Electric Vehicle Market Segmentation

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Project Link: https://github.com/Abdul-Jaweed/Feynn-Lab-Internship/tree/main/Project%202.1

INTRODUCTION

The transition to electric vehicles (EVs) represents a significant paradigm shift in the automotive industry, driven by the need for sustainable transportation solutions. As the world grapples with environmental concerns and the need to reduce carbon emissions, the EV market in India has emerged as a promising frontier for innovation and growth. This report delves into the analysis of the EV market in India and aims to develop a feasible strategy for market entry.

The Indian EV market has witnessed remarkable growth in recent years, fuelled by government initiatives, favourable policies, and increasing consumer awareness about the benefits of EVs. The country's ambitious goal to electrify a significant portion of its vehicle fleet presents immense opportunities for companies operating in this space. However, navigating the complexities of the Indian market requires a deep understanding of the unique challenges and dynamics at play.

This report is a comprehensive guide for the electric vehicle startup, providing valuable insights and actionable recommendations to enter the Indian market effectively. By analysing data related to EV registrations, charging infrastructure, vehicle sales, customer preferences, and government policies, this report sheds light on key insights and trends shaping the EV market in India. Additionally, the report explores the market segmentation concept, allowing us to categorise potential customers based on various factors such as demographics, psychographics, and behaviours.

With a focus on innovation, sustainability, and market potential, this report provides a strategic roadmap to help the electric vehicle startup establish a strong presence in the Indian market. By customising the marketing mix, targeting the most promising segments, and understanding the early market psychographics, the startup can position itself for success in the dynamic and evolving EV landscape. By capitalising on the immense growth opportunities presented by the Indian market, the startup can contribute to the country's vision of a cleaner and greener transportation ecosystem.

PROBLEM STATEMENT

The problem at hand is to develop a feasible strategy for market entry into the electric vehicle (EV) market in India for an electric vehicle startup. While the Indian EV market shows promising growth potential, it is crucial for the startup to navigate the unique challenges and dynamics of the market effectively. The goal is to establish a strong presence in the Indian market by capitalizing on the opportunities presented by the government initiatives, favorable policies, increasing consumer awareness, and the country's ambitious goal of electrifying a significant portion of its vehicle fleet.

To address this problem, the following key aspects need to be considered:

- **Market Analysis:** Conduct a comprehensive analysis of the EV market in India, including factors such as EV registrations, charging infrastructure, vehicle sales, customer preferences, and government policies. Identify key trends and insights that can inform the market entry strategy.
- **Market Segmentation:** Utilize market segmentation techniques to categorize potential customers based on demographics, psychographics, and behaviors. Understand the target audience and their preferences to tailor the marketing mix accordingly.
- **Competitive Landscape:** Evaluate the existing competition in the Indian EV market, including both domestic and international players. Analyze their market share, product offerings, pricing strategies, and distribution channels to identify opportunities for differentiation and competitive advantage.
- **Sustainable and Innovative Solutions:** Emphasize sustainability and innovation in the electric vehicle startup's offerings. Develop a unique value proposition that aligns with the environmental concerns and the country's vision of a cleaner and greener transportation ecosystem.
- **Marketing and Positioning Strategy:** Develop a strategic roadmap for the startup's marketing and positioning efforts in the Indian market. Determine the most effective channels and messaging to reach the target audience. Customize the marketing mix to create awareness, generate demand, and establish a strong brand presence.
- **Government Engagement:** Understand and leverage the government initiatives and policies supporting the EV market in India. Identify potential partnerships and collaborations with government bodies to gain market access and navigate regulatory requirements effectively.

By addressing these key aspects, the electric vehicle startup can develop a well-informed and tailored strategy for market entry into the Indian EV market. The objective is to establish a strong foothold, gain market share, and contribute to India's vision of sustainable and greener transportation.

Data Sources :

Abdul Jaweed :

- **Telangana Open Data :** https://data.telangana.gov.in/dataset/regional-transport-authority-vehicle-registrations-data

- **Indian EV Segmentation :** https://www.kaggle.com/datasets/krishnendubarman/indian-ev-segmentation

Ashvath Suresh Babu Piriya :

- **Public Charging Stations :** https://github.com/A2162014/Feynn-Lab-Internship/blob/main/Project%202/Codes/Code-2/EV-datasets/Details_of_Public_Charging_Stations_Installed.xlsx

- **Behavioural Segment Data:** https://github.com/A2162014/Feynn-Lab-Internship/blob/main/Project%202/Codes/Code-2/EV-datasets/behavioural_segment_data.csv

Satwik:

- **Electric Vehicle in India 2022 :** https://www.kaggle.com/datasets/fathimaibrahimkunju/electric-vehicle-in-india-2022

Shaleen Mishra :

- **Market Segmentation :** https://drive.google.com/file/d/1e1TJacooByJELBd7nmZbtVk_au4KotZ2/view

- **Electr Evehda :** https://drive.google.com/file/d/1veBO46wSBwtmED9V8DhEMhabK8TwFzy3/view

Yashaswini M :

- **EV Two Wheeler :** https://github.com/Yashaswini29026/EV__market_segmentation/blob/main/ev_two_wheeler.xlsx

Data Pre-processing

Data preprocessing refers to the steps and techniques applied to raw data before it is used for analysis or machine learning tasks. The goal of data preprocessing is to transform the data into a suitable format that can be easily understood and processed by algorithms.

Here are some common steps involved in data preprocessing:

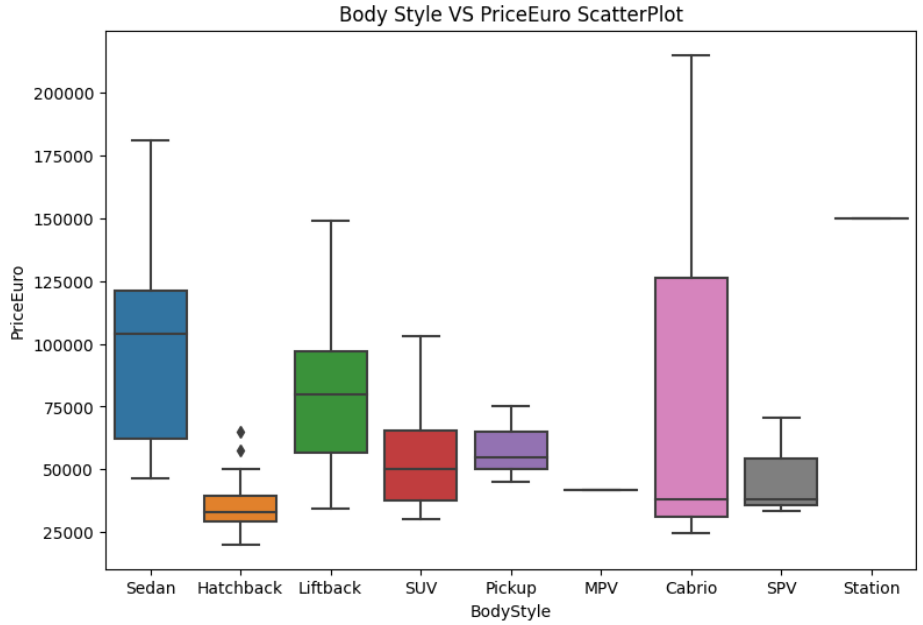
- **Data Cleaning:**

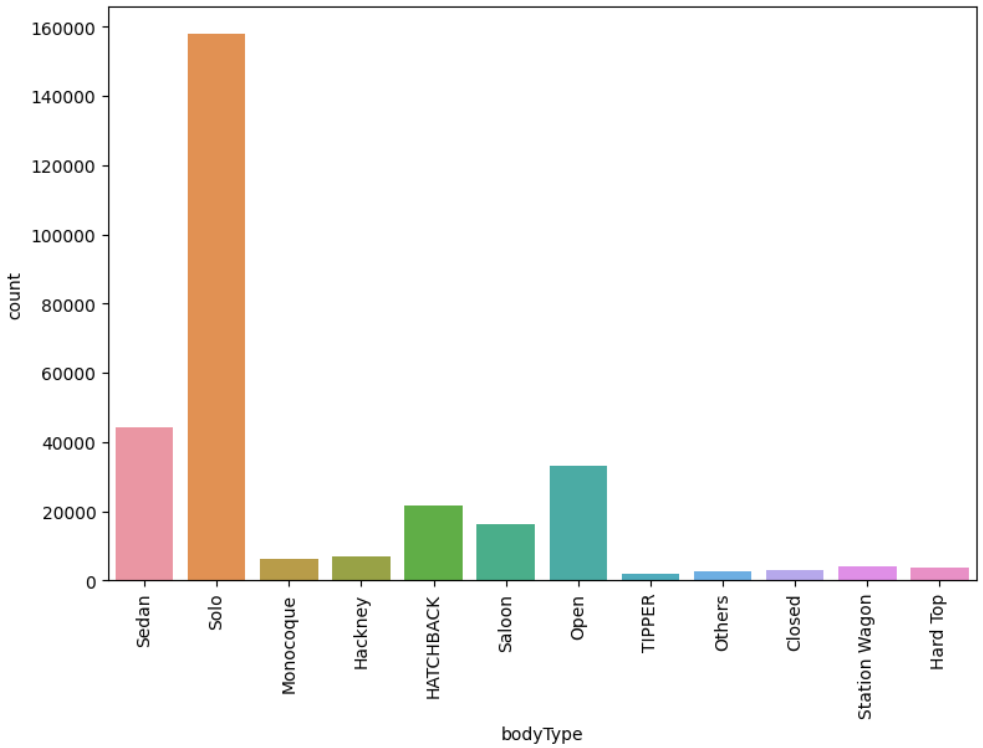
  Handle missing values: Check for missing values in the dataset and decide how to handle them. You can either impute missing values using techniques like mean, median, or mode imputation or remove the rows or columns with missing values, depending on the extent of missing data and the impact on the analysis.

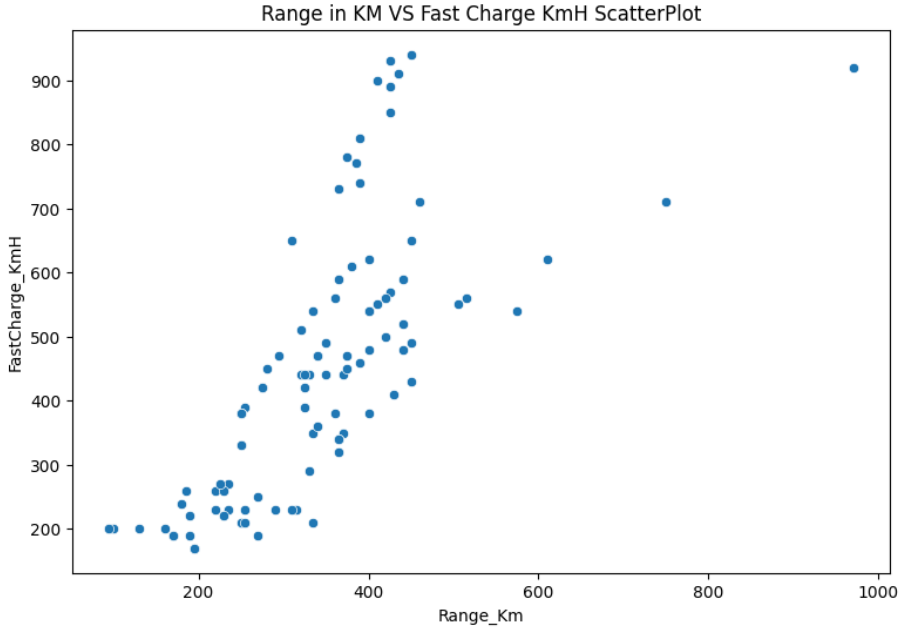
- **Deal with outliers**: Identify outliers specific to EV data, such as extreme values in battery capacity, charging time, or vehicle range. Outliers may require special attention as they could impact the analysis or model performance.
- **Data Integration:**
- Integrate multiple data sources: If you are working with multiple data sources, such as EV sales data, charging infrastructure data, or vehicle specifications, ensure they are integrated properly. Pay attention to variables that can link the data sources, such as vehicle models or identification numbers, to combine the data accurately.
- **Data Transformation:**
- **Convert units:** Verify and convert any inconsistent units in the dataset. For example, if different sources provide battery capacity in different units (kWh or Ah), standardize the units to maintain consistency.
- **Derive new features:** Create new features that might be useful for analysis or modeling. For instance, you could calculate the energy efficiency of EVs by dividing the range by the battery capacity.
- **Feature Selection:**
- Identify relevant features: Evaluate the significance and relevance of each feature in the dataset for the specific analysis or modeling task. Remove features that are redundant or have minimal impact on the target variable.
- **Encode categorical variables:** If your dataset contains categorical variables like vehicle models or charging station locations, apply suitable encoding techniques such as one-hot encoding or label encoding to convert them into numerical representations.

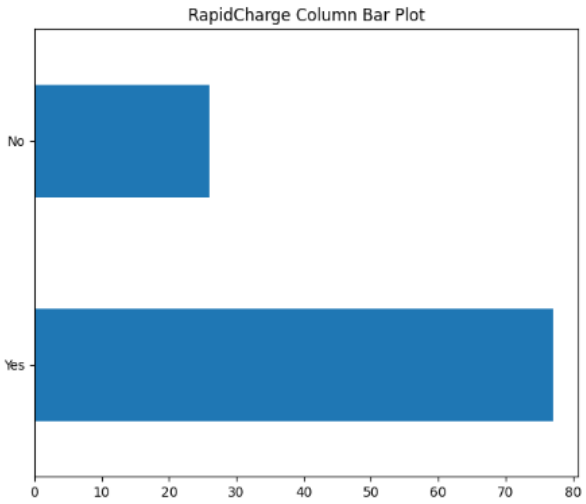
- **Data Normalization:**
- Normalize numeric variables: Normalize numeric variables like battery capacity, charging time, or vehicle range, if needed, to ensure they are on a similar scale. This step can help prevent certain variables from dominating the analysis or modeling process due to their larger magnitude.
- **Perform Segmentation Analysis:**
- Apply a suitable segmentation technique such as clustering algorithms (e.g., k-means clustering, hierarchical clustering) or latent class analysis to segment the data based on the selected variables. Analyze the resulting segments to understand the distinct customer groups within the Indian EV market.

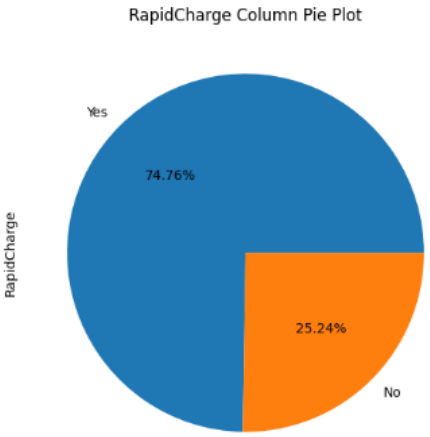
By following these steps, you can preprocess the Indian EV dataset specifically for market segmentation analysis. It is important to adapt these steps to the characteristics of your dataset and the specific requirements of your market segmentation objectives.











Libraries Used :

- **Numpy**
- **Pandas**
- **Matplotlib**
- **Seaborn**
- **Scikit Learn**

Segment Extraction (ML techniques used)

Segment extraction refers to the process of identifying and extracting meaningful segments or clusters from a dataset. Machine learning techniques can be applied to perform segment extraction by leveraging the patterns and relationships present in the data. Here are some commonly used ML techniques for segment extraction:

K-means Clustering:

K-means is an iterative algorithm that partitions data into K clusters, where K is a predefined number. It aims to minimize the within-cluster sum of squared distances. The steps involved in K-means clustering are as follows:

- Select the number of clusters, K.
- Initialize K centroids randomly.
- Assign each data point to the nearest centroid.
- Update the centroids by calculating the mean of data points assigned to each cluster.
- Repeat the previous two steps until convergence or a specified number of iterations.

Elbow Method:

The Elbow Method is a technique used to determine the optimal number of clusters (K) in K-means clustering. It involves plotting the within-cluster sum of squared distances (WCSS) against different values of K. The "elbow" point in the plot indicates the point of diminishing returns, where adding more clusters does not significantly improve the clustering performance. The number of clusters corresponding to the elbow point is often chosen as the optimal value for K.

Standard Scaler:

Standard Scaler is a data preprocessing technique that transforms numerical features by subtracting the mean and dividing by the standard deviation. It standardizes the features, making them have zero mean and unit variance. This step is often performed before applying clustering algorithms to ensure that all features are on a similar scale and have equal influence on the clustering process.

Principal Component Analysis (PCA):

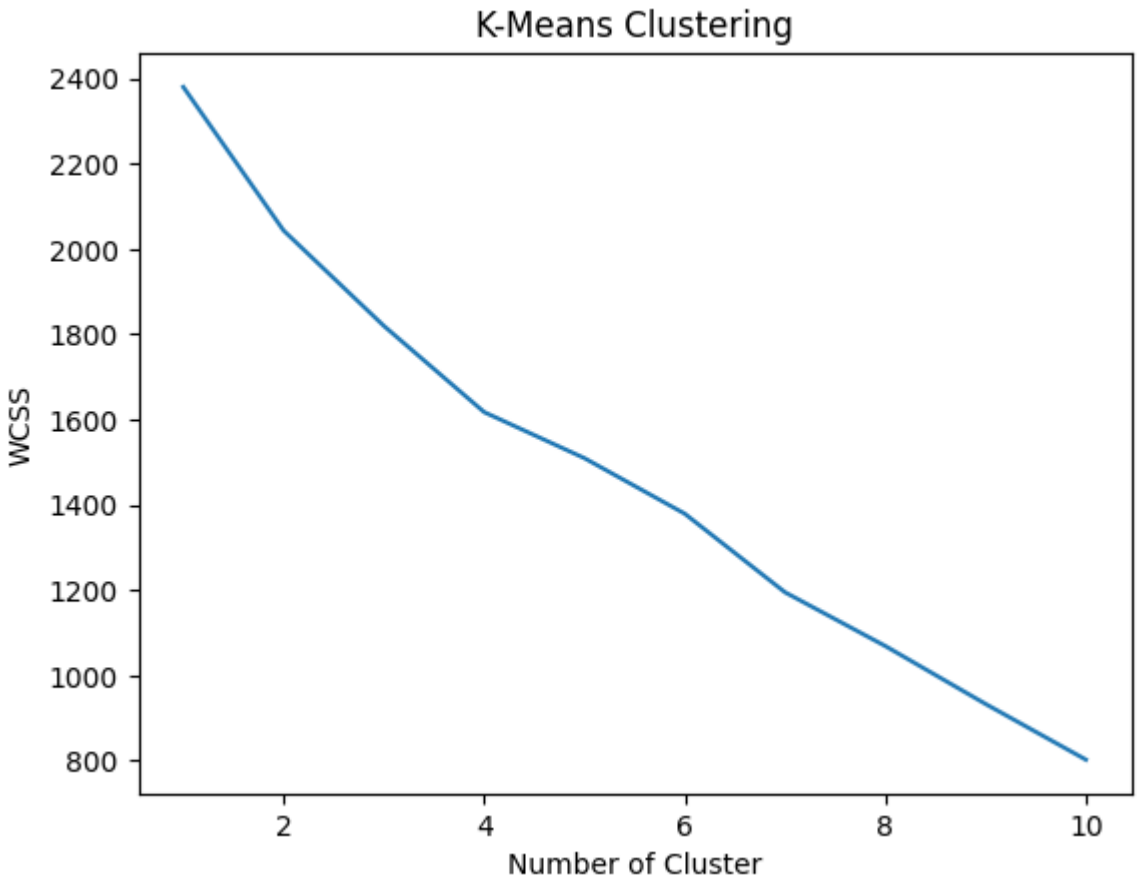
PCA is a dimensionality reduction technique that identifies the most important features or components in a dataset. It transforms the data into a lower-dimensional space while retaining as much of the original information as possible. PCA can be used before clustering to reduce the dimensionality of the data and capture the most significant patterns and variability. This can enhance the clustering performance and visualization.

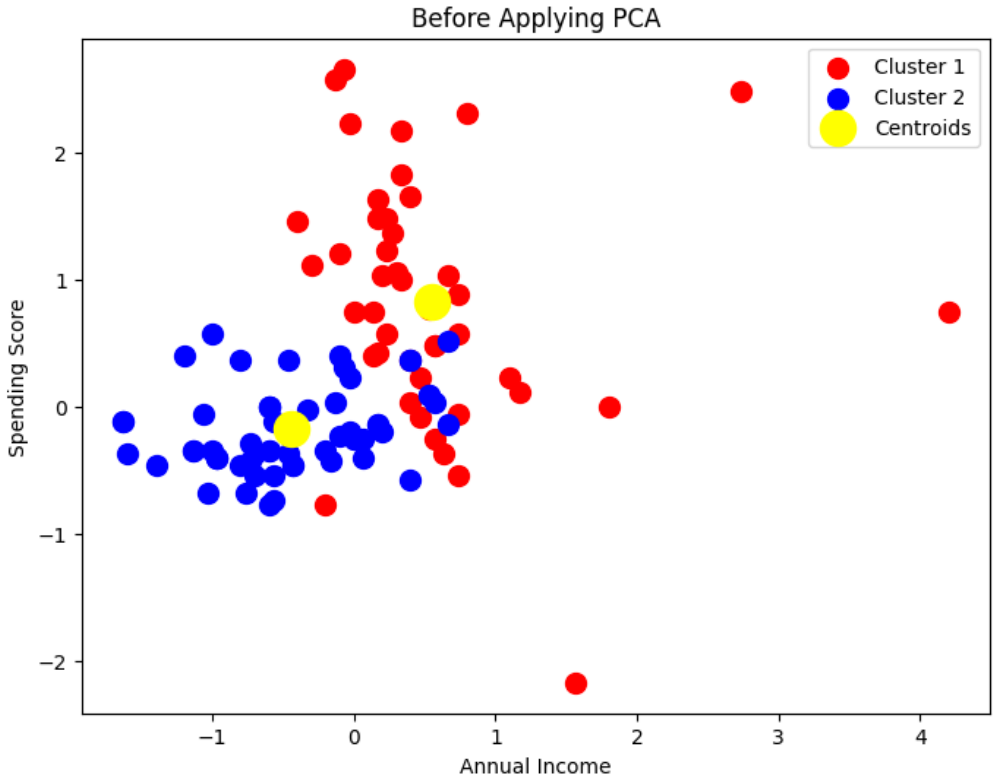
The typical workflow involving these techniques for segment extraction would be:

- **Preprocess the data:** Perform data cleaning, handle missing values, and encode categorical variables if applicable.
- **Standardize the data:** Apply Standard Scaler to normalize numerical features.
- **Apply PCA:** Use PCA to reduce the dimensionality of the data while retaining important information.
- **Determine the optimal number of clusters:** Use the Elbow Method to identify the optimal number of clusters for K-means clustering.
- **Perform K-means clustering:** Apply K-means algorithm to the preprocessed and dimensionality-reduced data with the chosen number of clusters.
- **Analyze and interpret the resulting segments:** Evaluate and interpret the characteristics of each segment to gain insights and make informed business decisions.

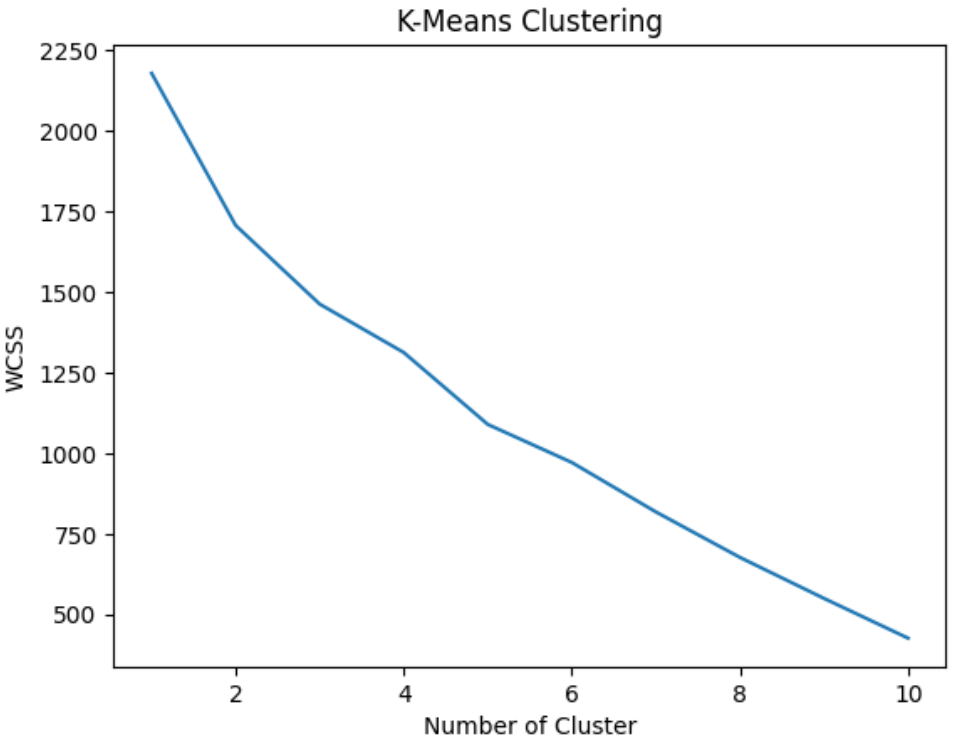
By incorporating the Elbow Method, Standard Scaler, and PCA into the workflow, you can enhance the quality of the segment extraction process and derive meaningful insights from your data.

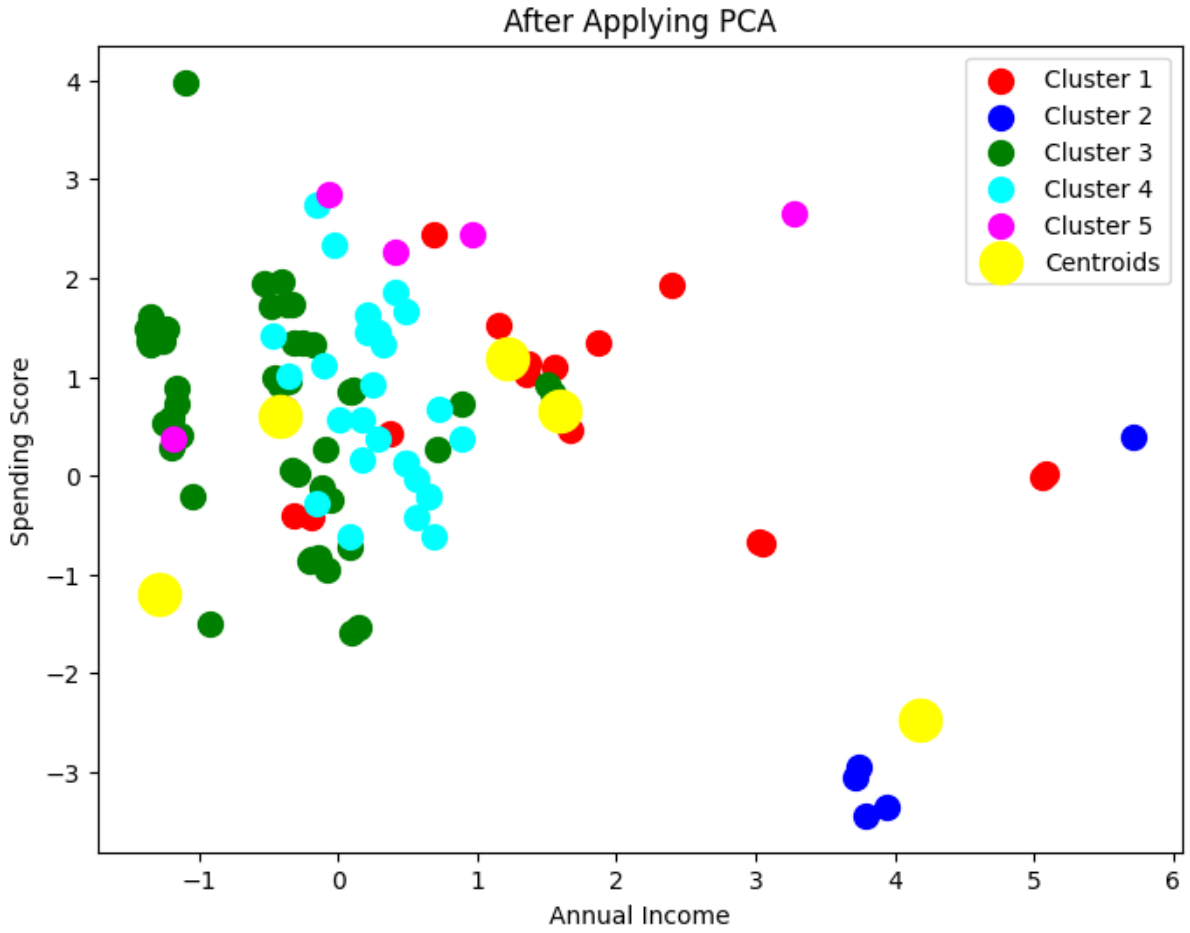
Before Applying PCA





After Applying PCA





Profiling and describing potential segments

Profiling link :

https://github.com/A2162014/Feynn-Lab-Internship/tree/main/Project%202/Codes/Code-2/EDA_Reports

Target Segmentation

Based on our findings, the younger population shows a strong inclination towards purchasing products with new technology, including Electric Vehicles (EVs), driven by their awareness of environmental benefits and a desire to promote positive change. However, our research also indicates that affordability is a concern for this demographic, as they tend to prefer less expensive vehicles. Consequently, it is recommended to target a segment that is enthusiastic about adopting new technologies yet financially capable of affording EVs. This segment is likely to fall within the age group of 30 to 40 years.

Furthermore, individuals residing in urban areas with well-established infrastructure and a good understanding of technology and its advantages are more inclined to purchase electric vehicles. Therefore, focusing marketing efforts on urban dwellers who have access to adequate charging infrastructure and are knowledgeable about the benefits of EVs would be beneficial.

Another key finding is that married individuals with dependents are more likely to proceed with purchasing a vehicle, including EVs. Therefore, this segment should be considered as a potential target audience.

In terms of financial considerations, it is essential to recognize that the average salary of individuals who purchase vehicles is around 30 lakhs. Additionally, the majority of automobile purchases fall within the price range of 10-20 lakhs, while purchases of two-wheelers are generally lower in value. These factors should be taken into account when developing marketing strategies and determining pricing and financing options for EVs.

In summary, to effectively target the desired segment for EVs, focus on financially stable individuals within the 30-40 age group who are eager to adopt new technologies. Prioritize urban residents with awareness of technology and environmental benefits. Consider marketing to married individuals with dependents, while ensuring pricing and financing options align with the average salary and purchasing preferences observed in the market.

Marketing Mix

Determining the prices for our products requires a blend of art and science. It is crucial to have a clear understanding of our production costs as a starting point. From there, we can make adjustments based on various factors such as product features, pricing strategies, customer price sensitivity, customer values, and other considerations.

The Marketing Mix concept plays a vital role in comprehending what our product or service can offer to our customers. It assists in planning and developing effective marketing strategies to ensure a successful product offering. By analyzing the marketing mix, we gain insights into how well our product aligns with customer needs and preferences.

Additionally, the marketing mix helps in assessing whether our product or service is suitable for our target customers. It enables us to evaluate the fit between what we offer and what our customers seek, leading to better decision-making and enhanced customer satisfaction.

In summary, pricing our products involves a thoughtful evaluation of costs and considerations such as product characteristics, pricing strategies, and customer values. The Marketing Mix framework guides us in understanding our customers' needs and developing effective marketing strategies to ensure our product's success in the market.

CONCLUSION

In conclusion, the analysis of the Electric Vehicle (EV) market in India has provided valuable insights into the opportunities and challenges that lie ahead for the electric vehicle startup. We have identified key market segments through extensive data collection, segmentation analysis, and market research and formulated a comprehensive strategy for entering the market and targeting the most promising customer groups.

The EV market in India presents immense potential for growth and sustainability. The demand for electric vehicles is rising with the increasing focus on environmental consciousness, rising fuel costs, and government initiatives promoting electric mobility. By capitalising on this growing trend, the electric vehicle startup can establish itself as a key player in the market and contribute to the country's transition towards greener transportation alternatives.

The analysis has highlighted the importance of geographic expansion, targeted marketing, strategic partnerships, diversified product offerings, competitive pricing, customer education, and after-sales service. These recommendations will enable the startup to effectively position its products and services, attract the identified market segments, and establish a competitive edge in the industry.

However, it is crucial to continuously monitor market dynamics, customer preferences, and industry trends to adapt and refine the strategies accordingly. The EV market is evolving rapidly, and staying abreast of technological advancements, regulatory changes, and customer demands will be vital for long-term success.

In conclusion, with a robust strategy, a deep understanding of the market segments, and a commitment to innovation and customer satisfaction, the electric vehicle startup is well-positioned to significantly impact the Indian EV market. By embracing the opportunities and addressing the challenges, the company has the potential to lead the sustainable transportation revolution in India and contribute to a greener and more eco-friendly future.

GitHub link :

Abdul Jaweed :

https://github.com/Abdul-Jaweed/Feynn-Lab-Internship/tree/main/Project%202.1

Ashvath Suresh Babu Piriya :

https://github.com/A2162014/Feynn-Lab-Internship/tree/main/Project%202/Codes/Code-2

Shaleen Mishra :

https://github.com/srvapm/marketsegmentation

Satwik :

https://github.com/satwikwrites7/My-Machine-Learning-Projects-/blob/b6b4232292a003a3f71ebd44708ee54a538eaccc/EDA%20on%20Electric%20Vehicle%20in%20India%202022.ipynb

Yashaswini M :

https://github.com/Yashaswini29026/EV__market_segmentation

And the Best part is I also create **web app** for overview of the project :

https://ev-segmentation.streamlit.app/