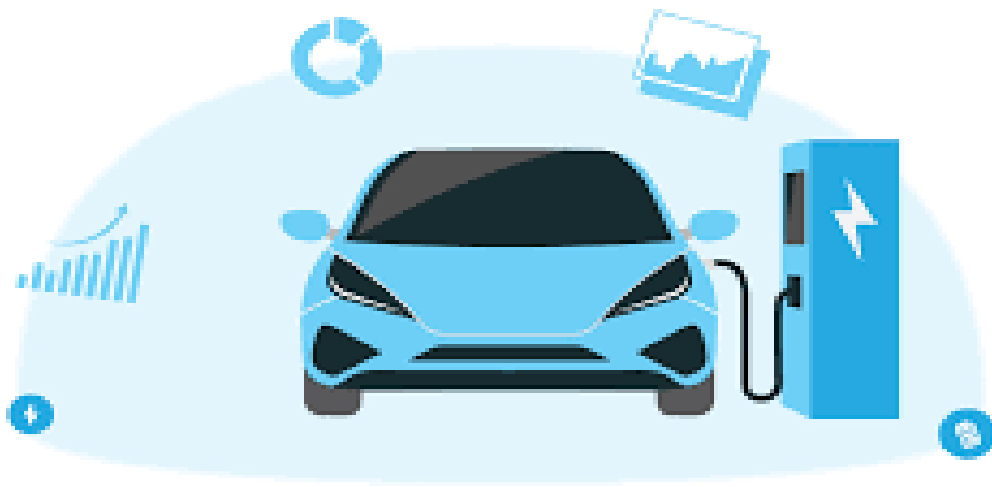


# **ELECTRIC VEHICLE MARKET SEGMENT ANALYSIS**



## **Team**

**Spandan Bandhu (Team Leader)**

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## Abstract

Automobiles that run on electric motors rather than internal combustion engines (ICEs), which depend on fossil fuels, are known as electric vehicles (EVs). They store electricity and supply it to the electric motor that drives the car using rechargeable batteries or other energy storage technologies. Compared to conventional ICE vehicles, EVs have a number of advantages, making them a more and more common choice among consumers and a crucial part of sustainable transportation solutions.

A major obstacle to the attainment of sustainable development goals is posed by the use of electric vehicles, which offer a potential solution to the rising levels of global air pollution. Due to India's urgent need for improved infrastructure and more benevolent governmental laws, electric vehicles (EVs) have become an essential part of the country's energy and mobility sectors.

The transportation sector in India has expanded and grown significantly in recent years.

The difference between domestic crude oil consumption and domestic crude oil output is widening. India imports enough oil to meet about 70% of its annual demand.

Therefore, there is a pressing need for research on the factors that contribute to and provide obstacles to the creation of environmentally friendly transportation options. A practical, sustainable, and ecologically beneficial means of transportation is represented by electric vehicles (EVs).

Electric vehicle market penetration is growing globally, but it still faces significant challenges, including high prices, limited driving range, lack of charging infrastructure, and consumer awareness.

1. **High costs:** For many potential purchasers, the cost of electric cars (EVs) is a major deterrent because they are typically more expensive than conventional automobiles. The battery pack, which may represent up to half of the vehicle's cost, is mostly to blame for the high price. Even while EVs may be less expensive to run in the long term, many buyers still find the initial expense to be prohibitive.
2. **Limited Driving Range:** When compared to conventional vehicles, the driving range of the majority of EVs is currently quite small. This means that long-distance travel and use by individuals without access to a charging station at their residence or place of employment may not be appropriate for EVs. For many consumers, range anxiety poses a substantial hurdle.
3. **shortage of Charging Infrastructure:** The EV market faces a substantial obstacle due to a shortage of charging infrastructure. Public charging stations are sometimes absent or put in awkward places, and many people do not have access to charging stations at home or at work. People find it challenging to rely on EVs for their regular transportation needs as a result.
4. **Consumer Education:** Many people are unaware of the advantages of electric vehicles and may have preconceived notions about them. Because they are unfamiliar with the technology or because they are worried about the range or the availability of charging infrastructure, some consumers could be hesitant to transition to EVs. The EV market is facing substantial growth challenges due to a lack of customer awareness.

For the EV market to continue to expand and succeed, these issues must be resolved. To overcome these obstacles and speed up the adoption of EVs, the industry will need to continue investing in battery technology, charging infrastructure, and customer education.

The goal of Electric Vehicle Startup is to break into the Indian market and take advantage of the expanding market for electric vehicles. We must carry out a detailed segmentation analysis to determine the most promising client segments for our EVs in order to guarantee a successful market debut. Our marketing

and product strategies can be effectively targeted to satisfy the needs of these niche markets by taking into account the distinctive traits and preferences of these segments.

## Market Overview

The global electric vehicle (EV) market, valued at \$163.01 billion in 2020, is projected to reach \$823.75 billion by 2030 with a compound annual growth rate (CAGR) of 18.2% from 2021 to 2030. The COVID-19 pandemic negatively impacted the automotive and EV industries, causing a 20% drop in new EV registrations in FY21 compared to FY20. Some companies adapted by using EVs for medical supplies during the pandemic. EVs, running on electricity rather than fuel, have gained popularity due to eco-friendliness and advancements, offering benefits like higher fuel efficiency, lower emissions, and convenient charging. Demand for fuel-efficient and low-emission vehicles has surged, while strict emission regulations and lack of charging infrastructure influence the market. Self-driving EV technology is on the rise, driving market growth.

### Key Points:

- The global EV market was valued at \$163.01 billion in 2020, and it's projected to reach \$823.75 billion by 2030, with an 18.2% CAGR from 2021 to 2030.
- The COVID-19 pandemic negatively affected the automotive and EV sectors, leading to a 20% decrease in new EV registrations during FY21 compared to FY20.
- Some companies adapted by using EVs for medical supply transportation during the pandemic.
- EVs, powered by electricity instead of fuel, have gained popularity due to environmental benefits and technological advancements.
- EVs offer advantages such as higher fuel efficiency, lower emissions, convenient home charging, smoother rides, and reduced engine noise.
- The market is driven by increased demand for fuel-efficient, high-performance, and low-emission vehicles.
- Stringent emission regulations and laws globally are pushing for cleaner transportation and driving the demand for EVs.
- Lack of charging infrastructure is hindering the growth of the EV market, despite government promotions in various countries.
- The development of self-driving EV technology is a promising trend, with various companies and start-ups investing in this field.
- Self-driving technology is expected to mature within the next 5-6 years, contributing to the growth of the EV market.

## Data Sources

1. Spandan Bandhu: <https://www.kaggle.com/datasets/karivedha/indian-consumers-cars-purchasing-behaviour>
2. Souvick Mazumdar: <https://www.kaggle.com/datasets/vishalturare/ev-cars-available-in-india-till-oct2021>
3. Omar Mahmood: [https://github.com/sanskar-singh-2403/feyn\\_proj\\_t-1-r/blob/main/EV\\_Car\\_data.csv](https://github.com/sanskar-singh-2403/feyn_proj_t-1-r/blob/main/EV_Car_data.csv)
4. Tarasha Ahuja: <https://www.kaggle.com/datasets/kkhandekar/cheapest-electric-cars?resource=download>
5. Adarsh Singh:  
(i)[https://github.com/AdarshSingh09/FeynnLabsTasks/blob/main/EV-market-problem-statement/charging\\_points.csv](https://github.com/AdarshSingh09/FeynnLabsTasks/blob/main/EV-market-problem-statement/charging_points.csv)  
(ii)[https://github.com/AdarshSingh09/FeynnLabsTasks/blob/main/EV-market-problem-statement/evs\\_car\\_data.csv](https://github.com/AdarshSingh09/FeynnLabsTasks/blob/main/EV-market-problem-statement/evs_car_data.csv)  
(iii)[https://github.com/AdarshSingh09/FeynnLabsTasks/blob/main/EV-market-problem-statement/evs\\_per\\_state.csv](https://github.com/AdarshSingh09/FeynnLabsTasks/blob/main/EV-market-problem-statement/evs_per_state.csv)

## Data Preprocessing

### Libraries Used:

This report focuses on multiple sectors of segmentation with respect to the EV industry, such as demographic, geographic, behavioural, vehicular, and many more. As a result, a varied set of Python dependencies or libraries have been utilized for data analysis and segmentation. They include

- **Pandas:** Pandas is a Python library used for data manipulation and analysis; it provides data structures and functions needed to manipulate structured data, making it easy to filter, sort, and display data in a market segmentation project.
- **Matplotlib:** Matplotlib is a plotting library for Python and is used to visualize data in the form of various graphical plots (like bar, scatter, histogram etc.). It can be used to illustrate the segmentation results.
- **NumPy:** NumPy is a foundational package for numerical computations in Python. It is used to perform mathematical and logical operations on arrays and matrices, which can be helpful for complex computations in market segmentation.
- **Seaborn:** Seaborn is a Python data visualization library based on Matplotlib. It provides a high-level interface for creating informative and attractive statistical graphics, aiding in the visualization of market segments.
- **KMeans:** KMeans is a clustering algorithm from the sklearn library. It is commonly used in market segmentation to partition customers into different groups or segments based on similarities within data.
- **Preprocessing:** The sklearn.preprocessing package provides several common utility functions and transformer classes to change raw feature vectors into a representation that is more suitable for the downstream estimators.

Since we are using 5 datasets we have used several data preprocessing method. Here are few examples for it:

1. In the dataset named EV\_car\_data we used following preprocessing method:
  - ➔ Using Label Encoder we had converted all the categorical data in numerical for easy computation.
  - ➔ Removed or cleaned the null cells
  - ➔ Look for any inconsistencies or errors in the dataset, such as conflicting information or incorrect values. Correct or remove such data points if necessary.
  - ➔ Standardised the data so that we can use it more efficiently for KMeans Clustering.
2. In the data named Cheapest Electric Cars EVDatabase we used following preprocessing method:
  - ➔ Removed the units like “km/h”, “\$” and other units so that we get proper data for computation.
  - ➔ Removed NULL values
  - ➔ Changing non-numerical values into numerical values
  - ➔ Memory usage of the dataset had to be checked for efficient runtime.

In other datasets which we have used similar kind of preprocessing methods like conversion of categorical data or non-numerical data to numerical, removing errors or null values, and few more which is required for proper analysing the datasets.

## EV Market Segmentation Reports

### 1. Spandan Bandhu:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
df = pd.read_csv("Indian automobile buying behaviour study 1.0.csv")
```

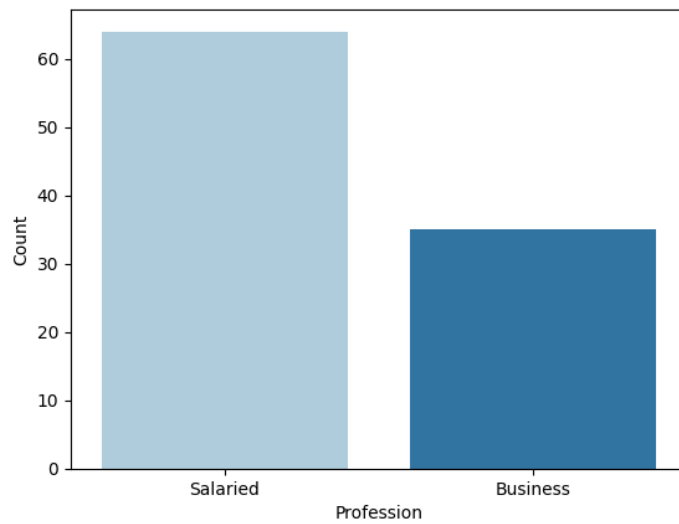
```
df.head()
```

	Age	Profession	Marrital Status	Education	No of Dependents	Personal loan	House Loan	Wife Working	Salary	Wife Salary	Total Salary	Make	Price
0	27	Salaried	Single	Post Graduate	0	Yes	No	No	800000	0	800000	i20	800000
1	35	Salaried	Married	Post Graduate	2	Yes	Yes	Yes	1400000	600000	2000000	Ciaz	1000000
2	45	Business	Married	Graduate	4	Yes	Yes	No	1800000	0	1800000	Duster	1200000
3	41	Business	Married	Post Graduate	3	No	No	Yes	1600000	600000	2200000	City	1200000
4	31	Salaried	Married	Post Graduate	2	Yes	No	Yes	1800000	800000	2600000	SUV	1600000

We can see, in this dataset we have variables like Age, profession, education, salary, price of purchased EV vehicles etc. Through this analysis we will get a clear conclusion on how these variables are associated with the EV market in India.

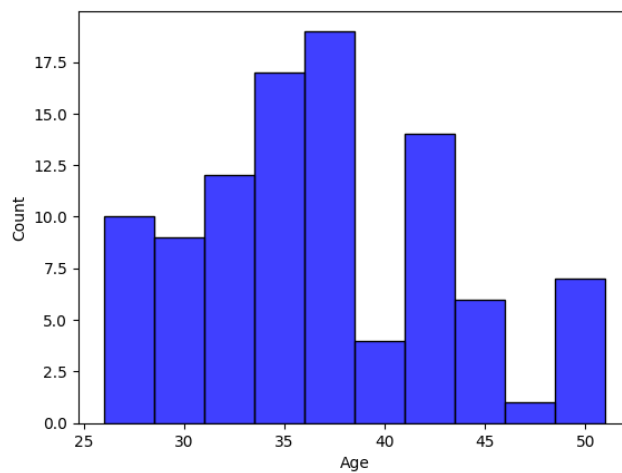
### Market Segment Analysis:-

#### Based on Profession:



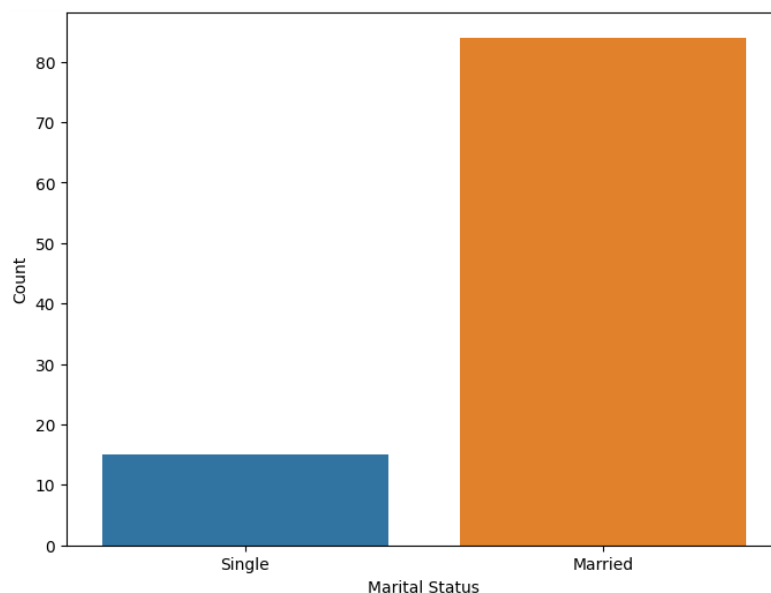
Here we come into the conclusion that salaried people are getting more attracted to the EV vehicles.

#### Based on Age:



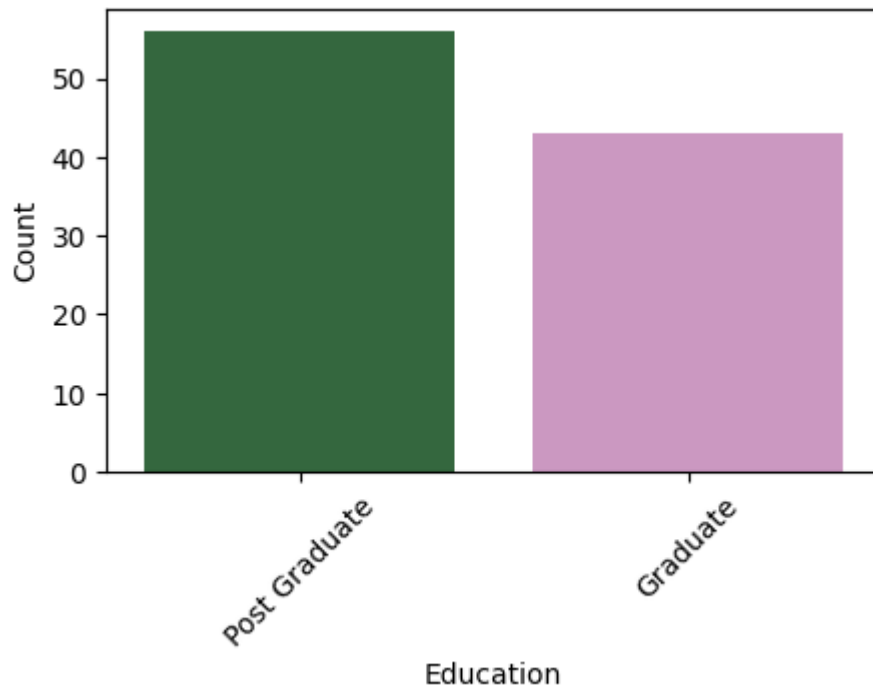
People of age between 32 and 38 are getting more interests in purchasing EV vehicle. So, Indians are taking Electric Vehicles into consideration after reaching almost mid 30's.

#### Based on Marital Status:



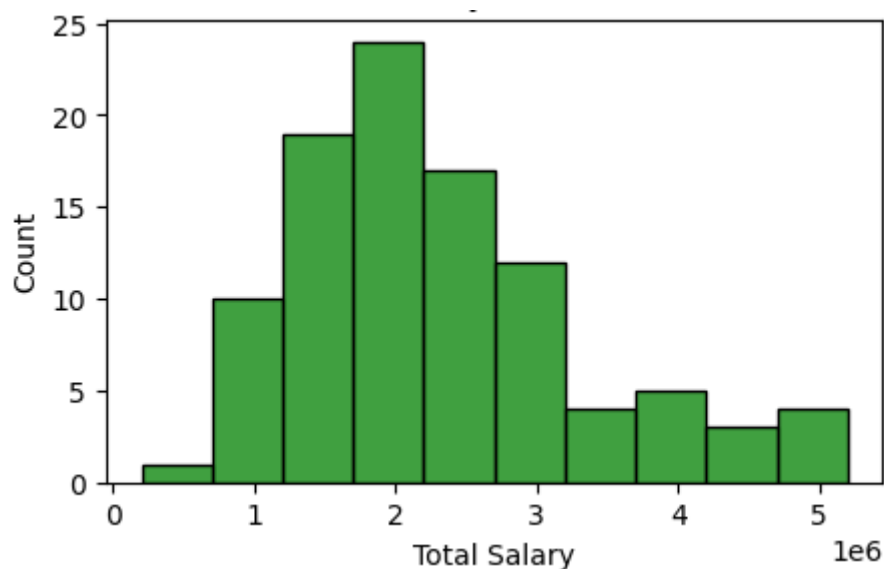
As mentioned earlier, we people having age between 32 and 38 are more interested in EV vehicles, so they are generally married at that age.

**Based on Education:**



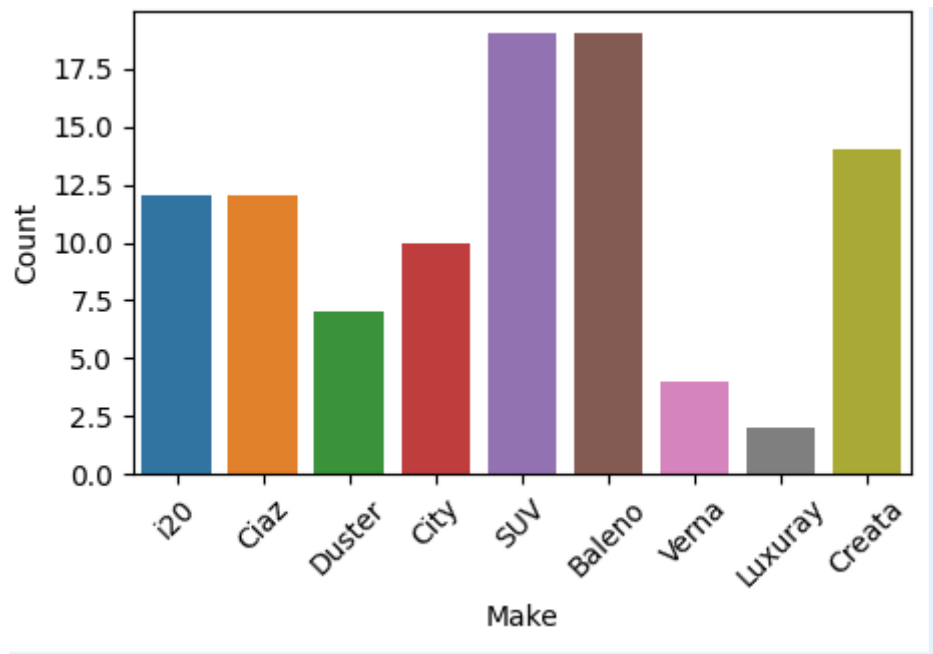
So, we can say people with more educational qualification are more aware of the importance of EV vehicles in our society.

**Based on Total Salary:**



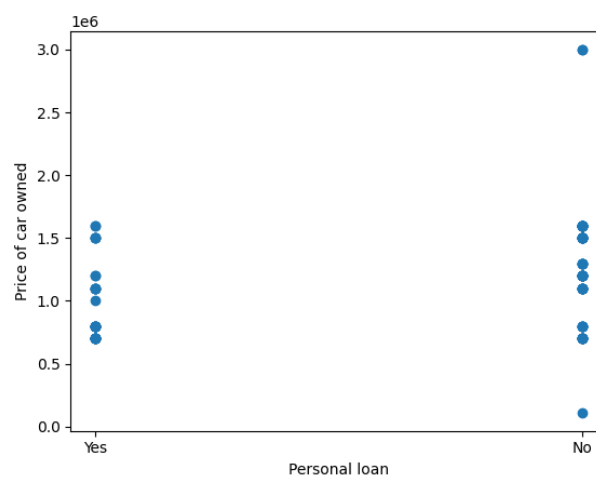
People, earning between 800000/- and 3200000/- are main buyers of Electric Vehicles in India.

**Based on EV making:**



Baleno and SUV are main market occupiers in Electric Vehicle market in India.

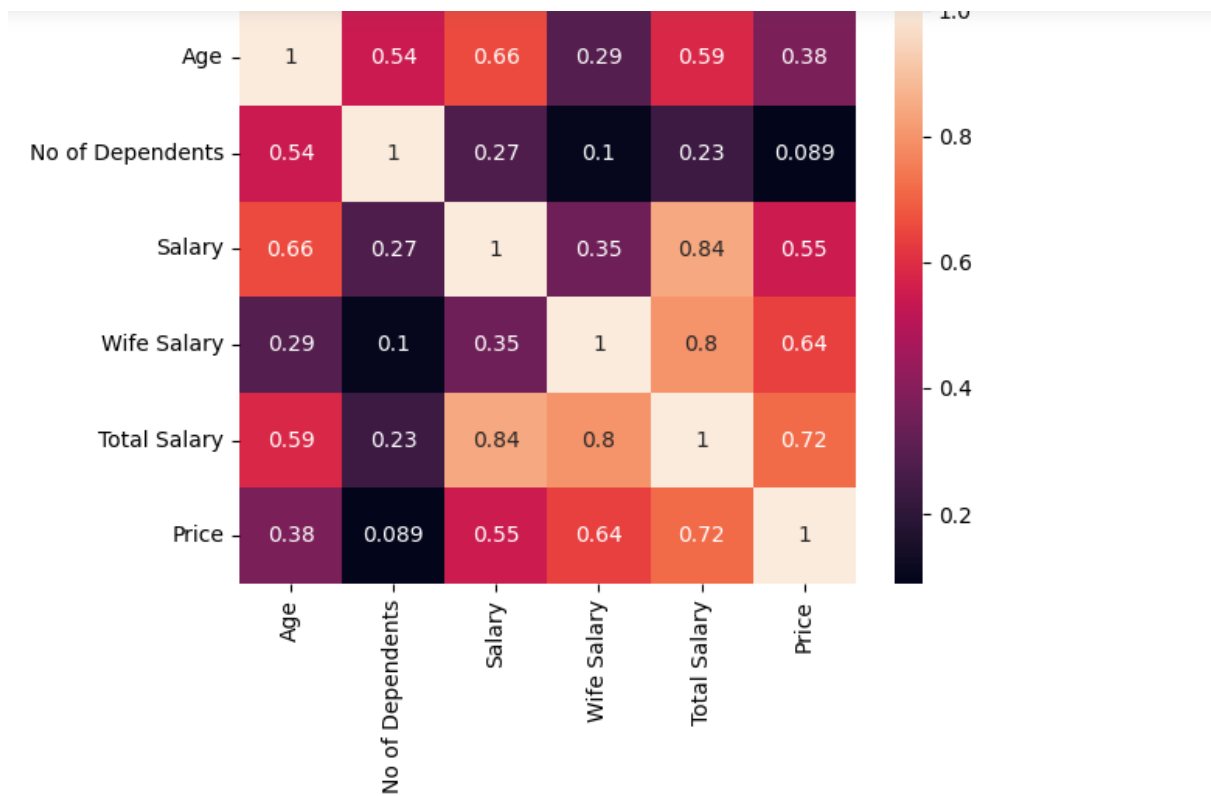
### Based on personal loan:



Personal loan is not differentiating people's mindset to purchasing EV cars. People with or without personal loan, getting attracted to Electric Vehicles of price between 800000/- and 1600000/-.

### Visualizing correlation of variables:





Through this heatmap we can see that

→ total salary and salary

→ Price and No. of dependents are highly correlated. We should avoid these data attributes to get unbiased outputs.

## 2. Souvick Mazumdar:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

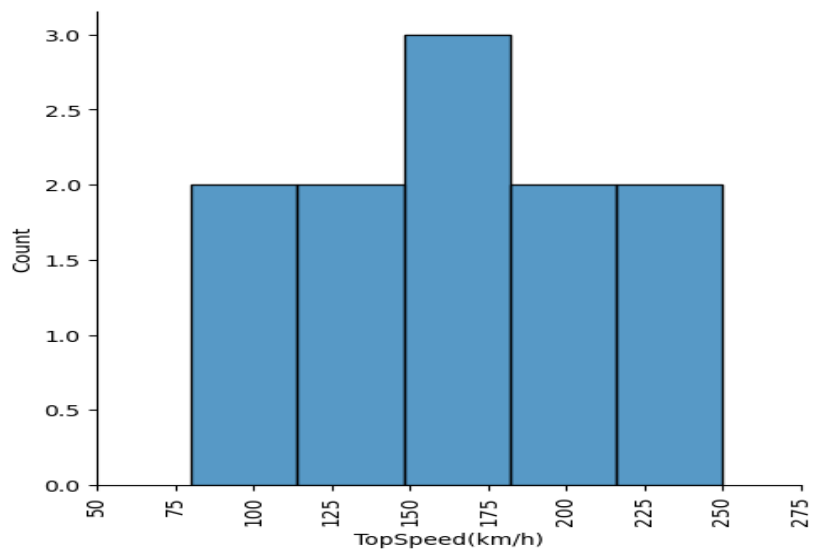
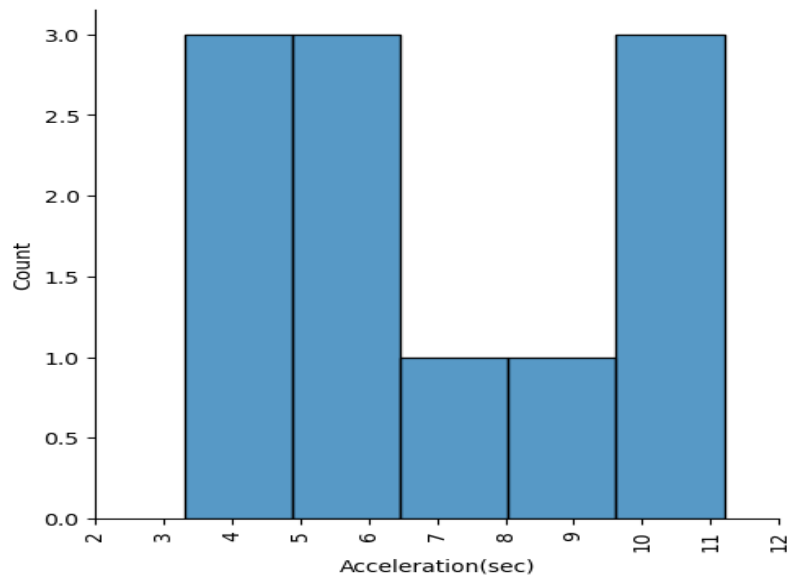
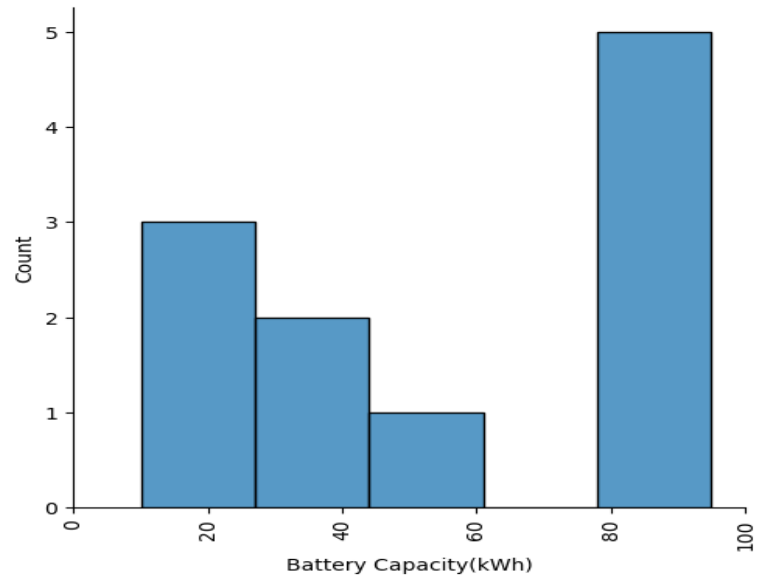
df = pd.read_csv("/kaggle/input/ev-cars-available-in-india-till-oct2021/EV_CARS_ININDIA.csv")

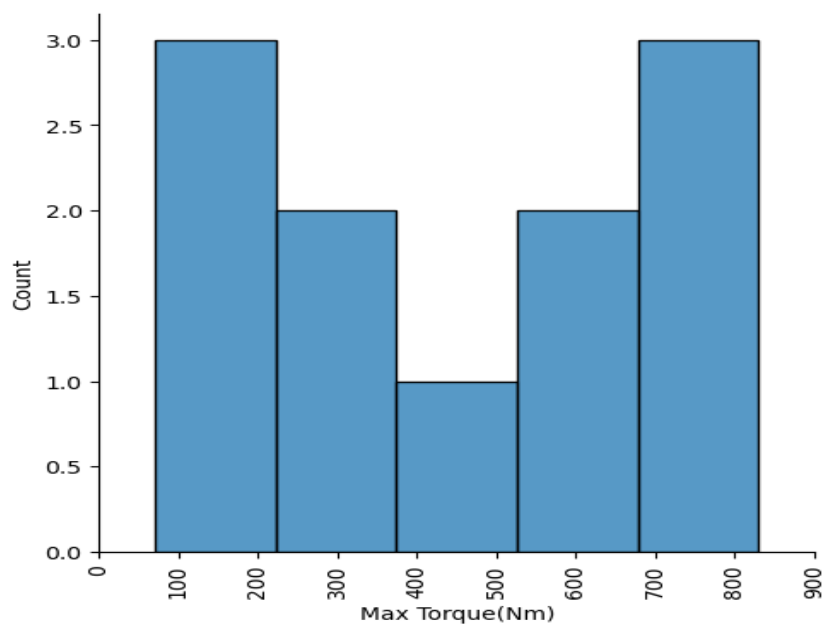
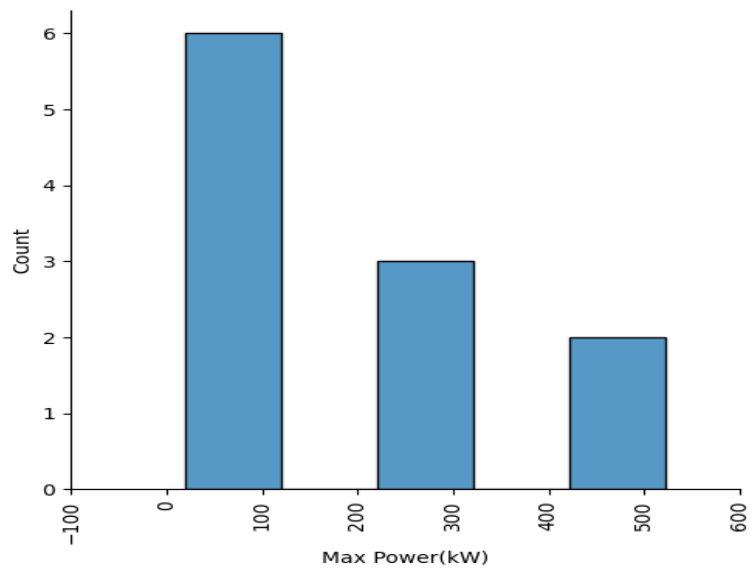
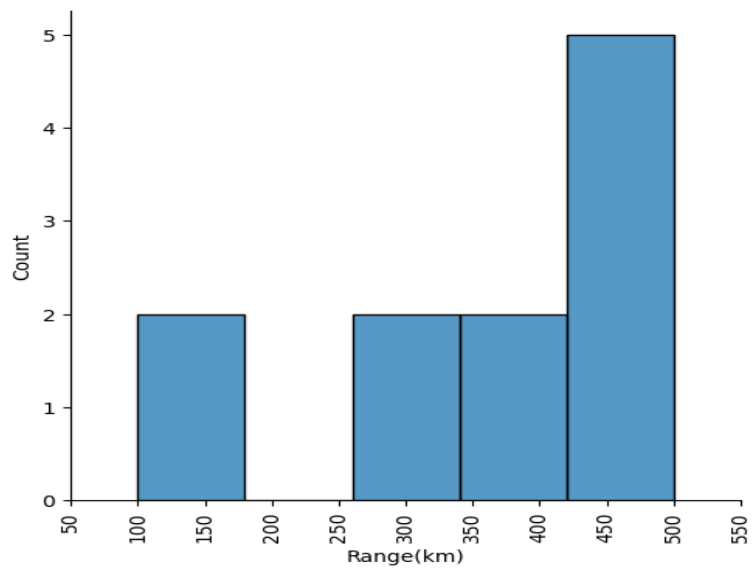
/opt/conda/lib/python3.10/site-packages/scipy/__init__.py:146: UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this version of SciPy (detected version 1.23.5)
warnings.warn(f"A NumPy version >={np_minversion} and <{np_maxversion}")

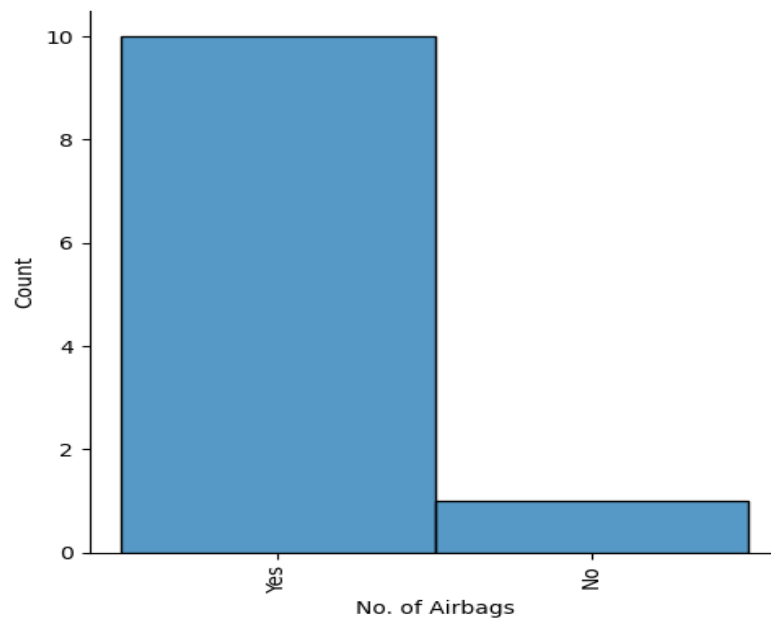
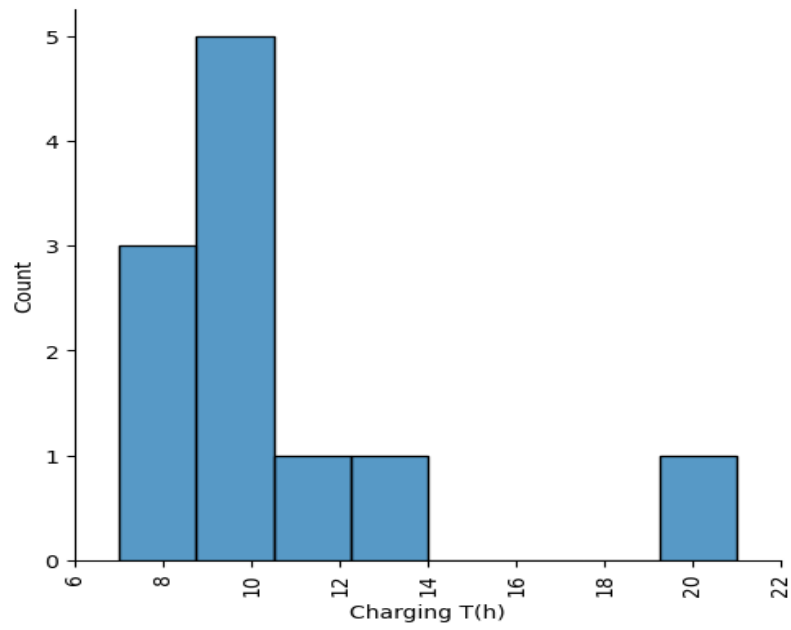
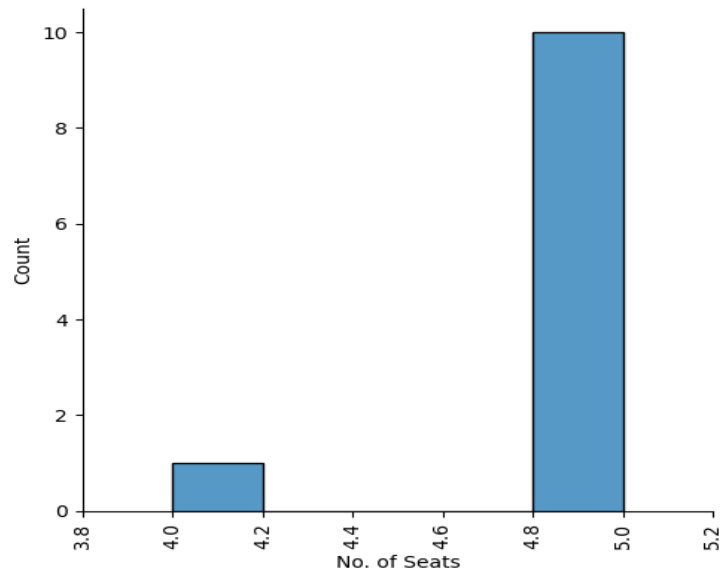
df.head()
```

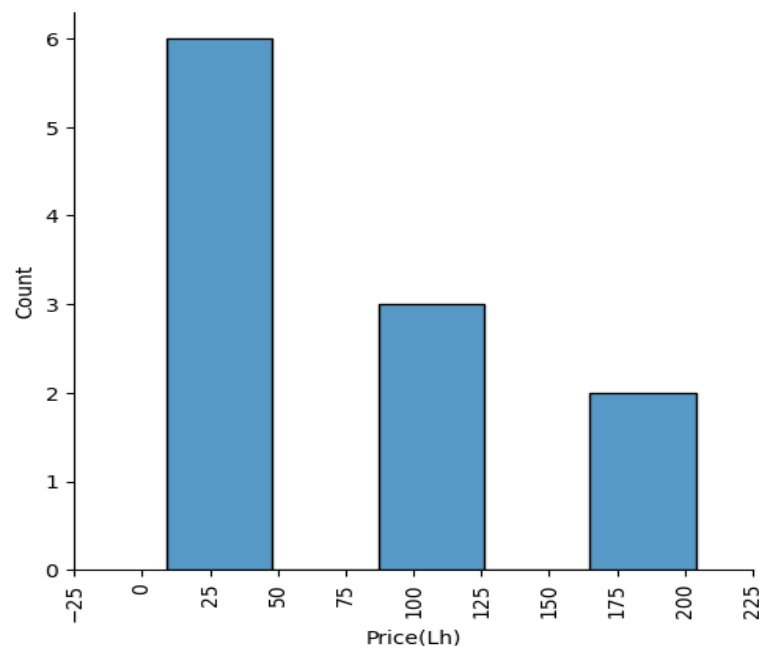
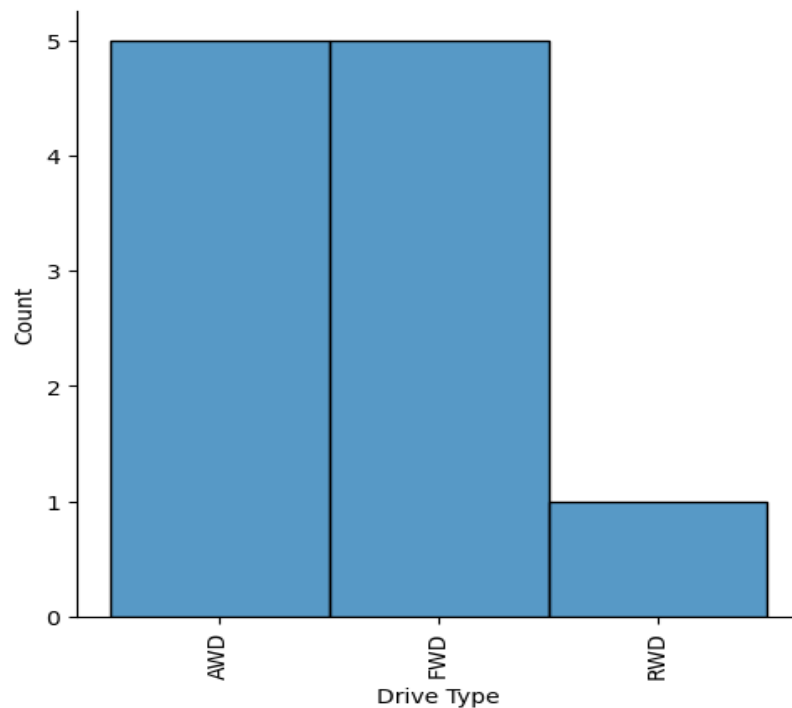
	Brand Name	Battery Capacity(kWh)	Acceleration(sec)	TopSpeed(km/h)	Range(km)	Max Power(kW)	Max Torque(Nm)	Transmission	No. of Seats	Charging Time(h)
0	Audi RS e-tron GT	93.4	3.3	250	480	500	830	Automatic	5	
1	Audi e-tron GT	93.4	4.1	245	500	523	630	Automatic	5	
2	Audi e-tron	95.0	5.7	200	484	300	664	Automatic	5	
3	Tata Nexon EV	30.2	9.9	180	312	96	245	Automatic	5	
4	Tata Tigor EV	26.0	5.7	120	306	55	170	Automatic	5	

We can see, in this dataset we have attributes like Brand name, top speed, acceleration, Max power, Max torque etc. Through this analysis we will get a clear conclusion on how these variables are associated with the EV market in India.





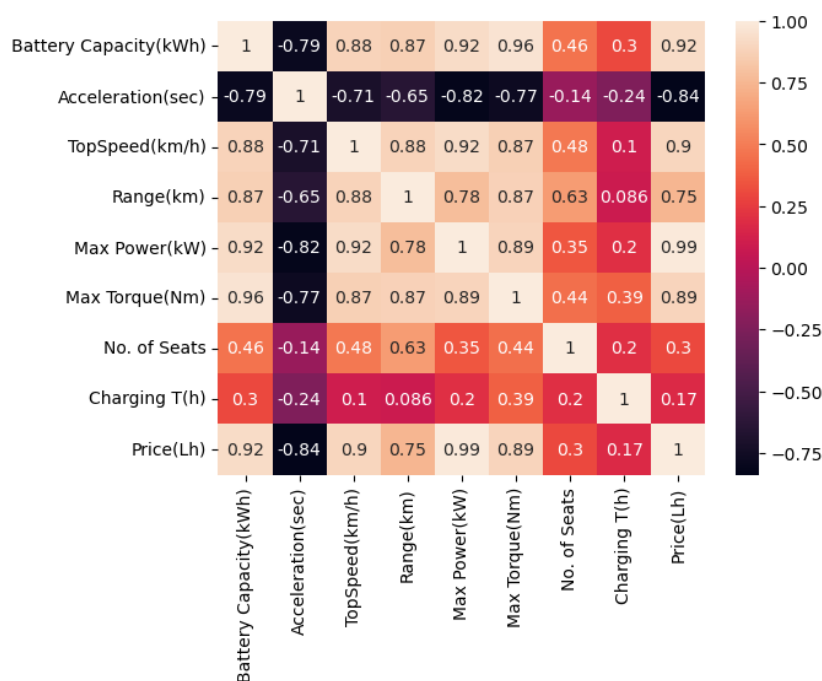




formation retrieved from above Histogram:

1. Count Vs Battery Capacity : out of 11 models 5 models have higher battery capacity from which we can derive that higher battery capacity vehicles is preferred.
2. Count Vs Top Speed: The highest count is of 3 for speed 150-175km/hr. From here we can conclude that an average speed is preferred not very high not very low while manufacturing any model
3. Count Vs Max Power: Out of 11, six car model had power between range of 10 to 100. This shows that not very high power models are used till October 2023 in India.
4. Count Vs Charging: Here also we can see that most of the models preferred lower charging
5. Count Vs No. of Seats: Most of the cars have 5 seater which means 5 seaters cars have more demand in the market rather than 4 or less.
6. Count Vs Air Bags: out of 11, 10 models have air bags. This also shows that most of the companies also gives higher priority to security of customer

7. Count Vs Drive Type: Both AWD(All Wheel Drive) and FWD(Forward Wheel Drive) have higher priority than RWD(Rear Wheel Drive). This shows that AWD or RWD vehicles will have higher demand
8. Count Vs Price: Out of 11, 6 car models have lower price as compare to others. So we can say that Cheap cars with best features is preferred in India.



By the above heatmap we can say that acceleration is inversely proportional to other characteristics. As well as top speed and max power are highly correlated so we can avoid this feature to reduce the correlation. Similarly we can see that max power and price is also highly correlated.

### 3. Omar Mahmood:

```
In [2]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn import preprocessing
from sklearn.cluster import KMeans

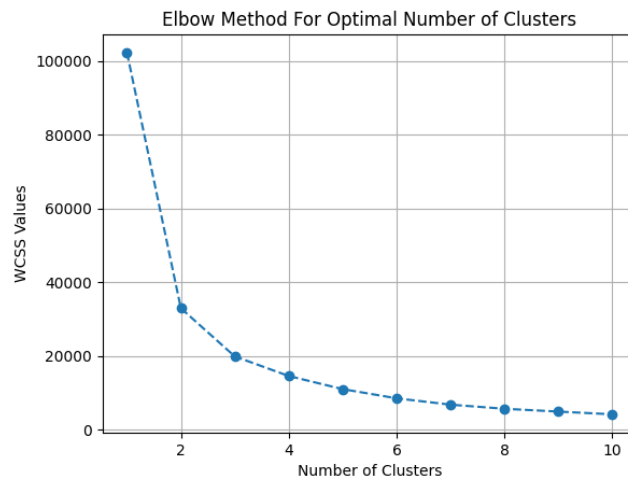
In [3]: df = pd.read_csv('EV_Car_data.csv')

In [4]: df.head()
```

	Brand	Model	Accel	TopSpeed	Range	Efficiency	FastCharge	RapidCharge	PowerTrain	PlugType	BodyStyle	Segr
0	Tesla	Model 3 Long Range Dual Motor	4.6 sec	233 km/h	450 km	161 Wh/km	940 km/h	Rapid charging possible	All Wheel Drive	Type 2 CCS	Sedan	
1	Volkswagen	ID.3 Pure	10.0 sec	160 km/h	270 km	167 Wh/km	250 km/h	Rapid charging possible	Rear Wheel Drive	Type 2 CCS	Hatchback	
2	Polestar	2	4.7 sec	210 km/h	400 km	181 Wh/km	620 km/h	Rapid charging possible	All Wheel Drive	Type 2 CCS	Liftback	
3	BMW	iX3	6.8 sec	180 km/h	360 km	206 Wh/km	560 km/h	Rapid charging possible	Rear Wheel Drive	Type 2 CCS	SUV	
4	Honda	e	9.5 sec	145 km/h	170 km	168 Wh/km	190 km/h	Rapid charging possible	Rear Wheel Drive	Type 2 CCS	Hatchback	

We can see, in this dataset we have attributes like Brand, top speed, Efficiency, Fast charge, rapid charge etc. Through this analysis we will get a clear conclusion on how these variables are associated with the EV market in India.

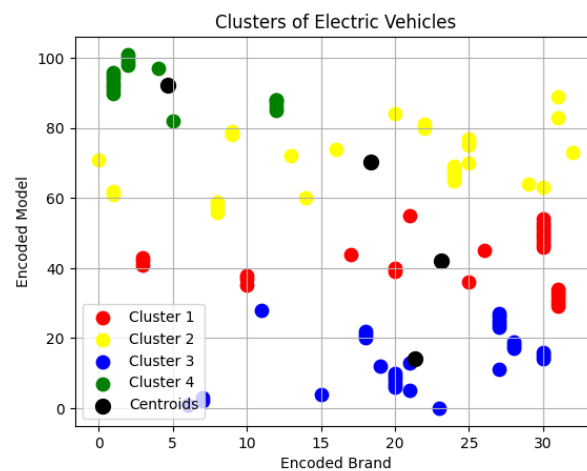
### K-Means clustering implementation:-



### KMeans Clustering

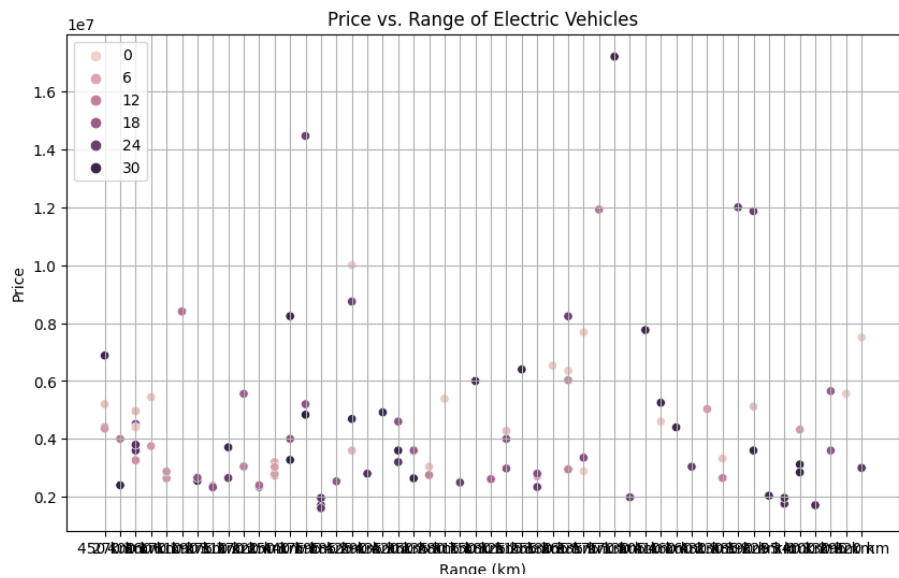
The elbow method suggests that a cluster number around 4 might be optimal, as indicated by the 'Elbow Method For Optimal Number of Clusters' plot. This means that the selected features can group the electric vehicles into roughly four distinct categories.

```
kmeans_model = KMeans(n_clusters=4, init='k-means++', random_state=0, n_init=10)
y_kmeans = kmeans_model.fit_predict(X)
```



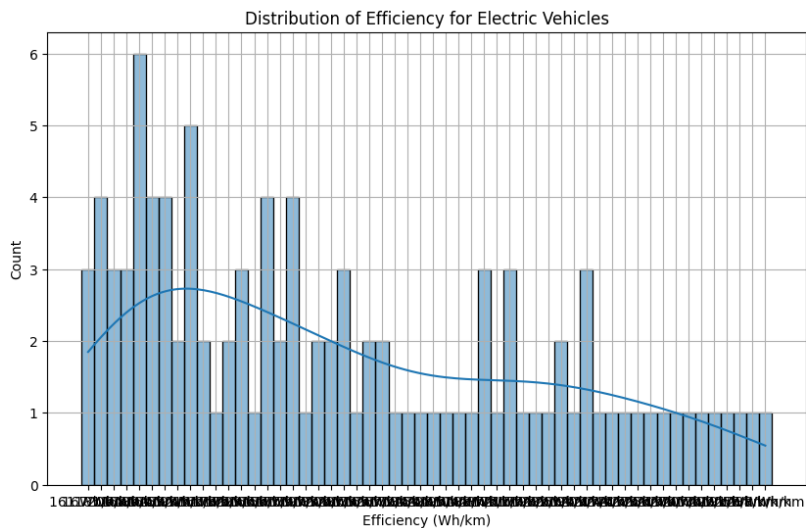
### Clusters of Electric Vehicles

The scatter plot titled 'Clusters of Electric Vehicles' provides an overview of how electric vehicles group based on their brand and model. Each cluster may represent vehicles with similar attributes. This can be further analyzed by examining the vehicles within each cluster to understand shared characteristics.



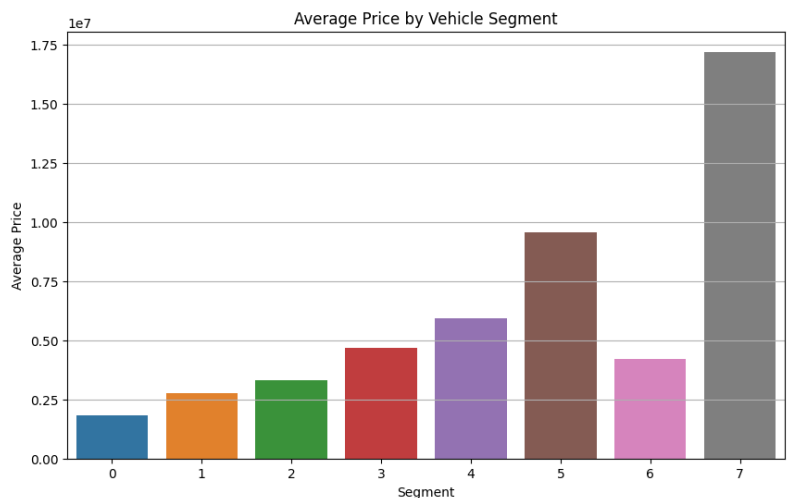
### Price vs. Range

The scatter plot suggests a positive correlation between price and range for many brands. However, some brands offer higher range at lower prices, indicating better value for money.

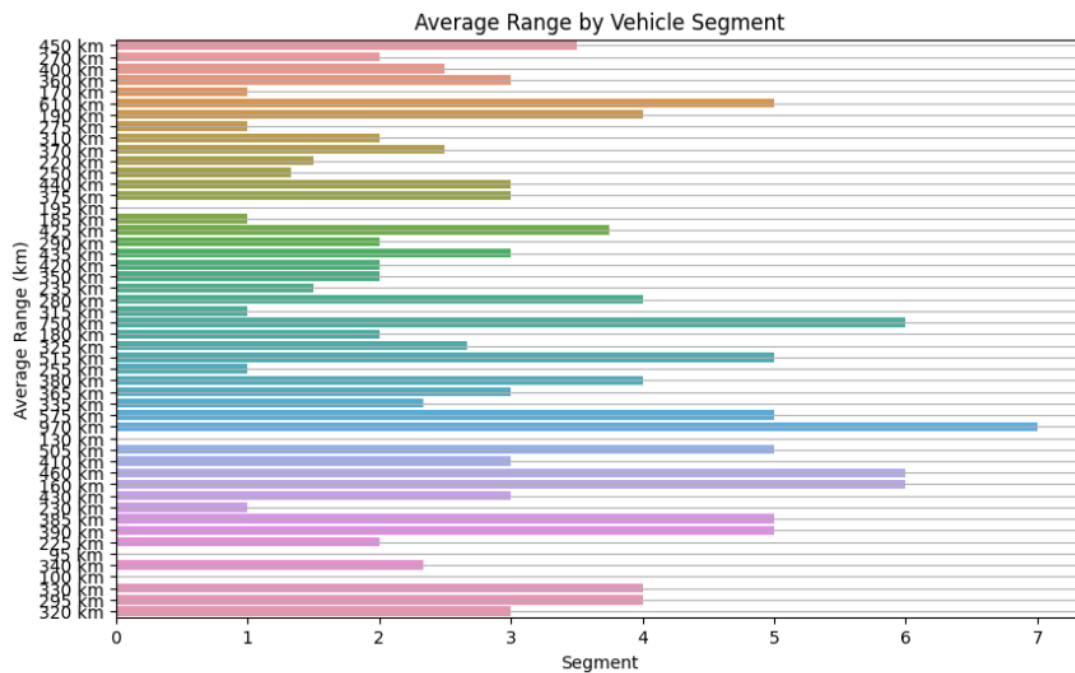


### Efficiency Distribution:

The efficiency histogram reveals that most electric vehicles have an efficiency within a particular range. Vehicles that deviate significantly from this norm might offer unique features or technology.







### Segment Analysis

The bar plots for segments indicate that different vehicle segments have varying price points and ranges. For instance, some segments might prioritize range over luxury or vice versa.

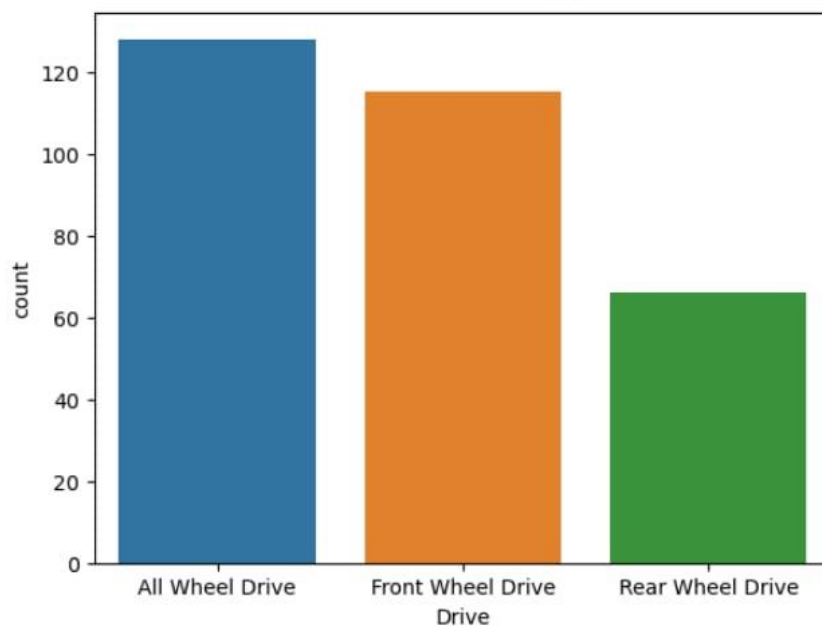
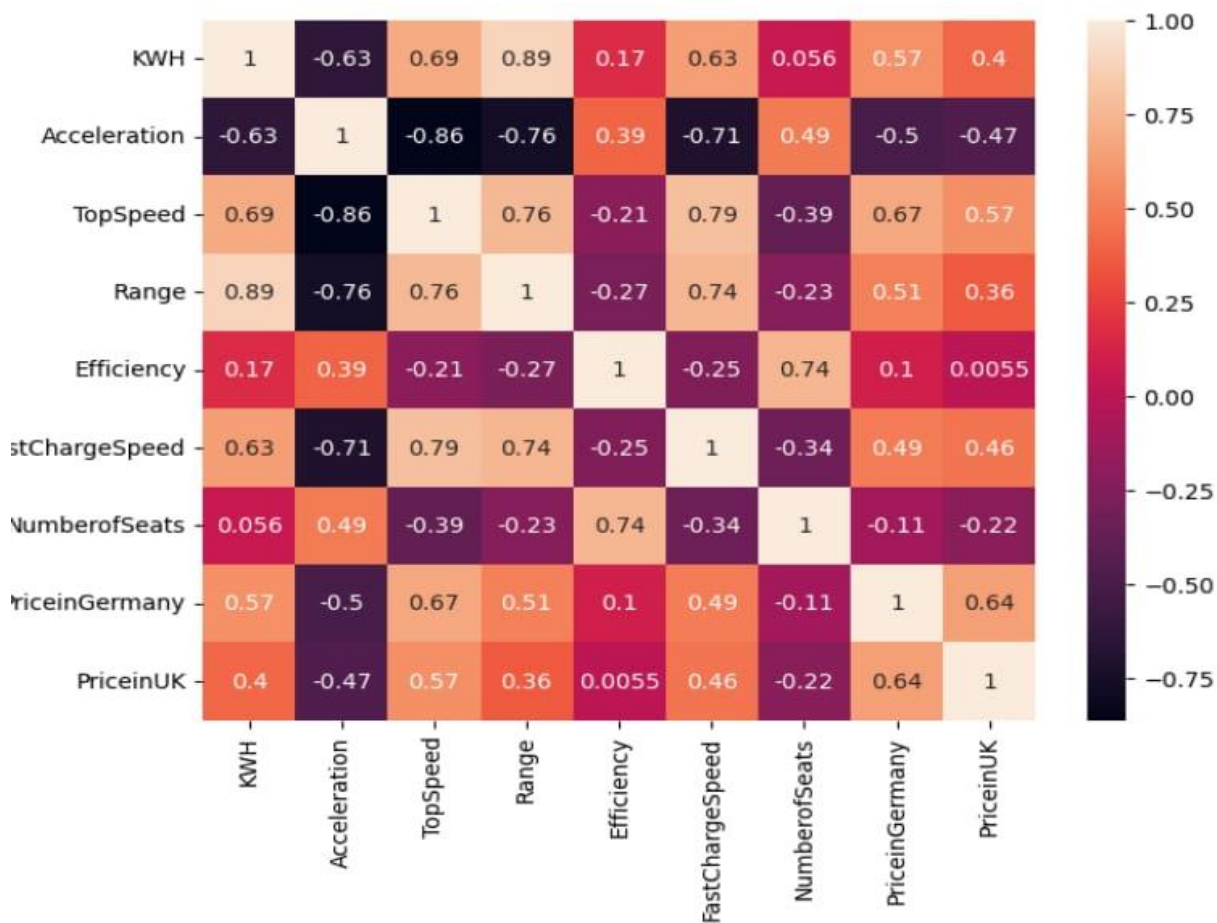
### 4. Tarasha Ahuja:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

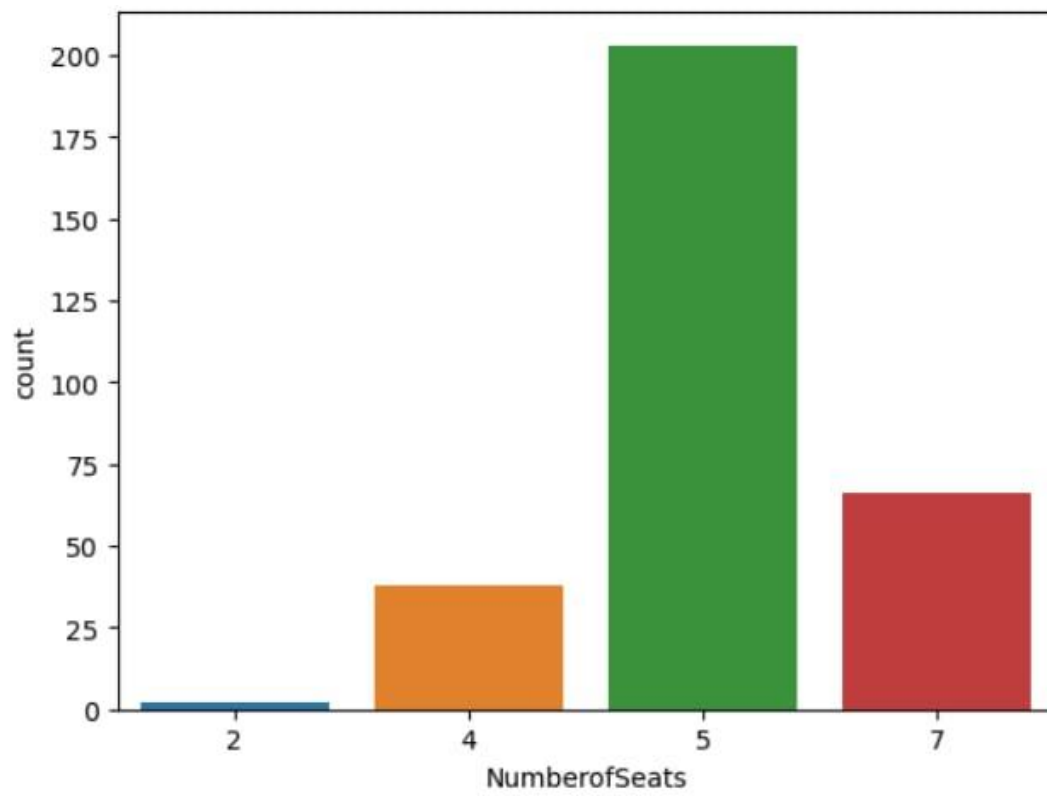
df1 = pd.read_csv("/Users/TT/Desktop/archive/Cheapestelectriccars-EVDatabase 2023.csv")

df1.head()
```

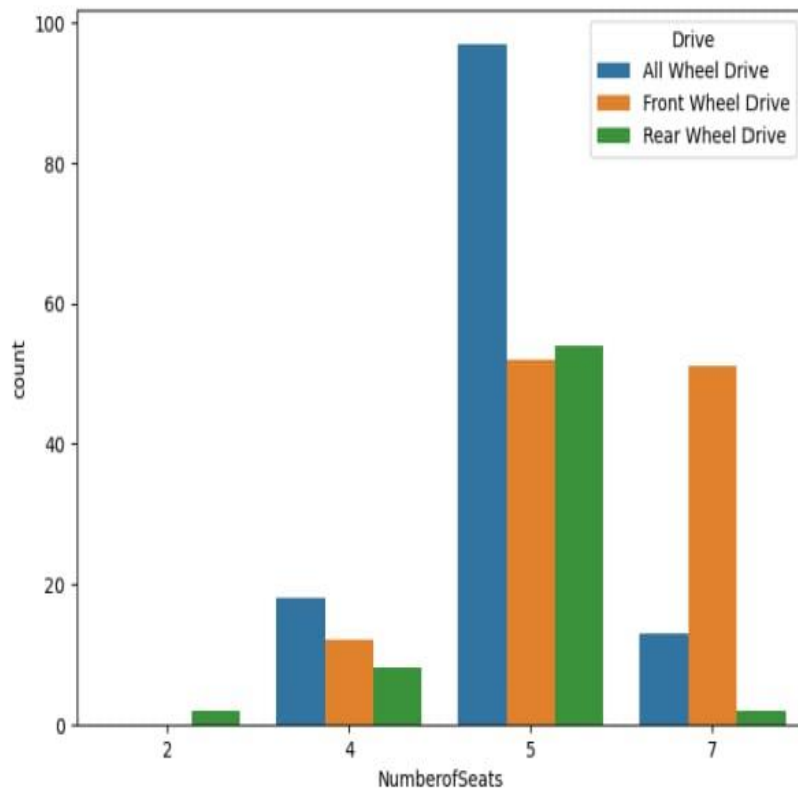
	Name	Subtitle	Acceleration	TopSpeed	Range	Efficiency	FastChargeSpeed	Drive	NumberOfSeats	PriceinGermany	PriceinUK
0	Lucid Air Dream Edition P	118 kWh useable battery Available sin...	2.7 sec	270 km/h	645 km	183 Wh/km	820 km/h	All Wheel Drive	5	€218,000	NaN
1	Porsche Taycan Turbo S	83.7 kWh useable battery Available si...	2.8 sec	260 km/h	400 km	209 Wh/km	980 km/h	All Wheel Drive	4	€189,668	£142,400
2	Audi e-tron GT RS	85 kWh useable battery Available sinc...	3.3 sec	250 km/h	405 km	210 Wh/km	1000 km/h	All Wheel Drive	4	€146,050	£115,000
3	Renault Zoe ZE50 R110	52 kWh useable battery Available sinc...	11.4 sec	135 km/h	315 km	165 Wh/km	230 km/h	Front Wheel Drive	5	€36,840	NaN
4	Audi Q4 e-tron 35	52 kWh useable battery Available sinc...	9.0 sec	160 km/h	285 km	182 Wh/km	360 km/h	Rear Wheel Drive	5	NaN	NaN



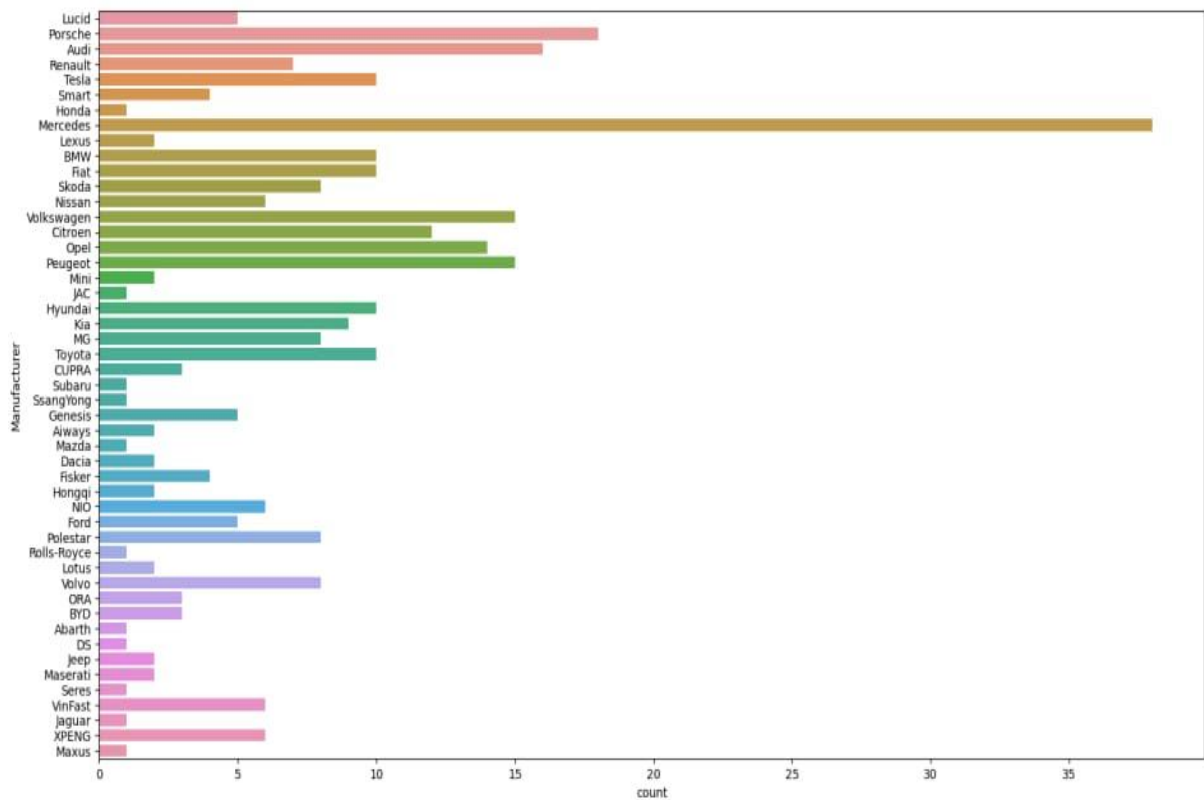
we can conclude from this that a majority of people buy all wheel drive > front wheel drive > rear wheel drive



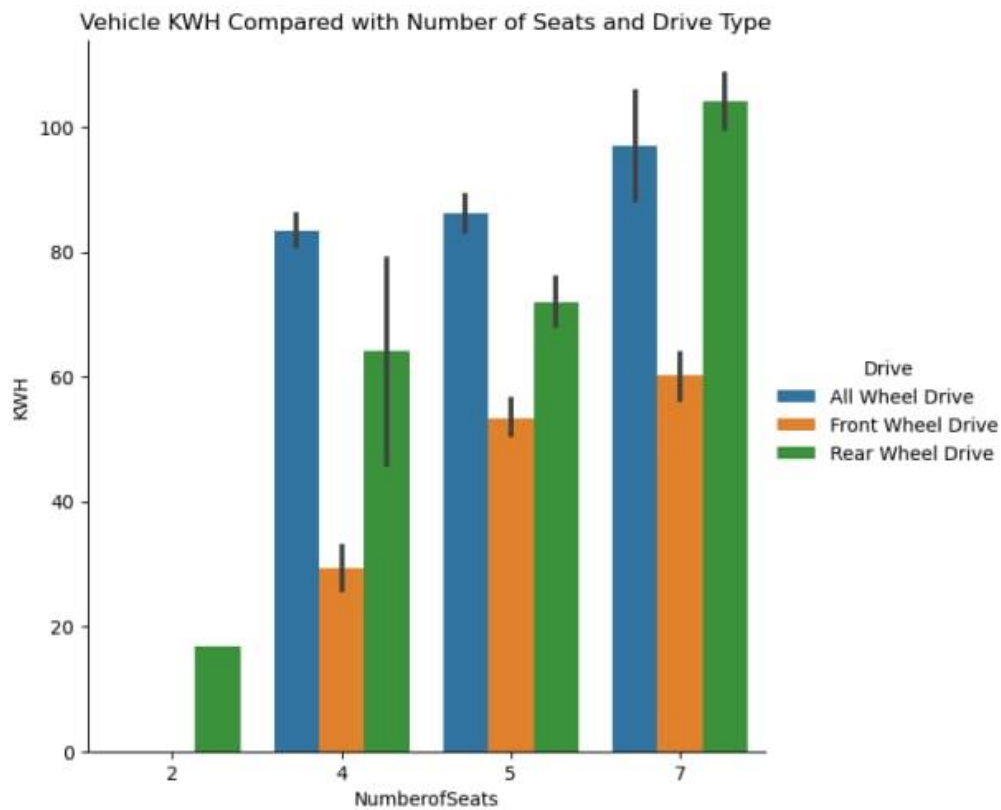
we can see here that people prefer buying 5 seater cars more > 7 > 4 > 2



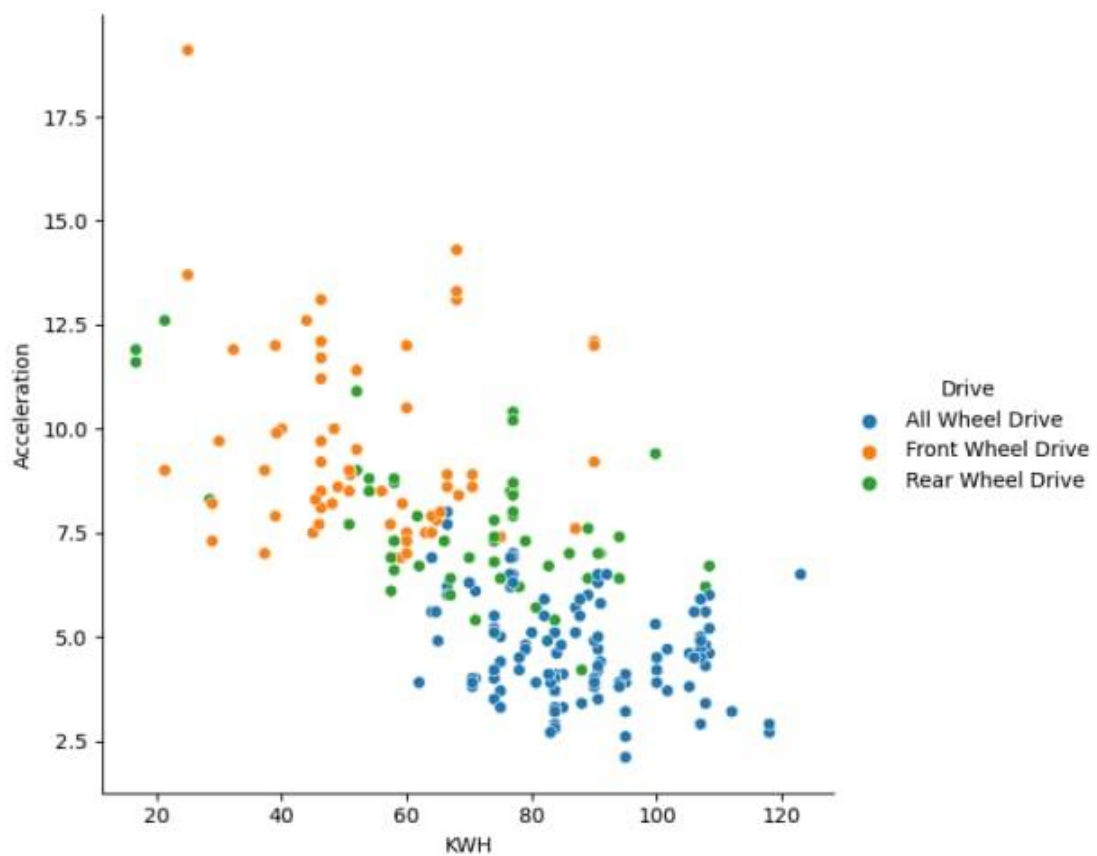
from this histogram we can make out that in 5 seater cars, the trend is to buy all wheel drive more whereas in 7 seater cars the trend is to buy front wheel drive more.



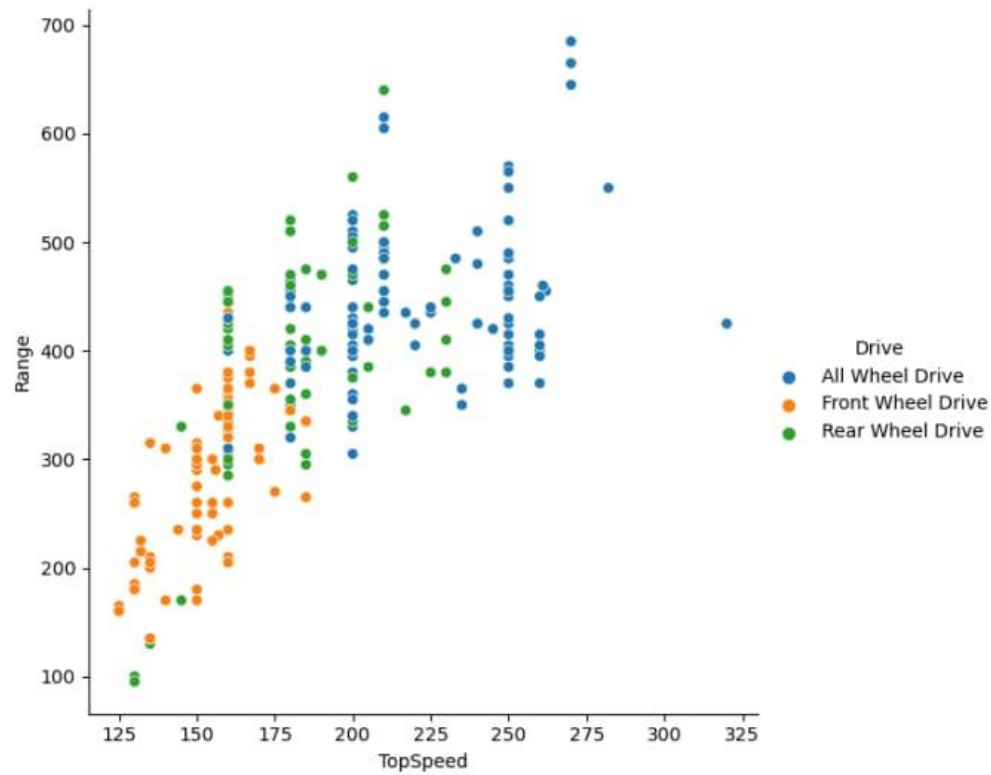
from this countplot we can makeout that the most ev cars are sold by mercedes and then porche



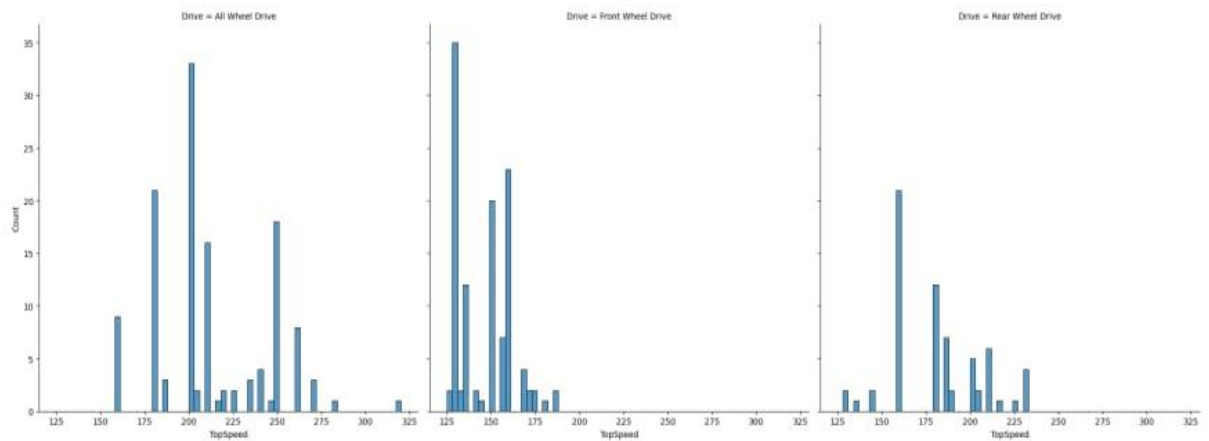
here we can makeout that 7 seater cars offer more kwh



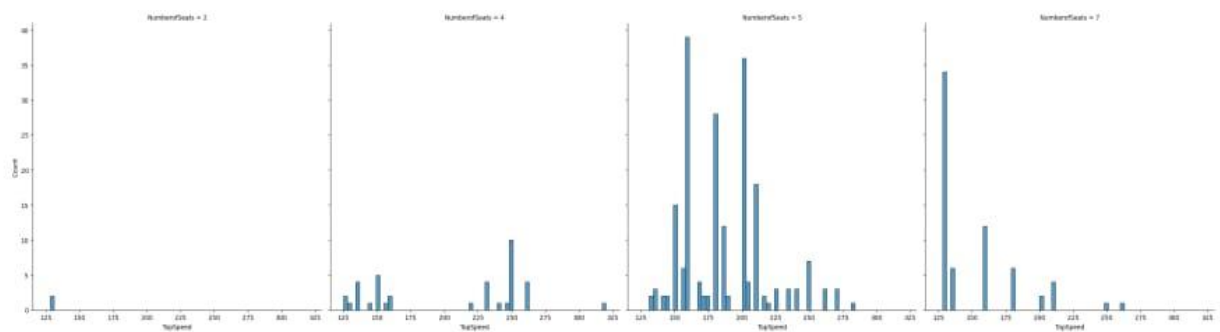
here we can makeout that all wheel drive cars offer more kwh



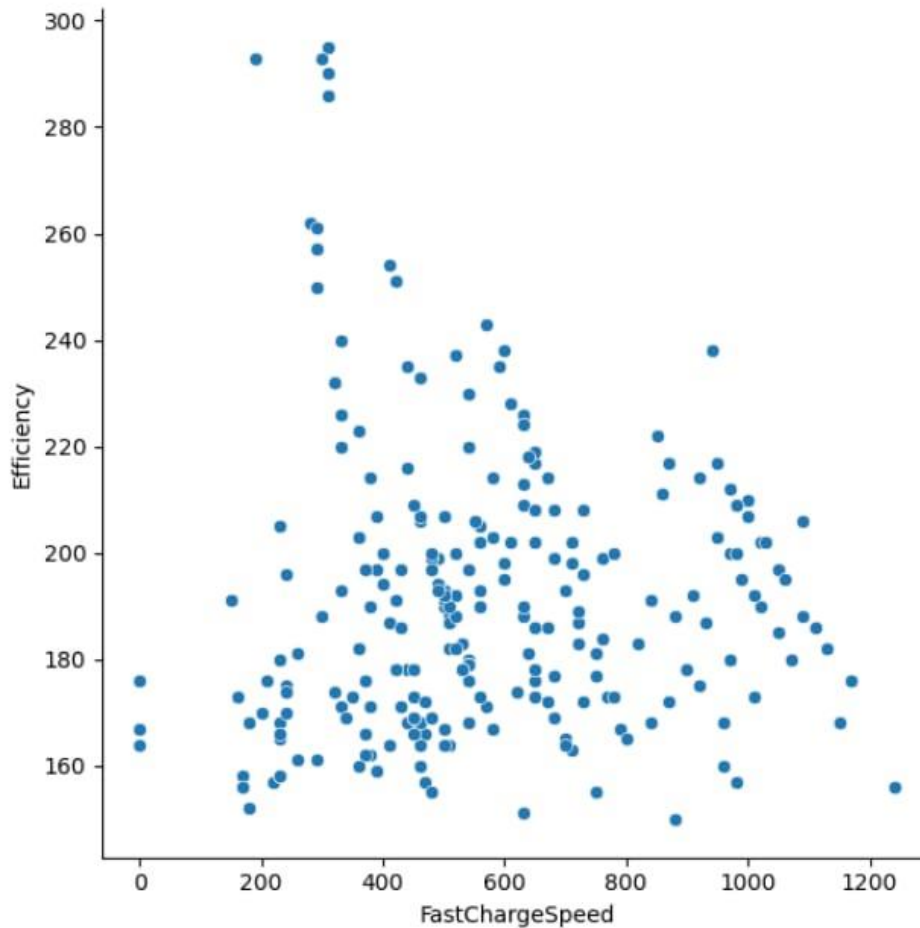
on an average we can makeout that all wheel drive cars offer more range



all wheel drive cars offer more top speed



4 seater car here has shown to give maximum topspeed



fast charge speed cars show lower efficiency

## 5. Adarsh Singh:

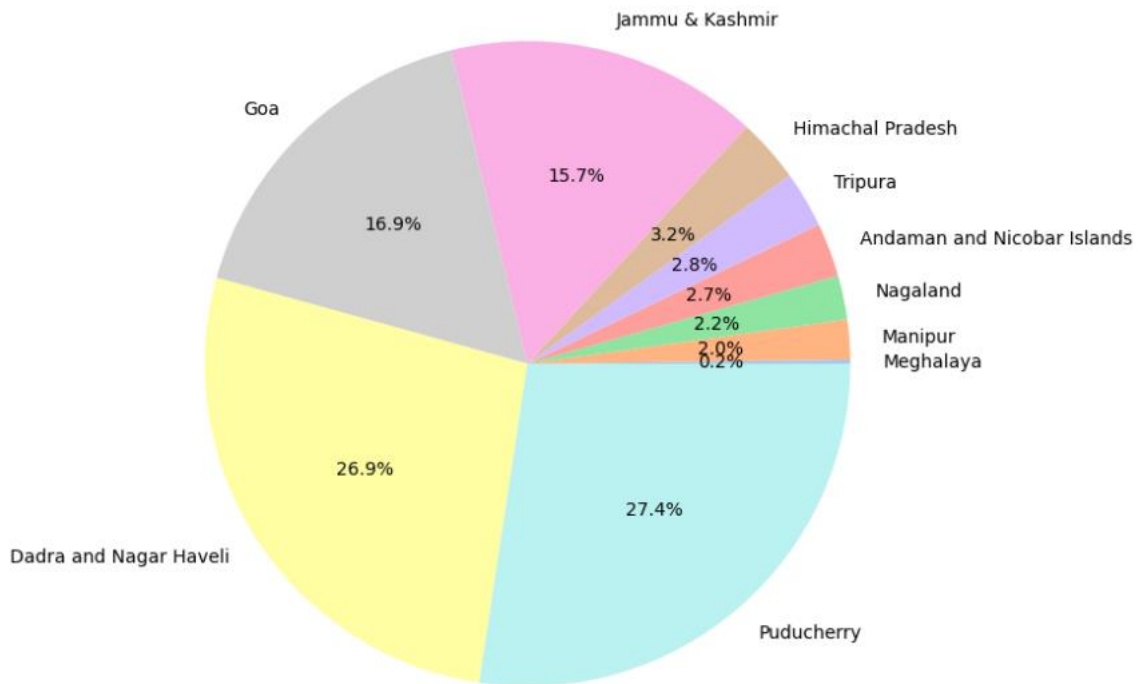
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

## Analysis on Number of EV's in different States

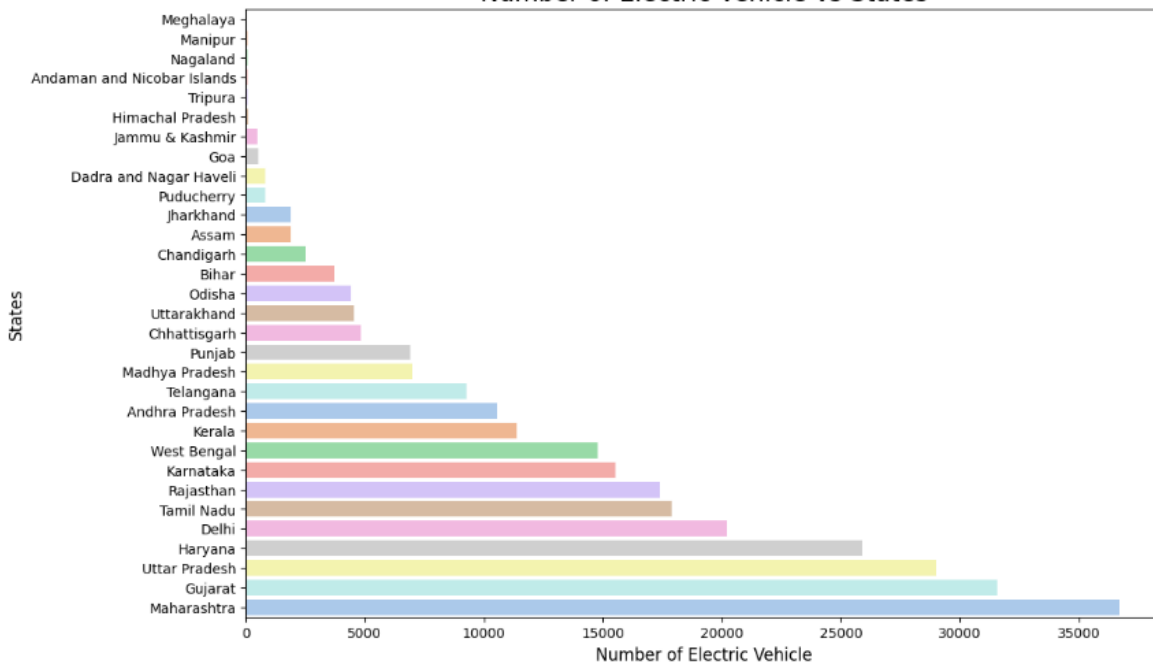
```
ev_count_per_state = pd.read_csv("./evs_per_state.csv")
ev_count_per_state.drop([len(ev_count_per_state)-1], axis=0, inplace=True)
ev_count_per_state.drop("Sl. No.", axis=1, inplace=True)
ev_count_per_state = ev_count_per_state.sort_values(["Number of Electric/Hybrid Vehicle (approx.)"], ascending=True)
ev_count_per_state.head()
```

	State/UT-wise	Number of Electric/Hybrid Vehicle (approx.)
25	Meghalaya	6
22	Manipur	61
23	Nagaland	67
19	Andaman and Nicobar Islands	82
21	Tripura	86

## Number of Electric Vehicle vs States



## Number of Electric Vehicle vs States

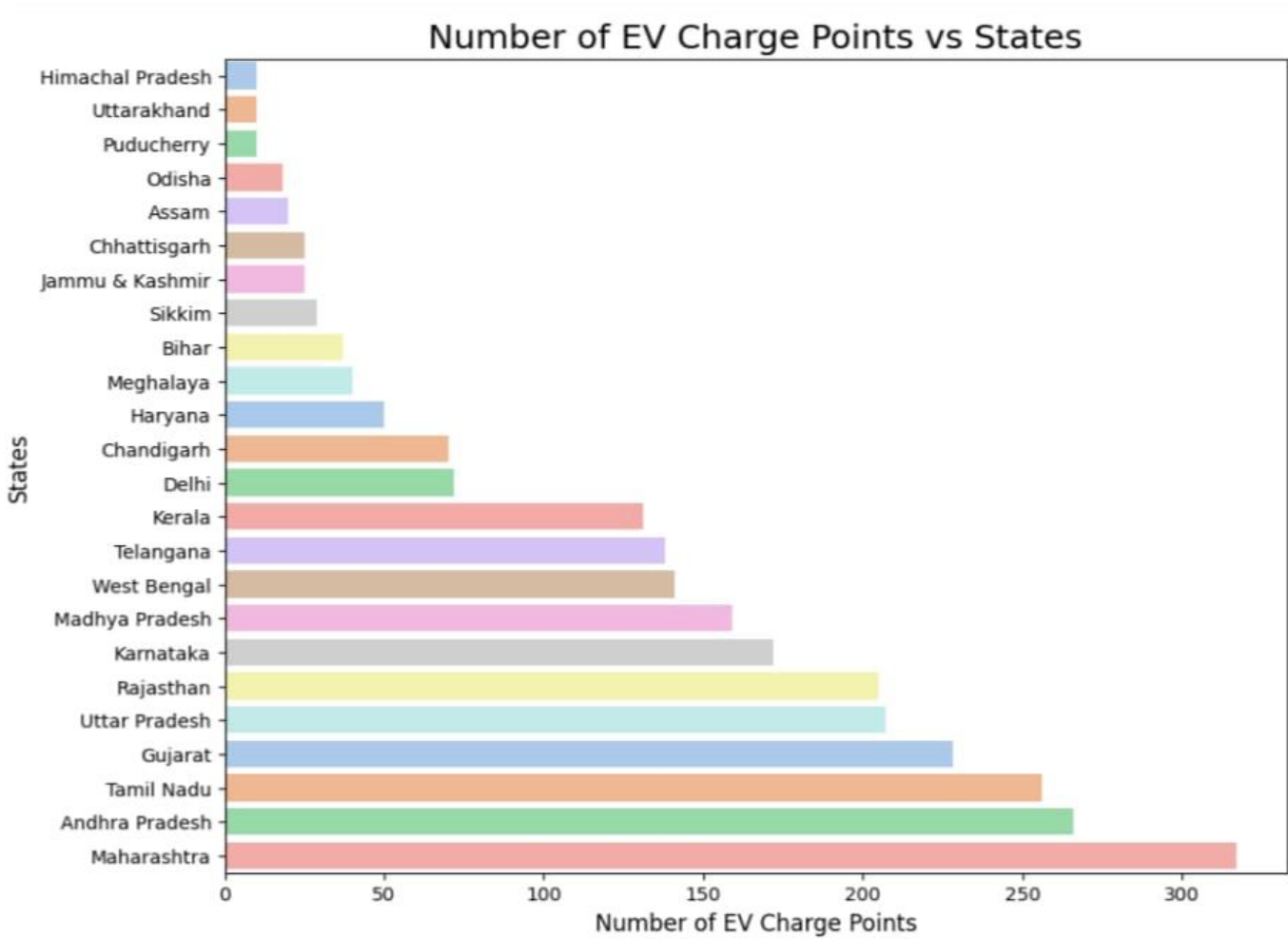




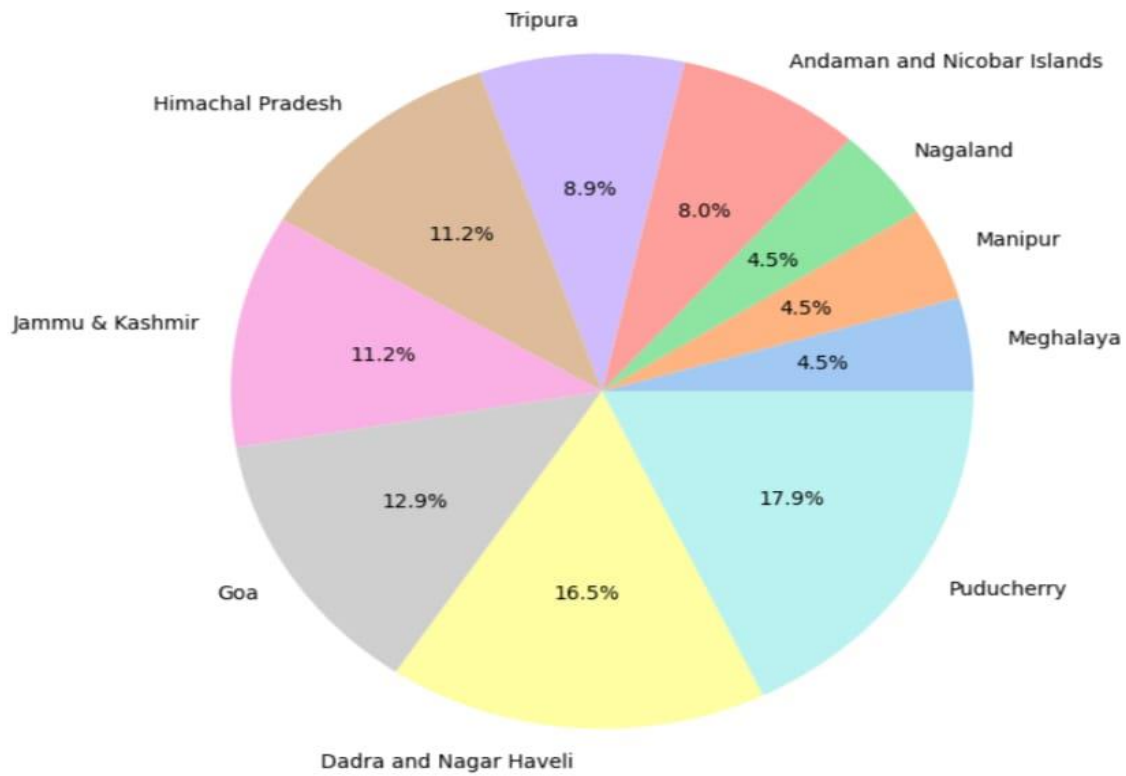
# Charging Points throughout Country

```
charge_points_per_state = pd.read_csv("/content/charging_points.csv")
charge_points_per_state.drop([len(charge_points_per_state)-1], axis=0, inplace=True)
charge_points_per_state = charge_points_per_state.sort_values(["Number of Electric Vehicle Charging Sanctioned"], ascending=True)
charge_points_per_state.head()
```

	State/UT-wise	Number of Electric Vehicle Charging Sanctioned
23	Himachal Pradesh	10
21	Uttarakhand	10
22	Puducherry	10
20	Odisha	18
19	Assam	20



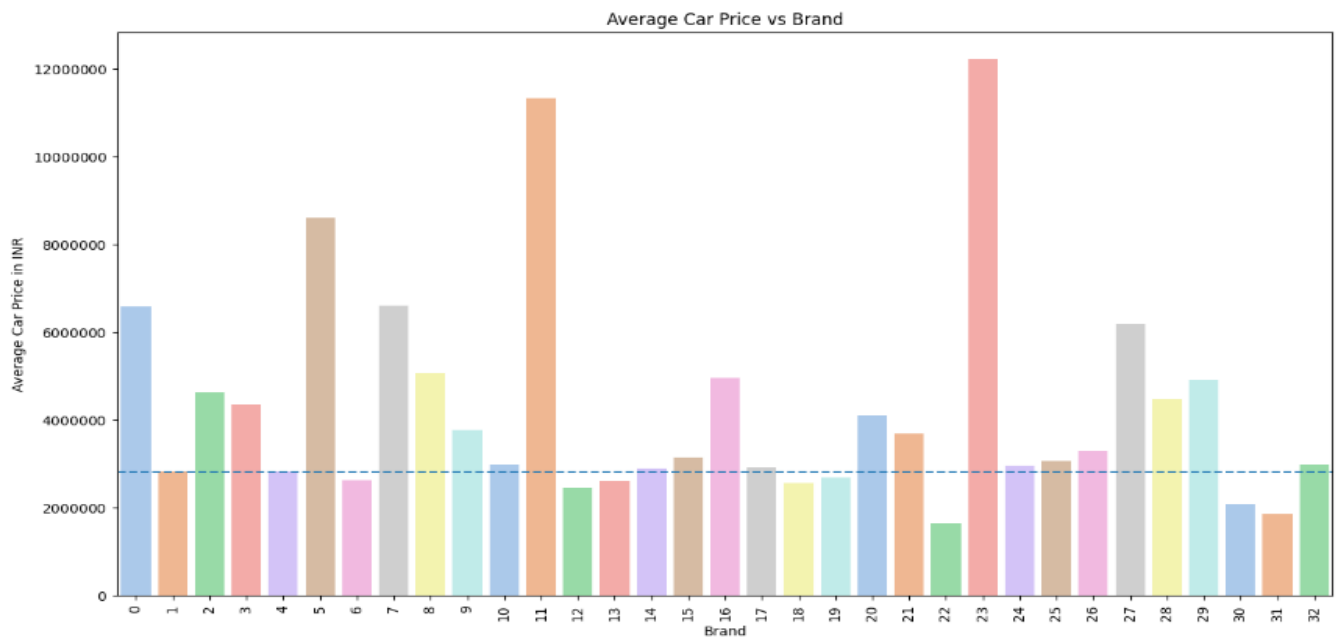
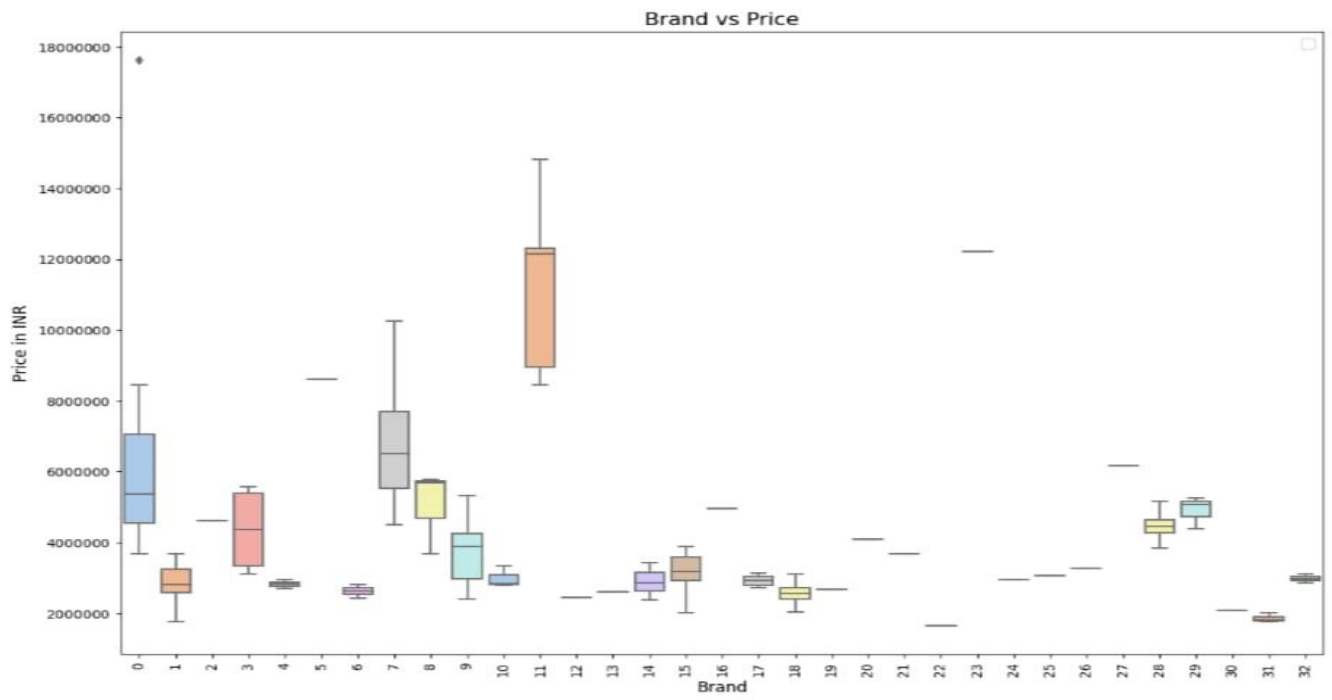
Number of EV Charge Points vs States

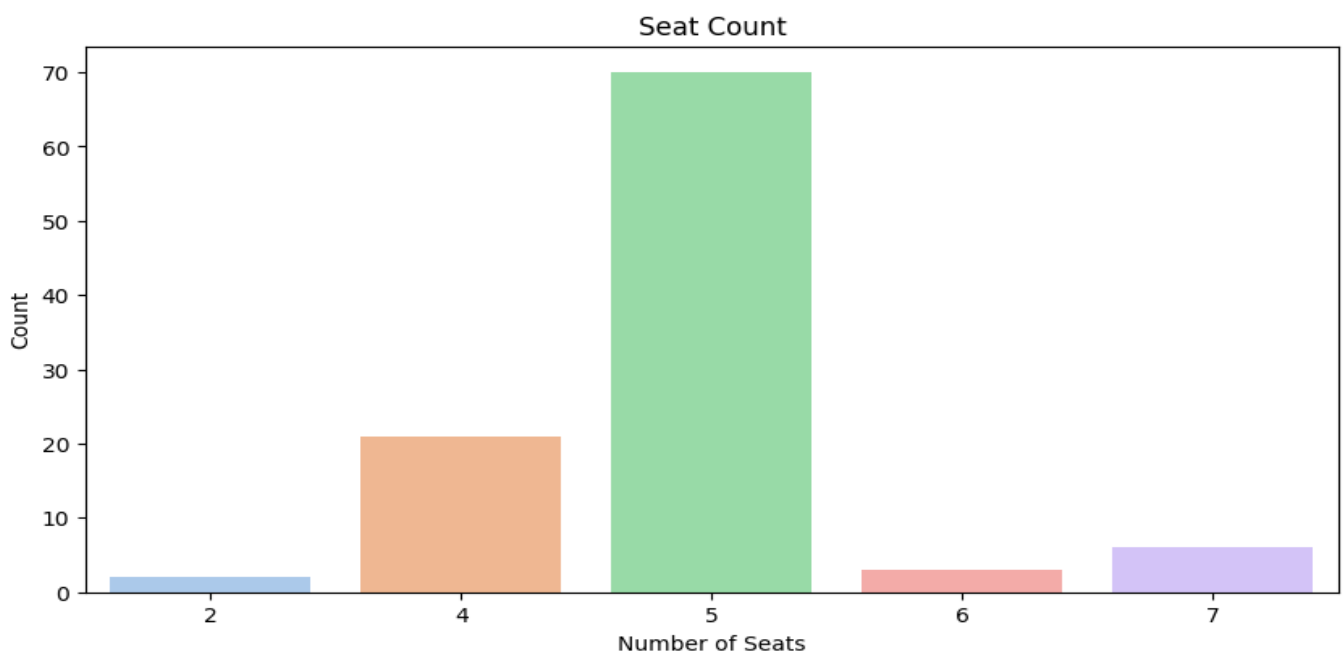
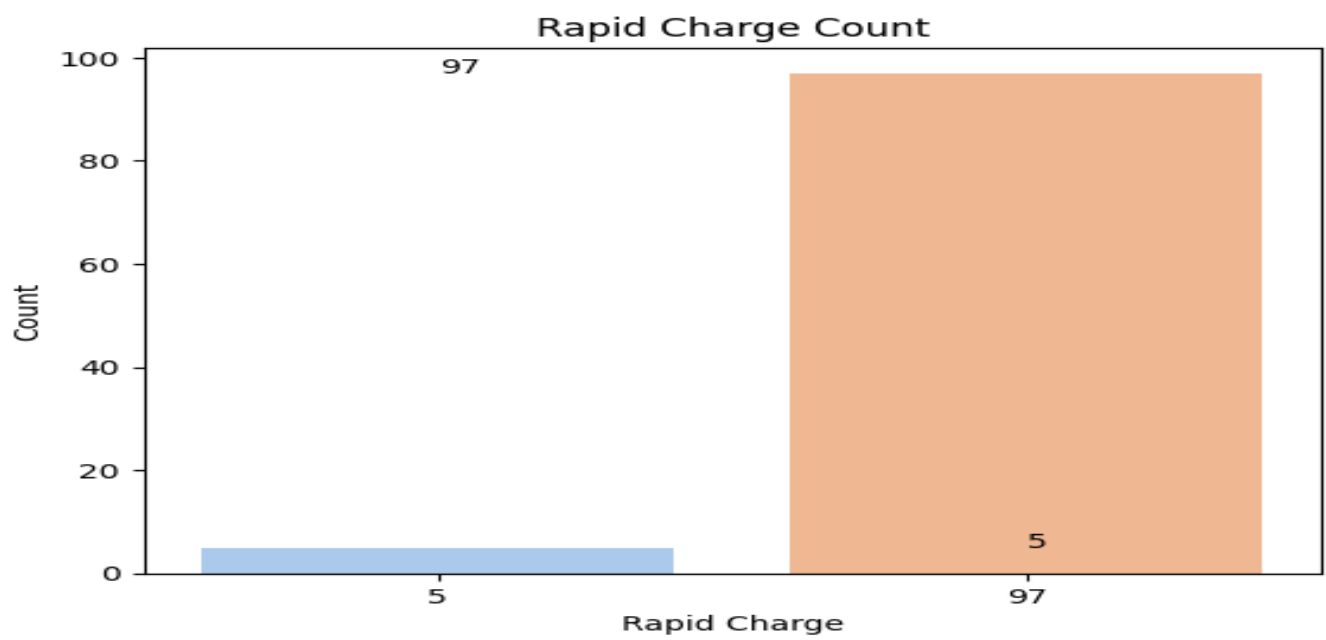
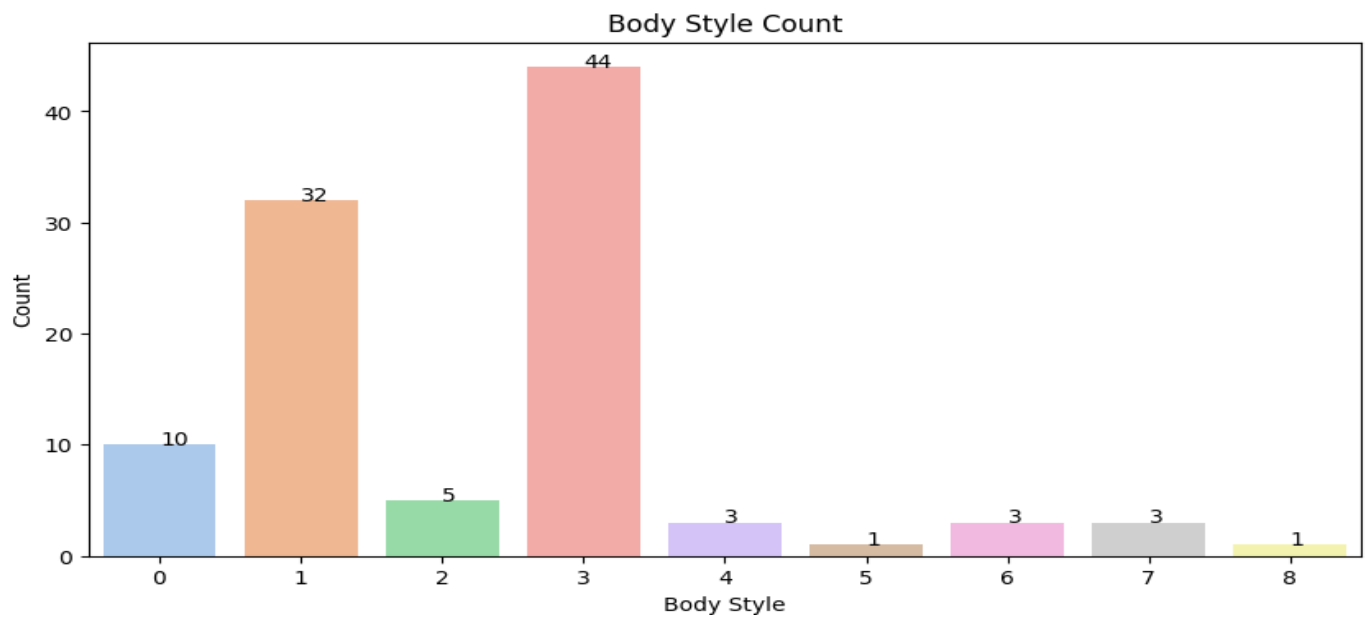


## Analysis of EV data

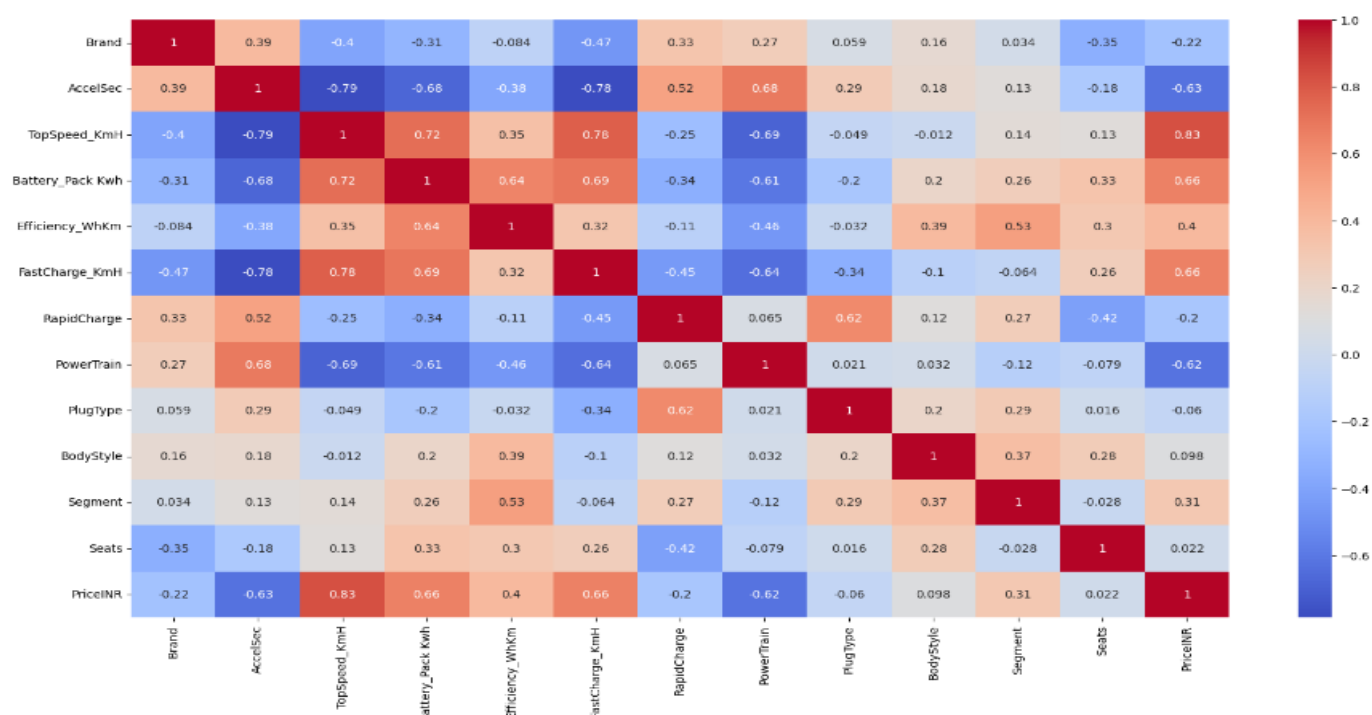
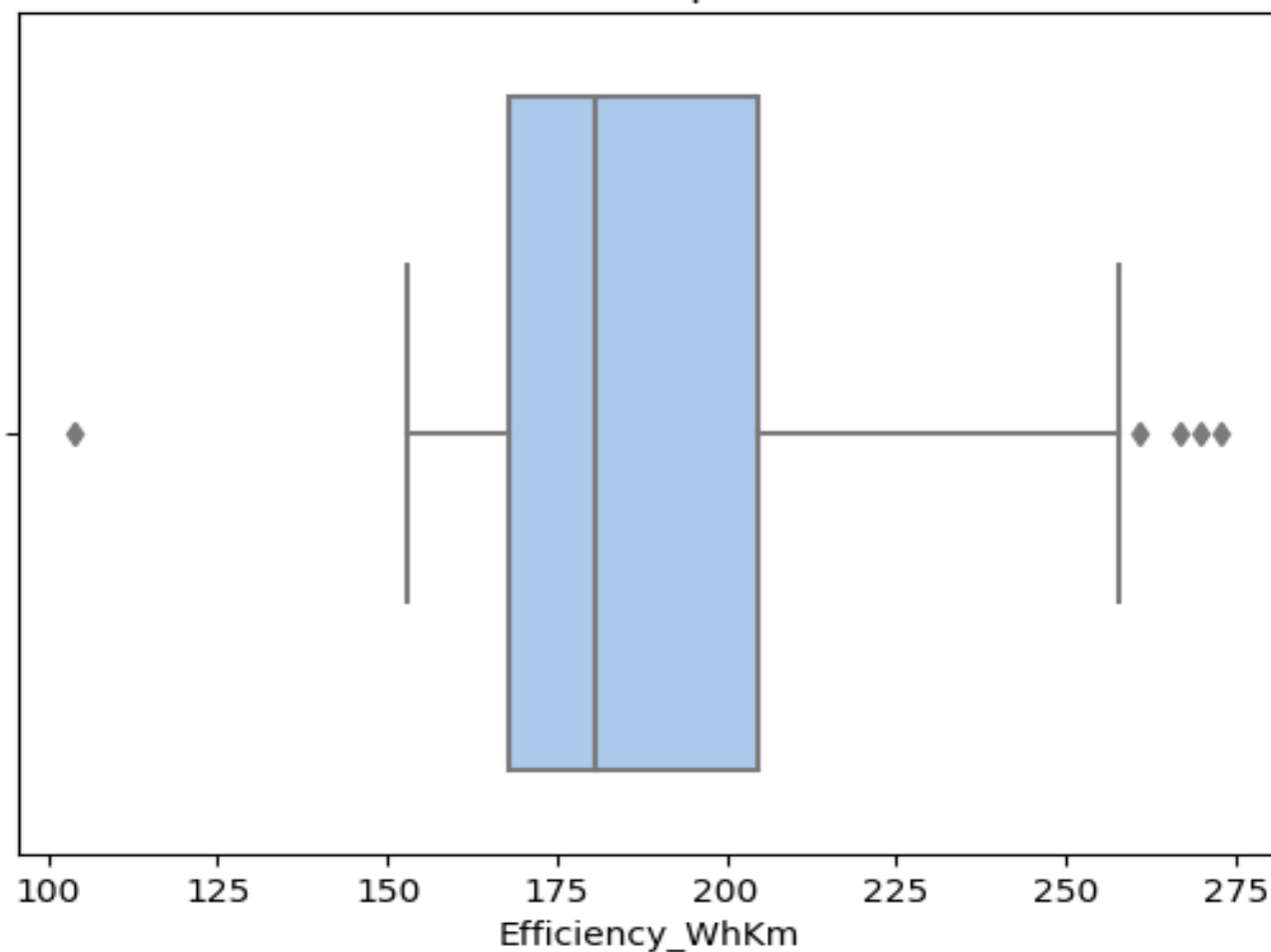
```
car_data = pd.read_csv("/content/evs_car_data.csv")
car_data.head()
```

	Brand	AccelSec	TopSpeed_KmH	Battery_Pack_Kwh	Efficiency_WhKm	FastCharge_KmH	RapidCharge	PowerTrain	PlugType	Body
0	0	4.6	233	70.0	161	940	0	0	0	
1	1	10.0	160	45.0	167	250	0	1	0	
2	2	4.7	210	75.0	181	620	0	0	0	
3	3	6.8	180	74.0	206	560	0	1	0	
4	4	9.5	145	28.5	168	190	0	1	0	





kilometers per Wh



### Analysis results for these 3 datasets:-

Maharashtra has most EV vehicles running and also has the most EV charging station available.

As the Acceleration/Sec Decrease the price of the car Increase

As the Top Speed Increase the price of the car Increase.

As the Battery Pack Increase the price of the car Increase.

In [19]:

Most of the production is of 5 seater cars and at 2nd 4 seater cars.

Average Price in INR range between[Rs. 25,00,000 - Rs. 40,00,000].

Most of the production is of SUV AND Hatchback BodyStyle vehicles.

Most of the production is with the Rapid Charge Feature.

Average Efficiency ranges from [160-200] Whkm.

## Segment Extraction

### 1. EV Market Buying Behavior:

- **Age-based Segmentation:** Young Professionals aged between 32 and 38 show a heightened interest in EVs.
- **Income-based Segmentation:** Middle-Income Earners with earnings between 800,000 to 3,200,000 annually form a significant portion of the EV buyers.
- **Vehicle Preference:** Baleno and SUV models are predominant in the market.
- **Education-based:** Individuals with advanced educational qualifications value sustainability and modern technology, indicating a heightened awareness of the benefits of EVs.

### 2. EV Market and Charging Infrastructure Analysis:

- **High EV Density States:** States that have a notably high number of electric vehicles.
- **Emerging EV Markets:** States that have a moderate number of electric vehicles.
- **Low EV Density States:** States with a minimal number of electric vehicles.
- **States with Robust Charging Infrastructure:** States with a significant number of EV charging points relative to the number of EVs.

### 3. Comprehensive EV Analysis:

- **Drive Type Segmentation:** Classification based on the drive type of the EVs.
- **Seating Capacity Segmentation:** Categorization based on the number of seats in the EVs.
- **Manufacturer-based Segmentation:** Segments based on the EV brand or manufacturer.
- **Battery Capacity Segmentation:** Classification based on the battery capacity of the EVs.

### 4. EV Market Analysis in India till 2023:

- **Battery Capacity:** There's a notable preference for vehicles with higher battery capacities.
- **Vehicle Speed:** Vehicles with an average top speed (150-175 km/hr) are preferred.
- **Vehicle Power:** The majority of models till 2023 focus on moderate power.

- **Seating Capacity:** 5-seater vehicles dominate the market.
- **Safety Features:** Almost all models prioritize safety, with airbags being a standard feature.
- **Vehicle Brand:** Certain brands, like 'Jaguar I-Pace', offer a balance of features and price.

## 5. EV Market Analysis:

**Average Price by Vehicle Segment:** Segmentation based on the average price of vehicles across different segments. Distinct segments cater to varied market demographics, reflecting luxury levels, brand reputation, or feature offerings.

**Average Range by Vehicle Segment:** Analysis on the average travel range of vehicles in different segments. The vehicle's range is crucial for potential EV buyers. Some segments might prioritize range over other attributes, indicating its primary use (city commute vs. long travels).

## MARKETING MIX

The marketing mix encompasses the 4Ps: Price, Product, Promotion, and Place.

- **Price:** The challenge of affordability presents a significant obstacle to the expansion of Electric Vehicles (EVs). It's crucial to note that for consumer attraction, the company's product must demonstrate cost-effectiveness in both initial purchase and ongoing maintenance. Ideally, the optimal price range for the product would fall between 10 to 20 lakh, aligning with the most preferred range among potential buyers.

- **Product:** The selection of the product naturally depends on the specific EV Startup in question. However, EV manufacturers should diversify their product offerings to cater to various psychographic segments. This involves providing luxury EVs for high-income individuals, practical and budget-friendly EVs for value-conscious consumers, and environmentally-conscious EVs for those prioritizing sustainability.

- **Place:** A well-crafted distribution strategy is vital for reaching the desired psychographic segments. EV manufacturers can establish partnerships with dealerships, develop urban charging infrastructure, and offer home charging solutions to cater to the convenience-oriented segment.

- **Promotion:** To effectively promote EV products, manufacturers should customize their promotional efforts to align with the distinct interests and preferences of each segment. This might involve targeted social media campaigns, leveraging influencer marketing, and hosting events tailored to specific psychographic segments. For instance, sponsoring environmental events for eco-conscious consumers, participating in tech fairs for tech-savvy buyers, or showcasing at auto shows to attract early adopters.

To flourish in the Indian EV market, companies must comprehensively grasp the unique requirements, preferences, and motivations of diverse psychographic segments. This understanding guides the development of a potent marketing mix, adjusting product offerings, pricing strategies, promotional activities, and distribution channels to cater to the distinct needs of each segment. Through this approach, companies can effectively engage their target audience and facilitate widespread adoption of EVs throughout India.

## **Conclusion:**

The consolidated insights provide a comprehensive overview of the EV market, highlighting key segments and preferences. Whether it's the buying behaviour in the Indian market, infrastructure analysis, comprehensive vehicle attributes, or specific insights about the Indian market until 2023, these findings offer valuable insights for stakeholders in the EV industry.

Brands and policymakers can leverage this report to make informed decisions, develop targeted marketing campaigns, and strategize product development to cater to the specific needs and preferences of various segments in the EV market.