ELECTRIC VEHICLE MARKET ANALYSIS

EV Market Segmentation for Feynn Lab

Task 1-R

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GitHub Link –

https://github.com/harsha-sreepathy/EV-Market-Segmentation

Abstract -

This document conducts an in-depth examination of the Electric Vehicle (EV) market through the application of market segmentation methodologies. Given the increasing interest in eco-friendly transportation and the continuous evolution of electric vehicle technology, it is imperative for enterprises to gain a nuanced understanding of the market dynamics and pinpoint profitable segments. Employing geographical, demographic, psychographic, and behavioral segmentation, this report scrutinizes the EV market, empowering businesses to formulate precise strategies for entering the market and maximizing revenue. The findings from the segmentation analysis offer valuable insights, and the report concludes with actionable recommendations for businesses seeking to leverage opportunities within the diverse customer segments of the EV market.

Problem Statement -

Electric vehicles (EVs) are gaining widespread popularity globally as a green substitute for conventional gasoline cars. In India, the rising interest in EVs is attributed to growing environmental consciousness, increasing fuel costs, and government incentives. As a startup in the electric vehicle industry, it is essential for us to carefully analyze the Indian EV market and formulate a viable strategy targeting the specific segments that are most receptive to adopting EVs.

Data Collection –

The information gathered originates from Kaggle and is both concise and tailored for visualization and clustering applications. Our aim is to comprehensively examine the Indian electric vehicle (EV) market through segmentation analysis. This involves considering diverse factors, including geographic, demographic, and behavioral data, to identify the optimal location for initiating an early market presence.

Market Overview –

The market analysis of the electric vehicle sector in India is structured around the segmentation of Vehicle Type and Power Source.

- Vehicle Type categorization encompasses Passenger Cars, Commercial Vehicles, and Two- and Three-wheelers.
- The Power Source Type classification includes Battery Electric Vehicle, Plug-in Electric Vehicle, and Hybrid Electric Vehicle. Although our primary focus in this report revolves around the segmentation by Vehicle Type in the Indian Electric Vehicle Market, we will touch upon the impact of Power Source accessibility on Electric Vehicles, providing a brief discussion.

In 2020, the valuation of the Indian Electric Vehicle Market stood at USD 5 billion, and it is anticipated to escalate to USD 47 billion by 2026. This growth trajectory signifies a remarkable compound annual growth rate (CAGR) exceeding 44% during the forecast period of 2021-2026.

The progression of the Indian Electric Vehicle Market has been influenced by the disruption caused by the COVID-19 pandemic. Supply chain interruptions and the suspension of manufacturing units due to prolonged lockdowns and travel restrictions across the country have played a significant role. Despite these challenges, the electric vehicle (EV) market in India is still in its early stages. Anticipated to surge at an accelerated pace in the forecast period, the growth is attributed to various government initiatives and policies

Market Challenges –

While the enthusiasm for electric vehicles (EVs) is gaining momentum in India, the actual sales figures do not align with the level of excitement. The sluggish growth in EV sales can be attributed to several factors, including a limited array of options in the passenger car segment, the driving range of the vehicles, affordability concerns, and the insufficient charging infrastructure.

Affordability emerges as a significant obstacle impacting the market's expansion. In India, a nation known for its price sensitivity, the majority of consumers prioritize the cost of the vehicle over other factors. Currently, a substantial portion of the population, which contributes significantly to overall vehicle sales, finds electric vehicles financially out of reach.

Given that the electric vehicle market in India is still in its early stages, the charging infrastructure remains minimal. In contrast, developed countries boast well-established charging stations that are easily accessible to vehicle owners for charging purposes. With the anticipated surge in EV sales, the development of a robust charging infrastructure becomes imperative for fostering a conducive ecosystem. Additionally, in terms of driving range, only a few available variants on the market exceed 150 km per charge.

Implementation –

Packages/Python Libraries used –

• Numpy - To calculate various calculations related to arrays.

• Pandas - To read or load the datasets.

• Matplotlib - To create static, animated, and interactive visualizations.

• SKLearn - To model the K-Means algorithm and PCA. We also have used OneHotEncoder() to encode our values.

• Seaborn - It provides a high-level interface for creating informative and attractive statistical graphics.

Data Pre-Processing –

The data collected is compact and is partly used for visualization purposes and partly for clustering. Python libraries such as NumPy, Pandas, Scikit-Learn, and SciPy are used for the workflow, and the results obtained are ensured to be reproducible.

Exploratory Data Analysis (EDA) initiates with an analysis of the data, both with and without employing Principal Component Analysis (PCA). In the dataset amalgamated from all available data sources, PCA, a statistical technique, is applied. PCA facilitates the transformation of correlated feature observations into a set of linearly uncorrelated features through orthogonal transformation. These newly derived features are referred to as Principal Components. This process proves valuable in reducing the data dimensions, enhancing the cost-effectiveness of classification, regression, or any machine learning procedures.

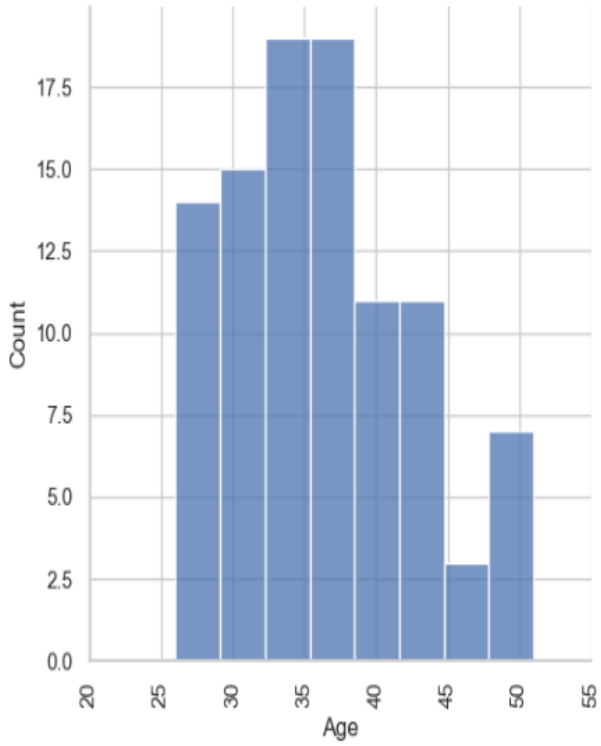
THE SIGNIFICANCE OF MARKETING MIX

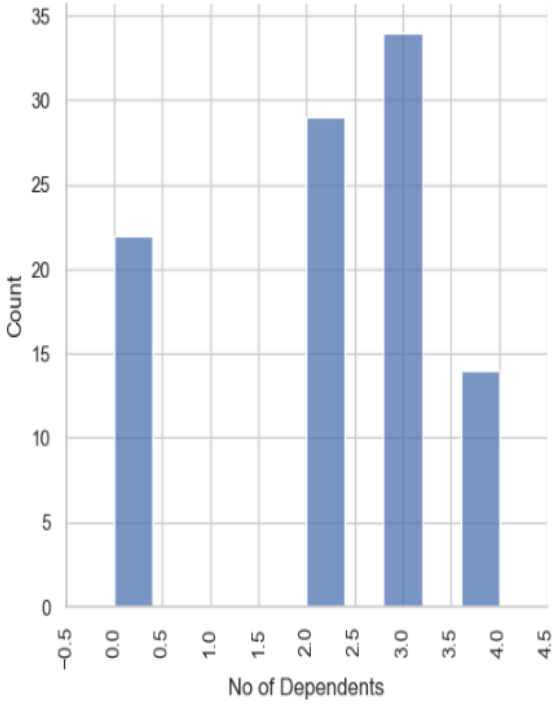
Understanding the capabilities of our product or service and formulating a successful product offering is facilitated by the marketing mix. It plays a pivotal role in planning, developing, and executing effective marketing strategies, aiding in the assessment of whether our product or service aligns with customer needs.

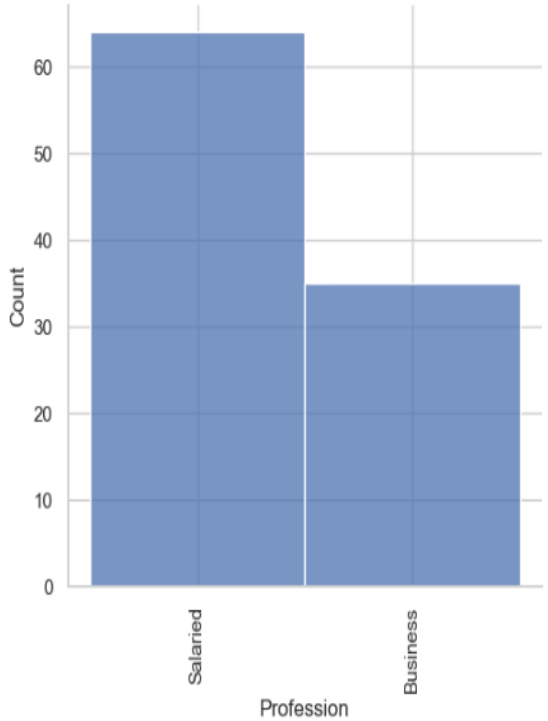
- Product: Given the company's initiation into the Electric Vehicles (EVs) sector, it is imperative that the product addresses all the concerns outlined.
- Price: The pricing strategy will be contingent on factors such as service parts and battery costs, influenced by whether these components are sourced locally or imported.
- Place: Analysis indicates that the southern states present the most favorable conditions for the company to achieve initial high sales and, consequently, should be prioritized for registration.
- Promotion: Tailoring promotions based on the analysis can be beneficial. Offering more incentives and promotions to segments that hold greater value for the company is recommended.

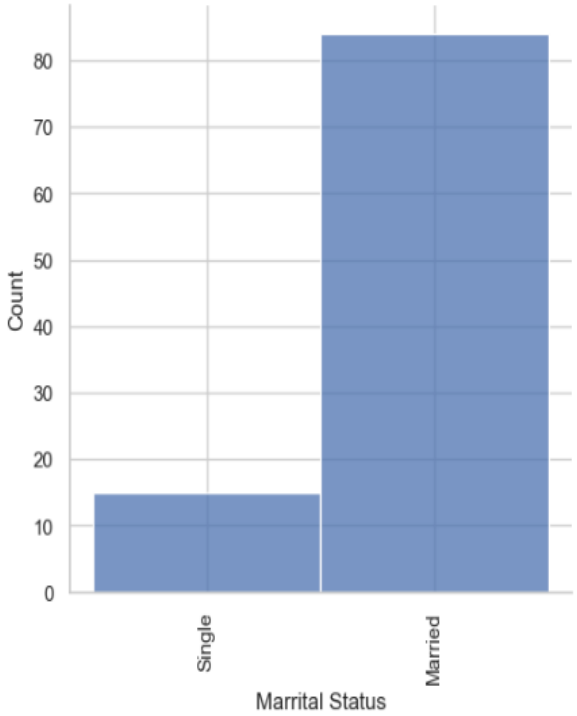
For a new startup entering the market, emphasis should be placed on the range and affordability of the e-vehicle.

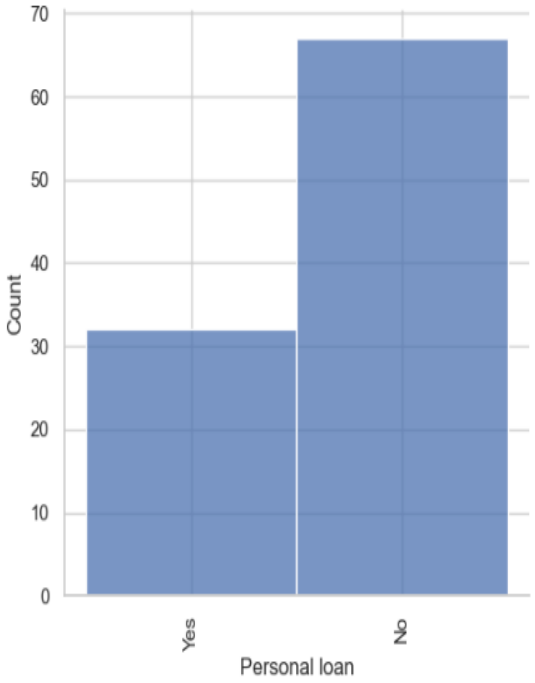
Behavioral Analysis –







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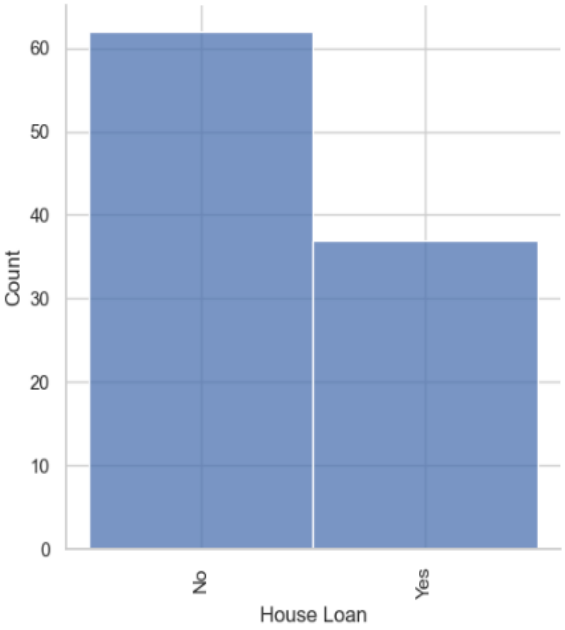
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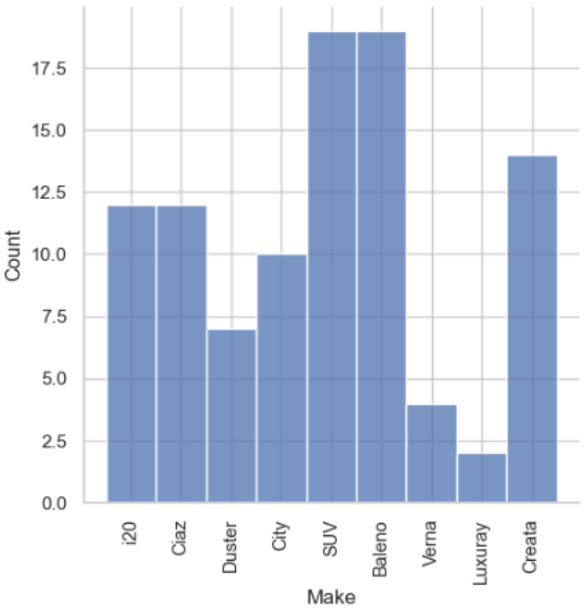
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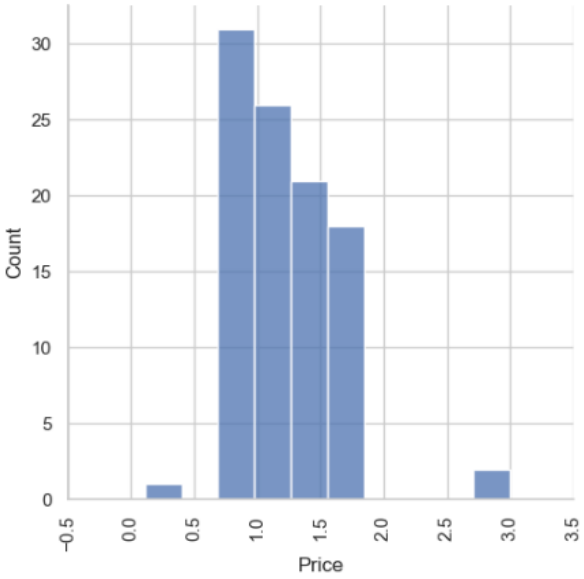
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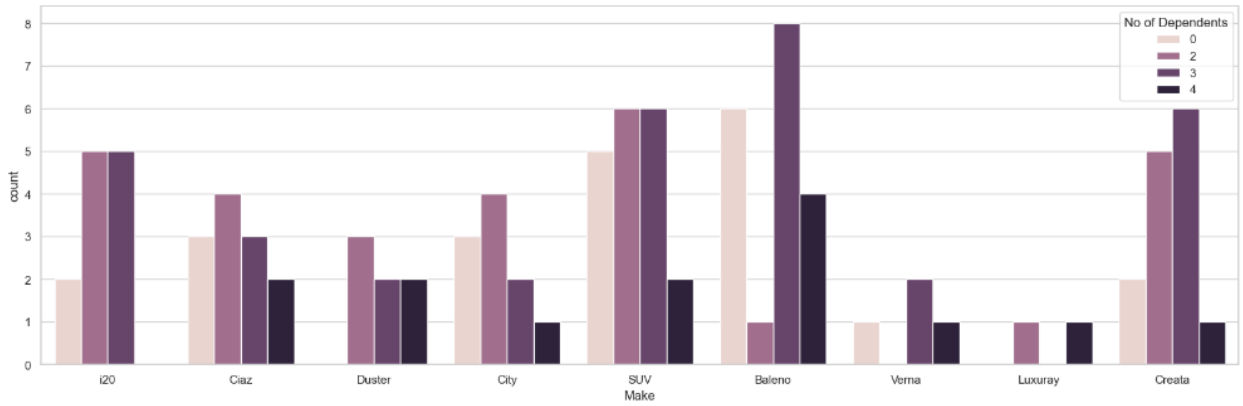
- Relation between number of dependents on a consumer and the vehicles they purchase



- Relation between consumers profession and the vehicles they tend to purchase

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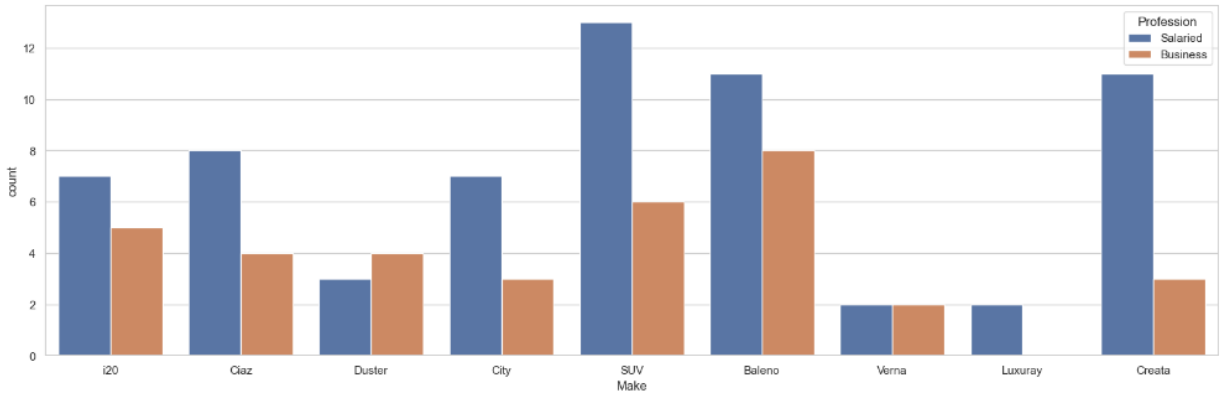
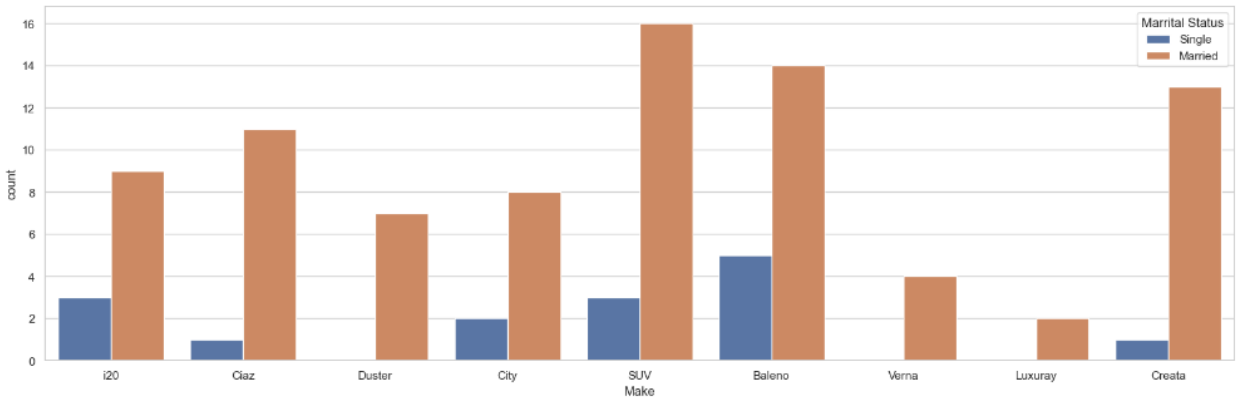
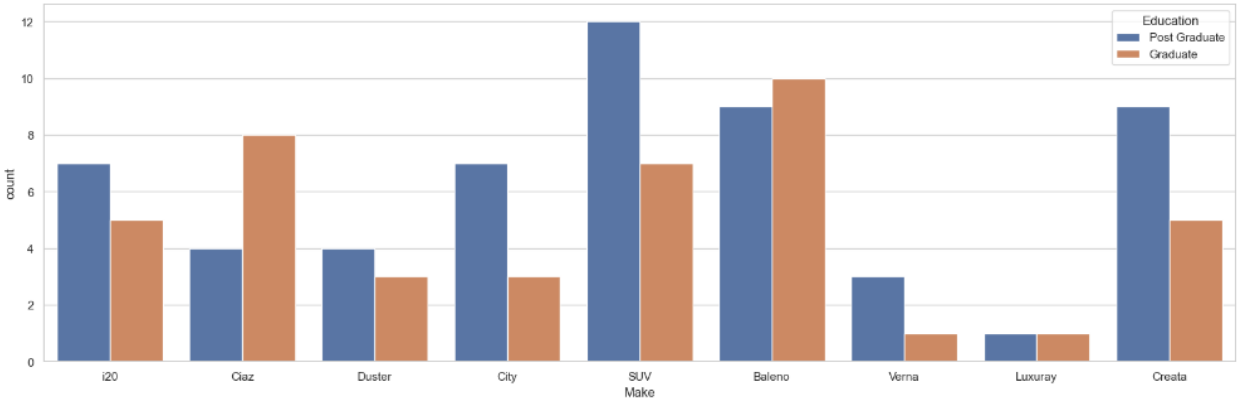


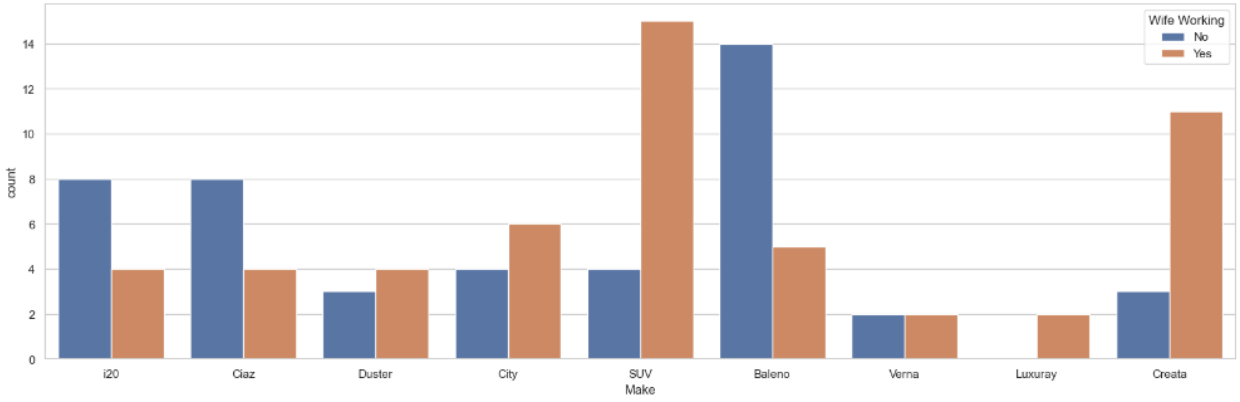
- Relation between consumers marital status and the vehicles they purchase



- Relation between consumers education and the vehicles they purchase



- Relation between consumers Wife Working and the vehicles they tend to purchase

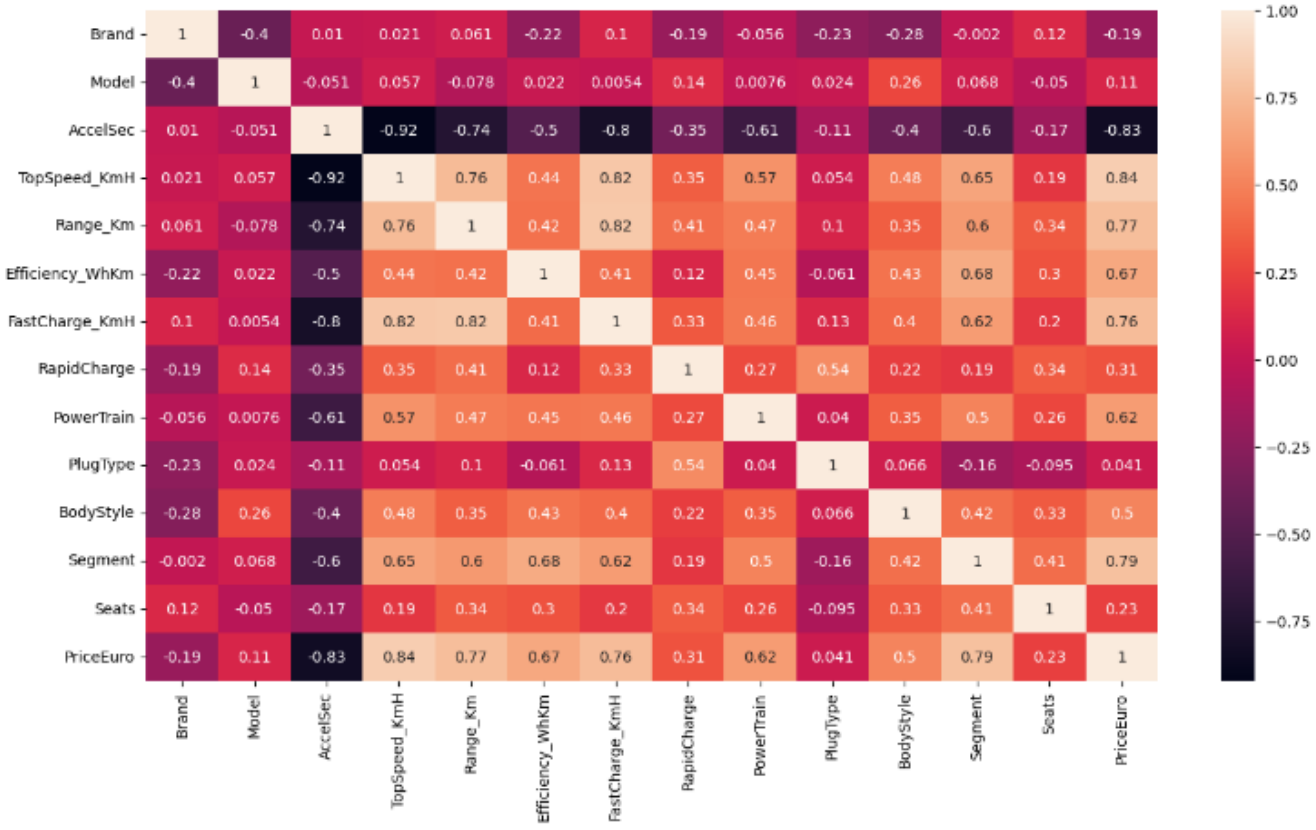


Observations from the above plots

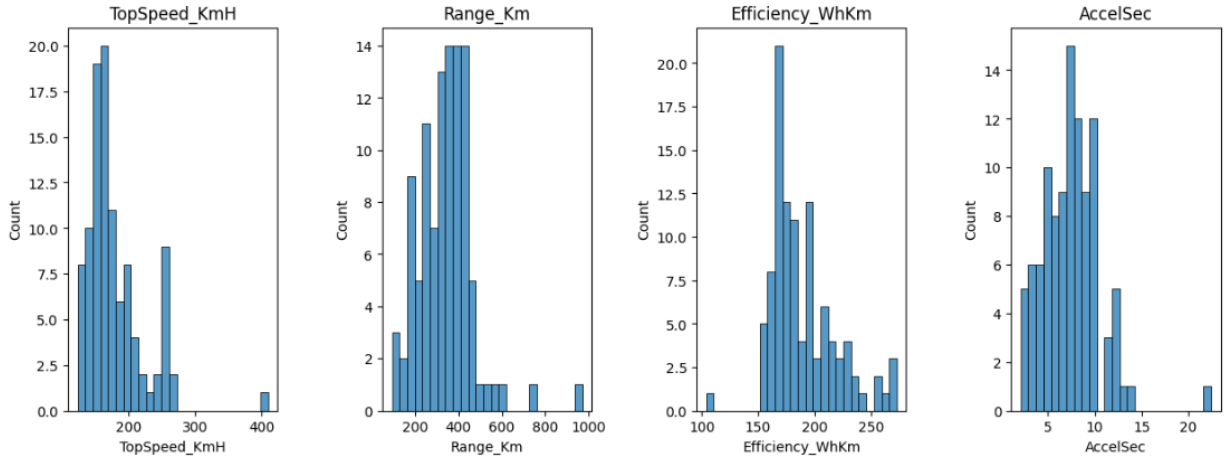
1. People with the age between 30 to 40 years and who are married mostly own a 4-wheeler
2. The number of dependents in the family also plays a significant role. The more dependents in the family the more chances of buying a 4-wheeler.
3. People who have an active personal loan or house loan have a less chance of buying a car.
4. If the partner/wife is as well earning, there is more chance to own a car.
5. Most of the people choose a car which is less than Rs. 13L
6. If both the couple are earning in a family, the preference vehicle would be an SUV

EV Vehicle Segmentation Analysis –

Correlation Plot



This correlation plot can clearly convey the attributes that affects the buying preference of any person.

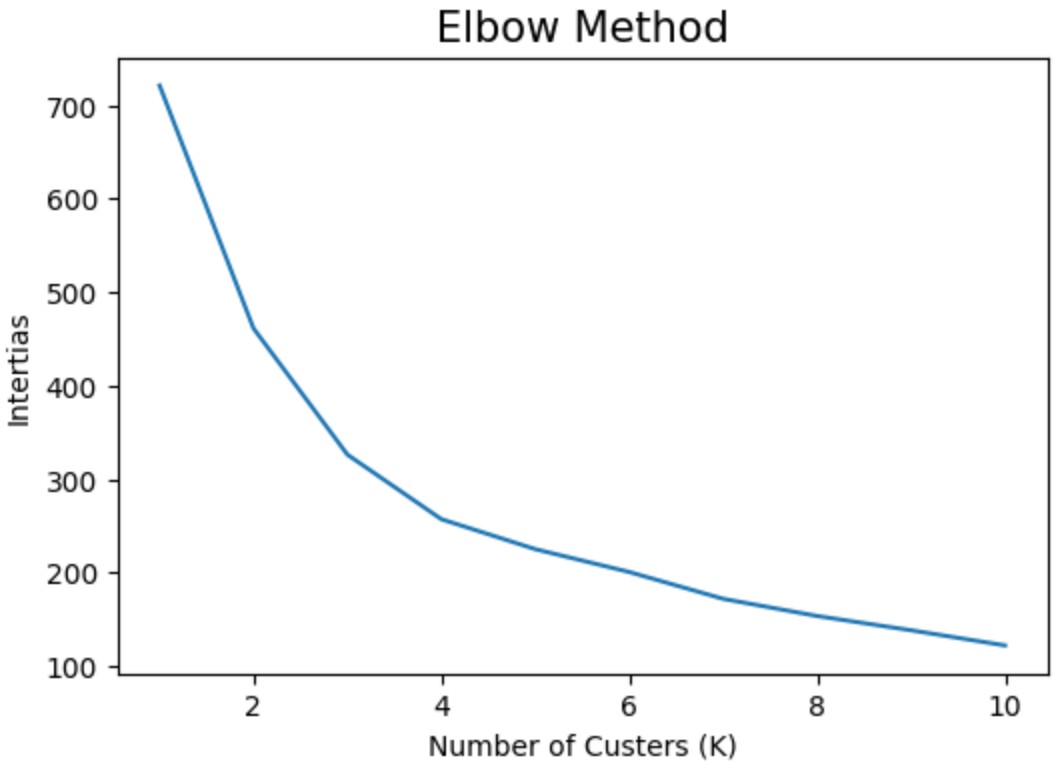


Segmentation

Elbow Curve -

The Elbow Method serves as a widely employed technique to ascertain the most suitable number of clusters. Its principle involves the computation of the Within-Cluster-Sum of Squared Errors (WSS) across varying cluster numbers (k). The optimal k is identified as the point where the reduction in WSS begins to decelerate. The rationale behind the elbow method lies in the observation that the explained variation undergoes a rapid change for a small number of clusters, after which it gradually slows down, resulting in the formation of an elbow in the curve. The elbow point signifies the ideal number of clusters for the clustering algorithm.

To implement the KElbowVisualizer function, the KMeans model is fitted for cluster values ranging from 2 to 8. The resulting figure showcases the attainment of the elbow point, which is distinctly highlighted by the function itself. Additionally, the function provides information regarding the time taken to generate models for different cluster numbers, as indicated by the green line in the plot.



K-Means Clustering -

The K-means clustering algorithm involves several steps, as outlined below:

- Specify the desired number of clusters, denoted as K.
- Initialize centroids by shuffling the dataset and randomly selecting K data points without replacement.
- Calculate the sum of squared distances between data points and all centroids.
- Assign each data point to the closest cluster (centroid).
- Compute the centroids for the clusters by averaging all data points belonging to each cluster.
- Repeat the process until there is no change in centroids, indicating stability in the assignment of data points to clusters.

In accordance with the Elbow method, we set K equal to 4 clusters for training the K-Means model. The resulting clusters are visualized in the figure below.

Conclusion

In conclusion, the analysis of the electric vehicle (EV) market in India has provided valuable insights into consumer preferences and behaviors. The study identified distinct clusters within the dataset, representing diverse consumer segments based on demographic, geographic, psychographic, and behavioral factors. This information can serve as a guide for refining marketing strategies, shaping product development, and selecting target markets to promote the adoption of EVs in India.

The growth and potential of electric vehicle (EV) market segments in India are noteworthy, influenced by various key factors.

The findings underscore the importance of targeted campaigns tailored to address the concerns and preferences of specific consumer segments. Additionally, the analysis emphasized factors such as affordability, perceptions of economic viability, and regional variations, all of which play a crucial role in influencing the adoption of EVs.

One notable trend is the increasing awareness among Indian consumers about the environmental benefits of EVs, leading to a rising demand among environmentally conscious individuals and organizations. This heightened awareness focuses on the reduced emissions and lower pollution levels associated with EV usage.

Moreover, urban areas in India, especially major cities, are experiencing a surge in demand for EVs for commuting and ride-sharing purposes. The allure of lower operating costs and the ability to navigate through congested traffic make EVs an attractive option for urban dwellers in India.

References -

https://www.kaggle.com

https://www.statista.com/statistics/1234761/india-electric-vehicle-sales-by-type/

https://www.sciencedirect.com/science/article/abs/pii/S0019850118307557

ttps://www.ceew.in/sites/default/files/CEEWIndiaElectricVehicleTransitionReportPDF26Nov19.pdf

https://www2.deloitte.com/content/dam/insights/us/articles/22869-electricvehicles/DI_Electric-Vehicles.pdf