Market Segmentation Analysis of Electric Vehicles Market in India

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Github link:github

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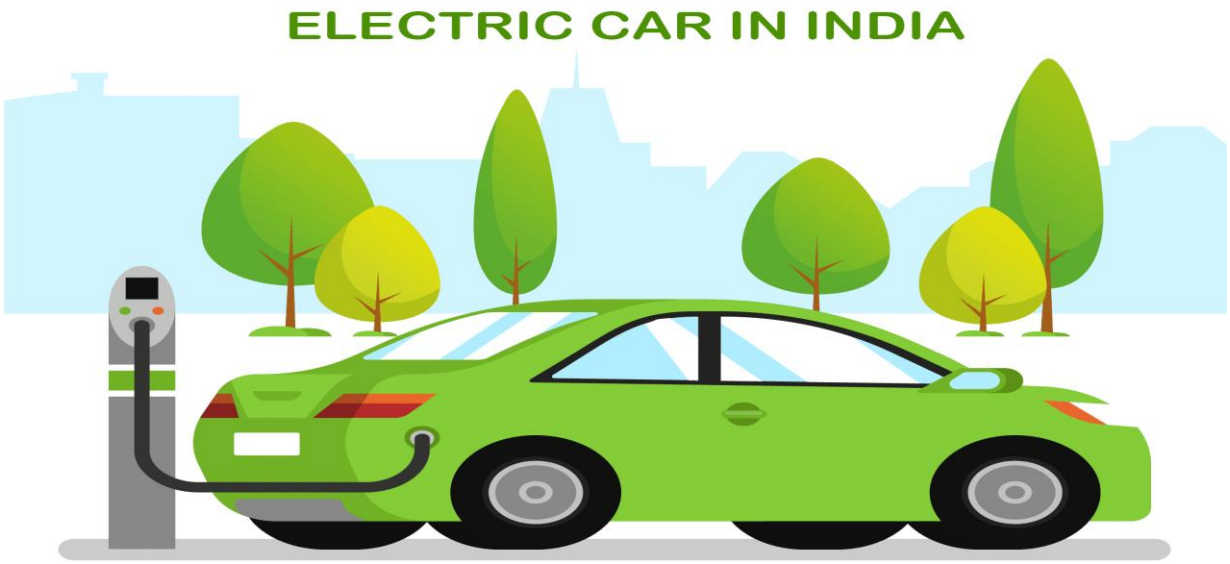


Problem Statement

Task is to analyze the Electric Vehicles Market in India using *Segmentation* analysis and come up with a feasible strategy to enter the market, targeting the segments most likely to use their product in terms of Geographic, Demographic, Psychographic, and Behavioral.
In this report we analyze the Electric Vehicles Market in India using segments such as region, price, charging facility, type of vehicles (e.g., 2 wheelers, 3 wheelers, 4 wheelers etc.), retail outlets, manufacturers, body type (e.g., Hatchback, Sedan, SUV, Autorickshaw etc.), safety, plug types and much more.

Fermi Estimation

Wild Guess: Around 8-10% people will have electric vehicles by the end of 2023 in India. Educated Guess:

Employment rate = it is the ratio of number of available labor force to the population of People in the working age.

We think there are about 1.5 billion Indians in the world. Let's assume the only people over18 and under 60 works, assuming that they account for around 60% of the population then that would make 0.9 billion Indians in the working class. Out of the 0.9 billion people not all are employed, assuming only 2023 had 45%employment rate that would bring the number around 405 million.
Since, not everyone can afford an electric vehicle, let’s assume only people above middle class can afford an electric vehicle, that would be 40 million. Not everyone buysan electric vehicle. Let’s assume out of these 40 million only 10 million are willing to buy an electric vehicle.

Variables and Formulas:

Let E(x) be the employment rate of the year x (in %).Let P(x) be the population

of the year x. Let A(x) be the number of available Labor in the year x.

Let r be the ratio of Indians between the age of 18 and 60 to the total

population of India. $E(x) = (A(x)*100)/(P(x)*r)$

This formula will formulate the Employment ratio for the year x.

Gathering More Information:
Estimation for the population of the year 2022 can be obtained by the increase inpopulation each year

P (2019) = 1.3676 billion
P (2020) = 1.3786 billion
P (2021) = 1.39199 billion

P (2020)-P (2019) = 11million
P (2021)-P (2020) = 13.39 million
the mean would be 12.195 million

thus P (2022) = 1.44185 billion
assuming A(x) is constant every year= 471,688,990r=0.6C=0.75
E (2022) = (471,688,990/(1,441,850,000*0.6))*0.75E (2022) = 42%

Conclusion: By this analysis, we conclude that by the end of the year 2024 there would a Employment rate of 42%. That would make 42% of 405 million i.e., 170 million. Out of these 170 million only 10% afford EV'S. So around 17 million people will have EV's by the end of 2024"

Data Collection

Data was extracted from the various websites mentioned below for EV market segmentation.

Link for data extraction:

- https://pib.gov.in/PressReleasePage.aspx?PRID=1842704
  https://www.ibef.org/blogs/electric- vehicles-market-in-india
  https://evreporter.com/indias-region-wise-ev-market-jan-may-2022/
- https://www.india-briefing.com/news/indias-ev-manufacturing-capacity-and-market- preferences- progress-25840.html/

Data from those links are extracted by Google play scraper available on libraries package. There are multiple datasets get extracted from those websites in CSV and Excel formats. There are some pdfs also which contains valuable information regarding the EV market. We have extracted data from those pdfs as well.

Raw data generated:

https://www.kaggle.com/datasets/kkhandekar/electric-vehicles-india

Columns explanations:

1. 'Brand' and tells the manufacturers of electric vehicles.
2. 'model' tells the various of electric vehicles.

3. ‘AccelSec’, ‘Top Speed’, ’Power Train’ tells specification about the vehicles.
4. ‘Range_km’, ‘Fast_Charge’, ‘Plug_type’ and ‘Bodystyle’ tells us about rangeof vehicle per full charge,fast charging is provided or not, type of charging plug and body style of vehicle respectively.
5. ‘Seats’ and ‘Price’ tells about the number of seats available on vehicle and theirprice.
6. ‘Region’ and ‘State/UT’ tells about the states of India.
7. ‘EV Charging Facility’ and ‘Chargers’ tells about the facility of charging in the respectivestates.
8. ‘2V’, ‘3V’, ‘4V’, ‘Bus’ tells about the type of vehicles in the market.

Data Preprocessing

Steps taken to preprocess the scraped raw data:

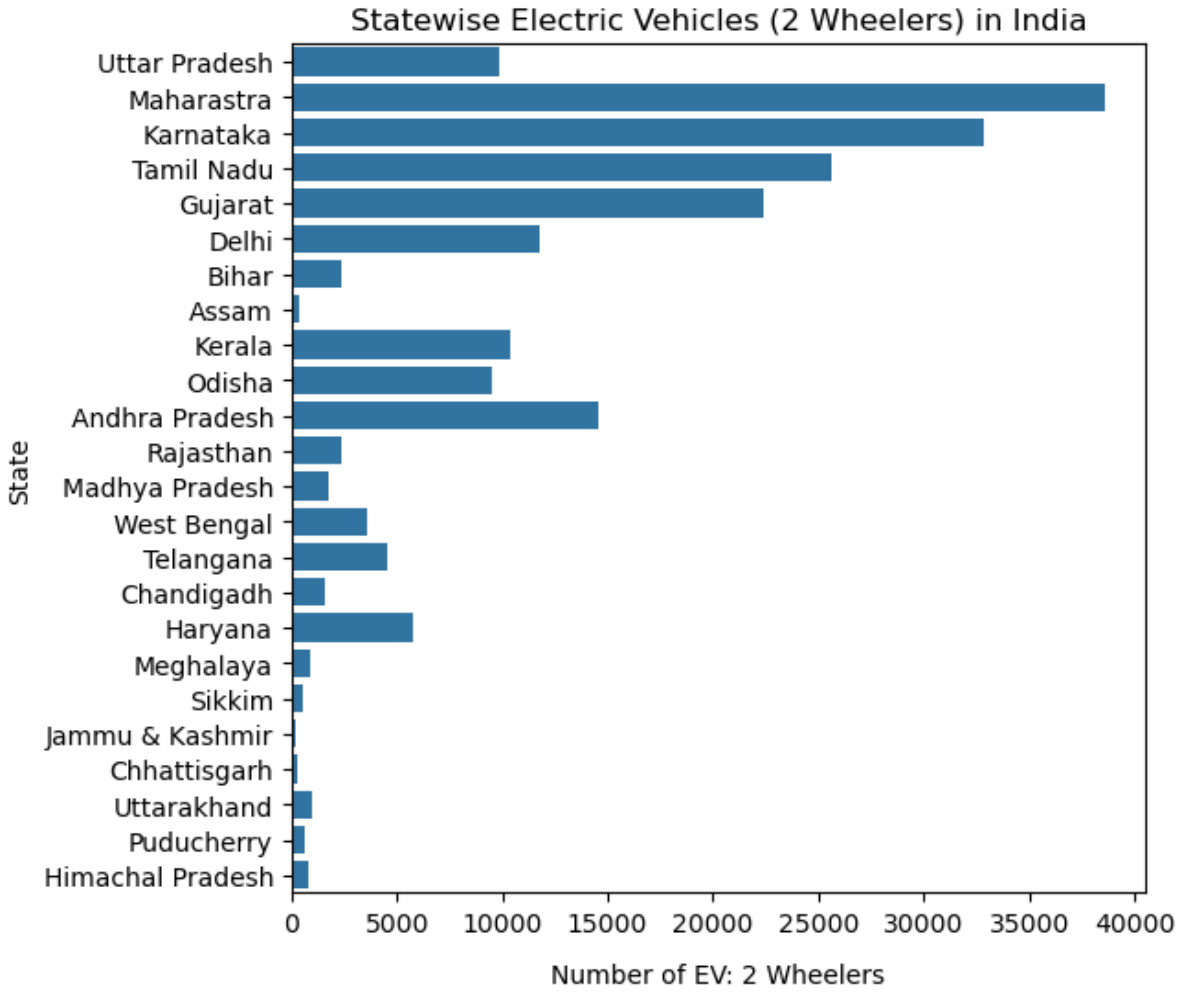
1. Ordinal encoded 'PowerTrain'
2. Label encoded 'RapidCharge’
3. Used Label Encoder and Standard Scaler package for preprocessing of the dataset.

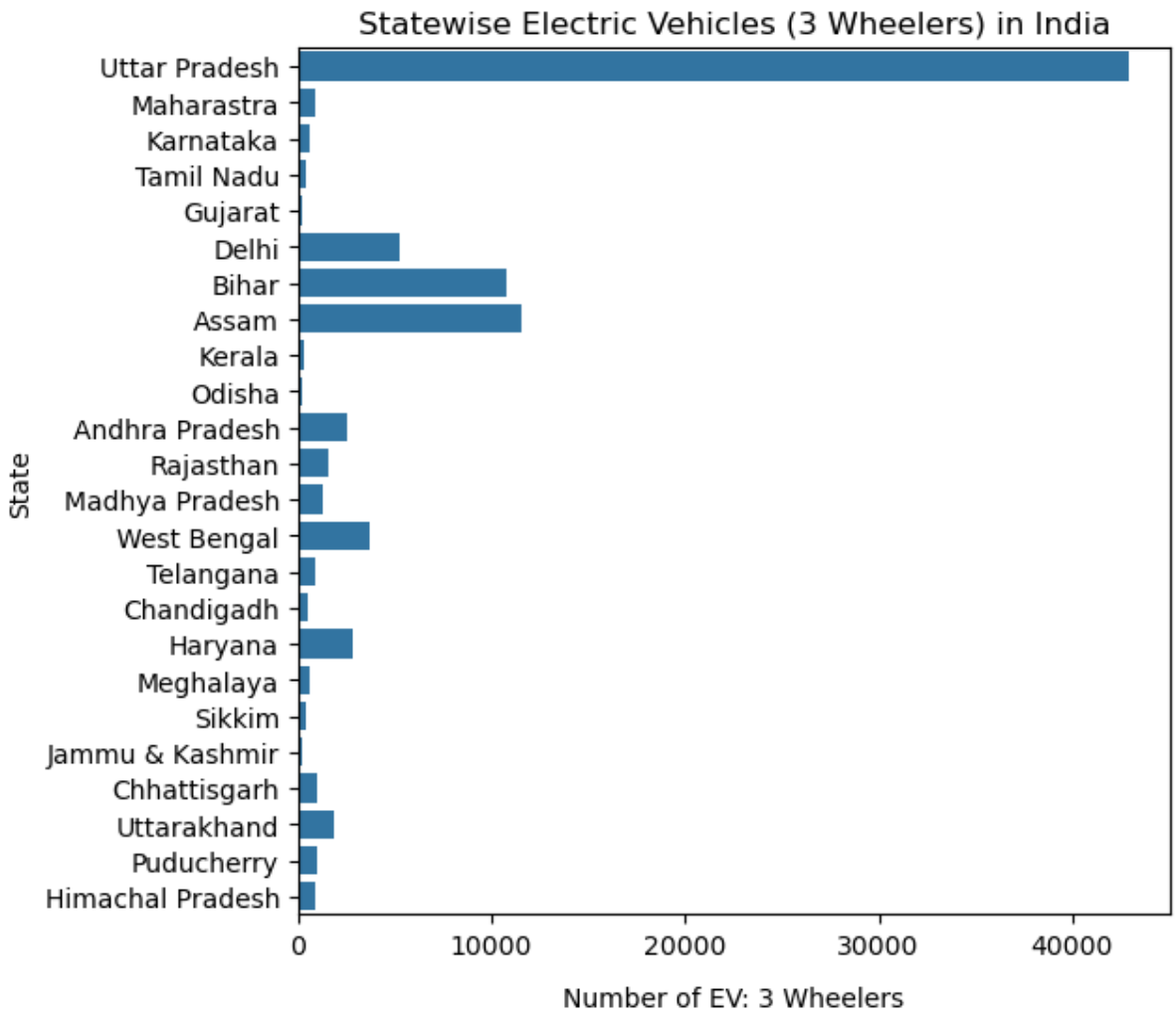
Exploratory Data Analysis

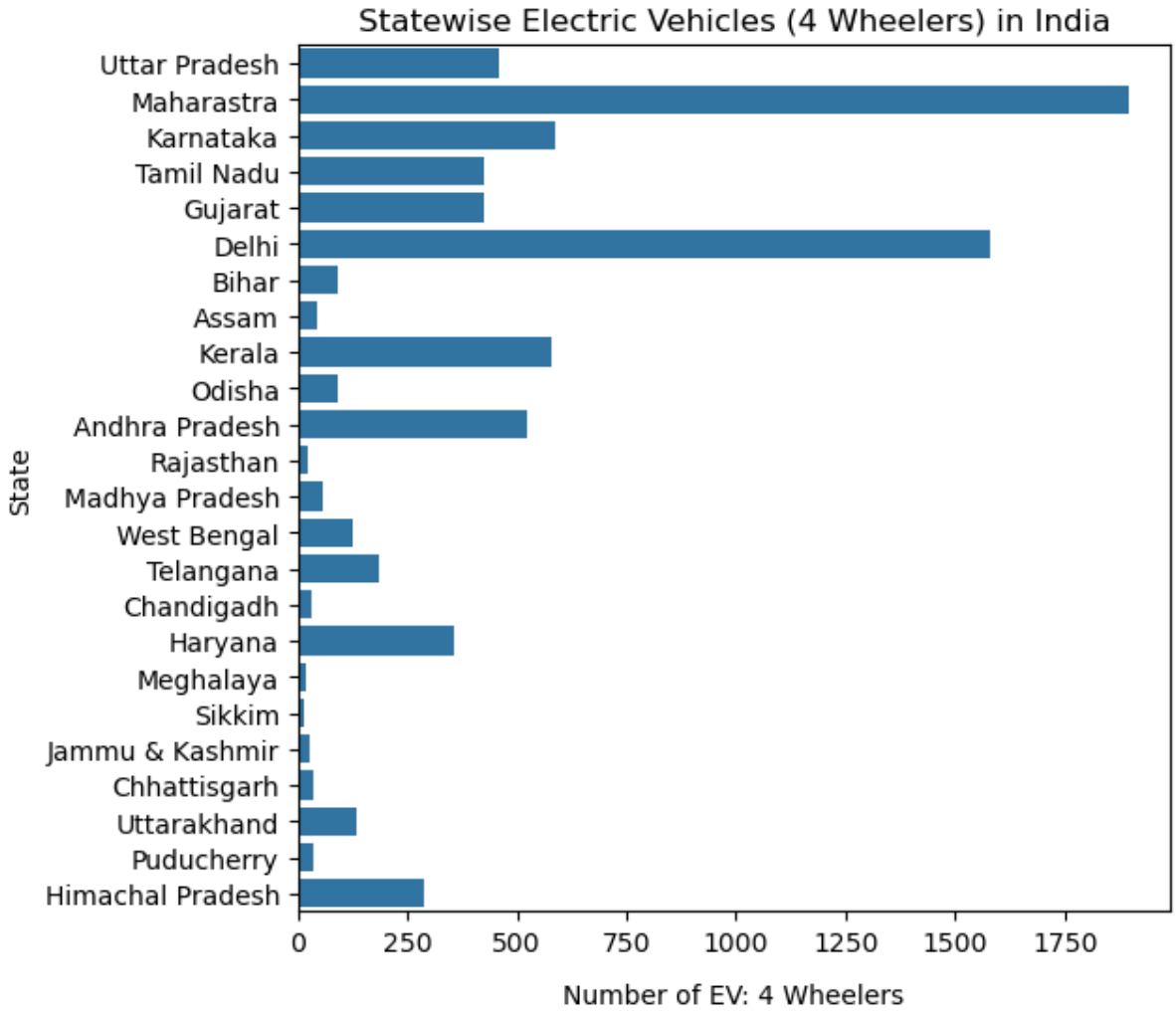
An Exploratory Data Analysis or EDA is a thorough examination meant to uncover the underlying structure of a data set and is important for a company because it exposes trends, patterns, and relationships that are not readily apparent.

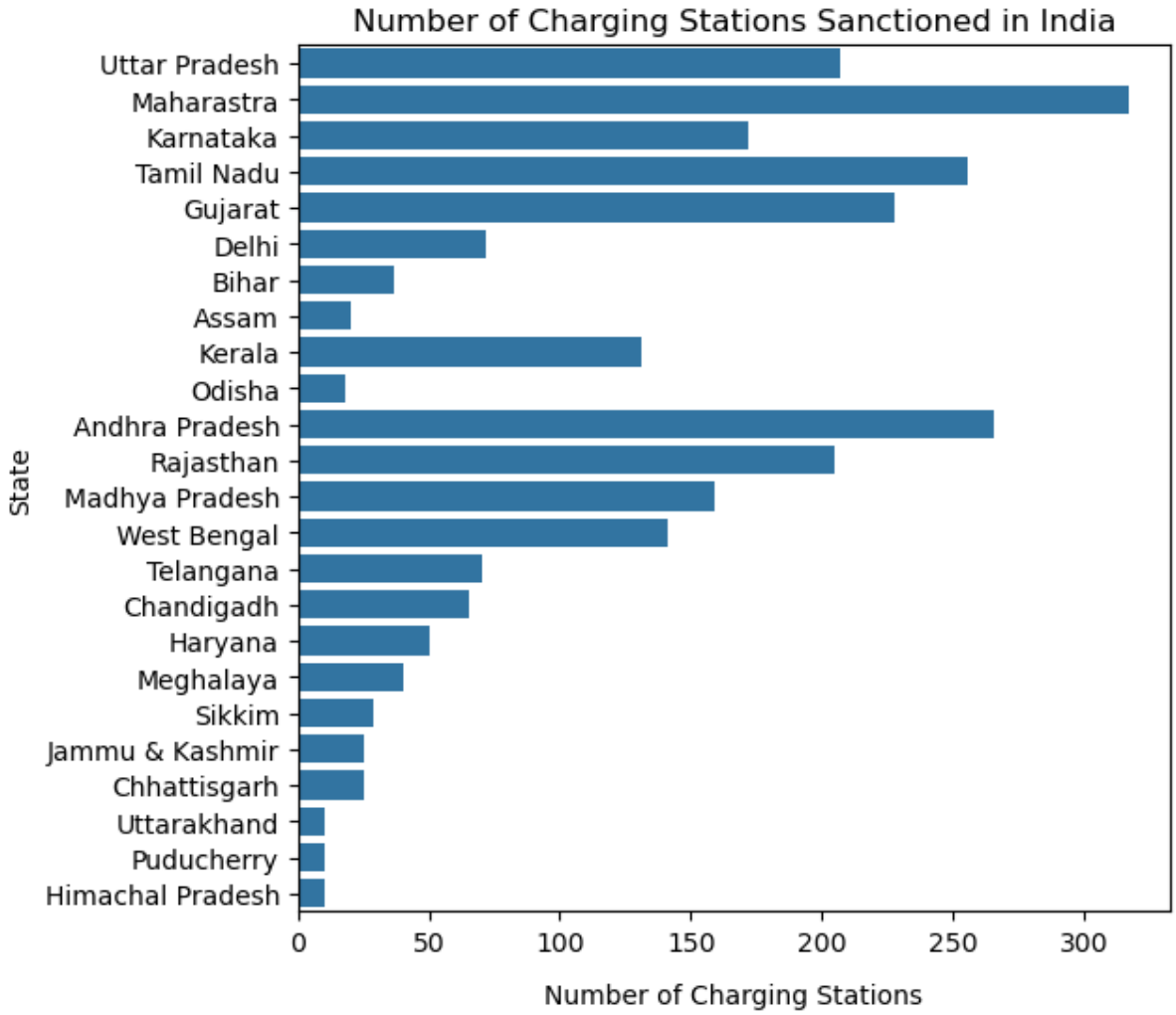
We analyzed our dataset using *univariate* (analyze data over a single variable/column from a dataset), *bivariate* (analyze data by taking two variables/columns into consideration from a dataset) and *multivariate* (analyze data by taking more than two variables/columns into consideration from a dataset) analysis.

The bar graph below shows the diversity of the data geographically. We can see that we have the maximum amount of data of states *Karnataka* and *Maharashtra*; and minimum amount of data for *Sikkim, Meghalaya, Lakshadweep, Ladakh,* and *Dadra and Nagar Haveli and Daman and Diu*. There are a total of 1536 rows of data distributed amongthe cities shown in the graph.

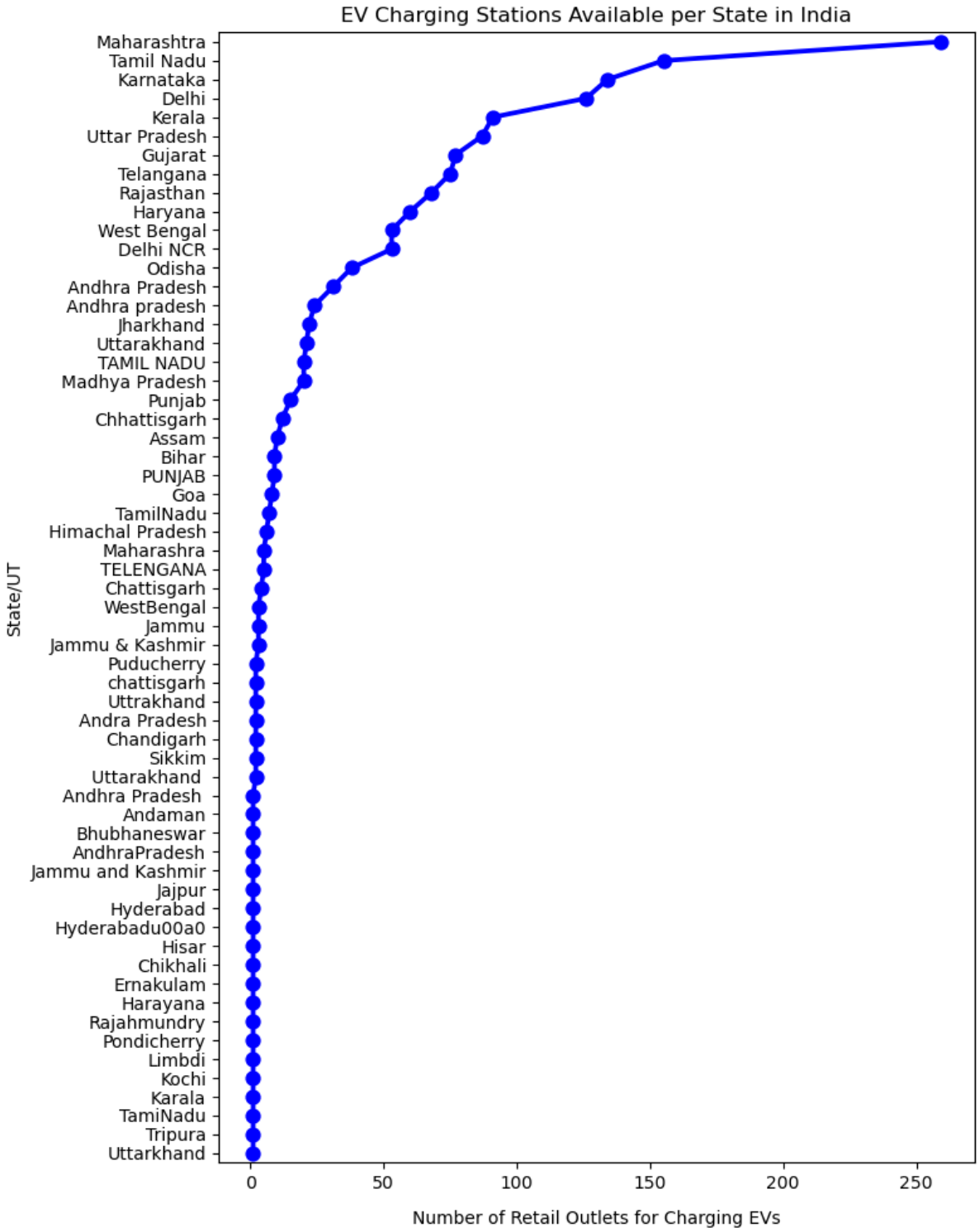

Statewise Electric Vehicles (2 Wheelers) in India
Uttar Pradesh
Maharastra
Karnataka
Tamil Nadu
Gujarat
Delhi
Bihar
Assam
Kerala
Odisha
Andhra Pradesh
Rajasthan
Madhya Pradesh
West Bengal
Telangana
Chandigadh
Haryana
Meghalaya
Sikkim
Jammu & Kashmir
Chhattisgarh
Uttarakhand
Puducherry
Himachal Pradesh
State
0
5000
10000
15000
20000
25000
30000
35000
40000
Number of EV: 2 Wheelers


Statewise Electric Vehicles (3 Wheelers) in India
Uttar Pradesh
Maharastra
Karnataka
Tamil Nadu
Gujarat
Delhi
Bihar
Assam
Kerala
Odisha
Andhra Pradesh
Rajasthan
Madhya Pradesh
West Bengal
Telangana
Chandigadh
Haryana
Meghalaya
Sikkim
Jammu & Kashmir
Chhattisgarh
Uttarakhand
Puducherry
Himachal Pradesh
State
0
10000
20000
30000
40000
Number of EV: 3 Wheelers

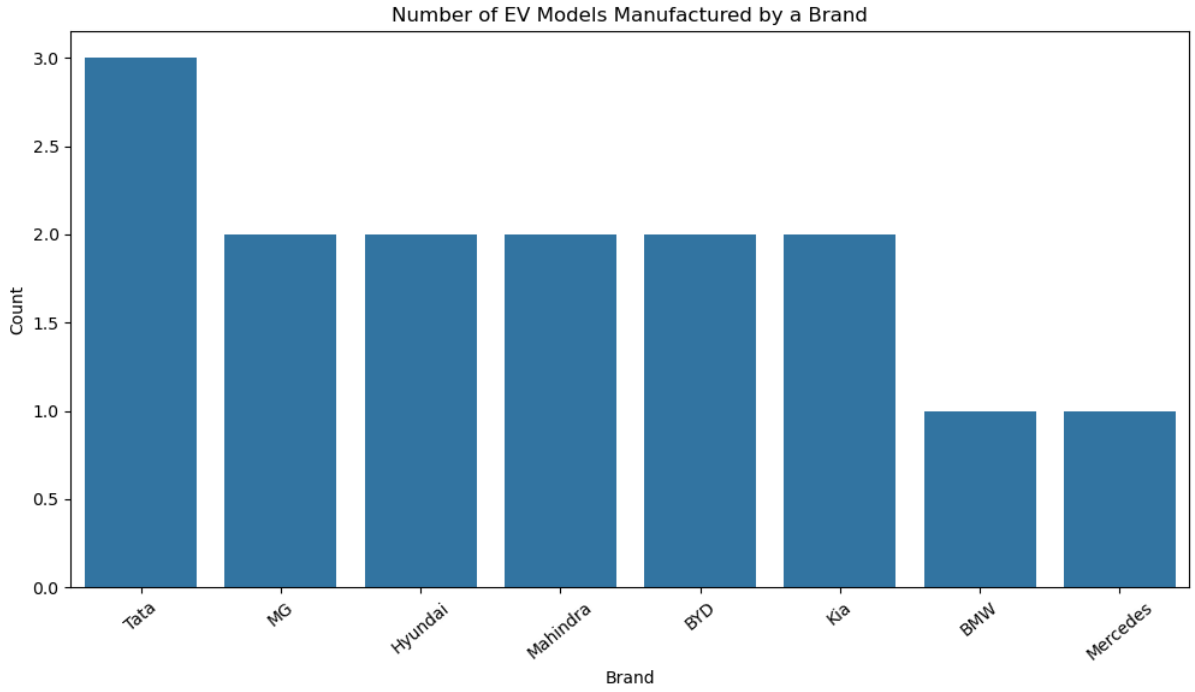

Statewise Electric Vehicles (4 Wheelers) in India
Uttar Pradesh
Maharastra
Karnataka
Tamil Nadu
Gujarat
Delhi
Bihar
Assam
Kerala
Odisha
Andhra Pradesh
Rajasthan
Madhya Pradesh
West Bengal
Telangana
Chandigadh
Haryana
Meghalaya
Sikkim
Jammu & Kashmir
Chhattisgarh
Uttarakhand
Puducherry
Himachal Pradesh
State
0
250
500
750
1000
1250
1500
1750
Number of EV: 4 Wheelers

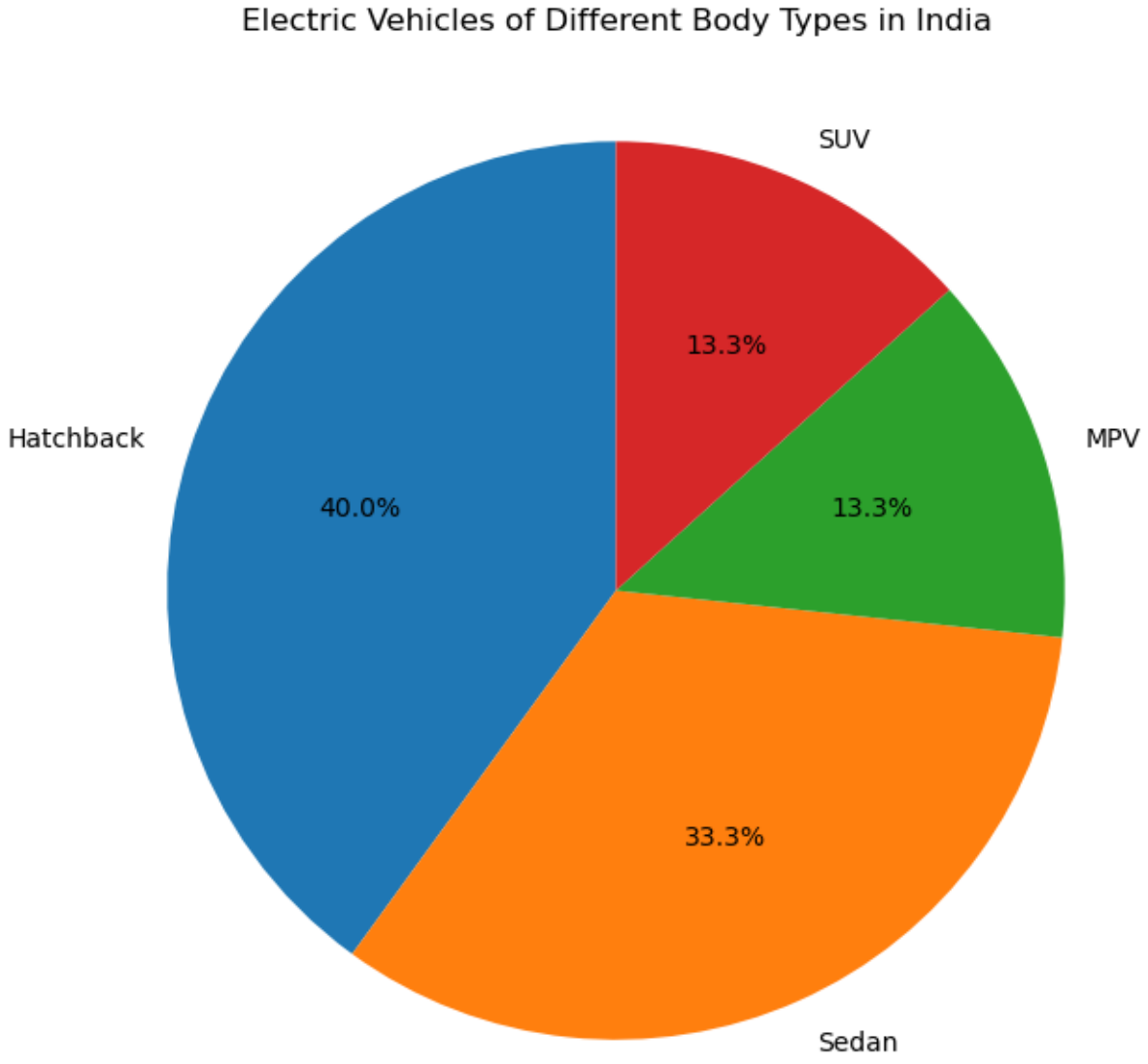


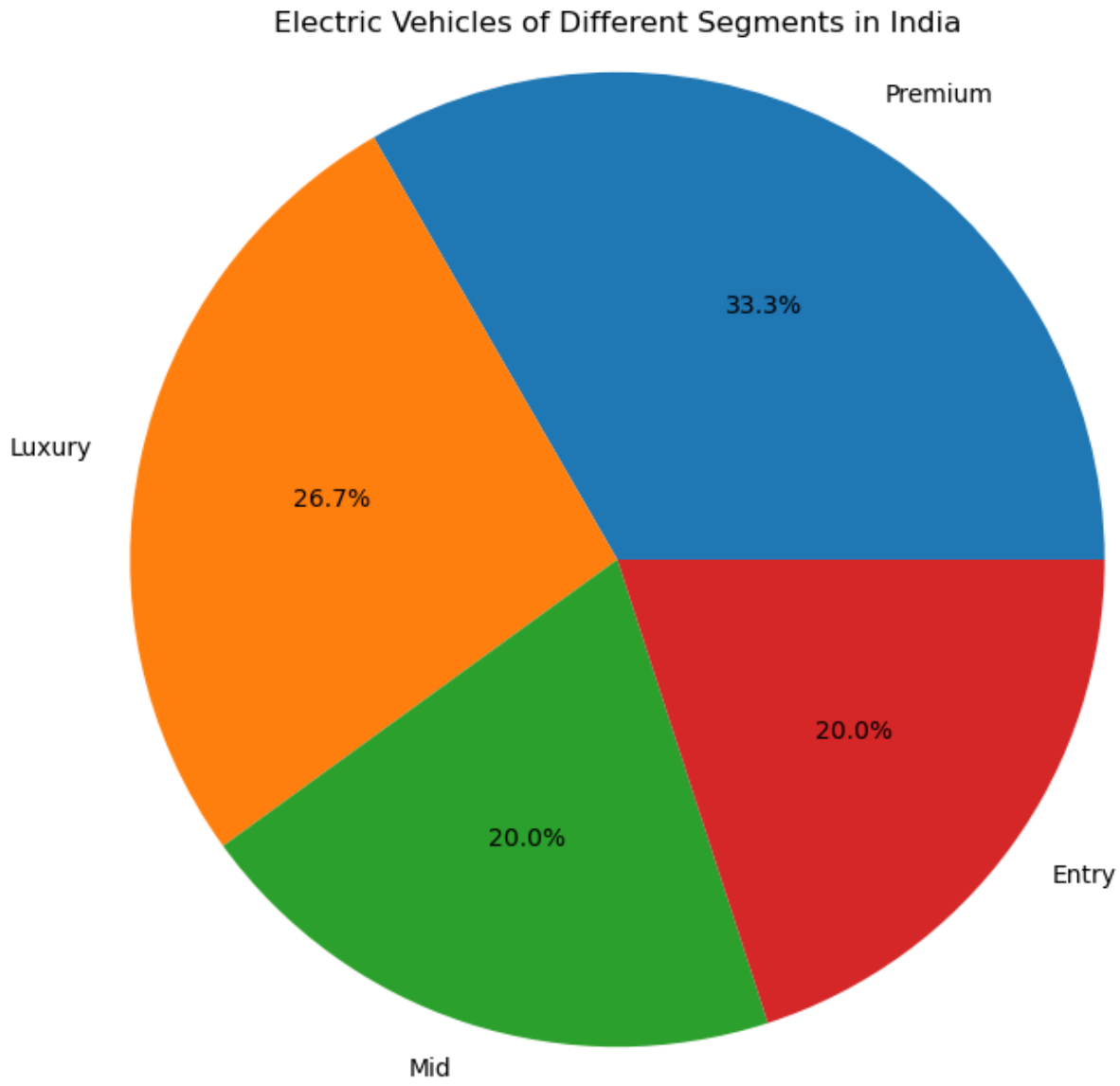
This Bar Chart shows the type of vehicles used in various states from the dataset after removing meaningless outliers. It also shows the Number of Charging Stations sanctioned in India state wise.

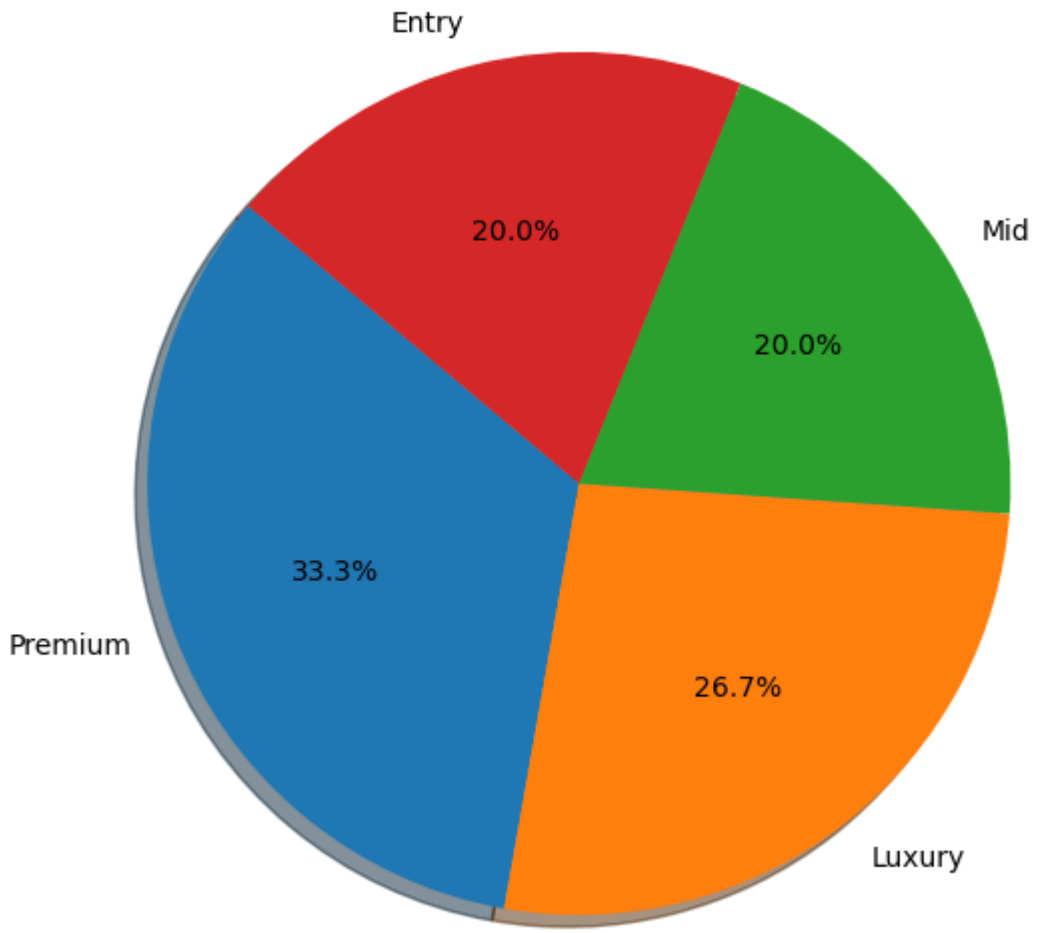


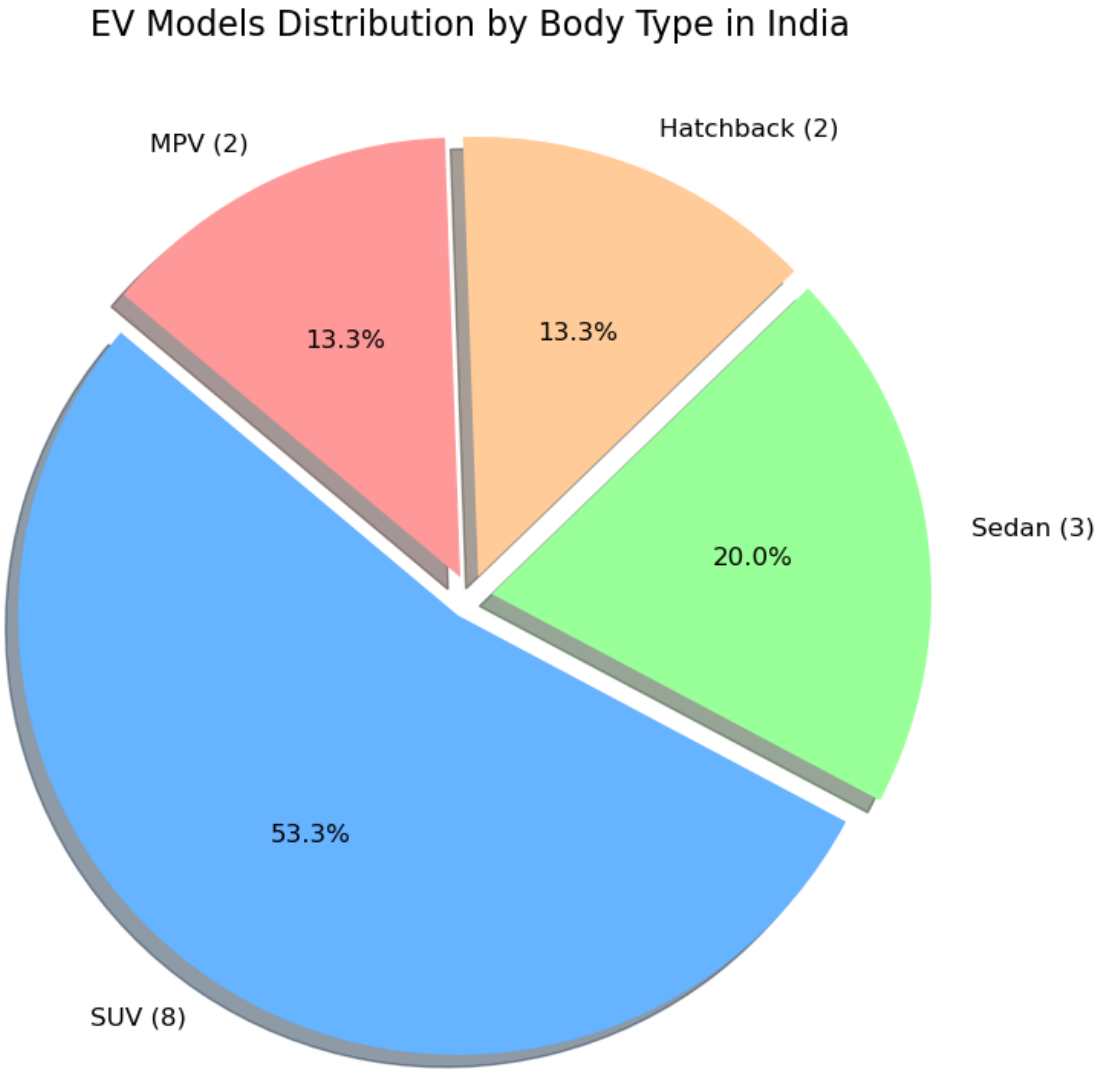
This point plot shows the number of retail outlets for charging EVs in various states from the dataset.

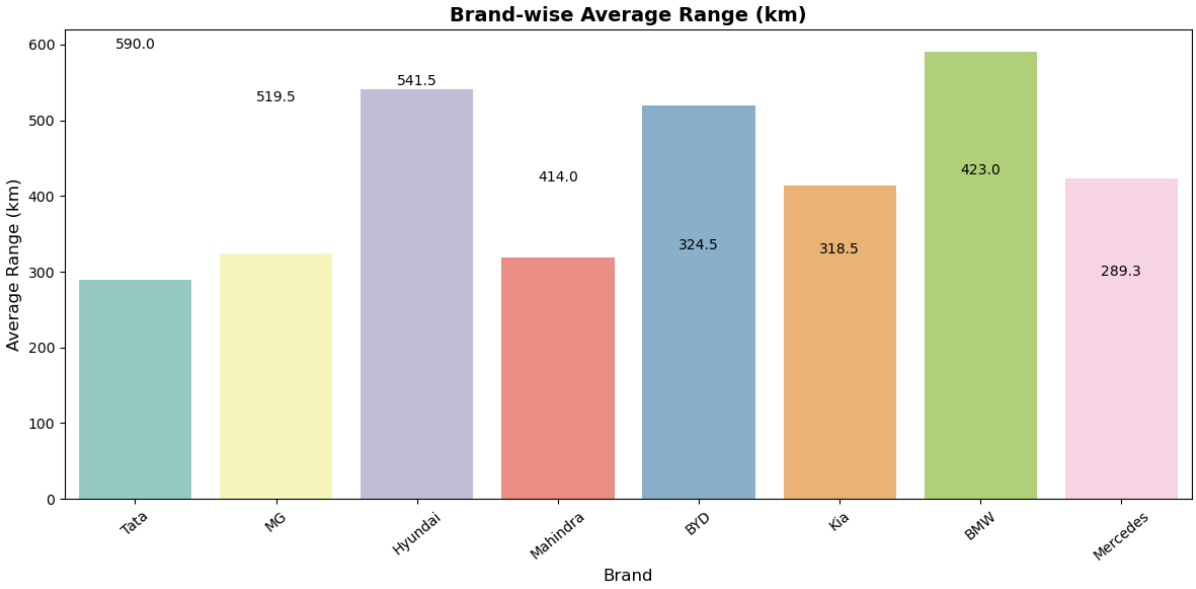

Number of EV Models Manufactured by a Brand
Count
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Tata
MG
Hyundai
Mahindra
BYD
Kia
BMW
Mercedes
Brand

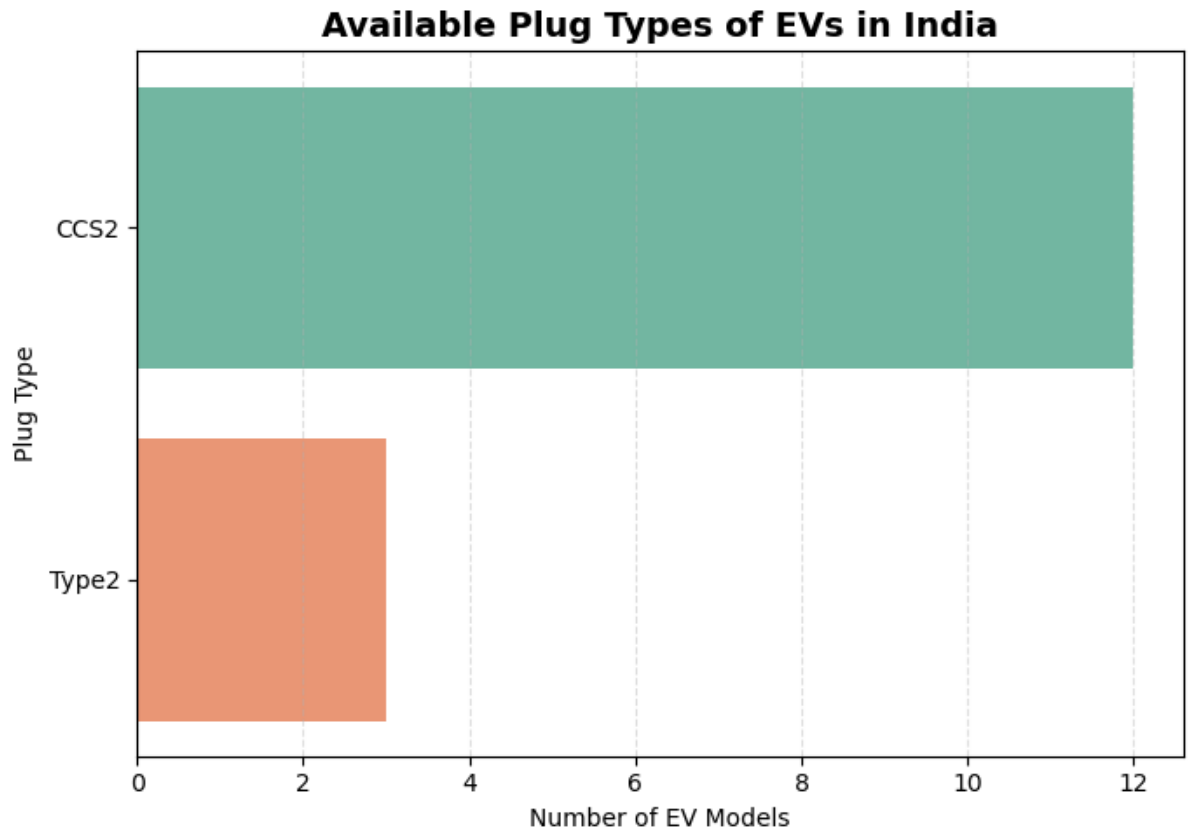

Electric Vehicles of Different Body Types in India
SUV
13.3%
Hatchback
40.0%
MPV
13.3%
33.3%
Sedan

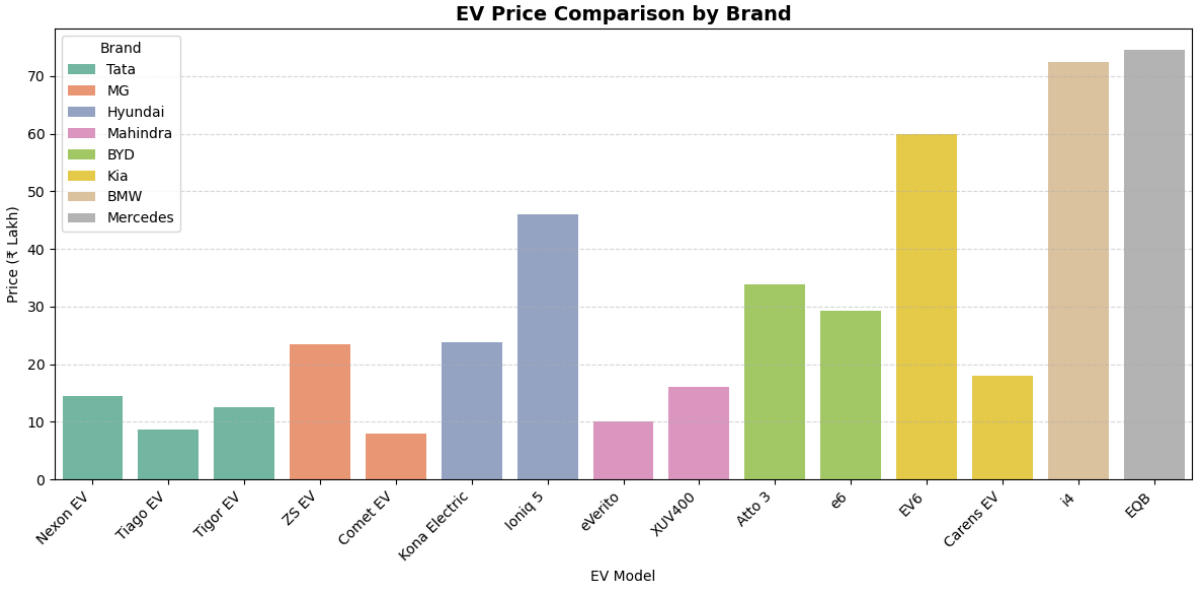

Electric Vehicles of Different Segments in India
Premium
33.3%
Luxury
26.7%
20.0%
Entry
20.0%
Mid

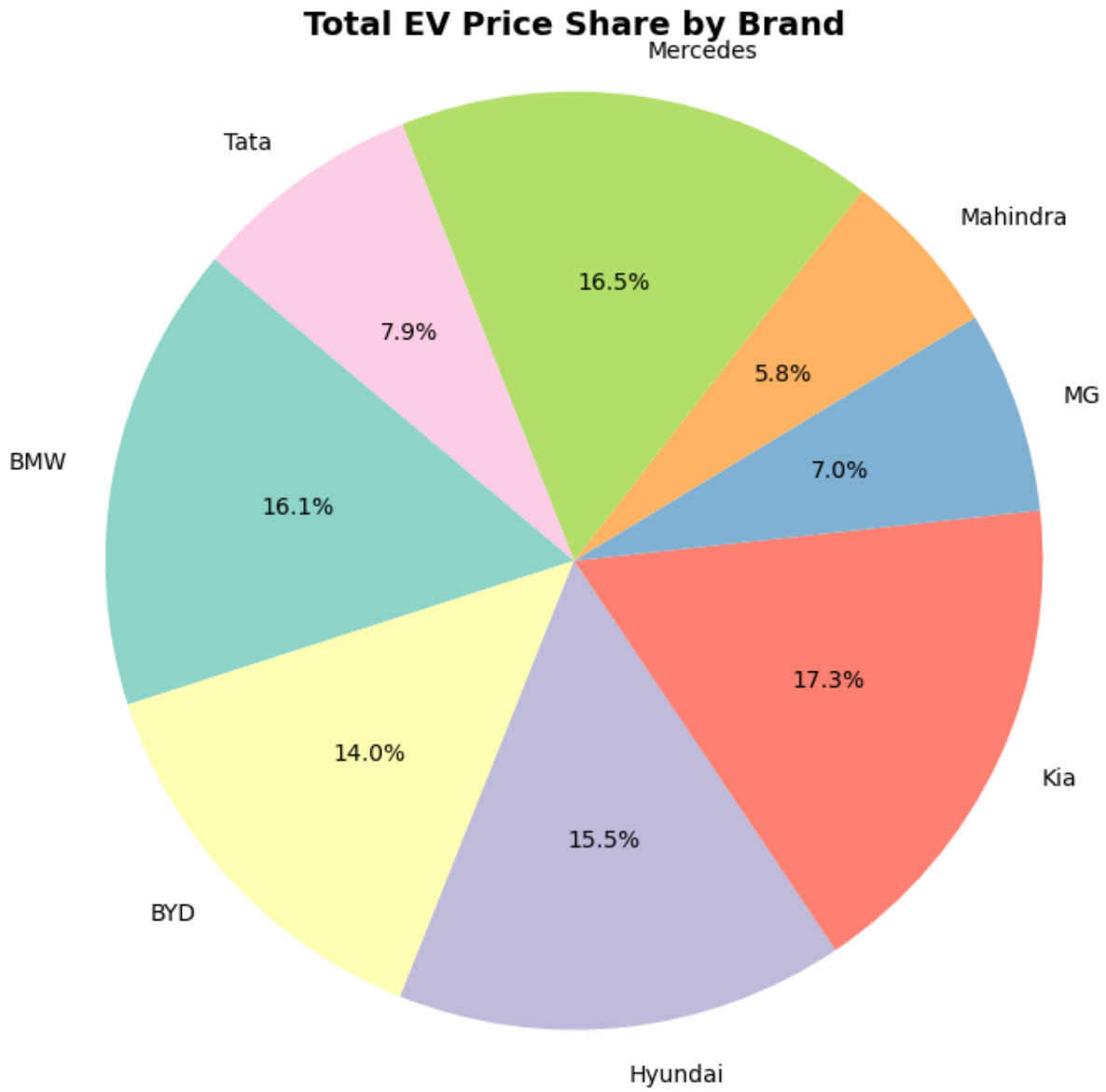

EV Models Distribution by Segment in India
Entry
20.0%
Mid
20.0%
33.3%
Premium
26.7%
Luxury

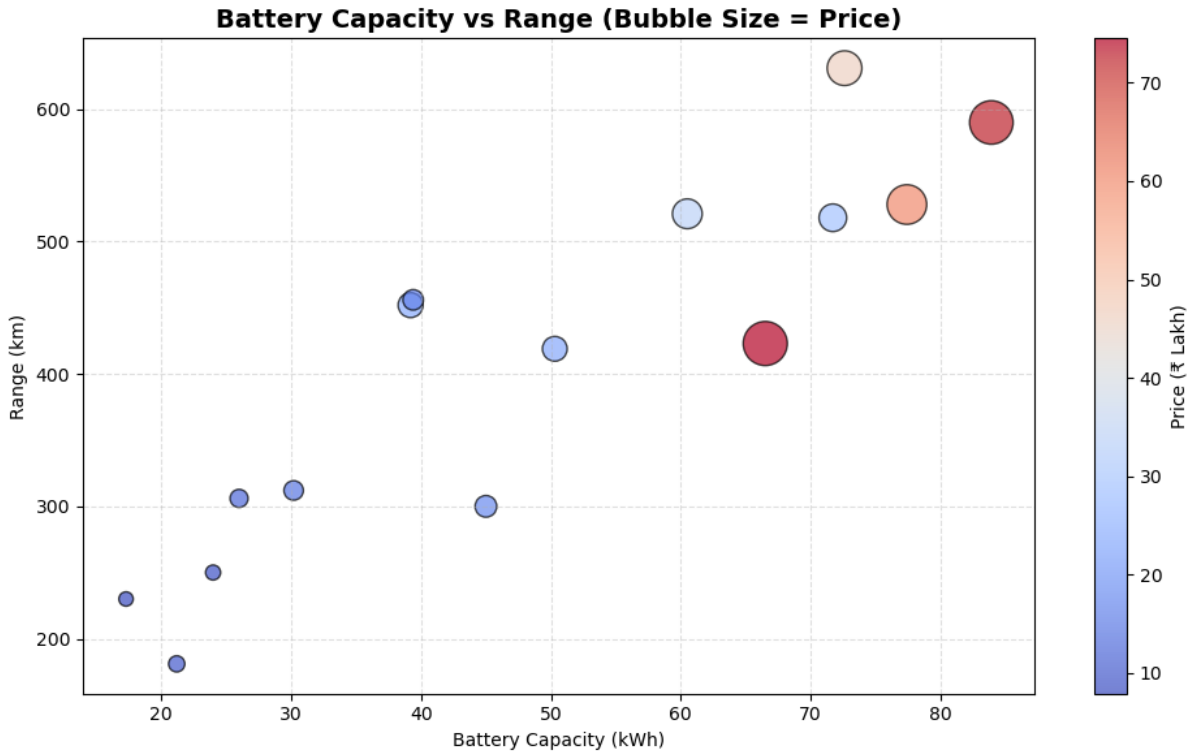

EV Models Distribution by Body Type in India
MPV (2)
Hatchback (2)
13.3%
13.3%
Sedan (3)
20.0%
53.3%
SUV (8)

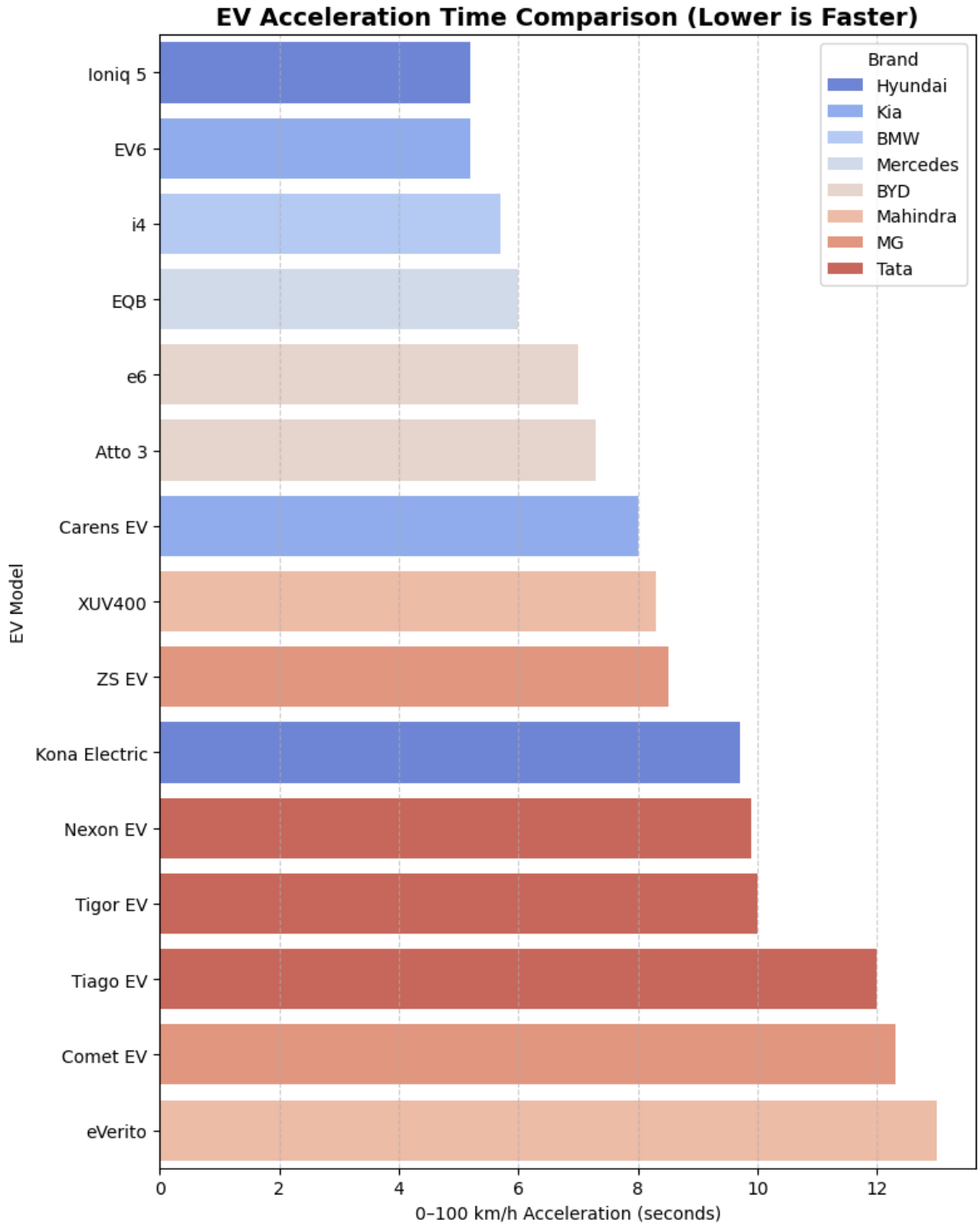

Brand-wise Average Range (km)
Average Range (km)
Brand
590.0
519.5
541.5
414.0
324.5
318.5
423.0
289.3
Tata
MG
Hyundai
Mahindra
BYD
Kia
BMW
Mercedes

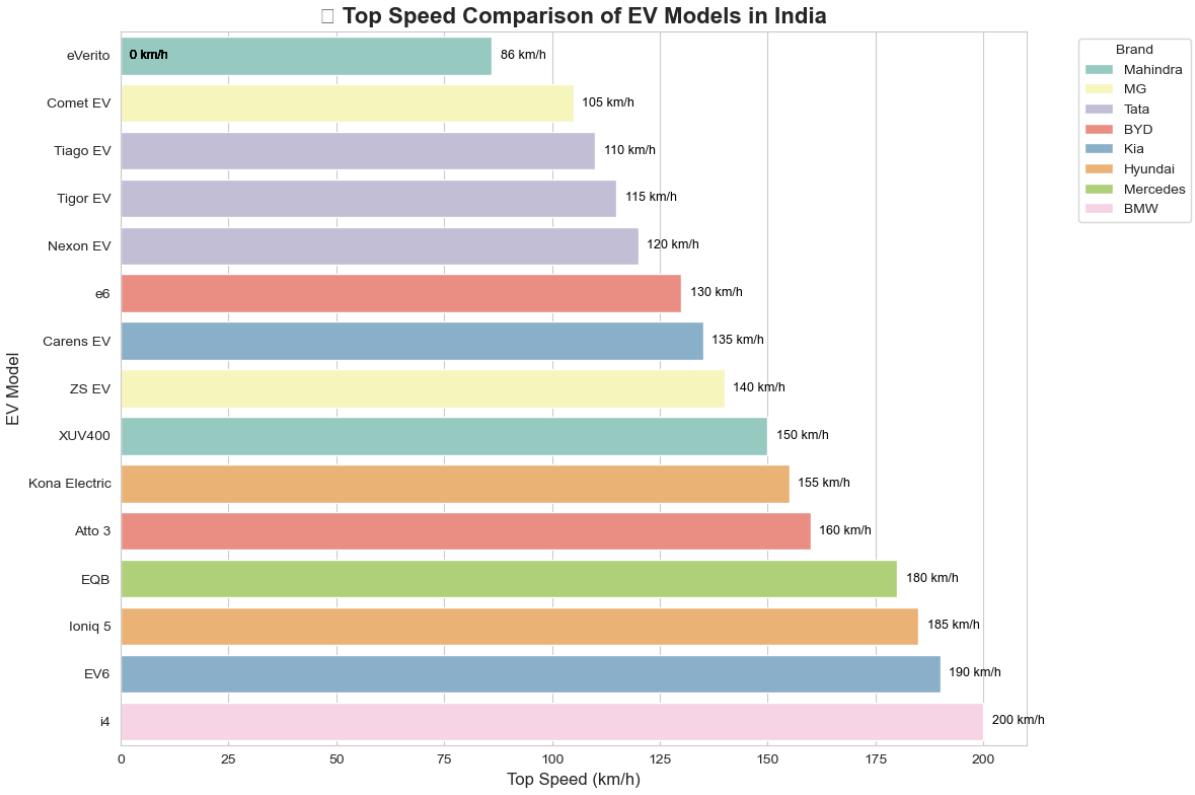

Available Plug Types of EVs in India
Plug Type
CCS2
Type2
0
2
4
6
8
10
12
Number of EV Models

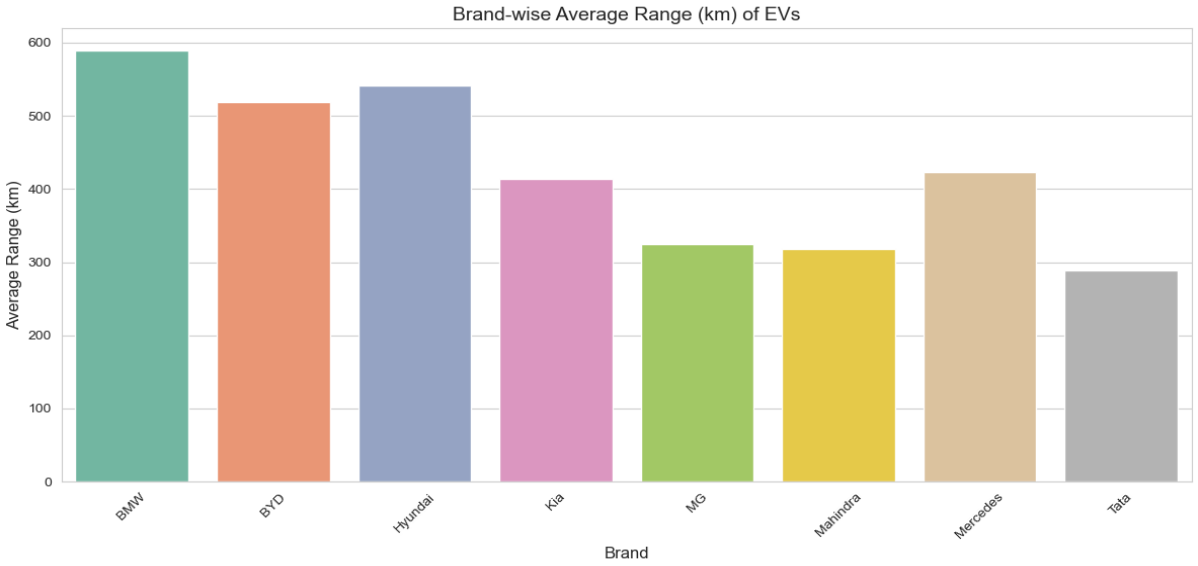

EV Price Comparison by Brand
Brand
Tata
MG
Hyundai
Mahindra
BYD
Kia
BMW
Mercedes
Price (₹ Lakh)
0
10
20
30
40
50
60
70
Nexon EV
Tiago EV
Tigor EV
ZS EV
Comet EV
Kona Electric
Ioniq 5
eVerito
XUV400
Atto 3
e6
EV6
Carens EV
i4
EQB
EV Model

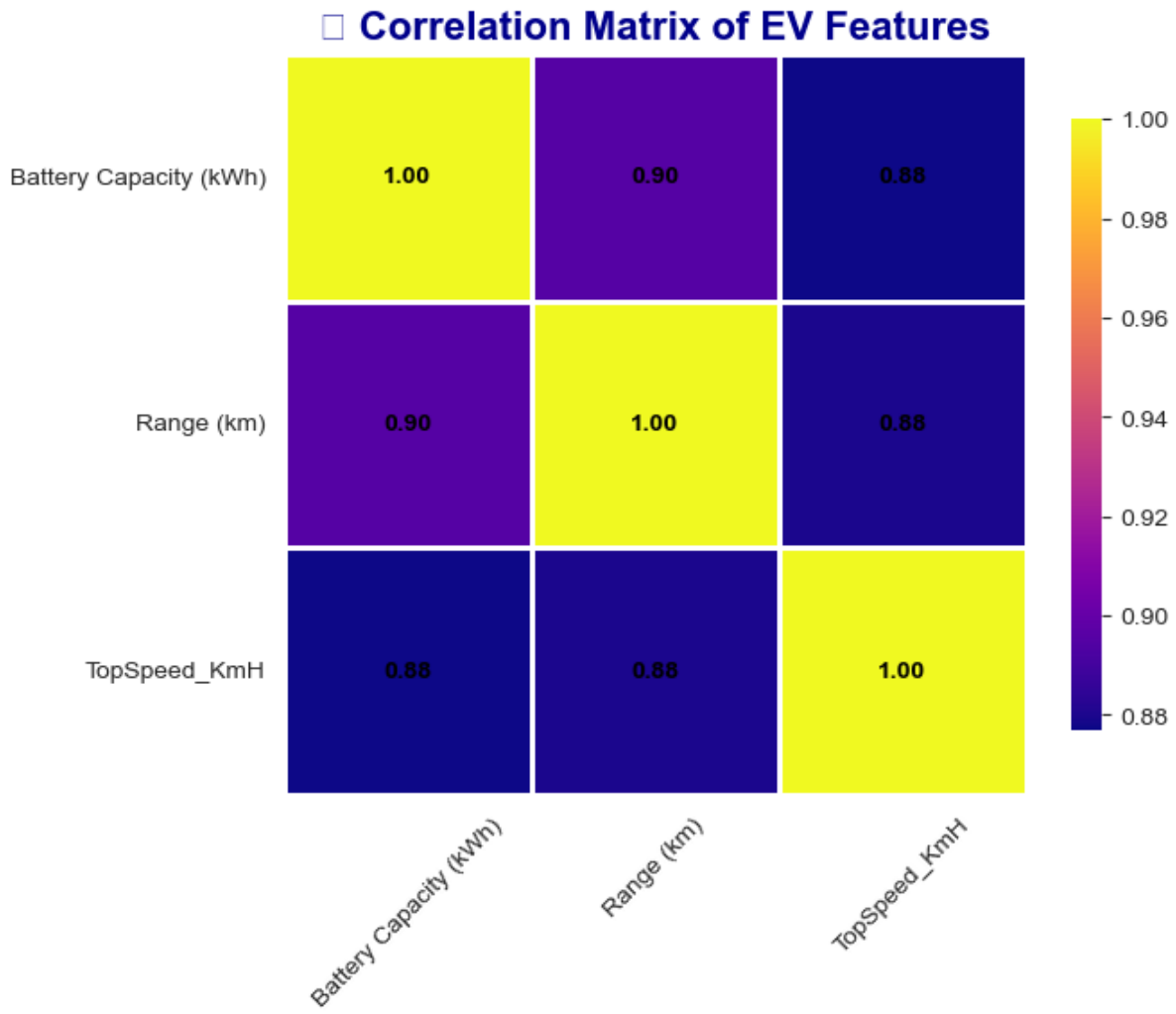

Total EV Price Share by Brand
Mercedes
16.5%
Mahindra
5.8%
MG
7.0%
Kia
17.3%
Hyundai
15.5%
BYD
14.0%
BMW
16.1%
Tata
7.9%


Battery Capacity vs Range (Bubble Size = Price)
Range (km)
Battery Capacity (kWh)
Price (₹ Lakh)
200
300
400
500
600
20
30
40
50
60
70
80
10
20
30
40
50
60
70


EV Acceleration Time Comparison (Lower is Faster)
Brand
Hyundai
Kia
BMW
Mercedes
BYD
Mahindra
MG
Tata
Ioniq 5
EV6
i4
EQB
e6
Atto 3
Carens EV
XUV400
ZS EV
Kona Electric
Nexon EV
Tigor EV
Tiago EV
Comet EV
eVerito
EV Model
0
2
4
6
8
10
12
0–100 km/h Acceleration (seconds)


Top Speed Comparison of EV Models in India
EV Model
Top Speed (km/h)
Brand
Mahindra
MG
Tata
BYD
Kia
Hyundai
Mercedes
BMW
eVerito
Comet EV
Tiago EV
Tigor EV
Nexon EV
e6
Carens EV
ZS EV
XUV400
Kona Electric
Atto 3
EQB
Ioniq 5
EV6
i4
0 km/h
86 km/h
105 km/h
110 km/h
115 km/h
120 km/h
130 km/h
135 km/h
140 km/h
150 km/h
155 km/h
160 km/h
180 km/h
185 km/h
190 km/h
200 km/h
0
25
50
75
100
125
150
175
200


Brand-wise Average Range (km) of EVs
Average Range (km)
Brand
0
100
200
300
400
500
600
BMW
BYD
Hyundai
Kia
MG
Mahindra
Mercedes
Tata



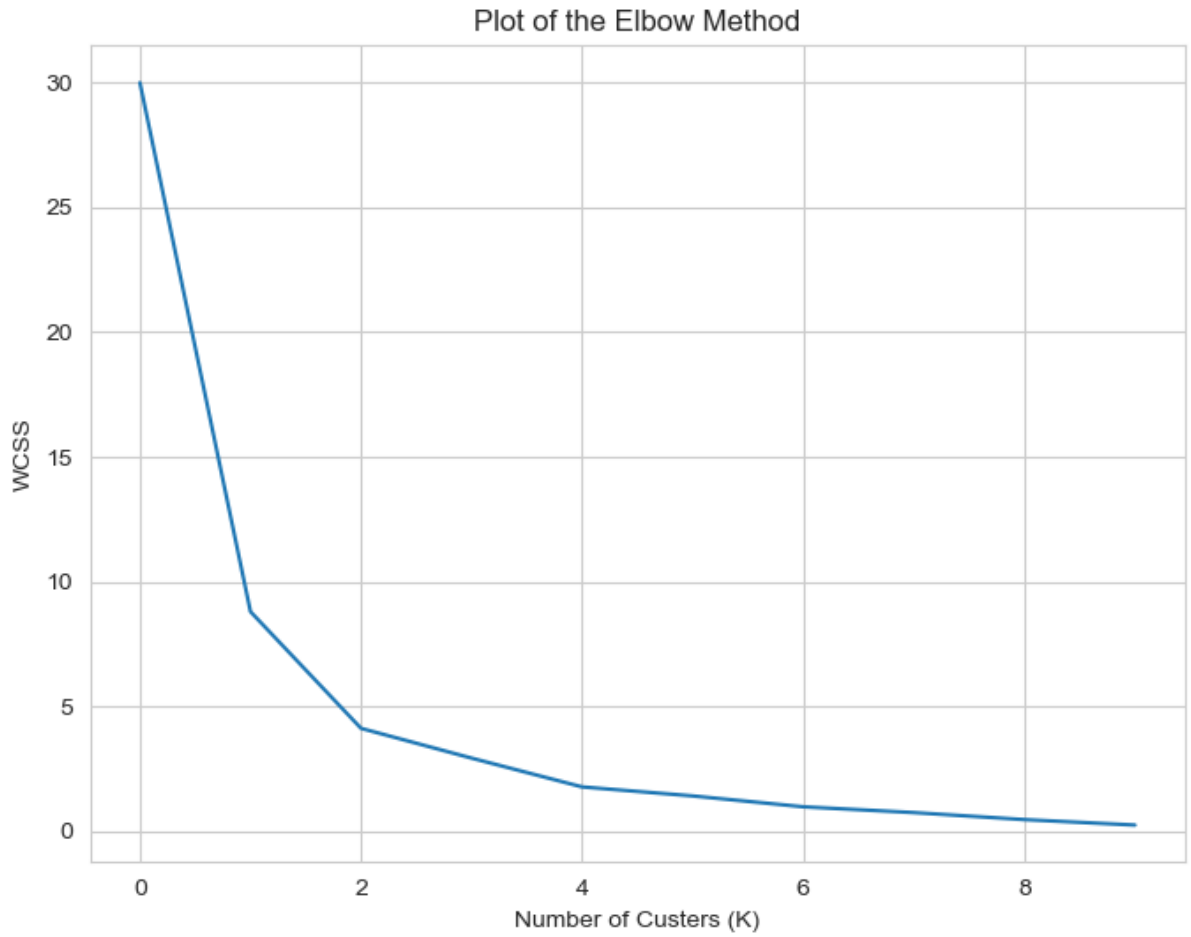
Segment Extraction

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

Suppose we have N number of Unlabeled Multivariate Datasets of various features like water- availability, 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.

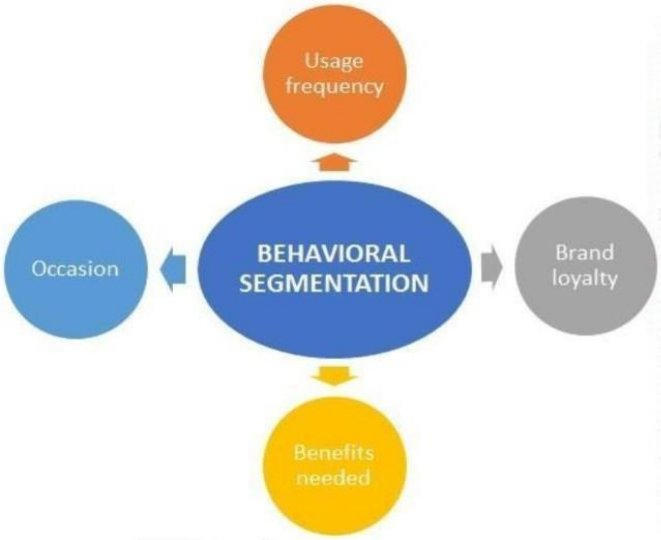
In the Elbow method, we are actually varying the number of clusters (K) from 1 – 10. For each value of K, we are calculating WCSS (Within-Cluster Sum of Square). WCSS is the sum of squared distance between each point and the centroid in a cluster. Whenwe plot the WCSS with the K value, the plot looks like an Elbow.

As the number of clusters increases, the WCSS value will start to decrease. WCSS value is largest when K = 1. When we analyze the graph, we can see that the graph will rapidly change at a point and thus creating an elbow shape. From this point, the graph starts to move almost parallel to the X-axis. The K value corresponding to this point is the optimal K value or an optimal number of clusters.

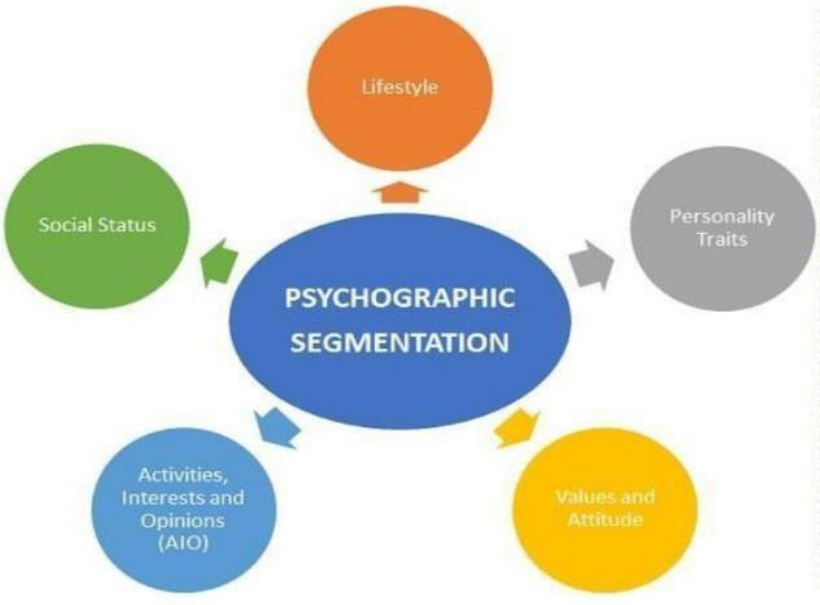


Profiling Potential Segments

Behavioral Segmentation: Segmenting the market based on customer behavior aspects suchas what price range customers usually buy in, what kind of specifications customers look for in their cars, etc.



Psychographic Segmentation: Segmenting the market based on psychological parameters,such as the likes and dislikes of customers, whether they prefer comfort over speed of a vehicle, etc.



Geographic Segmentation: Segmenting the market based on geography. This mainlyincludes characteristics of the market based on the location.

Most Optimal Market Segment

There are many EV manufacturing companies in the country like Hero Electric, Tata Motors, Ather Energy, Ashok Leyland, Hyundai Kona Electric, etc. Tesla has also arrived; the demand will get higher & higher since it is automotive so the investments and policies and all that would be bigger but it will take some time to perfectly settle in India. The following are the key insights of the project:

- The electric vehicle industry has not done that much good due to the devastating hit of the Covid outbreak but it will take a huge jump in upcoming years.
- The use of EVs will be game-changing in terms of environment, air, noise pollution-free, post- electric, and much more.
- The company should plan to establish local operations in India either by partnering with a local company or by setting up its own manufacturing/ development unit, potentially combined with imports of specific components.
- The company would expect to further grow in India, underpinned by a growing commercial fleet market for two-wheelers and three-wheelers especially for last km delivery/urban freight services. The company must see opportunities across the supply chain in the battery, EV component and charging infrastructure segments including the machinery and equipment needed for establishing manufacturing plants, training and provision of skilled workforce etc.
- The company should start their business from Metro Cities in India and then after considerable business expand to other cities of the same state of the Metro Cities. This will help the company to expand easily as

they will be having a prior knowledge of business from Metro Cities and Network of Supply chain will be easy for the company as the time goes in business.