

Electric Vehicle Market

Segmentation Analysis

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"In order to have clean air in cities, you have to go electric."- Elon Musk

Abstract

Market segmentation is a decision-making process used by marketing managers to choose a target market for a specific product and create an appropriate marketing mix. In this paper, the ideas and principles of market segmentation analysis have been applied to the Electric Vehicle market in India.

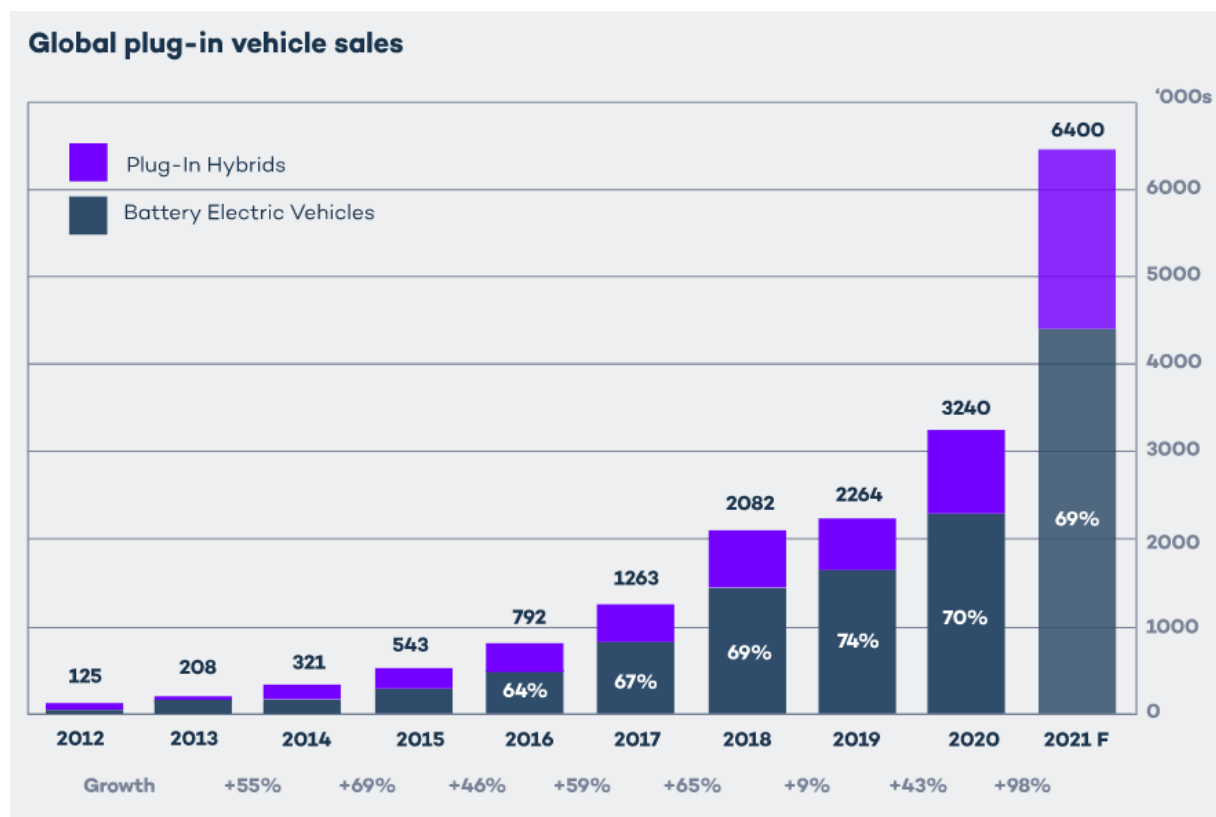
Problem Statement

To analyze 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.

Background

Global Trends

EVs are to play a central role in the ambitious objective of **zero emission targets** set for 2050, and the industry is clearly gearing up for it. The global EV sales trend is shown.

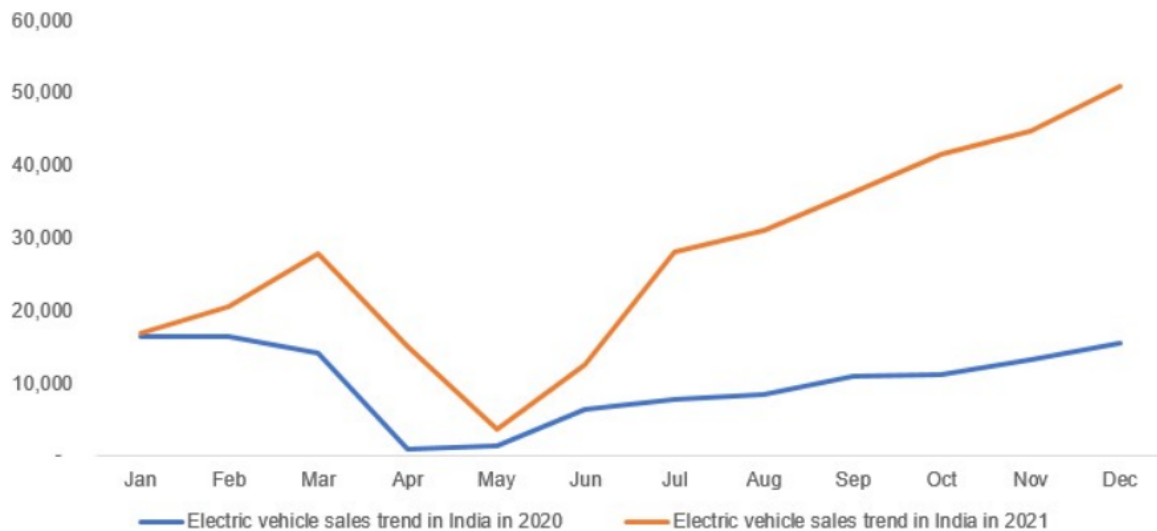


The Indian EV Market

Diverse economic opportunities are created in the mobility, infrastructure, and energy sectors as a result of India's EV drive. These potential include, among others, those in the battery

infrastructure, solar vehicle charging, EV OEM market, EV franchising, and battery swapping technologies.

Electric Vehicle Sales Trend in India (2020-21)



State -Wise-EV Sales Trend in 2021



According to the Ministry of Skill Development and Entrepreneurship (MSDE), the EV industry could add 10 million direct jobs by 2030 which would create 50 million indirect jobs in the sector.

Several automobile companies have plans to participate in the EV industry as listed in the table below:

Company	EV related plans
Kia	Kia plans to manufacture small SUV EVs in India for global markets in 2025.
Maruti Suzuki	Maruti Suzuki plans to launch its first EV model in India by 2025.
Tata Motors	Tata Motors bags an order worth US\$ 678 million (Rs 5,000 crore) order from the government for electric buses; it plans to launch 10 more EVs in India.
Hyundai	Hyundai plans to launch IONIQ 5 EV in India by the second half of 2022.
Hopcharge	Hopcharge, a Gurgaon- based start-up has created the world's first on-demand doorstep fast charge service.
MG Motors	MG Motors India has partnered with Bharath petroleum for expanding the EV charging infrastructure.
Mahindra & Mahindra	Mahindra and Mahindra targets to launch 16 EV models across its SUV and LCV categories by 2027.

Business Opportunities and programmes launched by the government of India to increase EV adoption

1. FAME India Scheme
2. PLI Scheme
3. Battery Swapping Policy
4. Tax exemption of up to Rs.1,50,000 (US\$ 1,960) under section 80EEB of income tax while purchasing an EV (2W or 4W) on loan.
5. Reduction of customs duty on nickel ore (key component of lithium-ion battery) from 5% to 0%.
6. State- wise reduction of road tax and other incentives

Data Sources

Data Collection was done through the following websites:

<https://data.gov.in/>

<https://medium.com/@vpsfahad/where-to-get-india-government-datasets-for-data-analytics-17bf359a5afd>

https://censusindia.gov.in/digitallibrary/Archive_home.aspx

<https://www.data.gov/>

<https://data.worldbank.org/>

<https://www.searchenginejournal.com/free-data-sources/302601/#close>

12 data sets have been collected, out of which 6 useful ones were selected. Out of these 6, 4 datasets have been used for majority of analysis.

Data Pre-processing

Data Set 1: Cheapestelectriccars-EVDatabase.csv

df1

df1.head()

	Name	Subtitle	Acceleration	TopSpeed	Range	Efficiency	FastChargeSpeed	Drive	NumberofSeats	PriceinGermany	PriceinUK
0	Opel Ampera-e	Battery Electric Vehicle 58 kWh	7.3 sec	150 km/h	335 km	173 Wh/km	210 km/h	Front Wheel Drive	5	€42,990	NaN
1	Renault Kangoo Maxi ZE 33	Battery Electric Vehicle 31 kWh	22.4 sec	130 km/h	160 km	194 Wh/km	-	Front Wheel Drive	5	NaN	£31,680
2	Nissan Leaf	Battery Electric Vehicle 36 kWh	7.9 sec	144 km/h	220 km	164 Wh/km	230 km/h	Front Wheel Drive	5	€29,990	£25,995
3	Audi e-tron Sportback 55 quattro	Battery Electric Vehicle 86.5 kWh	5.7 sec	200 km/h	375 km	231 Wh/km	600 km/h	All Wheel Drive	5	NaN	£79,900
4	Porsche Taycan Turbo S	Battery Electric Vehicle 83.7 kWh	2.8 sec	260 km/h	390 km	215 Wh/km	860 km/h	All Wheel Drive	4	€186,336	£138,830

Variables: Name (Model name), Subtitle (specification), Acceleration, TopSpeed, Range, Efficiency, FastChargeSpeed, Drive (Type of wheel Drive), Number of seats, Price in Germany, Price in UK

This dataset contains 180 observations. Also, there are no-null values hence no imputation or any other technique is required. Further, the columns Subtitle, Drive, Price in UK, Price in Germany and FastChargeSpeed are dropped as it's not useful.

After taking data.info() it is observed that

- 1 Acceleration
- 2 TopSpeed
- 3 Range
- 4 Efficiency
- 5 NumberofSeats

are all object data type hence they are converted into numeric data types first.

Then we use describe() method to summarize the data.

Data Set 2: ElectricCarData_Clean.csv

df2

```
df2.head()
```

	Brand	Model	AccelSec	TopSpeed_KmH	Range_Km	Efficiency_WhKm	FastCharge_KmH	RapidCharge	PowerTrain	PlugType	BodyStyle	Segment	S
0	Tesla	Model 3 Long Range Dual Motor	4.6	233	450	161	940	Yes	AWD	Type 2 CCS	Sedan	D	
1	Volkswagen	ID.3 Pure	10.0	160	270	167	250	Yes	RWD	Type 2 CCS	Hatchback	C	
2	Polestar	2	4.7	210	400	181	620	Yes	AWD	Type 2 CCS	Liftback	D	
3	BMW	iX3	6.8	180	360	206	560	Yes	RWD	Type 2 CCS	SUV	D	
4	Honda	e	9.5	145	170	168	190	Yes	RWD	Type 2 CCS	Hatchback	B	

The snapshot of the data set is provided above. It was checked for null values and its shape. No null values found. Hence directly moving on to EDA

Data Set 3: electric_vehicle_charging_station_list.csv

df3

```
df3.head()
```

	no	region	address	aux address	latitude	longitude	type	power	service
0	1	NDMC	Prithviraj Market, Rabindra Nagar, New Delhi- ...	Electric Vehicle Charger, Prithviraj Market, R...	28.600725	77.226252	DC-001	15 kW	Self Service
1	2	NDMC	Prithviraj Market, Rabindra Nagar, New Delhi- ...	Electric Vehicle Charger, Prithviraj Market, R...	28.600725	77.226252	DC-001	15 kW	Self Service
2	3	NDMC	Outside RWA Park, Jor Bagh Market, Jor Bagh Co...	Electric Vehicle Charger, Outside RWA Park, Jo...	28.588303	77.217697	DC-001	15 kW	Self Service
3	4	NDMC	Opposite Dory Pharmacy, Khanna Market, Aliganj...	Electric Vehicle Charger, Opposite Dory Pharma...	28.582654	77.220087	DC-001	15 kW	Self Service
4	5	NDMC	Opposite Goel Optical, Khanna Market, Aliganj...	Electric Vehicle Charger, Opposite Goel Optica...	28.584485	77.220316	DC-001	15 kW	Self Service

The snapshot of the data set is provided above. It was checked for null values and its shape. No null values found. Hence directly moving on to EDA

Data Set 4: RS_Session_252_AU_864.2.iii.csv

df4

```
df4.head()
```

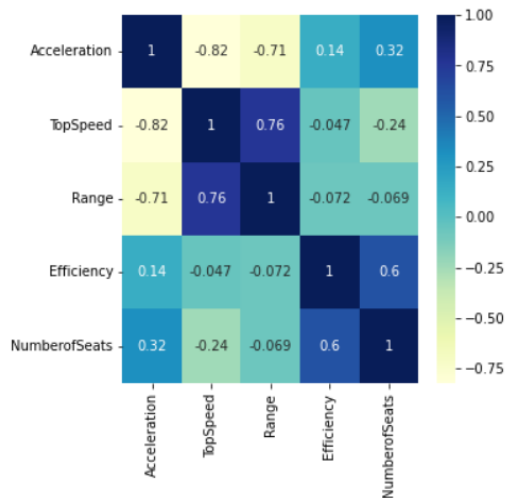
	State/UT-wise	Number of Electric Vehicle Charging Sanctioned
0	Maharashtra	317
1	Andhra Pradesh	266
2	Tamil Nadu	256
3	Gujarat	228
4	Uttar Pradesh	207

The snapshot of the data set is provided above. It was checked for null values and its shape. No null values found. Hence directly moving on to EDA

Segment Extraction

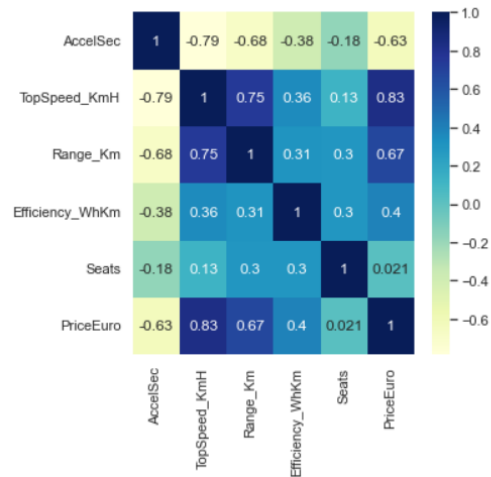
Heatmap of df1

```
plt.figure(figsize=(5,5))
sns.heatmap(df1.corr(), annot=True, cmap="YlGnBu")
plt.show()
```



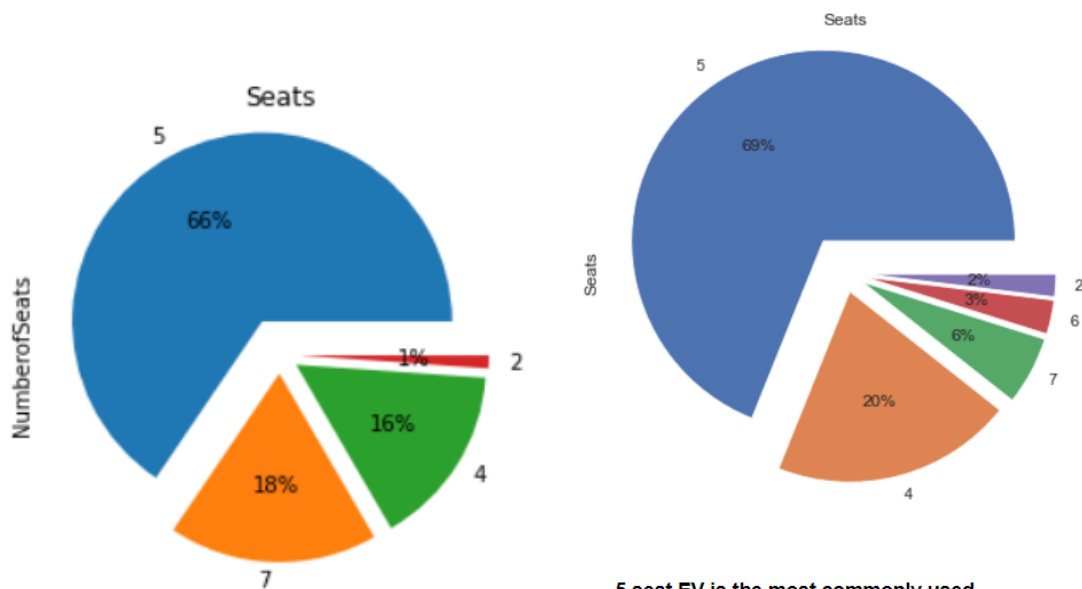
Heatmap of df2

```
plt.figure(figsize=(5,5))
sns.heatmap(df2.corr(), annot=True, cmap="YlGnBu")
plt.show()
```



- Range and top-speed are positively correlated.
- Range and top-speed, price and top-speed are more positively correlated

1. Number of Seats

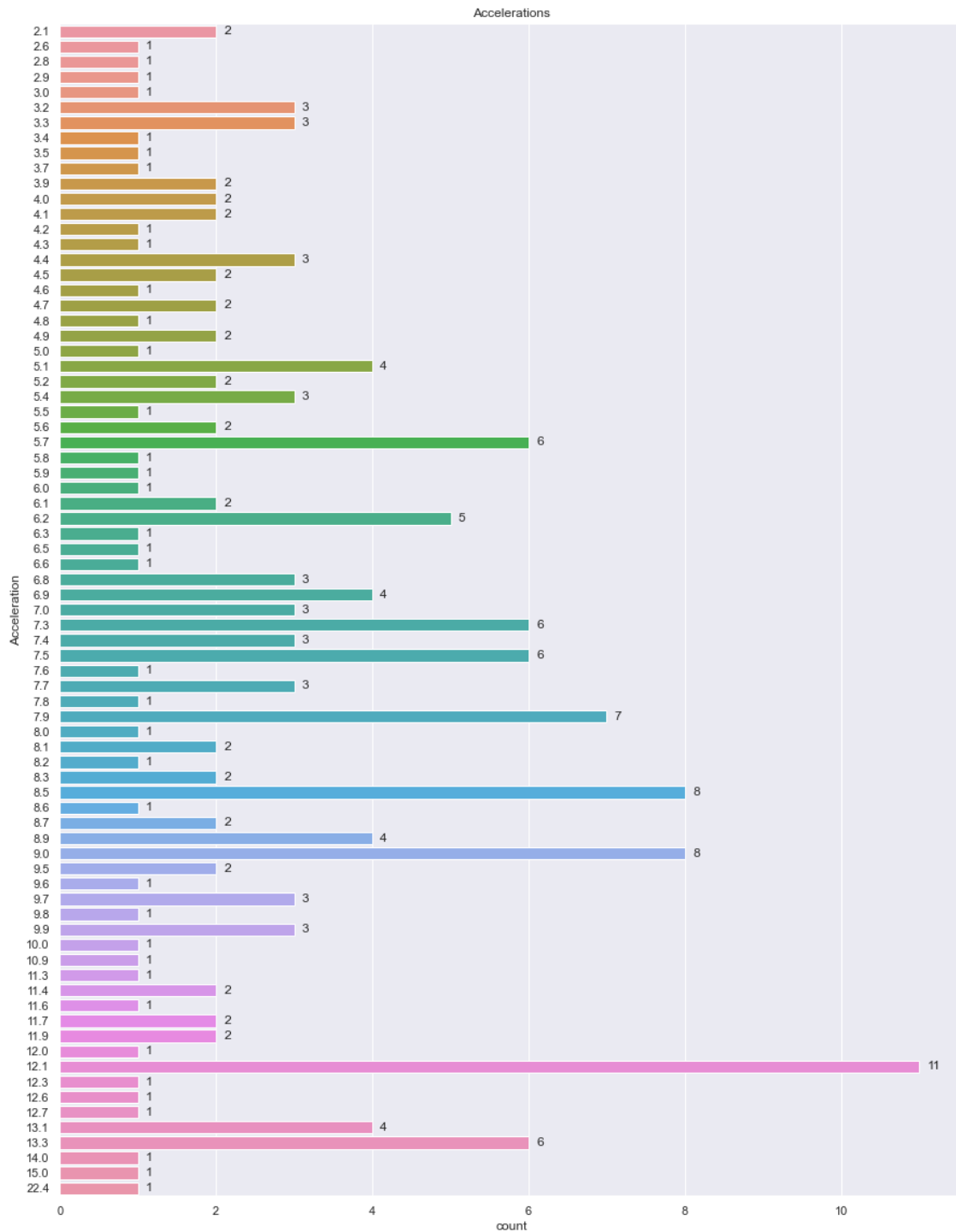


- 5 seat EV is the most commonly used.

seat EV is the most commonly used.

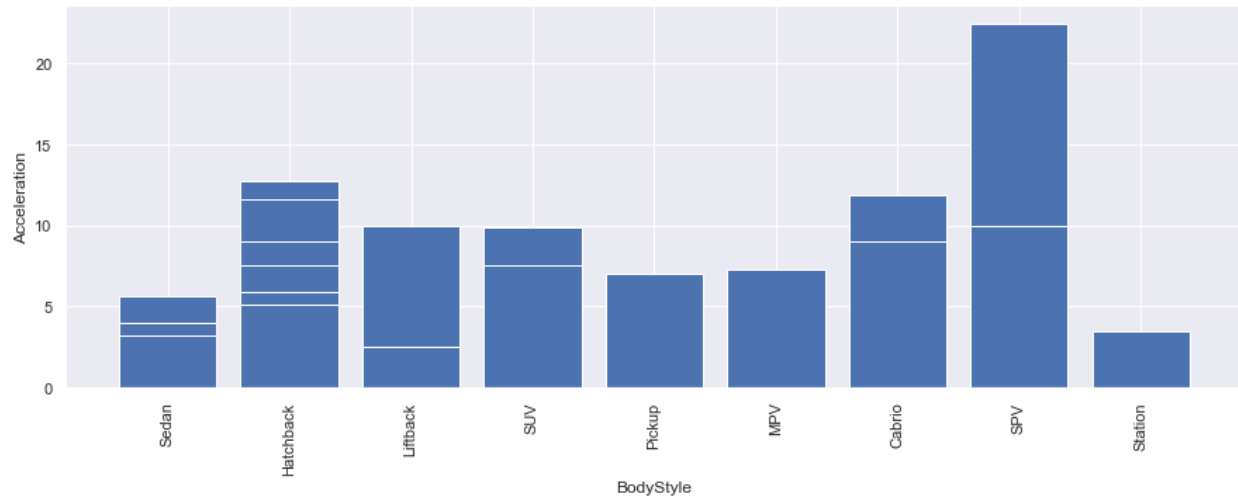
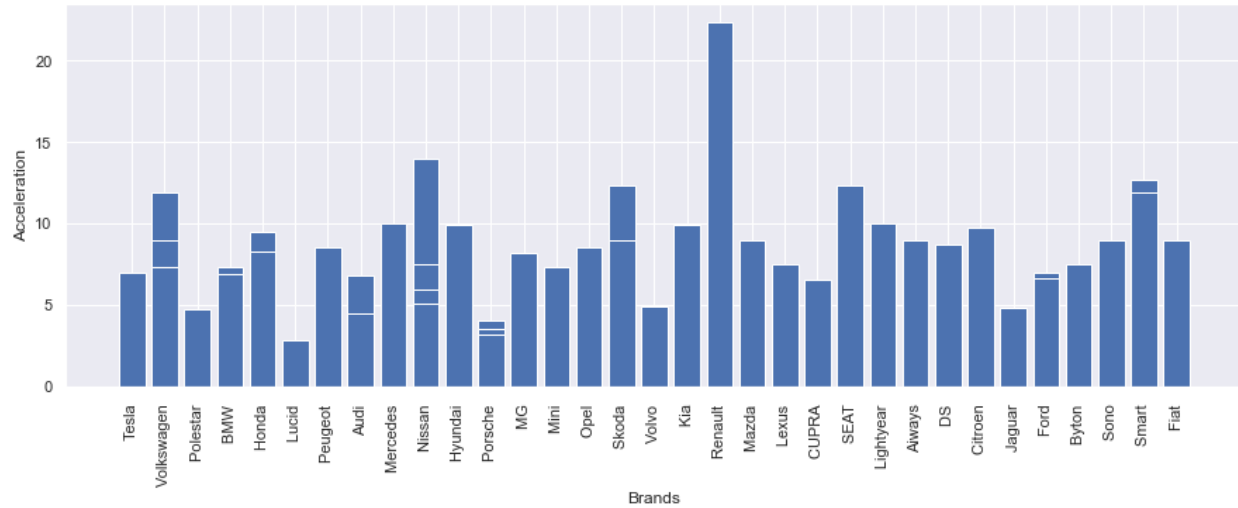
5

2. Acceleration



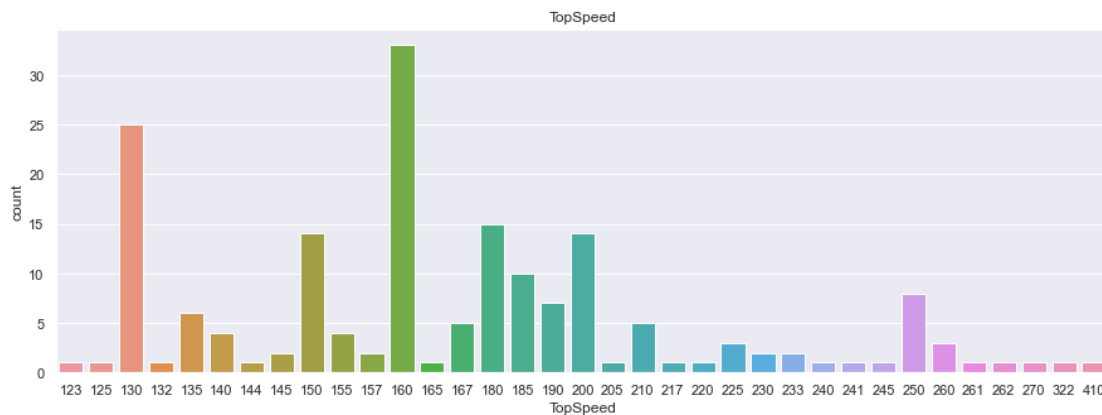
12.1 m/sec acceleartion is the most common.

Renault Kangoo Maxi ZE 33 has the max acceleration which is 22.4.

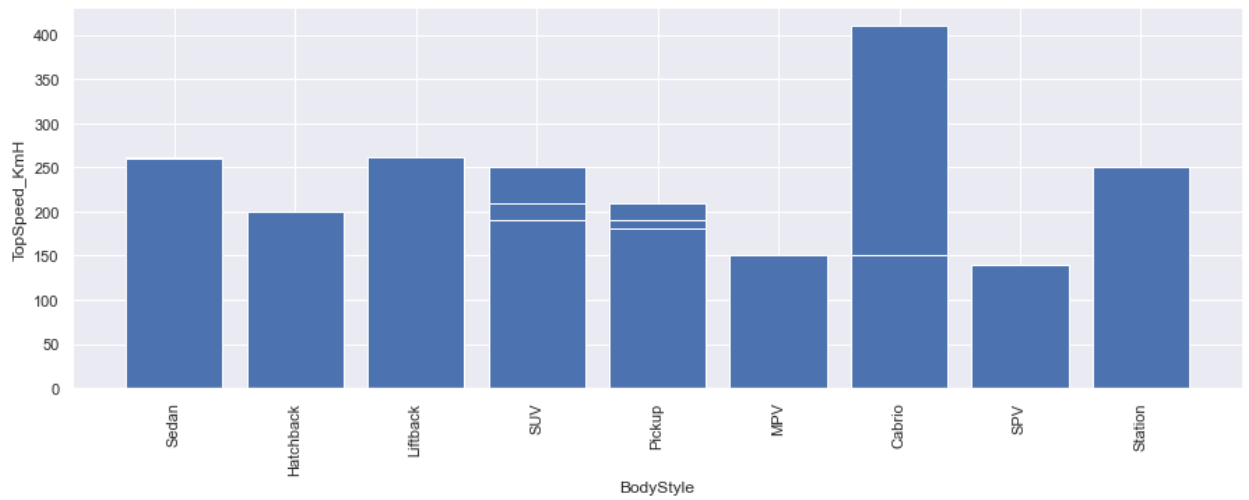
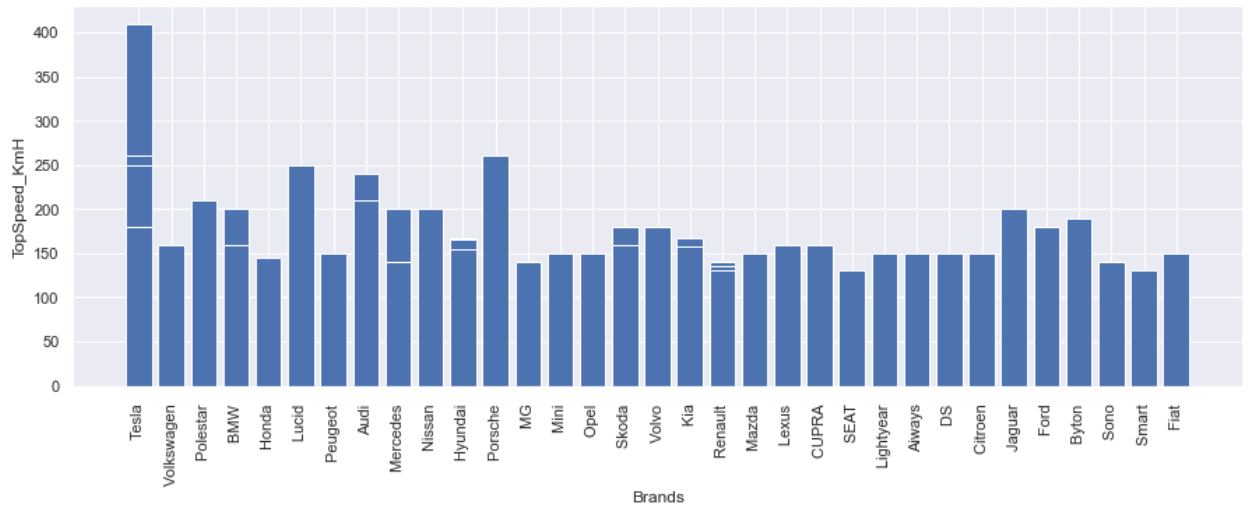


Renault brand has highest acceleration.
SPV bodystyle has highest acceleration.

3. Top Speed



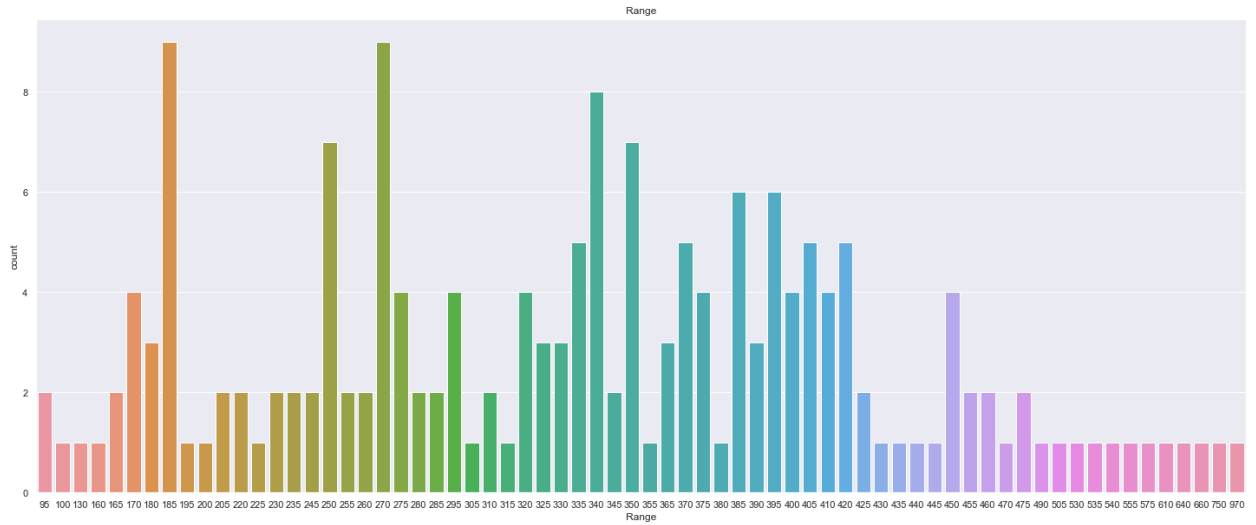
Tesla Roadster has the max speed of 410 kmph.



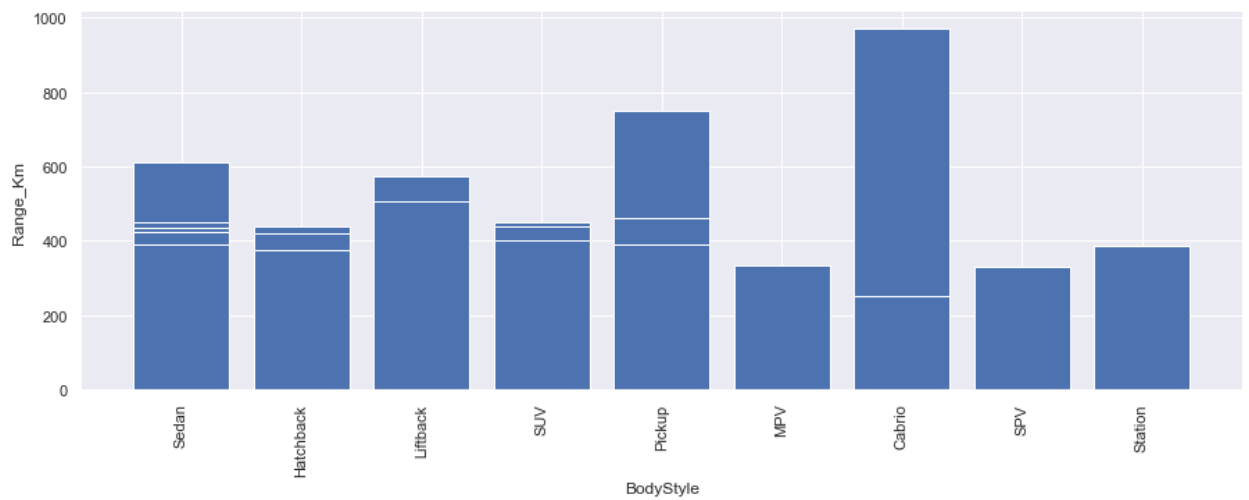
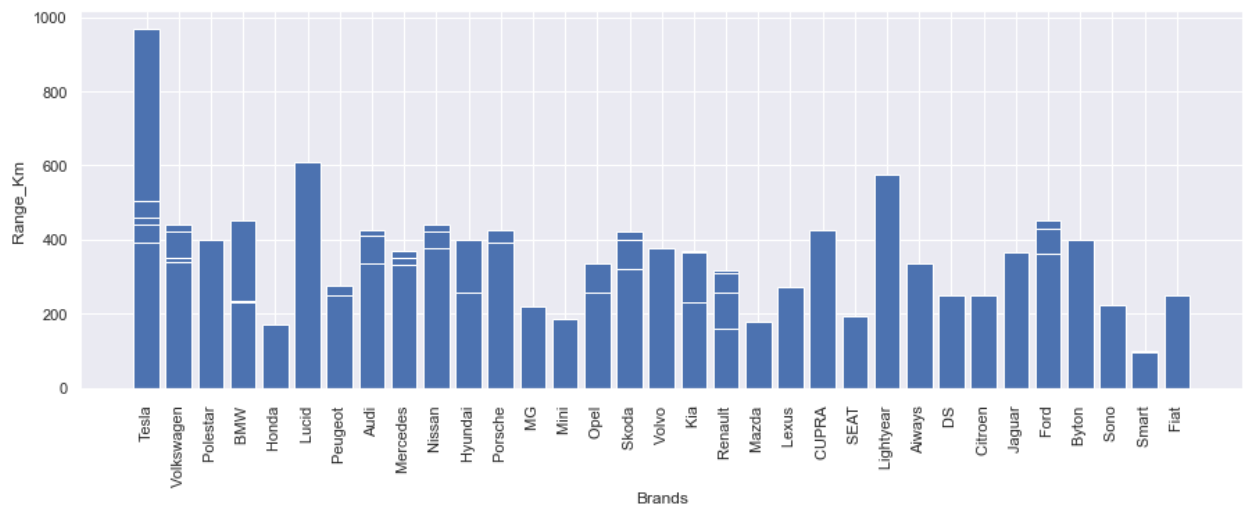
Tesla Brand EVs have the top-most speed.

Cabrio BodyStyle EVs have top speeds.

4. Range

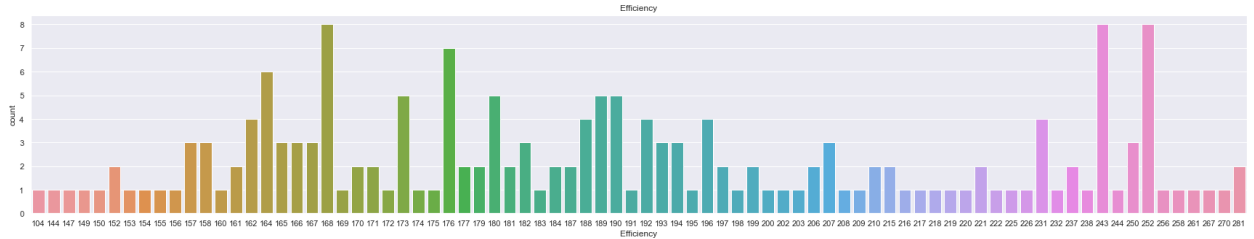


Tesla Roadster has the max range.

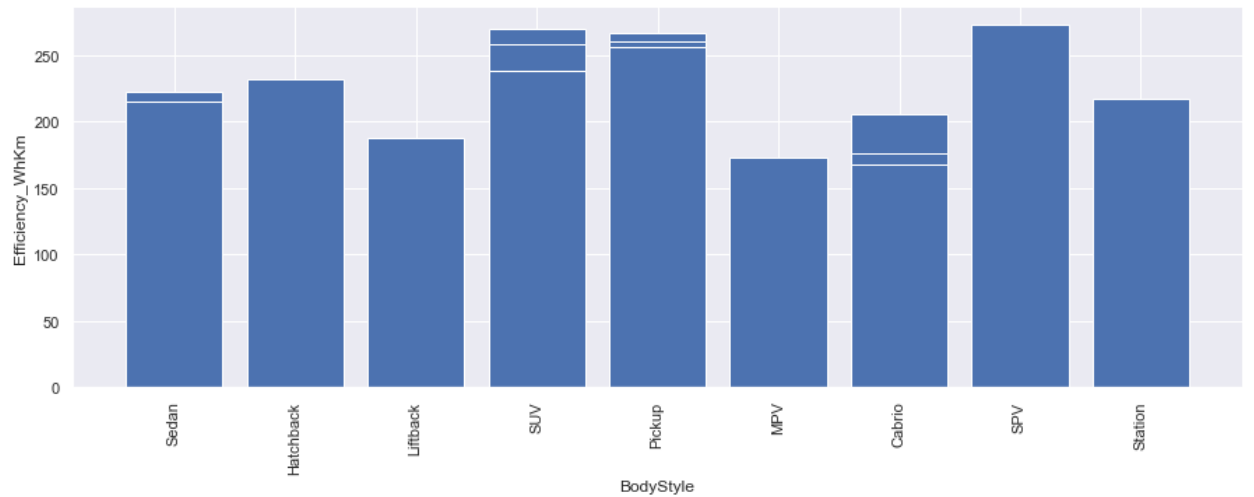
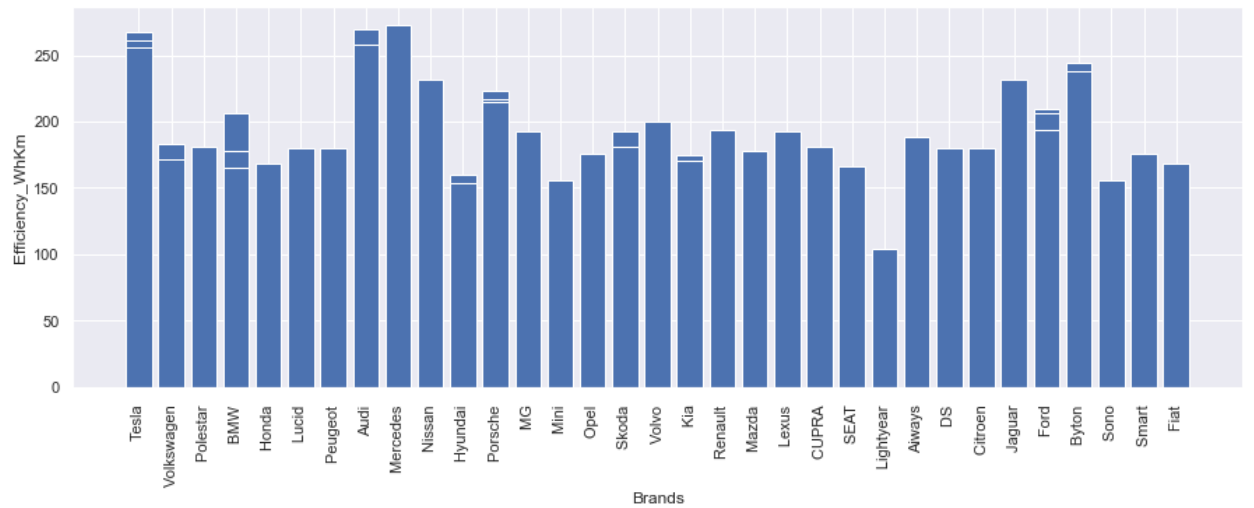


Tesla Brand EVs have the max range
Cabrio BodyStyle EVs have max range

5. Efficiency

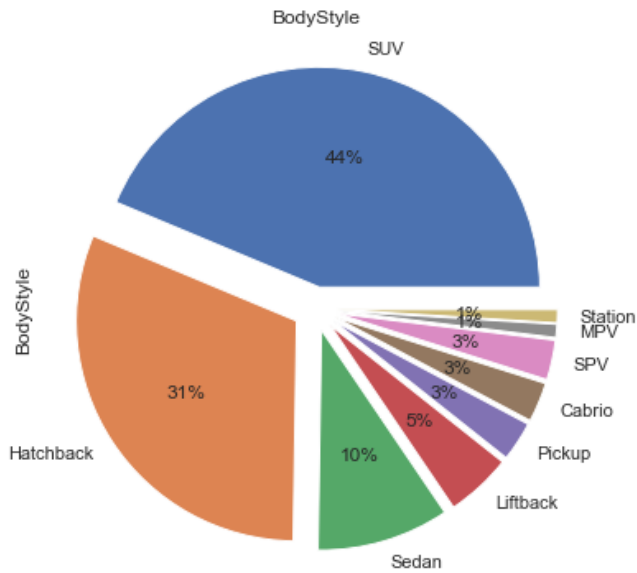


Mercedes EQV 300 Long and Mercedes EQV 300 Extra-Long have max efficiencies



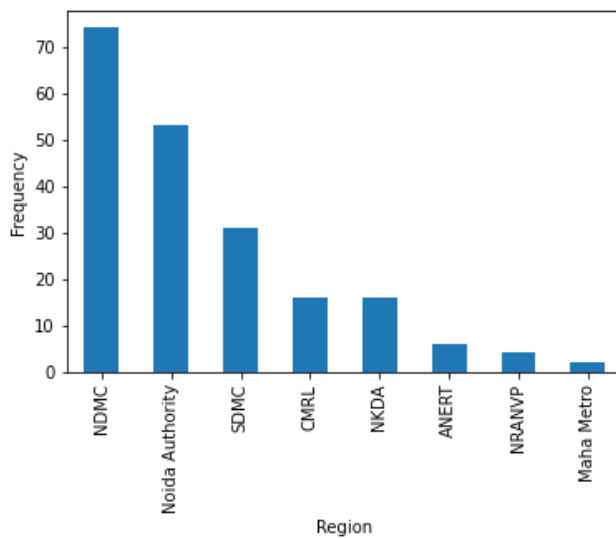
Tesla, Audi, Mercedes have max efficiencies
SUV, Pickup and SPV bodystyles have max efficiencies

6. BodyStyle



Max EVs are either SUVs or Hatchbacks

7. Charging Stations



NDMC and Noida Authority have the most number of charging stations.

Elbow Method

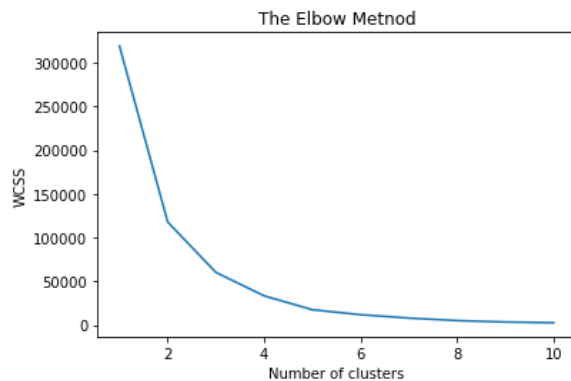
One of the most widely used techniques for determining the ideal number of clusters is the Elbow method. The WCSS value idea is used in this technique. The term "total variations inside a cluster" is denoted as "WCSS," or Within Cluster Sum of Squares.

$$WCSS = \sum_{P_i \text{ in Cluster } 1} \text{distance}(P_i C_1)^2 + \sum_{P_i \text{ in Cluster } 2} \text{distance}(P_i C_2)^2 + \sum_{P_i \text{ in Cluster } 3} \text{distance}(P_i C_3)^2$$

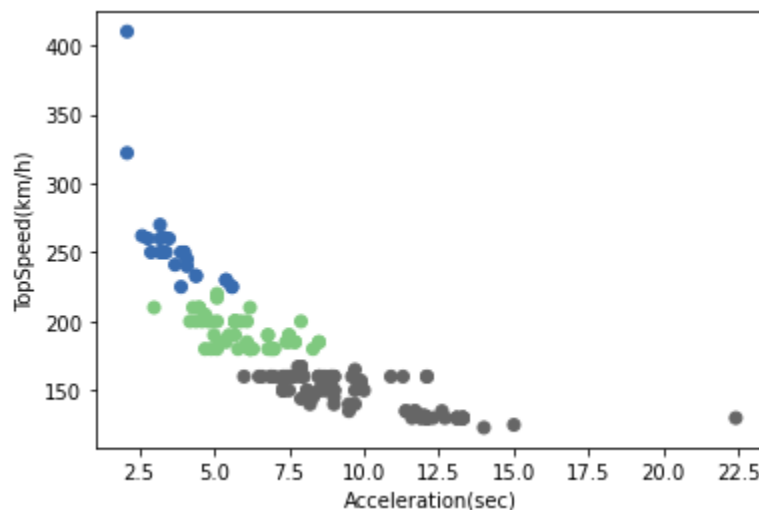
In the above formula of WCSS,

$\sum_{P_i \text{ in Cluster } 1} \text{distance}(P_i C_1)^2$: It is the sum of the square of the distances between each data point and its centroid within a cluster1 and the same for the other two terms. The sharp point of bend or a point of the plot looks like an arm, then that point is considered as the best value of K.

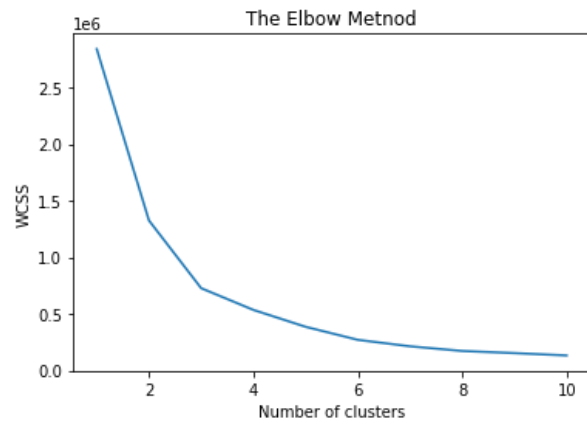
Acceleration vs top-speed



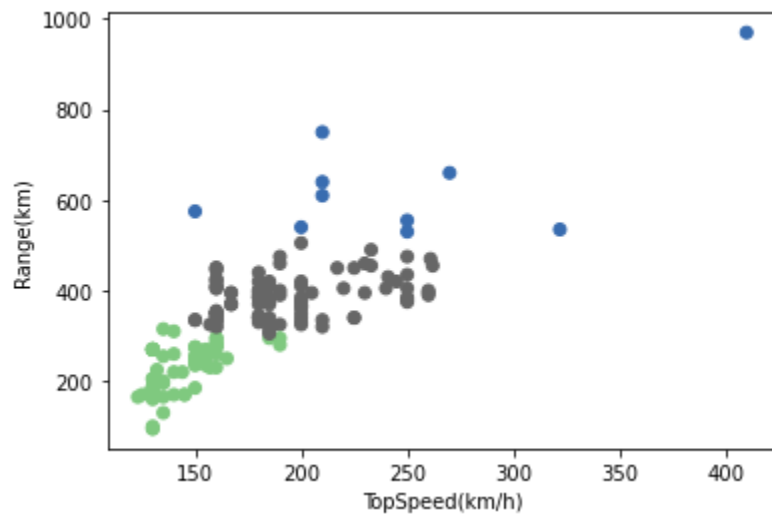
Number of segments = 3



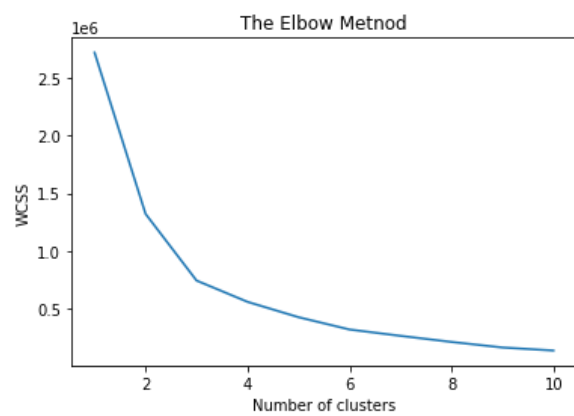
Top Speed vs Range



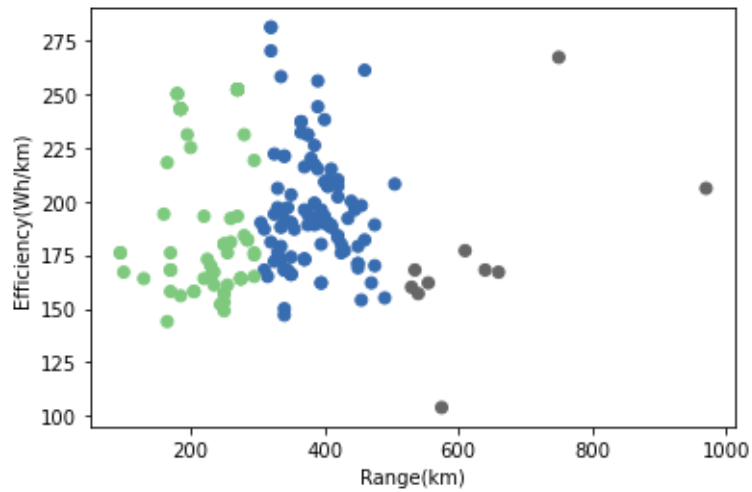
Number of segments = 3



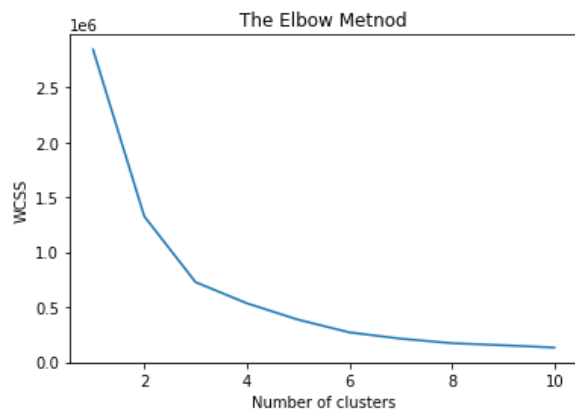
Range vs Efficiency



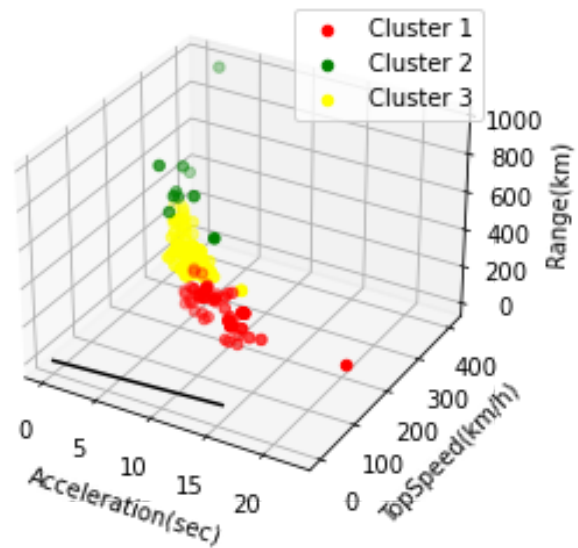
Number of segments = 3



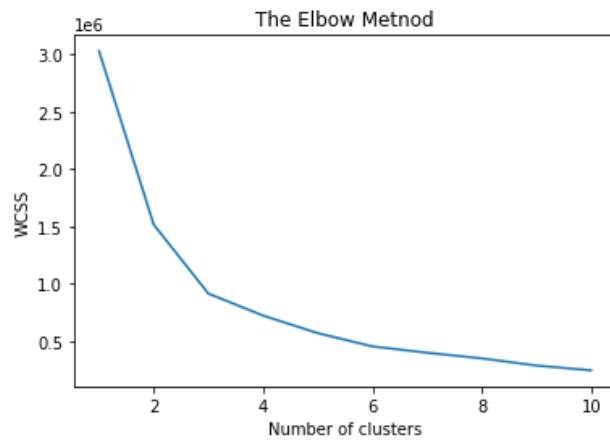
Acceleration vs Top-Speed vs Range



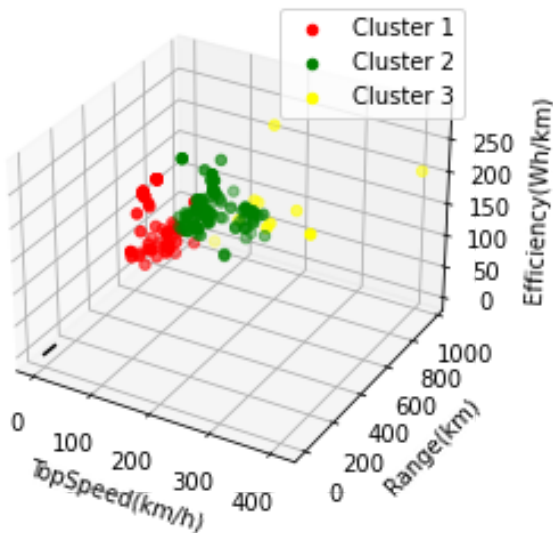
Number of segments = 3



Top-Speed vs Range vs Efficiency



Number of segments = 3



Profiling and describing potential segments

- Segmentation based on number of seats
- Segmentation based on speed
- Segmentation based on high number of Charging station
- Segmentation based on Cost.

Customizing the Market Mix



4Ps

Product

One of the key decisions an organization needs to make when developing the product dimension of the marketing mix, is to specify the product in view of customer needs. Often, this does not entail creating a completely new product, but rather modifying one that already exists. Other marketing mix decisions that fall under the product dimension include branding the product, packaging it, providing warranties (or not), and providing after-sales support services.

Price

Setting the pricing for a product and choosing on discounts to be offered are two common decisions an organization must make when building the price dimension of the marketing mix.

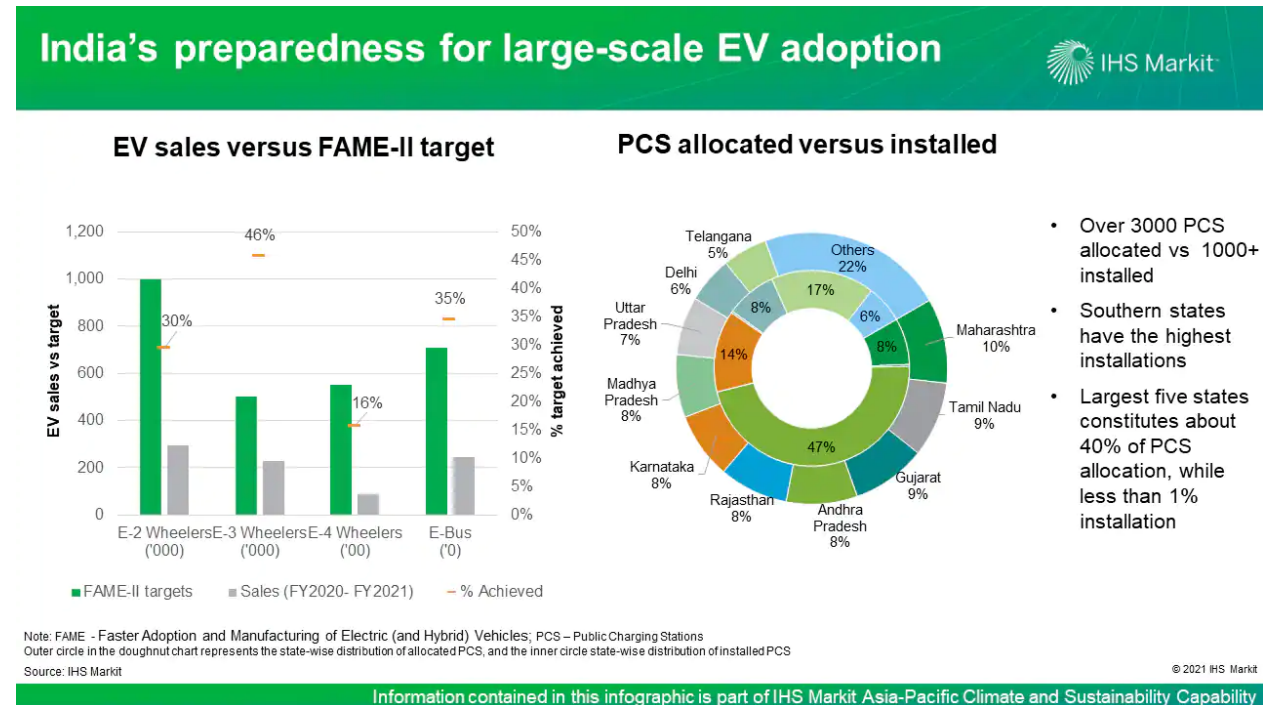
Place

How to distribute the product to clients is the most critical decision related to the place dimension of the marketing mix. This includes deciding if the product should be sold online alone, offline only, or both; whether the maker should sell directly to customers; and whether a wholesaler, retailer or both should be used.

Promotion

When creating a marketing mix, common promotion decisions involve creating an advertising message that will resonate with the target market and determining the most effective method to communicate this message. Public relations, personal selling, and sponsorship are all tools in the promotion category of the marketing mix.

Most Optimal Market Segments



- Maharashtra and Andhra Pradesh have the highest number of EV charging stations sanctioned, but, Andhra Pradesh has the most ambitious EV plan and Punjab the most balanced.
- Focusing on domestic manufacturing and research in battery and EV components will bring investments, jobs, and opportunities to serve demands.
- Max EVs are either SUVs or Hatchbacks.
- Tesla, Audi, Mercedes have max efficiencies and SUV, Pickup and SPV bodystyles have max efficiencies.
- Tesla EVs have maximum range. They also have top speeds.

An interesting fact to note is that, with 21 out of 30 most polluted cities situated in India, and the demand and prices of oil shooting up to extremely high levels, EVs will most likely become a requirement rather than a choice in the coming years.

“The time is not only right for electric cars, rather it’s critical!”

References

1. <https://www.virta.global/global-electric-vehicle-market>
2. <https://www.ibef.org/blogs/electric-vehicles-market-in-india#:~:text=According%20to%20EV%20volumes%2C%20overall,of%20108%25%20as%20of%202020.>
3. <https://www.newbreedrevenue.com/blog/are-the-4-ps-of-the-marketing-mix-still-relevant>
4. <https://www.india-briefing.com/news/electric-vehicle-industry-in-india-why-foreign-investors-should-pay-attention-21872.html/>
5. <https://ihsmarkit.com/research-analysis/indias-preparedness-for-largescale-ev-adoption-a-n-assessment.html>
6. <https://thestartuplab.in/electric-vehicle-startups-top-10-ev-startups-in-india-building-a-greener-future/>

[Github link](#)