

Electric Vehicle Market Segmentation Analysis



TEAM-HUNAR

Hunar

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Problem statement: -

To analyse the Electric Vehicle market in India using Segmentation Analysis to decide a strategy for start-up for developing an Electric vehicle.

Introduction

Electric vehicles are emerging in the automobile sector. Transport is an essential part of contemporary life, yet the typical combustion engine is rapidly becoming obsolete. Petrol and diesel vehicles emit a lot of pollution and are being phased out in favour of all-electric vehicles. Fully electric cars (EV) emit no exhaust emissions and are thus significantly better for the environment. As conventional fuel sources are limited in nature, technology is moving towards non-conventional energy sources. A vehicle can run using electrical energy. A vehicle that incorporates one or more electric motors for propulsion is referred to as an electric vehicle (EV). It may be driven independently by a battery, a collector system, or electricity from extravehicular sources (sometimes charged by solar panels, or by converting fuel to electricity using fuel cells or a generator). Road and rail vehicles, surface and underwater watercraft, electric aeroplanes, and electric spacecraft are all examples of EVs.

As technology and consumer interest advance, the landscape of electric vehicles is fast shifting. In the upcoming years, a significant increase in the number of EVs on land, sea, and in the air is expected. Since 2016, sales of electric vehicles in the US have increased by more than 40% annually. The greatest car market by 2035 will be all electric, offering a glimpse of a sustainable future as well as a major economic potential. With around 40 crore consumers in need of mobility solutions by 2030, India is the world's fifth largest automotive market and has the potential to become one of the top three in the near future. However, according to the Paris Accord, a rise in automotive consumers does not indicate an increase in conventional fuel consumption. The EV industry has expanded since the Ministry of Heavy Industry and Public Enterprises implemented the FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) plan in 2015.

The Indian government has launched many programmes to encourage the production and use of electric cars in India, to cut emissions in accordance with international agreements, and to advance e-mobility in the wake of rising urbanisation. The first real decision to incentivize electric automobiles was made in India in 2010. The government offered a financial incentive for makers of electric cars marketed in India under a 95-crore rupees. programme approved by the Ministry of New and Renewable Energy (MNRE). The plan, which went into effect in November 2010, provided discounts of up to 20% off ex-factory car pricing, subject to a cap. However, the MNRE eventually cancelled the subsidy plan in March 2012. The Union Cabinet approved a Rs 10,000 crore initiative under the FAME-II plan in February 2019. The implementation of this plan began on April 1, 2019. The scheme's primary goal is to hasten the adoption of electric and hybrid cars by providing upfront incentives for EV purchases and by setting up essential EV charging infrastructure.

India has the greatest untapped EV market in the world, particularly in the two-wheeler category. With multiple automakers rapidly releasing EV vehicles, the penetration of electric vehicles has expanded dramatically in recent years. According to a recent estimate, the market for electric cars (EVs) is predicted to be valued at least \$475 billion by 2025. Electric two-wheeler adoption is expected to increase to 15% by 2025, up from 1% today.

Advantages of Electric Vehicle

1. Eco-friendly

Our planet's supply of fossil fuels is limited, and their consumption is destroying it. Toxic emissions from gasoline and diesel automobiles have long-term negative consequences on public health. Electric automobiles emit far less pollution than gasoline or diesel vehicles. From an efficiency standpoint, electric vehicles can convert around 60% of the electrical energy from the grid to power the wheels, but gasoline or diesel vehicles can only convert 17% -21% of the energy contained in the fuel to the wheels. That is a waste of almost 80%. Although fully electric vehicles release no tailpipe emissions, even when power production is considered, petrol or diesel vehicles emit nearly three times the carbon dioxide as the average EV.

2. Lower running costs

Compared to a comparable petrol or diesel car, an electric vehicle has much reduced operating costs. Instead of utilising fossil fuels like gasoline or diesel to charge their batteries, electric cars utilise electricity. Due to their greater efficiency and the lower cost of power, charging an electric car is more affordable than purchasing gasoline or diesel for your travel needs. The usage of electric cars can be more environmentally benign when powered by renewable energy sources. If charging is done with the aid of renewable energy sources installed at home, such as solar panels, the cost of power can be further decreased.

3. Zero Tailpipe Emissions

Because there are no exhaust emissions, driving an electric vehicle can help you minimise your carbon impact. You may further lessen the environmental effect of charging your vehicle by using renewable energy for household power.

4. Low Maintenance

Because they have fewer moving parts than internal combustion engines, electric cars require extremely less maintenance. Compared to typical petrol or diesel automobiles, electric cars require less maintenance. As a result, operating an electric car has a very low annual cost.

5. Easy to Drive

Electric vehicles do not have gears and are extremely easy to drive. There are only three controls: accelerate, brake, and steer. Simply plug your car into a home or public charger to charge it. Electric cars are very quiet, which helps to decrease noise pollution caused by regular automobiles.

6. Charging at home

Imagine being at a busy fuel station during peak hours, and you are getting late to reach your workplace. These problems can easily be overcome with an electric vehicle. Simply plug your vehicle in at your home charger for 4-5 hours before you plan to go. If you are able to get a charger where you park at home, it is very convenient to plan your journeys in advance. What if you forget to plug in your machine someday? Then you can easily take the help of fast chargers or even battery swapping services if you are on a two-wheeler on the road.

7. No Noise Pollution

As there is no engine beneath the hood, electric vehicles may operate in silence. A silent vehicle has no engine. You have to look at your instrument panel to see whether the electric motor is on since it runs so quietly. Manufacturers must create fake noises to electric vehicles because they are so silent to keep pedestrians safe.

Fermi Estimation

Before turning to more advanced methods to determine a specific solution, we can check for Fermi estimates of the answer to a problem. This is a good way to double-check the results. While the estimate is probably definitely erroneous, it is a straightforward computation that allows for quick error testing and the identification of flawed assumptions if the result exceeds what we should reasonably anticipate. In comparison, accurate calculations might be highly complicated, but the result is expected to be right.

Wild Guess

As EVs (Electric Vehicles) are emerging in the automobile sector, we assume that 6 percent will be the EV count out of total running vehicles in the India at the end of the year 2022.

Educated Guess

Government is also planning to setup charging points. This will defiantly promote customers to think about buying Electric Vehicles. Considering facts about Electric Vehicle Market, by the year 2024, EVs would be priced the same as gasoline and diesel vehicles, according to Nitin Gadkari, minister of Union Road Transport and Highways. Due to this, customers can buy the Electric Vehicle instead of fuel vehicles. If his statement comes true, then defiantly drastic changes will be seen in automobile industry.

Let's look into the statistics related to previous years. Here are the sales of vehicles in India.

Sr. No.	Year	No. of Sold
1.	2019	21×10^6
2.	2020	18×10^6
3.	2021	17×10^6
Total		56×10^6
Avg.		18.66×10^6

Below is the statistics about no. of Electric Vehicles sold in previous three years.

Sr. No.	Year	No. of Sold EV's
1.	2019	16×10^4
2.	2020	13×10^4
3.	2021	42×10^4
Total		71×10^4
Avg.		23.66×10^4

Combined table of EV and total vehicles with percentage of EV.

Sr. No.	Year	No. of Sold Vehicles	No. of Sold Electric Vehicles	Percentage of EV
1.	2019	21 X 10 ⁶	16 X 10 ⁴	0.76%
2.	2020	18 X 10 ⁶	13 X 10 ⁴	0.72%
3.	2021	17 X 10 ⁶	42 X 10 ⁴	2.47%
Total		56 X 10 ⁶	71 X 10 ⁴	0.78%
Avg.		18.66 X 10 ⁶	23.66 X 10 ⁴	1.26%

As Covid affected Indian economy in 2020, it also affected sales in automobiles. As we can see in the above table, sales of EV increased to 2.47 percent in the year 2021. If situation will remain stable, then in the year 2022 sale of EV will increase.

Ratio of percentage for year 2021

$$= 2021 \% / \text{avg. } \%$$

$$= 2.47 / 0.78$$

$$= 3.16\%$$

Overall sales of EV increased by 3 % (approx.)

Similarly, for overall sales

$$= 2021 \% / \text{avg. } \% = 17/18.66$$

$$= 0.91$$

Sales of year 2021 was decreased by prox. 1% but EV sales are increased by 3 percent.

So, for the year 2021

EV sales will be...

$$= \text{EV ratio} - \text{Total ratio}$$

$$= 3 - (-1) = 4\%$$

Therefore, at the end of the year 2022 sales of EV will be more than 4%.

Our wild guess was 6 % but calculated guess is sales will be more than 4%.

EV Market

The global electric vehicle market is segmented on the basis of type, vehicle type, vehicle class, top speed, vehicle drive type, and region. By type, it is divided into battery electric vehicle (BEV), plug-in hybrid electric vehicle (PHEV), and fuel cell electric vehicle (FCEV). By vehicle type, it is classified into two-wheelers, passenger cars, and commercial vehicles. By vehicle class, it is classified into mid-priced and luxury class. On the basis of top speed, it is segmented into less than 100 MPH, 100 to 125 MPH, and more than 125 MPH. By vehicle drive type, it is segmented into front wheel drive, rear wheel drive, and all-wheel drive. By region, the market is analyzed across North, Europe, Asia-Pacific and LAMEA. Companies have adopted product development and product launch as their key development strategies in the electric vehicle market.

Key Market Segments

By Type

- Battery Electric Vehicle
- Plug-in Hybrid Electric Vehicle
- Fuel Cell Electric Vehicle

By Vehicle Type

- Two-Wheelers
- Passenger Cars
- Commercial Vehicles

By Vehicle Class

- Mid-Priced
- Luxury

By Top Speed

- Less Than 100 MPH
- 100 to 125 MPH
- More Than 125 MPH

By Vehicle Drive Type

- Front Wheel Drive
- Rear Wheel Drive
- All Wheel Drive

By Region

- North America
- U.S.
- Canada
- Mexico
- Europe
- UK
- Germany
- France
- The Netherlands
- Norway
- Rest of Europe
- Asia-Pacific
- China
- Japan
- India
- Singapore

- South Korea
- Rest of Asia-Pacific
- LAMEA
- Latin America
- Middle East
- Africa

Market segmentation

EV market is segmented by geographic, demographic, socioeconomic, psychographic and behavior variables.



Geographic segmentation:

The EV market is predominantly present in areas where the infrastructure is highly developed and expanded and where spending on charging networks is high.



Demographic segmentation:

Family size determines the manufacturing and development of EV cars as it also determines the type of target markets in this market.

Socioeconomic segmentation:

Consumers have a high level of income and are mostly highly educated about consequences of climate change and pollution.



Psychographic segmentation

Interest in being eco-friendly and sustainable transportation play an important role. Consumers are willing to pay more for eco-friendly vehicles and want to reduce pollution.

Behavioral segmentation:

Price-sensitivity among consumers, perceived benefits about quality, safety and performance are widespread in this market and determine the R&D and customers service of EV manufacturers.

➔ The process of marketing segmentation involves the identifying of variations in customer needs and the determining of how these needs can be fulfilled. Customers may differ in many ways; wants, purchasing power, geographical location, attitudes, personality, knowledge, benefits sought, and/or habits. Hence, by identifying specific groups within a market, a market campaign for a product or service can be more fine-tuned to fit specific segments. Besides usual socio-demographic variables psychographic and behavioural variables were included to identify specific market segments.

Relative advantage

The relative advantage of the electric vehicles is measured by means of speed, acceleration, driving range, recharge time, loading capacity, operating costs, price, ease of maintenance, and environment-friendliness. A nine-point important-unimportant scale was used.

Compatibility

Compatibility with one's lifestyle is measured by means of five items rating describing electric vehicles' usability for work trips, shopping, chauffeuring, vacation trips, and irregular short trips (e.g., to the doctor, to sport). A five-point agree-disagree scale was used.

Complexity and perceived risk.

A number of items were included in the questionnaire in order to measure the perceived complexity and some aspects of the perceived risk of driving an EV. These items were ease of maintenance, ease of driving, traffic safety, noise level, risk when recharging, and risk of radiation from the batteries. Again, a five-point agree-disagree scale was used.

Attitudes towards the electric vehicles.

The attitude towards electric vehicles is measured by means of attractiveness, feelings of luxury, and intention to buy an electric vehicle rather than a conventional vehicle of the same make and model. Again, a five-point agree-disagree scale was used. In wave 1 buying intention a simple yes-no scale was used.

Data Collection

Dataset:-We have sent out google forms to the people we knew and they have further circulated the google forms and this is how we collected data and worked on it. Below is the link.....

https://github.com/Chatak1/Feyann-Labs-EV-Market-Segmentation/blob/main/EV_Data.csv

Data

Unnamed: 0	Age	City	Profession	Marital Status	Education	No. of Family members	Annual Income	Would you prefer replacing all your vehicles to Electronic vehicles?	If Yes/Maybe what type of EV would you prefer?	Do you think Electronic Vehicles are economical?	Which brand of vehicle do you currently own?	How much money could you spend on an Electronic vehicle?	Preference for wheels in EV	Do you think Electronic vehicles will replace fuel cars in India?	
0	0	30	Nabha	None	Single	Graduate	5	1.193876e+06	Maybe	SUV	Yes	Hyundai	<5 lakhs	2	I don't think so
1	1	27	Pune	None	Single	Graduate	4	1.844540e+06	Yes	SUV	Yes	Honda	<15 lakhs	4	Yes, in <20years
2	2	32	Kashipur	None	Single	Graduate	4	2.948150e+06	Yes	Hatchback	Yes	KIA	<15 lakhs	4	Yes, in <20years
3	3	55	Pune	Business	Single	Graduate	3	2.832380e+06	Maybe	Hatchback	No	Hyundai	<5 lakhs	4	Yes, in <10 years
4	4	26	Satara	None	Single	Graduate	4	2.638751e+06	Yes	Sedan	Yes	McLaren	<15 lakhs	4	Yes, in <20years

Unnamed: 0	Unnamed: 0.1	Age	City	Profession	Marital Status	Education	No. of Family members	Annual Income	Would you prefer replacing all your vehicles to Electronic vehicles?	If Yes/Maybe what type of EV would you prefer?	Do you think Electronic Vehicles are economical?	Which brand of vehicle do you currently own?	How much money could you spend on an Electronic vehicle?	Preference for wheels in EV	Do you think Electronic vehicles will replace fuel cars in India?	lab
0	0	322	41	25	3	0	1	1	3.035679e+06	2	3	0	3	6	4	2
1	1	566	19	7	3	1	0	4	6.940532e+05	2	4	2	10	4	4	3
2	2	696	25	8	1	1	0	4	1.408973e+06	1	4	2	4	4	3	2
3	3	761	25	18	3	0	1	5	5.565419e+05	2	4	1	15	4	4	2
4	4	904	25	30	0	1	0	7	1.279026e+06	2	3	2	5	6	4	1

Pre-processing

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

```

Unnamed: 0      0
Unnamed: 0.1    0
Age             0
City            0
Profession      0
Marital Status  0
Education       0
No. of Family members  0
Annual Income   0
Would you prefer replacing all your vehicles to Electronic vehicles?  0
If Yes/Maybe what type of EV would you prefer?  0
Do you think Electronic Vehicles are economical?  0
Which brand of vehicle do you currently own?  0
How much money could you spend on an Electronic vehicle?  0
Preference for wheels in EV  0
Do you think Electronic vehicles will replace fuel cars in India?  0
label           0
dtype: int64

```

```
df.columns
```

```

Index(['Unnamed: 0', 'Age', 'City', 'Profession', 'Marital Status',
      'Education', 'No. of Family members', 'Annual Income',
      'Would you prefer replacing all your vehicles to Electronic vehicles?',
      'If Yes/Maybe what type of EV would you prefer?',
      'Do you think Electronic Vehicles are economical?',
      'Which brand of vehicle do you currently own?',
      'How much money could you spend on an Electronic vehicle?',
      'Preference for wheels in EV',
      'Do you think Electronic vehicles will replace fuel cars in India?'],
      dtype='object')

```

```
df.shape
```

```
(1000, 15)
```

```

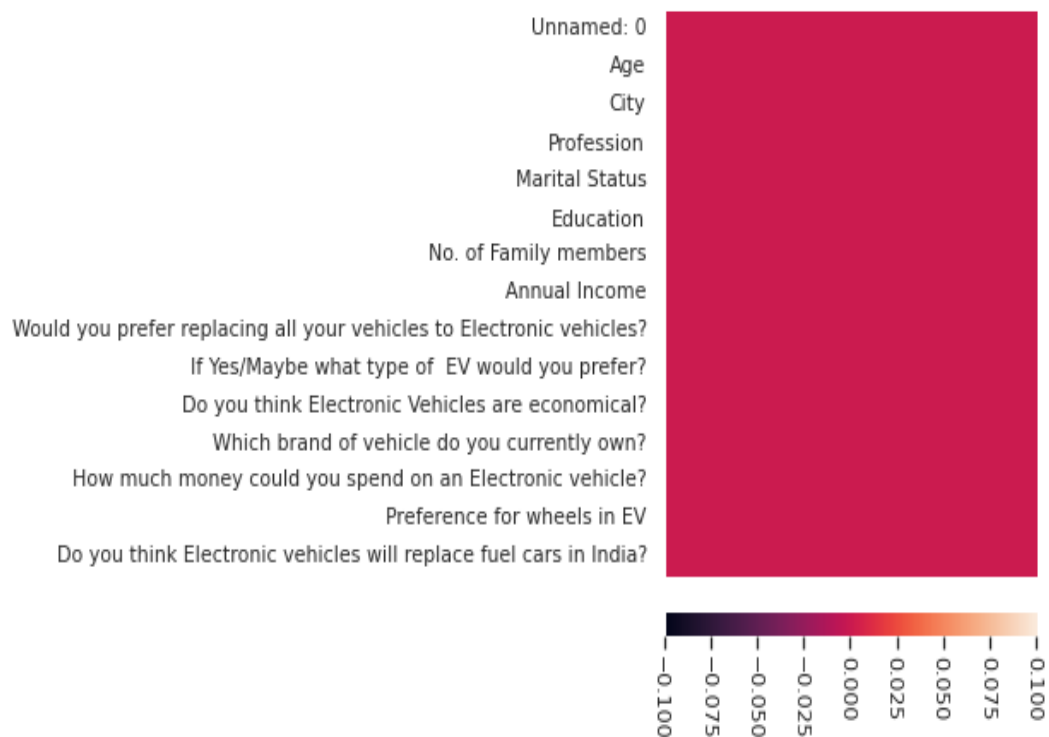
#Data Preprocessing
df.info()

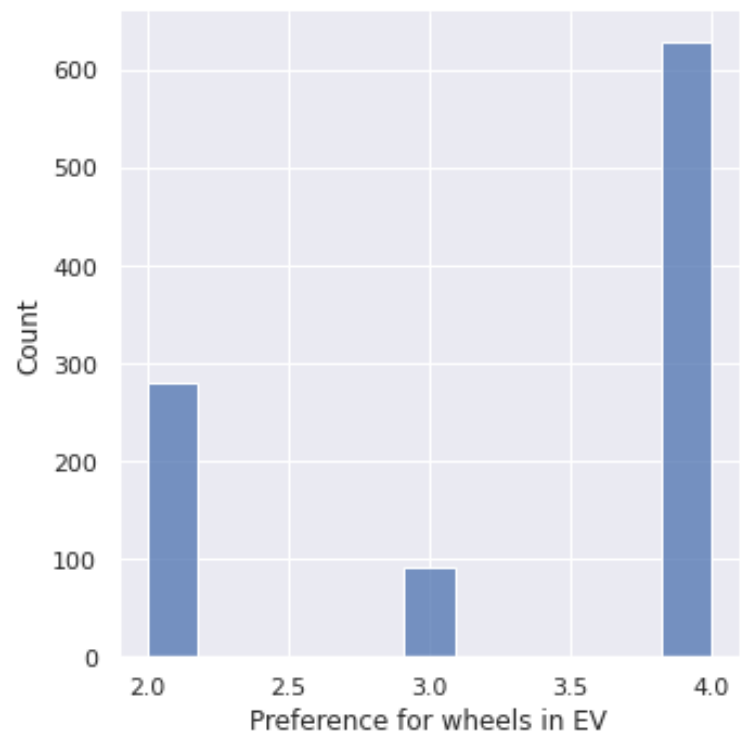
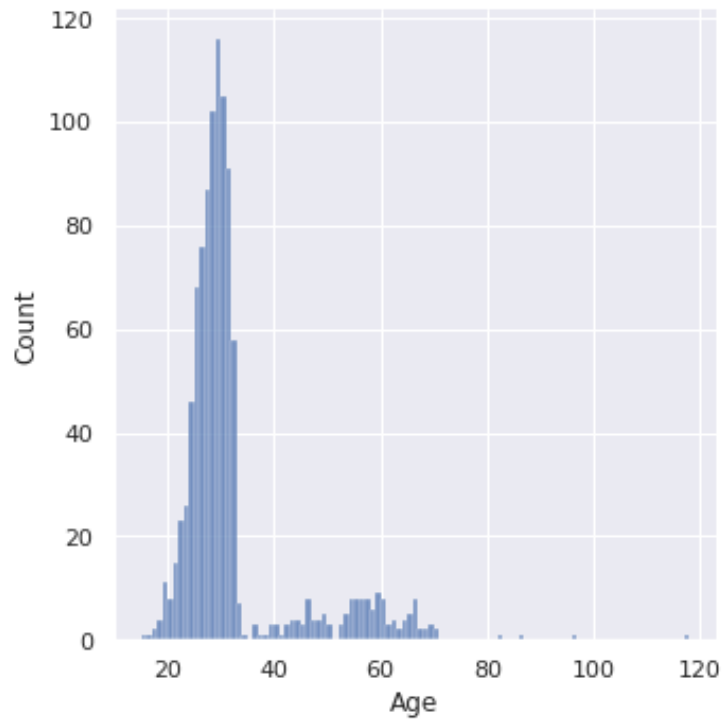
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RangeIndex: 1000 entries, 0 to 999
Data columns (total 15 columns):
#   Column                                          Non-Null Count  Dtype
---  -
0   Unnamed: 0                                     1000 non-null   int64
1   Age                                           1000 non-null   int64
2   City                                           1000 non-null   object
3   Profession                                    1000 non-null   object
4   Marital Status                               1000 non-null   object
5   Education                                    1000 non-null   object
6   No. of Family members                        1000 non-null   int64
7   Annual Income                                1000 non-null   float64
8   Would you prefer replacing all your vehicles to Electronic vehicles?  1000 non-null   object
9   If Yes/Maybe what type of EV would you prefer?  1000 non-null   object
10  Do you think Electronic Vehicles are economical?  1000 non-null   object
11  Which brand of vehicle do you currently own?    1000 non-null   object
12  How much money could you spend on an Electronic vehicle?  1000 non-null   object
13  Preference for wheels in EV                   1000 non-null   int64
14  Do you think Electronic vehicles will replace fuel cars in India?  1000 non-null   object
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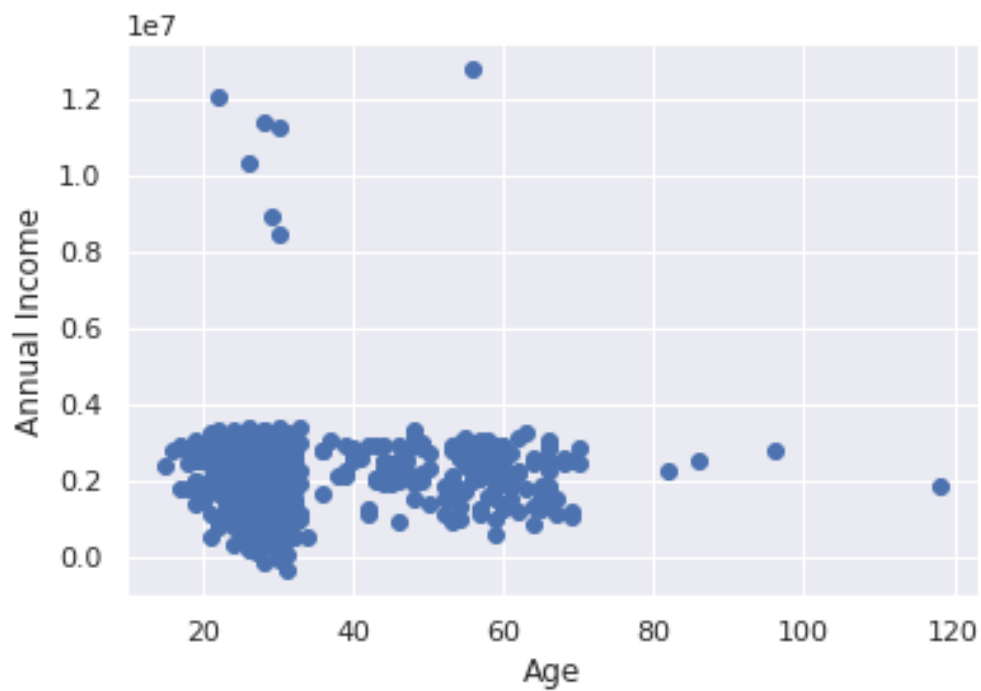
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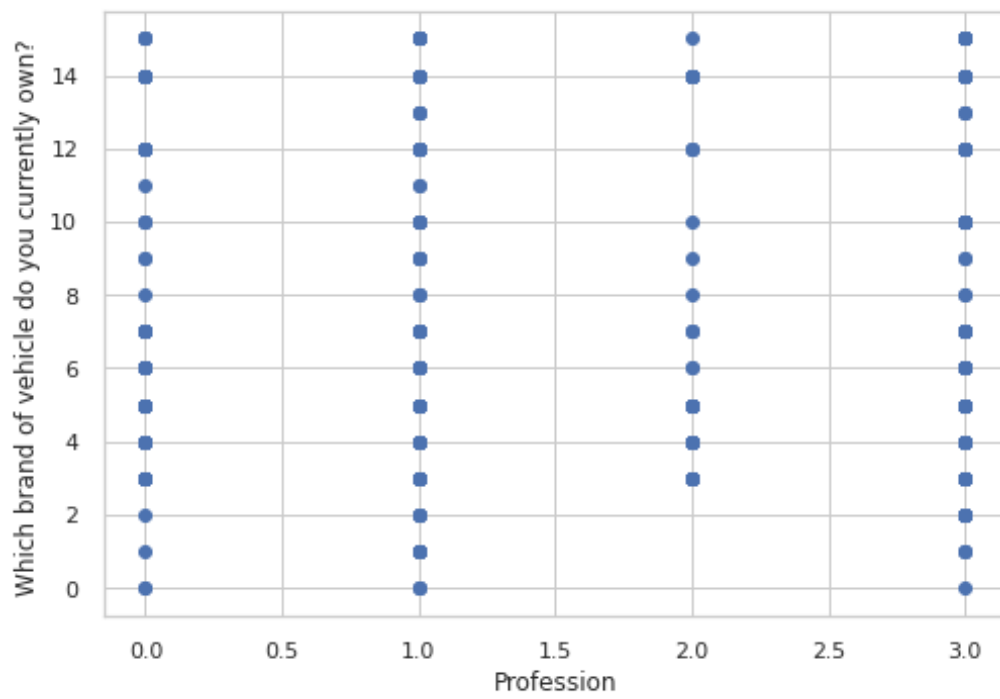
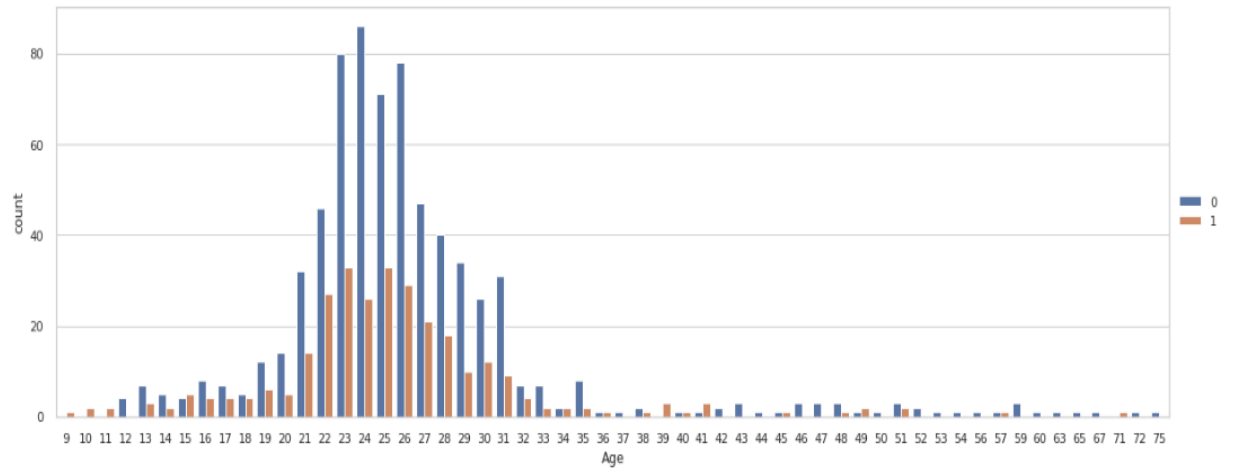


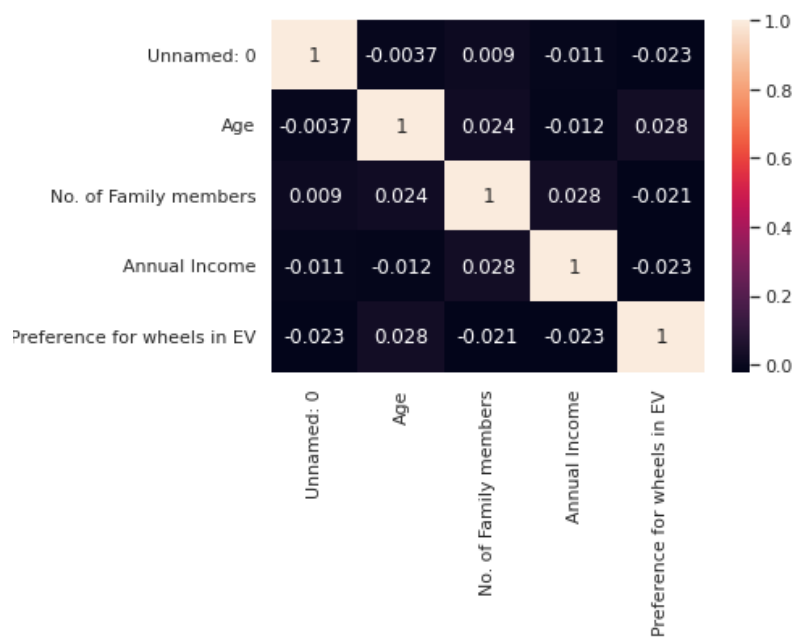
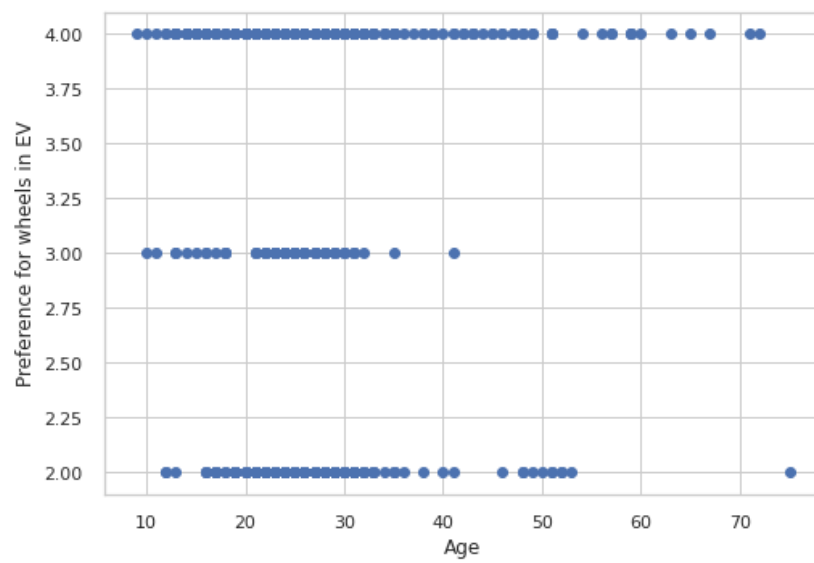
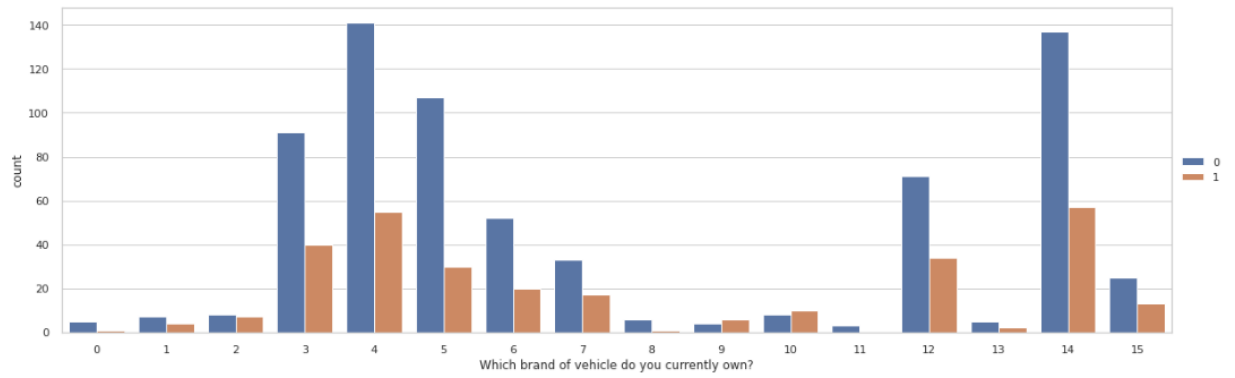


PCA

	Unnamed: 0	Age	No. of Family members	Annual Income	Preference for wheels in EV
count	1000.000000	1000.000000	1000.000000	1.000000e+03	1000.000000
mean	499.500000	31.800000	4.118000	2.258342e+06	3.349000
std	288.819436	11.294847	1.469774	9.993558e+05	0.887686
min	0.000000	15.000000	0.000000	-3.761509e+05	2.000000
25%	249.750000	26.000000	4.000000	1.782116e+06	2.000000
50%	499.500000	29.000000	4.000000	2.329246e+06	4.000000
75%	749.250000	31.000000	5.000000	2.753170e+06	4.000000
max	999.000000	118.000000	8.000000	1.282128e+07	4.000000



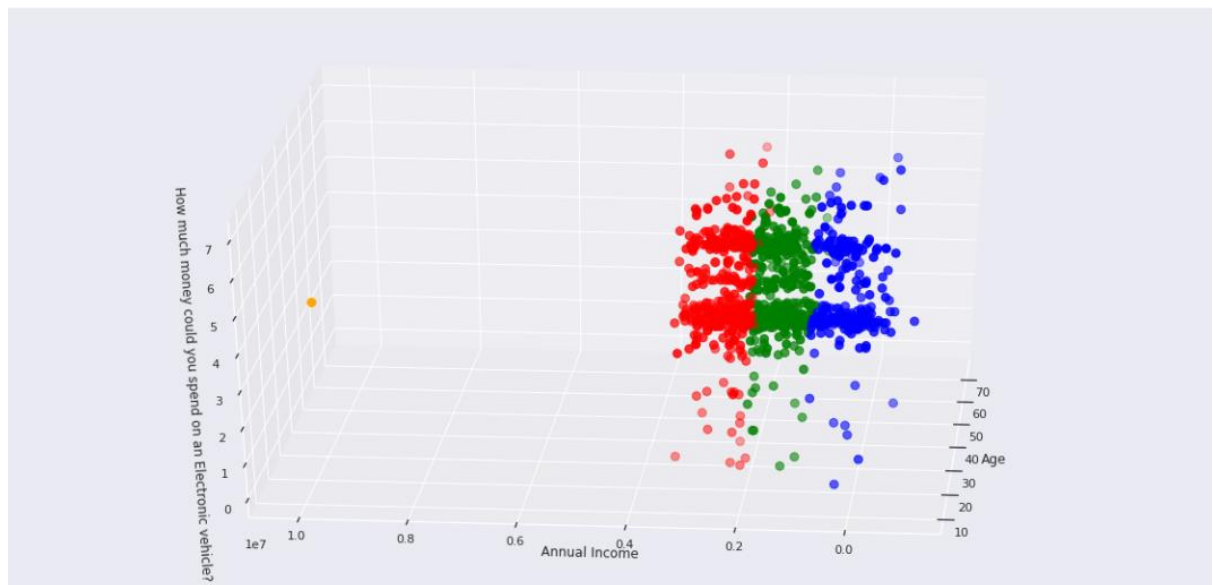
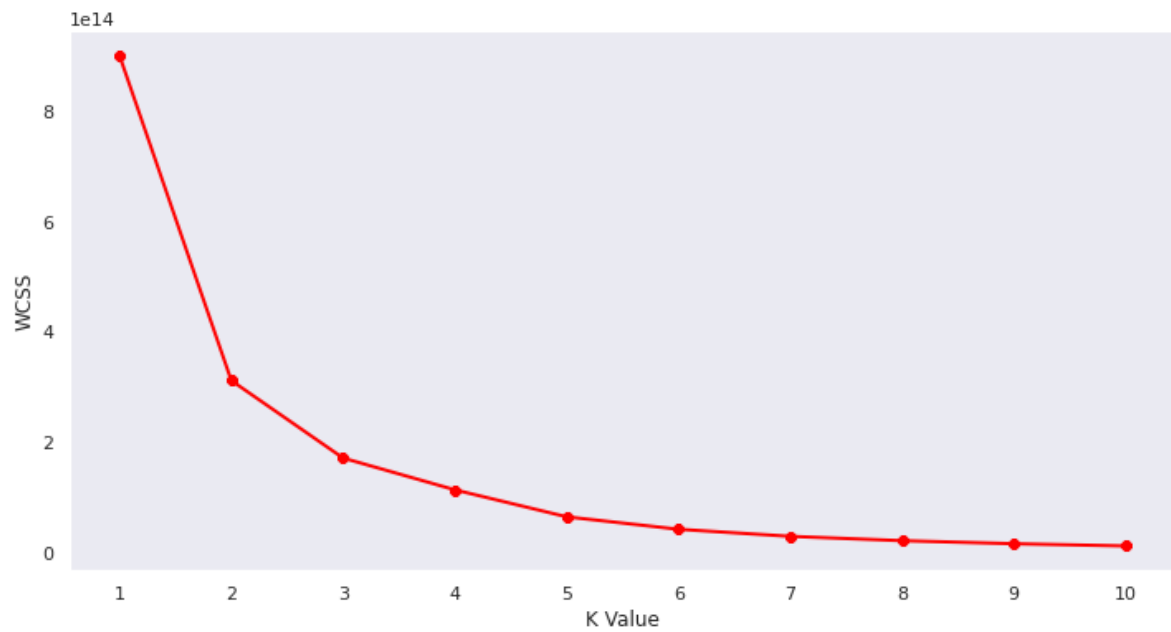




Unnamed: 0	Age	City	Profession	Marital Status	Education	No. of Family members	Annual Income	Would you prefer replacing all your vehicles to Electronic vehicles?	If Yes/Maybe what type of EV would you prefer?	Do you think Electronic Vehicles are economical?	Which brand of vehicle do you currently own?	How much money could you spend on an Electronic vehicle?	Preference for wheels in EV	Do you think Electronic vehicles will replace fuel cars in India?	
0	322	41	Pune	Working Professional	Married	Post Graduate	1	3.035679e+06	Yes	SUV	Maybe	Honda	<5 lakhs	4	Yes, in <20years
1	566	19	Faridabad	Working Professional	Single	Graduate	4	6.940532e+05	Yes	Sedan	Yes	McLaren	<15 lakhs	4	Yes, possibly after 20 years
2	696	25	Gurugram	None	Single	Graduate	4	1.408973e+06	No	Sedan	Yes	Hyundai	<15 lakhs	3	Yes, in <20years
3	761	25	Nagpur	Working Professional	Married	Post Graduate	5	5.565419e+05	Yes	Sedan	No	Volkswagen	<15 lakhs	4	Yes, in <20years
4	904	25	nashik	Business	Single	Graduate	7	1.279026e+06	Yes	SUV	Yes	KIA	<5 lakhs	4	Yes, in <10 years

Unnamed: 0	Unnamed: 0.1	Age	City	Profession	Marital Status	Education	No. of Family members	Annual Income	Would you prefer replacing all your vehicles to Electronic vehicles?	If Yes/Maybe what type of EV would you prefer?	Do you think Electronic Vehicles are economical?	Which brand of vehicle do you currently own?	How much money could you spend on an Electronic vehicle?	Preference for wheels in EV	Do you think Electronic vehicles will replace fuel cars in India?	
0	0	322	41	25	3	0	1	1	3.035679e+06	2	3	0	3	6	4	2
1	1	566	19	7	3	1	0	4	6.940532e+05	2	4	2	10	4	4	3
2	2	696	25	8	1	1	0	4	1.408973e+06	1	4	2	4	4	3	2
3	3	761	25	18	3	0	1	5	5.565419e+05	2	4	1	15	4	4	2
4	4	904	25	30	0	1	0	7	1.279026e+06	2	3	2	5	6	4	1

K MEANS MODEL



GithubLink:- https://github.com/SayaliC-github/ElectricVehicle_MarketSegmentation Team Hunar

Conclusion:-

From the above analysis, we can conclude that customers prefer cars more to bikes or three-wheeler automobiles. From our data collection, we observed that EV cars will have more sales from Pune, Delhi, and Mumbai. Indian buyers are primarily interested in vehicles of Tata, Hyundai, and Honda. Our target age group will be 20 – 40. As per our analysis youth is more interested in EVs than senior citizens. Especially age from 24 to 27 is more intended towards buying EV cars.

Market Segmentation on EV market has really helped us know and analyse about the electric vehicles and the need for the following in today's world. Its advantages, Disadvantages, its demand and its market are some of the most significant things that one should know. Collecting data via google forms and knowing people's choices and preferences helped a lot to work on.