

EV (Electric Vehicle) Market Segmentation analysis

- *"Silent streets, clean energy – the electric revolution is here."*

-Submitted by

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GitHub Repository Link: <https://github.com/preathi/Electric-Vehicle-Market-Segmentation-Analysis-India.git>

Abstract

The global Electric Vehicle (EV) market is undergoing dynamic transformations, and market segment analysis has become imperative for understanding the diverse landscape of EV adoption. In this report, we leverage insights from two distinct datasets related to EV sales and statistics, employing rigorous data analysis techniques to unravel key market segments.

Our methodology encompasses comprehensive data preparation, exploratory data analysis, and the implementation of advanced machine learning techniques. Particularly, the utilization of the K-Means Clustering algorithm emerges as a pivotal aspect of our analysis. This unsupervised learning algorithm facilitates the identification of intrinsic patterns within the datasets, aiding in the delineation of distinct market segments.

1.Utilization of K Means Clustering Algorithm

Why K Means Clustering?

In the pursuit of a comprehensive Electric Vehicle (EV) market analysis, the integration of the K-Means Clustering algorithm proves to be a strategic and indispensable choice. K-Means Clustering is an unsupervised machine learning algorithm, making it well-suited for scenarios where the inherent patterns and structures within the data are not explicitly known. In the context of EV market analysis, where diverse consumer preferences and market segments exist, an unsupervised approach allows for the unbiased identification of distinct groups.

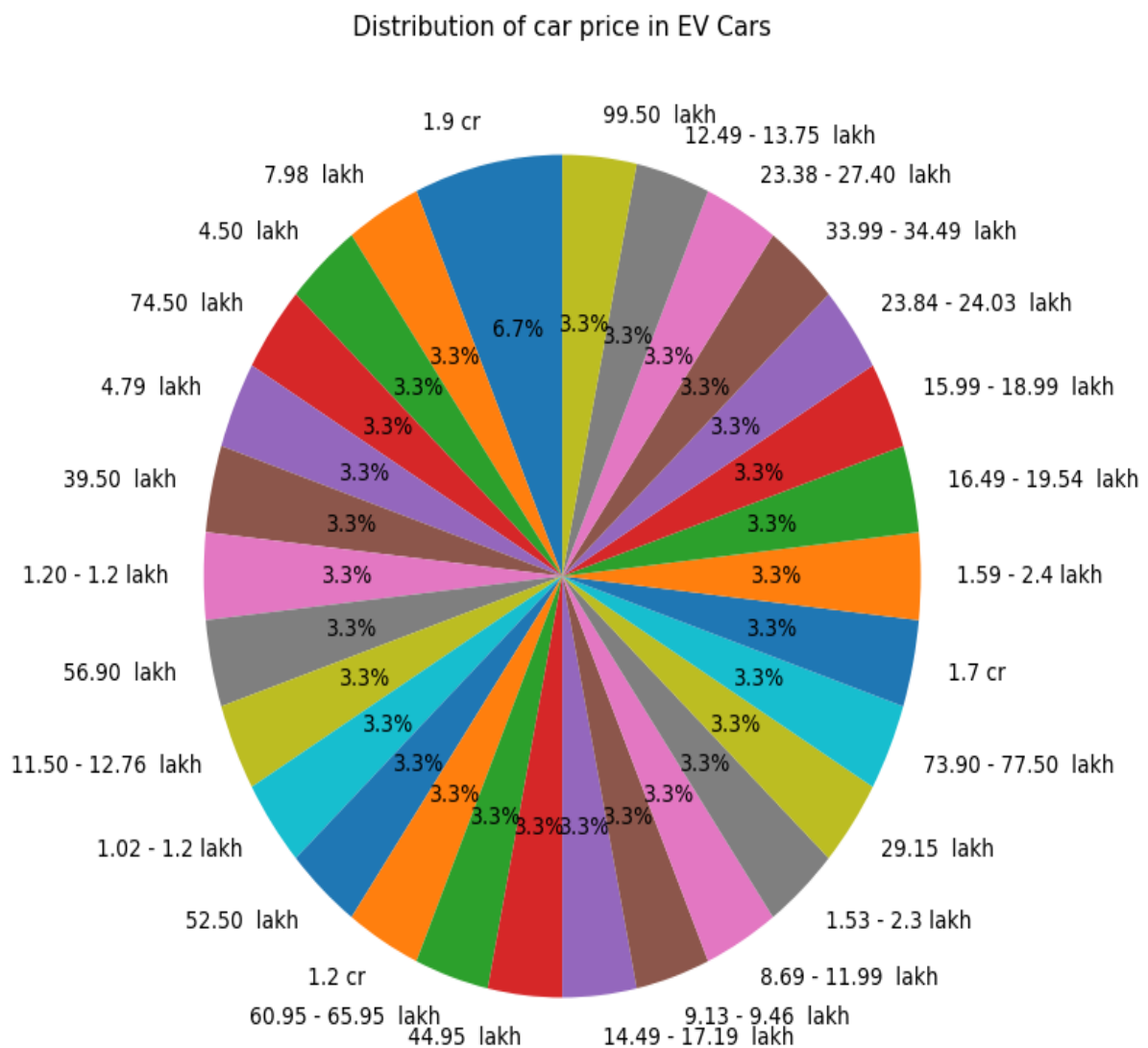
By clustering EV-related datasets, the algorithm helps identify patterns and preferences among consumers. This is particularly to comprehend the intricate interplay of factors such as car specifications, pricing, and regional variations that influence purchasing decisions.

How it is useful in this analysis?

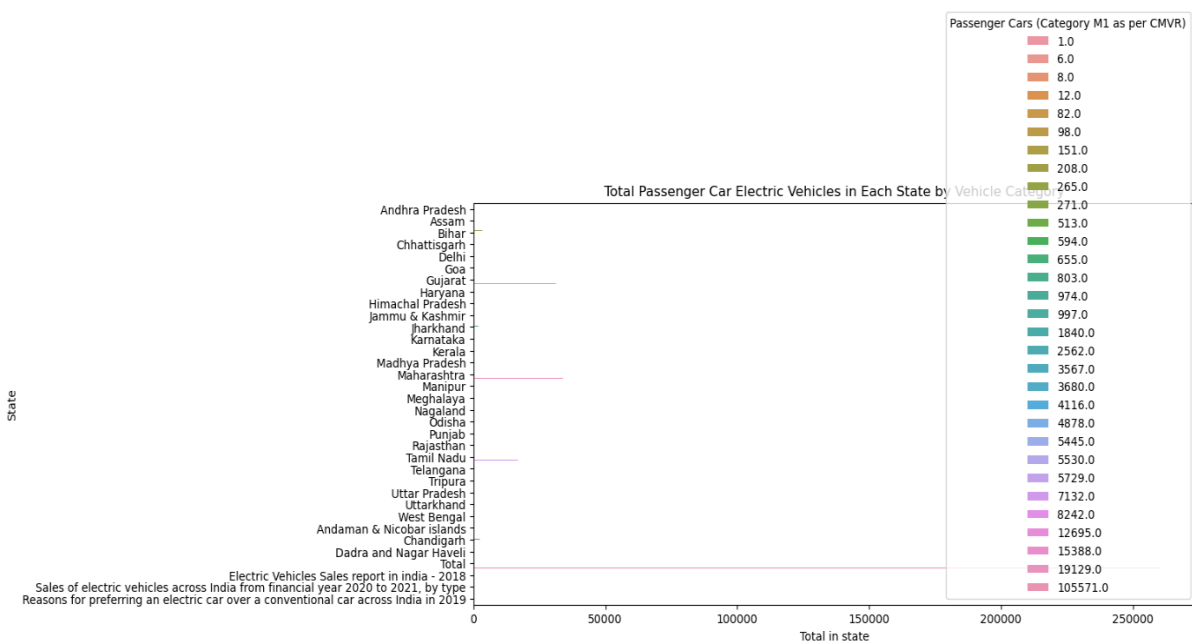
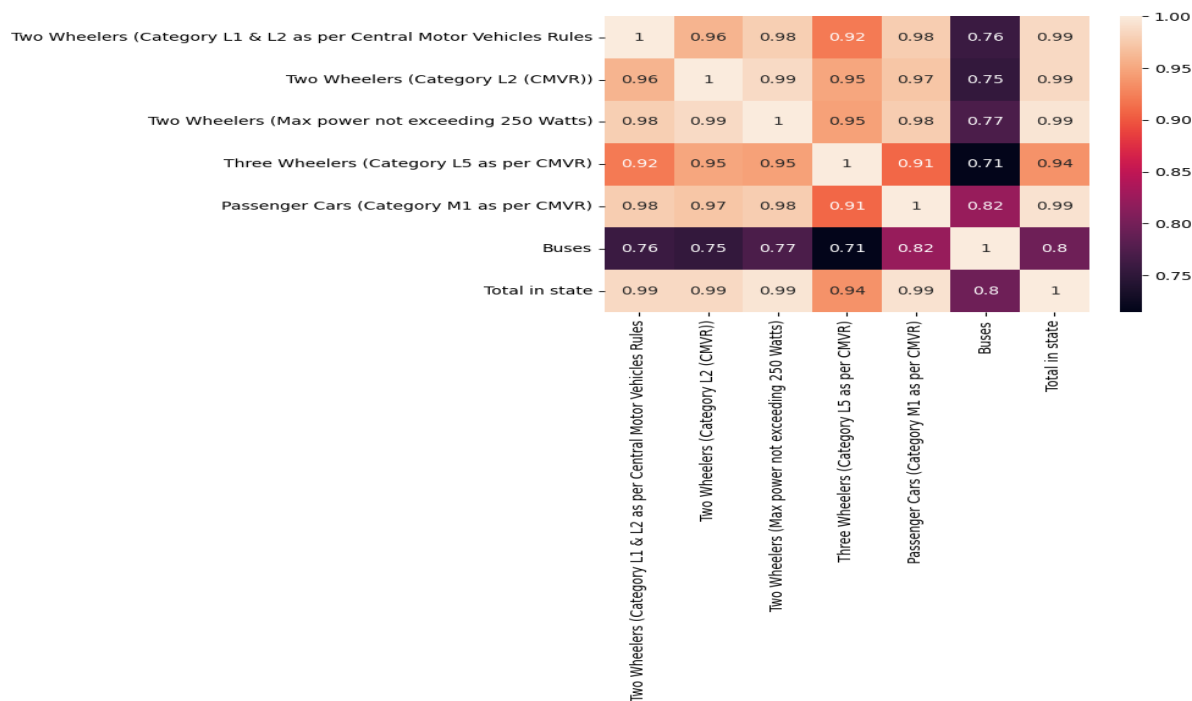
The first dataset focuses on EV car specifications, including features such as battery capacity, driving range, power, and more. The second dataset delves into EV statistics across different states, emphasizing numerical values related to various vehicle categories. Through the amalgamation of these datasets and the application of K-Means Clustering, uncover nuanced market segments that shed light on the diverse preferences and patterns within the EV market.

By employing K-Means Clustering, the algorithm identifies patterns and preferences in consumer behaviour. This is crucial for understanding which vehicle characteristics appeal to certain consumer groups. For instance, it could reveal whether a particular consumer segment prioritizes longer drive ranges or is more cost-sensitive.

By clustering similar electric vehicles, the analysis highlighted the prevalence or scarcity of specific types of EVs in the market. Manufacturers can leverage this information to optimize their product offerings, ensuring they align with market demand. The clustering analysis offers a clear view of the competitive landscape within the EV market. Understanding the distribution of different types of electric vehicles helps stakeholders position their offerings effectively against competitors. The clustering process highlighted the features that significantly influence the market dynamics. This information aids in streamlining datasets, focusing on the most impactful variables, and enhancing the efficiency of future analysis.



Correlation Matrix



3. Enhancements and Future Directions for Market Segmentation

Given additional time and a budget for data acquisition, the Market Segmentation Project can be further refined and expanded to extract deeper insights and improve model accuracy. Here are specific areas of improvement.

Dataset Enrichment

Introduce additional features to the existing datasets, such as environmental impact metrics, charging infrastructure availability, and government incentives. These factors can provide a more comprehensive view of the electric vehicle market and enhance the accuracy of clustering.

Geospatial Data Integration

Incorporate geospatial data to analyse the geographical distribution of charging stations, customer demographics, and regional climate patterns. This addition can refine regional market insights and contribute to a more precise segmentation.

Advanced Machine Learning Models

Experiment with advanced clustering algorithms like hierarchical clustering or density-based spatial clustering. Additionally, consider employing dimensionality reduction techniques such as t-SNE or PCA to handle high-dimensional data more effectively.

Time Series Data for Trend Analysis

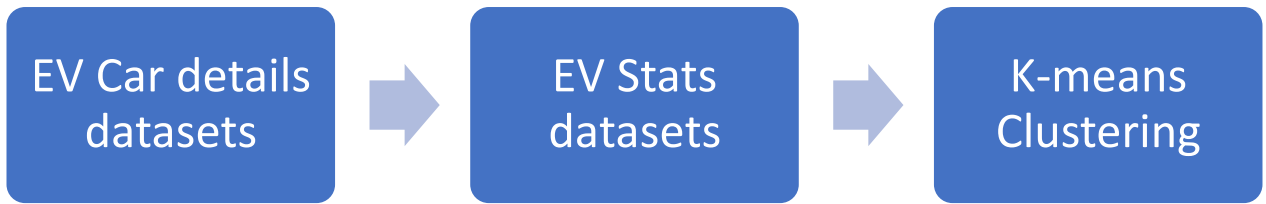
Include time series data to analyse how preferences and market dynamics evolve over time. This can uncover trends and seasonal patterns, allowing for more adaptive marketing and product development strategies.

4. Estimated Market Size

According to my market domain and the datasets I collected, that India Electric Vehicle Market size is estimated at USD 34.80 billion in 2024, and is expected to reach USD 110.74 billion by 2029, growing at a CAGR of 26.05% during the forecast period (2024-2029).

- Largest Segment by Fuel Type - HEV: The reasons influencing the rise of BEV are state subsidies and the continued encouragement of BEV adoption among Indian private automobile owners and corporate and leasing fleets.
- Fastest-growing Segment by Fuel Type - HEV: Government norms, incentives and rebates, and awareness of e-mobility are attracting consumers to buy EVs, further is making BEV the fastest-growing segment in the Indian electric vehicle market.
- Largest Segment by Vehicle Type - Commercial Vehicles: The passenger vehicle acquired the largest sales in electric vehicles in India, due to the increasing need of passenger vehicles and there are very few models of electric CV available in the India.

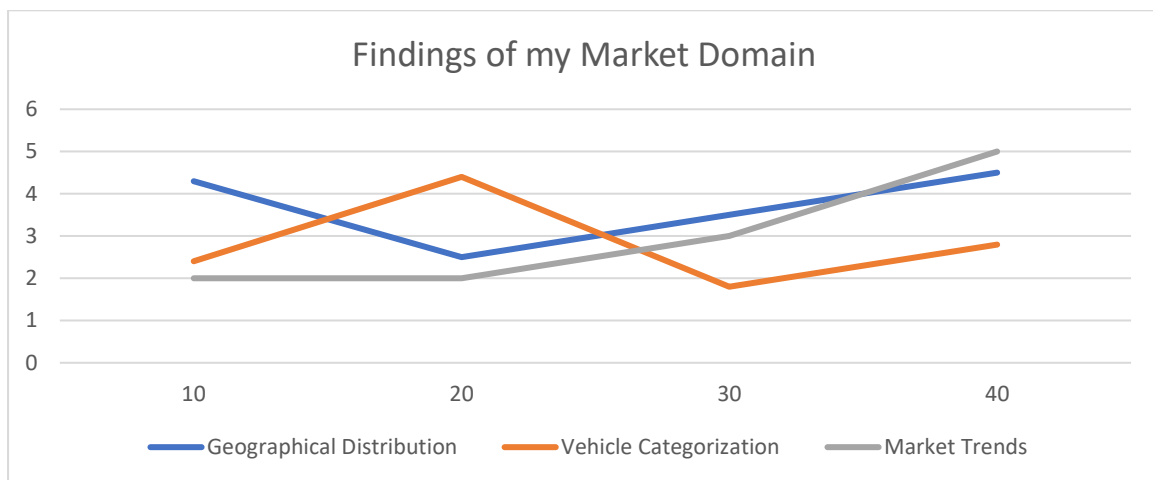
The India Electric Vehicle Market is moderately consolidated, with the top five companies occupying 53.49%. The major players in this market are Audi AG, Hyundai Motor India, Mahindra & Mahindra Ltd, MG Motor India Pvt. Ltd. and Tata Motors are predicted according to my market domain.



Methodology

Findings

- **Geographical Distribution:** Examining the EV stats dataset provides insights into the distribution of electric vehicles across different states, highlighting regions with significant market presence.
- **Vehicle Categorization:** The segmentation of electric vehicles into distinct categories (two-wheelers, three-wheelers, passenger cars, and buses) offers granularity in understanding market dynamics.
- **Market Trends:** The application of clustering algorithms identifies patterns and trends within the electric vehicle market, enabling stakeholders to adapt strategies based on consumer preferences and regional variations.



5. Top 4 Variables that provide optimal Market Segment for my analysis

The top 4 features that can be used to create optimal market segments for my electric vehicle market domain, I need to consider the characteristics that significantly influence consumer behavior and market trends. Based on the datasets I have used (EV cars India and EV stats), here are four potential variables for market segmentation.

Drive Range

This variable indicates the distance an electric vehicle can travel on a single charge. Consumers often prioritize the drive range as a key factor in their purchase decision, especially for daily commuting and longer trips.

Top Speed

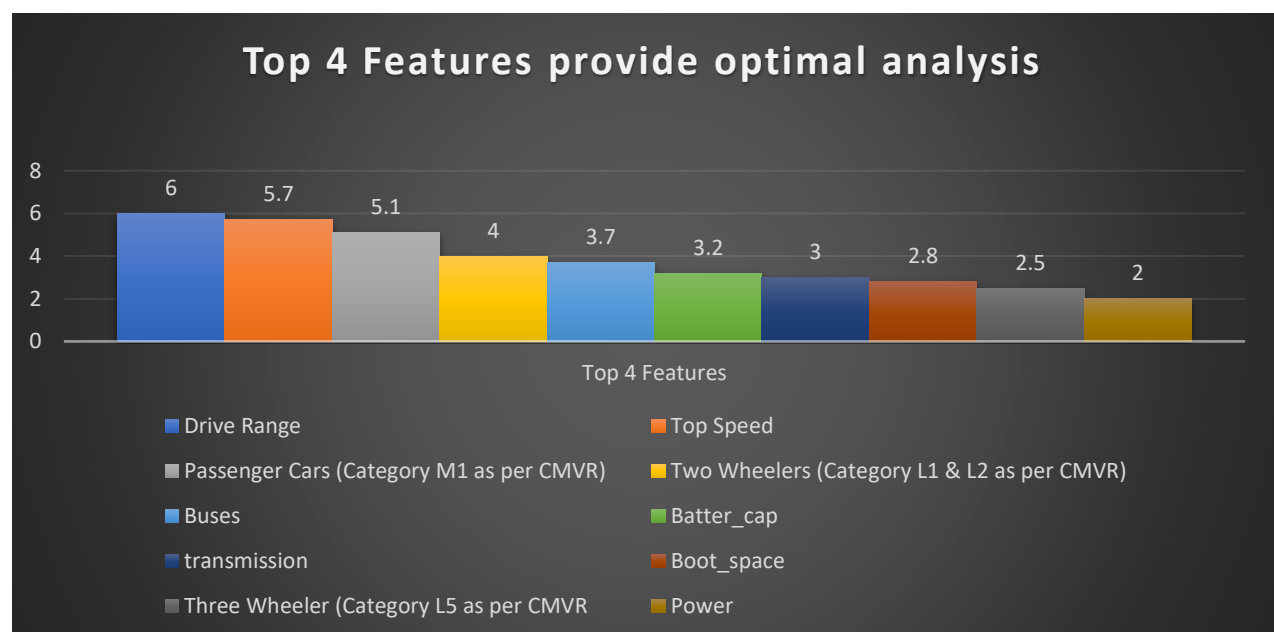
The top speed of an electric vehicle is a performance-related feature. Some consumers may prioritize higher top speeds, especially for sports or luxury electric cars. This variable can be relevant for market segments looking for specific performance characteristics.

Passenger Cars (Category M1 as per CMVR)

Considering the EV stats dataset, the number of registered passenger cars is a crucial variable. Different regions may have varying preferences for passenger cars, and analyzing this variable can help identify market segments based on the demand for personal electric vehicles.

Two Wheelers (Category L1 & L2 as per CMVR)

Two-wheelers are a significant category in the electric vehicle market, particularly in regions with high population density. Analyzing the number of registered two-wheelers can help identify market segments interested in electric scooters and motorcycles.



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