ELECTRIC VEHICLE MARKET SEGMENTATION IN INDIA

FEYNN LAB

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LINK: https://github.com/ishaaaa12/Electric-Vehicle-Market-Segmentation

PROBLEM STATEMENT

Task is to analyse the Electric Vehicle market in India using Segmentation analysis and come up with a feasible strategy to enter the market, targeting the segments most likely to use Electric vehicles.

In this report, we analyse the Electric Vehicle Market in India using segments such as region, type of vehicle (two wheeler, passenger car etc.), manufacturing brand, selling price, fuel type, transmission type etc.

FERMI ESTIMATION

Approximate population of India: 1.4 billion (1,400,000,000)

where

Urban population: ~35% of the total population.

Rural population: ~65% of the total population.

Urban population: 1.4 billion * 0.35 = 490 million.
Rural population: 1.4 billion * 0.65 = 910 million.

Assume the middle and upper-income segments are the primary target for EVs.
Middle and upper-income households: ~20% of the urban population.
Middle and upper-income households in urban areas: 490 million * 0.20 = 98 million.

Average household size: ~4 members.
Number of middle and upper-income households: 98 million / 4 = 24.5 million households.

Suppose percentage of households owning vehicles: ~50%.

Households with vehicles: 24.5 million * 0.50 = 12.25 million.

Current EV market penetration in India: ~1%.

Existing EV owners: 12.25 million * 0.01 = 0.1225 million (122,500 households).

Expected annual growth rate of the EV market: ~30% per year over the next decade.

Doubling time (using Rule of 70): 70 / 30 ≈ 2.3 years.

Projected EV market size in 5 years: 122,500 * (1.3) ^5 ≈ 456,000 households.

Projected EV market size in 10 years: 122,500 * (1.3 ^10 ≈ 1.7 million households.

DATA SOURCES

Data was collected from various sources to study the Electric Vehicle Market in India.

Links:

https://www.kaggle.com/datasets/karivedha/indian-consumers-cars-purchasing-behaviour

https://www.kaggle.com/datasets/praveenchoudhary1217/electric-vehicle-sales-in-india

https://www.kaggle.com/datasets/gokulprasantht/car-details-from-car-dekho

https://github.com/ishaaaa12/Electric-Vehicle-Market-Segmentation/tree/main/Datasets

Column Explanation:

1. ‘Name’ tells the name of the vehicle
2. ‘Brand’ tells the manufacturer of the vehicle
3. ‘Year’ gives the year in which the vehicle was sold

4. ‘Selling price’ and ‘km driven’ gives us the price and range of vehicle.
5. ‘States’ gives the name of the state of India where the vehicle was sold.
6. **‘**Two Wheelers (Category L1 & L2 as per Central Motor Vehicles Rules’, ‘Two Wheelers (Category L2 (CMVR)), ‘Two Wheelers (Max power not exceeding 250 Watts)’, ‘Passenger Cars (Category M1 as per CMVR)’ etc are the types of vehicles in the market.

DATA PREPROCESSING

Libraries Pandas, NumPy and Scikit-learn were used for this purpose.

1. Created the column ‘brand’
2. Deleted the columns ‘Three Wheelers (Category L5 slow speed as per CMVR)’, Three Wheelers (Category L5 as per CMVR)’, ‘Buses’ as they mostly had null values.
3. Used Column Transformer to apply StandardScaler for numerical features and OneHotEncoder for categorical features.

EXPLORATORY DATA ANALYSIS (EDA)

EDA is a thorough examination meant to uncover the underlying structure of a dataset and is important for a company because it exposes trends, patterns and relationships that are not readily apparent.

We analysed our data using univariate, bivariate and multivariate analysis with the help of the libraries Matplotlib and Seaborn

The bar graph below shows the diversity of the data geographically.

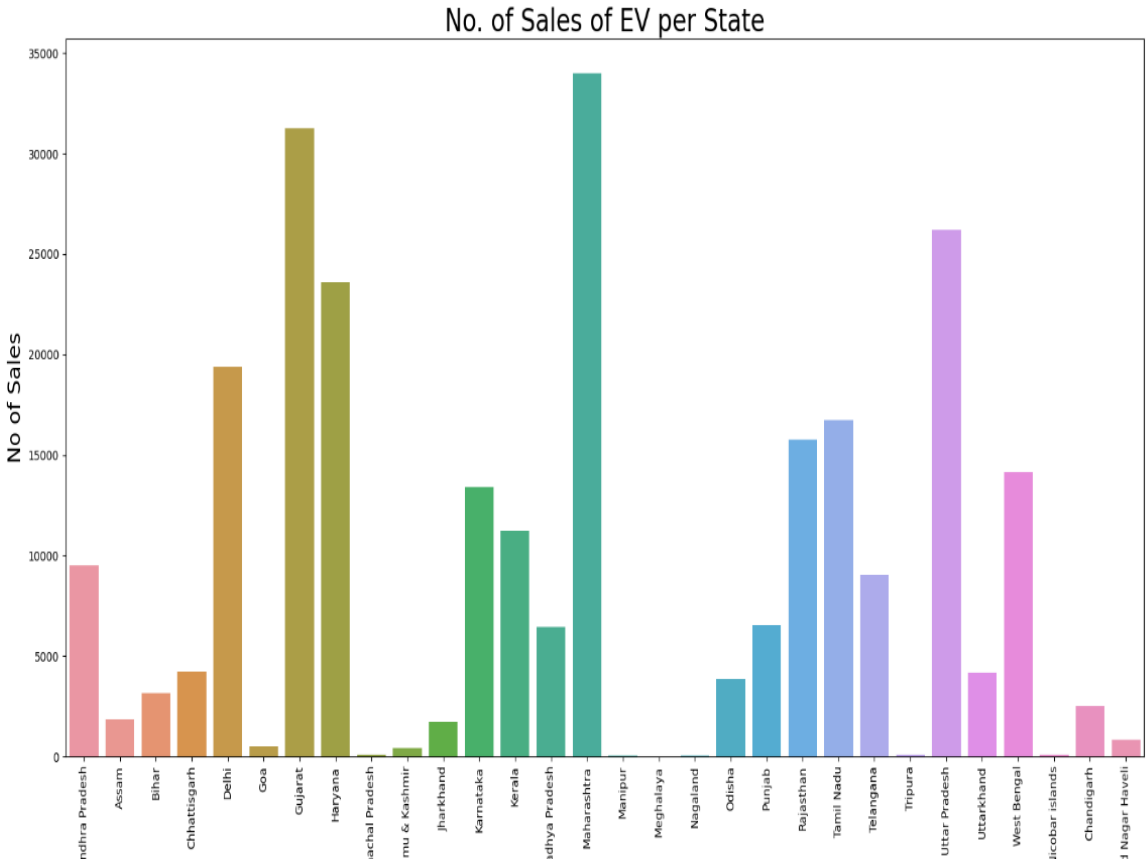

No. of Sales of EV per State
No of Sales
35000
30000
25000
20000
15000
10000
5000
0
Assam
Bihar
Chhattisgarh
Delhi
Goa
Gujarat
Haryana
Jharkhand
Karnataka
Kerala
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
Chandigarh

Fig 1

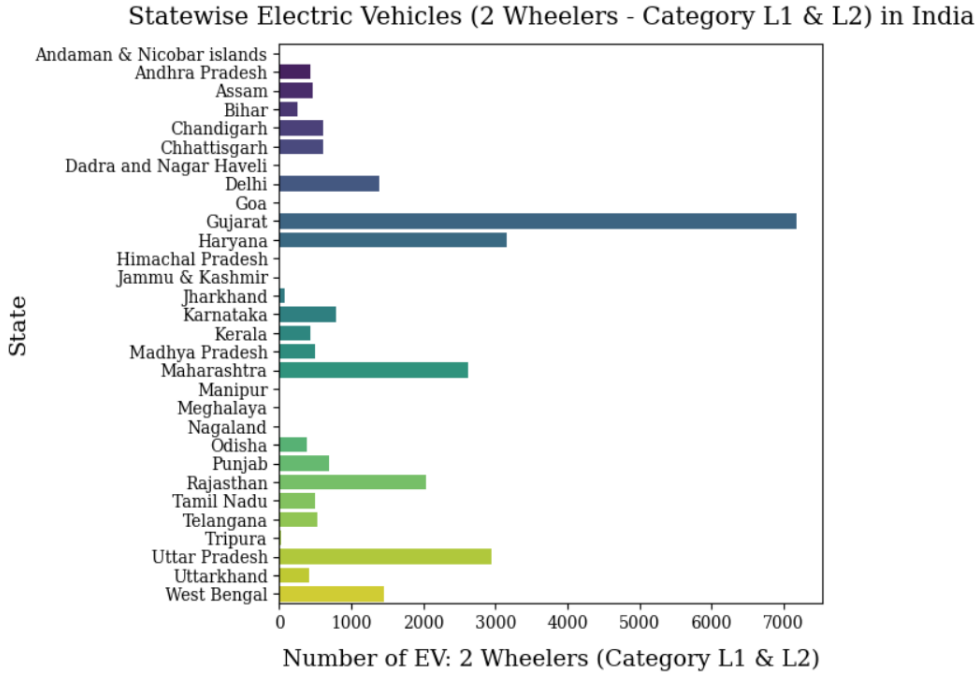

Statewise Electric Vehicles (2 Wheelers - Category L1 & L2) in India
State
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
0
1000
2000
3000
4000
5000
6000
7000
Number of EV: 2 Wheelers (Category L1 & L2)

Fig 2

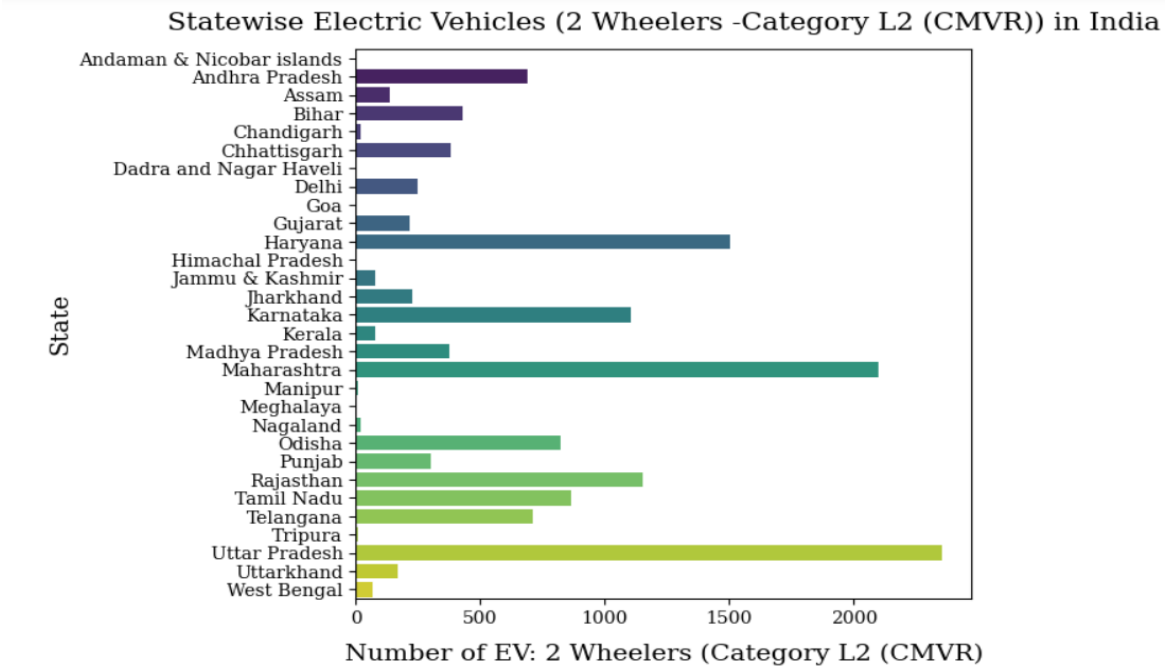

Statewise Electric Vehicles (2 Wheelers -Category L2 (CMVR)) in India
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
State
0
500
1000
1500
2000
Number of EV: 2 Wheelers (Category L2 (CMVR)

Fig 3

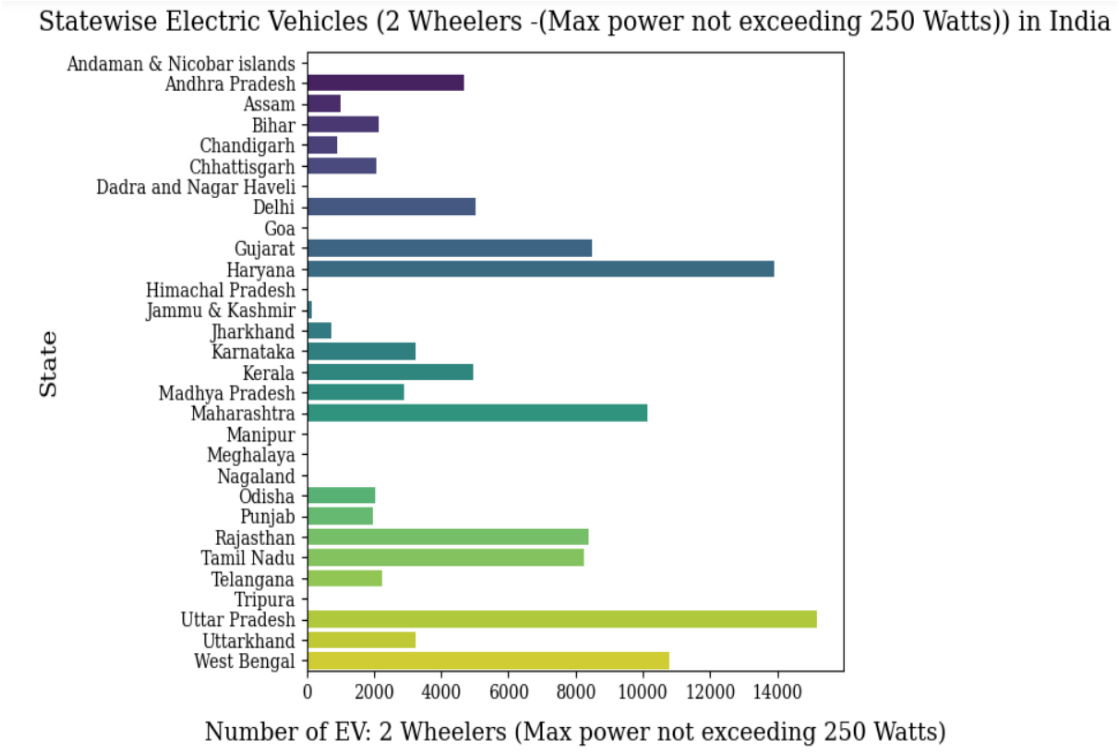

Statewise Electric Vehicles (2 Wheelers -(Max power not exceeding 250 Watts)) in India
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
State
0
2000
4000
6000
8000
10000
12000
14000
Number of EV: 2 Wheelers (Max power not exceeding 250 Watts)

Fig 4

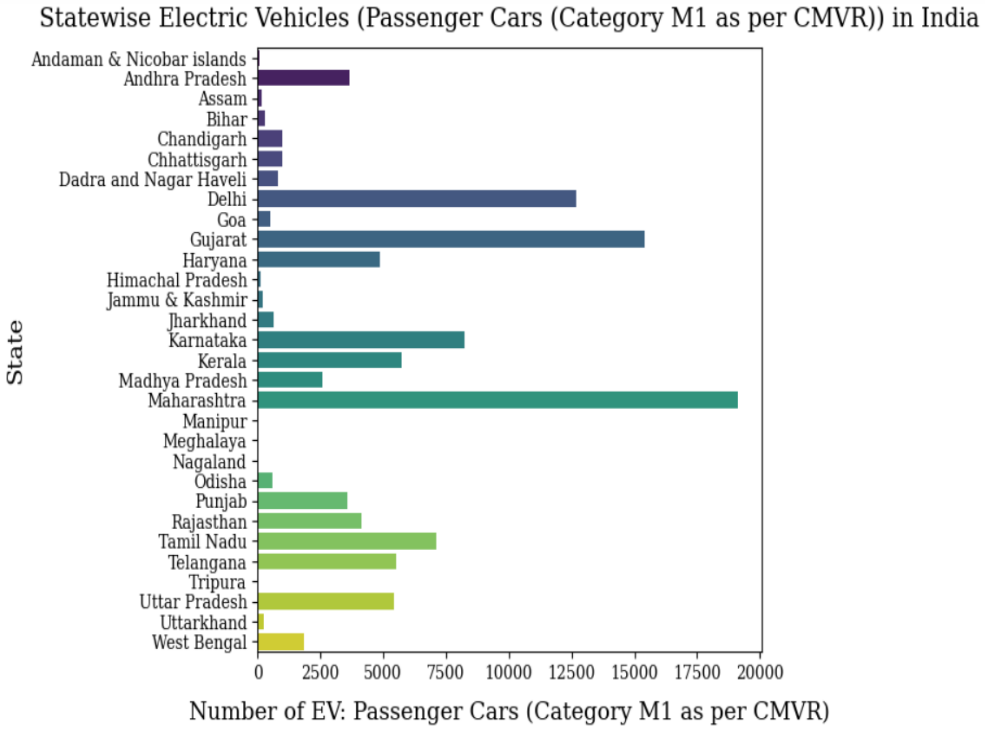

Statewise Electric Vehicles (Passenger Cars (Category M1 as per CMVR)) in India
Andaman & Nicobar islands
Andhra Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Dadra and Nagar Haveli
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jammu & Kashmir
Jharkhand
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Nagaland
Odisha
Punjab
Rajasthan
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarkhand
West Bengal
State
0
2500
5000
7500
10000
12500
15000
17500
20000
Number of EV: Passenger Cars (Category M1 as per CMVR)

Fig 5

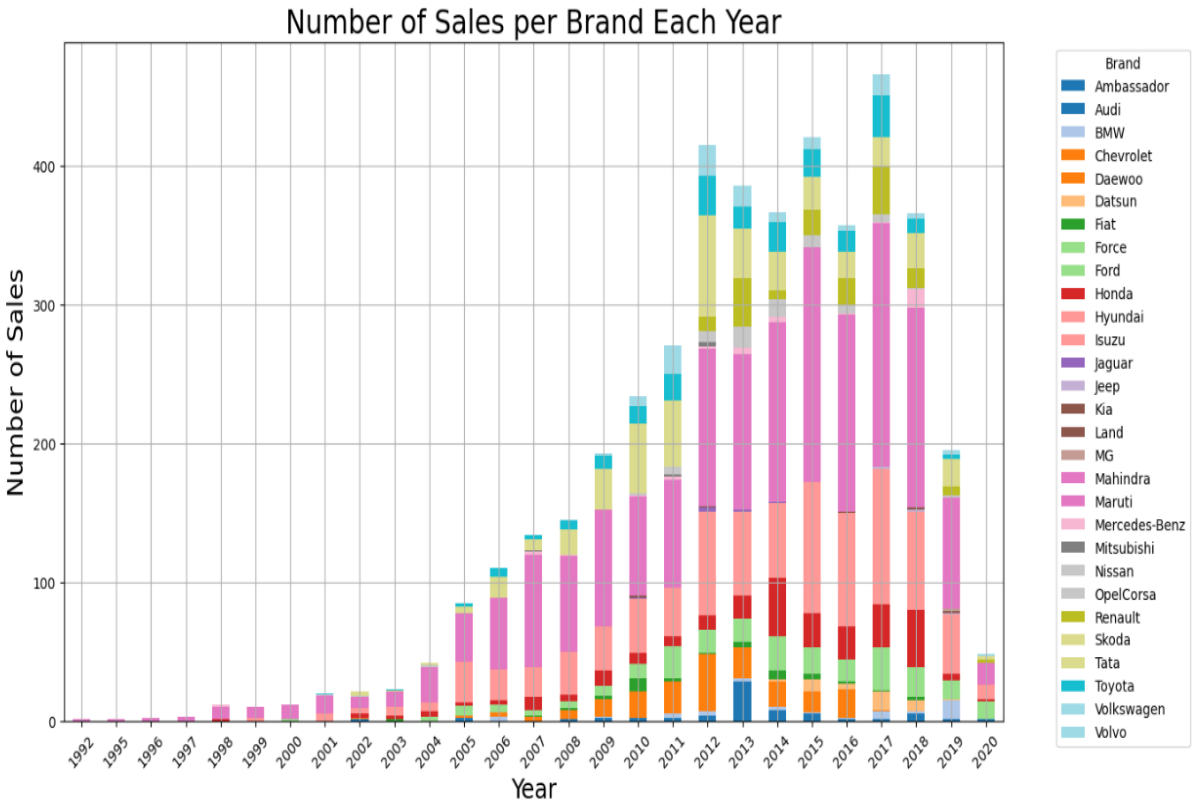

Number of Sales per Brand Each Year
Number of Sales
0
100
200
300
400
1992
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Year
Brand
Ambassador
Audi
BMW
Chevrolet
Daewoo
Datsun
Fiat
Force
Ford
Honda
Hyundai
Isuzu
Jaguar
Jeep
Kia
Land
MG
Mahindra
Maruti
Mercedes-Benz
Mitsubishi
Nissan
OpelCorsa
Renault
Skoda
Tata
Toyota
Volkswagen
Volvo

Fig 6

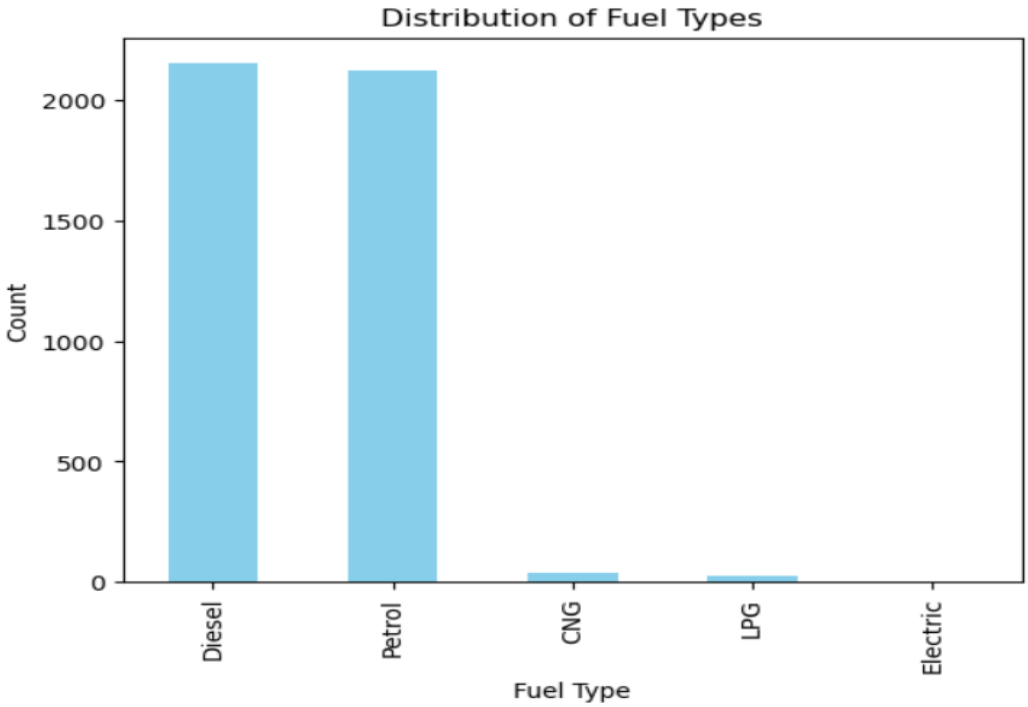

Distribution of Fuel Types
Count
2000
1500
1000
500
0
Diesel
Petrol
CNG
LPG
Electric
Fuel Type

Fig 7

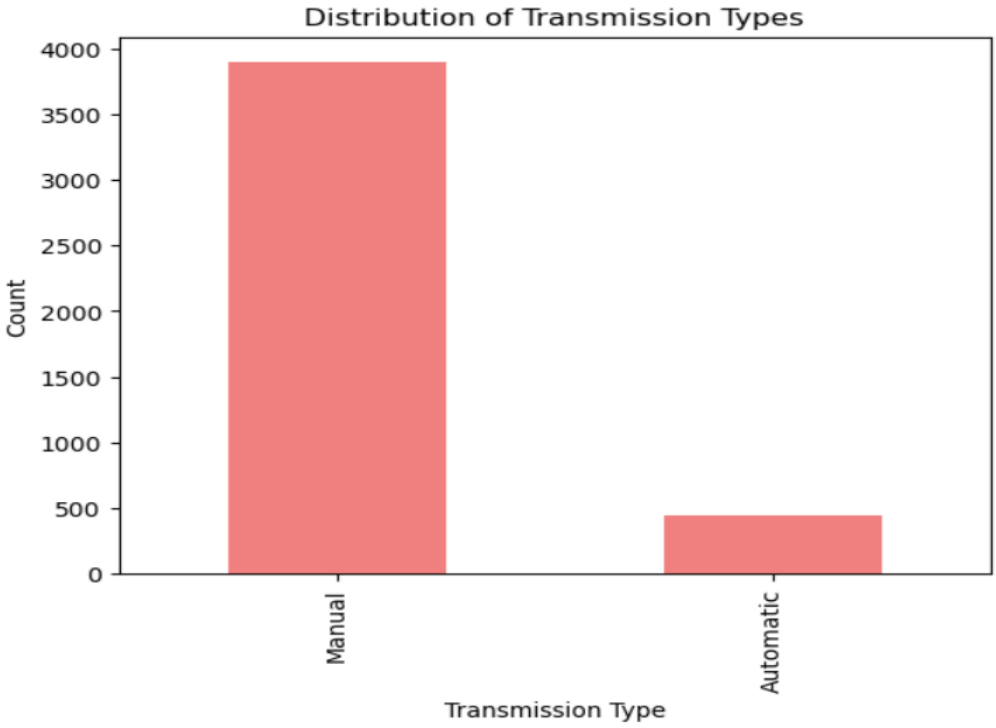

Distribution of Transmission Types
Count
4000
3500
3000
2500
2000
1500
1000
500
0
Manual
Automatic
Transmission Type

Fig 8

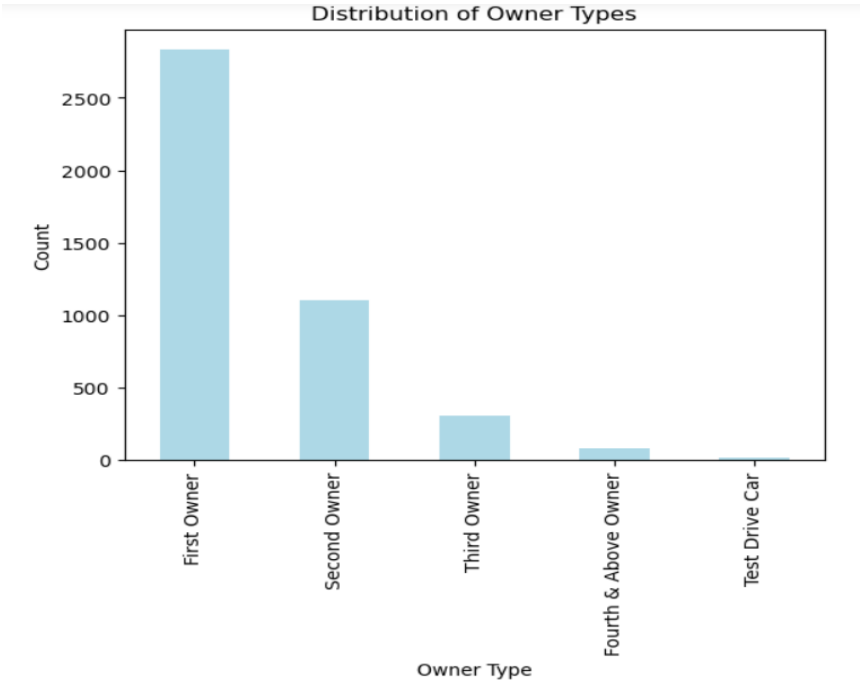

Distribution of Owner Types
Count
2500
2000
1500
1000
500
0
First Owner
Second Owner
Third Owner
Fourth & Above Owner
Test Drive Car
Owner Type

Fig 9

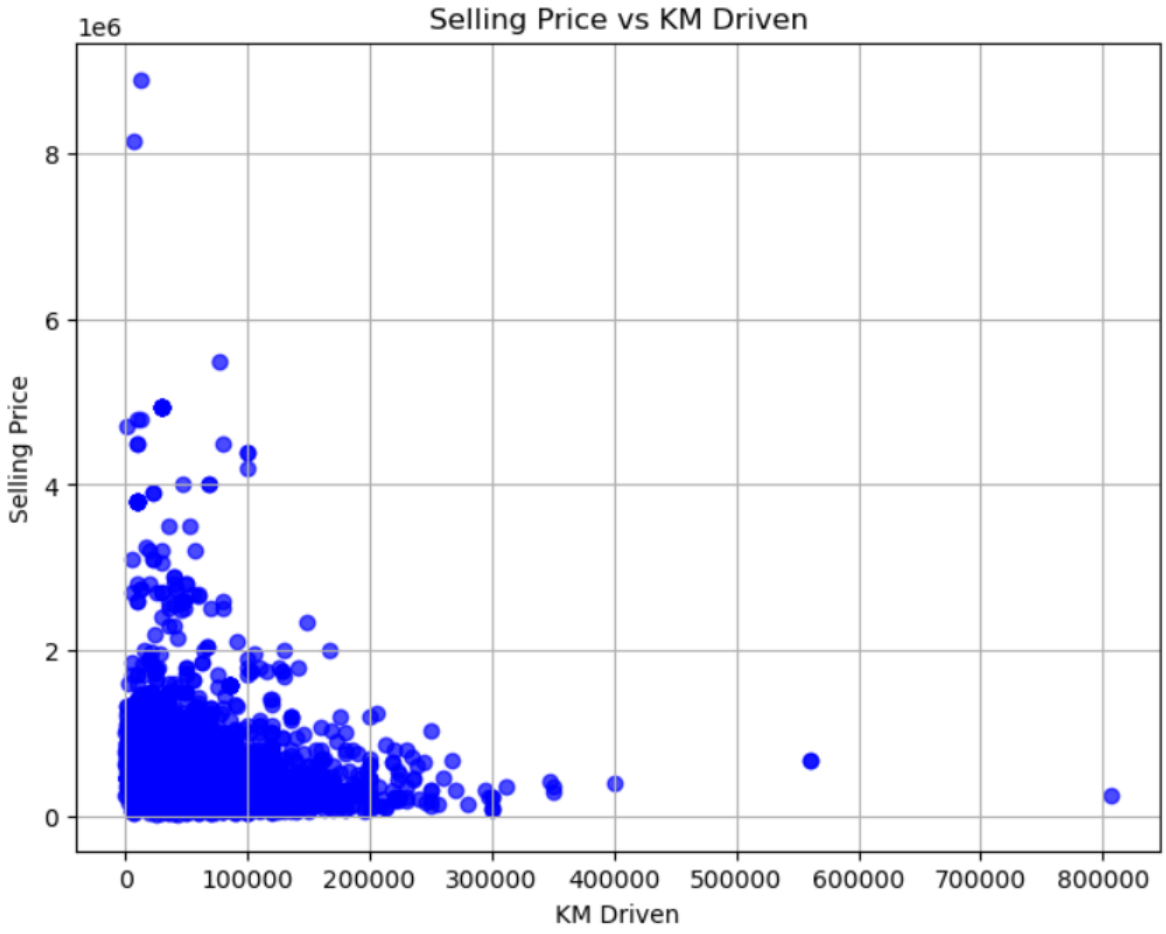

Selling Price vs KM Driven
1e6
8
6
4
2
0
Selling Price
0
100000
200000
300000
400000
500000
600000
700000
800000
KM Driven

Fig 10

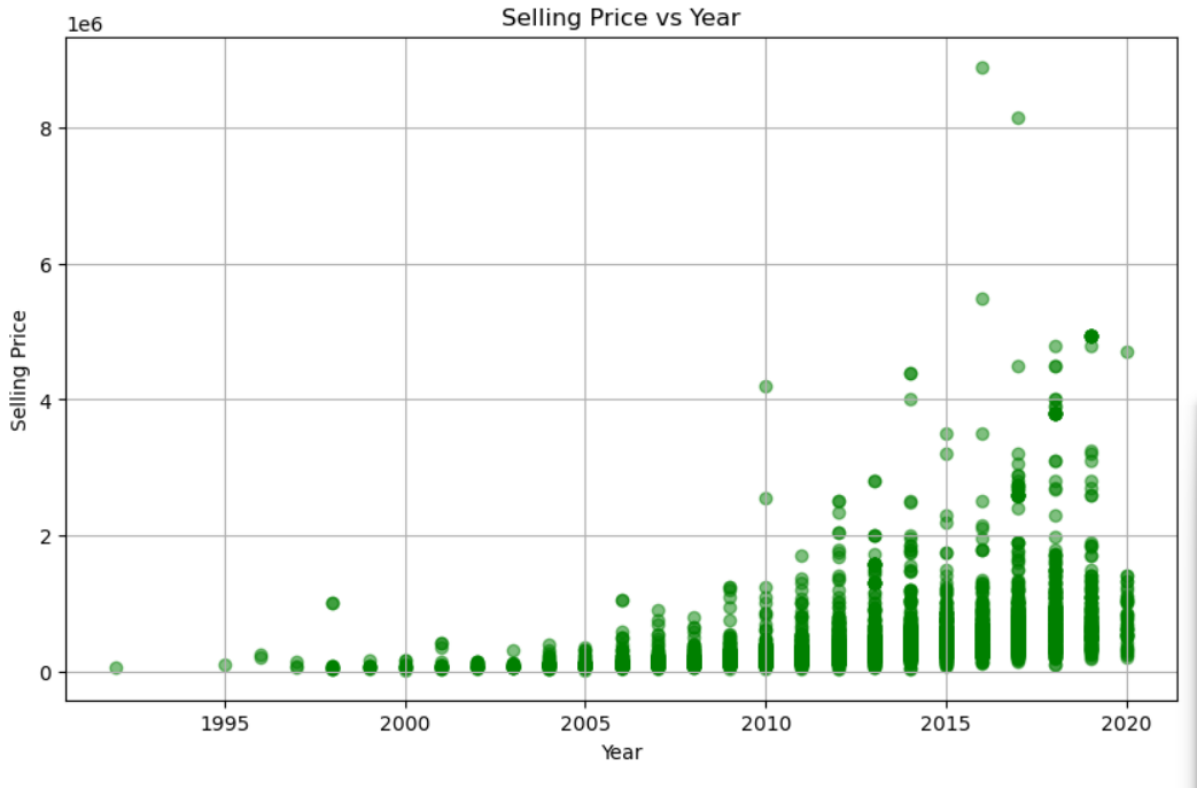

Selling Price vs Year
1e6
Selling Price
Year
0
2
4
6
8
1995
2000
2005
2010
2015
2020

Fig 11

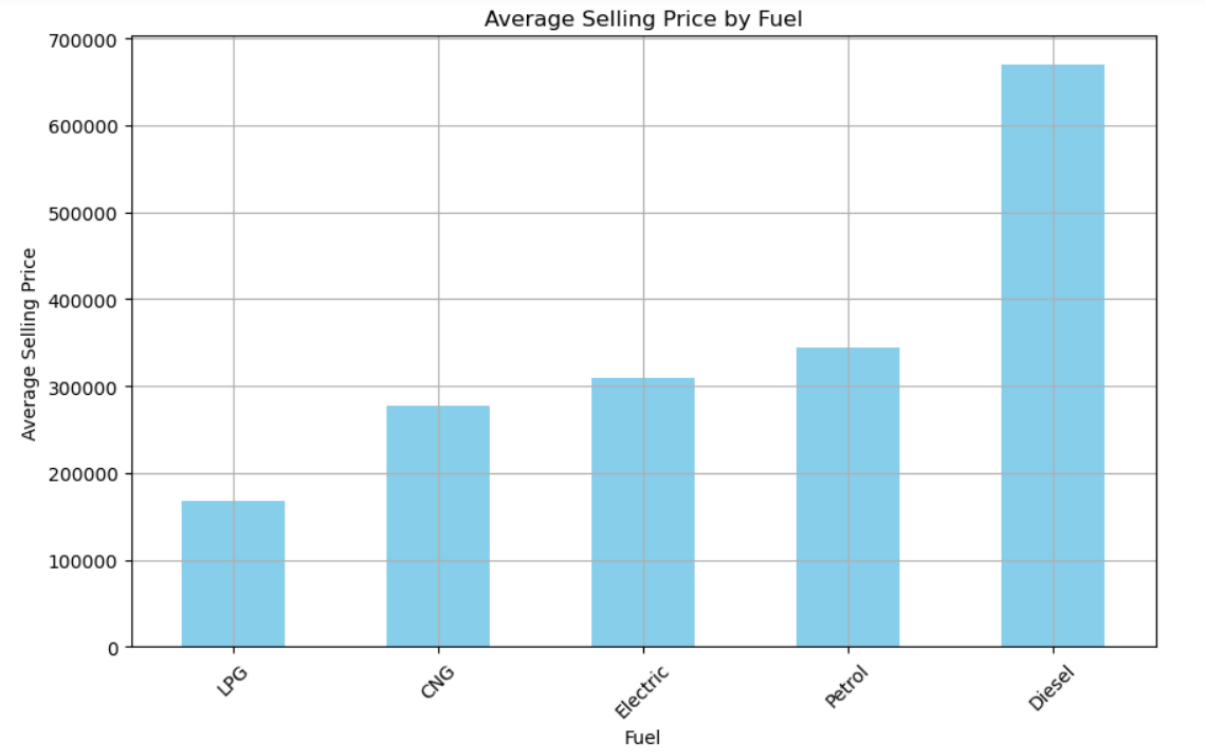

Average Selling Price by Fuel
Average Selling Price
Fuel
0
100000
200000
300000
400000
500000
600000
700000
LPG
CNG
Electric
Petrol
Diesel

Fig 12

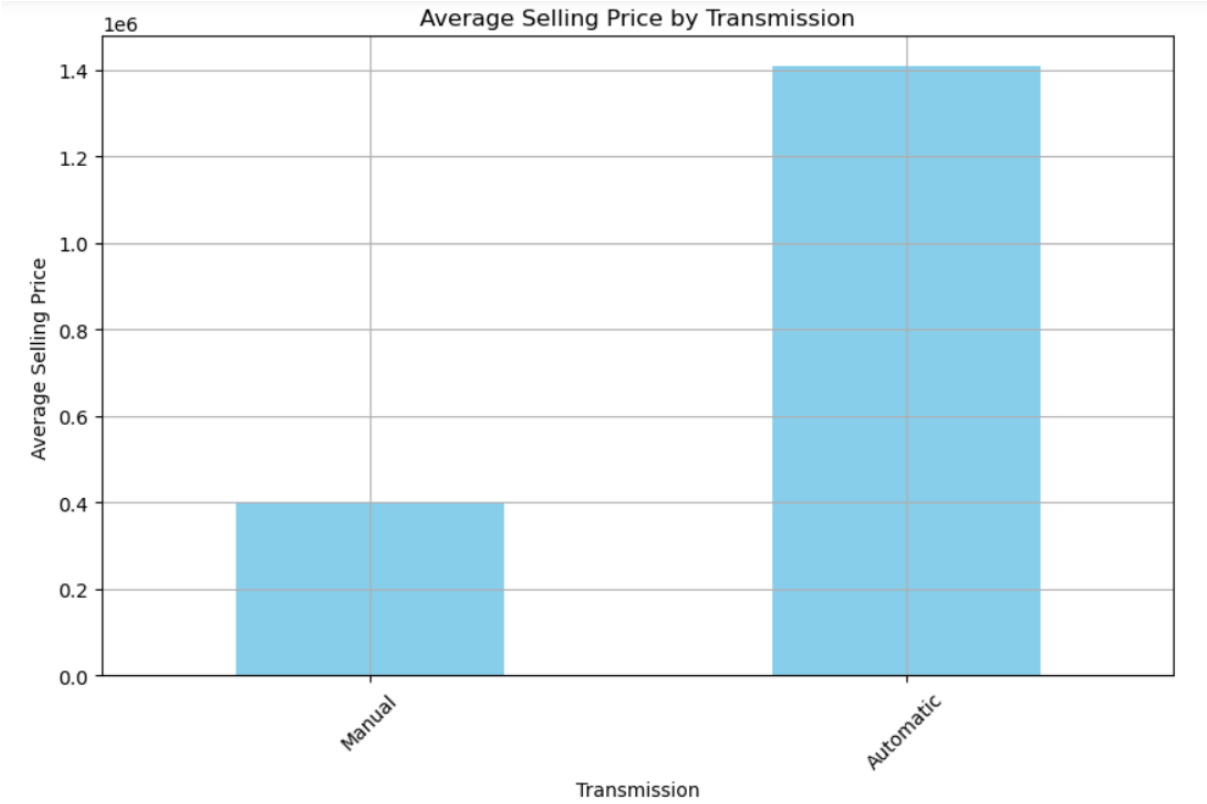


Fig 13

SEGMENT EXTRACTION

K means is one of the most popular Unsupervised Machine Learning Algorithms Used for Solving Classification Problems. K Means segregates the unlabelled data into various groups, called clusters, based on having similar features, common patterns.

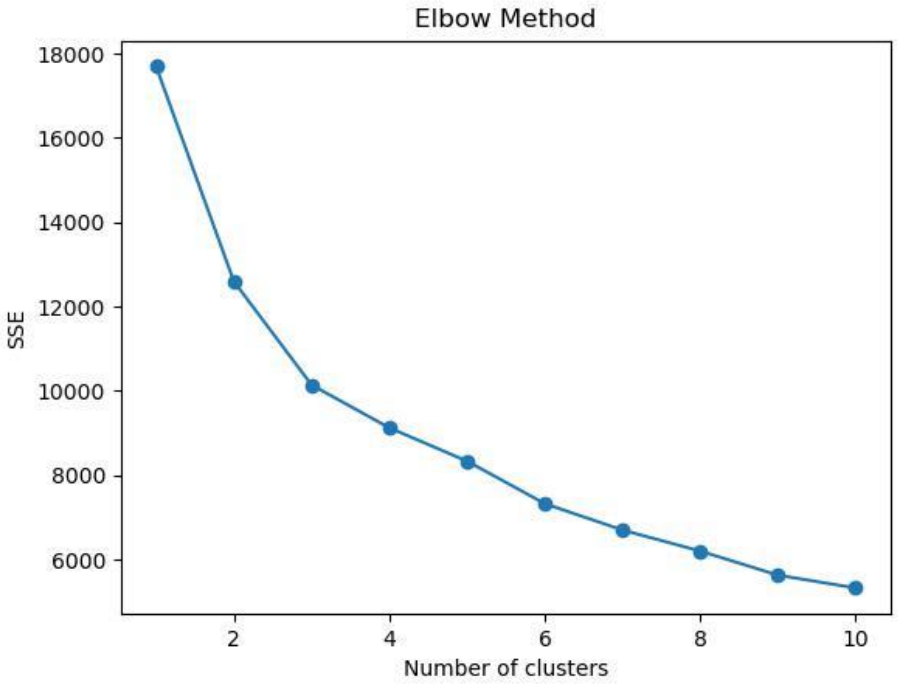
Suppose we have N number of Unlabelled Multivariate Datasets of various features like fuel, price, city etc. from our dataset. The technique to segregate Datasets into various groups, on the basis of having similar features and characteristics, is called Clustering. The groups being Formed are known as Clusters. Clustering is being used in Unsupervised Learning Algorithms in Machine Learning as it can segregate multivariate data into various groups, without any supervisor, on the basis of a common pattern hidden inside the datasets.

The Elbow Method is a technique used to determine the optimal number of clusters (k) in K-means clustering. It involves plotting the sum of squared errors (SSE) against the number of clusters and identifying the "elbow point," where the rate of decrease in SSE sharply slows down. The "elbow" point represents a balance between having a low SSE (indicating tight clusters) and avoiding overfitting (having too many clusters). The number of clusters at this point is considered optimal.

The Silhouette Score is a measure of how similar an object is to its own cluster compared to other clusters. It ranges from -1 to 1, where a higher score indicates that the object is well-matched to its own cluster and poorly matched to neighbouring clusters.

Both methods are useful for determining the appropriate number of clusters in your data, with the Elbow Method providing a visual way to identify the optimal k and the Silhouette Score providing a numerical measure of cluster quality.

When we analyse the graph below, we can see that the graph is rapidly changing at a point and thus an elbow shape is created.




```
Number of clusters: 3, Silhouette Score: 0.304788268044309
```

Fig 14

Based on the K-means clustering output, we have 3 clusters with different characteristics. Analysing these findings, it can interpretated that-

CLUSTER 0
This cluster likely represents older, more affordable EVs with higher mileage. These vehicles are generally older models, which might appeal to budget-conscious buyers or those looking for a secondary vehicle.

CLUSTER 1
This cluster likely represents relatively newer, mid-range EVs with moderate mileage. These vehicles are mostly newer models with a balance of affordability and features, appealing to average consumers looking for a reliable and reasonably priced EV.

CLUSTER 2
This cluster likely represents premium, high-end EVs with higher price points but lower mileage compared to cluster 0. These vehicles are likely to be luxury models, appealing to affluent buyers who prioritize advanced features and newer models.

PROFILING POTENTIAL SEGMENTS

- GEOGRAPHIC SEGMENTATION
  Geographic segmentation is based on consumer's location such as city, state or country.
  Some factors that can be considered are –
  1. Urban vs rural areas
  2. City specific segmentation
     Metropolitan cities have higher EV penetration due to better infrastructure, higher purchasing power.
     Tier-2 and Tier-3 cities are witnessing gradual growth in EV adoption as infrastructure improves and awareness increases.

- DEMOGRAPHIC SEGMENTATION
  Demographic segmentation is based on demographic characteristics such as age, gender, income, family size, occupation, education level etc.

- PSYCHOGRAPHIC SEGMENTATION
  Psychographic segmentation is based on consumer's personality and lifestyle characteristics such as lifestyle, personality, values, attitudes etc.

- BEHAVIOURAL SEGMENTATION
  Behavioural segmentation is based on consumer's buying behavior such as consumer's buying habits, consumer's brand loyalty etc.

SELECTION OF TARGET SEGMENT

The selection of a target segment for the electric vehicle (EV) market in India involves identifying a specific group of consumers who are most likely to adopt EVs based on their needs, preferences, and behaviors.

A potential target segment could be **Urban Young Professionals**:

- **Demographics:** Age 25-40 years, urban residents, with moderate to high income levels.
- **Psychographics:** Tech-savvy, environmentally conscious, value convenience and innovative features.
- **Behavioral Factors:** Early adopters of technology, willing to invest in sustainable products, use EVs for daily commute.

CUSTOMISING THE MARKET MIX

Customizing the marketing mix for the electric vehicle (EV) market in India involves tailoring the 4Ps (Product, Price, Place, and Promotion) to effectively reach and engage the target segments identified through geographic, demographic, psychographic, and behavioral segmentation

PRODUCT

Product segmentation strategy is based on consumer's need, benefit, price sensitivity etc. Product segmentation strategy is used to develop the product or service which will satisfy the needs of consumers. It is very important for the companies to identify their target market before developing their products and services. For the general urban market, EVs should feature advanced technology, robust safety features, and efficient designs to appeal to a broad audience. Offering a variety of models, from entry-level to premium, can cater

to different customer preferences and budgets. Entry-level models should focus on essential features for budget-conscious consumers, while premium models can offer luxury features and advanced technology.

Price

Pricing should be competitive with traditional vehicles, leveraging government incentives and subsidies to make EVs more attractive. Providing flexible financing options, such as low-interest loans and leasing plans, can further enhance affordability. Setting clear price segments for affordable, mid-range, and premium models ensures that different income groups can find suitable options.

Place

Distribution should focus on both online and offline channels. Developing robust online sales platforms can reach tech-savvy consumers, while establishing dealerships and experience centers in urban areas ensures accessibility. Expanding the charging infrastructure through partnerships with real estate developers and local governments is crucial for convenience and widespread adoption.

Promotion

Marketing efforts should combine digital and traditional media to maximize reach. Digital marketing, influencer partnerships, and content marketing can engage younger, tech-savvy consumers, while TV, radio, and print ads can target a broader audience. Organizing test drive events and eco-friendly campaigns can showcase the benefits of EVs, building trust and credibility among potential customers.

MOST OPTIMAL MARKET SEGMENT

Based on the above factors, an optimal segment could be **Urban Young Professionals**:

- **Rationale:**
    - **Demographics:** Typically aged 25-40 years, urban residents with higher disposable incomes.
    - **Psychographics:** Tech-savvy, environmentally conscious, and early adopters of new technology.
    - **Behavioral Traits:** Likely to value convenience, innovative features, and sustainability, making them prime candidates for EV adoption.

- **Market Potential:**
  - Significant market size within urban areas with potential for growth.
  - Increasing awareness and adoption of EVs among younger demographics.
- **Accessibility:**
  - Reachable through digital marketing channels, urban dealership networks, and lifestyle-focused promotions.
  - Willingness to engage with brands offering innovative and sustainable mobility solutions.

CONCLUSION

India is on its way to becoming the third-largest automobile market in the world by 2020. The fastest-growing segment of this market in India is the electric vehicles category. In fact, if EV sales continue to grow at the current rate, they are projected to account for 2% of all new car sales by 2020. This rate of growth is faster than other developed markets and is being driven by government policy, consumer awareness and increased affordability. The Indian government has been driving policy changes that support the development of a sustainable and cost-effective EV charging infrastructure across the country. Electric Vehicle Charging Infrastructure (EVCI) is a technology that enables the charging of electric vehicles. The government has been actively promoting EVCI as a key component of its vision for a sustainable future. In the end, we can say that the market segmentation will be helpful in several ways such as it helps to make your target market clear and also helps to enhance the chances of Electric Vehicles product acceptance. In order to increase market share, marketers must develop a strong strategy focusing on the target segment.