

Electric Vehicle Market in India
Market Segmentation



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Abstract

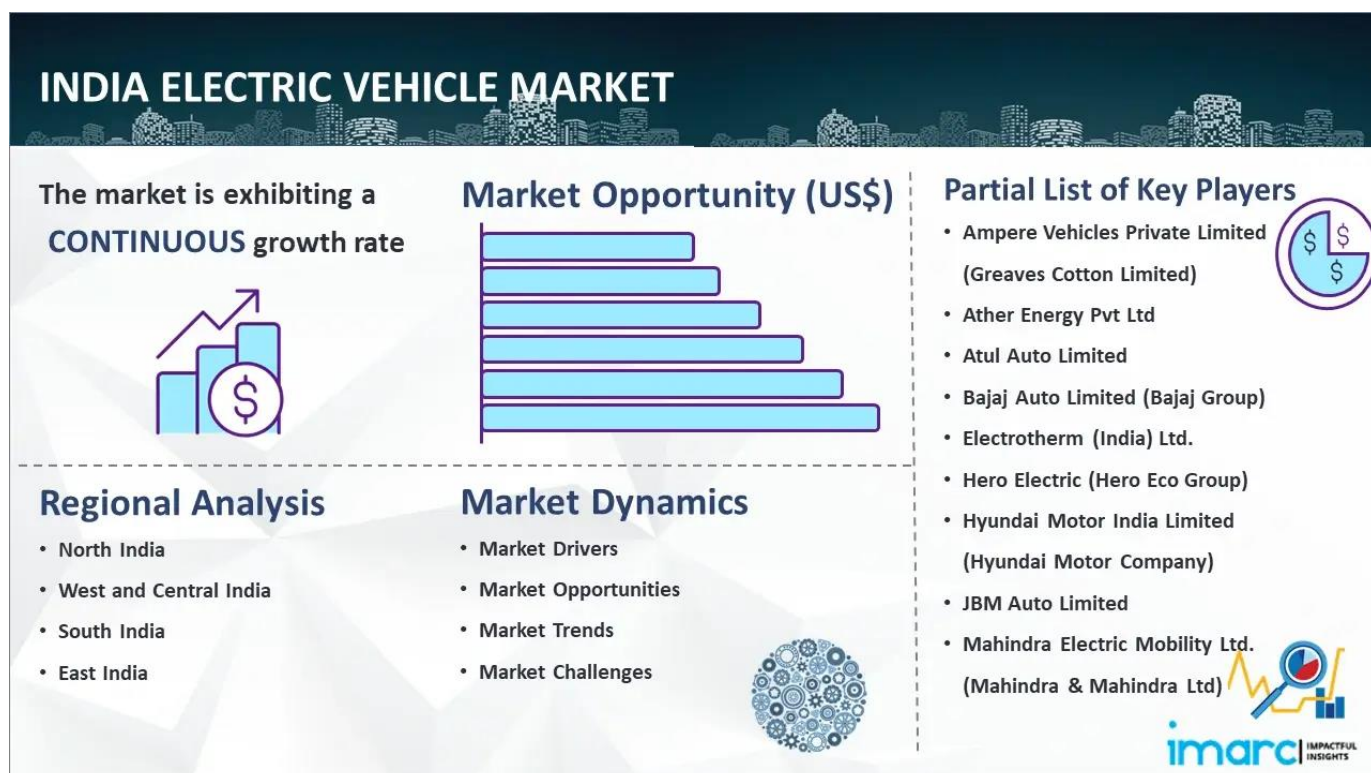
Market segmentation is essential for EV adoption in emerging markets, as it helps identify potential buyer segments based on psychographic, behavioral, and socio-economic characteristics. This study uses an integrated research framework of perceived benefits-attitude-intention to explore and validate segments from a cross-sectional online survey of 563 respondents. The findings suggest that three distinct groups of young consumers, 'Conservatives', 'Indigenents', and 'Enthusiasts,' are budding EV buyers. These findings may offer guidance for scholars and policymakers to encourage EV adoption in the emerging sustainable transport market. The report analyzes data using Fermi Estimation to solve the problem.

The EV market in India has gained significant momentum after the implementation of the (Faster Adoption and Manufacturing of Hybrid & Electric Vehicles in India) FAME India scheme with its aim of shifting toward e-mobility in the wake of growing international policy commitments and environmental challenges. Moreover, India offers the world's largest untapped market, especially in the electric two-wheeler segment. As 100% foreign direct investment is allowed in this sector, the automatic route market is expected to gain momentum during the forecast period.



Electric vehicles (EVs) have the potential to outperform conventional vehicles from an environmental perspective, but their perceived higher capital cost remains a significant barrier for consumers. To comprehensively assess the true cost for consumers, recent studies have focused on calculating the Total Cost of Ownership (TCO) considering various vehicle classes, powertrain technologies, and use cases. To provide a broad overview, researchers developed a probabilistic simulation model that captures a substantial portion of the national market. The findings reveal that the cost efficiency of EVs improves as consumers' driving distance increases, and smaller vehicles tend to have higher cost advantages over larger ones. However, the results of sensitivity analysis highlight the uncertainty in the TCO due to the development of vehicle and operating costs.

While the study suggests that the TCO of EVs may approach or even become lower than that of conventional vehicles by 2025, it also emphasizes that the current consumer purchase decision-making process does not fully consider the TCO. The research adds evidence to previous studies, indicating that consumer perceptions of higher upfront costs still affect their adoption decisions. In light of these findings, the study discusses potential policy measures to educate consumers about the TCO of different vehicle types based on their individual preferences. By raising awareness about the long-term cost benefits of EVs and addressing misconceptions about their affordability, policymakers can encourage greater EV adoption and expedite the transition to a greener and more sustainable transportation system.



Market Segmentation

Types of Market Segmentation

There are four primary types of market segmentation. However, one type can usually be split into an individual segment and an organization segment. Therefore, below are five common types of market segmentation.

Market segmentation can be done in a handful of ways.

Within each, you can split them into smaller segments for an even more granular understanding of a market.

Behavioral. Essentially, this means how consumers interact with products or brands. It can include how and where they engage, their social media usage, or their wider consumer journey.

Demographic. Criteria can include gender, age, income, education, social class, religion, and nationality.

Geographic. This uses information on where they live, work, or even spend their weekends. This can be subdivided by nation, state, town, county, and so on.

Psychographic. This can include personality variables like introverted Ness and extroverted Ness, lifestyles, attitudes, likes, and dislikes.

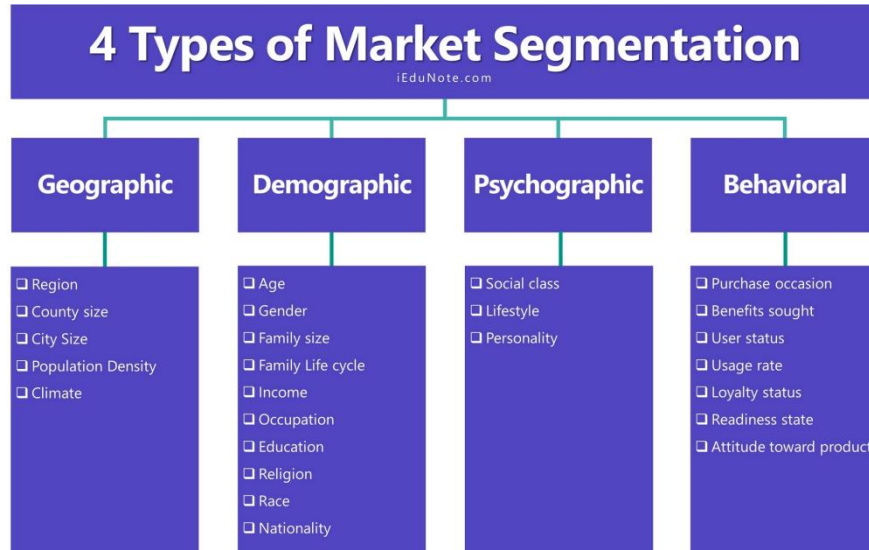


Figure 1: *Behavioral Segmentation*

How to Determine Your Market Segment

There's no single universally accepted way to perform market segmentation. To determine your market segments, it's common for companies to ask themselves the following questions along their market segmentation journey.

Phase I: Setting Expectations/Objectives • *What is the purpose or goal of performing market segmentation?*

- *What does the company hope to find out by performing marketing segmentation?*
- *Does the company have any expectations on what market segments may exist?*

Phase 2: Identify Customer Segments

- *What segments are the company's competitors selling to?*
- *What publicly available information (i.e. U.S. Census Bureau data) is relevant and available to our market?*
- *What data do we want to collect, and how can we collect it?*
- *Which of the five types of market segments do we want to segment by?*

Phase 3: Evaluate Potential Segments

- *What risks are there that our data is not representative of the true market segments?*
- *Why should we choose to cater to one type of customer over another?*
- *What is the long-term repercussion of choosing one market segment over another?*
- *What is the company's ideal customer profile, and which segments best overlap with this "perfect customer"?*

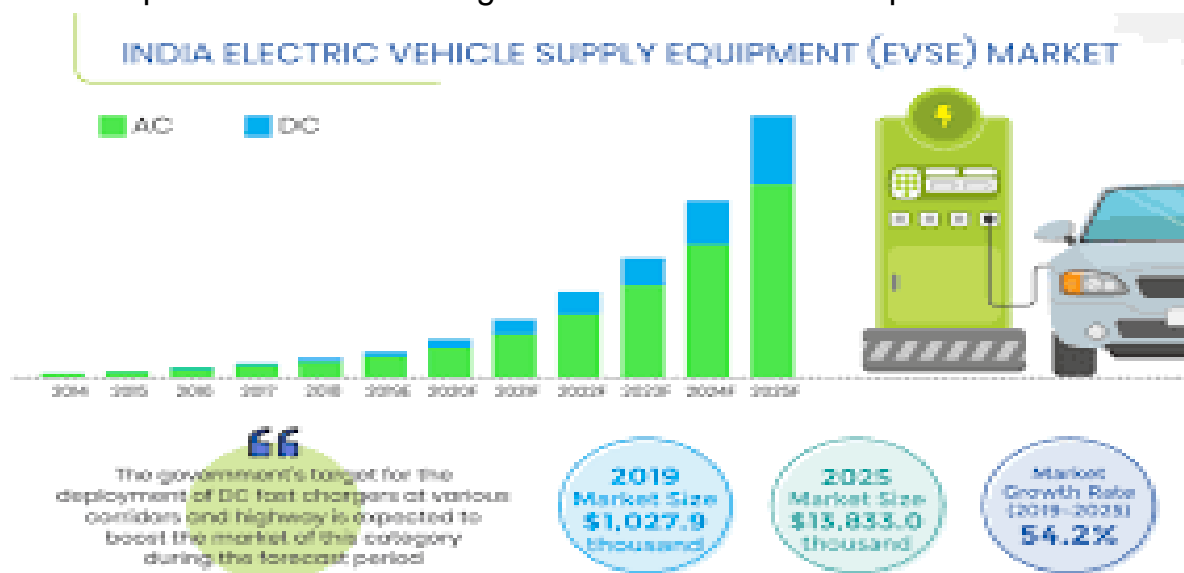
Phase 4: Develop Segment Strategy

- *How can the company test its assumptions on a sample test market?*
- *What defines a successful marketing segment strategy?*
- *How can the company measure whether the strategy is working?*

Phase 5: Launch and Monitor

- *Who are key stakeholders that can provide feedback after the market segmentation strategy has been unveiled?*
- *What barriers to execution exist, and how can they can be overcome?*
- *How should the launch of the marketing campaign be communicated internally?*

The Indian Electric Vehicle Market was valued at USD 5 billion in 2020, and it is expected to reach USD 47 billion by 2026, registering a compound annual growth rate (CAGR) of above 44% during the forecast period (2021-2026). The Indian Electric Vehicle Market has been impacted by the outbreak of the COVID-19 pandemic due to supply chain disruptions and halt of manufacturing units due to continuous lockdowns and travel restrictions across the country. However, the electric vehicle (EV) market is still in its nascent stage in India. It is expected to grow at a much faster rate during the forecast period due to various government initiatives and policies.

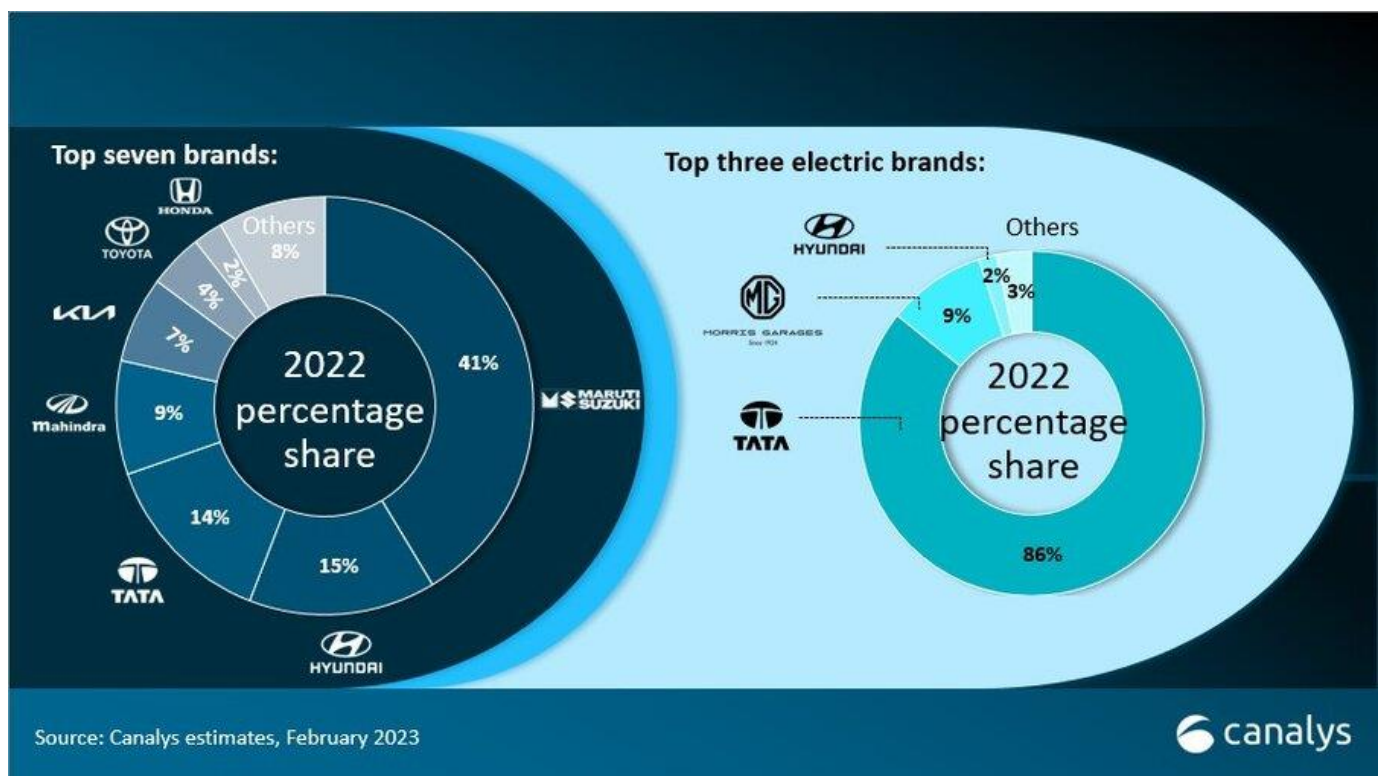


Why Is Market Segmentation Important?

Market segmentation realizes that not all customers have the same interests, purchasing power, or consumer needs. Instead of catering to all prospective clients broadly, market segmentation is important because it strives to make a company's marketing endeavors more strategic and refined. By developing specific plans for specific products with target audiences in mind, a company can increase its chances of generating sales and being more efficient with resources. When a company has

identified specific market segments, it helps them to focus on what segments they want to target with specific products/ services/ content/ blogs and campaigns. When a company has a focus on specific segments, they ensure they are targeting the right segment with the right product which will see the greatest ROI.

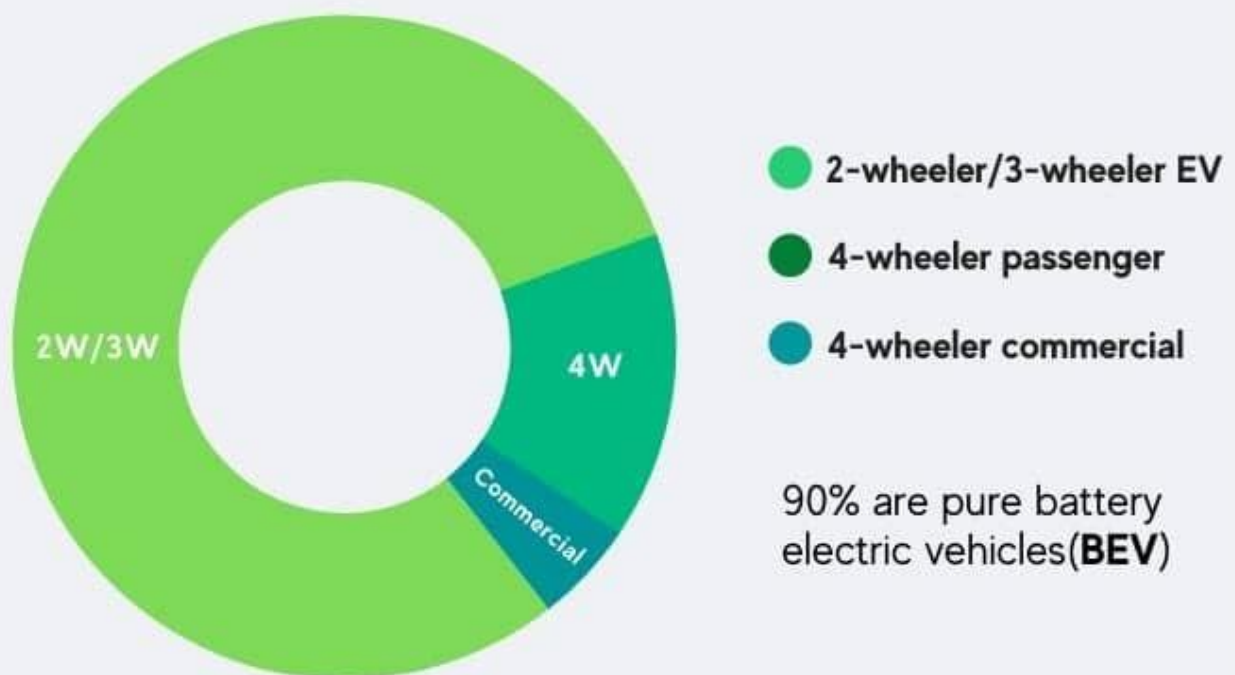
Even when product features and benefits are the same, it is important for companies to target segments with specific communication. For example, if your segment was senior engineers, they may respond better to technical information about a product in the form of white papers or infographics, but a project manager might respond better to information regarding cost savings, efficiencies etc in the form of a blog, case study or video. Messaging will be different for different segments. Platforms which are used to target different segments will be different also. The key is to understand your segments and target communication relevant to them on the relevant platforms.



Segmentation for EVs:

Market segmentation aims to define actionable, manageable, and homogeneous subgroups of individual customers for marketers to target using similar marketing strategies. There are two methods: a-priori and post-hoc. A-priori uses predefined characteristics like age, gender, income, and education to define segments, while post-hoc segments are identified based on the relationship among multiple measured variables. Both approaches determine the 'segmentation theme'. The present study uses an a-priori approach to divide potential EV customers into sub-groups.

Indian Electric Vehicles (EV) Market : EV Segment Dominations



Source : CEEW-CEF | ecogears.in

Graphics@ecogears.in

Figure 4: Market Segmentation Electric Vehicles

The creation of sub-market strategies that cater to customer preferences and tastes is made possible by the combination of psychographic and socioeconomic factors in market segmentation. According to Straughan and Roberts, psychographic traits are seen to be more effective in explaining environmentally conscious consumer behavior than sociodemographic and economic ones. The study suggests employing psychographic traits to profile different customer groups in the market for eco-friendly goods. For improved market segmentation, the research also includes perceived-benefit characteristics that are influenced by a combination of psychographic and socioeconomic factors.

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.

Data-Preprocessing

Data Cleaning

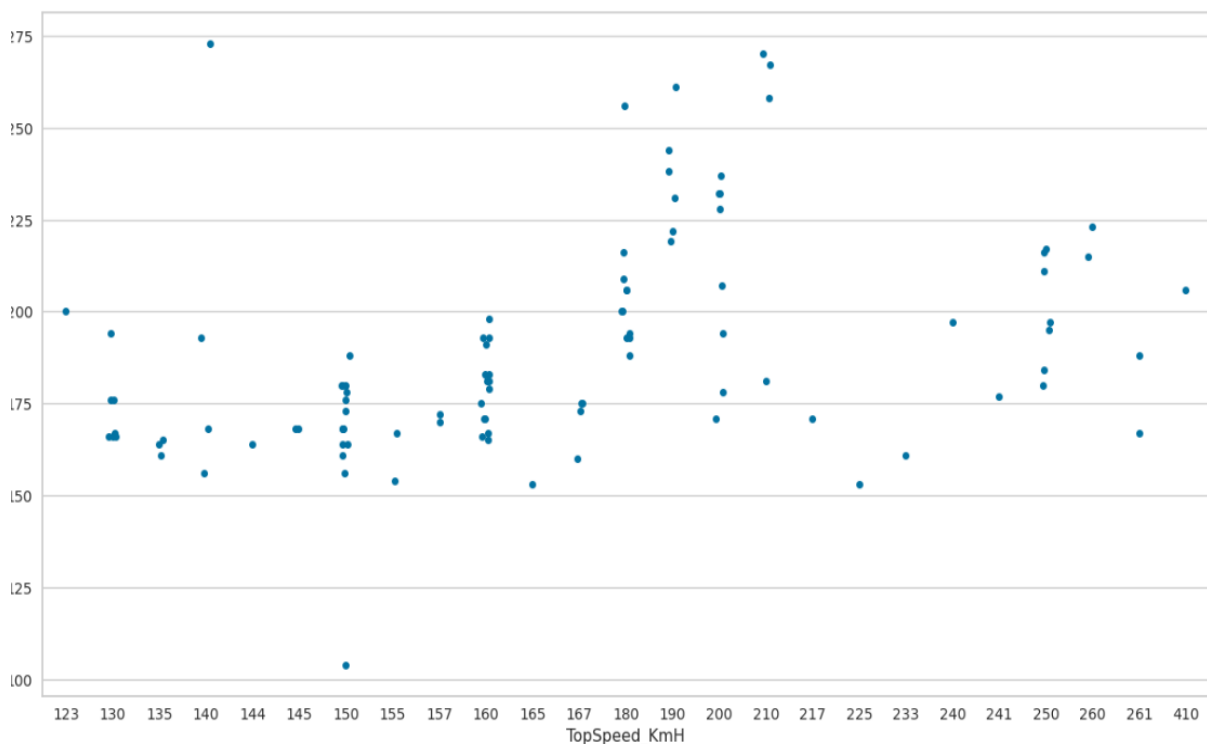
The data collected is compact and is partly used for visualization purposes and partly for clustering. Python libraries such as NumPy, Pandas, Scikit-Learn, and SciPy are used for the workflow, and the results obtained are ensured to be reproducible.

[49]:

	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	RapidCharge	Seats	PriceEuro	inr(10e3)
count	103.0000	103.0000	103.0000	103.0000	103.0000	103.0000	103.0000	103.0000	103.0000
mean	7.3961	179.1942	338.7864	189.1650	444.2718	0.7476	4.8835	55811.5631	5067.1318
std	3.0174	43.5730	126.0144	29.5668	203.9493	0.4365	0.7958	34134.6653	3099.0863
min	2.1000	123.0000	95.0000	104.0000	170.0000	0.0000	2.0000	20129.0000	1827.5119
25%	5.1000	150.0000	250.0000	168.0000	260.0000	0.5000	5.0000	34429.5000	3125.8543
50%	7.3000	160.0000	340.0000	180.0000	440.0000	1.0000	5.0000	45000.0000	4085.5500
75%	9.0000	200.0000	400.0000	203.0000	555.0000	1.0000	5.0000	65000.0000	5901.3500
max	22.4000	410.0000	970.0000	273.0000	940.0000	1.0000	7.0000	215000.0000	19519.8500

EDA

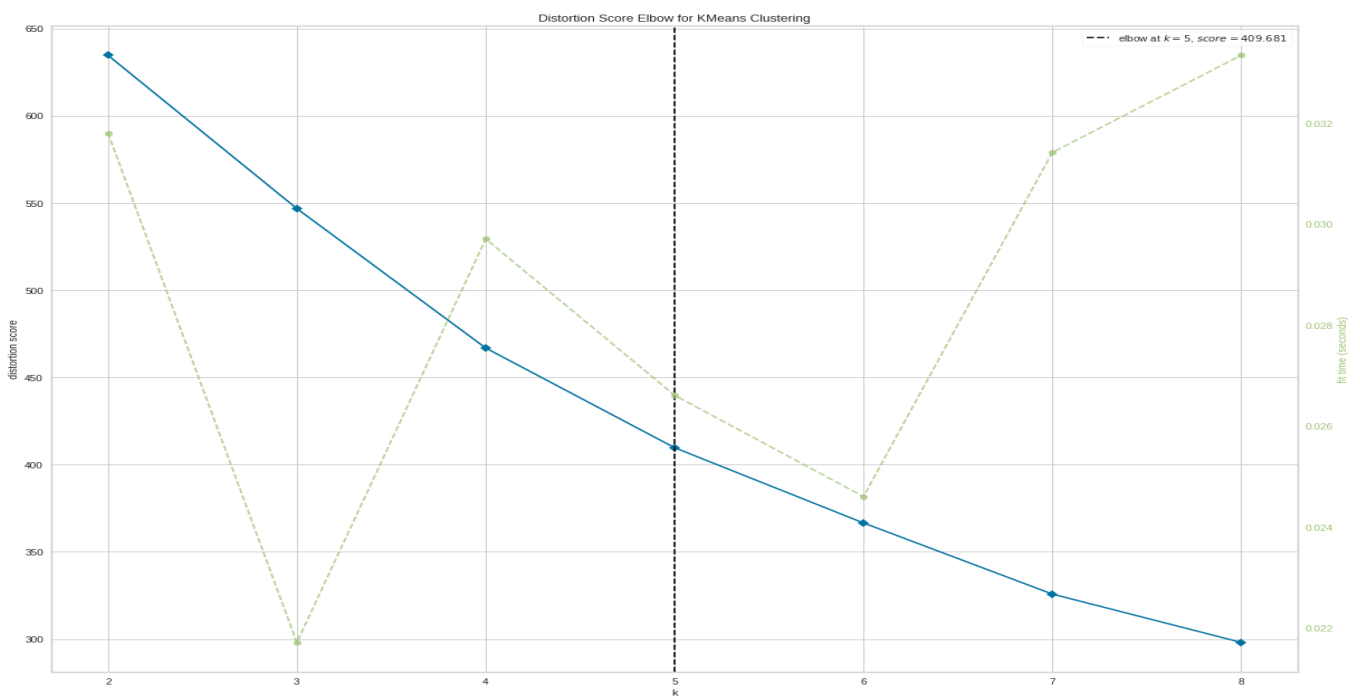
We start the Exploratory Data Analysis with some data Analysis drawn from the data without Principal Component Analysis and with some Principal Component Analysis in the dataset obtained from the combination of all the data we have. PCA is a statistical process that converts the observations of correlated features into a set of linearly uncorrelated features with the help of orthogonal transformation. These new transformed features are called the Principal Components. The process helps in reducing dimensions of the data to make the process of classification/regression or any form of machine learning, cost-effective.

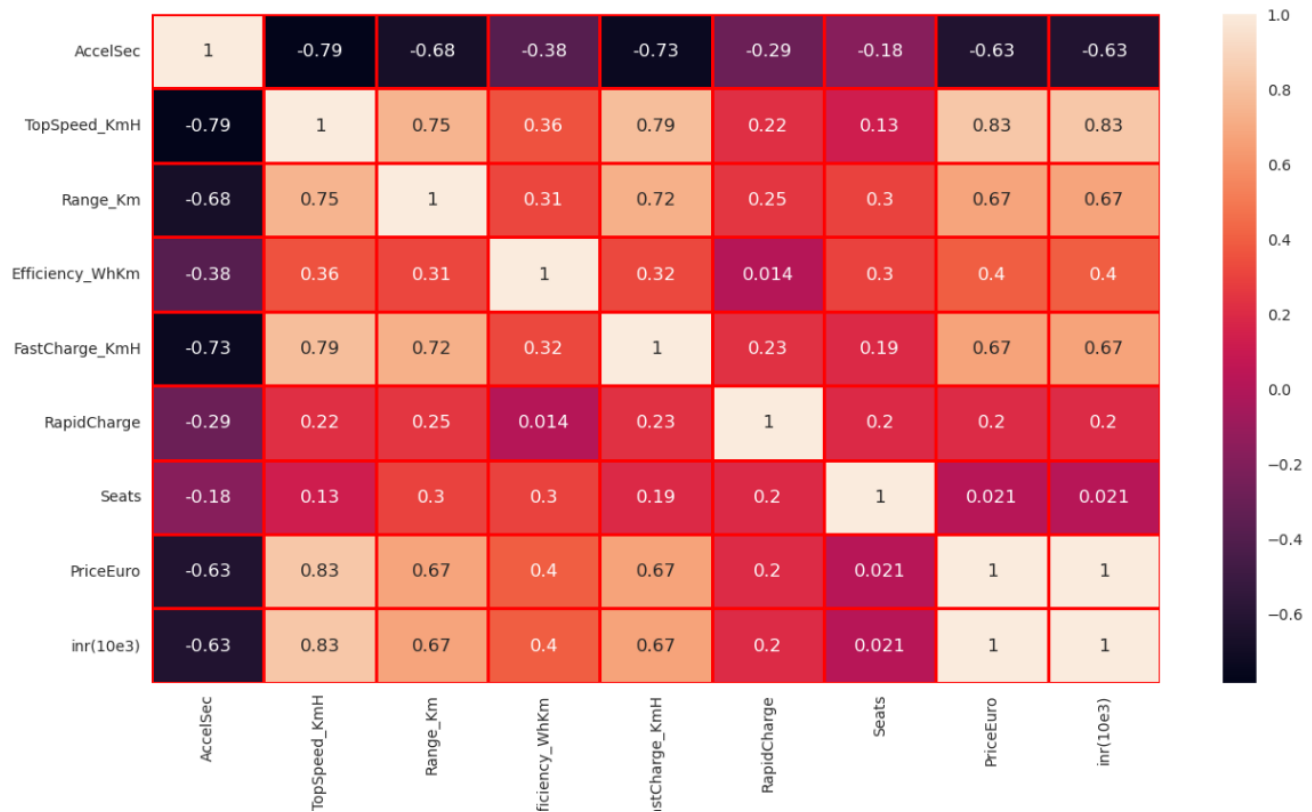
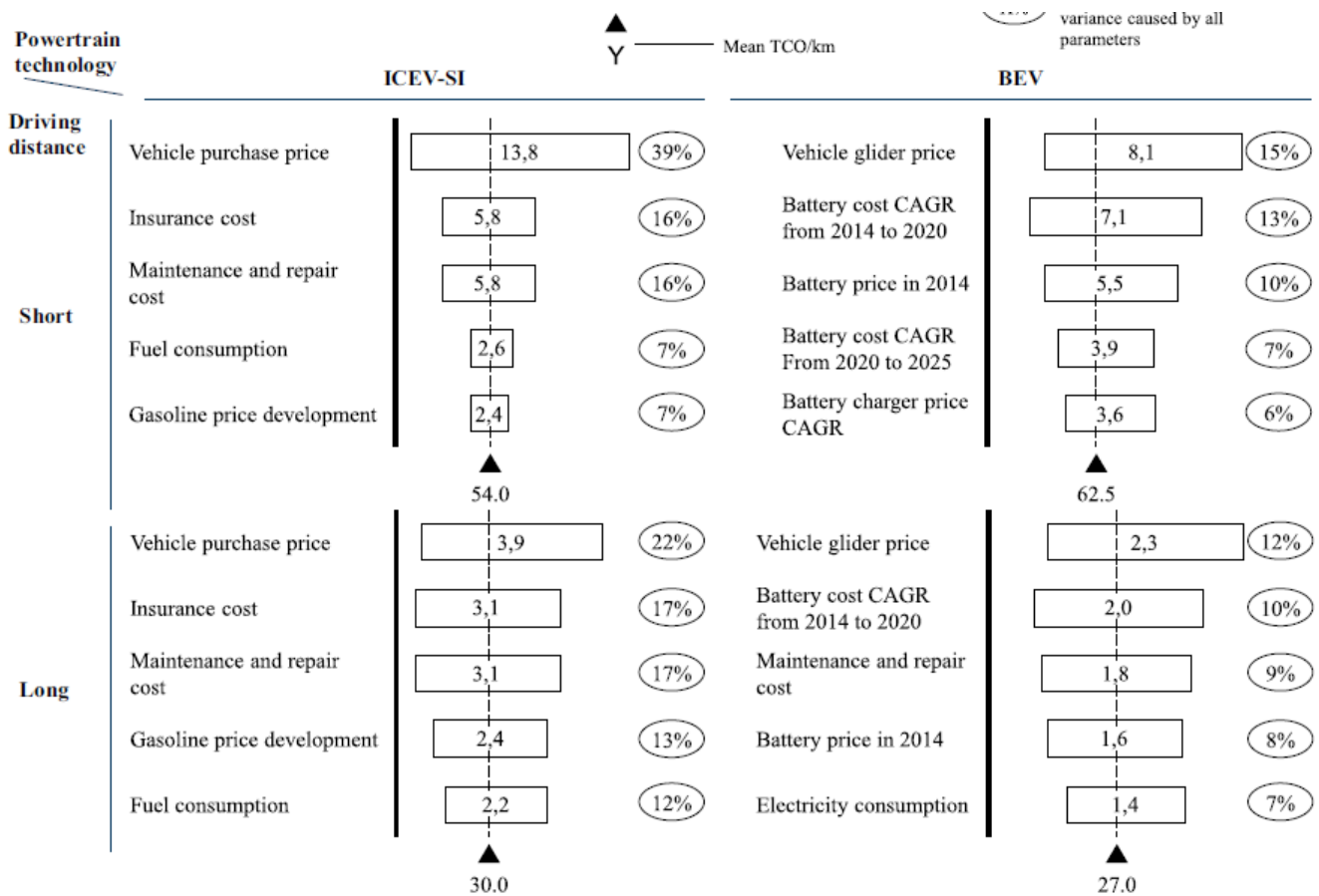


Elbow Method

The Elbow method is a popular method for determining the optimal number of clusters. The method is based on calculating the Within-Cluster-Sum of Squared Errors (WSS) for a different number of clusters (k) and selecting the k for which change in WSS first starts to diminish. The idea behind the elbow method is that the explained variation changes rapidly for a small number of clusters and then it slows down leading to an elbow formation in the curve. The elbow point is the number of clusters we can use for our clustering algorithm.

The `KElbowVisualizer` function fits the `KMeans` model for a range of clusters values between 2 to 8. As shown in Figure, the elbow point is achieved which is highlighted by the function itself. The function also informs us about how much time was needed to plot models for various numbers of clusters through the green line.





Analysis and Approaches used for Segmentation

Clustering

Clustering is one of the most common exploratory data analysis techniques used to get an intuition about the structure of the data. It can be defined as the task of identifying subgroups in the data such that data points in the same subgroup (cluster) are very similar while data points in different clusters are very different. In other words, we try to find homogeneous subgroups within the data such that data points in each cluster are as similar as possible according to a similarity measure such as euclidean-based distance or correlation-based distance.

The decision of which similarity measure to use is application-specific. Clustering analysis can be done on the basis of features where we try to find subgroups of samples based on features or on the basis of samples where we try to find subgroups of features based on samples.

K-Means Algorithm

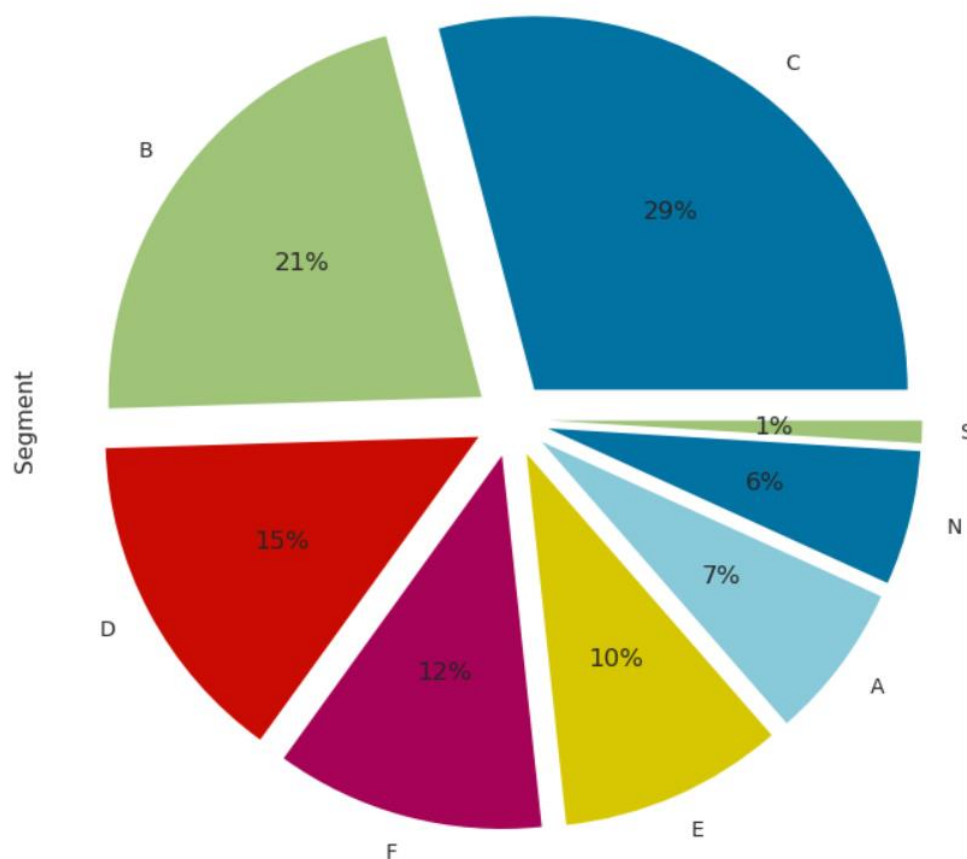
K Means algorithm is an iterative algorithm that tries to partition the dataset into pre-defined distinct non-overlapping subgroups (clusters) where each data point belongs to **only one group**. It tries to make the intra-cluster data points as similar as possible while also keeping the clusters as different (far) as possible. It assigns data points to a cluster such that the sum of the squared distance between the data points and the cluster's centroid (arithmetic mean of all the data points that belong to that cluster) is at the minimum. The less variation we have within clusters, the more homogeneous (similar) the data points are within the same clusters.

Applications

K means algorithm is very popular and used in a variety of applications such as market segmentation, document clustering, image segmentation and image compression, etc.

The goal usually when we undergo a cluster analysis is either:

1. Get a meaningful intuition of the structure of the data we're dealing with.
2. Cluster-then-predict where different models will be built for different subgroups if we believe there is a wide variation in the behaviors of different subgroups.



The **k-means clustering algorithm** performs the following tasks:

- Specify number of clusters K
- Initialize centroids by first shuffling the dataset and then randomly selecting K data points for the centroids without replacement.
- Compute the sum of the squared distance between data points and all centroids.
- Assign each data point to the closest cluster (centroid).
- Compute the centroids for the clusters by taking the average of the all data points that belong to each cluster.
- Keep iterating until there is no change to the centroids. i.e assignment of data points to clusters isn't changing.

Conclusions:-

1] **Geographic:** The Electric Vehicle dataset sheds light on the significant impact of Indian geographic factors on the adoption and deployment of electric vehicles across the nation. India's diverse landscape, vast country size, varying climate patterns, city sizes, and population density all play crucial roles in shaping the trajectory of electric vehicle usage in the country.

Moreover, the geographic diversity of India presents both challenges and opportunities for the electric vehicle industry. While the large country size offers a vast market potential for electric vehicle manufacturers, it also necessitates the establishment of an extensive and efficient charging network to cater to the diverse and widespread population. Understanding regional variations in population density, city sizes, climate conditions, and country size is crucial for creating targeted initiatives that encourage sustainable mobility solutions across the nation. By leveraging this data-driven knowledge, India can pave the way for a greener and more sustainable future, reducing carbon emissions and mitigating the impact of climate change through the widespread adoption of electric vehicles.

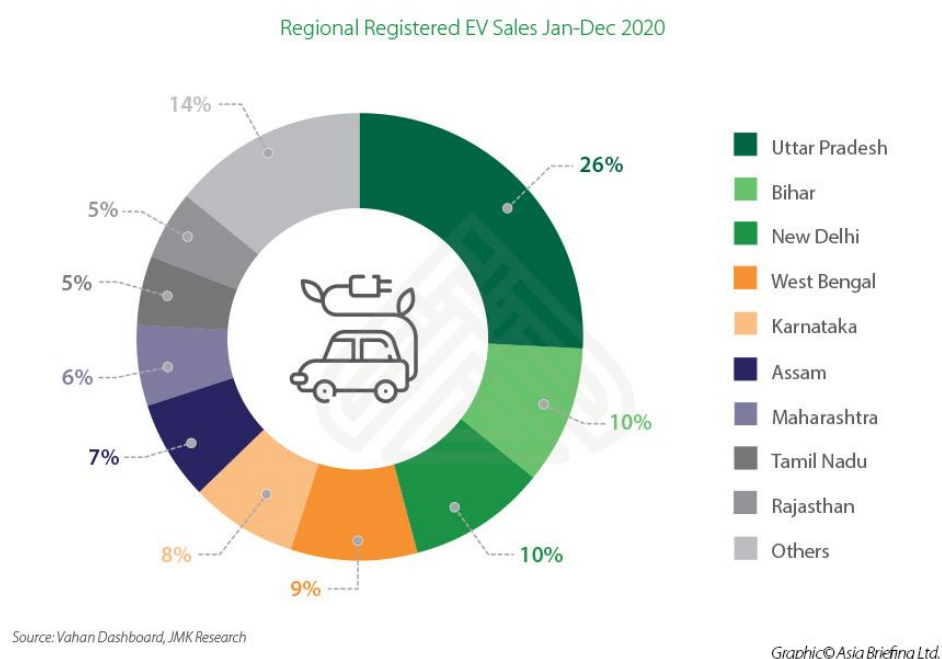
2] **Behavioral:** To effectively target these behavioral segments, the marketing and sales strategies should be tailored to address their unique preferences, needs, and motivations. By understanding the distinct characteristics of each segment, the company can design targeted campaigns, products, and messaging to successfully enter the Indian EV market and capture the attention of the most relevant potential customers.

3] **Psychographic:** Psychographic segmentation in the context of Electric Vehicles (EVs) in India refers to a marketing strategy that divides potential customers into distinct groups based on their psychological characteristics, lifestyle, attitudes, values, interests, and behavior related to EVs. This approach helps EV manufacturers and marketers understand the needs, preferences, and motivations of different consumer segments to tailor their products and marketing messages effectively. Psychographic segmentation is

usually combined with other segmentation approaches, such as demographic (age, income, education), geographic (location), and behavioral (previous buying habits) to create a comprehensive understanding of the target market. By identifying and targeting specific psychographic segments, EV manufacturers and marketers can design targeted advertising campaigns, pricing strategies, and product offerings that resonate with their intended audience and, in turn, accelerate the adoption of EVs in India.

4] Demographic: In conclusion, demographic market segmentation proves to be an indispensable tool for the electric vehicle (EV) market in India. By tailoring products and marketing strategies to specific demographic groups, the industry can effectively address the diverse needs and preferences of different consumer segments. Understanding factors such as age, income, occupation, and lifestyle enables manufacturers and policymakers to create targeted offerings, thus fostering greater EV adoption. Additionally, this approach facilitates the identification of untapped market segments, driving innovation and competitiveness within the industry. With India's ambitious goals to transition towards greener mobility, demographic market segmentation emerges as a vital component in accelerating the adoption of EVs and creating a sustainable future for the nation's transportation landscape.

So, from the analysis we can see that the company should also focus on many aspects of vehicles, especially on Performance, Range and service cost, as people buy cars for the long term. Age doesn't seem to matter as people from every age group are interested in adopting EV's, there is definitely anxiety in terms of range, service costs and battery safety which have been already mentioned. If the company can solve those issues, it would help in building customer trust, which would eventually help grow the business. New startups should focus on the range and affordability of the e-vehicle.



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GITHUB LINKS:-

<https://github.com/SumeetD003/EV-Market-Segment-India.git>
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