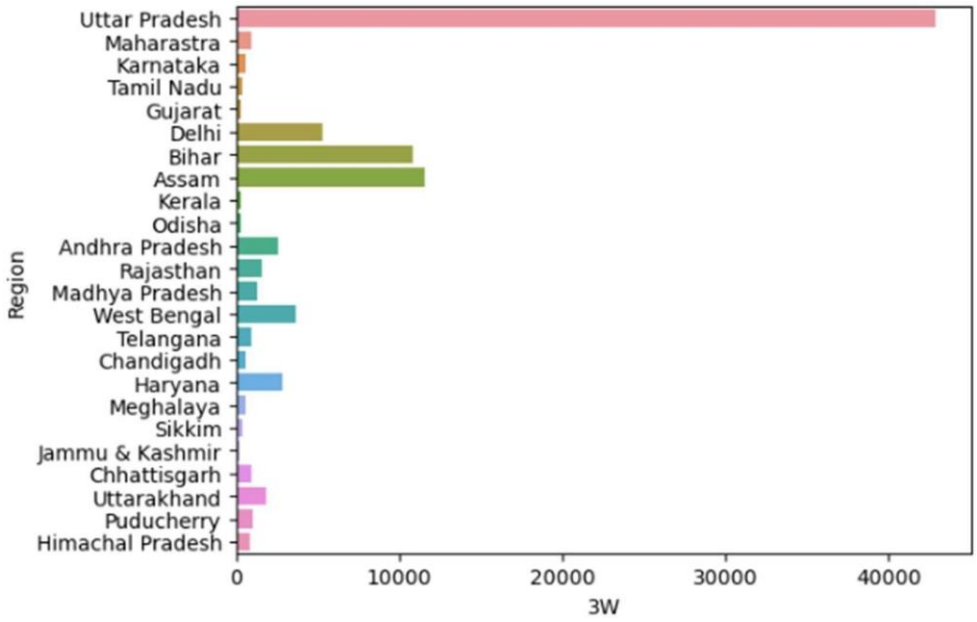
important features, deletion of unnecessary variables. This part ensured that our datasets are for further analysis of features.

5 Exploratory Data Analysis

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.

We performed EDA on two datasets. The first dataset determines the number of electric vehicles manufactured per state and number of charges in each state.




Uttar Pradesh
Maharastra
Karnataka
Tamil Nadu
Gujarat
Delhi
Bihar
Assam
Kerala
Odisha
Andhra Pradesh
Rajasthan
Madhya Pradesh
West Bengal
Telangana
Chandigadh
Haryana
Meghalaya
Sikkim
Jammu & Kashmir
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Uttarakhand
Puducherry
Himachal Pradesh
Region
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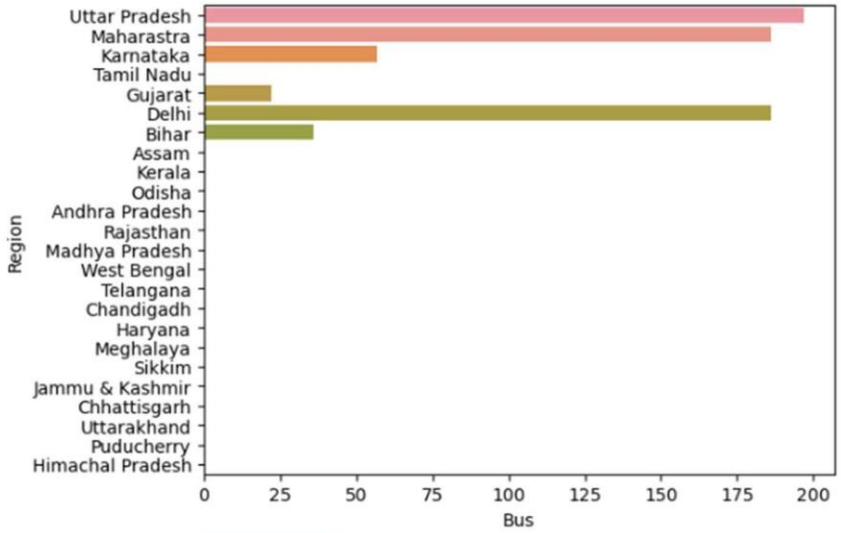
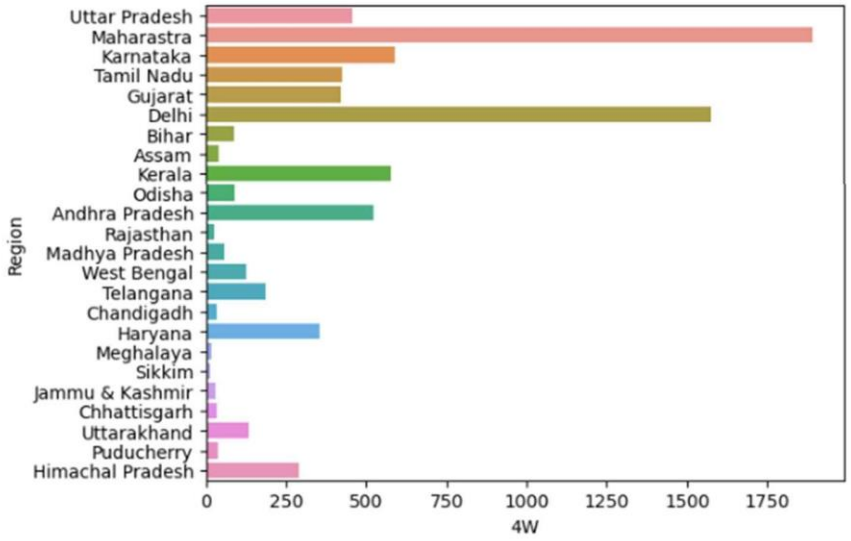
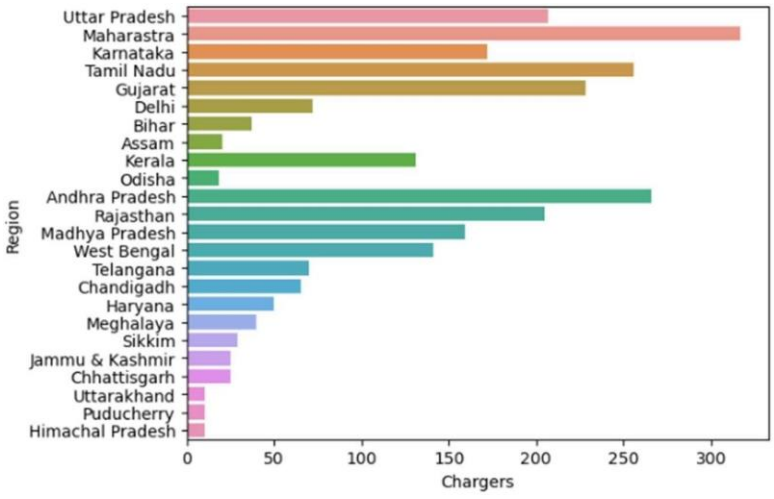
20000
30000
40000
3W

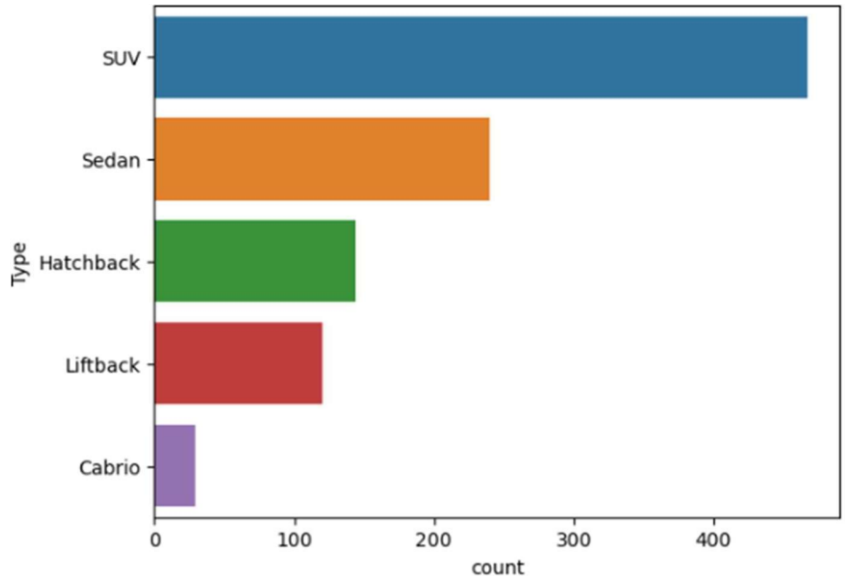

Uttar Pradesh
Maharastra
Karnataka
Tamil Nadu
Gujarat
Delhi
Bihar
Assam
Kerala
Odisha
Andhra Pradesh
Rajasthan
Madhya Pradesh
West Bengal
Telangana
Chandigadh
Haryana
Meghalaya
Sikkim
Jammu & Kashmir
Chhattisgarh
Uttarakhand
Puducherry
Himachal Pradesh
Region
0
25
50
75
100
125
150
175
200
Bus

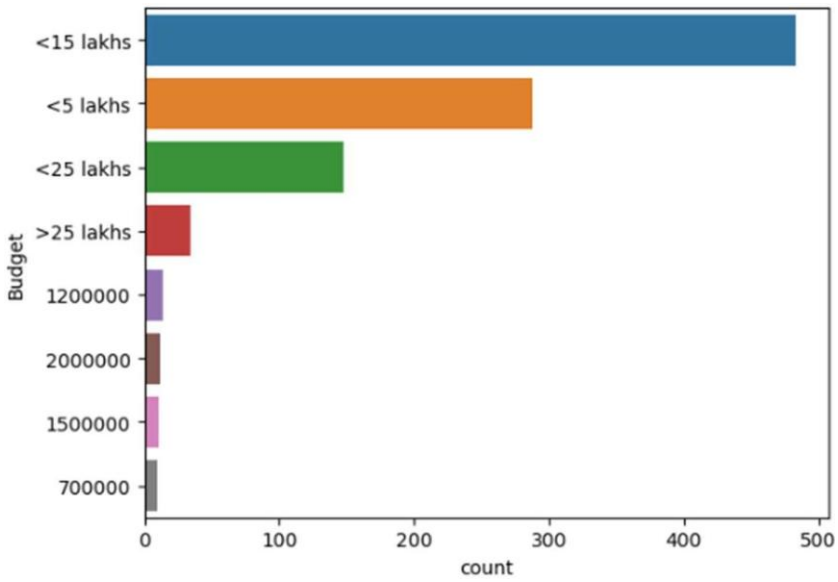

Uttar Pradesh
Maharastra
Karnataka
Tamil Nadu
Gujarat
Delhi
Bihar
Assam
Kerala
Odisha
Andhra Pradesh
Rajasthan
Madhya Pradesh
West Bengal
Telangana
Chandigadh
Haryana
Meghalaya
Sikkim
Jammu & Kashmir
Chhattisgarh
Uttarakhand
Puducherry
Himachal Pradesh
Region
0
250
500
750
1000
1250
1500
1750
4W

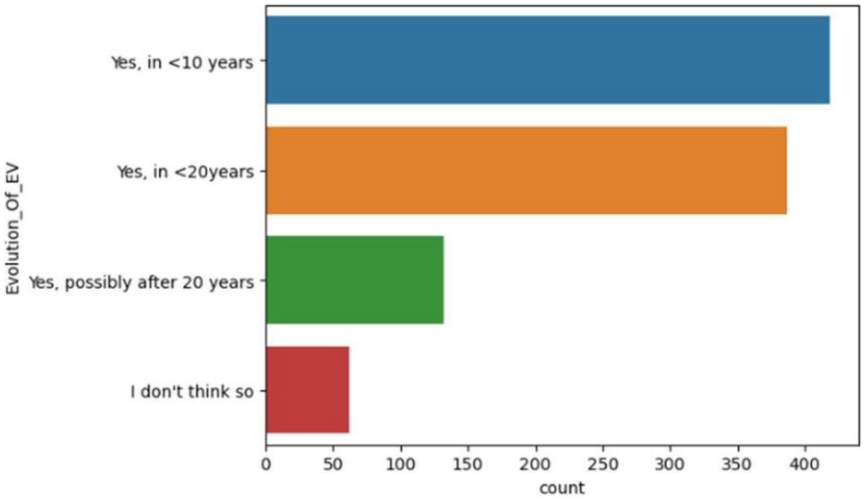

Uttar Pradesh
Maharastra
Karnataka
Tamil Nadu
Gujarat
Delhi
Bihar
Assam
Kerala
Odisha
Andhra Pradesh
Rajasthan
Madhya Pradesh
West Bengal
Telangana
Chandigadh
Haryana
Meghalaya
Sikkim
Jammu & Kashmir
Chhattisgarh
Uttarakhand
Puducherry
Himachal Pradesh
Region
0
50
100
150
200
250
300
Chargers

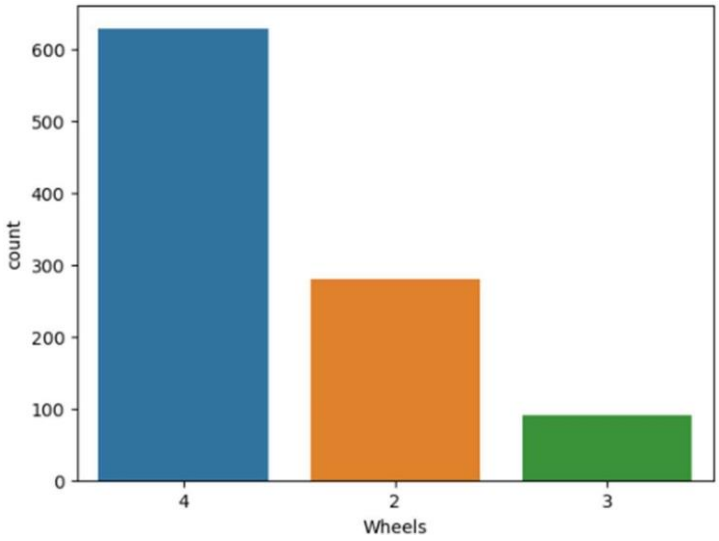
Maharashtra uses the highest number of electric vehicles in entire India with the highest usage of 2 wheeler and 4 wheeler vehicles. Maharashtra and Karnataka have the highest number of 2 wheeler EVs in India. Uttar Pradesh has the highest number of 3 wheeler EVs in India. Maharashtra and Delhi have the highest number of 4 wheeler EVs in India. Only 6 states have electric buses throughout India. Maharashtra, Andhra Pradesh and Tamil Nadu are leading producers of EV chargers.

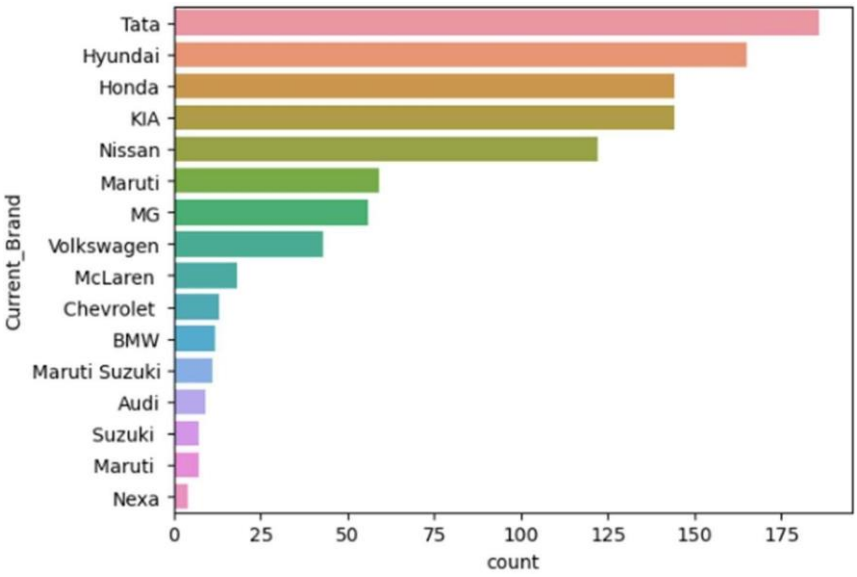
The second dataset was a survey conducted regarding the preferences and views of different people regarding electric vehicles. The variables consist of profession, annual income, vehicle choice, budget, their views regarding EV evolution.






Yes, in <10 years
Yes, in <20years
Yes, possibly after 20 years
I don't think so
Evolution_Of_EV
0
50
100
150
200
250
300
350
400
count


600
500
400
300
200
100
0
count
4
2
3
Wheels


Tata
Hyundai
Honda
KIA
Nissan
Maruti
MG
Volkswagen
McLaren
Chevrolet
BMW
Maruti Suzuki
Audi
Suzuki
Maruti
Nexa
Current_Brand
0
25
50
75
100
125
150
175
count

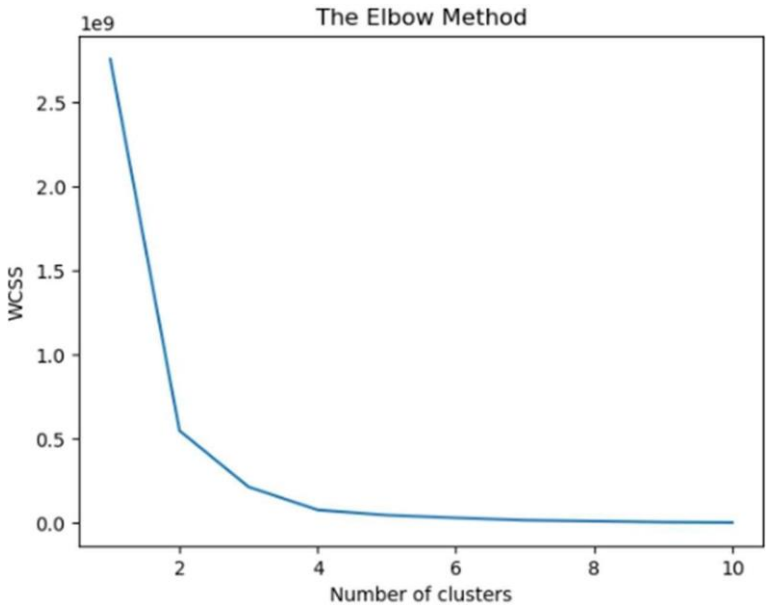
A large number of the survey takers owned Tata, Hyundai, Honda and Kia. They prefer to own a SUV, Sedan as their preferred electric vehicle. They prefer to buy such electric vehicles having a budget less than 15 lakh rupees. Very less people want to buy a two wheeler EV. Majority of the people are positive about evolution of electric vehicles and believe that the EV market will evolve within the next 10 years.

6 K-Means Clustering

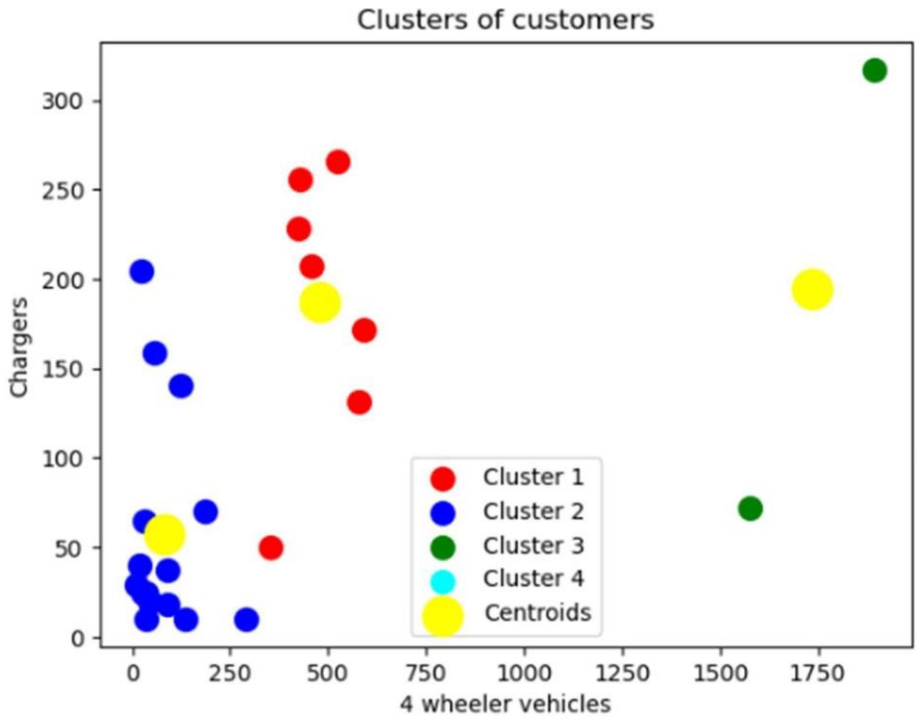
K-Means Clustering is one of the most popular Unsupervised Machine Learning Algorithms Used for Solving Classification Problems. K Means segregates the unlabeled data into various groups, called clusters, based on having similar features, common patterns.
Suppose we have N number of Unlabeled Multivariate Datasets of various features like water-availability, price, city etc. from our dataset. The technique to segregate Datasets into various groups, on the basis of having similar features and characteristics, is called Clustering. The groups being Formed are known as Clusters. Clustering is being used in Unsupervised Learning Algorithms in Machine Learning as it can segregate multivariate datainto various groups, without any supervisor, on the basis of a common pattern hidden inside the datasets.
In the Elbow method, we are actually varying the number of clusters (K) from 1 – 10. For each value of K, we are calculating WCSS (Within-Cluster Sum of Square). WCSS is the sum of squared distance between each point and the centroid in a cluster. When we plot the WCSS with the K value, the plot looks like an Elbow.

1st dataset

For the survey of the 2nd dataset, we observe that more people intend to purchase 4 wheeler vehicles, so in the 1st dataset we considered the features: 4 wheeler, bus and number of chargers.



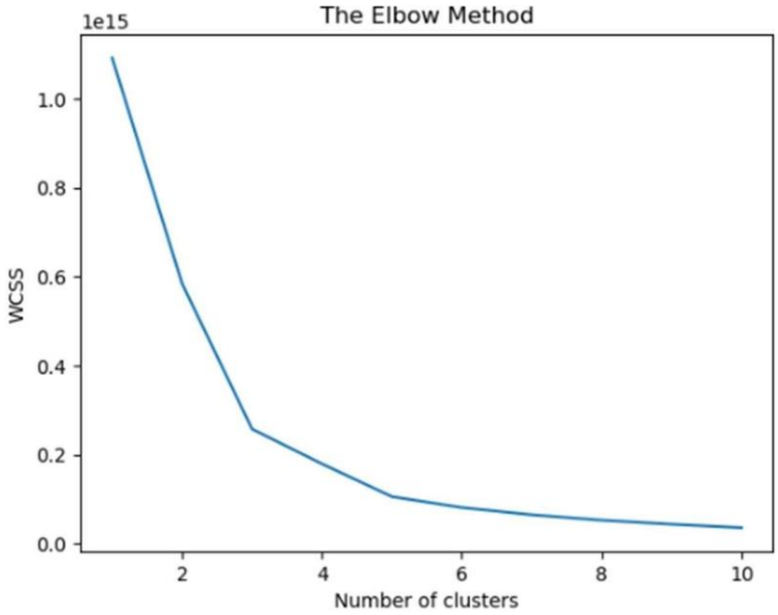
As we saw, there is a clink on 4th cluster. So we'll be selecting 4 clusters



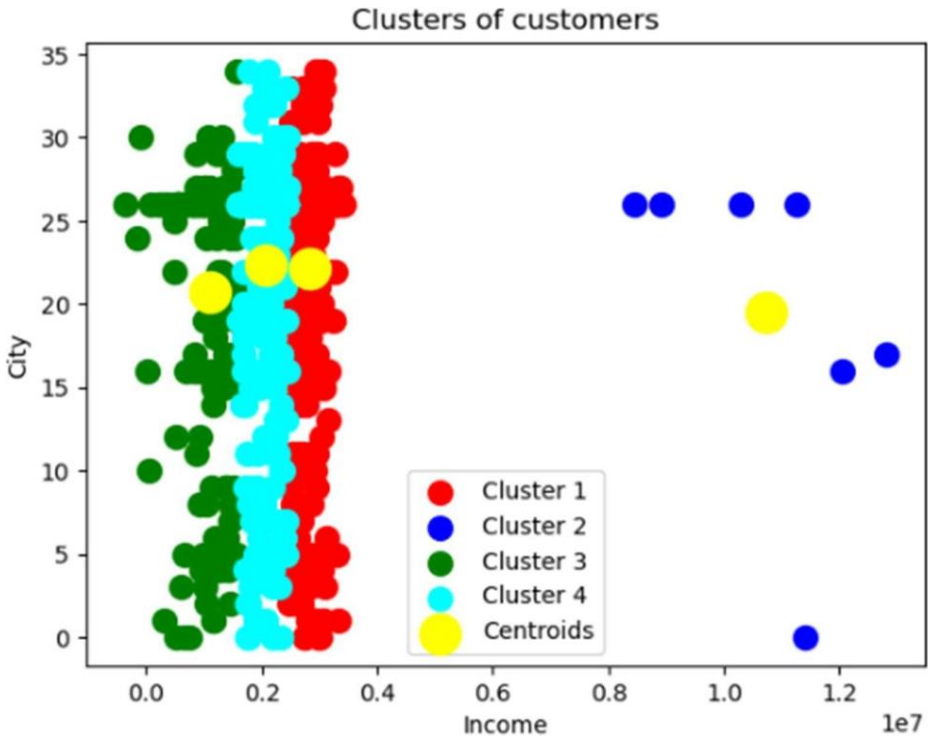
The K-Means cluster plot for the 1st dataset is as shown above.

2nd dataset

For the 2nd dataset, we considered Age, Income and Budget as our essential features for the model



As we saw, there is a clink on 4th cluster. So we'll be selecting 4 clusters



The K-Means cluster plot for the 2nd dataset is as shown above.

7 Principal Component Analysis

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into values of linearly uncorrelated variables called principal components. This transformation is defined so that the first principal component has the largest possible variance (that is, it accounts for as much of the variability in the data as possible). Each succeeding component has the highest variance possible under the constraint that it is orthogonal to (i.e., uncorrelated with) the preceding components.

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

The clusters of each observation obtained from the K-Means model were added to the dataset and were used in the PCA model to check the accurate prediction of each cluster point.

Like we do in supervised learning, we split the dataset into train and test data to see how our model works on unseen data. Then we used a logistic regressor to train the model and evaluate the principal components on the train and test data.

1st dataset

In [59]:
```
from sklearn.metrics import confusion_matrix, accuracy_score
y_pred = classifier.predict(X_test)
print(confusion_matrix(y_test, y_pred))
accuracy_score(y_test, y_pred)
```

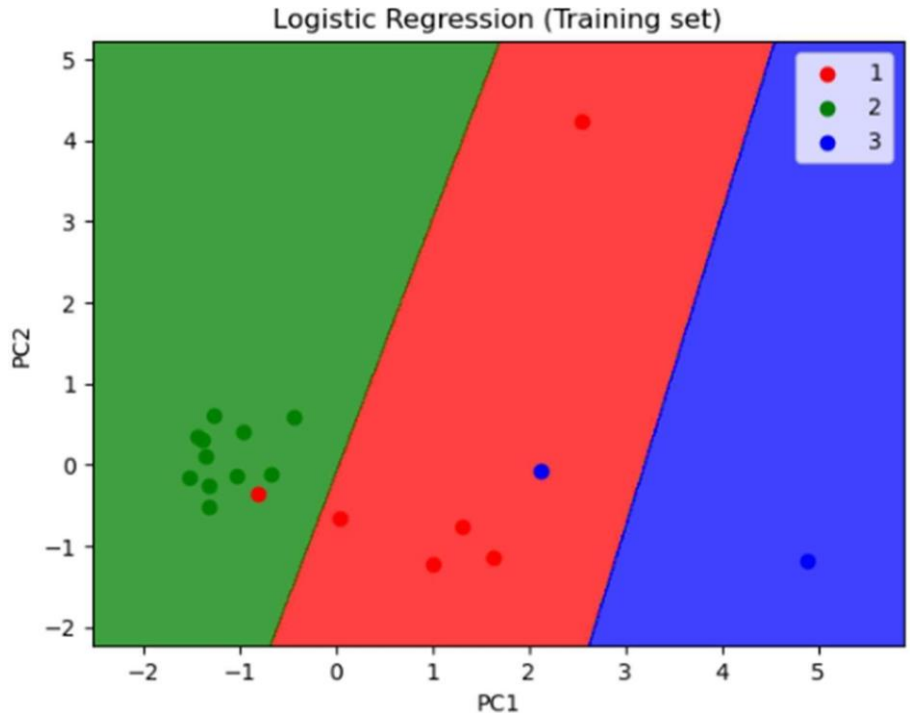
```
[[1 0]
 [0 4]]
```

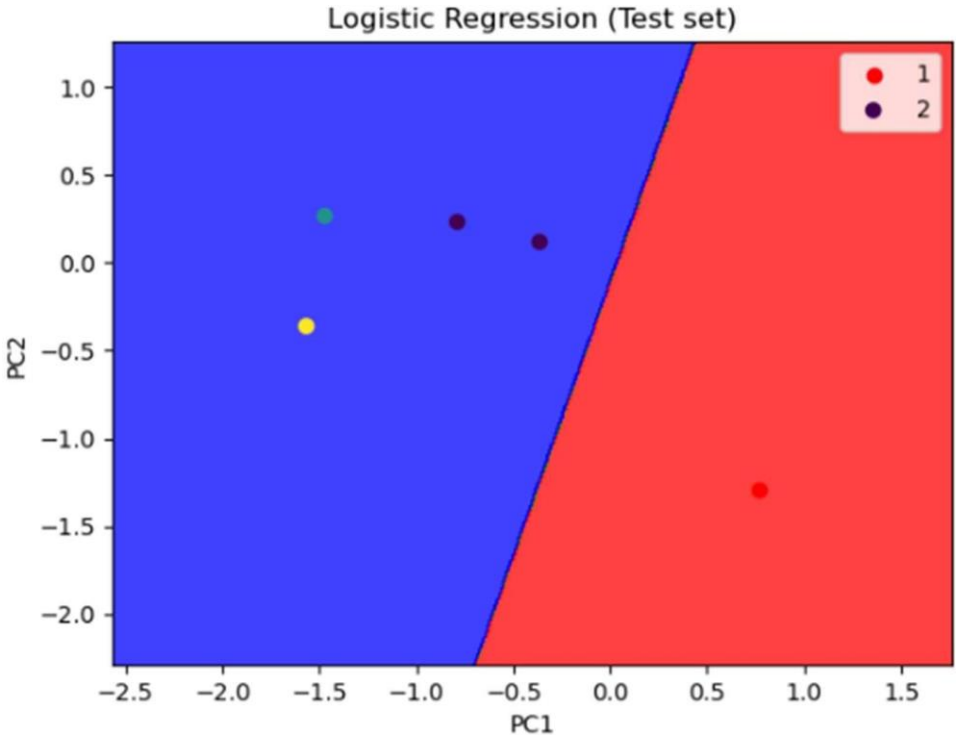
Out[59]: 1.0

In [60]:
```
from sklearn.metrics import confusion_matrix, accuracy_score
y_pred = classifier.predict(X_train)
print(confusion_matrix(y_train, y_pred))
accuracy_score(y_train, y_pred)
```

```
[[ 5  1  0]
 [ 0 11  0]
 [ 1  0  1]]
```

Out[60]: 0.8947368421052632

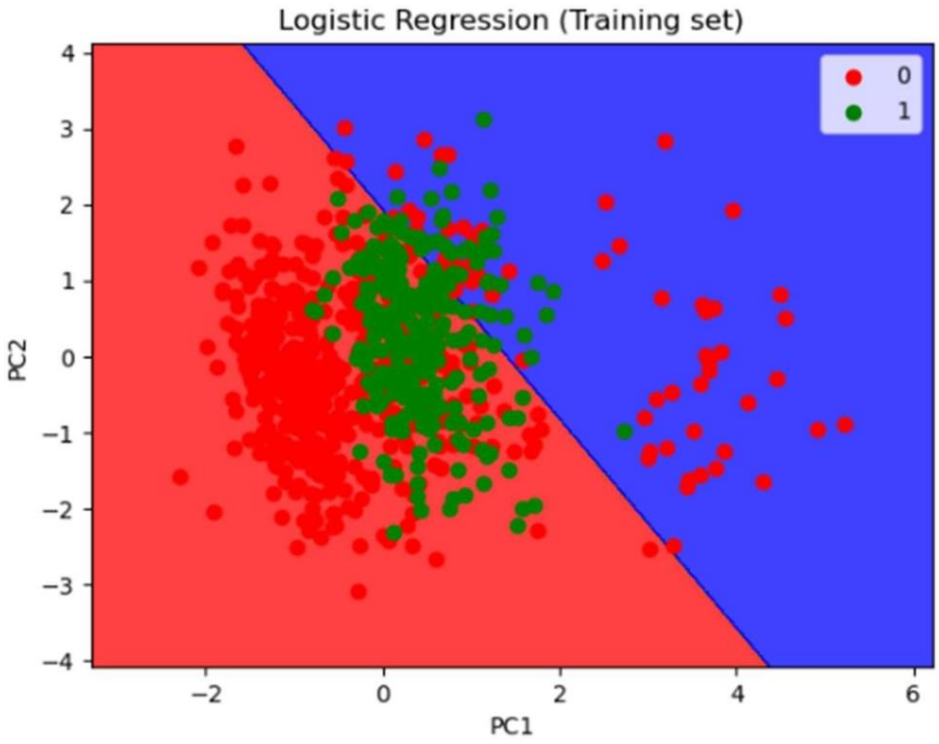


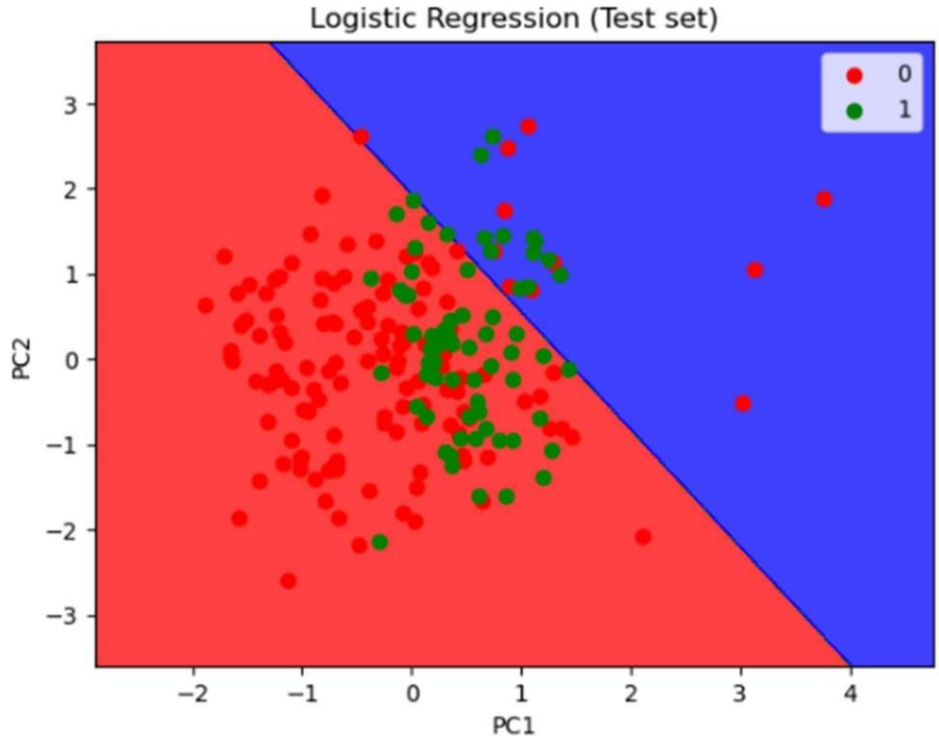


We were able to achieve an accuracy of 89.47% on the training set and 100% accuracy on the test set.

2nd dataset

```
In [74]: from sklearn.metrics import confusion_matrix, accuracy_score
         y_pred = classifier.predict(X_test)
         cm = confusion_matrix(y_test, y_pred)
         print(cm)
         accuracy_score(y_test, y_pred)

         [[59  0  0 22]
          [ 2  0  0  0]
          [30  0  0 18]
          [51  0  0 18]]

Out[74]: 0.385

In [75]: from sklearn.metrics import confusion_matrix, accuracy_score
         y_pred = classifier.predict(X_train)
         print(confusion_matrix(y_train, y_pred))
         accuracy_score(y_train, y_pred)

         [[257   0   0  92]
          [  4   0   0   1]
          [ 96   0   0  51]
          [194   0   0 104]]

Out[75]: 0.4518147684605757
```





We were able to achieve an accuracy of 45.18% on the training set

8 Final Strategy

The first dataset identifies cluster 3 as its potential target segment to set up more 4 wheeler vehicles in the state of Maharashtra and Delhi. This is because Mumbai and Delhi are economic states, so they have the purchasing power to automate more vehicles and chargers. Delhi has widely adopted electric vehicles, but it needs to introduce more chargers to be able to produce more vehicles and compete with Mumbai. The customers in this cluster are mostly working class and are expected to be aware of technology, traffic problems, and the environment's cleanliness. The states belonging to cluster 2 such as Bihar, Assam, Rajasthan,, Madhya Pradesh, etc has more enough number of chargers but the import rate of vehicles is very low.

In the second dataset, the cluster 2 is the target segment with people belonging from Mumbai, Pune and Ahmedabad having an annual income between 8 to 12 lacs. They are more likely ready to convert their standard cars to electric vehicles and the vehicles should be priced considering their income.

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

9 Code Implementation

The directory containing the code can be found here on my GitHub repository:

https://github.com/ShreyasG482/Feynn_Labs_Projects.git

MARKET SEGMENTATION ANALYSIS OF ELECTRIC VEHICLESMARKET IN INDIA

Akshay Lanjewar

Problem Statement

Our goal is to analyze market segment for an Electric Vehicle Chargingbased startup to decide which vehicle/customer space is suitable for developing its EVs.

In this report we analyze the Electric Vehicles Charging Market in Indiausing segments such as region, The dataset encompasses various attributes, including latitude, longitude, payment modes, vendor

names, and station types

Data Collection

Data collected from one of the most popular data science platforms
which is Kaggle and public datasets to extract meaningful insights. We'llbe using these datasets for our market segmentation analysis.

https://www.kaggle.com/datasets/nezukokamaado/e-v-charging-stations

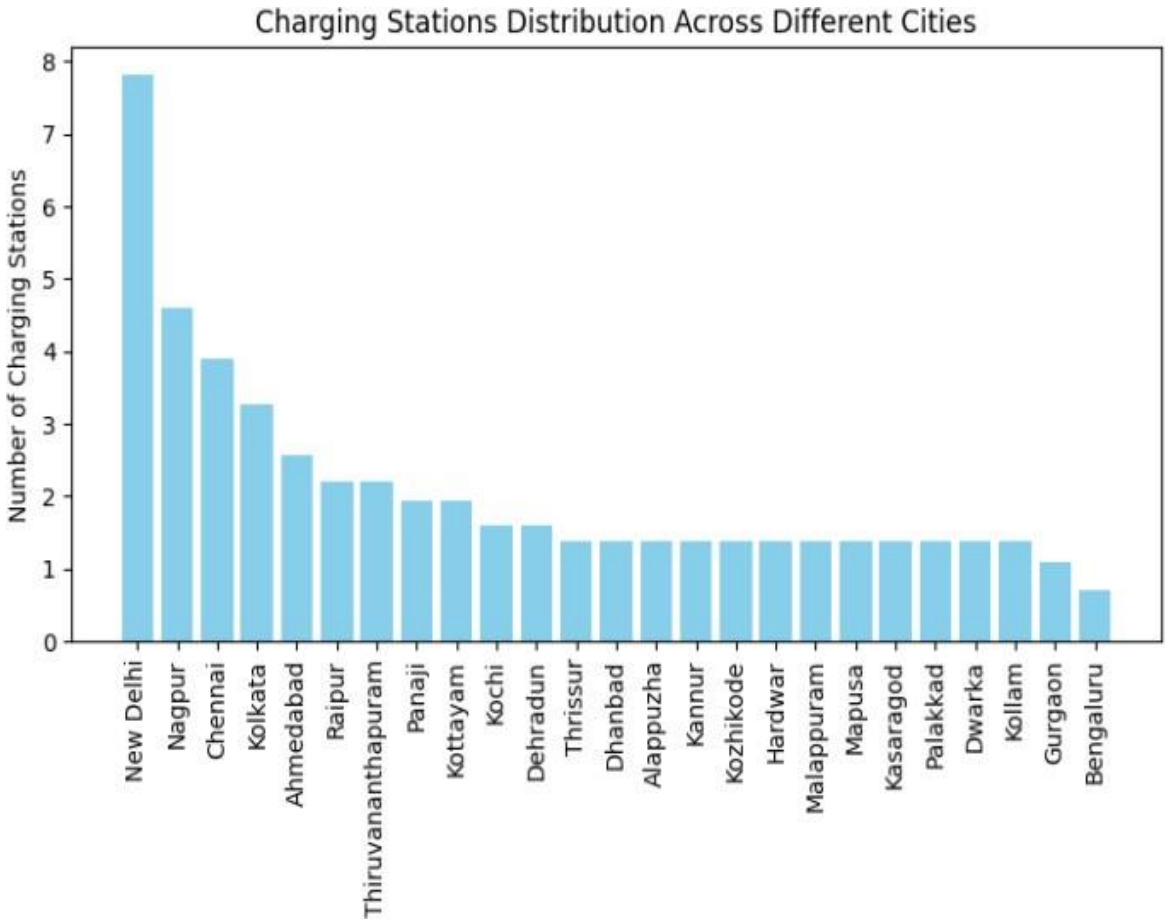
Loding Data

Using Python libraries such as NumPy and Pandas, the data was loadedinto the notebook and preprocessed. The preprocessing involved
encoding of categorical variables, extraction of important features, deletion of unnecessary variables. This part ensured that our datasetsare for further analysis of features.

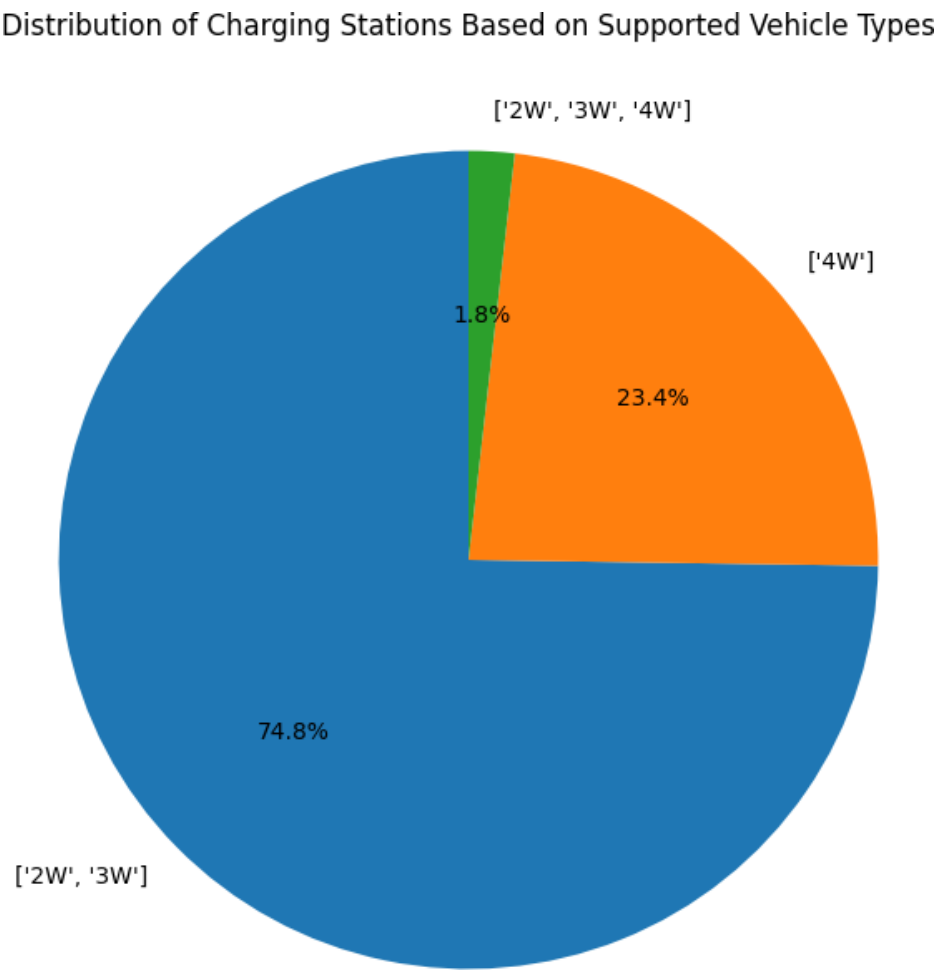
```
df = pd.read_excel('D:\ev_final.xlsx')
df
```

Exploratory Data Analysis

Exploratory data analysis (EDA) is used for data analysis to analyze and investigate data sets and summarize their main characteristics. It helps determine how best to manipulate data sources to get the answers you need, making it easier to discoverpatterns, spot anomalies, test a hypothesis, or check assumptions.

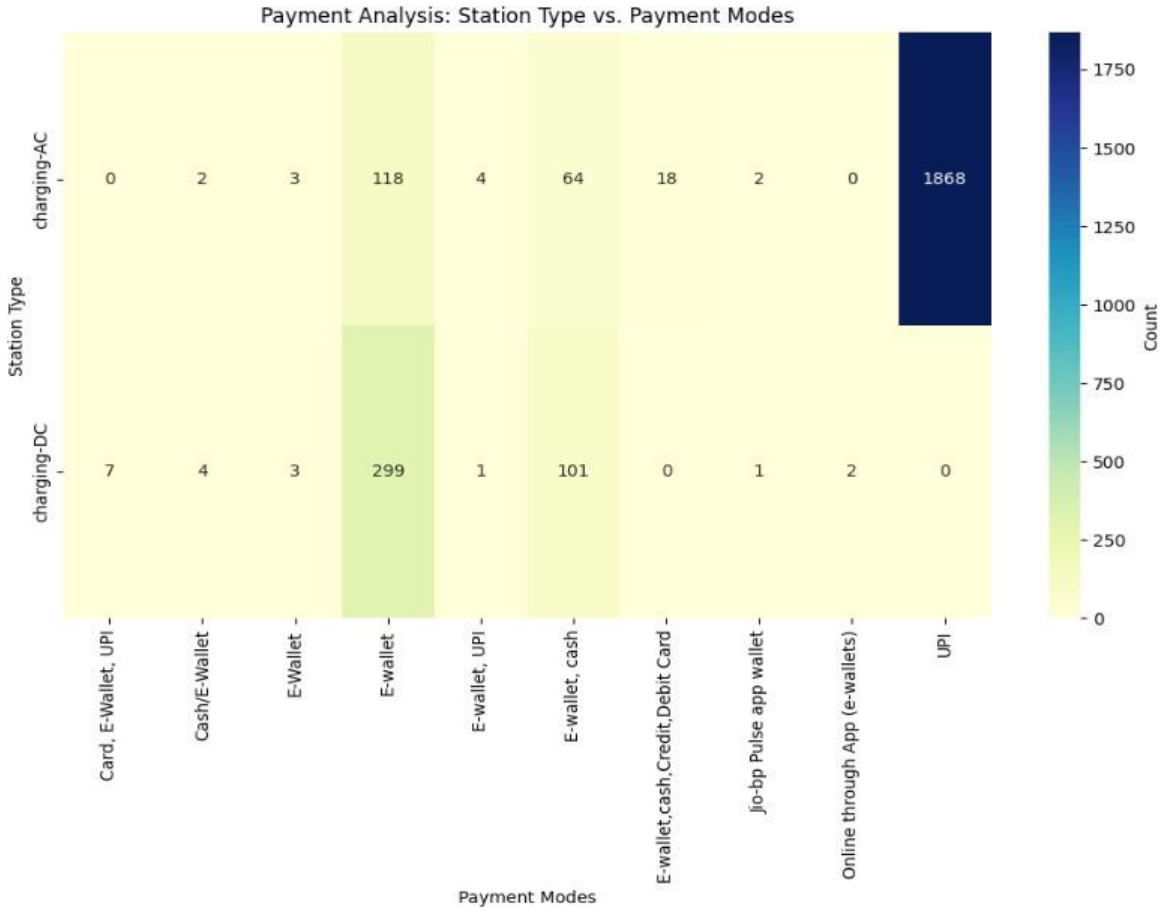


The above dataset determines the number of charging station acrossdifferent cities.



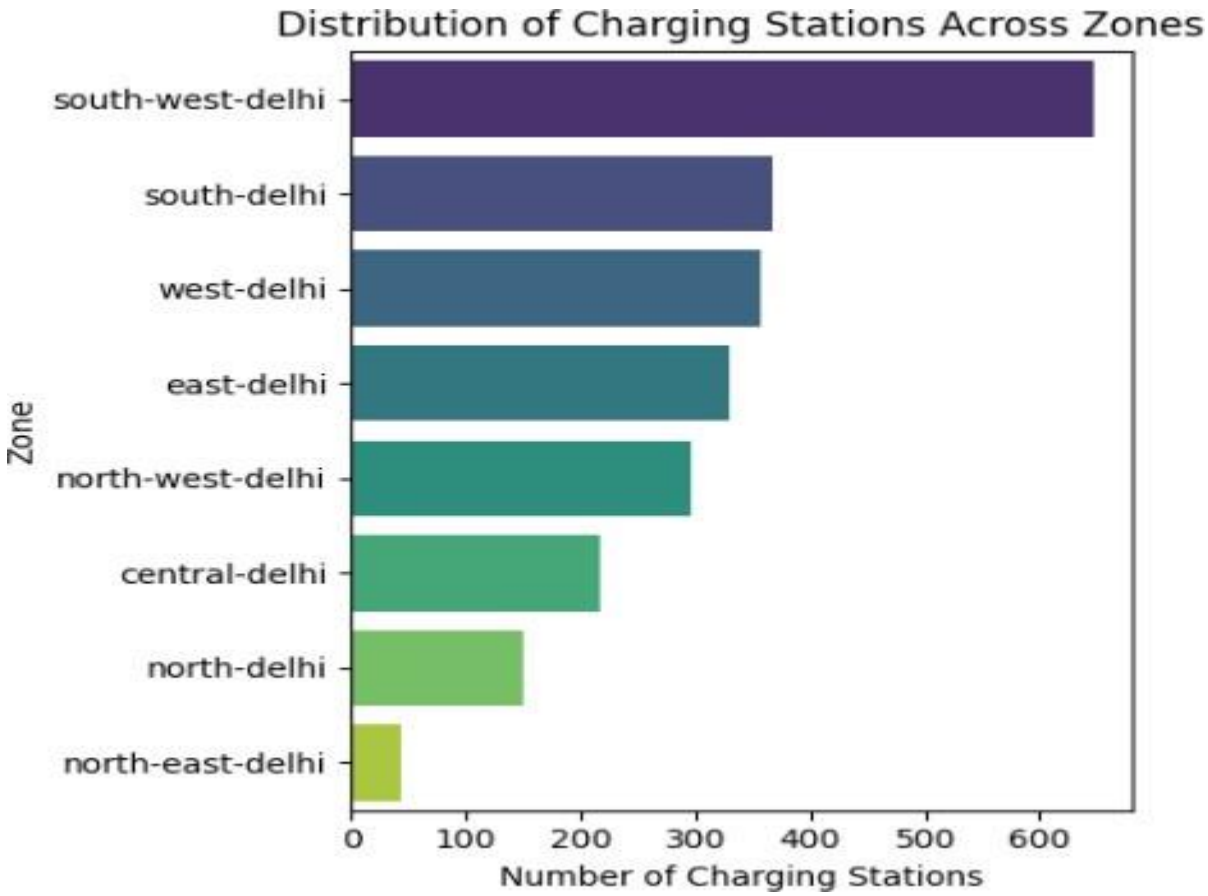
The above figure says that charging station with only '4W' facility are very less in number compared to 2W and 3W. One inference that we can draw is that 4W are new set of vehicle types and infrastructure forthese types are under development and possibly many of 2W and 3W stations will eventually have facility for 4W as well. We see this happening already with 1.8% having all 3 options

The below figure shows payment method UPI payments happening in large number followed by E-wallets. It is interesting to see that are no cash only stations as expected and what is surprising to see is that evencard payments are neglible.

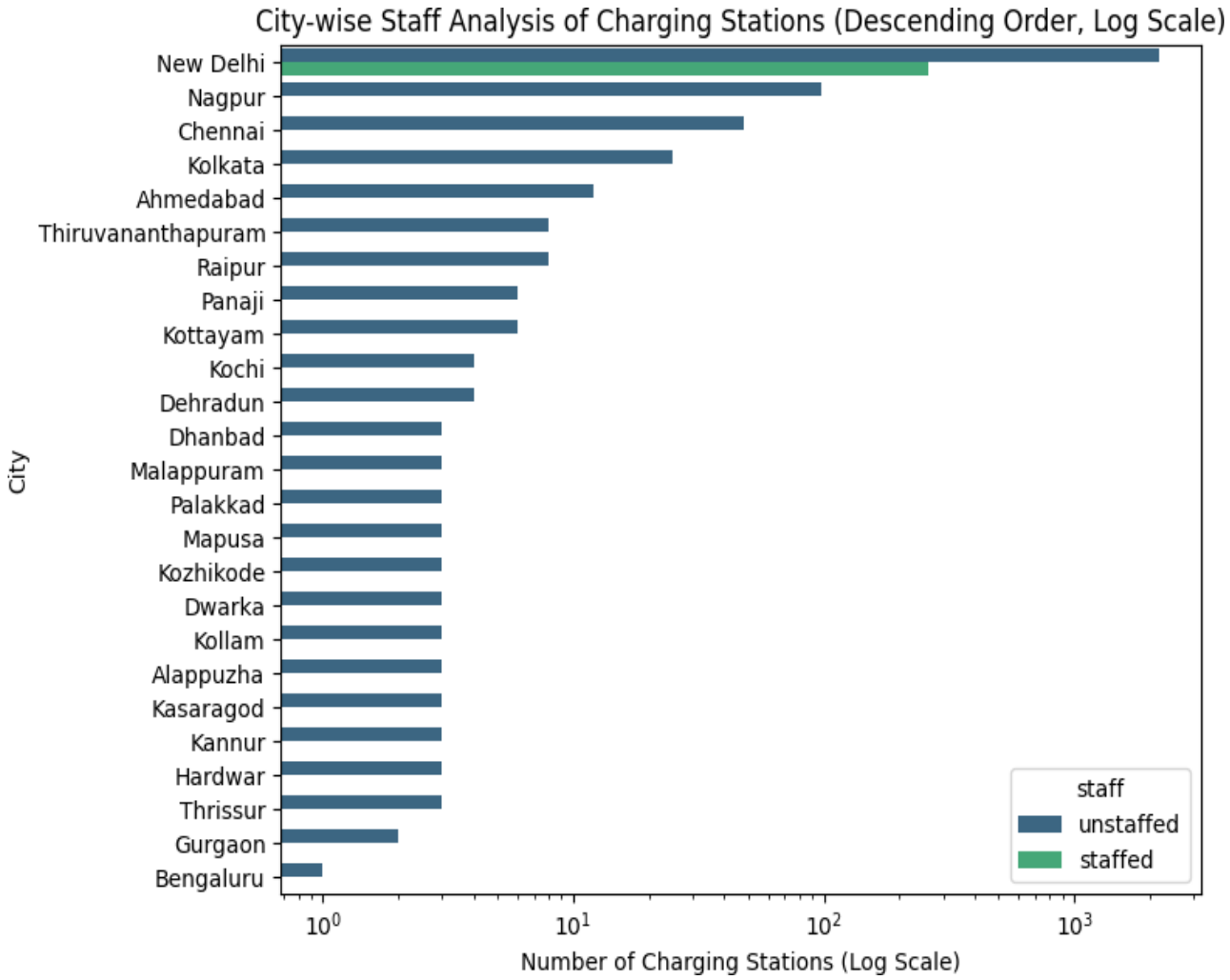


Although the dataset mainly focusses on the New Delhi, it will be good to analyse all the cities to check if there is any EV initiatives happening. We observe that other metropoliton cities like Chennai and Kolkatta hassome EV station presence. In Nagpur there are 98 vendors operating.

The below graph plot between charging station and city zone in New Delhi, its shows that south west delhi having large number of chargingstation.

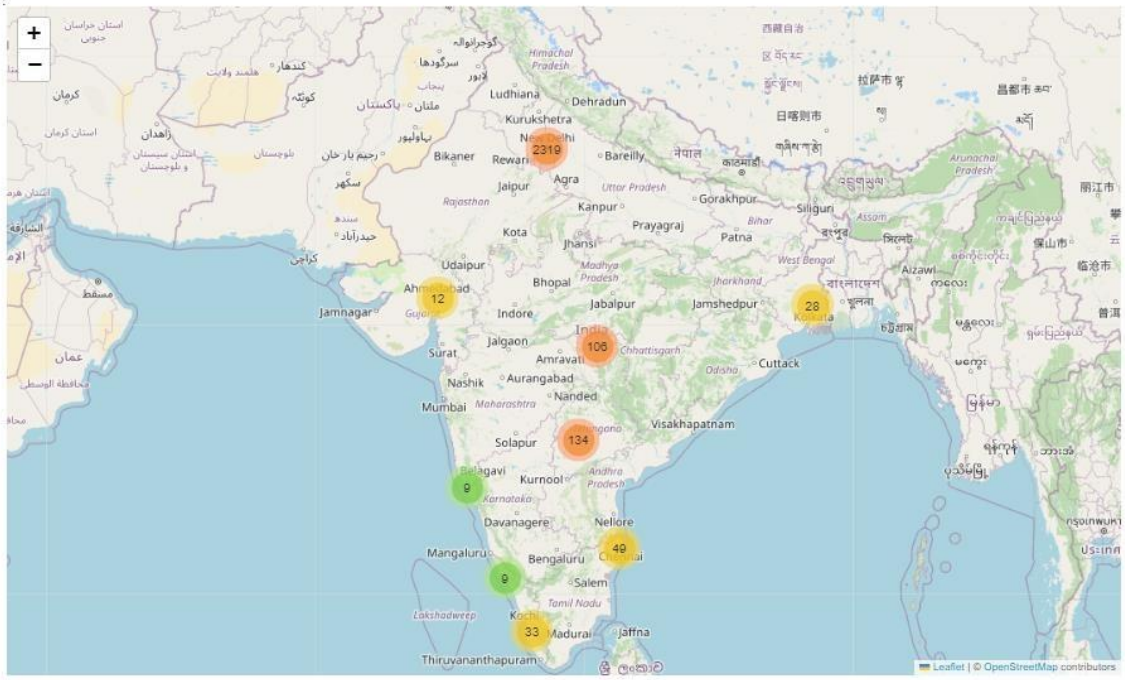


Let's now bring the citywise staffing to check the trends. As the data is mostly focused on Delhi, it is clearly mention in graph we should have some decent numbers for Delhi but for other cities unstaffed numberswill be high.



As the data has latitude and longitude, it will be interesting to locate thevendors / Ev stations on the map. Let's use Folium to achieve this. The idea is to have cluster to start with and we as we zoom in, the cluster gets divided and in the end the name of the EV station and the contact number is shown in the pop up.

Out[17]:



Conclusion

Thus, charging is more popular than battery swapping, and though battery swapping is discussed for its ease, it may take time to establish the needed infrastructure. Few charging station with only '4W' facility are very less in number compared to 2W and 3W. Payment options, particularly UPI, dominate in India, with a lack of cash-only stations, andsurprisingly low card payments. While the dataset focuses on New Delhi, exploration of other cities reveals EV initiatives in places like Chennai and Kolkata. Staffing trends vary across cities, requiring furthervisualization to validate assumptions. Lastly, using latitude and longitude data to map EV stations.

Implementation

https://github.com/akshaylanjewar0872/EV-Market-Analysis/

EV Marget Segment Analysis

Hiya Nachnani

Github Link: https://github.com/Hiyanachnani/EV_Market_Segmentation_Analysis

1. **Problem Statement**

   The electric vehicle (EV) market is experiencing rapid growth globally, driven by environmental concerns, government incentives, and advancements in technology. This report provides a comprehensive analysis of market segmentation within the EV industry, examining key trends, challenges, and opportunities.

2. **Problem Statement**

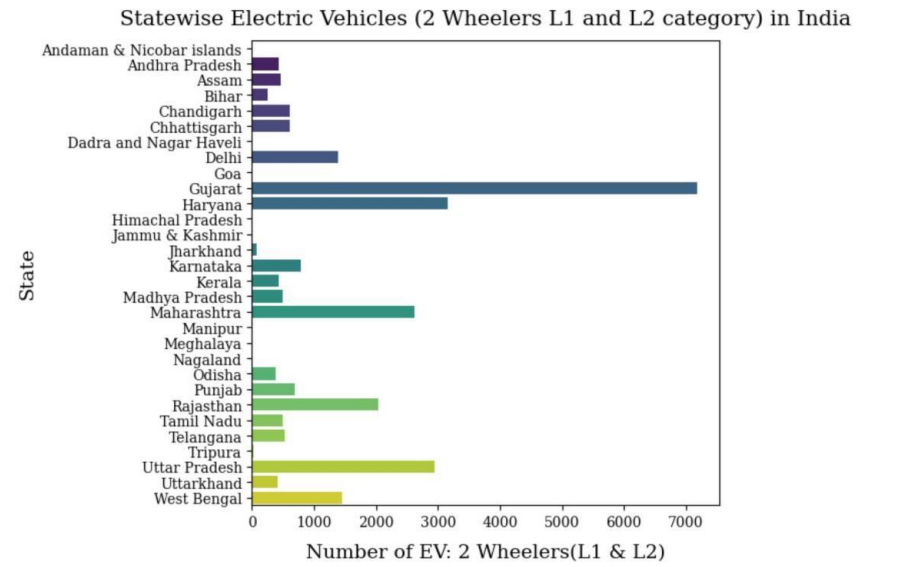
   The datasets for the analysis was taken from one of the most popular data science platforms Kaggle.
   Here's the link to the datasets being used:
   Dataset-1:
   https://github.com/Hiyanachnani/EV_Market_Segmentation_Analysis/blob/main/EVStats.csv
   Dataset-2:
   https://github.com/Hiyanachnani/EV_Market_Segmentation_Analysis/blob/main/buyers.xls

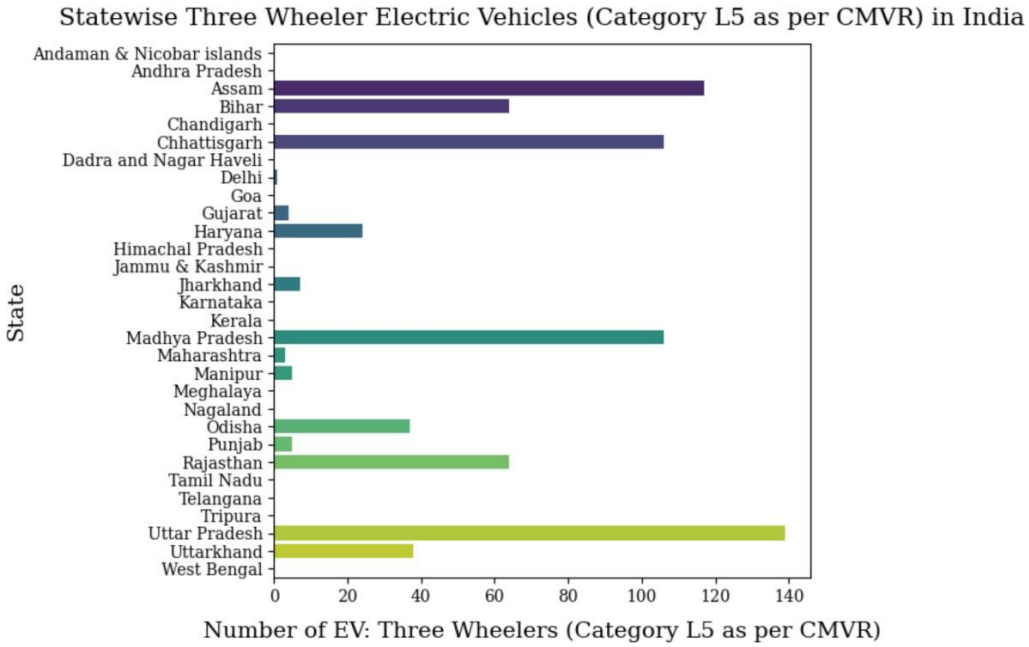
3. **Data Processing**

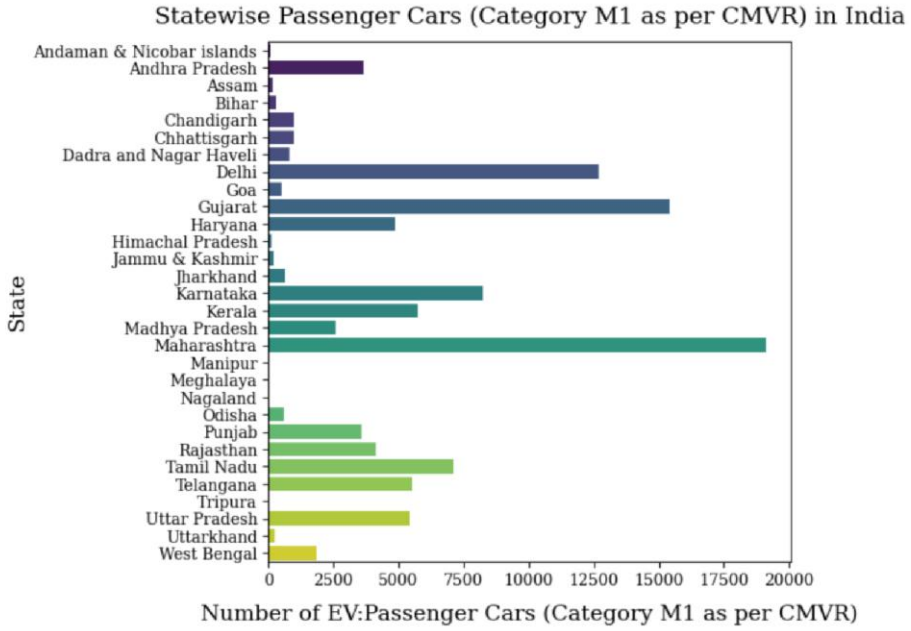
   Preprocessing data is a crucial step in the data analysis. Using Python libraries such as NumPy and Pandas, the data was loaded into the notebook and preprocessed.

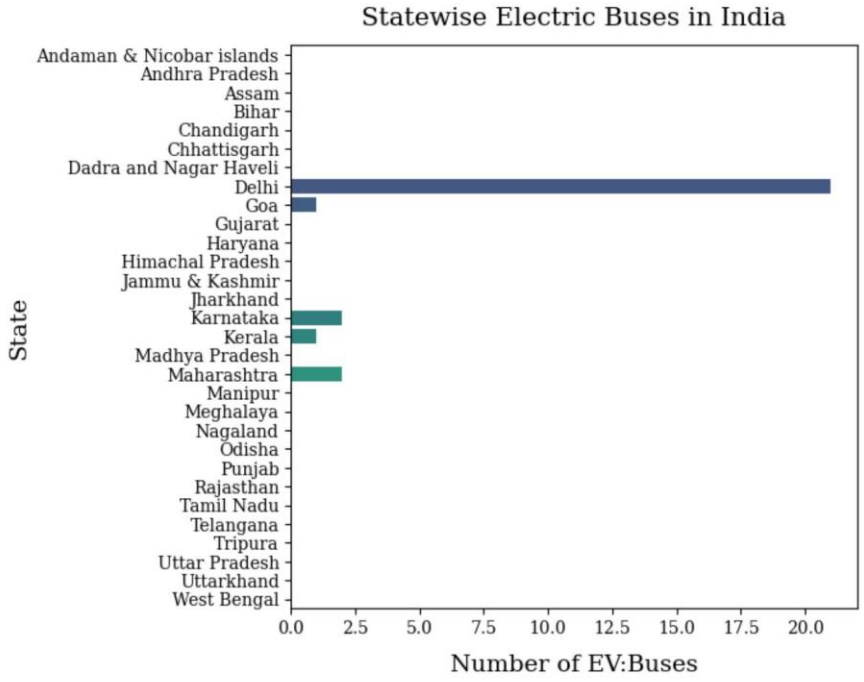
4. **Exploratory Data Analysis**

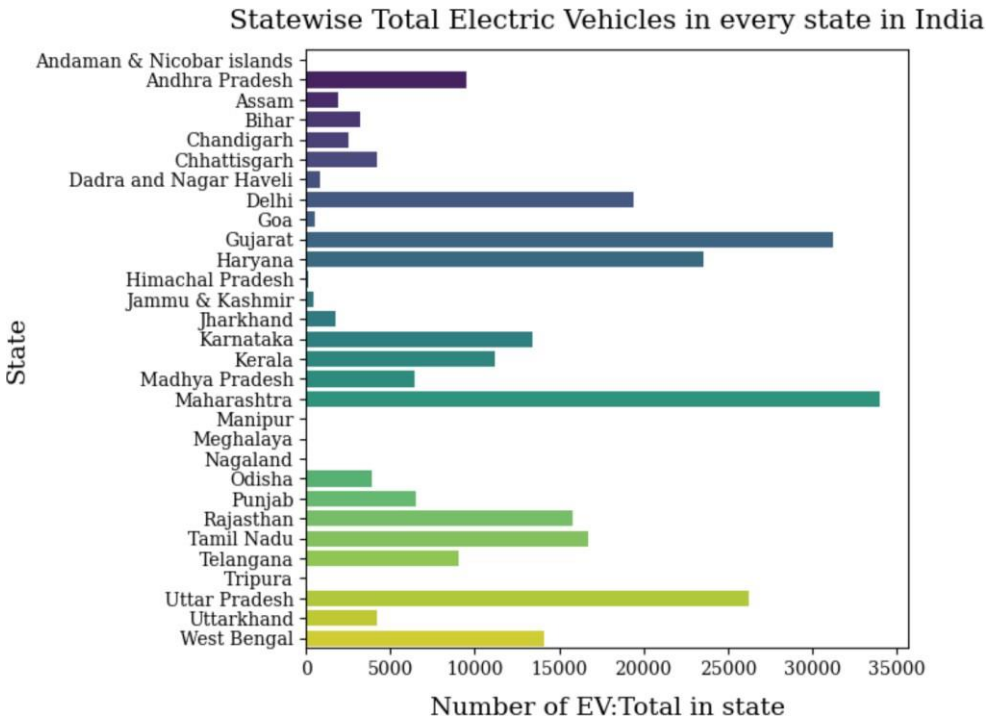
   An Exploratory Data Analysis, or EDA is a thorough examination meant to uncover the underlying structure of a data set and is important for a company because it exposes trends, patterns, and relationships that are not readily apparent.
   EDA was performed on two datasets, first one being the dataset with data of statistics of EV vehicles in all states.


Statewise Electric Vehicles (2 Wheelers L1 and L2 category) in India
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
State
0
1000
2000
3000
4000
5000
6000
7000
Number of EV: 2 Wheelers(L1 & L2)


Statewise Three Wheeler Electric Vehicles (Category L5 as per CMVR) in India
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
State
0
20
40
60
80
100
120
140
Number of EV: Three Wheelers (Category L5 as per CMVR)

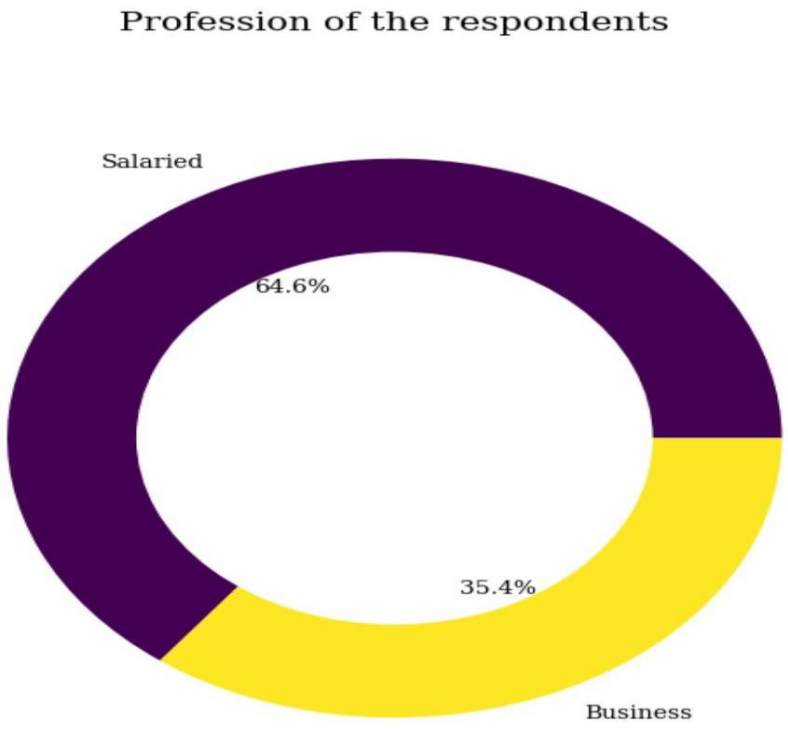

Statewise Passenger Cars (Category M1 as per CMVR) in India
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
State
0
2500
5000
7500
10000
12500
15000
17500
20000
Number of EV:Passenger Cars (Category M1 as per CMVR)

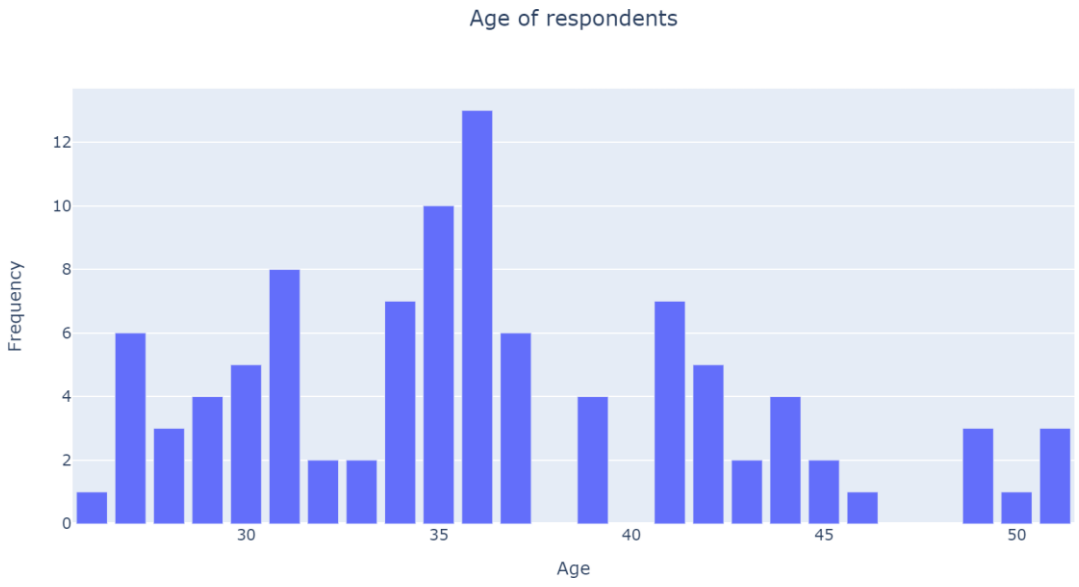

Statewise Electric Buses in India
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
State
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Number of EV:Buses



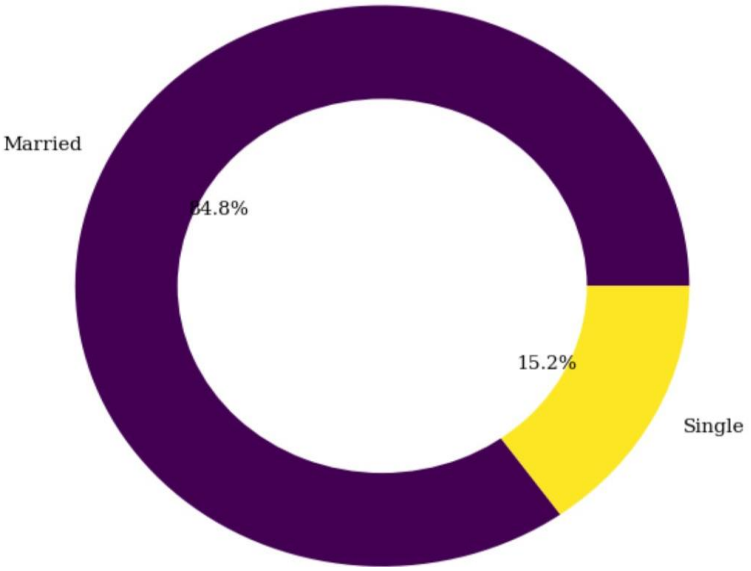
From the above plots we can conclude that Maharashtra has the most number of EV vehicles while Gujarat is a close second. Delhi, being one of the 5 states to have EV buses, has the most number of EV buses. EV 2 wheelers are higer in number in Gujarat, Haryana and Utter Pradesh.

The second dataset describes the buyers of vehicles and contains information like their education level, marital status, salary etc.

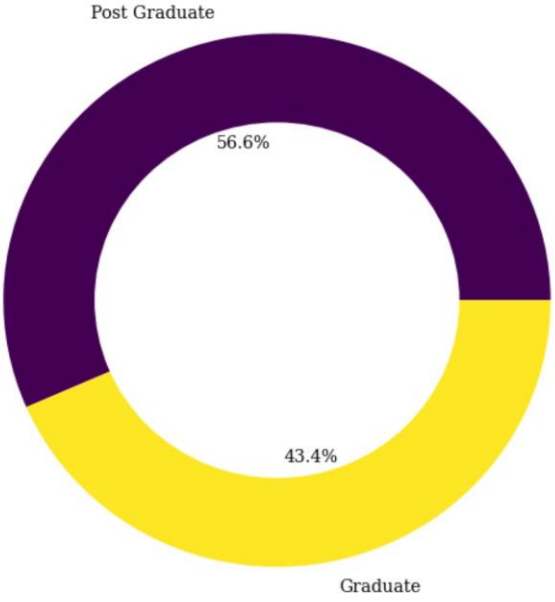

Profession of the respondents
Salaried
64.6%
35.4%
Business


Age of respondents
Frequency
0
2
4
6
8
10
12
30
35
40
45
50
Age

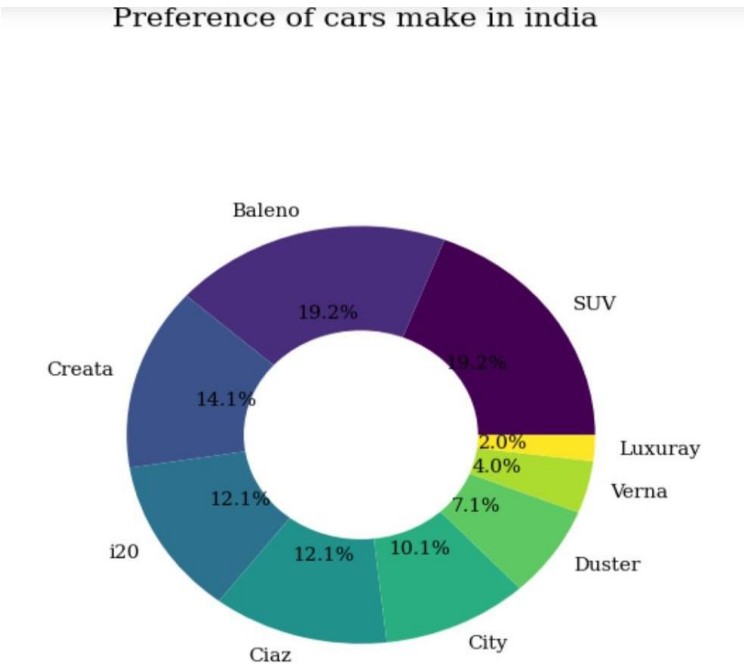
Marital Status of electric Vehicle owners in india

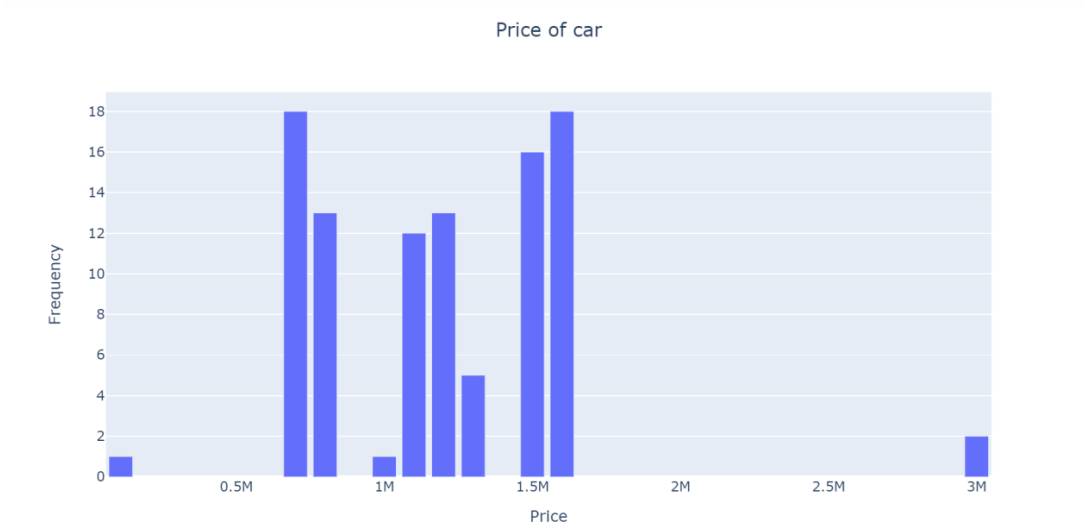


Highest Educational qualification of electric Vehicle owners in india




Total Salary of respondents
Frequency
0
1
2
3
4
5
6
7
8
1M
2M
3M
4M
5M
Salary


Preference of cars make in india
Baleno
19.2%
SUV
19.2%
Creata
14.1%
2.0%
Luxuray
4.0%
Verna
12.1%
7.1%
i20
12.1%
10.1%
Duster
Ciaz
City


Price of car
Frequency
0
2
4
6
8
10
12
14
16
18
0.5M
1M
1.5M
2M
2.5M
3M
Price

MARKET SEGMENTATION ANALYSIS OF ELECTRIC VEHICLES MARKET IN INDIA

Sanchit Singla

1. Problem Statement

The problem statement revolves around the strategic decision-making process for an Electric Vehicle (EV) startup aiming to enter the Indian market. The startup seeks to identify the most promising segments within the electric vehicle market in India for developing its EVs. This involves conducting a comprehensive market segmentation analysis, considering various criteria such as geographic, demographic, psychographic, and behavioral factors. The goal is to understand the different customer segments and their preferences to devise a feasible strategy for market entry. Factors such as competition, regulatory landscape, infrastructure, consumer preferences, and technological trends must be evaluated to make informed decisions. By analyzing these aspects and estimating key parameters such as the total addressable market, segment sizes, and market entry costs, the startup can develop a strategic roadmap to effectively penetrate the Indian electric vehicle market.

2. Data Sources (Data Collection):

- Scraped electric car, bikes, scooter dataset using BeautifulSoup & Selenium using website https://www.zigwheels.com/
- Electric vehicle purchase Intention: https://data.mendeley.com/

3. Data Pre-processing (Steps and Libraries used)

3.1 Electric Vehicle Purchase Intention dataset

```
df = pd.read_excel("Electric Cars Purchase Intention.xlsx")
df.head()
```

This dataset contains 509 responses and columns are as follows:

- Commuted by e-car: 0 - No, 1 – Yes
- Educational Background: Science -1, Arts-2, Commerce-3, Engg/Tech-4, Others-5
- Student Gender: Male -1, Female-2
- Own a Car: 1- Yes, 2- No
- Own a e-bike: 1- Yes, 2-No
- Own a e-car: 1-Yes, 2-No
- Student Region: East-1, West-2, North-3, South-4
- Annual Family Income in INR: < 5 Lakhs-1, 5-10 Lakhs-2, >10 Lakhs-3
- Work Experience in Years: 0 year-1, <1 year-2, 1-5 years-3
- Student's Age: Age of students mainly between 20 to 29
- All other variables range between 1 to 5: 1-Strongly disagree and 5-Strongly Agree
    1. DRIVING CONVENIENCE (DC)
        - I think sufficient battery charging points are available on highways (DC1)
        - I think adequate service centres are available for e-cars (DC2)

- I think the range (the distance travelled in a single charge) of e-cars is adequate for me (DC3)
- I think charging speed of e-cars is adequate (DC4)

2. TECHNICAL ATTRIBUTES (TA)

- I think e-cars are sleek (TA1)
- I think e-cars are durable (TA2)
- I think e-cars are available in different size, colours and designs (TA3)
- I think e-cars are aesthetically appealing (TA4)
- I think e-cars are technologically superior (TA5)
- I think e-cars give comfortable ride (TA6)

3. GOVERNMENT POLICY (GP)

- I think that the government is providing incentives for the purchase of e-cars (GP1)
- I think that the government is providing subsidies to the manufacturers (GP2)
- I think the government is incentivizing research and development in electric vehicle technologies (GP3)
- I think the government is investing on the establishment of electric vehicle charging points (GP4)
- I think the government is planning to introduce electric vehicle policy (GP5)

4. ENVIRONMENTAL CONCERN (EC)

- I prefer to purchase ecologically safe products (EC1)
- Conventional vehicles are contributing to increasing level of air pollution in the country (EC2)
- I care about energy conservation (EC3)
- I think e-cars make less noise (EC4)

5. CHARGINING CONVENIENCE (CC)

- I think batteries can be charged at home (CC1)
- I think batteries can be charged at my college/ workplace (CC2)
- I think E-cars batteries can be charged at lower rates at off-peak hours (CC3)

6. ECONOMIC BENEFITS (EB)

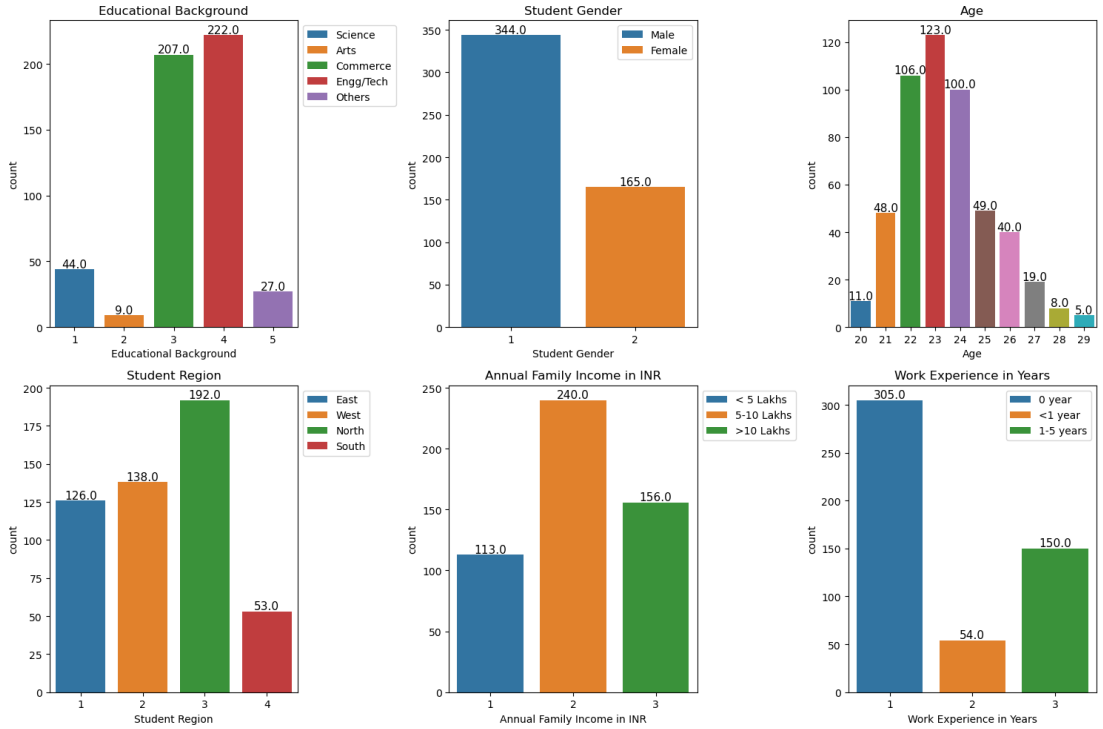
- I think e-cars have better fuel efficiency (EB1)
- I think e-cars have lesser maintenance cost (EB2)
- I think e-cars have lesser mechanical complexity (EB3)

7. SYMBIOTIC ATTRIBUTES (SA)

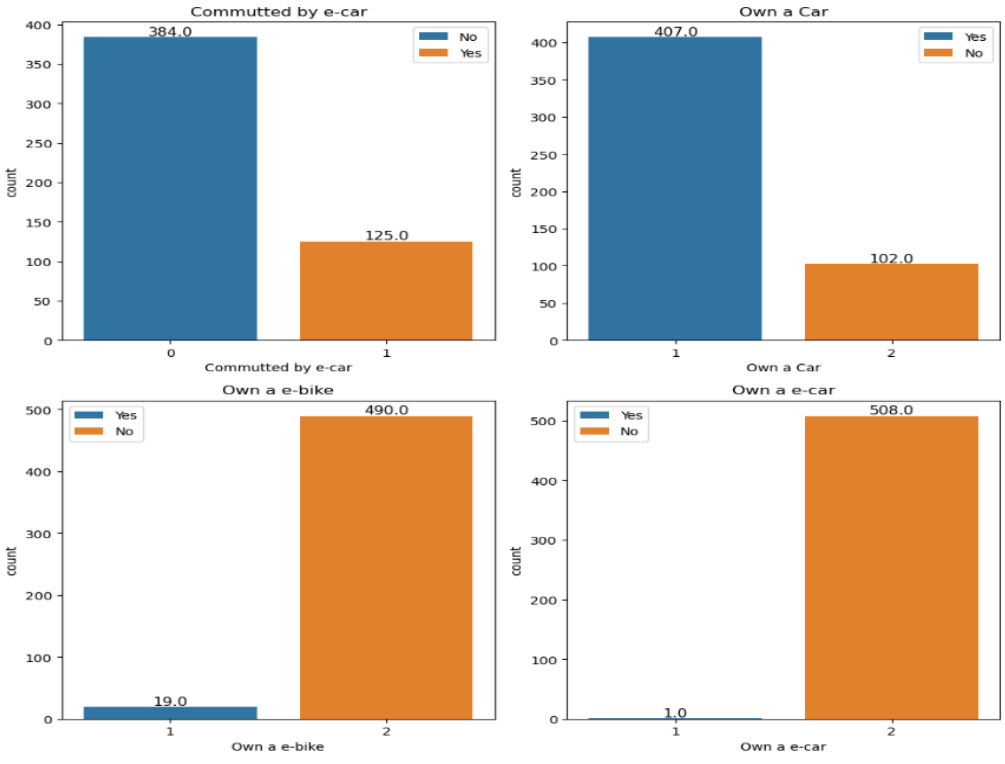
- The society perceives that the persons with e-vehicles are more concerned for the environment (SA1)
- The society perceives that the persons with e-vehicles are more concerned for the societal health (SA2)

8. I think pickup of e-cars is adequate
9. I would recommend my friends and relatives to purchase an e-car
10. I intend to buy an e-car as my first car
11. I would like to be a part of promotional campaigns of e-cars

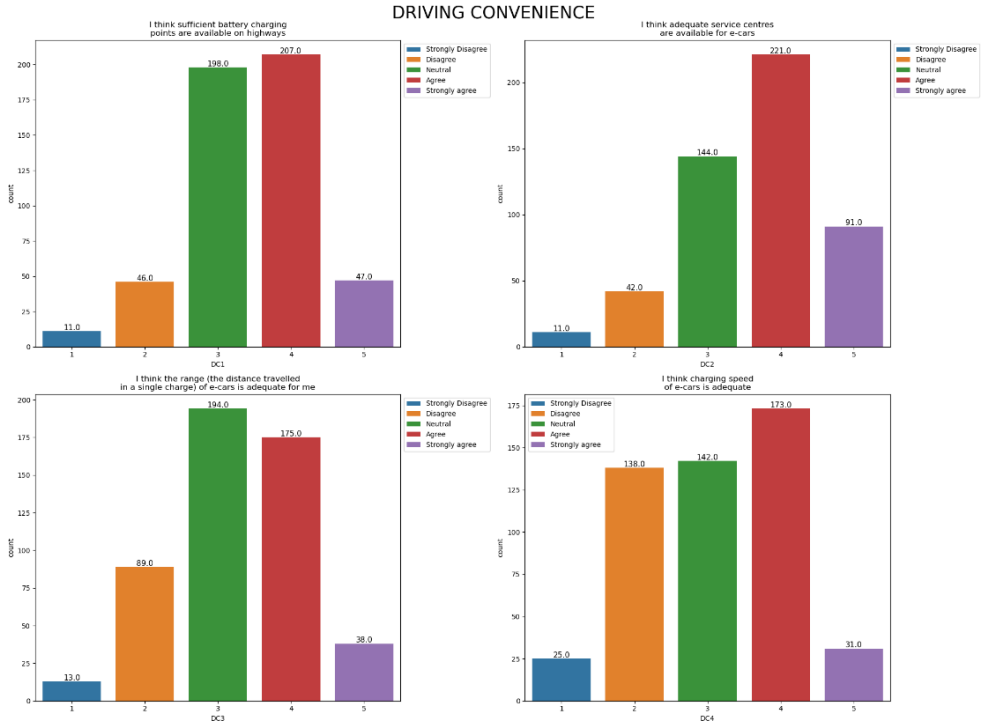
3.1.1 EDA (Visualizations)



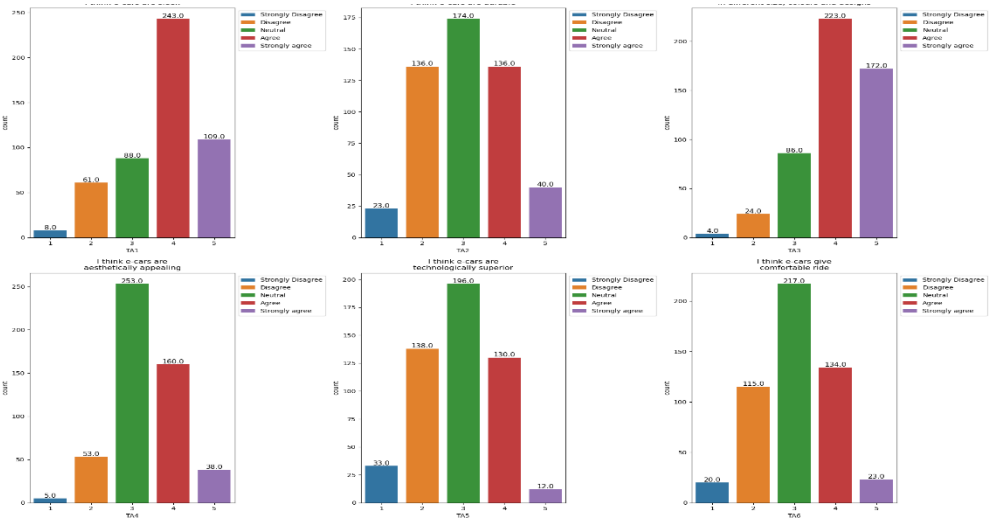
- Educational Background: This survey contains high number of responses from Engg/Tech followed by Commerce
- Student Gender: 67.5% of males & 32.5% of females have filled the form
- Age: Age distribution is right skewed, as we get low response from 28, 29 age group students, almost 64% of response are from 22-24 age group students
- Student Region: North region student has given high response followed by West, East, South.
- Annual Income: Almost 77% of student family income is more than 5 lakhs.
- Work Experience: Almost 40% of students have more than 0 years of experience



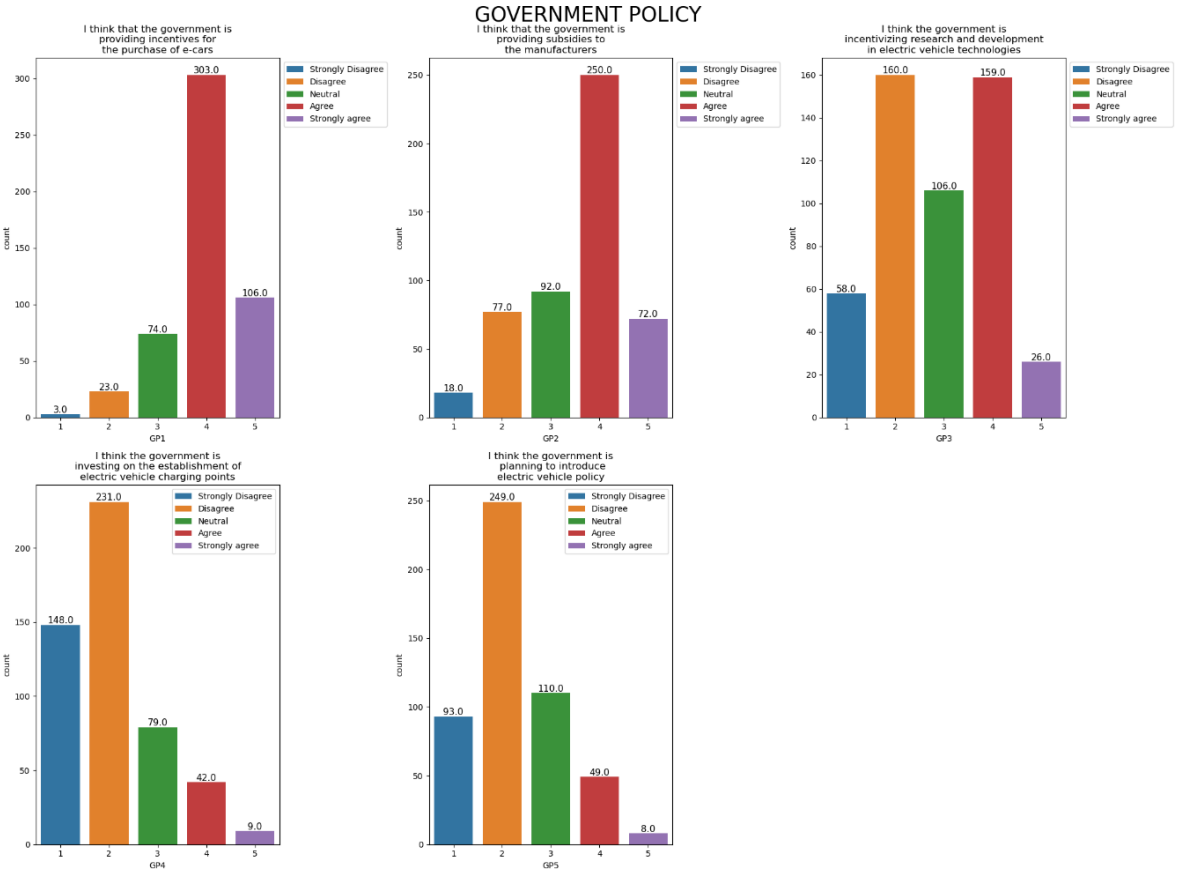
- Commuted by e-car: only 24.5% of students use e-cars
- Own a car and e-car: Almost 80% own a car and only 1 student has e car
- Own a e-bike: Only 3.7% of students owns a ebike.



- I think sufficient battery charging points are available on highways: Almost 50 % of people have positive sentiment
- I think adequate service centres are available for e-cars: Almost 61% of people have positive sentiment
- I think the range (the distance travelled in a single charge) of e-cars is adequate for me: only 41 % of people are satisfied by range, & 38% of customers don't care about range i.e customer are less satisfied with range providing by companies today.
- I think charging speed of e-cars is adequate: only 40% are satisfied by charging speed of e-cars
- Here we can conclude that customer is less satisfied with charging speed, Range of e-cars

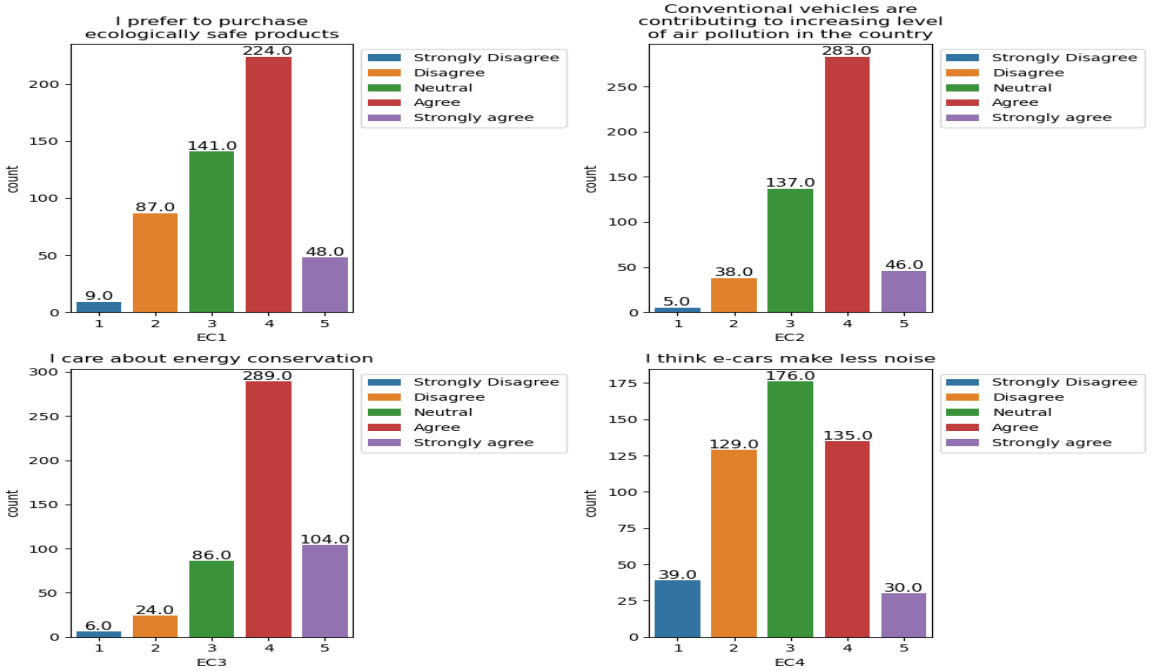


- I think e-cars are sleek: 69% customers are satisfied
- I think e-cars are durable: only 34% customers are satisfied, 34% are neutral
- I think e-cars are available in different size, colours and designs: almost 80% customers are satisfied
- I think e-cars are aesthetically appealing: 38% customers are satisfied, 50% are neutral
- I think e-cars are technologically superior: 27% customers are satisfied, 38% are neutral
- I think e-cars give comfortable ride (TA6): 30% customers are satisfied, 42% are neutra
- Here we can conclude that customer is not much satisfied with durability, comfortablity, and technologically superiority of e-cars.



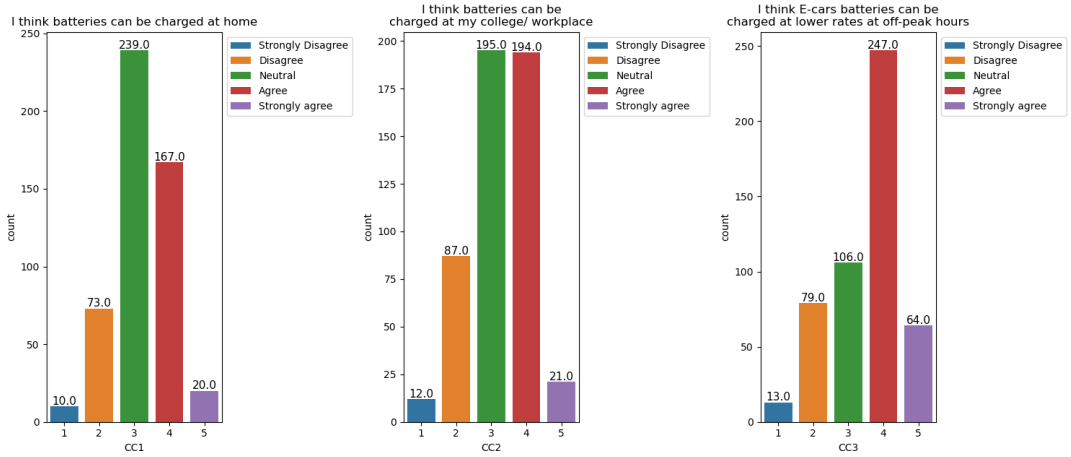
- I think that the government is providing incentives for the purchase of e-cars: 80% customers are satisfied
- I think that the government is providing subsidies to the manufacturers: 63% customer agrees
- I think the government is incentivizing research and development in electric vehicle technologies: only 36% agrees and almost 40 % doesn't agree
- I think the government is investing on the establishment of electric vehicle charging points: 74% customer disagrees
- I think the government is planning to introduce electric vehicle policy: 67% customer disagree.
- Here we can conclude that customers disagrees that government is planning for any ev policy and adding more charging points

ENVIRONMENTAL CONCERN



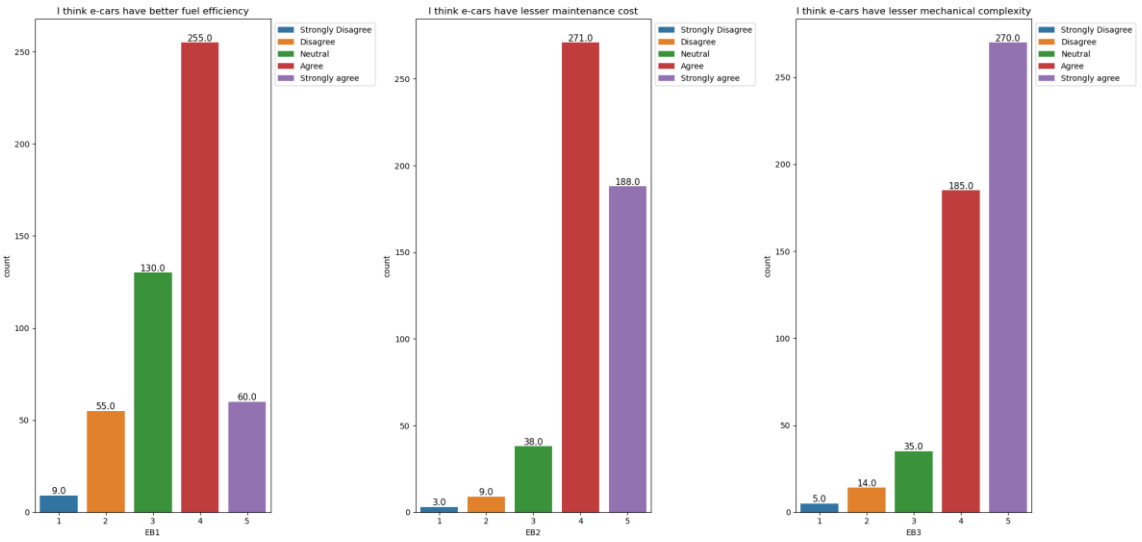
- I prefer to purchase ecologically safe products: 53% of customers prefer enviornment friendly products
- Conventional vehicles are contributing to increasing level of air pollution in the country: 64% customer agrees
- I care about energy conservation: 77% agrees
- I think e-cars make less noise: only 32 % agrees, and 34% are neutral
- Here we can conclude that customers do care about enviornment & conservation of energy and disagrees that e cars make less noise.

CHARGINING CONVENIENCE



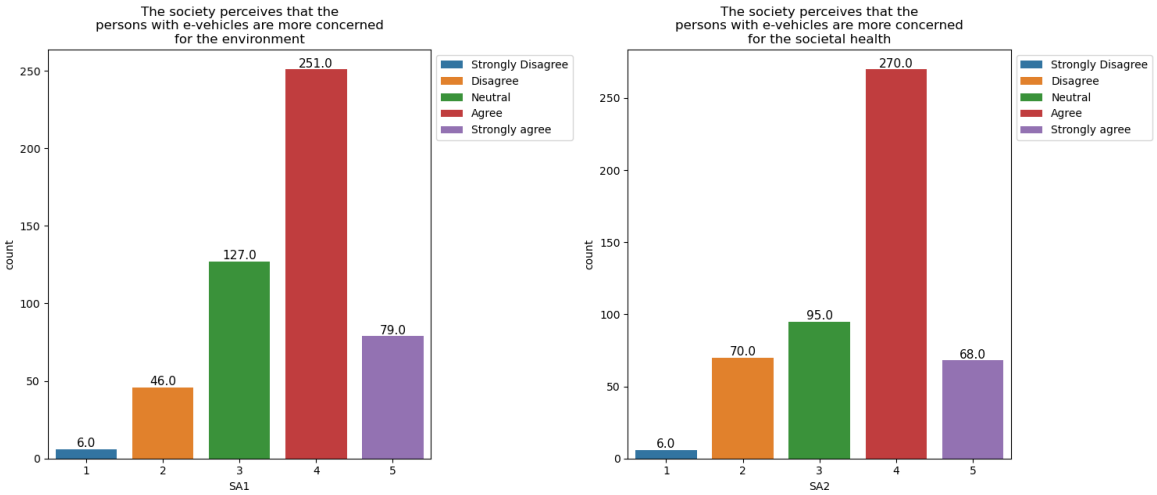
- I think batteries can be charged at home: 36% agrees, 46 % neutral
- I think batteries can be charged at my college/ workplace: 42% agrees, 38% neutral
- I think E-cars batteries can be charged at lower rates at off-peak hours: 61% agrees
- Here we can conclude that we 30-50% of customers agrees that batteries can be charged at home, college, workplace

ECONOMIC BENEFITS



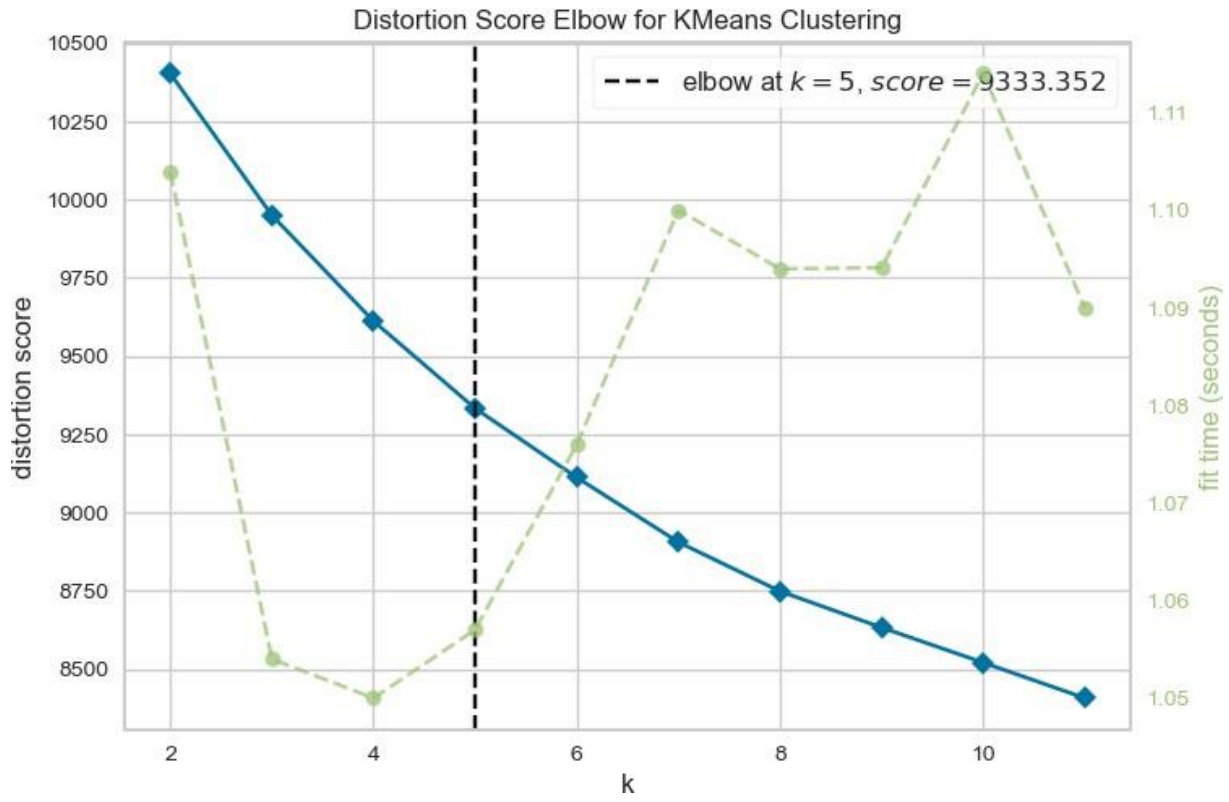
- I think e-cars have better fuel efficiency: 61% agrees
- I think e-cars have lesser maintenance cost: 90% agrees
- I think e-cars have lesser mechanical complexity: 89% agrees
- From here we can conclude that e-cars are fuel efficient, requires less maintainence cost, and less mechanical complexity

SYMBIOTIC ATTRIBUTES



- The society perceives that the persons with e-vehicles are more concerned for the environment: only 29% agrees to it, 32% are neutral
- The society perceives that the persons with e-vehicles are more concerned for the societal health: 64% agrees to it, 23 % are neutral

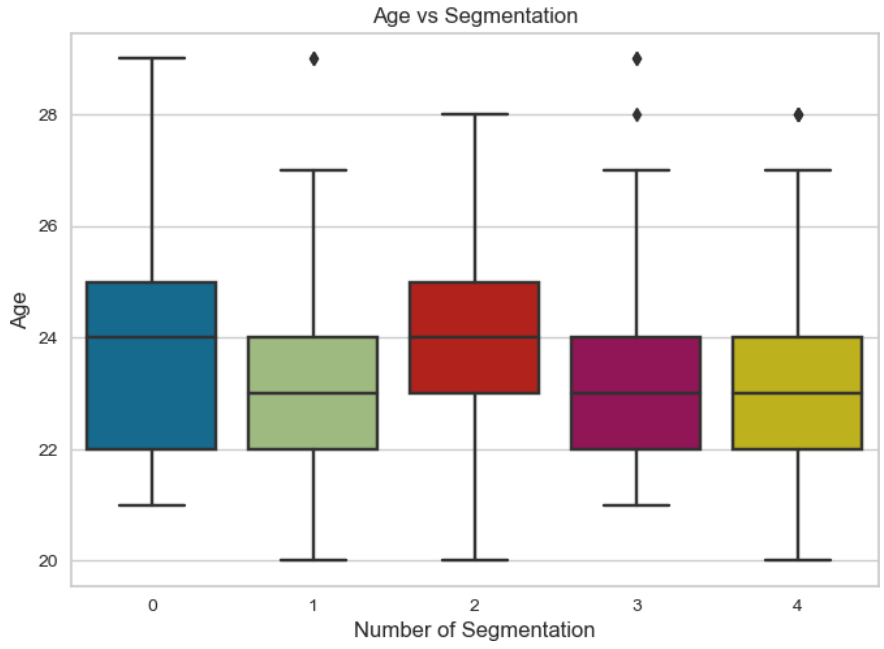
3.1.2 Segment Extraction (K Means Clustering)



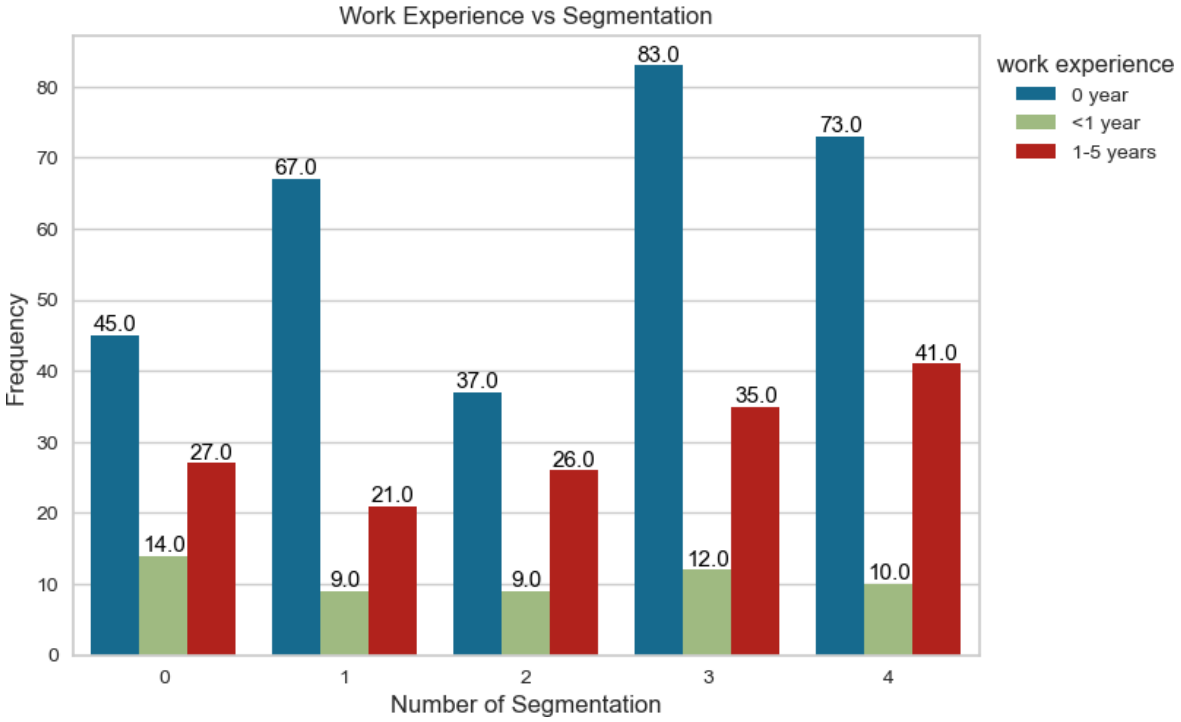
We utilized a set of 34 attributes encompassing various aspects such as Driving Convenience (DC1, DC2, DC3, DC4), Technical Attributes (TA1, TA2, TA3, TA4, TA5, TA6), Government Policy (GP1, GP2, GP3, GP4, GP5), Environmental Concern (EC1, EC2, EC3, EC4), Charging Convenience (CC1, CC2, CC3), Economic Benefits (EB1, EB2, EB3), and Symbiotic Attributes (SA1, SA2).

Using the K-means algorithm, we partitioned the data into 5 clusters. This segmentation was visualized utilizing the "KElbowVisualizer" from the Yellowbrick library.

3.1.3 Profiling and describing potential segments

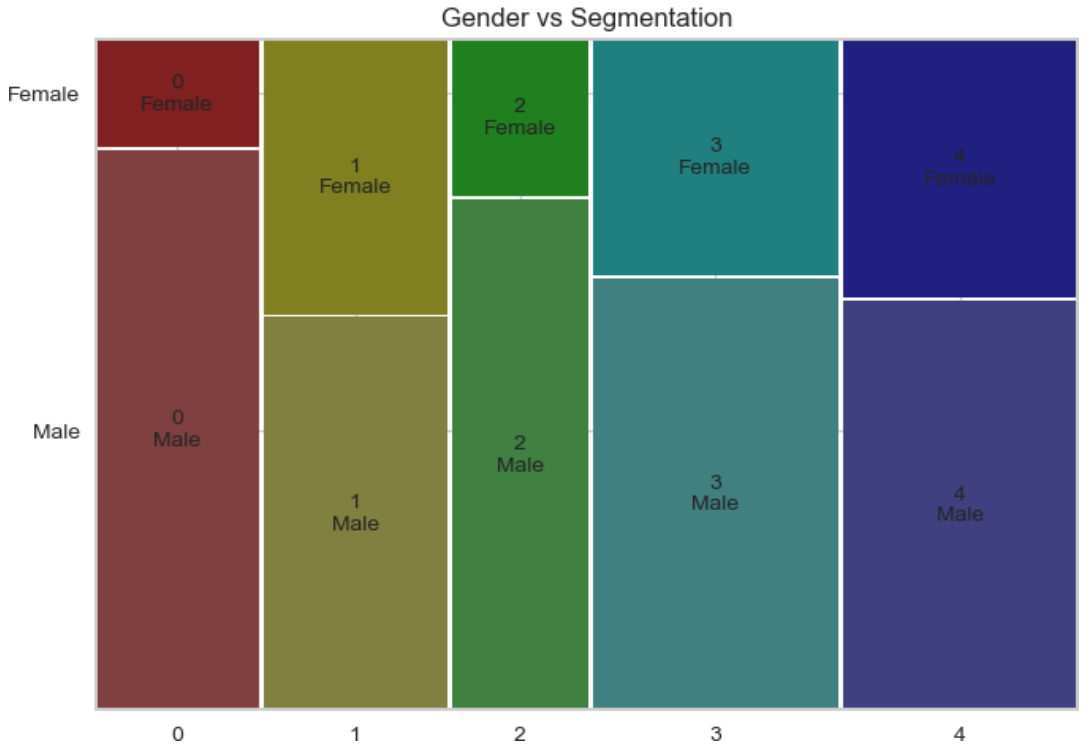


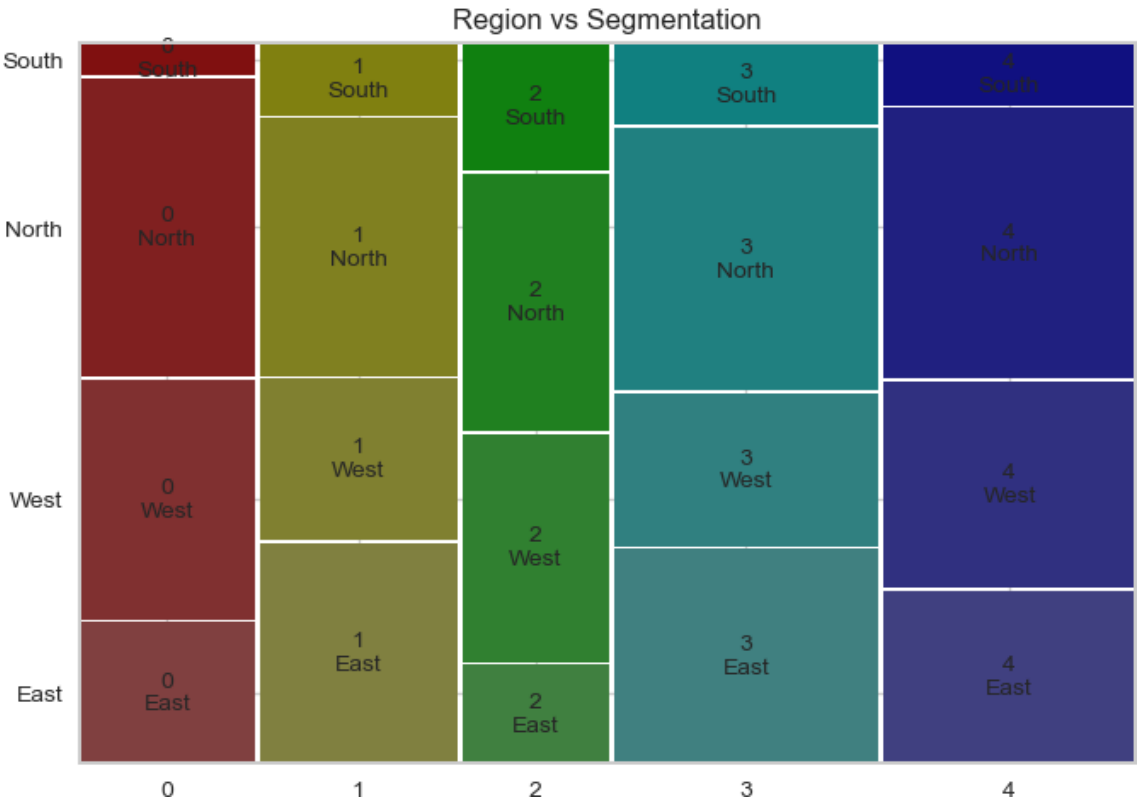
- The above boxplot concludes that:
- segment 1, Segment 3 &ented customer who are 23 years and
- Segment 0 & 2 has segmented customer who are 24 years
    1. Segment 0 ranges from [21,29]
    2. Segment 1 ranges from [20, 27]
    3. Segment 2 ranges from [20,28]
    4. Segment 3 ranges from [21, 27]
    5. Segment 4 ranges from [20,27]

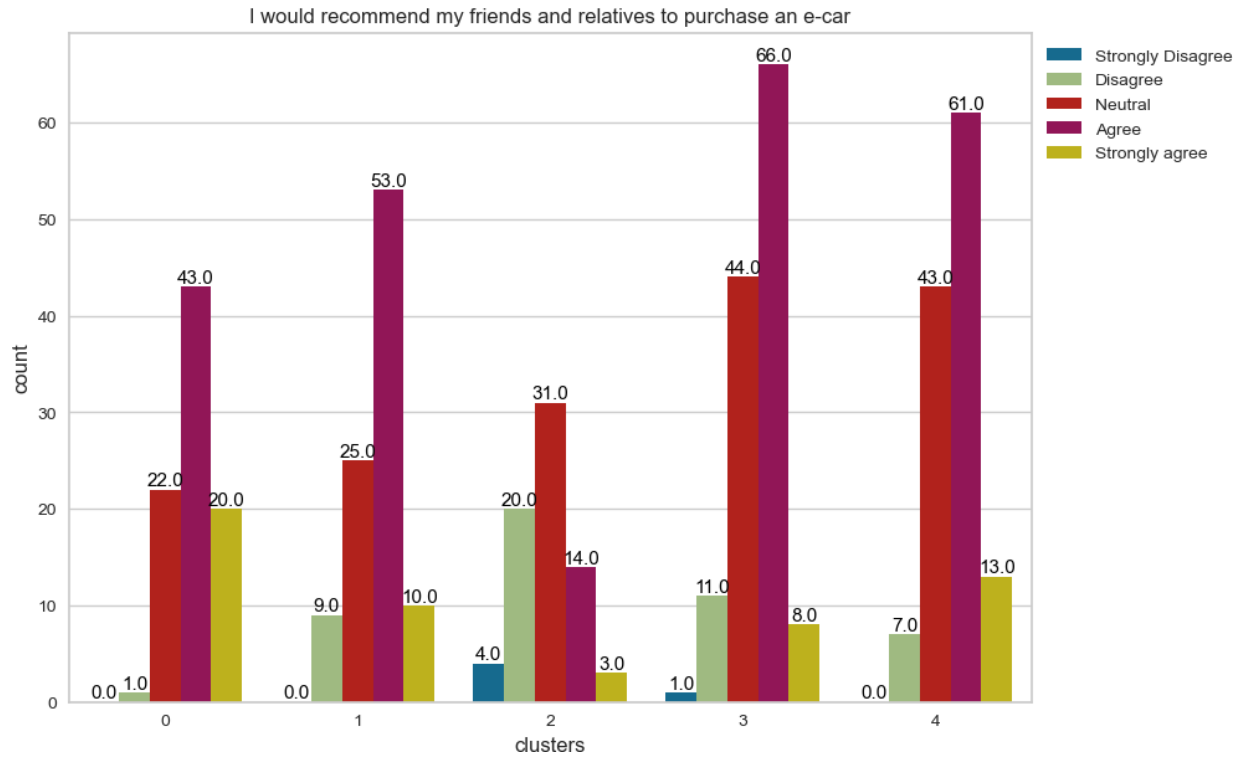


- Customer with 1-5 years of experience are clustered more into 4th segment
- Customer with 0 years of experience are clustered into 3rd segment heavily
- Customer with <1 years of experience is almost stable through each segment.

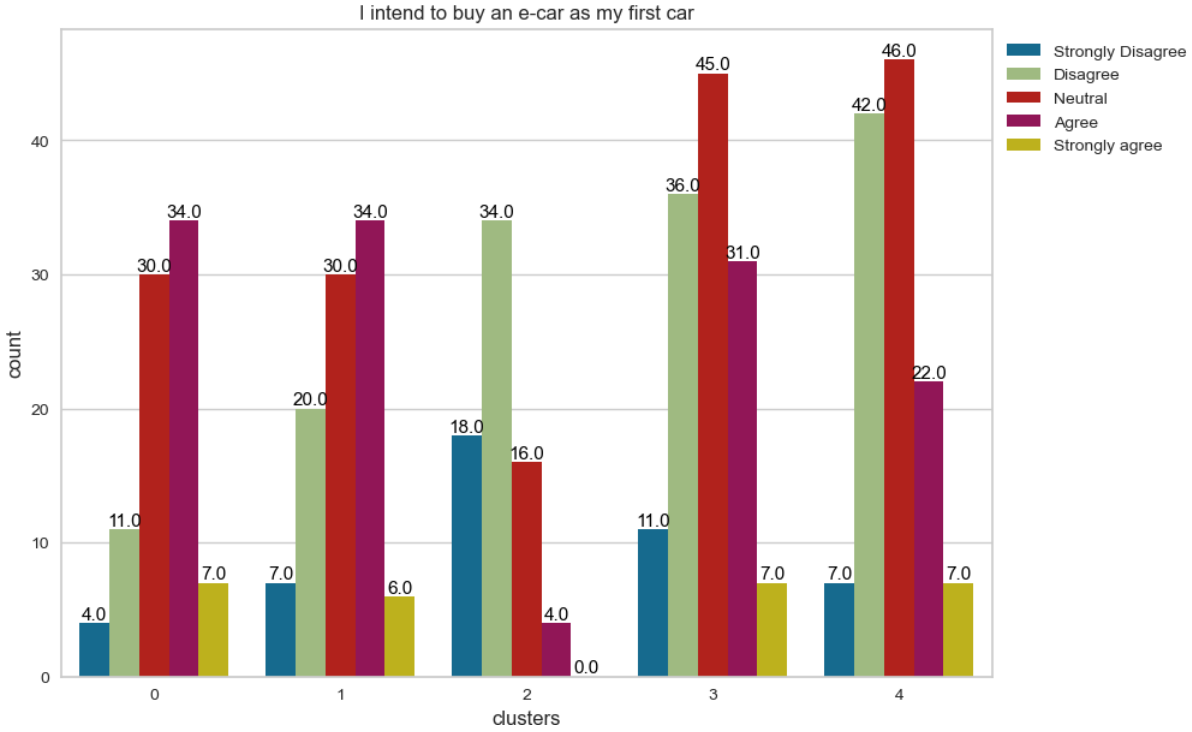
- Customer with 5-10L annual family income are segmented into segment 3 & 4.
- Customer with >10L annual income are segmented into segment 3.
- Customer with <5L annual income are segmented more into segment 3 & 4



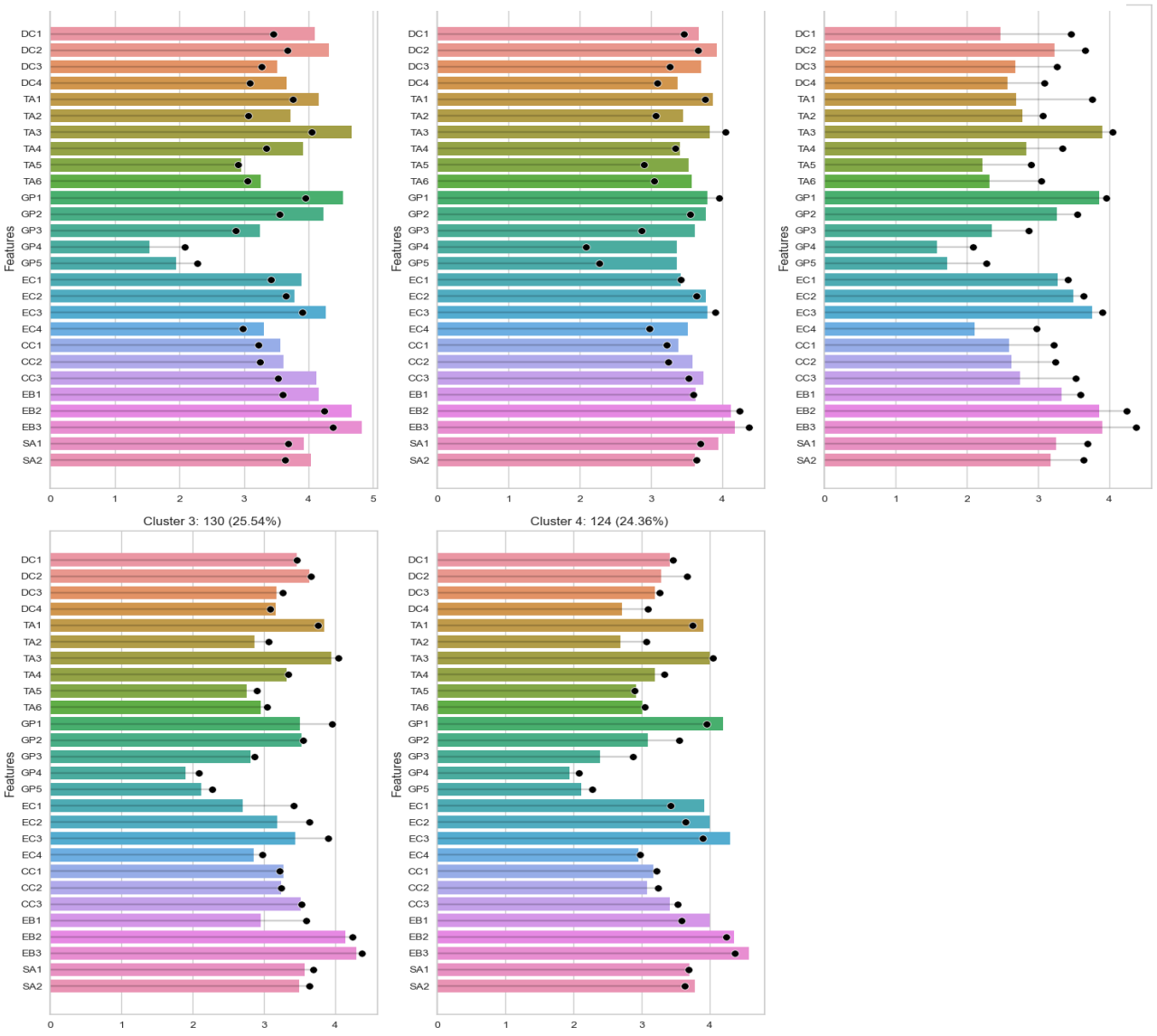




- Segment 3 & 4 customers would recommend family/friend for EV
- Segment 2 customers would not recommend family/friend for EV compared to other segments



- Segment 3 & 4 customers are more neutral towards purchasing ev as there first car
- Segment 1 & 0 customers are more shifted towards purchasing ev as their first car



3.1.4 Selection of target segment

Based on the above graphs, we can infer that Segment 4 comprises a higher number of customers with 5-10L annual incomes. Additionally, the age range of students within this segment falls between 20 to 27 years. Moreover, there is a predominance of male customers compared to females. Furthermore, individuals from the South region are less represented in this segment. Interestingly, customers in Segment 4 are inclined to recommend purchasing EV cars to their relatives. Moreover, they exhibit a neutral stance towards purchasing their first vehicle as EV vehicles themselves.

Attributes that customers in Segment 4 are not satisfied with can provide valuable insights for entering the Indian EV market. By addressing these areas of dissatisfaction, companies can improve customer satisfaction and competitiveness in the market. Here are the attributes identified for Segment 4 along with potential strategies for addressing them:

- Sufficient battery charging points on highways (DC1): Invest in expanding the charging infrastructure network along highways to alleviate range anxiety for EV owners traveling long distances.
- Adequate service centers for e-cars (DC2): Increase the number of service centers and enhance service quality to ensure timely maintenance and repairs for EV owners.
- Range of e-cars is adequate (DC3): Focus on developing EV models with longer range capabilities to meet the diverse needs of customers, including those who require extended driving ranges.
- Charging speed of e-cars is adequate (DC4): Invest in fast-charging technology and infrastructure to reduce charging times and improve convenience for EV owners.
- E-cars are durable (TA2): Enhance the durability and reliability of EV components and systems to increase customer confidence in the longevity of EVs.
- E-cars are available in different sizes, colors, and designs (TA3): Expand the range of EV models available in the market to cater to diverse customer preferences and lifestyles.
- E-cars provide a comfortable ride (TA6): Focus on improving vehicle comfort features, such as seating, suspension, and cabin noise insulation, to enhance the overall ride experience for EV owners.
- Batteries can be charged at home (CC1): Encourage the adoption of home charging solutions by providing incentives, subsidies, and educational programs to promote residential EV charging infrastructure installation.
- Batteries can be charged at college/workplace (CC2): Collaborate with educational institutions and workplaces to install charging stations and offer incentives for EV charging during off-peak hours.
- E-cars batteries can be charged at lower rates during off-peak hours (CC3): Implement time-of-use pricing schemes and incentives to encourage EV owners to charge their vehicles during periods of lower electricity demand, reducing charging costs.

By addressing these key areas of dissatisfaction, companies can better meet the needs and preferences of customers in Segment 4 and improve their competitiveness in the Indian EV market. Additionally, continuous monitoring of customer feedback and market trends will be essential for adapting strategies and maintaining customer satisfaction over time.

3.2 Electric vehicle Specification dataset

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.cluster import KMeans
from yellowbrick.cluster import KElbowVisualizer
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

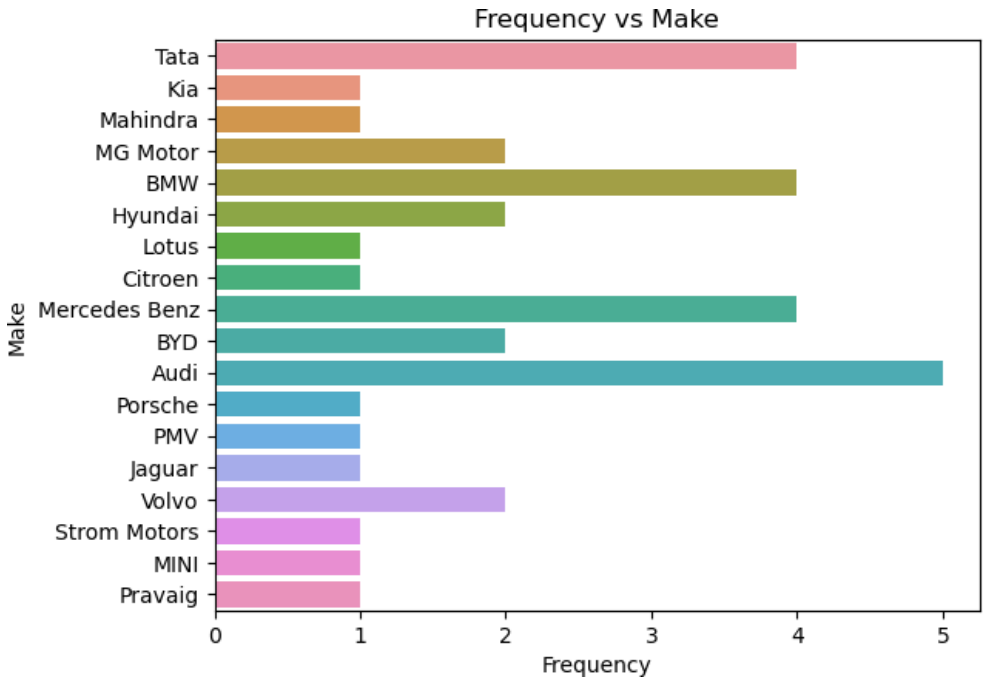
```
df_cars = pd.read_csv('Electric_cars_vehicle_spec.csv')
df_cars.head()
```

This dataset contains 14 columns as:

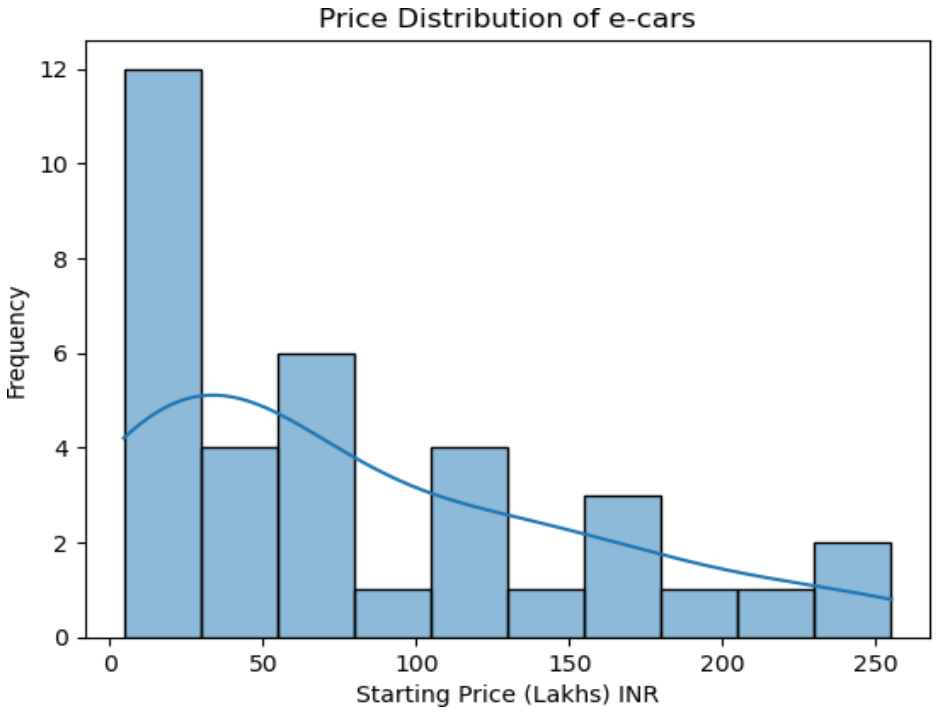
- VehicleType
- Make
- BodyType
- Model
- StartingPrice(INR Lakhs)
- NoofSeats

- MaxTorque(Nm)
- MaxPower(BHP)
- Range(km/charge)
- BatteryCapacity(kwh)
- ChargingTime(Mins)
- GroundClearance(mm)
- BootSpace(Liters)
- FastCharging

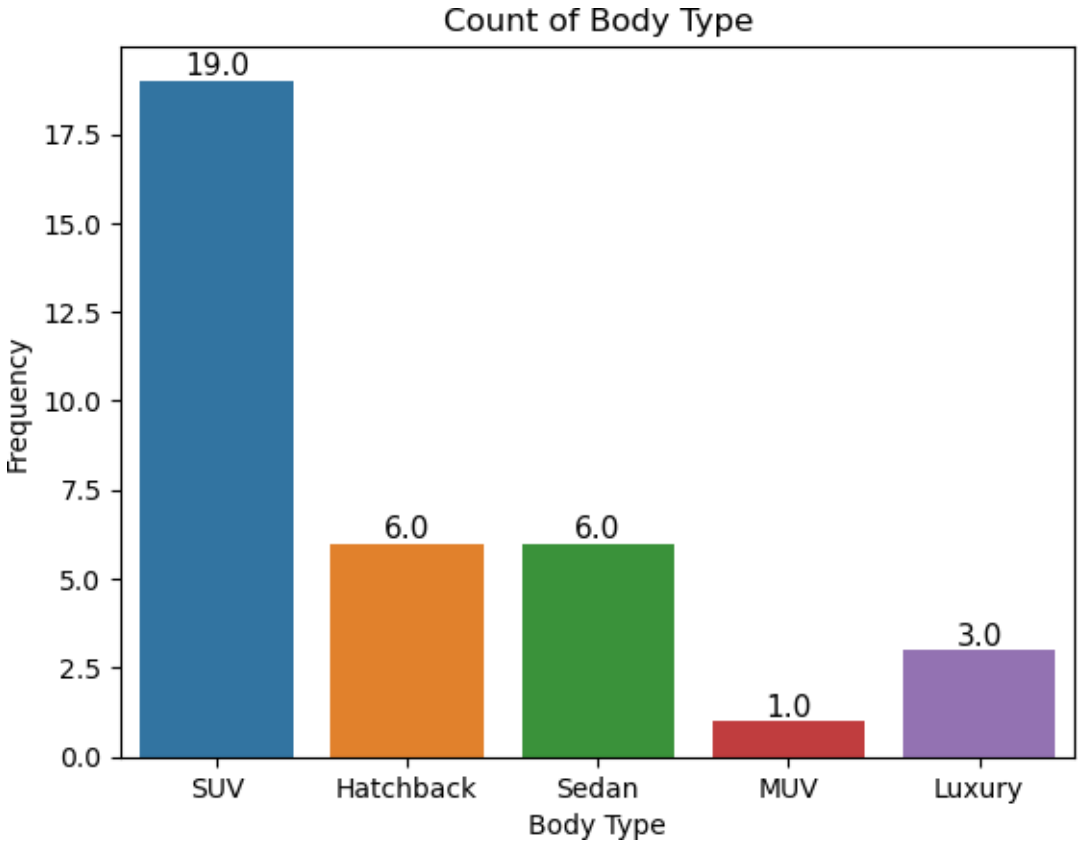
3.2.1 EDA (Visualisation)



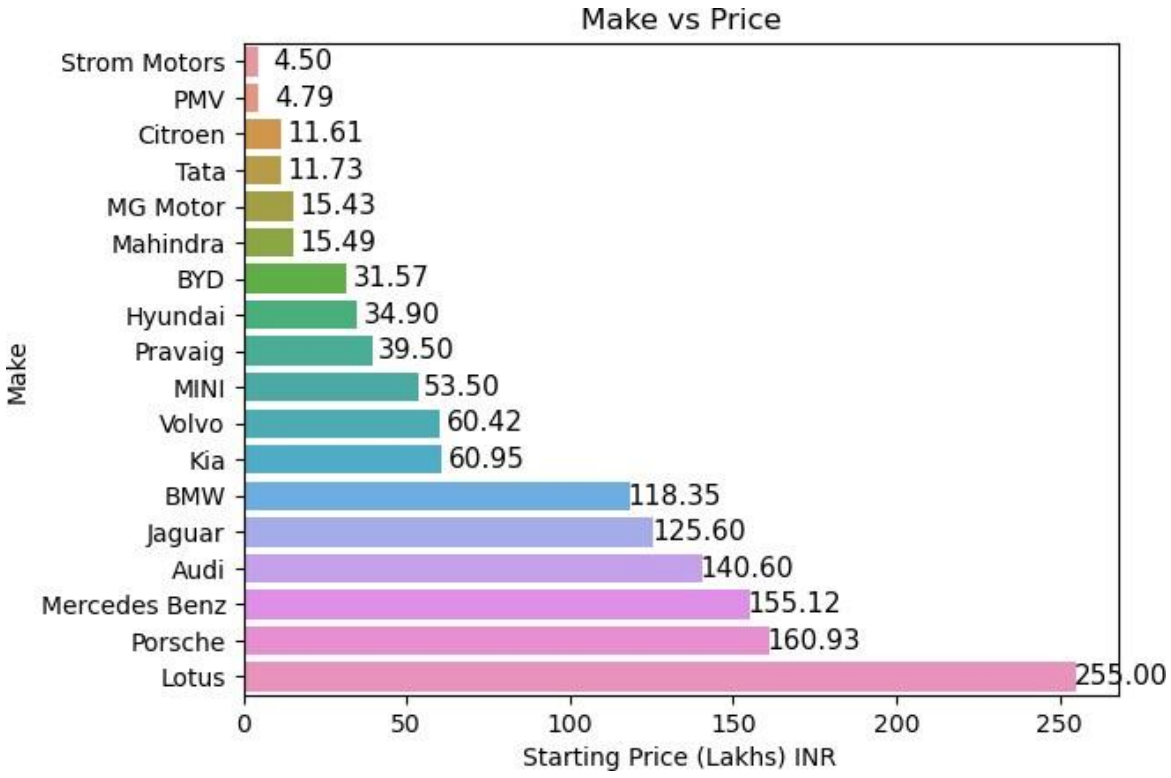
- Audi has make 5 cars which are running in India, followed by Tata, BMW, Mercedes Benz.



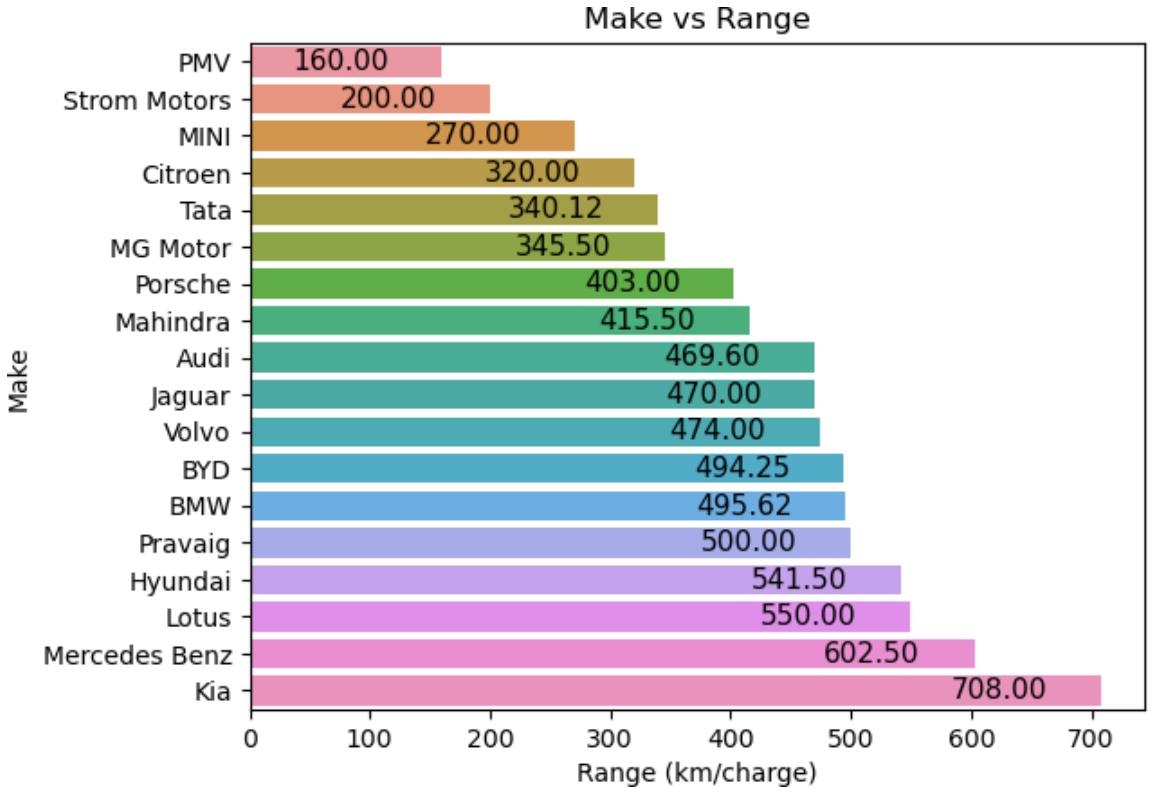
- Above histogram provides a skewed dataset showing the Starting price of e-cars. We can conclude that EV cars come with many different price segments.

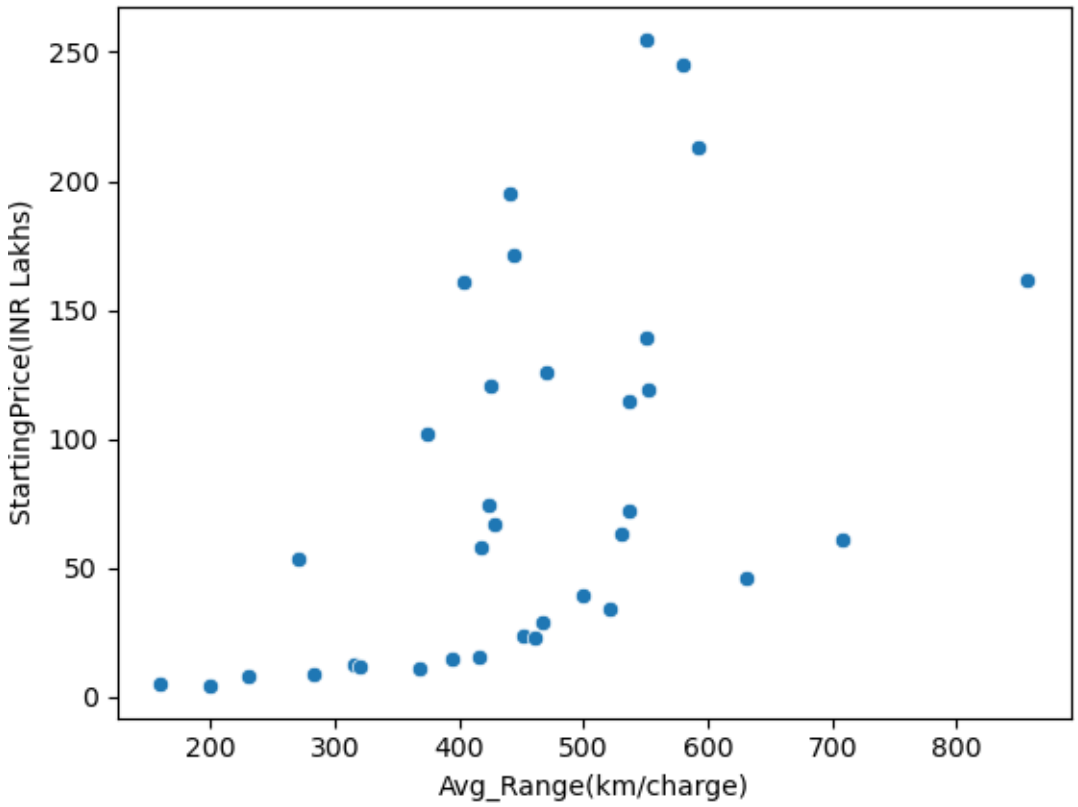


- From the Body Type bar plot we can conclude that Ev- cars come with all Body Types which were used for conventional vehicles



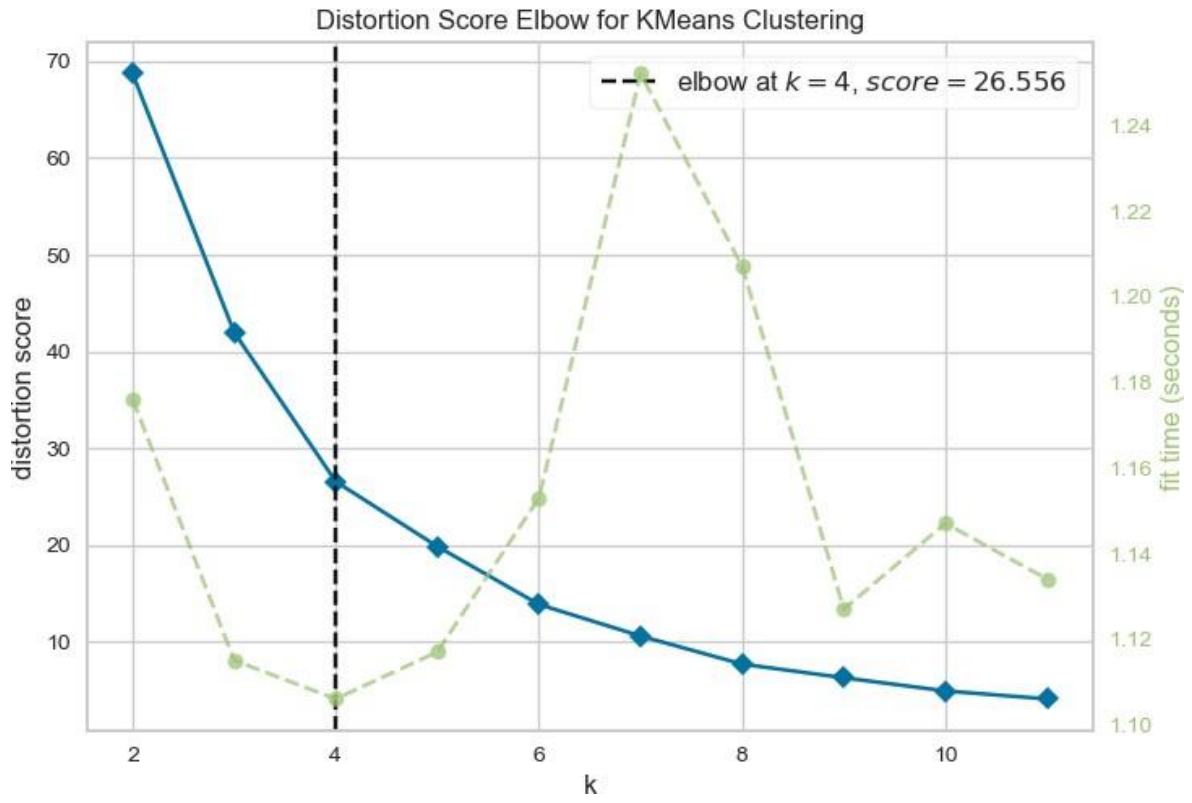
- Make vs Price graph shows distribution of Price among the manufacturers. As per mean starting price of each manufacturer, we can conclude that Indian Middle class can afford Top four manufacturers Strom Motors, PMV, Citreon, Tata.



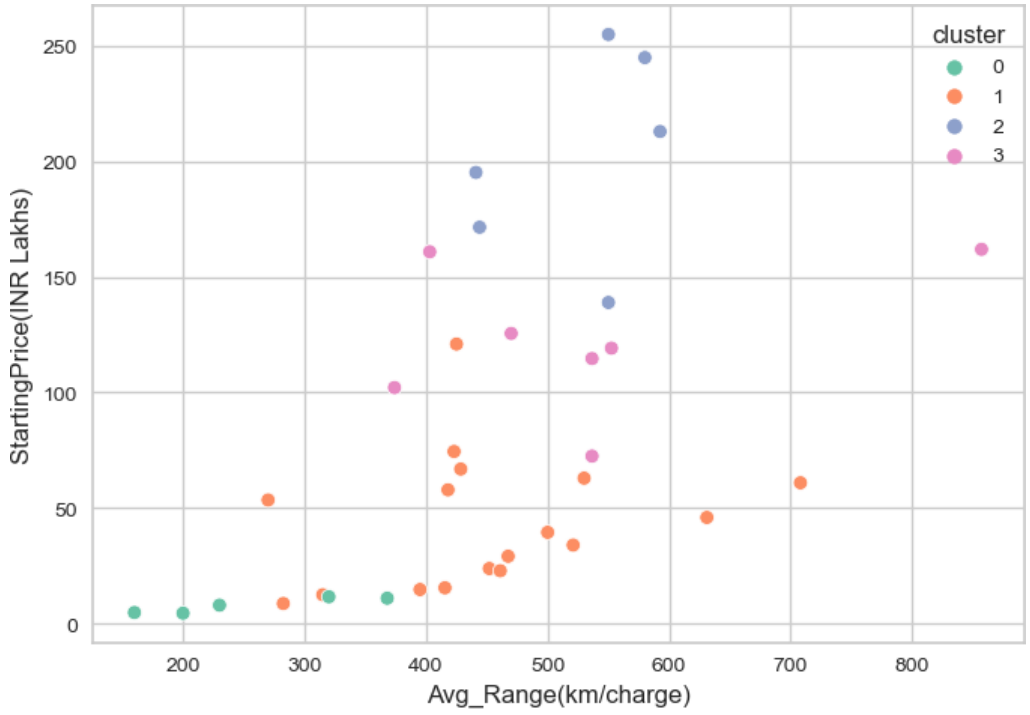


- This Visualisation concludes that as price of car goes up, Range also increases.

3.2.2 Segment Extraction (K Means Clustering)



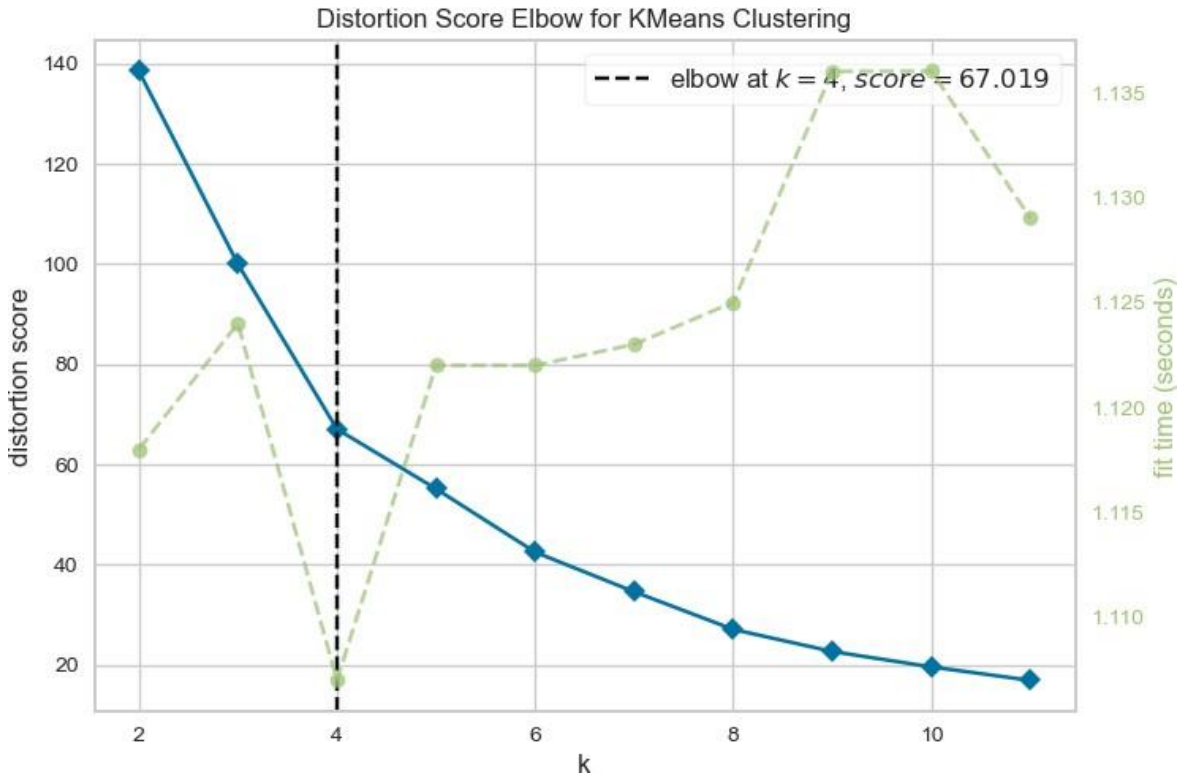
We utilized a set of 3 attributes encompassing various aspects such as StartingPrice, Range, Fast Charging. Using the K-means algorithm, we partitioned the data into 4 clusters. This segmentation was visualized utilizing the "KElbowVisualizer" from the Yellowbrick library.



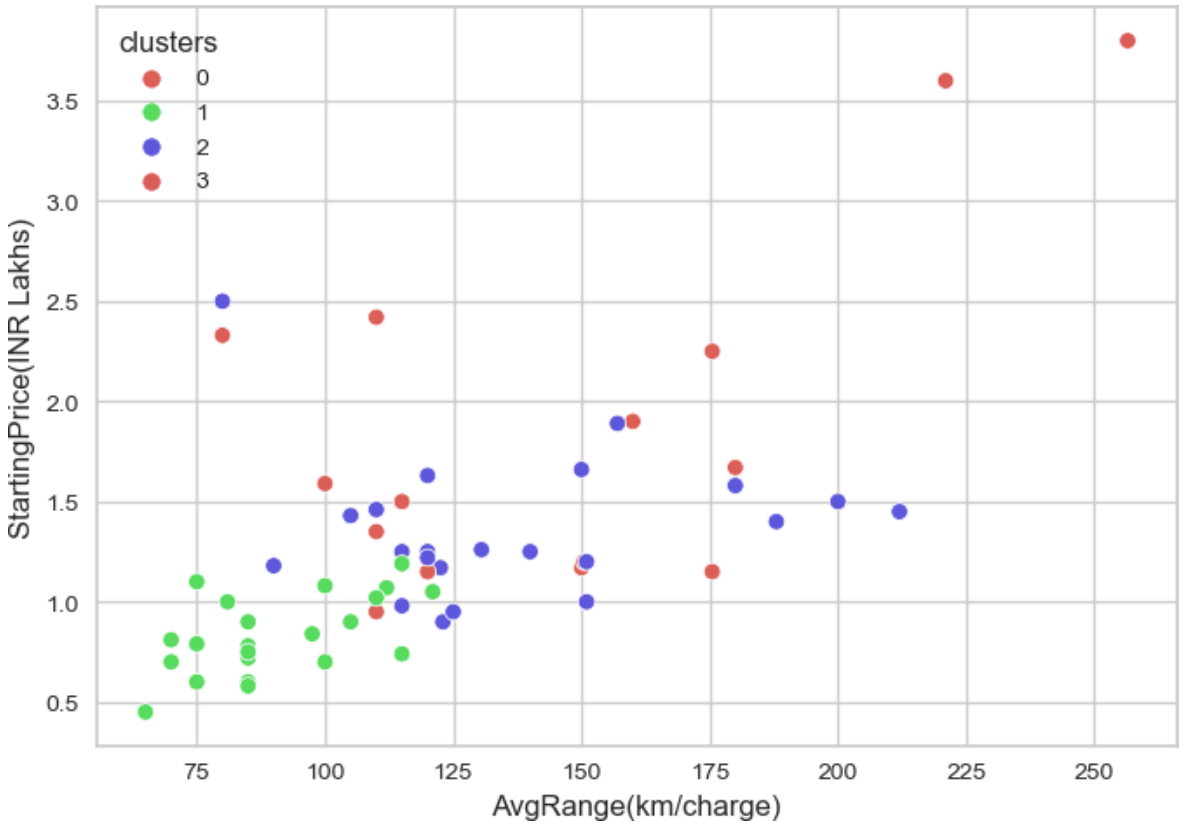
```
df_bikes = pd.read_csv("electric_two_wheeler_specs.csv")
df_bikes.head()
```

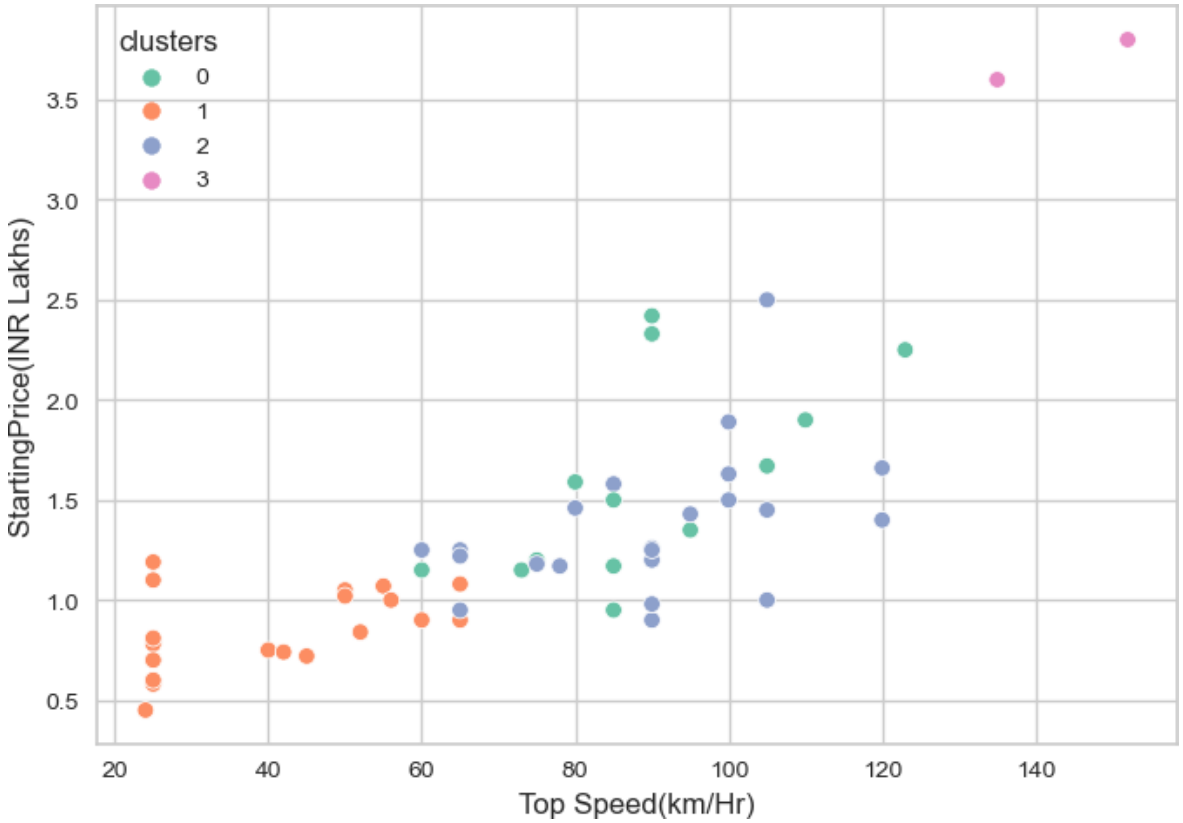
This datasets is of 2 wheelers EV and it contains features like

- VehicleType
- Make
- Model
- StartingPrice(INR Lakhs)
- Range(km/charge)
- BatteryCapacity(kwh)
- ChargingTime(Mins)
- Top Speed(km/Hr)
- KerbWeight(Kg)
- TyreType
- GroundClearance(mm)
- FastCharging



We utilized a set of 4 attributes encompassing various aspects such as StartingPrice, Range, Fast Charging, Top Speed. Using the K-means algorithm, we partitioned the data into 4 clusters. This segmentation was visualized utilizing the "KElbowVisualizer" from the Yellowbrick library.


clusters
0
1
2
3
StartingPrice(INR Lakhs)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
75
100
125
150
175
200
225
250
AvgRange(km/charge)


clusters
0
1
2
3
StartingPrice(INR Lakhs)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
20
40
60
80
100
120
140
Top Speed(km/Hr)

4. Most Optimal Market Segments

- **Segment Selection:** Segment 4, comprising 24.36% of consumers, represents a substantial portion of the target market, offering considerable market potential and opportunities for growth. With its balanced blend of specifications and price range, Segment 1's characteristics align well with the preferences of the target market, providing a harmonious balance between technical specifications and affordability.

- **Technical Specifications:**

1. Price Range: The recommended price range for EV cars is ₹2L to ₹15L, and for EV two-wheelers, it is ₹50,000 to ₹3.6L. This range ensures affordability while offering a diverse range of options to accommodate various budget preferences within Segment 4.
2. Riding Range: A recommended riding range of 250 to 500 km for EV cars and 50 to 250 km for EV two-wheelers addresses the commuting needs of consumers while providing flexibility for longer trips.
3. Fast Charging: Vehicles should be equipped with fast charging options that allow charging on highways, workplaces, etc. This practical feature meets the daily usage needs of consumers, minimizing downtime.

5. Conclusions

In conclusion, after conducting a comprehensive analysis of India's electric vehicle market, Segment 4 emerged as the optimal target for our strategic focus. With a substantial consumer base of 24.36%, this segment presents a significant market opportunity ripe for exploration and growth. By customizing our electric two-wheeler and four-wheeler specifications to align with the preferences of Segment 4, we aim to seamlessly cater to the demands of this large customer base. This strategic decision is underpinned by a deep understanding of consumer behavior and technical specifications, ensuring that our products are finely attuned to meet market needs.

Furthermore, our approach emphasizes precision and relevance in both product development and marketing strategies. By leveraging these insights, we are well-positioned to make impactful market entry decisions and cultivate a strong presence within India's evolving electric vehicle landscape. Moving forward, this strategic foundation provides us with a robust framework for success, enabling our offerings to resonate effectively and drive sustainable growth in the dynamic Indian market.

6. GitHub Link:

https://github.com/sa-1-2/Feynn-Labs-EV-Market-Segmentation