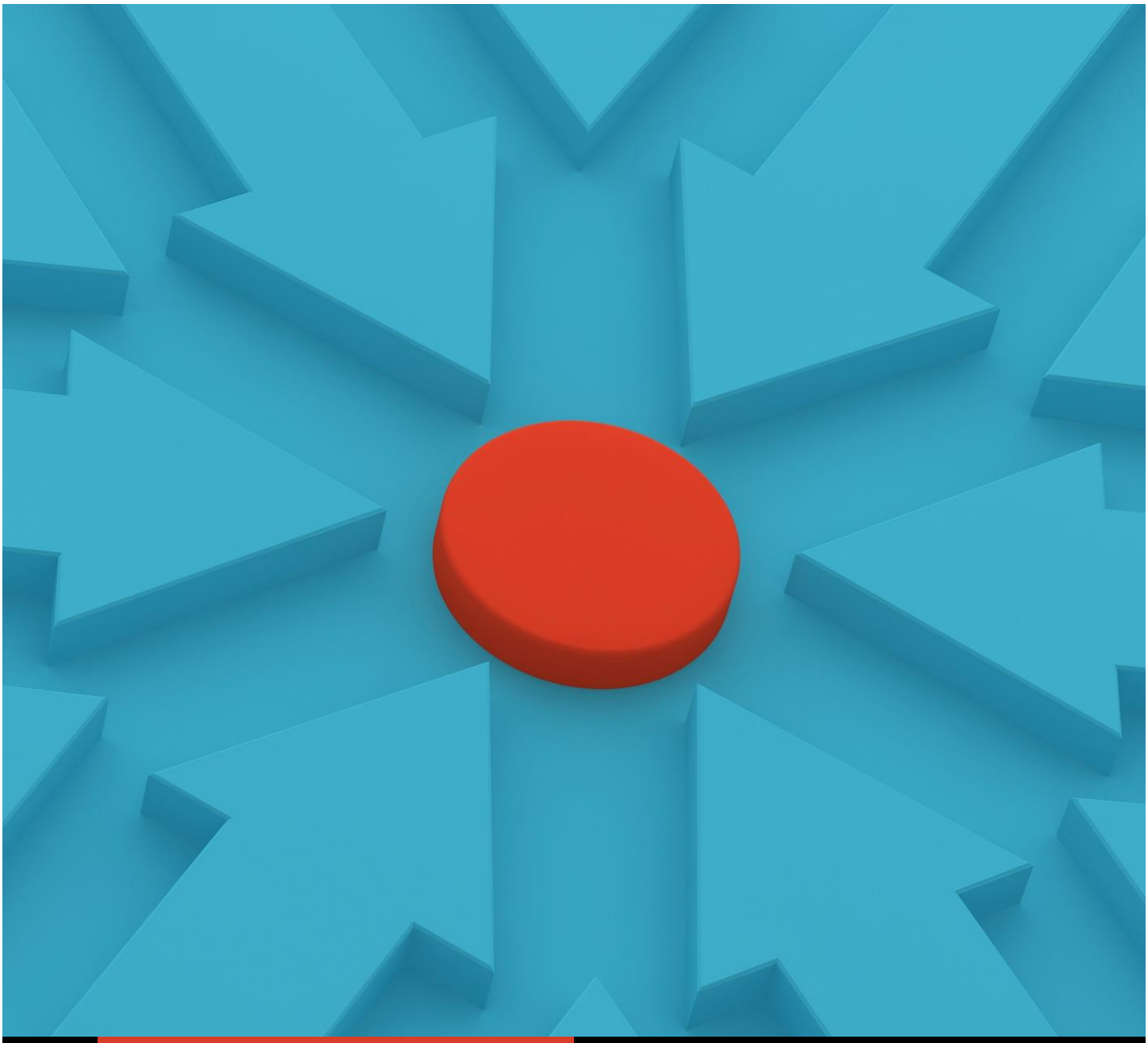

ELECTRIFYING INDIA

MARKET SEGMENTATION IN INDIA'S ELECTRIC VEHICLE MARKET

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OBJECTIVE

This report aims to provide a comprehensive analysis of market segmentation within the Electric Vehicle (EV) market in India. By examining the diverse needs, preferences, and behaviors of consumers, the report seeks to uncover actionable insights that can inform strategic decision-making for stakeholders across the EV ecosystem. Through a detailed exploration of market segmentation dynamics, the objective is to facilitate a deeper understanding of the EV market landscape in India, identify key market segments, and uncover opportunities for targeted interventions and initiatives to drive sustainable growth and adoption of electric vehicles.

INTRODUCTION

With the current depletion of fossil fuels and its price hike, there is a need for another energy resource to run the vehicle. The automobile sector is considering Electric Vehicle as a solution to the industry and environment in India. Electric Vehicles are the replacement for petroleum-based vehicles. They are one of the emerging technologies as well as eco-friendly and viable. The replacement of internal combustion engines with electric engines will reduce pollution to a great extent and be profitable to consumers. Many countries around the globe have implemented this technology and are contributing towards betterment of the environment.

India being an economy of around 140 crore people, our daily activities cannot be imagined without the use of vehicles. There has been a duopoly of petrol and diesel as our main source of fuel for the vehicles. This not only causes air pollution, but is also hard on our pockets. Petrol prices hiking as much as up to 98 rupees liter, we are eagerly looking for a substitute. Commonly, the term EV is used to refer to an electric car. In the 21st century, EVs have seen a resurgence due to technological developments, and an increased focus on renewable energy and the potential reduction of transportation's impact on climate change and other environmental issues. Project Drawdown describes electric vehicles as one of the 100 best contemporary solutions for addressing climate change. The main reason for taking up this topic for research is to make people more aware about the Electrical vehicle Industry and it’s comparison with the fuel operated vehicles so that people are made aware about the benefits of eco-friendly vehicles that go an extra mile to look out for environment.

OVERVIEW OF THE EV MARKET IN INDIA:

The Electric Vehicle (EV) market in India has witnessed significant growth and transformation in recent years, driven by a confluence of factors including technological advancements, environmental concerns, and government initiatives. India, being one of the world's largest and fastest-growing economies, is increasingly focusing on sustainable mobility solutions to address pollution and energy security challenges.

The EV market in India encompasses a wide range of vehicles, including electric cars, two-wheelers, three-wheelers, and commercial vehicles. With increasing urbanization and rising awareness about environmental sustainability, there has been a growing interest among consumers and businesses in adopting electric vehicles as a cleaner and more efficient mode of transportation.

Government policies and incentives have played a crucial role in shaping the EV landscape in India. Initiatives such as the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme, which provides subsidies and incentives for the adoption of electric vehicles, have encouraged manufacturers to invest in EV technology and infrastructure development.

Despite the promising growth trajectory, the EV market in India still faces several challenges, including high upfront costs, limited charging infrastructure, and consumer perceptions regarding range anxiety and battery life. However, advancements in battery technology, declining battery costs, and supportive government policies are expected to drive continued growth and adoption of electric vehicles in the coming years.

IMPORTANCE OF MARKET SEGMENTATION ANALYSIS:

Market segmentation analysis plays a crucial role in understanding the diverse needs, preferences, and behaviors of consumers in the EV market in India. By segmenting the market into distinct groups based on various criteria such as demographics, psychographics, and behavior, businesses can gain valuable insights that enable them to effectively target and serve different customer segments.

Segmentation analysis helps companies identify key market segments with the highest growth potential, allowing them to tailor their product offerings, marketing strategies, and distribution channels to better meet the needs of specific customer groups. This targeted approach not only enhances customer satisfaction and loyalty but also enables companies to optimize resource allocation and maximize return on investment.

In the context of the EV market in India, segmentation analysis can help stakeholders identify segments with different levels of awareness, adoption readiness, and preferences for electric vehicles. By understanding the unique characteristics and drivers of each segment, manufacturers, policymakers, and other industry players can develop targeted interventions and initiatives to accelerate EV adoption and drive sustainable growth in the market.

METHODOLOGY

1. . **Data Collection:**
    - Gather relevant data from multiple sources, including market reports, government publications, industry databases, and research papers.
    - Collect data on various parameters such as vehicle type, technology, sales figures, charging infrastructure, consumer preferences, and regional market data.
2. **Preprocessing and Data Preparation:**
    - Cleanse the data by removing any inconsistencies, errors, or missing values.
    - Normalize or standardize the data to bring all variables to a common scale, ensuring no variable dominates the analysis.
3. **Segmentation Criteria:**
    - Determine the segmentation criteria based on the research objectives and available data.
    - Select relevant variables for segmentation, such as vehicle type, technology, sales volume, market share, charging infrastructure, and consumer preferences.
4. **Principal Component Analysis (PCA):**
    - Apply Principal Component Analysis to reduce the dimensionality of the dataset and identify the most significant variables.
    - Perform PCA to transform the original variables into a new set of uncorrelated variables (principal components) while retaining the maximum variance in the data.
    - Determine the optimal number of principal components based on the explained variance ratio and scree plot analysis.
5. **K-means Clustering:**
    - Perform K-means clustering on the transformed data obtained from PCA.
    - Select the appropriate number of clusters based on techniques like the Elbow method or Silhouette analysis.
    - Apply the K-means algorithm to assign each data point to the respective cluster based on the similarity of the variables.
6. **Interpretation and Analysis:**
    - Analyze the results of the clustering to understand the characteristics and profiles of different market segments.
    - Examine the distribution of variables within each cluster to identify the key differentiators.

- Evaluate the significance of each segment based on criteria such as market size, growth potential, and consumer demand.
- Conduct statistical tests or visualizations to compare the clusters and validate the segmentation results.

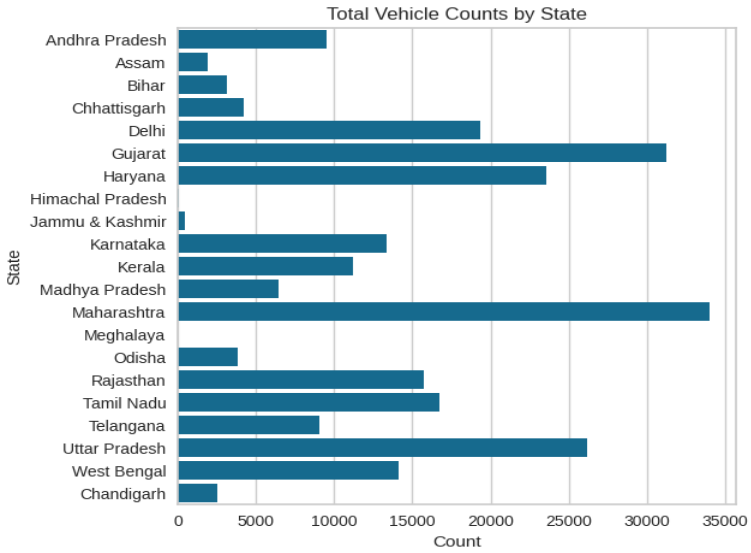
DATA USED FOR SEGMENTATION ANALYSIS:

The segmentation analysis of the Electric Vehicle (EV) market in India utilized data collected from diverse sources, including demographic, psychographic, and behavioral variables. The data columns used in the analysis are summarized below:

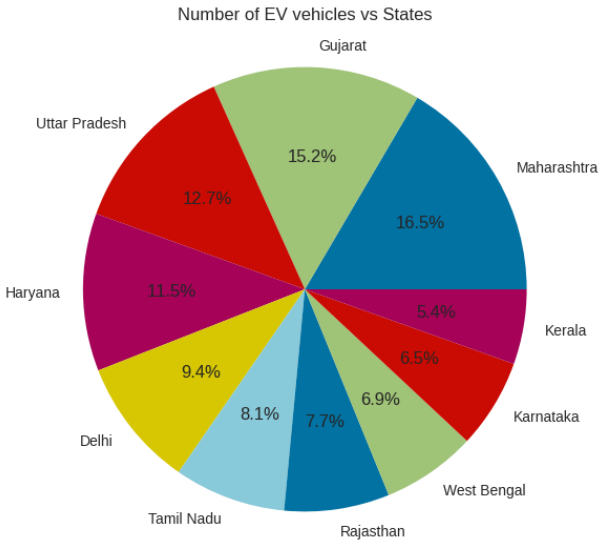
1. **Demographic Variables:**
    - Age: Age of the respondents, providing insights into generational differences and life stage considerations.
    - Profession: Occupation or profession of the respondents, indicating income level, lifestyle, and mobility needs.
    - Marital Status: Marital status of the respondents, reflecting household composition and purchase decision-making dynamics.
    - Education: Educational attainment of the respondents, influencing awareness, and perception of electric vehicles.
2. **Psychographic Variables:**
    - No of Dependents: Number of dependents in the household, reflecting family size and transportation requirements.
    - Personal loan: Indicates whether respondents have personal loans, providing insights into financial commitments and affordability.
    - Total Salary: Total monthly salary of the respondents, indicative of disposable income and purchasing power.
    - Price: Price of electric vehicles, influencing affordability and purchase considerations.
3. **Additional Data Sources:**
    - State: Geographic location of respondents, allowing for regional segmentation and analysis of market dynamics across different states in India.
    - Two Wheelers, Three Wheelers, Passenger Cars, Buses: Categories of electric vehicles as per Central Motor Vehicles Rules, providing insights into vehicle preferences and market demand.
    - Number of Electric Vehicle Charging Sanctioned: Availability of charging infrastructure in each state, influencing EV adoption and usage patterns.

GEOGRAPHIC SEGMENTATION ANALYSIS

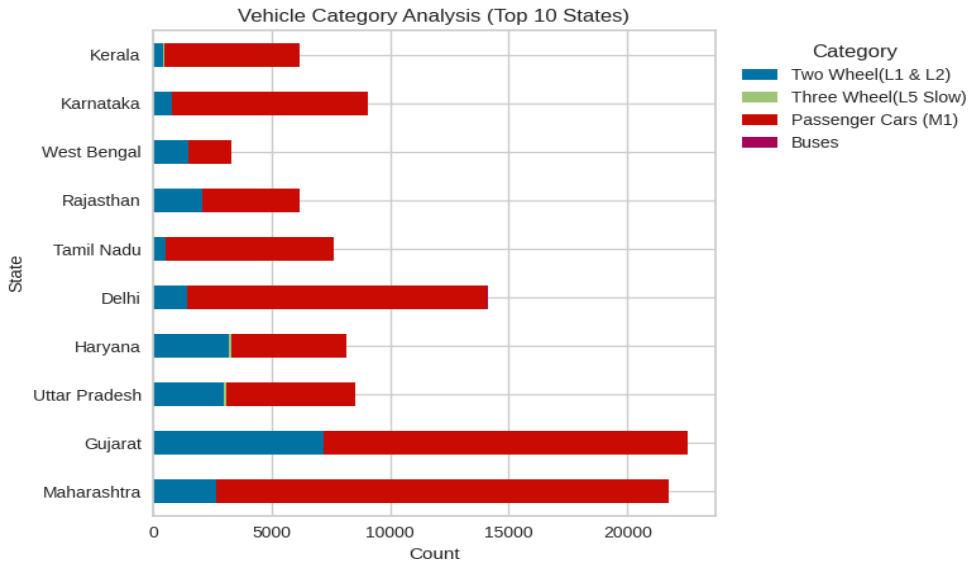
The distribution of Electric Vehicles differs extensively in each state of India. Due to the EV market and various factors, some states have a huge number of growing potentials for EV compared to other states. The analysis conducted by our team also showcases the distribution of EV vehicles in various states comparatively. To showcase the data using visualization, a bar plot has been used.



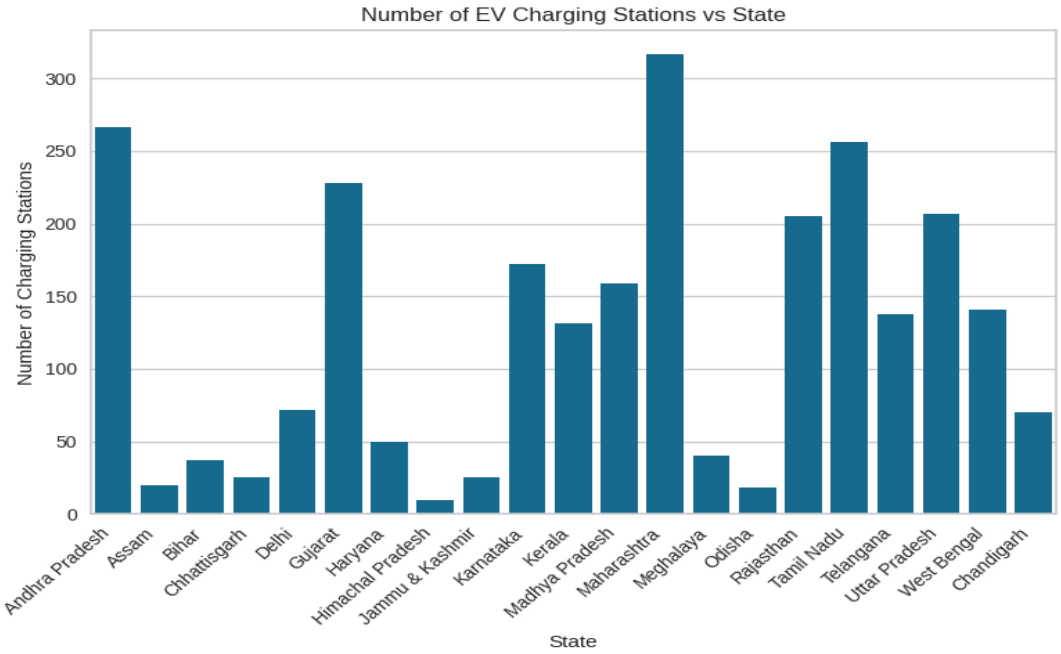
The pie chart illustrates the distribution of electric vehicles across the top 10 states in India. Maharashtra leads with 18.6%, followed by Gujarat (17.1%) and Uttar Pradesh (14.4%). These states collectively account for over 70% of electric vehicles nationwide, indicating regional disparities in adoption and infrastructure development within the EV market.



The horizontal bar plot depicts the distribution of electric vehicle categories across the top 10 states in India. Maharashtra leads in all categories, particularly in passenger cars, while other states show varying preferences. Two-wheelers dominate across most states, reflecting their popularity as a mode of electric transportation nationwide.

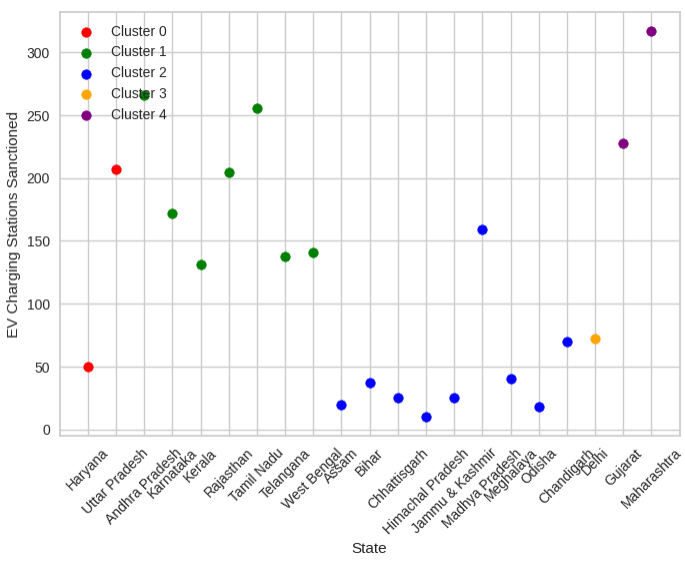


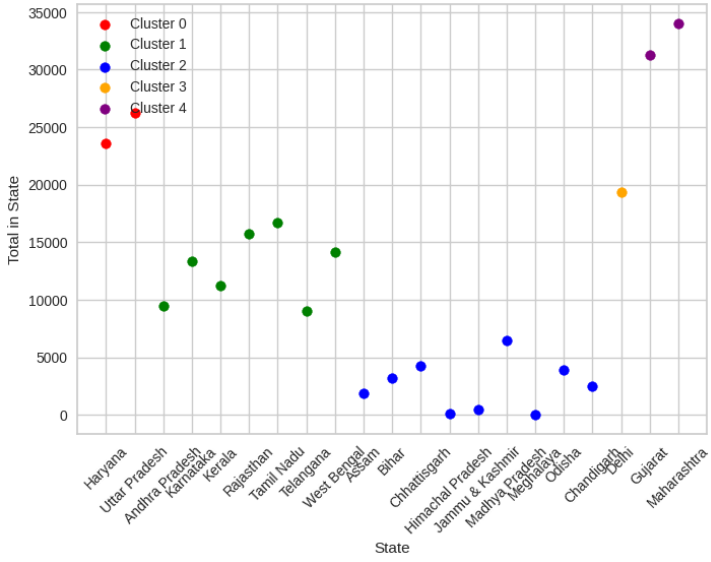
The bar plot illustrates the distribution of Electric Vehicle (EV) charging stations across the states in India. Maharashtra leads with 317 stations, followed by Andhra Pradesh (266) and Tamil Nadu (256). These states exhibit varying levels of infrastructure development to support the growing EV market.



SEGMENTATION AND INSIGHTS: UNVEILING STATE DYNAMICS

KMeans clustering was employed to segment the data into distinct groups based on similar characteristics. This unsupervised learning technique partitions the dataset into 'k' clusters, aiming to minimize the within-cluster sum of squares. The algorithm iteratively assigns each data point to the nearest cluster centroid, updating the centroids until convergence. The optimal number of clusters was determined using techniques like the elbow method .





The analysis revealed five clusters differentiated by various features. Notably, Cluster 4 stands out with significantly higher values across most variables, indicating states with robust performance in terms of Two Wheel, Passenger Cars, and Total in State. In contrast, Cluster 2 represents states with lower engagement across multiple dimensions. Additionally, Cluster 3 consists of a single state, Delhi, showcasing unique characteristics compared to other clusters. Such insights can inform targeted interventions and resource allocation strategies tailored to each cluster's needs and potential.

OBSERVATIONS:

Cluster 1: Haryana, Gujarat

- These states have a moderate presence of various types of vehicles, including two-wheelers, passenger cars, and buses.
- Gujarat stands out with a relatively higher count of two-wheelers (L1 & L2) compared to other clusters.

Cluster 2: Andhra Pradesh

- Andhra Pradesh shows a significant presence of two-wheelers (L1 & L2) and two-wheelers with CMVR.
- The state also has a considerable number of passenger cars (M1) and EV charging sanctioned points.

Cluster 3: Assam

- Assam exhibits a relatively lower count of vehicles across all categories compared to other clusters.
- The state has a smaller number of EV charging sanctioned points compared to other clusters.

Cluster 4: Delhi

- Delhi has a significant count of passenger cars (M1) and a relatively high number of buses compared to other clusters.
- It also has a high total count of vehicles in the state.

Cluster 5: Gujarat

- Gujarat, in addition to being part of Cluster 0, also appears in Cluster 4, indicating a diverse vehicle presence in the state.
- The state has a notably high count of two-wheelers (L1 & L2) and two-wheelers with CMVR.
- Gujarat also has a substantial total count of vehicles in the state.

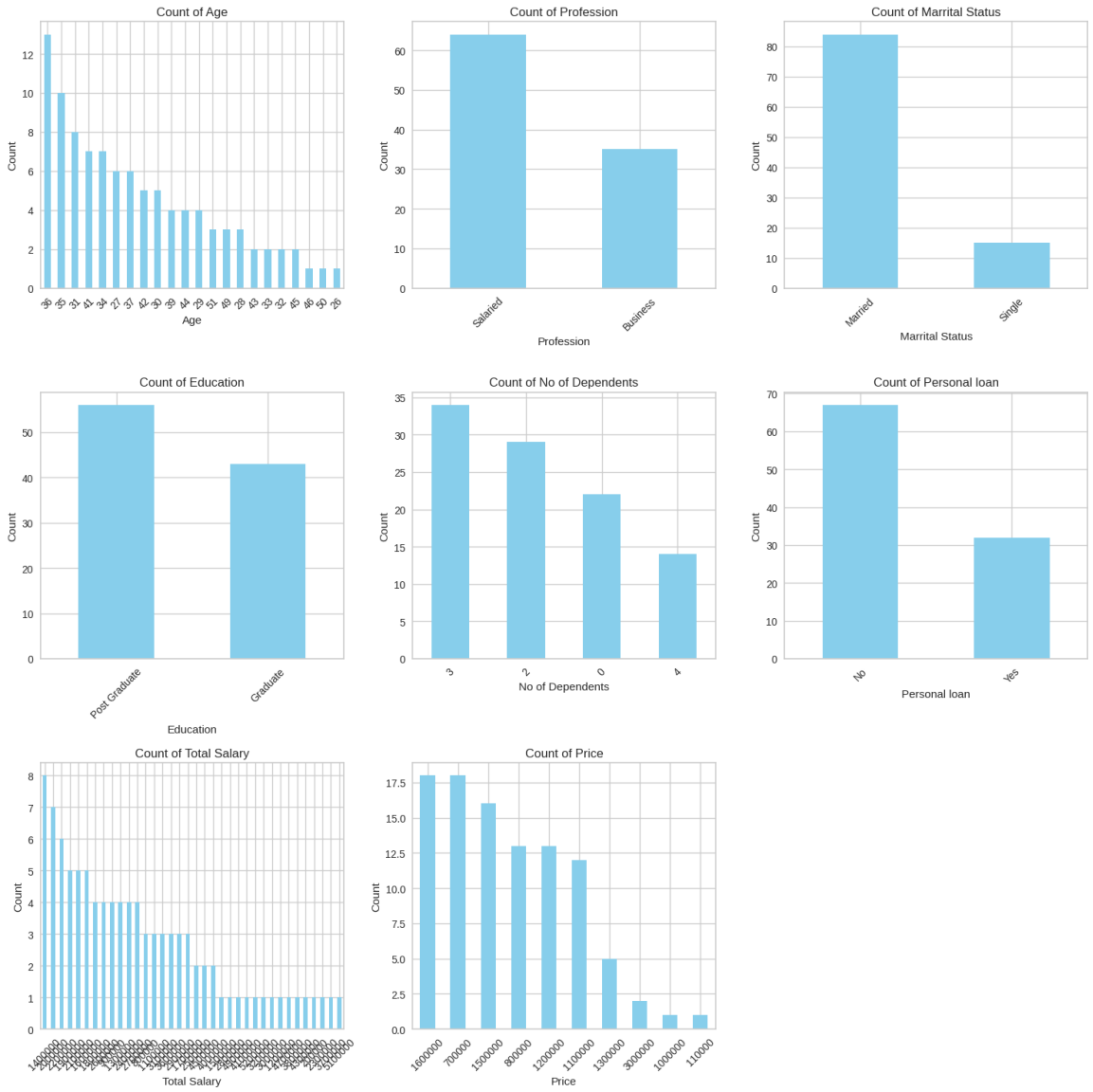
TARGET MARKETING STRATEGIES

Cluster	Recommendations
1	- Introduce premium two-wheelers with advanced features catering to the preferences of the affluent consumer base.
	- Offer personalized after-sales services and maintenance packages to enhance customer loyalty.
	- Emphasize the reliability and performance of your products through targeted advertising campaigns on digital platforms and local media channels.
2	- Develop affordable and fuel-efficient two-wheelers targeting the middle-income segment.
	- Offer flexible financing options and discounts for first-time buyers to encourage sales.
	- Leverage social media platforms and influencer partnerships to create brand awareness among tech-savvy millennials and young professionals.
3	- Introduce entry-level electric vehicles suitable for urban commuting and short-distance travel.
	- Offer battery leasing options and installment plans to overcome affordability barriers.
	- Conduct roadshows and community events in rural areas to educate consumers about the benefits of electric vehicles and charging infrastructure.
4	- Focus on premium electric cars and buses equipped with advanced safety features and autonomous driving technology.
	- Offer exclusive membership programs and concierge services to cater to the needs of affluent customers.
	- Collaborate with government agencies and environmental organizations to promote sustainable mobility solutions through press releases and public awareness campaigns.
5	- Invest in innovative electric vehicle technologies and infrastructure to support the growing demand for eco-friendly transportation solutions.
	- Offer fleet management solutions and vehicle customization services tailored to the needs of corporate clients and government agencies.
	- Partner with industry influencers and sports celebrities to endorse electric vehicles as a symbol of status and environmental responsibility.

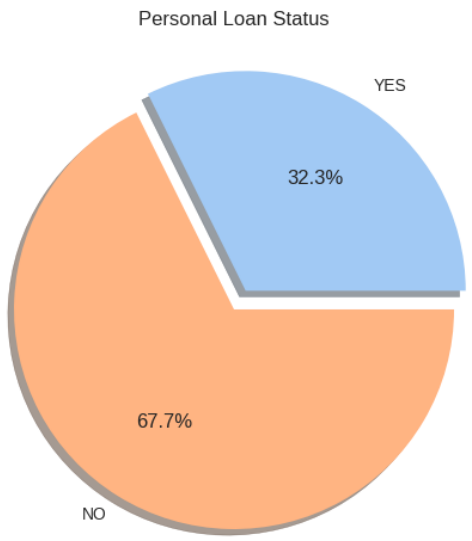
BEHAVIOURAL ANALYSIS

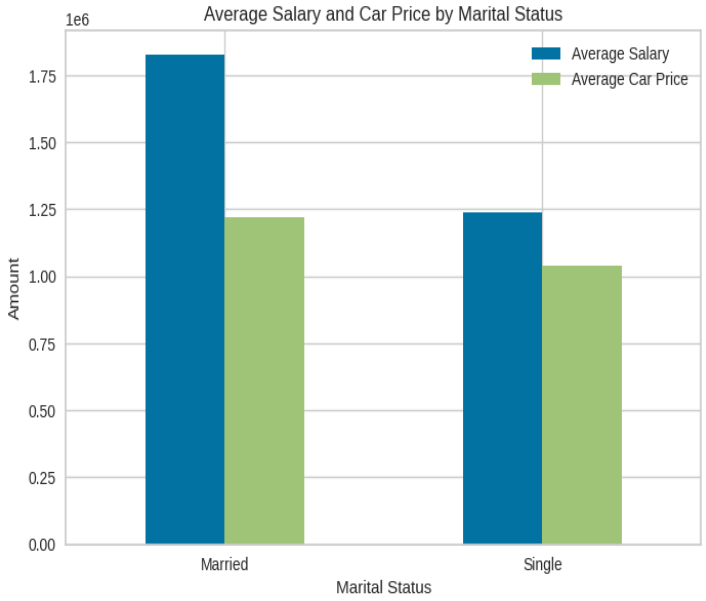
EXPLORING DEMOGRAPHIC FACTORS AND FINANCIAL BEHAVIOR

In today's dynamic financial landscape, understanding the behavioral patterns that influence individual financial decisions is paramount. This analysis delves into the demographic factors shaping financial behavior, focusing on variables such as profession, marital status, education, number of dependents, personal loan status, total salary, and purchase price. By examining these factors, we aim to uncover insights into how individuals from different demographic backgrounds approach financial decisions, providing valuable insights for businesses, financial institutions, and policymakers alike.



The plotted data provides insights into various demographic and financial variables. Age distribution is skewed towards younger individuals, with the majority falling between 26 to 36 years old. Most individuals are employed as salaried professionals, and a significant portion are married with a post-graduate education. The number of dependents ranges from 0 to 4, with 3 being the most common. Personal loans are less common, with a majority of individuals not having one. Total salary distribution is diverse, with peaks at 1400000 and 2000000. Regarding purchase price, 1600000 and 700000 are the most prevalent, indicating preferences for mid-range priced items.





The pie plot illustrates the distribution of individuals with and without personal loans. Approximately 68% of individuals do not have a personal loan, while the remaining 32% have opted for one. This indicates that a significant portion of the sample population has chosen not to take out personal loans for financial purposes.

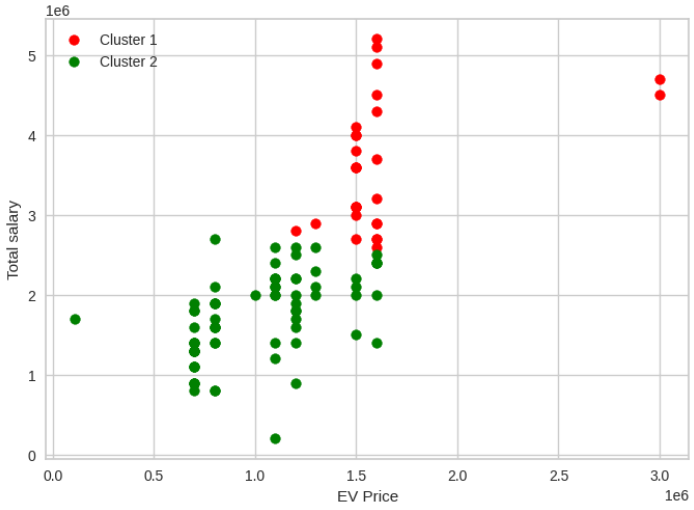
The bar plot compares the average salary and car price based on marital status. It shows that married individuals, comprising 84% of the sample, have a higher average salary compared to single individuals. Additionally, married individuals tend to purchase cars at higher prices compared to their single counterparts, reflecting potentially different financial priorities.

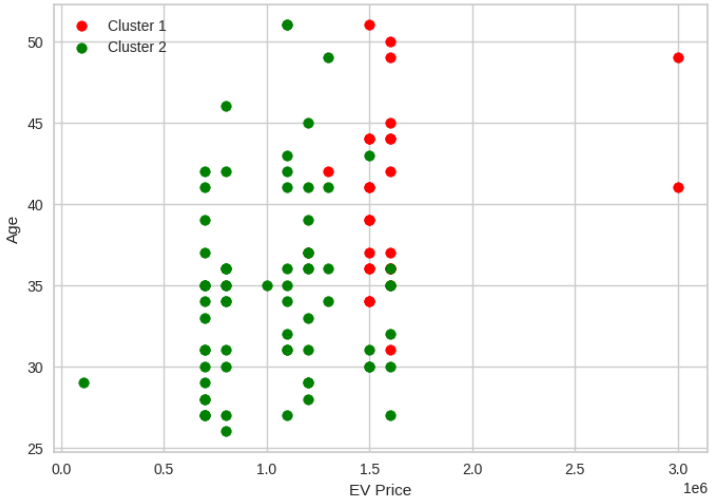
The k-prototypes clustering algorithm was employed for segmentation, combining k-means for numerical data and k-modes for categorical data. This hybrid approach ensures robust clustering in mixed data types. By iteratively assigning data points to clusters based on both distance and mode dissimilarity, it maximizes intra-cluster homogeneity and inter-cluster separation. The deterministic initialization method and algorithmic process aim to minimize the cost function, optimizing cluster centroids for effective segmentation. The algorithm's deterministic nature, along with the iterative refinement process, enhances stability and reproducibility, yielding meaningful insights into the dataset's structure and underlying patterns.

	Attribute	Cluster 1	Cluster 2
1	**Average Age**	40.36	34.72
2	**No of Dependents**	2.57	2.03
3	**Total Salary**	3,617,857.14	1,739,436.62
4	**Price**	1,632,142.86	1,021,267.61
5	**Profession**	Salaried	Salaried
6	**Marrital Status**	Married	Married
7	**Education**	Post Graduate	Post Graduate
8	**Personal loan**	No	No

Table: Cluster Centroids

The dataset was clustered into two distinct groups based on demographic and financial attributes. Cluster 1, characterized by an average age of approximately 40 years, a higher number of dependents, and a significantly higher total salary around 3.6 million, predominantly consists of married individuals with salaried jobs holding post-graduate degrees. In contrast, Cluster 2 has a slightly younger average age, fewer dependents, and a lower total salary of around 1.7 million. It also comprises mostly married individuals with salaried jobs and post-graduate qualifications, but with a notably lower proportion. This segmentation highlights distinct socio-economic profiles within the dataset, providing insights for targeted marketing strategies or financial services.





The plot illustrates the relationship between salary and EV price across two clusters. Cluster 1, characterized by higher mean salary and EV price, represents individuals with more purchasing power. Conversely, Cluster 2 exhibits lower mean salary and EV price, indicating a segment with comparatively lower financial resources. This visualization helps identify distinct segments based on salary and EV price preferences, providing insights for targeted marketing strategies or product positioning within different income brackets.

The second plot illustrates the relationship between EV price and age within different clusters. In Cluster 1 (red), where EV prices tend to be higher, the distribution of ages appears to be relatively older, indicating a preference for more expensive EVs among older individuals. Conversely, in Cluster 2 (green), characterized by lower EV prices, the age distribution skews younger, suggesting a preference for more affordable options among younger consumers. This insight underscores the influence of age on purchasing decisions in the EV market, with older individuals leaning towards higher-priced models and younger individuals favoring lower-priced alternatives.

OBSERVATIONS:

- Cluster 0 consists of individuals with a higher average age (mean age: 40.36) compared to Cluster 1 (mean age: 34.72).
- The majority of individuals in both clusters are employed, with the "Salaried" profession being predominant.
- Marital status is predominantly "Married" in both clusters, with Cluster 0 having a higher frequency of married individuals.
- Post Graduate education is more common in both clusters, with Cluster 0 having a higher frequency.
- The mean number of dependents is higher in Cluster 0 (mean: 2.57) compared to Cluster 1 (mean: 2.03).
- Personal loan uptake is higher in Cluster 0 (78.6%) compared to Cluster 1 (63.4%).
- Total salary is substantially higher in Cluster 0 (mean: $3,617,857) compared to Cluster 1 (mean: $1,739,437).
- Higher total salary tends to correlate with higher EV prices.
- Age distribution suggests older individuals prefer higher-priced EVs, while younger individuals opt for more affordable options.
- Both clusters primarily consist of married, salaried individuals with post-graduate education, indicating a demographic with stable financial backgrounds.

TARGET MARKETING STRATEGIES

Cluster 1:

1. **Premium EV Offerings:** Since Cluster 1 has a higher average total salary and tends to purchase higher-priced EVs, focus on marketing premium EV models with advanced features, luxury designs, and higher performance capabilities.
2. **Family-Oriented Promotions:** Given that Cluster 0 consists of married individuals with a higher number of dependents, emphasize the safety, spaciousness, and family-friendly features of EVs in your marketing campaigns.
3. **Exclusive Membership Programs:** Offer exclusive membership programs or loyalty rewards targeting affluent customers in this cluster, providing them with special privileges, personalized services, and incentives to enhance their ownership experience.

Cluster 2:

1. **Affordable EV Options:** Since Cluster 2 has a lower average total salary and tends to opt for lower-priced EVs, focus on marketing affordable EV models with competitive pricing, attractive financing options, and cost-effective ownership benefits.
2. **Young Professional Appeal:** Target young professionals and singles in this cluster with marketing messages emphasizing the stylish design, technological innovations, and environmental benefits of EVs, appealing to their eco-conscious and tech-savvy preferences.
3. **Flexible Financing Solutions:** Offer flexible financing solutions, such as zero or low down payment options, extended warranties, and affordable lease programs, to make EV ownership more accessible and budget-friendly for customers in this cluster.

CONCLUSION:

In conclusion, the combined geographical and behavioral analyses offer valuable insights into the electric vehicle (EV) market:

Geographical Analysis: The distribution of EV usage across different regions reveals varying patterns. States like Gujarat and Andhra Pradesh exhibit a significant presence of EVs, with diverse vehicle types and infrastructure support. In contrast, regions like Assam show lower EV adoption rates and infrastructure development.

Behavioral Analysis: Understanding consumer behavior provides crucial insights for marketing strategies. Customers with higher total salaries tend to opt for higher-priced EVs, indicating a preference for premium offerings. Conversely, those with lower salaries may prioritize affordability, opting for more budget-friendly options.

Overall, these analyses underscore the importance of tailoring marketing strategies to regional nuances and consumer preferences. By leveraging insights from both geographical and behavioral data, stakeholders can devise targeted approaches to effectively penetrate the EV market and cater to diverse consumer needs.