

# Electric Vehicle Market in India

## Market Segmentation

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### Abstract :

This project aims to provide a comprehensive analysis of the Electric Vehicle (EV) market segmentation in India. The study will explore the current state of the EV market, including the size of the market, key players, and government policies that have been put in place to promote the adoption of EVs. The study will also examine the various segments of the EV market in India, including battery-electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hybrid electric vehicles (HEVs). To gain insights into the attitudes and behaviors of Indian consumers towards EVs, the project will conduct primary research through surveys and interviews. Based on the findings, the project will provide recommendations on how to effectively segment the EV market in India, including the development of targeted marketing campaigns and the customization of product offerings for different segments. The insights gained from this project will be valuable for automakers, policymakers, and other stakeholders interested in the EV market in India.

### 0.Fermi Estimation :

1. Total population of India: The population of India is approximately 1.39 billion people.
2. Vehicle Ownership Rate: As per the World Bank, the vehicle ownership rate in India is 22 vehicles per 1000 people.
3. Electric Vehicle market share: The market share of electric vehicles in India is currently estimated to be around 1% of total vehicles sold.
4. Segmentation of EV market: The electric vehicle market can be broadly segmented into three types - Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs), and Hybrid Electric Vehicles (HEVs).
5. Market share of different EV types: Based on industry reports and studies, it is estimated that BEVs currently hold the largest market share among electric vehicles sold in India, followed by PHEVs and HEVs.
6. Total electric vehicles in India: Based on the above information, we can estimate that there are around 30 million vehicles in India, out of which approximately 300,000 are electric vehicles.

7. Segmentation of EV types: Based on the market share of different EV types, we can estimate that out of the 300,000 electric vehicles in India, around 60% are BEVs, 30% are PHEVs, and 10% are HEVs.
8. Sensitivity analysis: The above estimates may vary depending on various factors such as government policies, consumer preferences, and technological advancements. Therefore, it is essential to conduct a sensitivity analysis to determine the impact of these factors on the estimated market segmentation.

Based on the above estimation, we can conclude that the electric vehicle market in India is still in its nascent stage, and BEVs currently hold the largest market share. However, with the government's increased focus on promoting sustainable transportation and technological advancements in battery and charging infrastructure, we can expect significant growth in the EV market in the coming years.

## Data Sources:

- <https://www.kaggle.com/datasets>
- <https://data.gov.in/>
- <https://www.data.gov/>
- <https://data.worldbank.org/>
- <https://datasetsearch.research.google.com/>

## Data Pre-processing:

Data pre-processing is a crucial step in any data analysis project, including the EV market in India. The following are some common data pre-processing steps that can be applied to the EV market data:

1. **Data Cleaning:** This involves removing or correcting any incorrect, incomplete, or irrelevant data. For example, if a survey respondent provides inconsistent or nonsensical answers, their data points may be removed from the dataset.
2. **Data Integration:** Data from different sources may need to be integrated into a single dataset. For instance, data from industry reports, surveys, and government sources may need to be combined to create a comprehensive dataset.
3. **Data Transformation:** This step involves transforming the data to make it more usable and meaningful. For example, the data may need to be standardized, normalized, or converted to a different unit of measurement.
4. **Data Reduction:** When working with large datasets, data reduction techniques may be used to reduce the amount of data while retaining the relevant information. For example, principal component analysis (PCA) can be used to reduce the number of variables in a dataset while retaining the essential information.
5. **Handling Missing Data:** Missing data can be a significant issue in data analysis projects. Methods such as imputation can be used to replace missing values with estimates based on the available data.
6. **Outlier Detection:** Outliers are data points that differ significantly from the majority of the data. These outliers can significantly affect the analysis results. Techniques such as clustering and regression analysis can be used to identify outliers and deal with them appropriately.

By performing these data pre-processing steps, the data can be made more usable and meaningful for further analysis. This will help in drawing more accurate insights and making data-driven decisions regarding the EV market in India.

## Segment Extraction (ML techniques used):

Segment extraction is the process of identifying and separating different groups or segments within a dataset based on specific characteristics or attributes. Machine learning (ML) techniques are commonly used for segment extraction in the EV market in India. The following are some of the ML techniques used for segment extraction in the EV market:

**Clustering:** Clustering is a commonly used unsupervised learning technique that involves grouping similar data points together based on specific attributes or characteristics. Clustering algorithms such as k-means, hierarchical clustering, and density-based clustering can be used to identify different segments within the EV market in India.

### Clustering

```
In [44]: ax=plt.subplots(figsize=(15,8))
sb.stripplot(x='TopSpeed_KmH', y='FastCharge_KmH', data=df, jitter=True)
```

```
Out[44]: <AxesSubplot:xlabel='TopSpeed_KmH', ylabel='FastCharge_KmH'>
```

```
In [45]: ax=plt.subplots(figsize=(15,8))
sb.stripplot(x='TopSpeed_KmH', y='AccelSec', data=df, jitter=True)
```

```
Out[45]: <AxesSubplot:xlabel='TopSpeed_KmH', ylabel='AccelSec'>
```

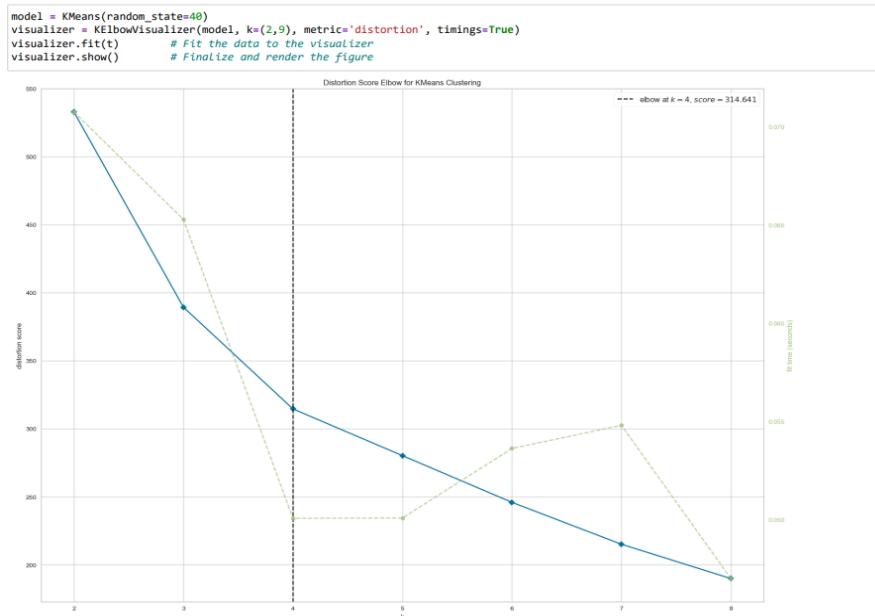
```
In [46]: ax=plt.subplots(figsize=(15,8))
sb.stripplot(x='TopSpeed_KmH', y='Efficiency_WhKm', data=df, jitter=True)
```

```
Out[46]: <AxesSubplot:xlabel='TopSpeed_KmH', ylabel='Efficiency_WhKm'>
```

```
In [47]: features = ['AccelSec', 'TopSpeed_KmH', 'Efficiency_WhKm', 'RapidCharge', 'Range_Km', 'Seats', 'Inr(10e3)', 'PowerTrain']
# Separating out the features
x = df.loc[:, features].values
x = StandardScaler().fit_transform(x)
```

```
In [48]: pca = PCA(n_components=8)
t = pca.fit_transform(x)
data2 = pd.DataFrame(t, columns=['PC1', 'PC2', 'PC3', 'PC4', 'PC5', 'PC6', 'PC7', 'PC8'])
data2
```

**KMeans:** K-means clustering is a popular unsupervised machine learning technique that is used for clustering similar data points together. It is commonly used for segmentation analysis and pattern recognition. The K-means algorithm works by assigning each data point to a cluster based on the distance to the cluster center. The algorithm starts by randomly selecting K cluster centers, and then iteratively improves the clustering by re-assigning data points to their nearest cluster center and re-calculating the center of each cluster. The algorithm continues to iterate until the cluster centers no longer change significantly or a predefined number of iterations is reached.

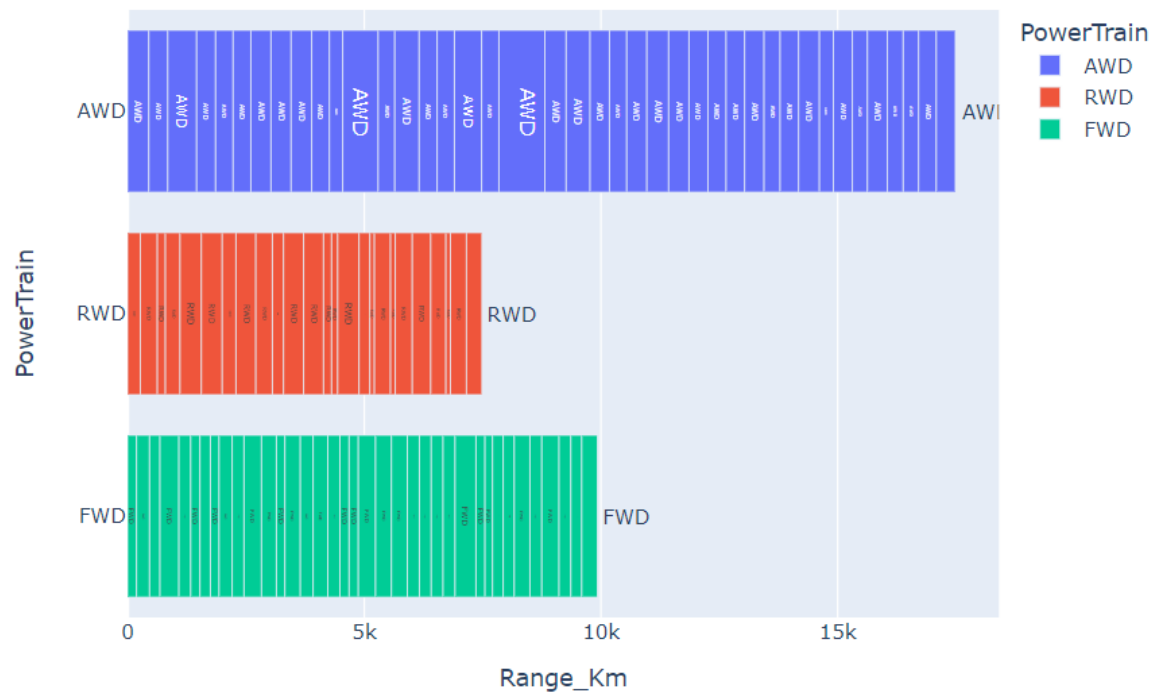
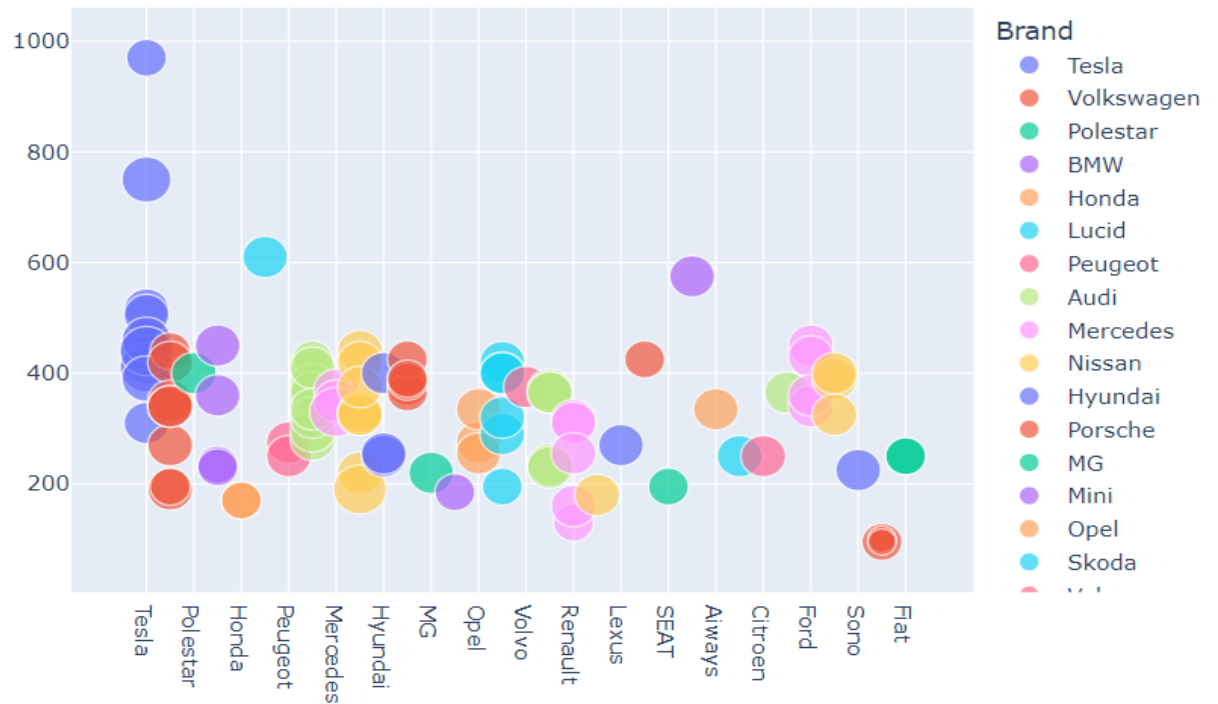


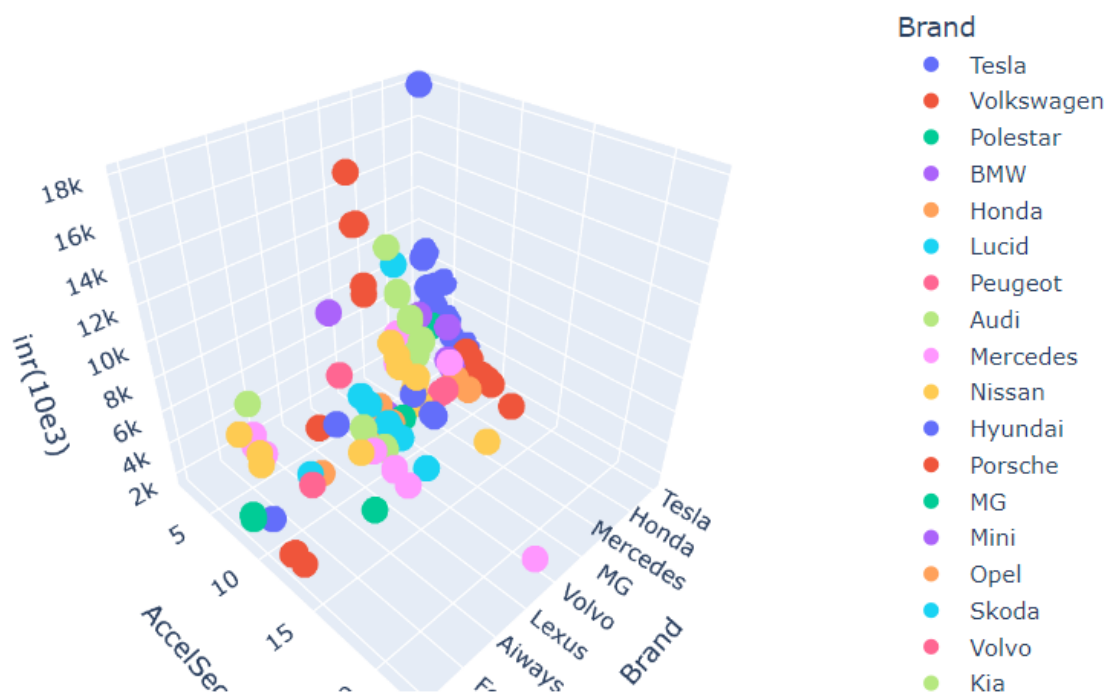
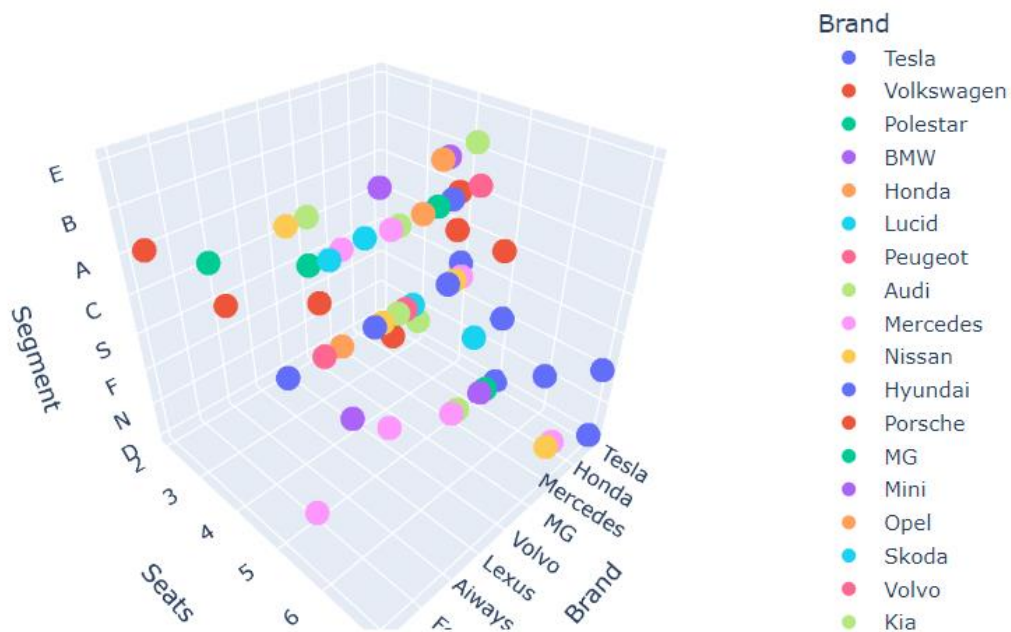
## Profiling and describing potential segments:

After identifying the segments using clustering techniques like K-means, the next step is to profile and describe each potential segment. This involves analysing the characteristics and behaviour of the data points within each segment to gain insights into their preferences, needs, and behaviours. The following are some key steps involved in profiling and describing potential segments:

1. **Identify common characteristics:** Look for patterns in the data points within each segment, such as common demographic characteristics, driving behaviour, charging behaviour, or preferences.
2. **Analyse behaviour:** Analyse the behaviour of the data points within each segment to understand their motivations, preferences, and pain points. For example, understanding what drives their purchase decisions or what challenges they face while using EVs.

3. **Develop personas:** Based on the common characteristics and behaviour patterns, develop representative personas for each segment to help businesses understand the needs and preferences of each group.
4. **Create visualizations:** Create visualizations such as charts or graphs to better understand the relationships between different variables and characteristics within each segment. This can also help in communicating the insights to other stakeholders.





5. **Conduct further analysis:** Conduct further analysis such as regression analysis or predictive modelling to better understand the drivers of each segment's behaviour and preferences.

## Regression

### Putting independent variable as x and dependent variables as y

```
df['PowerTrain'].replace(to_replace=['RWD','AWD','FWD'],value=[0, 2,1],inplace=True)
x=df[['AccelSec','Range_Km','TopSpeed_KmH','Efficiency_WhKm','RapidCharge','PowerTrain']]
y=df['PriceEuro']
```

x

	AccelSec	Range_Km	TopSpeed_KmH	Efficiency_WhKm	RapidCharge	PowerTrain
0	4.6000	450	233	161	1	2
1	10.0000	270	160	167	1	0
2	4.7000	400	210	181	1	2
3	6.8000	360	180	206	1	0
4	9.5000	170	145	168	1	0
...	...	...	...	...	...	...
98	7.5000	330	160	191	1	1
99	4.5000	335	210	258	1	2
100	5.9000	325	200	194	1	2
101	5.1000	375	200	232	1	2
102	7.5000	400	190	238	1	2

By profiling and describing potential segments, businesses can gain a deeper understanding of their customers and tailor their marketing efforts, product offerings, and other business strategies to better target each segment. For example, if a segment consists primarily of young, urban customers who prioritize convenience and sustainability, businesses may focus on offering fast charging options or EV rental services. Similarly, if a segment is primarily concerned with the cost of ownership, businesses may offer financing or leasing options to attract customers. Overall, profiling and describing potential segments can help businesses make more informed decisions and better serve their customers.

#### Selection of target segment:

Selecting a target segment is a critical decision that can significantly impact the success of a business. The following are some key factors that businesses should consider when selecting a target segment:

1. **Segment size and growth potential:** The size and growth potential of the segment should be carefully evaluated, as targeting a large and growing segment can provide significant opportunities for business growth.
2. **Segment profitability:** The profitability of the segment should also be considered, as targeting segments with higher profit margins can help maximize revenue and profitability.

3. **Alignment with business objectives:** The target segment should align with the business objectives and goals of the company. For example, if the company's goal is to increase its market share in the EV market, targeting segments with low market penetration may be a good strategy.
4. **Competitive landscape:** The competitive landscape should also be evaluated when selecting a target segment, as targeting segments with low competition can help businesses gain a competitive advantage.
5. **Resource availability:** The resources available to the business should also be considered when selecting a target segment. For example, if a business has limited resources, targeting a large and diverse segment may not be feasible.
6. **Customer needs and preferences:** The needs and preferences of the customers in each segment should be carefully evaluated, as targeting segments that align with the business's offerings can help improve customer satisfaction and loyalty.

Overall, selecting a target segment is a strategic decision that should be based on a careful analysis of various factors such as segment size, growth potential, profitability, alignment with business objectives, competitive landscape, resource availability, and customer needs and preferences. By targeting the right segment, businesses can improve their chances of success and achieve their goals in the EV market in India.

## Customizing the Marketing Mix:

Customizing the marketing mix for each target segment is essential to effectively reach and engage with customers in each segment. The marketing mix consists of the four Ps: product, price, promotion, and place. The following are some key strategies for customizing the marketing mix for different target segments in the EV market in India:

1. **Product:** The product offerings should be tailored to the specific needs and preferences of each target segment. For example, offering EV models with longer range and faster charging options for segments that prioritize convenience, or affordable EV models for price-sensitive segments.
2. **Price:** The pricing strategy should be aligned with the budget and price sensitivity of each target segment. For example, offering financing or leasing options for segments that are concerned about the cost of ownership, or premium pricing for segments that value luxury and performance.
3. **Promotion:** The promotion strategy should be customized to resonate with the values and preferences of each target segment. For example, using social media and influencer marketing to target younger, tech-savvy segments, or partnering with sustainability-focused organizations to reach environmentally conscious segments.
4. **Place:** The distribution strategy should be tailored to the convenience and accessibility needs of each target segment. For example, offering home charging solutions or partnering with charging station networks to improve the availability and accessibility of charging infrastructure for segments that prioritize convenience.



By customizing the marketing mix for each target segment, businesses can improve the effectiveness of their marketing efforts and better connect with customers. This can help businesses build brand awareness, increase customer loyalty, and ultimately drive revenue and profitability in the EV market in India.

### **Potential customer base in the early market, thereby calculating the potential sale (profit) in the early market (Potential Customer Base \* Your Target Price Range = Potential Profit):**

To estimate the potential customer base in the early market for electric vehicles in India, we need to consider factors such as demographic data, consumer behavior, and market trends.

According to recent market research, the early market for electric vehicles in India is expected to be driven by tech-savvy consumers who prioritize environmental sustainability and are willing to pay a premium for the latest technology. This segment is expected to be dominated by urban consumers, particularly in large cities like Delhi, Mumbai, and Bangalore.

Based on this information, we can estimate the potential customer base by looking at the total urban population in India and calculating the percentage of consumers who fit the target demographic. For example, assuming a target demographic of tech-savvy, environmentally conscious urban consumers in the 25-44 age range, we can estimate the potential customer base as follows:

- Total urban population in India: 471 million (Source: World Bank)
- Estimated target demographic: 20% of urban population = 94.2 million
- Estimated market penetration in early market: 5% of target demographic = 4.7 million

To calculate the potential profit in the early market, we need to multiply the potential customer base by the target price range. Assuming a target price range of Rs. 10 lakh - 20 lakh for electric vehicles, we can estimate the potential profit as follows:

- Potential customer base: 4.7 million
- Target price range: Rs. 10 lakh - 20 lakh
- Potential profit: Rs. 47,000 crore - 94,000 crore

Of course, these estimates are based on assumptions and market research and should be treated as a rough estimate rather than an exact prediction. Nevertheless, they can provide valuable insights into the potential size and profitability of the early market for electric vehicles in India.



# Indian EV Market

