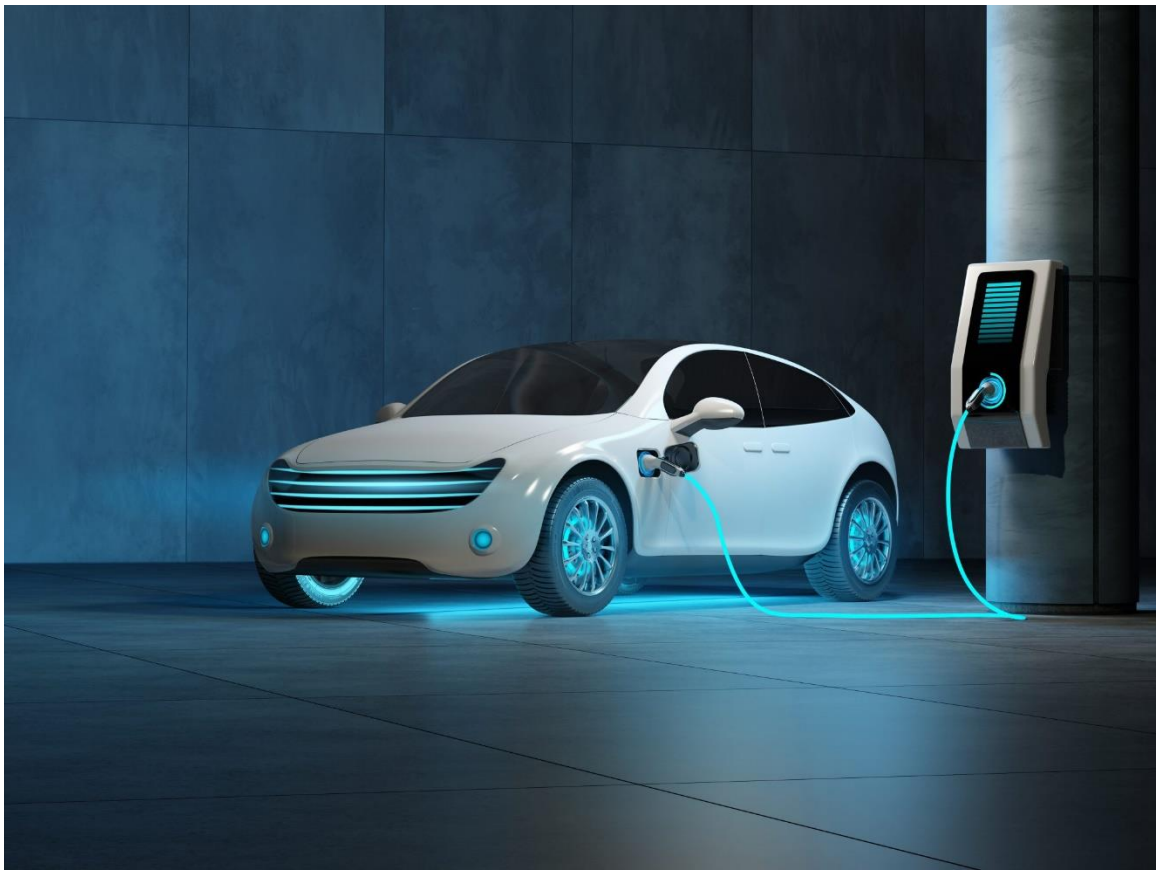

ELECTRIC VEHCILE MARKET SEGMENTATION

PROJECT REPORT

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PROBLEM STATEMENT:

This is a team task to Conduct an in-depth analysis of the electric vehicle market in India utilizing the method of market segmentation, in order to identify specific segments within the market. and come up with a feasible strategy to enter the market, targeting the segments most likely to use Electric vehicles.

ABSTRACT:

Electric vehicles are the key technology to de carbonize road transport, a sector that accounts for 16% of global emissions. Recent years have seen exponential growth in the sale of electric vehicles together with improved range, wider model availability and increased performance. Passenger electric cars are surging in popularity - we estimate that 13% of new car sold in 2022 will be electric; if the growth experienced in the past two years is sustained, CO_2 emissions from cars can be put on a path in line with the Net Zero Emissions by 2050 Scenario. However, electric vehicles are not yet a global phenomenon. Sales in developing and emerging countries have been slow due to higher purchase costs and a lack of charging infrastructure availability.

The Indian EV market is also evolving fast as close to 0.32 million vehicles were sold in 2021, up 168% YoY. Ongoing electric vehicle adoption in India is based on the Paris agreement to reduce carbon emissions, to improve the air quality in urban areas and reduce oil imports.

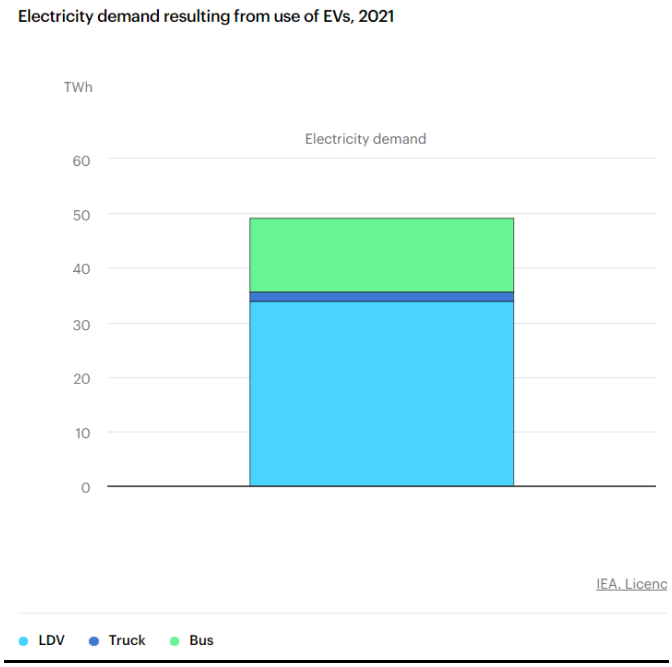
This report aims to conduct a market segmentation analysis of the electric vehicle market in India. The report will segment the market based on vehicle type, price range, and customer demographics, among other factors. By identifying specific segments within the market, this report will provide a clearer picture of the Indian electric vehicle market and help in developing a successful market entry

strategy. The report will also cover the current market scenario, future market projections and key players in the market.

Electric car sales reached a record high in 2021, despite supply chain bottlenecks and the ongoing Covid-19 pandemic. Compared with 2020, sales nearly doubled to 6.6 million (a sales share of nearly 9%), bringing the total number of electric cars on the road to 16.5 million. The sales share of electric cars increased by 4 percentage points in 2021. The Net Zero Emissions by 2050 Scenario sees an electric car fleet of over 300 million in 2030 and electric cars accounting for 60% of new car sales. Getting on track with the Net Zero Scenario requires their sales share to increase by less than 6% percentage points per year.

EVs AVOID OIL CONSUMPTION:

The global EV fleet in 2021 consumed about 50 TWh of electricity, which accounts for less than 0.5% of current total final electricity consumption worldwide. The use of EVs displaced around 0.3 Mb/d of oil in 2021. EVs would need to displace more than 7 Mb/d of oil in 2030 to be in step with the Net Zero Scenario.



Energy density is key to ensuring that BEVs have sufficient range. The energy density of batteries for EVs has been rising over the past year, and now some of the highest performing battery cells can reach energy densities of over 300 Wh/kg, up from around 100-150 Wh/kg a decade ago – meaning that with the same mass, electric cars can now travel twice as far. This progress has been made thanks to continuous improvement in battery chemistry and cell design. Key examples of this include Tesla's upcoming 4680 cells and LG Energy Solution's Ultium cells.

It is not all about energy density, though. Reducing the need for critical metals is also a priority for EV innovation. The past year has seen a doubling in the market share of lithium iron phosphate (LFP) cathodes, which require no nickel or cobalt. This was in part thanks to innovative cell-to-pack technologies that enable a higher pack density by reducing pack dead weight, but mainly due to automakers switching to LFP to reduce commodity price exposure. Another key development has been the announcement of important supply chain development for sodium-ion batteries by the world's largest battery manufacturer, CATL. This technology has the potential to completely avoid the use of critical metals. The IEA's assessment of sodium-ion technology has increased from TRL 3-4 to TRL 6.

Deployment of publicly available EV charging points increased by close to 40% in 2021, although in 2020 the growth rate was higher at 45%. Nevertheless, 500 000 public charging points were installed in 2021, which is more than the total stock of chargers available in 2017. The rate of fast charger installations increased slightly in 2021 (up 48%) compared with 2020 (up 43%), while growth in slow charger installations slackened (33% in 2021, compared with 46% in 2020). Increasingly, automakers have been exploring electrification plans to both comply with policy regulations and maintain a competitive position in a transitioning market. In 2021 several major automakers announced ambitions to achieve a fully electric future. In the coming

years the development of a wider range of models and more competitive pricing is anticipated.

DATA COLLECTION:

The data has been collected by viewing different datasets, and the sources used for this process are: https://www.kaggle.com/datasets

Market Segmentation for EV Market:

This report aims to conduct a market segmentation analysis of the electric vehicle market in India. The report will segment the market based on vehicle type, price range, and customer demographics, among other factors. By identifying specific segments within the market, this report will provide a clearer picture of the Indian electric vehicle market and help in developing a successful market entry strategy. The report will also cover the current market scenario, future market projections and key players in the market.

The report is structured as follows: First, we will provide an overview of the current state of the electric vehicle market in India. This will include market size, growth rate, and key players. Next, we will conduct a market segmentation analysis of the electric vehicle market in India, identifying specific segments within the market. Finally, we will provide recommendations for how to develop a successful market entry strategy based on the findings of the market segmentation analysis.

LIBRARIES USED IN THE PROJECT:

- Pandas
- Numpy
- Matplotlib
- Seaborn
- Sklearn
- Plotly

DATA PRE-PROCESSING:

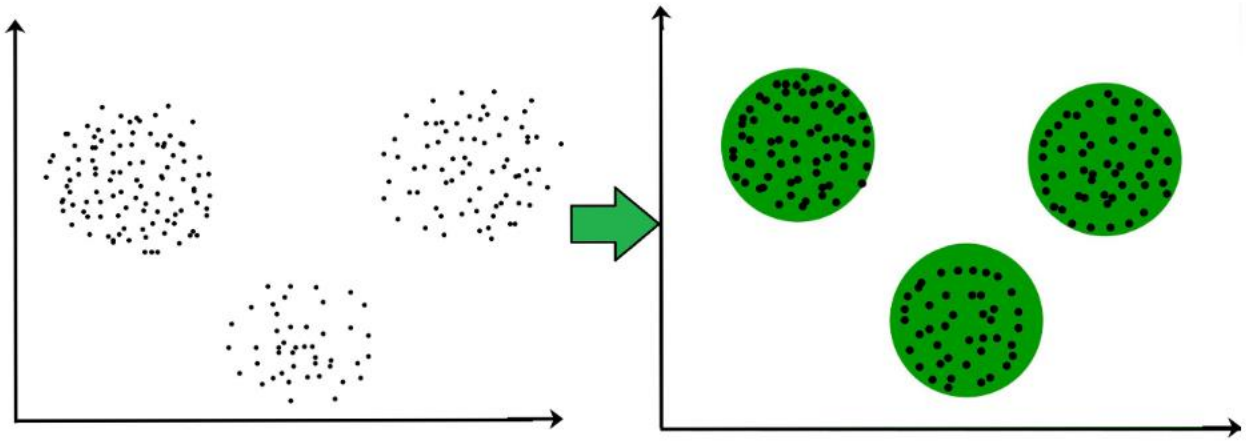
Data pre-processing is a stage that helps us identify the measurement levels of variables, and the relationship between the variables drives hidden insights from the raw data and guides us on the suitable algorithms to use for market segmentation. To derive insights from the raw data we have used data visualization as a step to create multiple plots. For numerical variables, we have used histogram, and kernel density plot. For categorical variables, we have used bar plots, count plots, and pie charts. To understand the relationship between two numeric variables, we have used pairs plot, scatter plot and heatmap.

SEGMENT EXTRACTION(ML TECHNIQUE USED):

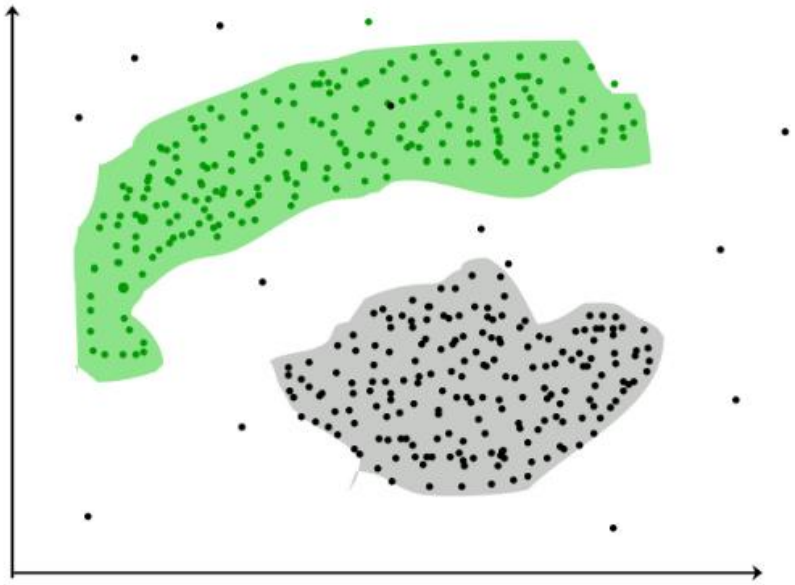
K-Means Algorithm (Clustering):

Clustering is the task of dividing the population or data points into a number of groups such that data points in the same groups are more similar to other data points in the same group and dissimilar to the data points in other groups. It is basically a collection of objects on the basis of similarity and dissimilarity between them.

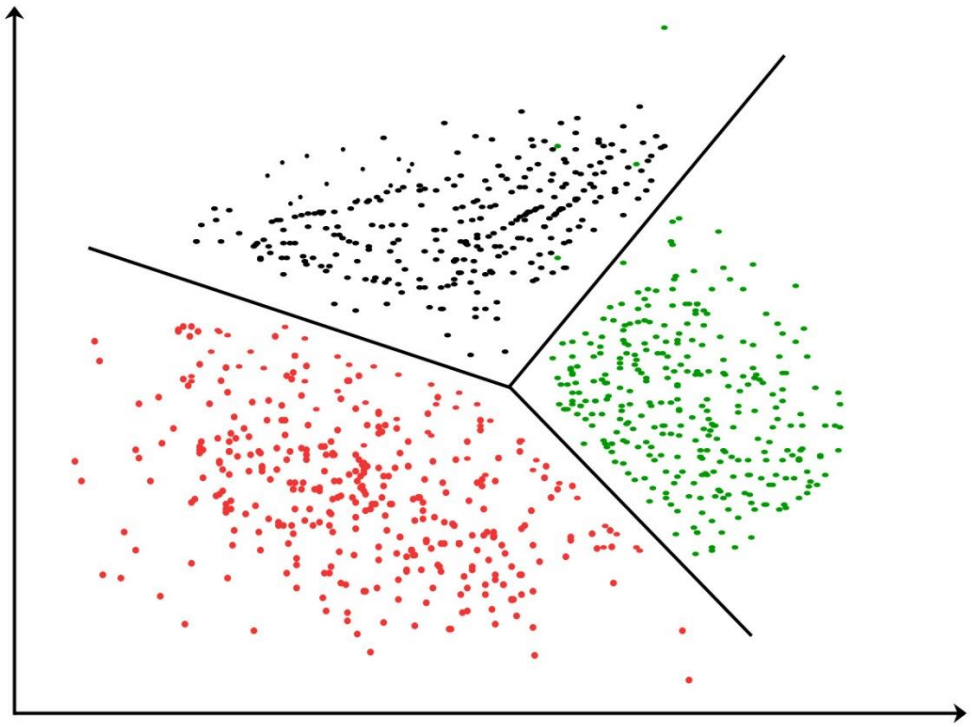
For ex– The data points in the graph below clustered together can be classified into one single group. We can distinguish the clusters, and we can identify that there are 3 clusters in the below picture



It is not necessary for clusters to be spherical. Such as:



K-Means Algorithm is the simplest unsupervised learning algorithm that solves clustering problem. K-means algorithm partitions n observations into k clusters where each observation belongs to the cluster with the nearest mean serving as a prototype of the cluster.



IMPORTING LIBRARIES:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sb
import statsmodels.api as sm
```

DATA PREPROCESSING:

```
df= pd.read_csv('EVmarket.csv')
```

```
df.head()
```

]:

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

```
df.describe()
```

]:

	Accel()	TopSpeed(km/h)	Range(km)	Efficiency(Wh/km)	Seats	PriceEuro	PriceIndian
count	103.000000	103.000000	103.000000	103.000000	103.000000	103.000000	1.030000e+02
mean	7.396117	179.194175	338.786408	189.165049	4.883495	55811.563107	4.850583e+06
std	3.017430	43.573030	126.014444	29.566839	0.795834	34134.665280	2.966644e+06
min	2.100000	123.000000	95.000000	104.000000	2.000000	20129.000000	1.749411e+06
25%	5.100000	150.000000	250.000000	168.000000	5.000000	34429.500000	2.992268e+06
50%	7.300000	160.000000	340.000000	180.000000	5.000000	45000.000000	3.910950e+06
75%	9.000000	200.000000	400.000000	203.000000	5.000000	65000.000000	5.649150e+06
max	22.400000	410.000000	970.000000	273.000000	7.000000	215000.000000	1.868565e+07

```
df.isnull().sum()
```

```
Brand                0
Model                0
Accel()              0
TopSpeed(km/h)       0
Range(km)            0
Efficiency(Wh/km)    0
FastCharge(km/h)     0
RapidCharge          0
PowerTrain           0
PlugType             0
BodyStyle            0
Segment              0
Seats                0
PriceEuro            0
PriceIndian          0
dtype: int64
```

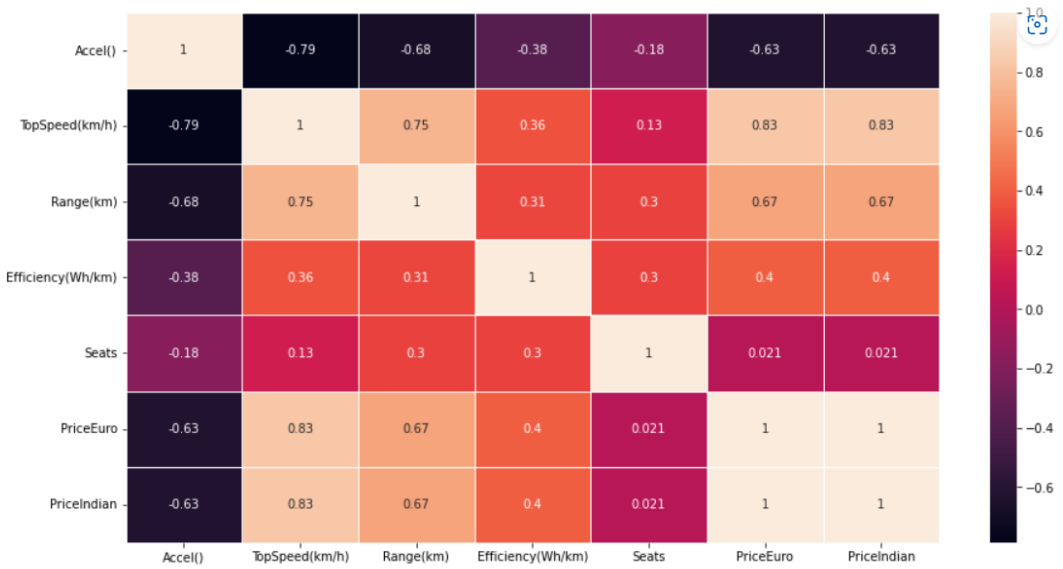
As there are no Null values in the data set the data is clean and can be used for Analysis.

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 103 entries, 0 to 102
Data columns (total 15 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Brand              103 non-null    object 
 1   Model              103 non-null    object 
 2   Accel()            103 non-null    float64
 3   TopSpeed(km/h)     103 non-null    int64  
 4   Range(km)          103 non-null    int64  
 5   Efficiency(Wh/km)  103 non-null    int64  
 6   FastCharge(km/h)   103 non-null    object 
 7   RapidCharge        103 non-null    object 
 8   PowerTrain         103 non-null    object 
 9   PlugType           103 non-null    object 
 10  BodyStyle          103 non-null    object 
 11  Segment            103 non-null    object 
 12  Seats              103 non-null    int64  
 13  PriceEuro          103 non-null    int64  
 14  PriceIndian        103 non-null    int64  
dtypes: float64(1), int64(6), object(8)
memory usage: 12.2+ KB
```

HEAT MAP TO SHOW CORRELATION IN THE DATA

```
ax= plt.figure(figsize=(15,8))
sb.heatmap(df.corr(),linewidths=1,linecolor='white',annot=True)
```

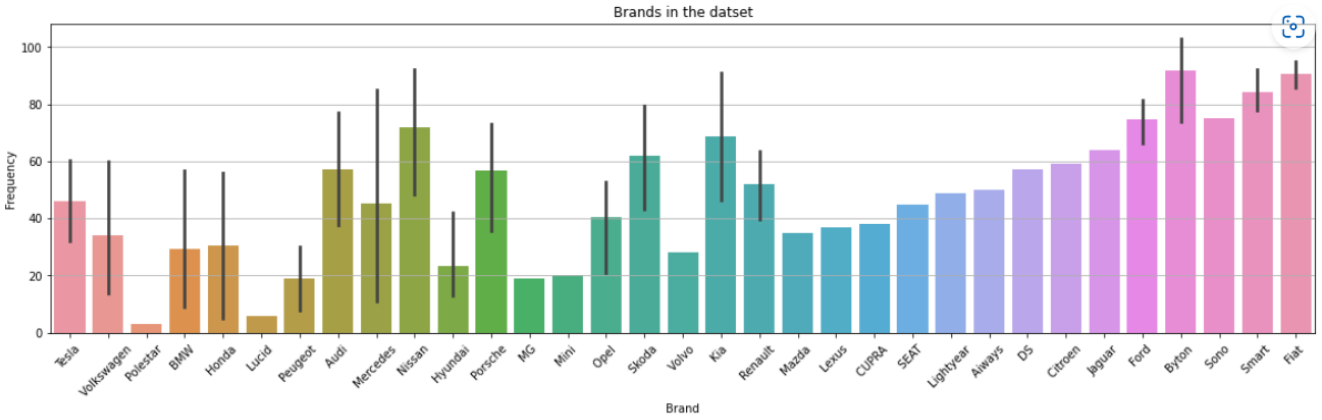


Demographic analysis involves dividing the market into groups based on characteristics such as age, gender, income, education, and occupation. By identifying specific segments of the market based on these demographic factors, the report can provide insights into the preferences and purchasing power of different groups of consumers, which can help to inform a successful market entry strategy.

For example, the report could provide insight on which age groups are more likely to purchase electric vehicles, or which income groups are more inclined to afford higher-priced electric vehicles. Additionally, it could also show the difference in buying behavior across different regions, urban and rural areas, and other demographic characteristics.

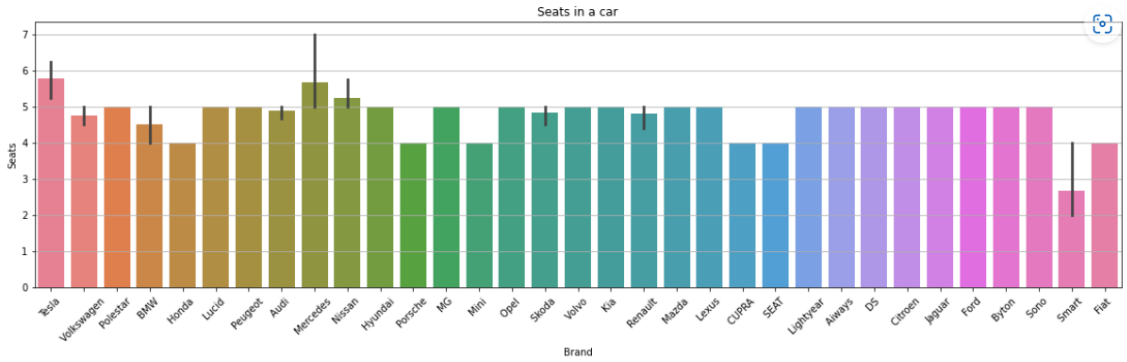
FREQUENCY OF BRANDS

```
ax= plt.figure(figsize=(20,5))
sb.barplot(x='Brand',y=a,data=df)
plt.grid(axis='y')
plt.title('Brands in the datset')
plt.xlabel('Brand')
plt.ylabel('Frequency')
plt.xticks(rotation=45)
```



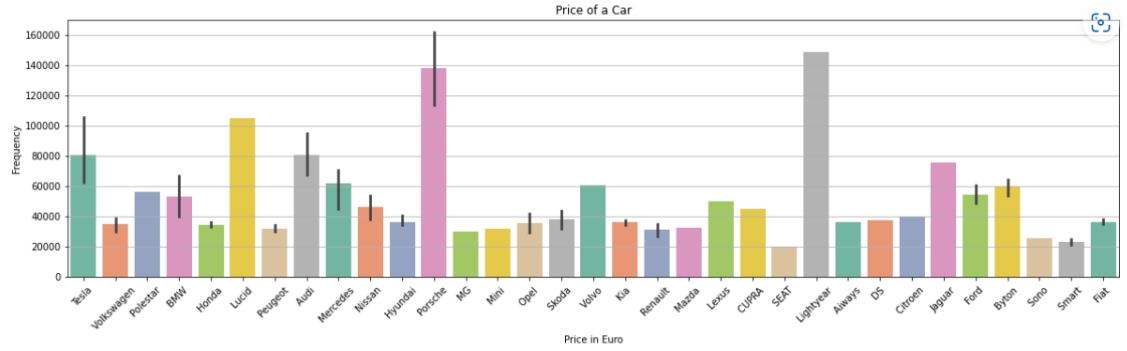
Number of seats in each car

```
ax= plt.figure(figsize=(20,5))
sb.barplot(x='Brand',y='Seats',data=df,palette='husl')
plt.grid(axis='y')
plt.title('Seats in a car')
plt.xlabel('Brand')
plt.ylabel('Seats')
plt.xticks(rotation=45)
```



Price of cars (in Euro)

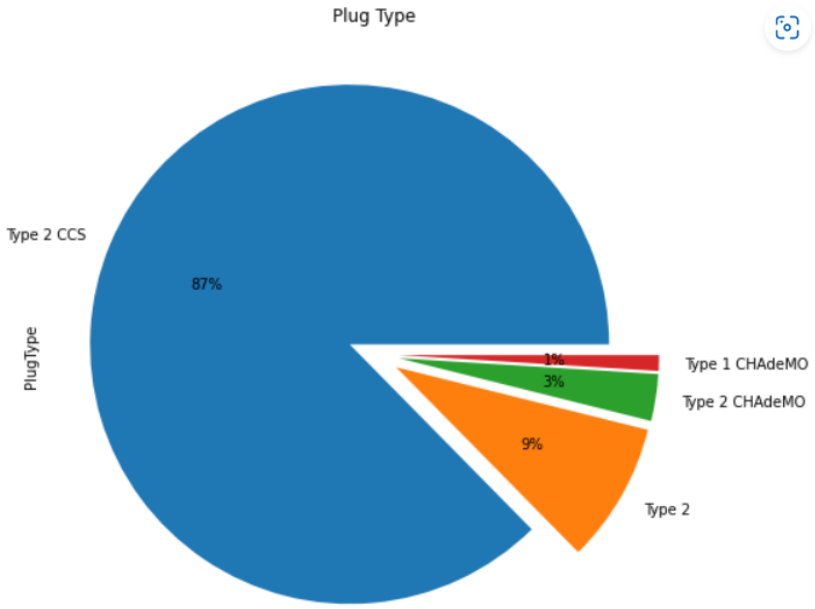
```
ax= plt.figure(figsize=(20,5))
sb.barplot(x='Brand',y='PriceEuro',data=df,palette='Set2')
plt.title('Price of a Car')
plt.xlabel('Price in Euro')
plt.grid(axis='y')
plt.ylabel('Frequency')
plt.xticks(rotation=45)
```



Type of Plug used for charging

```
df['PlugType'].value_counts().plot.pie(figsize=(8,15),autopct='%.0f%%',explode=(.1,.1,.1,.1))
plt.title('Plug Type')
```

```
Text(0.5, 1.0, 'Plug Type')
```

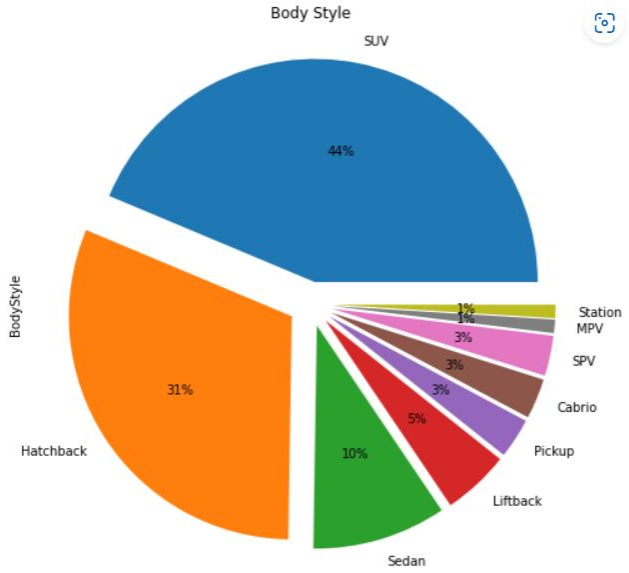


Most companies use Type 2 CCS and Type 1 CHAdeMo the least

Cars and their body style

```
df['BodyStyle'].value_counts().plot.pie(figsize=(8,15),autopct='%.0f%%',explode=(0.1,0.1,0.1,0.1,0.1,0.1,0.1,0.1,0.1,0.1))
plt.title('Body Style')
```

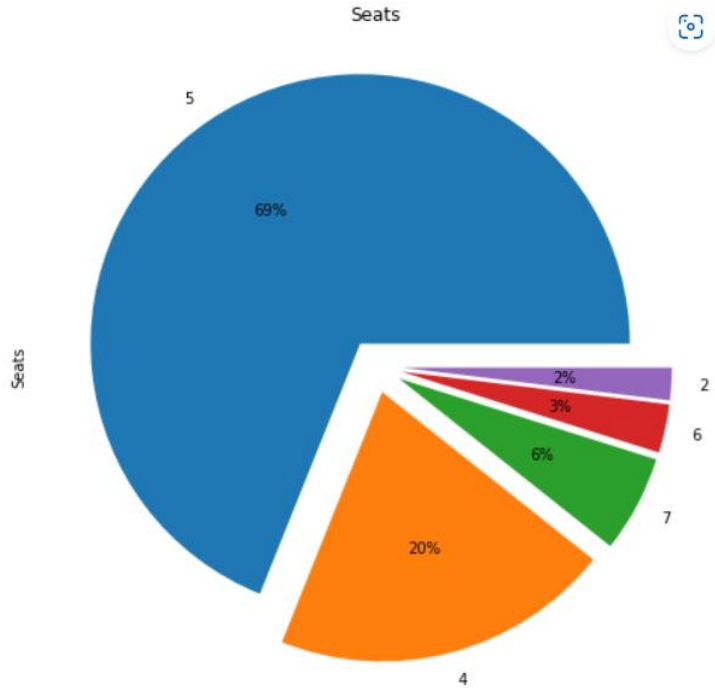
```
Text(0.5, 1.0, 'Body Style')
```



Most of the cars are eiher SUV or Hatchback with a majority of 75% followed by Sedan which is 10%

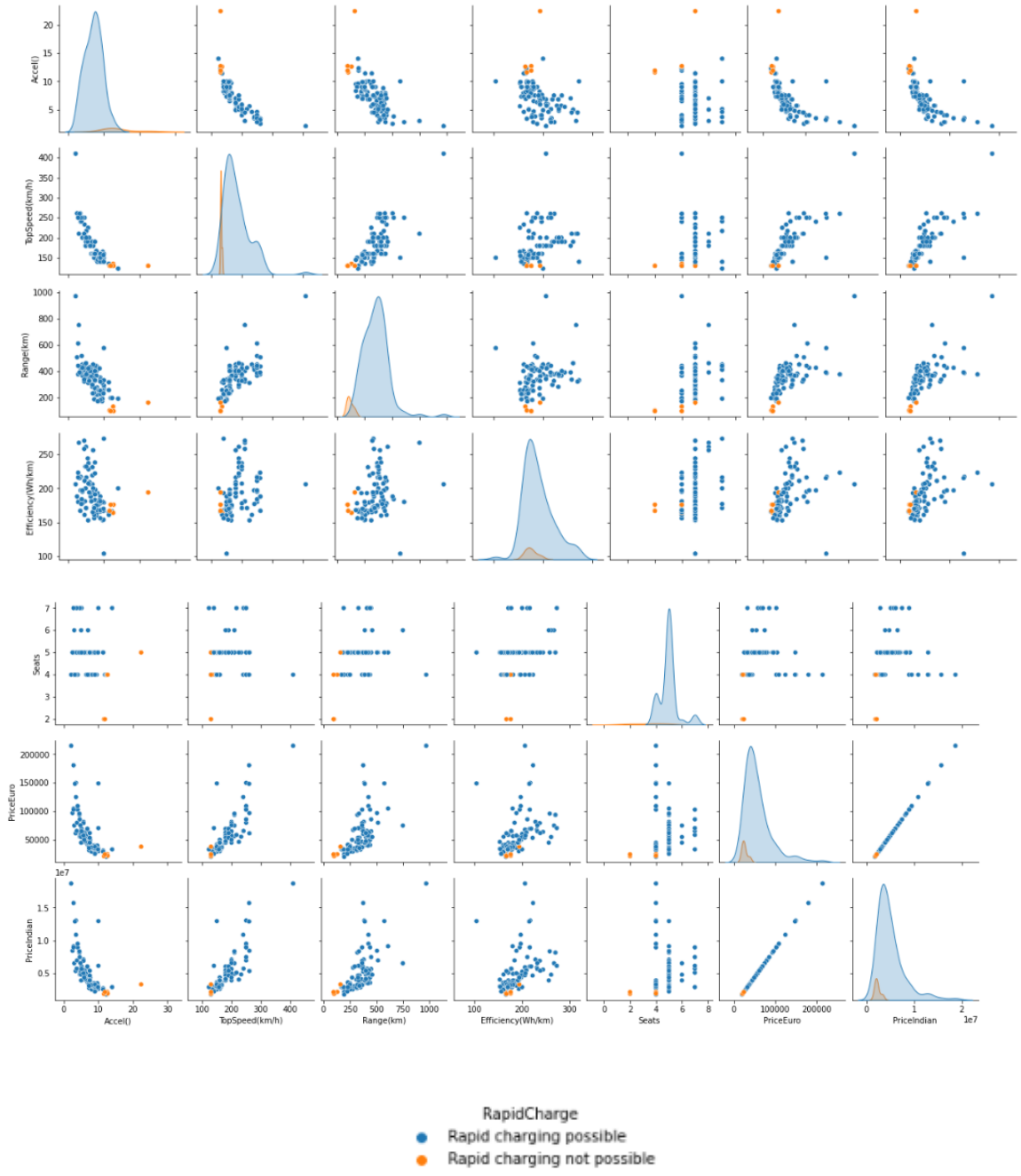
Number of Seats

```
df['Seats'].value_counts().plot.pie(figsize=(8,15),autopct='%.0f%%',explode=(0.1,0.1,0.1,0.1,0.1))
plt.title('Seats')
```



Majority of cars have 5 seats

PAIR PLOTS BASED ON RAPID CHARGER PRESENCE:



THANK YOU