

Project Report on Electric Vehicle Market Segmentation Analysis in India

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Date: 04/07/2024



“In Order To Have Clean Air In Cities, You Have To Go Electric”

1. Introduction

The electric vehicle (EV) market in India is growing rapidly, driven by increasing environmental concerns, government incentives, and advancements in technology. Understanding market segmentation within this industry is crucial for companies to tailor their strategies and products to different consumer groups. This report analyses the EV market segmentation based on the provided dataset and the clustering analysis conducted

2. Problem Statement

Despite the growing interest in EVs, manufacturers and marketers face challenges in identifying and targeting distinct consumer segments within the Indian EV market. The lack of clear segmentation leads to inefficient marketing strategies, suboptimal product offerings, and missed opportunities to address specific consumer needs. Without a detailed understanding of market segments, companies may struggle to maximize their reach and profitability.

3. Data Collection

Data was extracted from the various websites mentioned below for EV market segmentation.

<https://www.fortunebusinessinsights.com/india-electric-vehicle-market-106623>

<https://www.kaggle.com/datasets/kkhandekar/electric-vehicles-india>

<https://www.kaggle.com/code/atom1991/electric-vehicle-market-segmentation#Conclusion>

<https://catalog.data.gov/dataset/electric-vehicle-population-data>

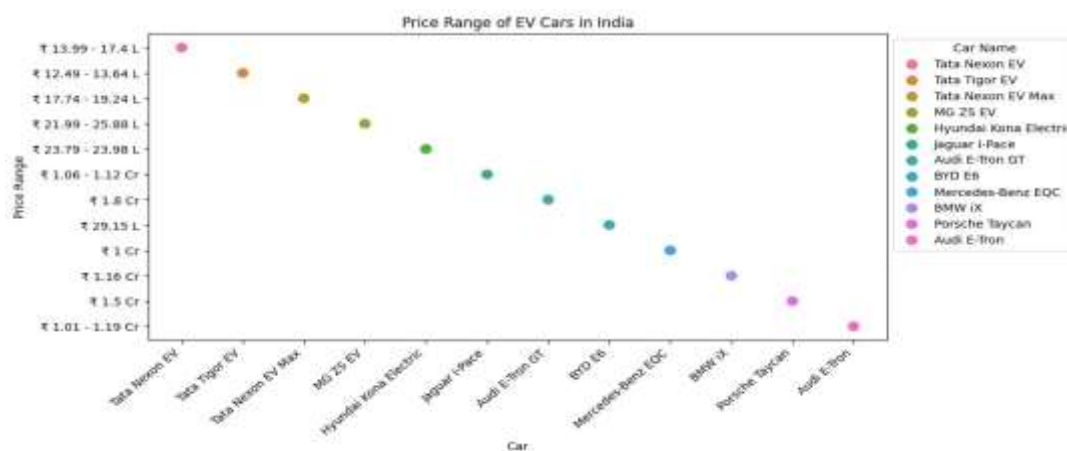
https://github.com/yashps7/EV_Segment_India/blob/main/EV_Segment_India.ipynb

4. Implementation Packages/Tools used

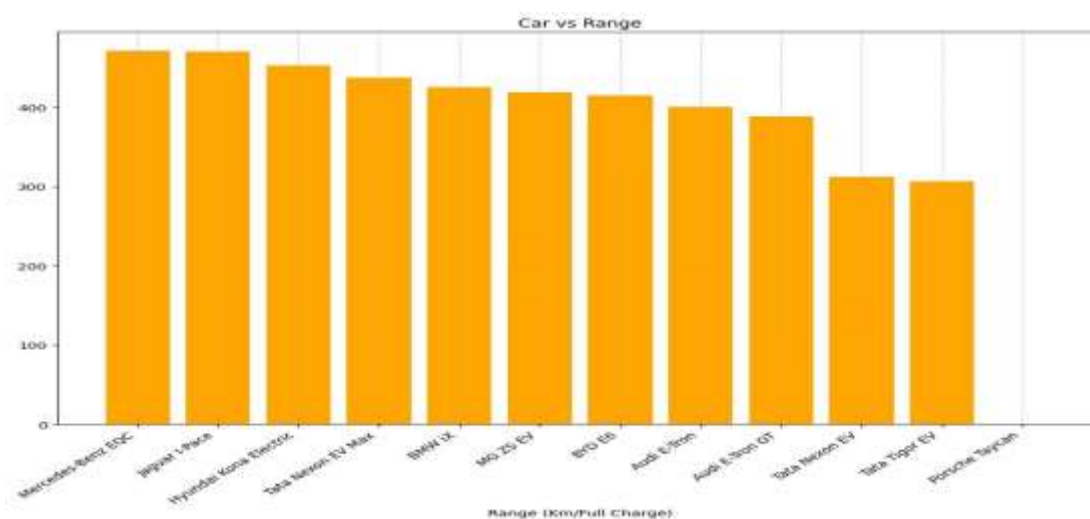
1. Numpy: To calculate various calculations related to arrays.
2. Pandas: To read or load the datasets.
3. SKLearn: We have used LabelEncoder() to encode our values.

5. Exploratory Data Analysis

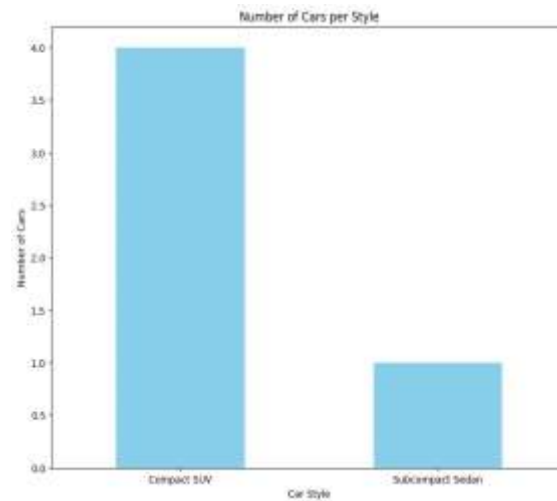
Exploratory Data Analysis (EDA) for the Indian EV market dataset involves initial inspection to understand its structure and variable types like car model, style, range, transmission type, vehicle type, price range, capacity, boot space, base model, and top model. This is followed by handling missing data through appropriate strategies. Statistical summaries and visualizations such as histograms, box plots, and other charts help reveal distributions, outliers, and relationships between variables. Feature engineering and correlation analysis further refine insights, identifying patterns and trends like consumer preferences across different price ranges or vehicle types. Documenting key findings and hypotheses guides iterative analysis, ensuring a comprehensive understanding of market segmentation to tailor strategies and enhance consumer satisfaction in this rapidly growing EV sector in India.



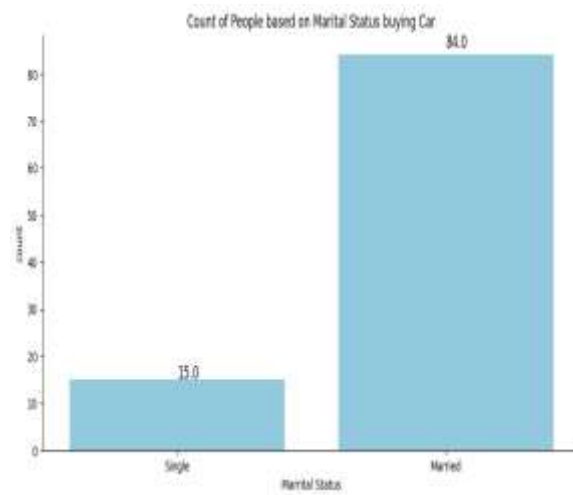
This graph shows that the Tata Nexon EV and Tata Tigor EV have the highest price range, between 12.49 and 17.4 lakh.



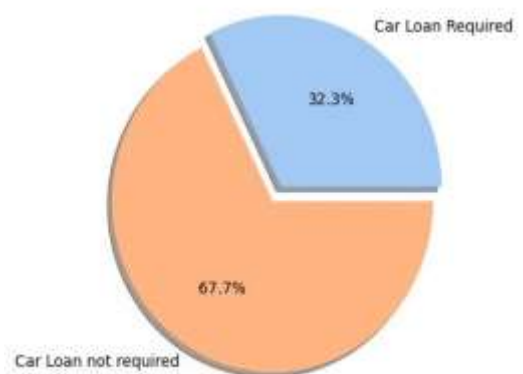
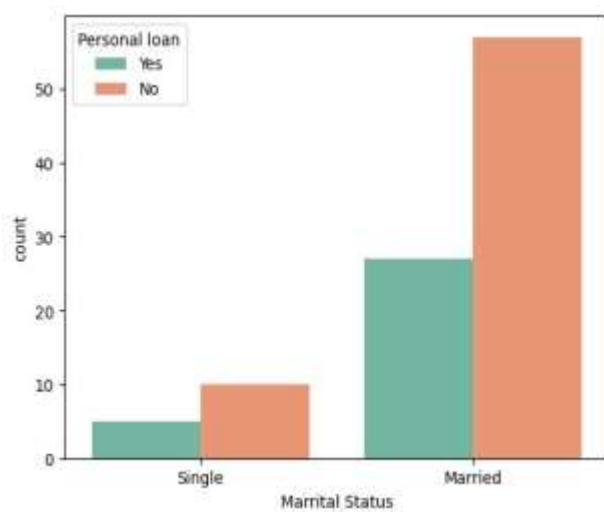
This graph shows that the distance covered in a single charge is the highest for the Mercedes-Benz EQC. It can travel 471 km per full charge



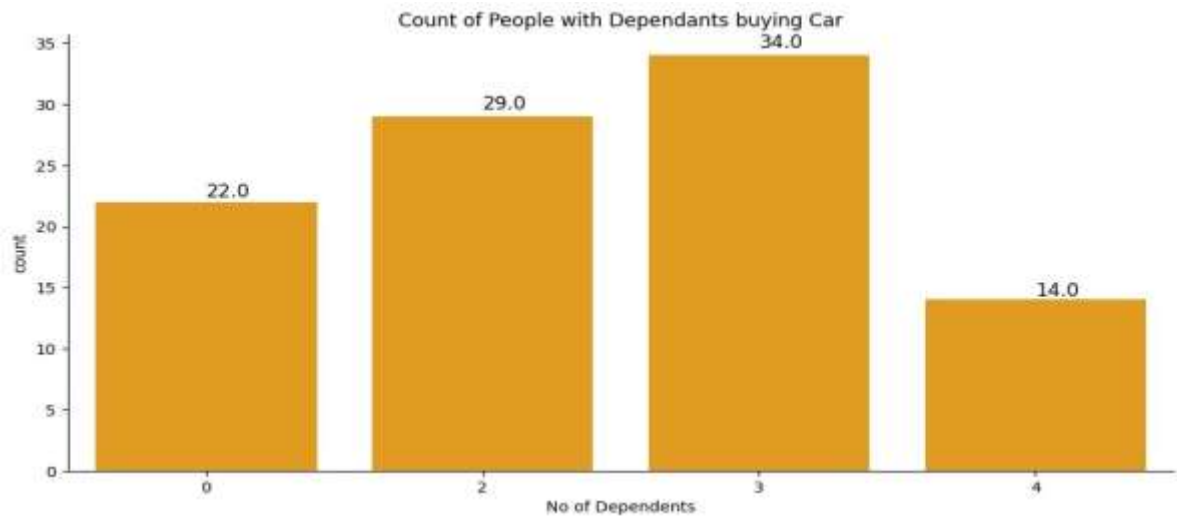
This shows that Compact SUVs are the most popular style in the given electric vehicle data.



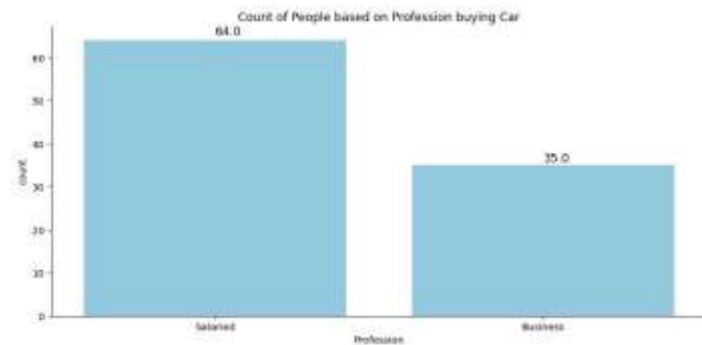
This shows that more married individuals are buying cars compared to singles.



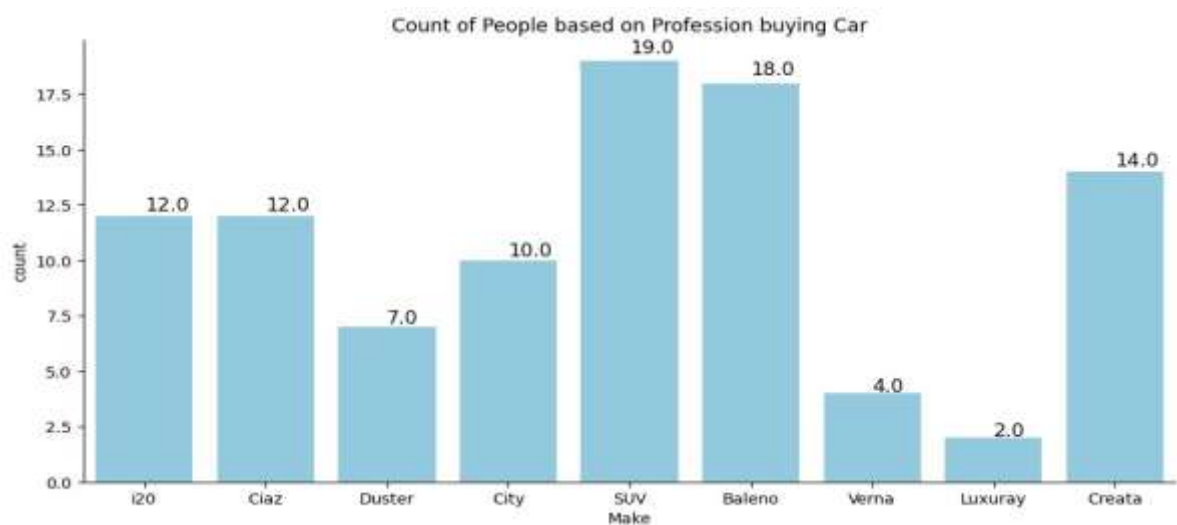
More married people have a personal loan compared to singles and 67.7% of people do not require a car loan, while 32.3% do require a car loan.



The bar chart shows that the highest number of people buying a car is among those with 3 dependents (34 people), while the lowest is among those with 4 dependents (14 people). Additionally, 29 people with 2 dependents and 22 people with no dependents are buying a car.



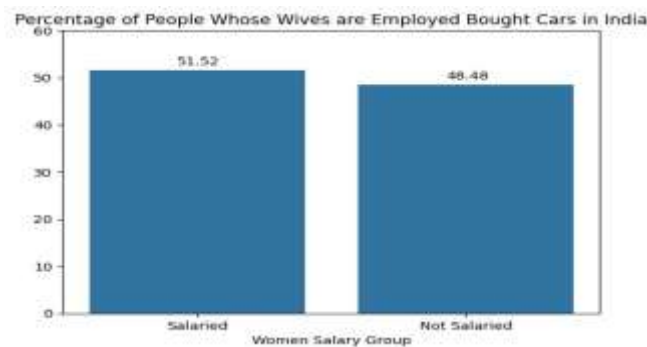
The bar chart indicates that 64 salaried individuals are buying a car compared to 35 business individuals.



The bar chart shows the count of people buying different car makes. SUVs have the highest count at 19, followed by Baleno (18), Creta (14), i20 and Ciaz (both 12), City (10), Duster (7), Verna (4), and Luxury (2).



This graph shows that the highest percentage of people from the 15-25 lakh salary group buying cars in India is 41.41%.



This graph shows that in India, 51.52% of car buyers have salaried wives, while 48.48% have non-salaried wives.



This graph shows heatmap of PCA Loadings.

6. Segment Extraction

K-means clustering aims to partition data into clusters based on similarities without predefined labels. In our dataset—featuring variables like water availability, price, and city—the Elbow Method determines the optimal number of clusters (K) by plotting the Within-Cluster Sum of Squares (WCSS), which measures variance within clusters.

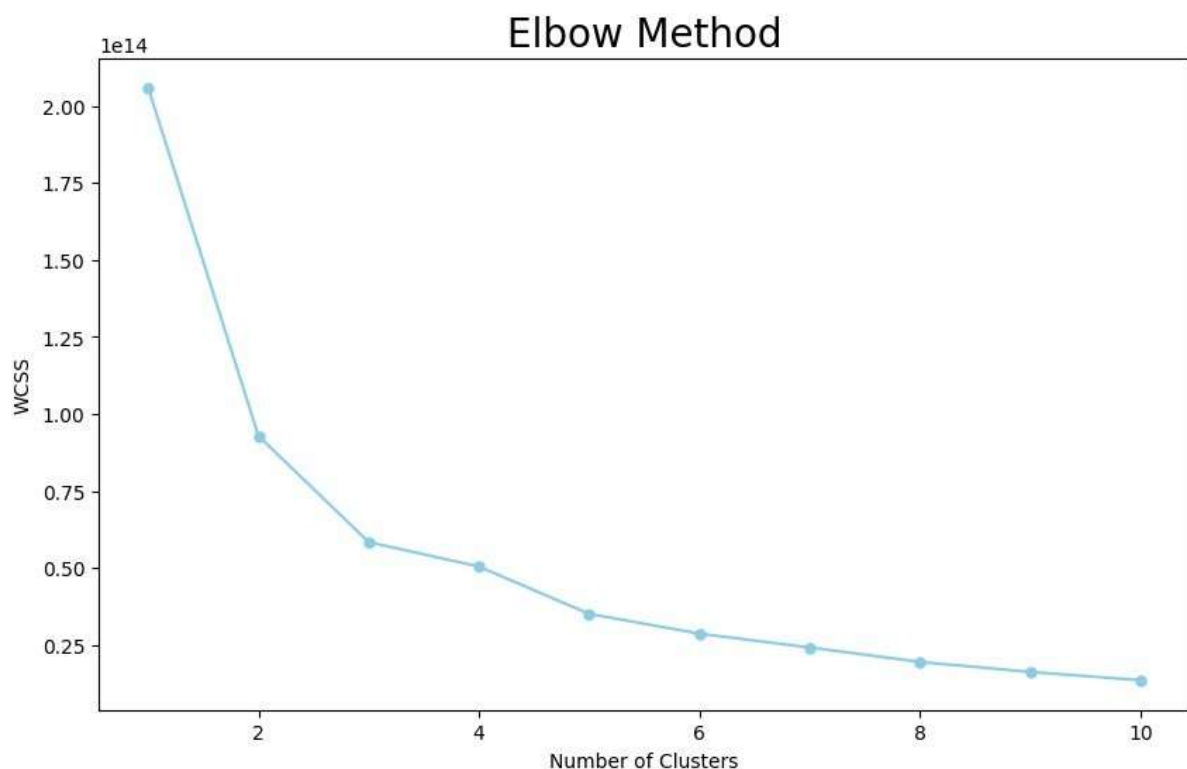
The objective function is:

$$J = \sum_{i=1}^m \sum_{k=1}^K w_{ik} \|x^i - \mu_k\|^2$$

And M-step is:

$$\frac{\partial J}{\partial \mu_k} = 2 \sum_{i=1}^m w_{ik} (x^i - \mu_k) = 0$$

$$\Rightarrow \mu_k = \frac{\sum_{i=1}^m w_{ik} x^i}{\sum_{i=1}^m w_{ik}}$$

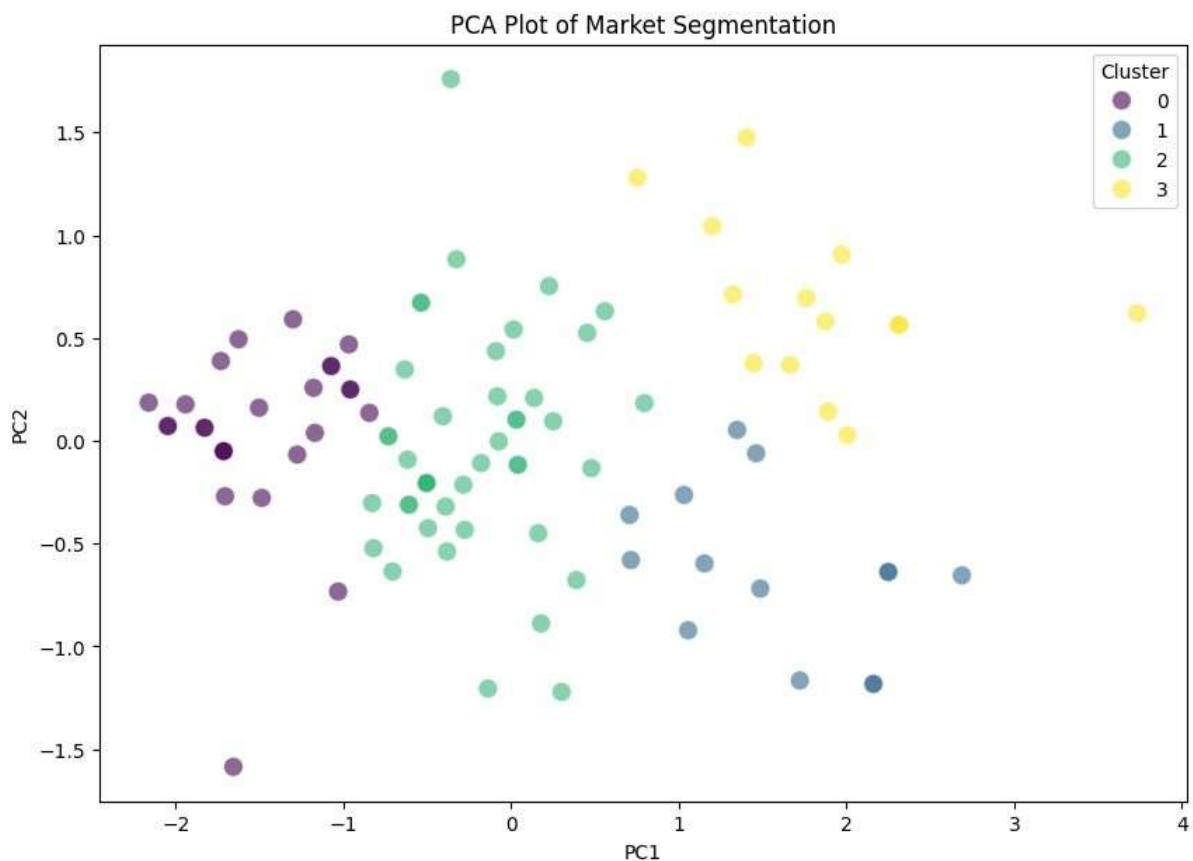


The graph shown is an Elbow Method plot used in cluster analysis to determine the optimal number of clusters (k) in a dataset. The x-axis represents the number of clusters, ranging from 1 to 10, and the y-axis represents the Within-Cluster Sum of Squares (WCSS), which is a measure of the variance within each cluster.

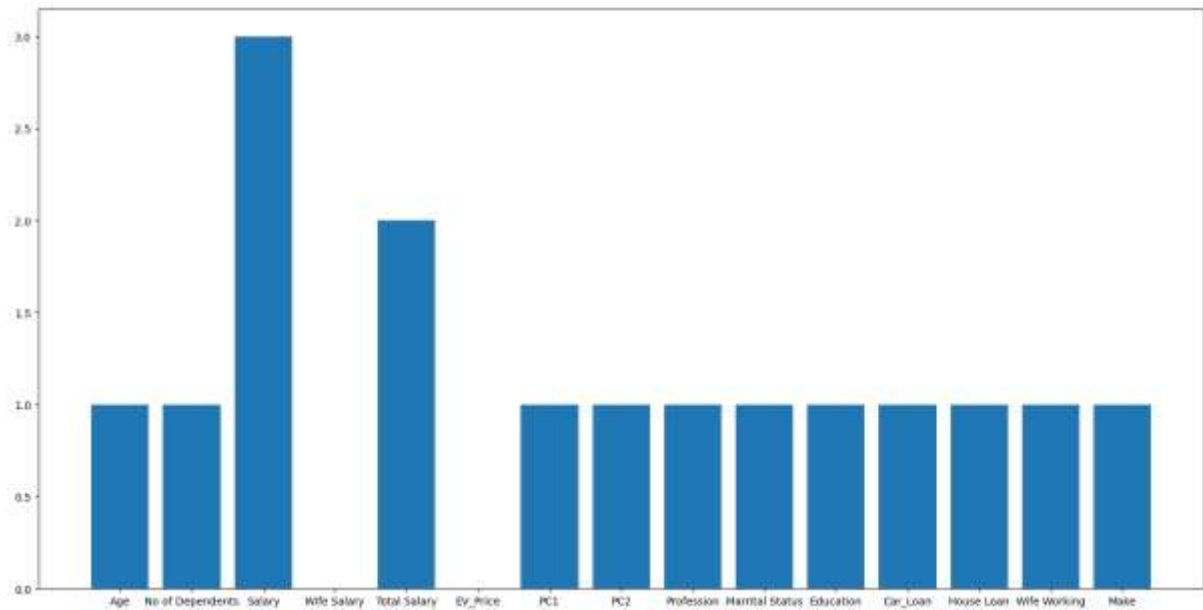
From the graph:

- The WCSS decreases sharply as the number of clusters increases from 1 to 3, indicating a significant reduction in variance.
- After 3 clusters, the decrease in WCSS becomes less pronounced, indicating that additional clusters contribute less to reducing the variance.

The "elbow" point is typically identified where the WCSS starts to decrease more slowly, which in this case is at 3 clusters. This suggests that the optimal number of clusters for this dataset is 3.



This graph shows PCA Plot of Market Segmentation.



The bar chart shows that "Salary" and "Total Salary" have the highest values, with "Salary" being the highest. "Age" and "Number of Dependents" have moderate values, while the rest of the attributes have lower values.

7. Profiling and describing Potential Segments

7.1 Behavioural Segmentation

Behavioural segmentation in the Indian EV market can be categorized based on several factors:

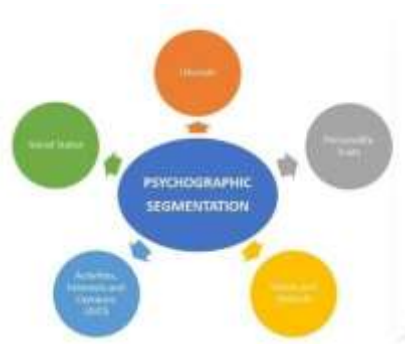
- **Price Range Preferences:** Segments may include affluent buyers interested in premium EVs like the Tata Nexon EV and Tata Tigor EV, which fall within the higher price range of 12.49 to 17.4 lakh. Another segment might prioritize budget-friendly options, such as EVs priced below 10 lakh.
- **Specifications Preferences:** Consumers may segment based on preferences for specific features such as extended range capabilities, advanced safety technologies, or luxurious interiors. For example, some segments may prioritize vehicles that offer high mileage per charge or fast charging capabilities.



7.2. Psychographic Segmentation

Psychographic factors delve into the preferences and values that influence consumer choices in the EV market:

- **Comfort vs. Performance:** Segments can be defined by whether consumers prioritize comfort, opting for spacious interiors and smooth rides, or performance, seeking EVs with powerful engines and dynamic driving capabilities.
- **Environmental Consciousness:** Some segments may prefer EVs due to environmental concerns, prioritizing vehicles that offer low emissions and contribute to sustainability efforts.



7.3. Geographic Segmentation

Geographic segmentation focuses on regional characteristics influencing EV market dynamics in India:

- **Urban vs. Rural Preferences:** Urban areas may show a higher demand for compact EVs suited for city commuting, whereas rural regions may favor EVs with robust performance and longer range capabilities.
- **Government Policies and Incentives:** Segments can also be shaped by state-specific policies and incentives promoting EV adoption, influencing purchasing behaviours and preferences across different states.



8. Target Segments:

The Indian EV market presents diverse opportunities segmented into four key consumer profiles:

- **Affluent Urban Consumers:** High-income earners in urban areas, interested in premium EV models with advanced features and extended range capabilities.
- **Family-Oriented Consumers:** Salaried individuals with moderate to large families, prioritizing practicality and space, especially in compact SUVs.
- **Tech-Savvy Early Adopters:** Young professionals and tech enthusiasts fascinated by technological innovations and eco-consciousness, seeking EVs with cutting-edge features.
- **Environmentally Conscious Consumers:** Individuals across income brackets committed to reducing their carbon footprint, interested in EVs that align with environmental values and government incentives.



9. Customizing the Marketing Mix:

Customizing the marketing mix is essential for effectively targeting diverse consumer segments in the Indian EV market. Our product strategy will focus on introducing a versatile range of EV models that cater to different consumer preferences, emphasizing extended range capabilities and practical vehicle designs to meet varied needs. In terms of pricing, we will implement segmented strategies that align with consumer purchasing power and emphasize value propositions such as cost savings and environmental benefits. Our promotional efforts will leverage digital platforms to deliver targeted campaigns, highlighting eco-friendliness, technological advancements, and the economic advantages of EV ownership. For distribution, we will expand EV charging infrastructure across urban and rural areas, establish dedicated showrooms, and enhance dealership networks to ensure personalized consumer experiences and maximize market reach.



9.1. Product Mix:

Our product mix will include a diverse lineup of EV models ranging from compact SUVs to premium sedans, each equipped with advanced features such as extended range capabilities, fast-charging technology, and customizable options to appeal to various consumer segments.

9.2. Prices and Pricing Strategies:

We will implement segmented pricing strategies tailored to different consumer segments, emphasizing competitive pricing that reflects the value proposition of EVs, including long-term cost savings on fuel and maintenance, along with promotional offers to stimulate initial market demand.

9.3. Promotional Mix:

Our promotional mix will utilize digital marketing channels for targeted campaigns, focusing on educating consumers about the environmental benefits, technological innovations, and overall advantages of adopting EVs. We will also engage in content marketing, event sponsorships, and public relations to build brand awareness and credibility.

9.4. Place/Distribution:

Efficient distribution strategies will include expanding EV charging infrastructure in strategic urban and rural locations, establishing dedicated EV showrooms for enhanced consumer experiences, and leveraging online platforms for seamless sales transactions and customer engagement. We will prioritize urban centers with high EV adoption potential while developing tailored strategies to penetrate rural markets and improve accessibility.

10. Potential Sales in Early Market

The analysis indicates promising early sales potential driven by:

- **Market Dynamics:** Rapid expansion propelled by environmental concerns, government incentives, and technological advancements.
- **Consumer Preferences:** Strong demand for premium EV models, extended range capabilities, and practical vehicle styles like compact SUVs.
- **Demographic Insights:** Significant interest from mid to high-income earners, particularly those in the 15-25 lakh salary range, and consumers with stable income sources and moderate to large families.



11. Most Optimal Market Segment

The most optimal market segment identified is mid to high-income earners in the 15-25 lakh salary bracket, characterized by:

- **Consumer Profile:** Salaried individuals with stable incomes and moderate to large families, prioritizing premium EV models with extended range capabilities.
- **Behavioural Insights:** Strong inclination towards technological innovations, eco-consciousness, and practical vehicle designs like compact SUVs.
- **Strategic Implications:** Tailoring strategies to meet the specific needs and preferences of this segment can maximize market penetration, enhance consumer satisfaction, and drive sustainable growth in the Indian EV market.

12. Conclusion

The EV market in India is segmented into four key clusters: Affluent Urban Consumers, Family-Oriented Consumers, Tech-Savvy Early Adopters, and Environmentally Conscious Consumers. Tailoring strategies to these segments, such as offering diverse EV models with advanced features, implementing competitive and segmented pricing, utilizing targeted digital marketing campaigns, and expanding EV charging infrastructure, can enhance customer satisfaction and drive market growth. The most optimal market segment is mid to high-income earners in the 15-25 lakh salary bracket, who prioritize premium EV models with extended range capabilities, making them ideal targets for maximizing market penetration and sustainable growth.

Github Link:

https://github.com/bhavikawagh123/Feynn_Labs_Internship2024