# Market Segmentation

Analysing the EV market in India using Segmentation analysis for Raising Electric Vehicle Start-up.

By
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# Overview:

This report provides a comprehensive overview of electric vehicles (EVs) and their role in the global transportation landscape. As the world grapples with environmental challenges and the need for sustainable solutions, the rise of electric vehicles has gained significant attention. This report explores the history, technology, environmental impact, market trends, and future prospects of electric vehicles.

The concept of electric vehicles dates back to the 19th century, but recent advancements in battery technology and a growing focus on sustainability have propelled their resurgence. Key milestones in the history of electric vehicles, including the development of hybrid and fully electric cars, will be discussed.

EVs first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Internal combustion engines were the dominant propulsion method for cars and trucks for about 100 years, but electric power remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

In the 21st century, EVs have seen a resurgence due to technological developments, and an increased focus on renewable energy and the potential reduction of transportation's impact on climate change and other environmental issues. Project Drawdown describes electric vehicles as one of the 100 best contemporary solutions for addressing climate change.

Electric vehicles are often lauded for their potential to reduce greenhouse gas emissions and dependence on fossil fuels. However, a holistic view of their environmental impact, considering manufacturing processes, battery disposal, and the energy sources used for electricity generation, will be examined.

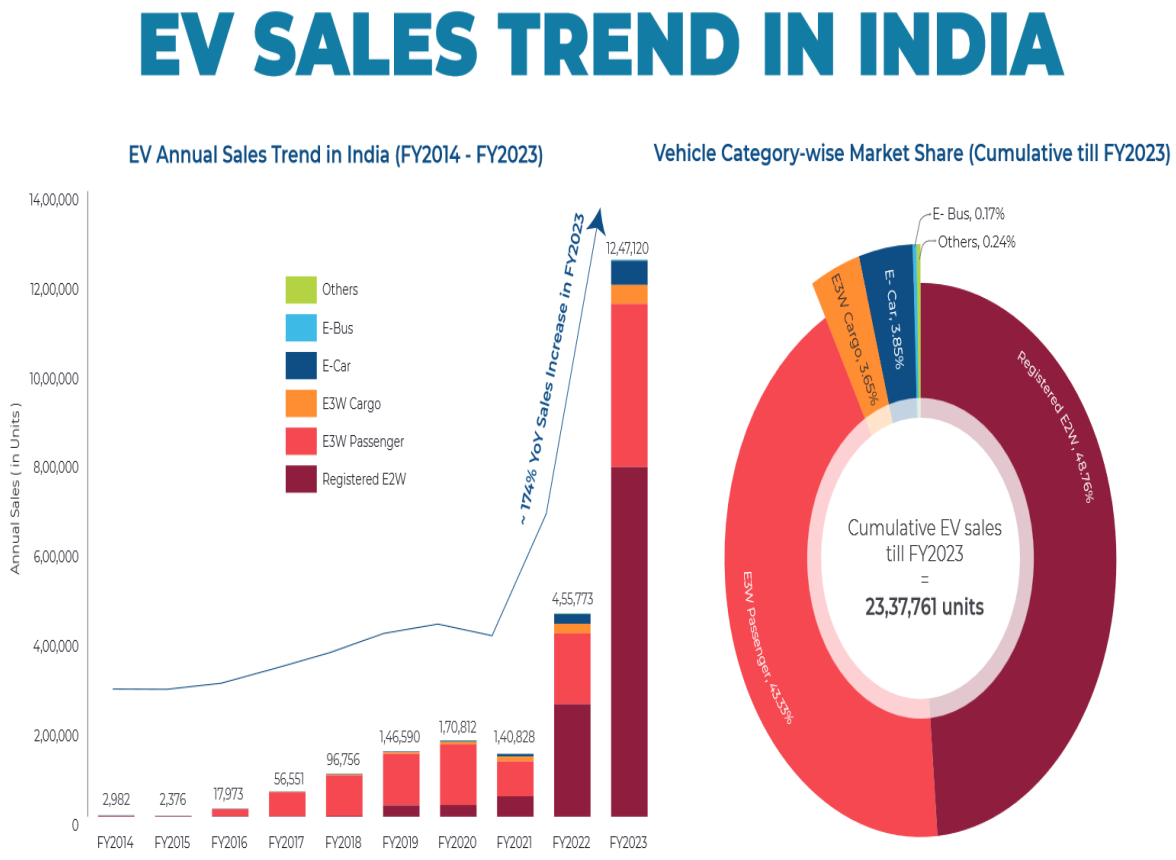
India is one among the world’s fastest growing major economies. The expeditious growth in India’s urbanization, population and per capita income has had a pronounced impact on the mobility of its citizens and the number of vehicles on the roads have increased. Though this growth has tremendously elevated the competitiveness of India’s mobility industries, pertinent challenges remain to be addressed in terms of pollution and climate friendliness. Electric Mobility is one of the key focus areas to counter India's air pollution and reduce GHG emissions. Faster transition to Electric Mobility will enable India to reach Net Zero target

announced by Honourable Prime Minister at COP 26 in Glasgow in November 2021.

Innovation centres for electric mobility in India will help to explain the benefits of EVs while highlighting the line-up of EVs and charging infrastructure currently available. The facility will not be intended as an EV sales location, but as a priority to education on EVs as India aims to achieve electrification of 70 percent for commercial cars, 30 percent for private cars, 40 percent for buses, and 80 percent for two and three-wheelers by 2030.

## Market Overview:

As previously mentioned, the majority of the Indian automobile market is dominated by cars with gasoline or diesel engines, and the electric vehicle sector is still in its infancy. As the likelihood of climate change increases, the supply of electric vehicles worldwide is likewise growing quickly. Indian EV producers have a fantastic opportunity to join the market. The increasing EVs over a ten-year period are displayed as follows:

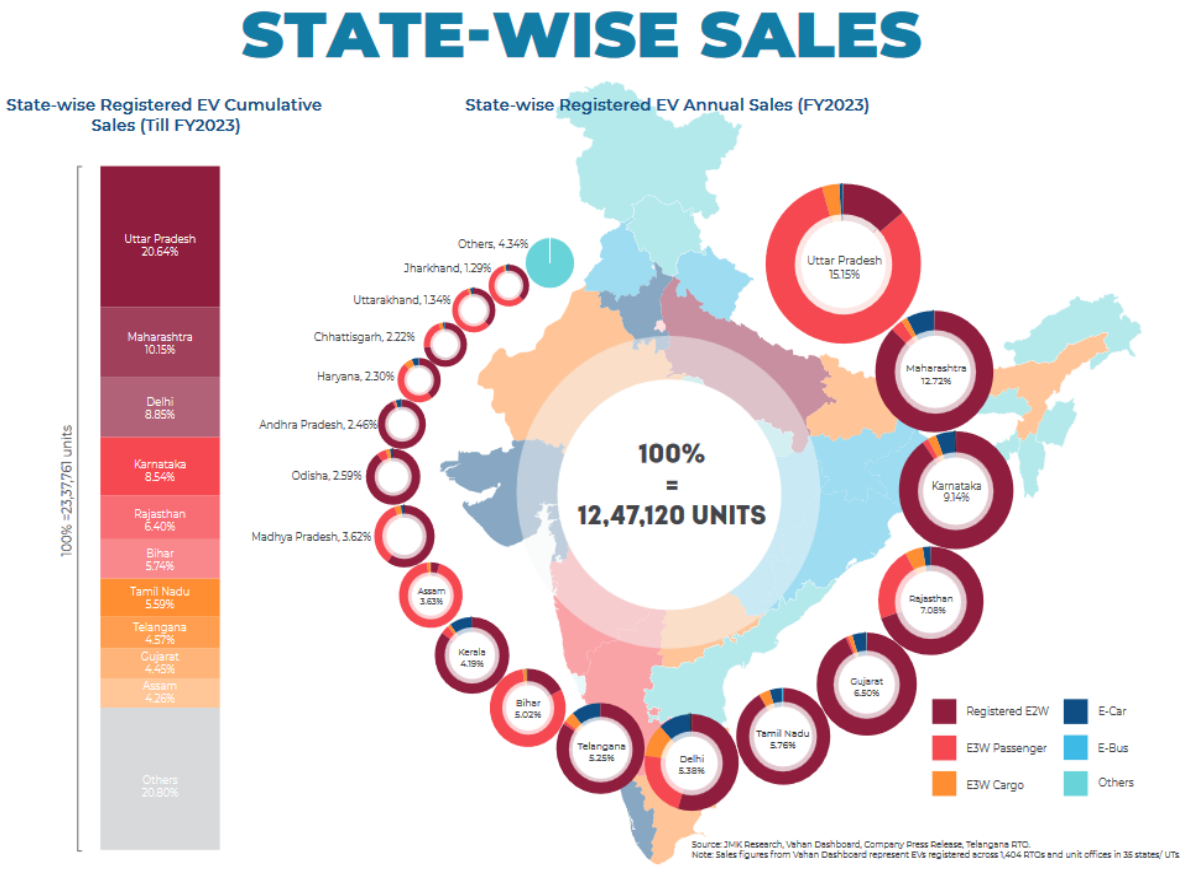


The cumulative EV sales in India reached 23,37,761 units by the end of FY2023. While the annual EV sales crossed 12 lakh vehicles in FY2023 with more than 60% of the share accounted for by registered electric two-wheelers (E2W) followed by passenger electric three-wheeler (E3W P) with ~29% market share.

The Indian Electric Vehicle Market has been impacted by the outbreak of the COVID-19 pandemic due to supply chain disruptions and halt of manufacturing units due to continuous lockdowns and travel restrictions across the county. However, the electric vehicle (EV) market is still in its nascent stage in India. It is expected to grow at a much faster rate during the forecast period due to various government initiatives and policies.

E-commerce companies (Amazon, for example) are launching initiatives to use e-Mobility for last-mile deliveries to reduce carbon footprint. India is experimenting with e-Mobility for public transport, and the country has deployed electric inter-city buses across some major cities. In addition, state governments are also playing an active role in the deployment of policies encouraging the usage of EVs.

Uttar Pradesh, Maharashtra, Delhi, Karnataka, and Rajasthan were the top EV-selling states between FY2014 and FY2022, accounting for more than 50% of the market share. In terms of FY2023 sales share, Uttar Pradesh, Maharashtra, Karnataka, Rajasthan, and Gujarat were the top EV-selling states.



The EV market in India has gained significant momentum after the implementation of the FAME India scheme with its aim of shifting toward e-mobility in the wake of growing international policy commitments and environmental challenges. Moreover, India offers the world's largest untapped market, especially in the electric two-wheeler segment. As 100% foreign direct investment is allowed in this sector, the automatic route market is expected to gain momentum during the forecast period.

## Market Segmentation:

The Indian Electric Vehicle Market is segmented by Vehicle Type and Power Source.
By Vehicle Type, the market is segmented into Passenger Cars, Commercial Vehicles, and Two- and Three-wheelers.
By Power Source Type, the market is segmented into Battery Electric Vehicle, Plug-in Electric Vehicle, and Hybrid Electric Vehicle.
India is the second most populated country in the world after China, and just like China, which has the largest electric bus fleet in the world. India is also pushing hard for the electrification of buses. Many state governments have already started procuring electric buses from Chinese and local electric bus manufacturers.
With the growing need for controlling GHG (Greenhouse gases) emissions emitted by vehicles, the government is encouraging the use of electric-powered vehicles across various states, boosting the demand for electric buses in India.
The market is driven by factors such as the increase in domestic manufacturing, rapid urbanization, and a rise in environmental awareness.

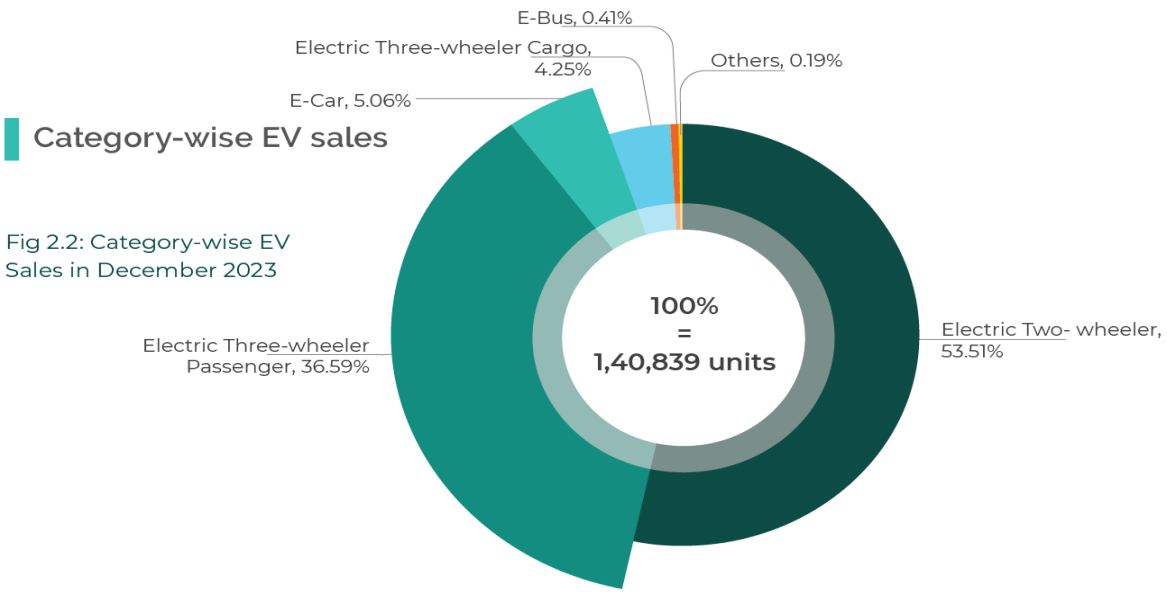
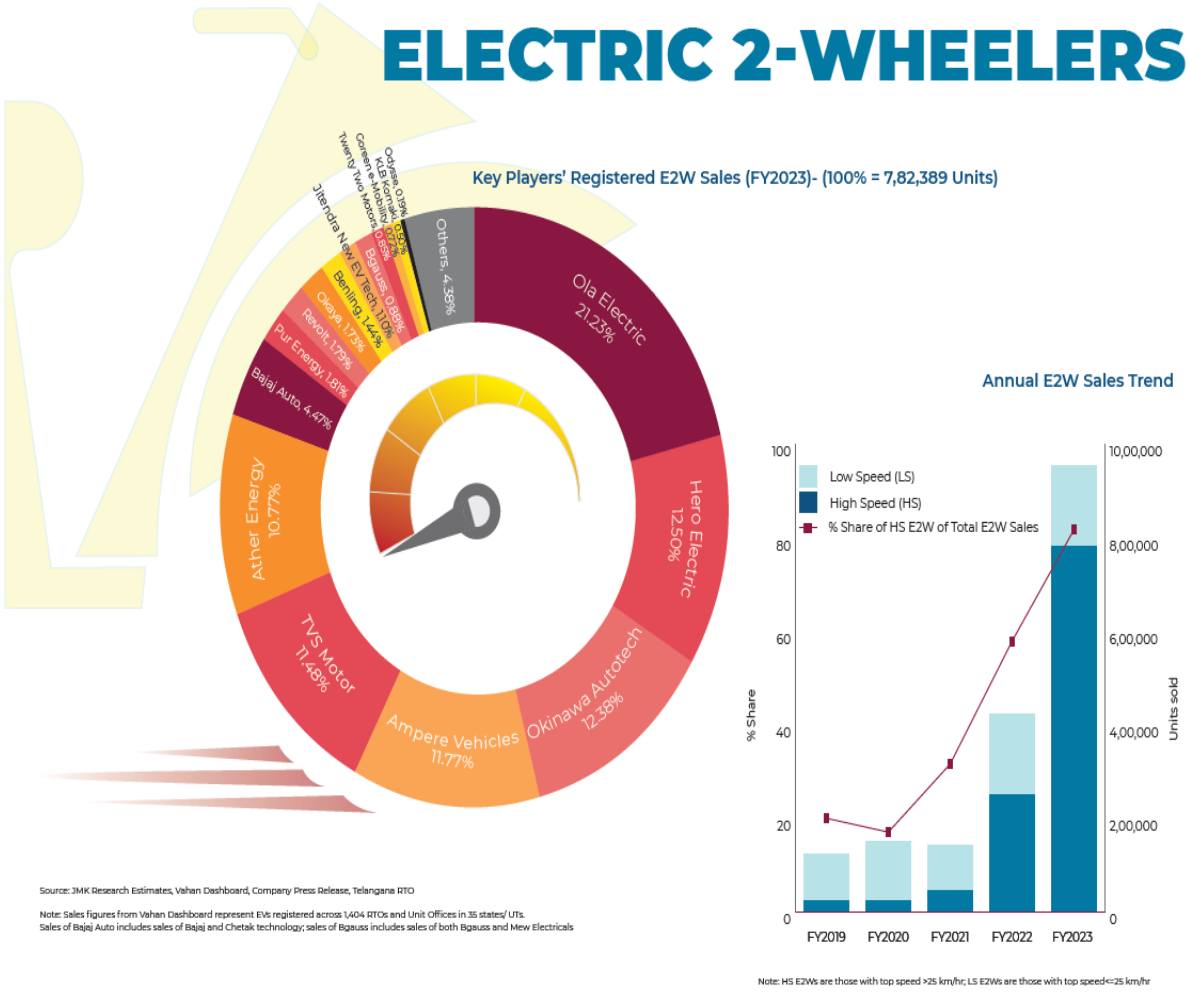



Fig 2.2: Category-wise EV Sales in December 2023

**Electric Two-Wheelers (E2Ws):** On an annual basis, the sales for E2W segment recorded an increase of 210% in FY2023 over sales in FY2022. Ola Electric, Hero Electric, and Okinawa Auto tech were the top 3 E2W players in FY2023, accounting for more than ~45% market share in registered vehicle category sales.

The Overall high-speed electric two-wheelers (HS E2Ws) sales in India decreased by ~17% m-o-m in December 2023 to reach 75,366 units. The top 10 players in the industry accounted for approximately 90.93% of the total registrations witnessed in December 2023. Furthermore, compared to December 2022, E2W sales in December 2023 experienced a y-o-y increase of 17.12%.

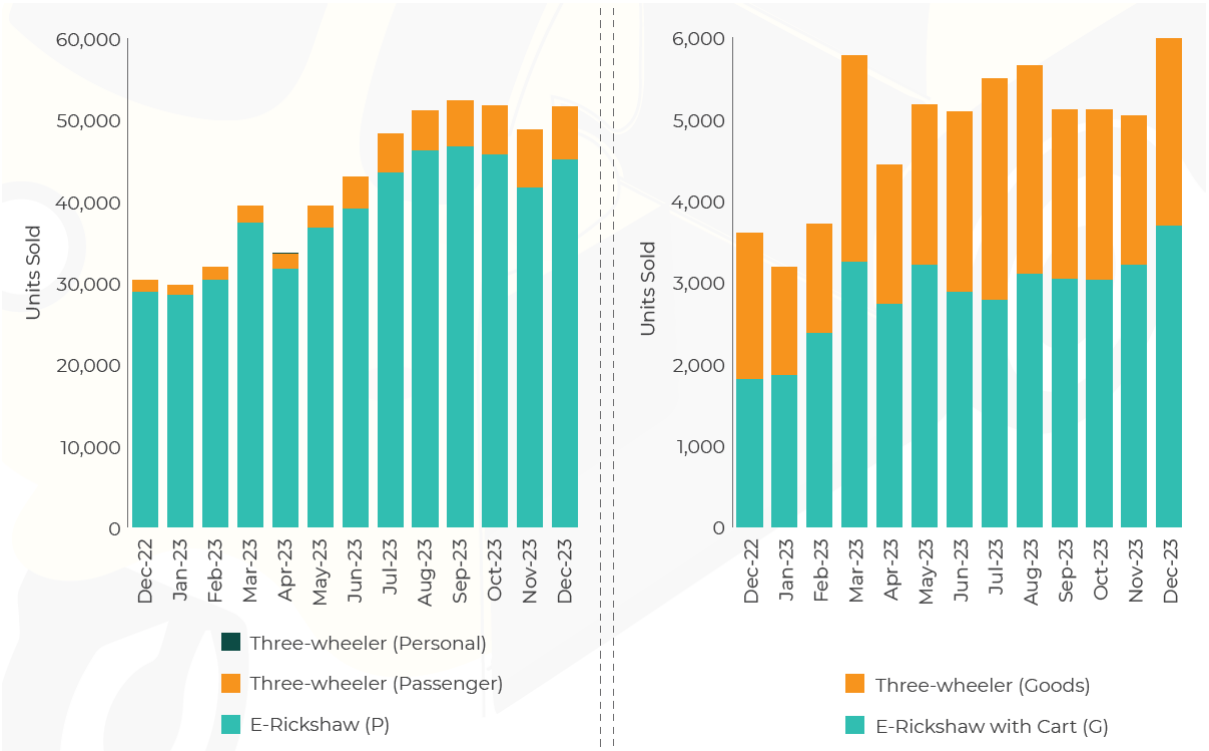


## Electric Three-Wheeler (E3W):

The sales of registered passenger and cargo-type E3Ws in December 2023 stood at 51,526 units and 5,984 units, respectively, with a m-o-m increase of ~6% in passenger E3W and increase of 18.90% in cargo E3W. Overall E3W sales recorded a m-o-m increase of ~7% over last month.

On a y-o-y basis, passenger E3W sales in December 2023 increased by ~70% and cargo E3W sales increased by more than 66% from that of passenger and cargo-type E3W sales respectively in December 2022.

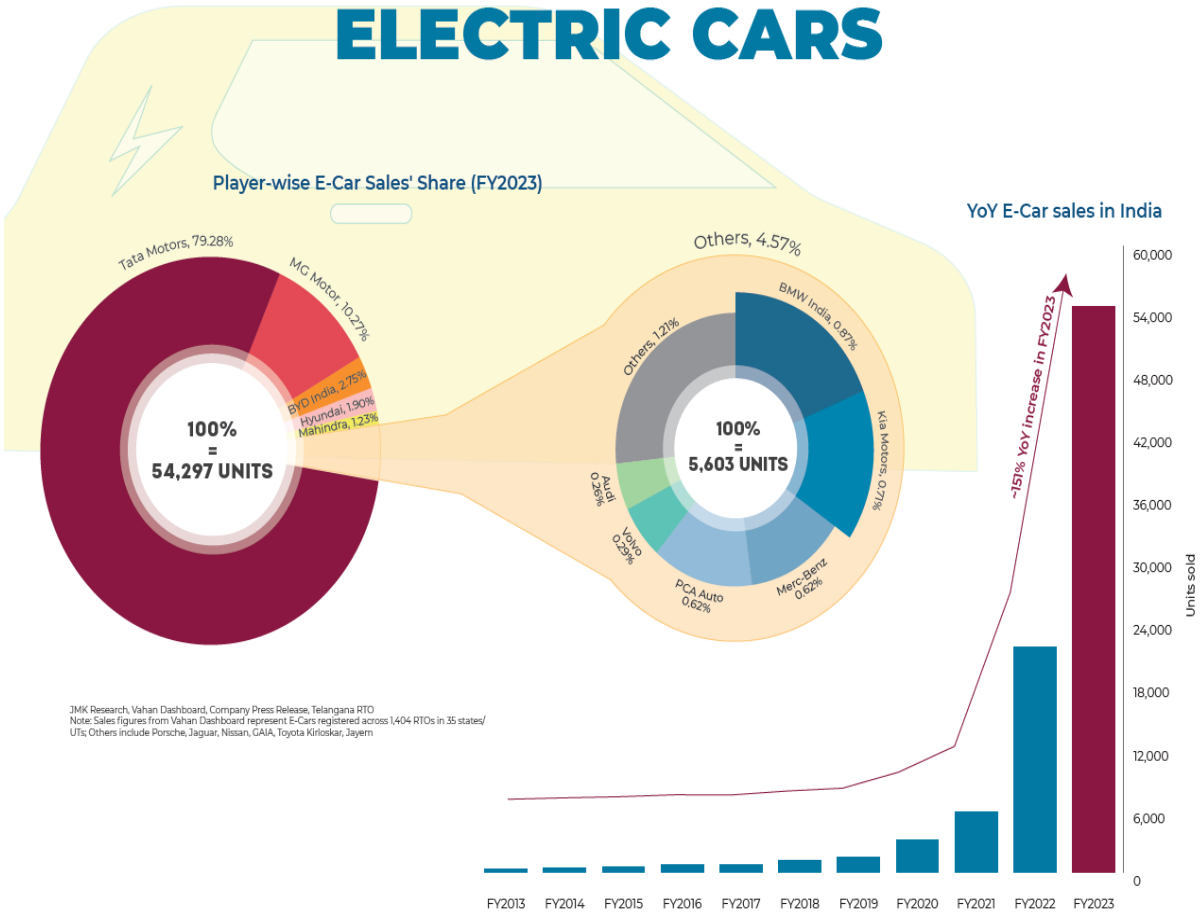
The cumulative sales of the top 8 electric 3-wheeler players across passenger and cargo segments in December 2023 accounted for 34.92% share of the entire E3W market. Mahindra and YC Electric came at first (8.86% share) and second (6.64% share) positions respectively. This was followed by Saera Electric Auto (4.61%), Dilli Electric (3.98%), Piaggio (3.58%), Mini Metro (2.66%), Hot age Corporation (2.31%) and Champion Polyp last (2.26%).



## Electric cars (E-Cars):

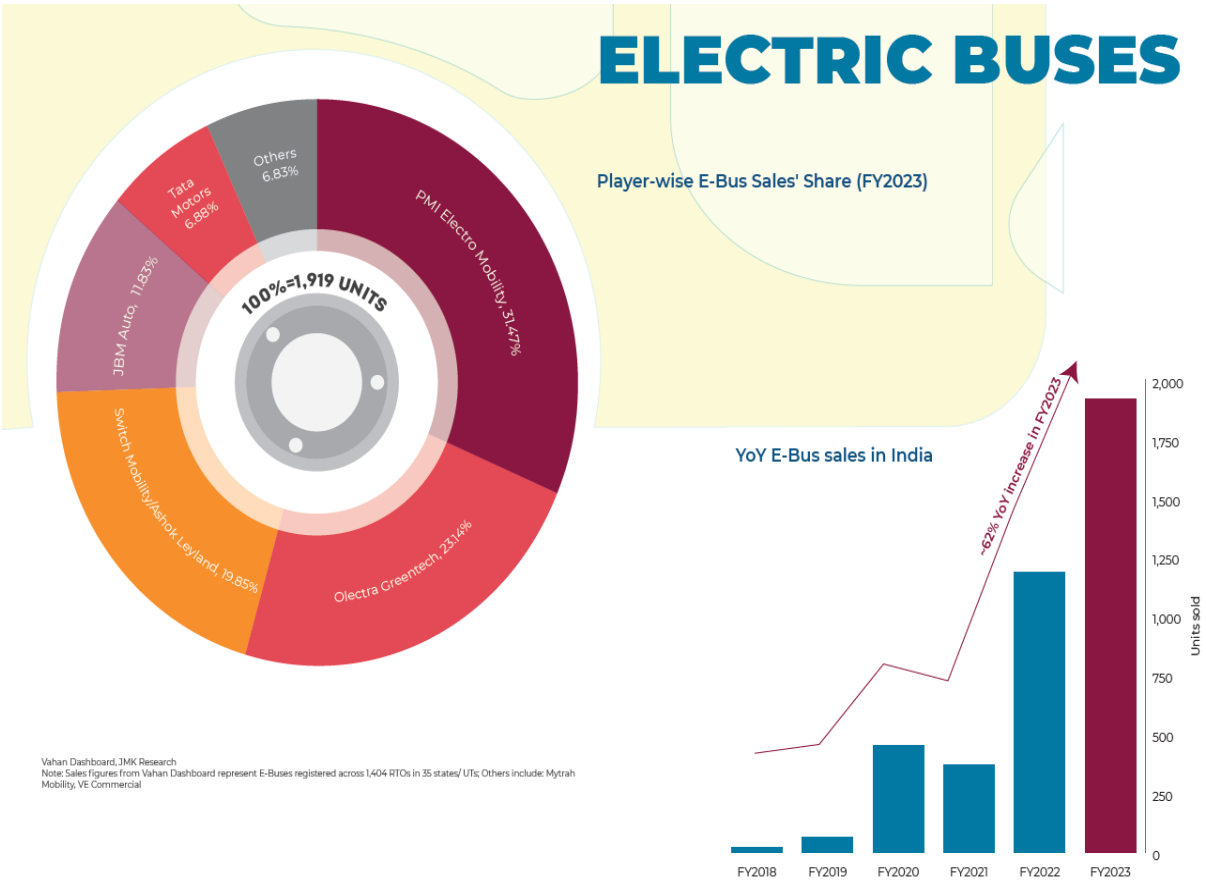
The total sales of E-cars in December 2023 stood at 7,124 units, witnessing a m-o-m increase of ~1%. Tata Motors has been driving the E-car sales (with 67.46% of the market share) this month as well. BYD India has secured a position in the top 5 this month with sales reaching 168 units. On a y-o-y basis, E-Car sales in December 2023 increased by ~88% from that of E-Car sales in December 2022.

On a yearly basis, E-Car sales registered an increase of more than 150% in FY2023 over FY2022 sales. Tata Motors was the top E-Car player, accounting for more than 75% of the entire market share, followed by MG Motor which accounted for 10% of the market share.



**Electric Buses (E-Buses):** On an annual basis, E-Bus sales witnessed a jump of 62% in FY2023 over sales in FY2022. PMI Electro Mobility, Olectra greentech, and Switch Mobility (Ashok Leyland) were the top 3 E-Bus players accounting for 74% of the total E-buses sold in FY2023.

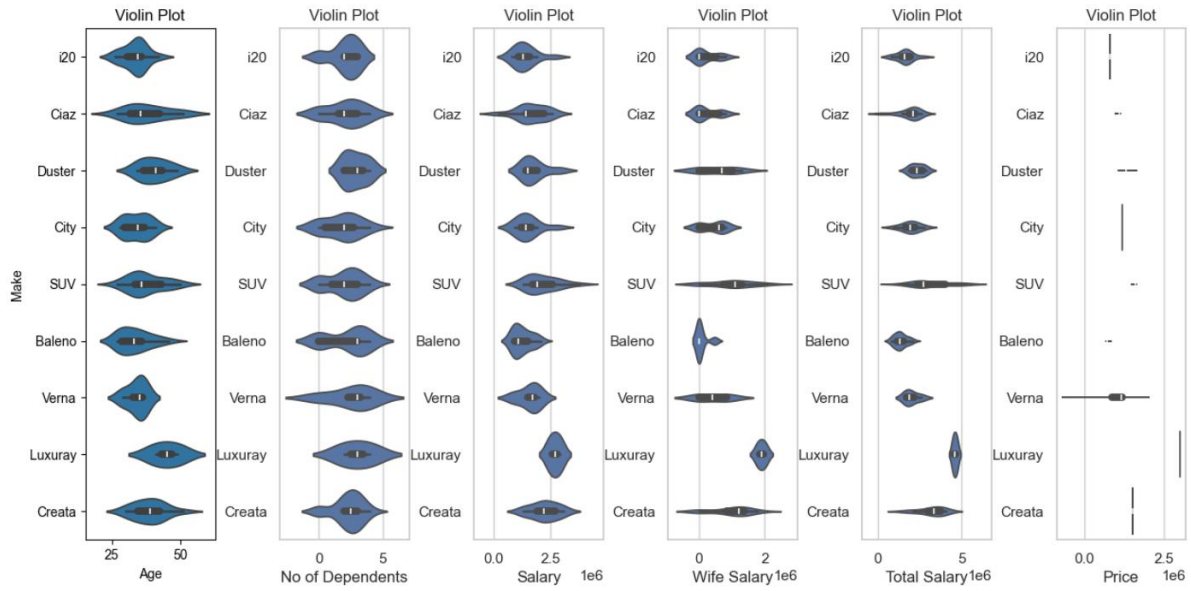
The total sales of E-buses in December 2023 stood at 577 units, witnessing a m-o-m increase of ~12%. On a y-o-y basis, E-Bus sales in December 2023 increased by more than 300% from that of E-Bus sales in December 2022. Tata Motors is the leader in December 2023 (with a 61.18% market share), followed by JBM Auto (23.74%), Olectra Greentech (11.96%), Mytrah Mobility (1.21%), PMI Electro Mobility (1.04%) , Switch Mobility (0.69%), and Pinnacle Mobility (0.17%).



# Population Behavioural Study:

To enter a market an in-depth knowledge of the end user psychology, behaviour is required. This market research is imperative for setting prices, study spending habits, study the product they use the most, like 4-wheel diesel/petrol automobiles, what is their price range, the requirement of the automobile etc. The next series of visualizations are regarding this niche where we do a requirement analysis.

The below violin plot shows top existing cars and their dependency on various variables such as age, marital status, price, salary and number of dependents.




## Age:

Younger people have a smaller number of dependents, less salary, and are single so the they are not usually our target segment but they are the most likely to buy electric vehicles are they are informed about climate change and it effects and want to help the planet.

The price range for younger target segment is below 10 Lakhs.

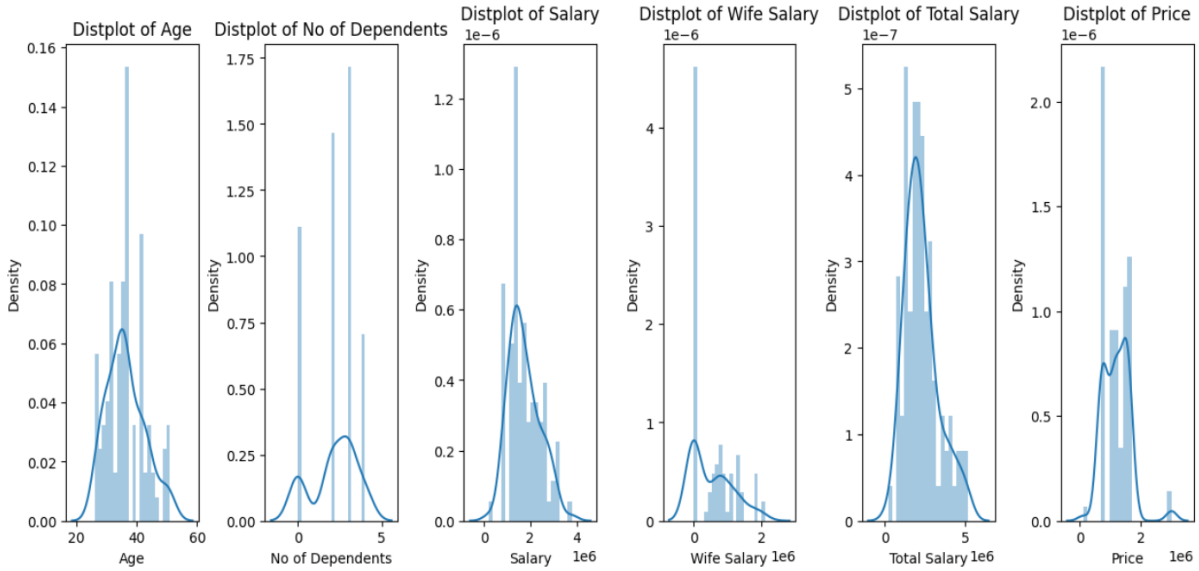
## Number of Dependents:

The more the number of dependents, the bigger the need of cars for transportation, here SUVs are preferred for higher target segments.

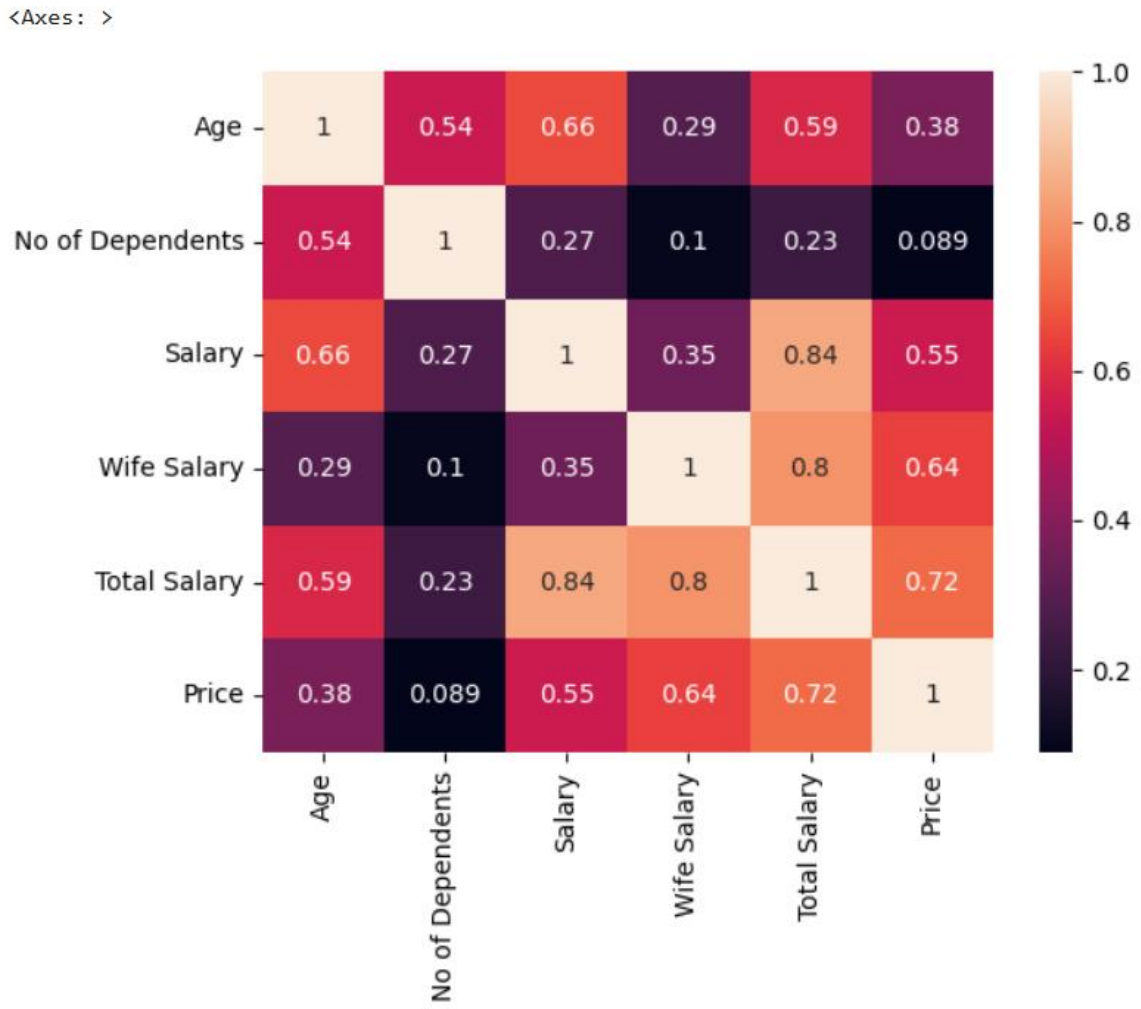
## Salary:

Different demographic has different people of different salaries. This is the main thing we should consider while segmenting the market based on 4-wheeler and 2-wheeler automobiles as higher salaried people are highly likely to purchase a 4-wheeler.

To further see that what are the most important factors which affect the market of automobile, below is a heatmap and a continuous distribution-plot.




Here we can compare all variables with all the other variables.



# K-Means Clustering:
# Clustering:

Clustering is a data science technique in machine learning that groups similar rows in a data set. After running a clustering technique, a new column appears in the data set to indicate the group each row of data fits into best. Since rows of data, or data points, often represent people, financial transactions, documents or other important entities, these groups tend to form clusters of similar entities that have several kinds of real-world applications.

Since clustering generally groups input data, it can be very creative and flexible. Clustering can be used for data exploration and preprocessing, as well as specific applications. From a technical perspective, common applications of clustering include the following:

- Data visualization. Data often contains natural groups or segments, and clustering should be able to find them. Visualizing clusters can be a highly informative data analysis approach.
- Prototypes. Prototypes are data points that represent many other points and help explain data and models. If a cluster represents a large market segment, then the data point at the cluster centre -- or cluster centroid -- is the prototypical member of that market segment.
- Sampling. Since clustering can define groups in the data, clusters can be used to create different types of data samples. Drawing an equal number of data points from each cluster in a data set, for example, can create a balanced sample of the population represented by that data set.
- Segments for models. Sometimes the predictive performance of supervised models -- regression, decision tree and neural networks for example -- can be improved by using the information learned from unsupervised approaches such as clusters. Data scientists might include clusters as inputs to other models or build separate models for each cluster.

# K Means Algorithm:

K Means algorithm is an iterative algorithm that tries to partition the dataset into pre-defined distinct non-overlapping subgroups (clusters) where each data point belongs to only one group. It tries to make the intra-cluster data points as similar as possible while also keeping the clusters as different (far) as possible. It assigns data points to a cluster such that the sum of the squared distance between the data points and the cluster's centroid (arithmetic mean of all the data points that

belong to that cluster) is at the minimum. The less variation we have within clusters, the more homogeneous (similar) the data points are within the same cluster. The way k means algorithm works is as follows:

1. Specify number of clusters *K*.
2. Initialize centroids by first shuffling the dataset and then randomly selecting *K* data points for the centroids without replacement.
3. Keep iterating until there is no change to the centroids. i.e. assignment of data points to clusters isn't changing.

The approach k-means follows to solve the problem is expectation maximization The E-step is assigning the data points to the closest cluster. The M-step is computing the centroid of each cluster. Below is a breakdown of how we can solve it mathematically.

The working of the K-Means algorithm is explained in the below steps:

Step-1: Select the number K to decide the number of clusters.
Step-2: Select random K points or centroids. (It can be other from the input dataset).
Step-3: Assign each data point to their closest centroid, which will form the predefined K clusters.
Step-4: Calculate the variance and place a new centroid of each cluster.
Step-5: Repeat the third steps, which means reassign each datapoint to the new closest centroid of each cluster.
Step-6: If any reassignment occurs, then go to step-4 else go to FINISH.
Step-7: The model is ready.

Applications:

K means algorithm is very popular and used in a variety of applications such as market
segmentation, document clustering, image segmentation and image compression, etc. The
goal usually when we undergo a cluster analysis is either:

1. Get a meaningful intuition of the structure of the data we're dealing with.
2. Cluster-then-predict where different models will be built for different subgroups if we
believe there is a wide variation in the behaviours of different subgroups.

Packages/ Tools used:

1. NumPy: To calculate various calculations related to arrays.
2. Pandas: To read or load the datasets.

We have considered a dataset which contains data regarding the spending habits of people regarding type of cars etc.
With respect to the above data the population can be segmented on the basis of age, marital status and salary, each of these segments should be targeted separately as they have different requirements.

```
df= pd.read_csv("E:\\Projects\\internship\\Indian automoble buying behavour 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 |

# Data Pre-processing:

[6]:
```
from sklearn.preprocessing import LabelEncoder
Loan','Wife Working']] = df[['Profession', 'Marrital Status', 'Education', 'Personal loan','House Loan','Wife Working']].apply(LabelEncoder().fit_transform)
df.head()
```

[6]:

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

[12]:
```
df_Price=df.drop('Make',axis=1)
```

[ ]:
```
df_Price
```

[8]:
```
df_car = df.drop('Price',axis=1)
df_car.head()
```

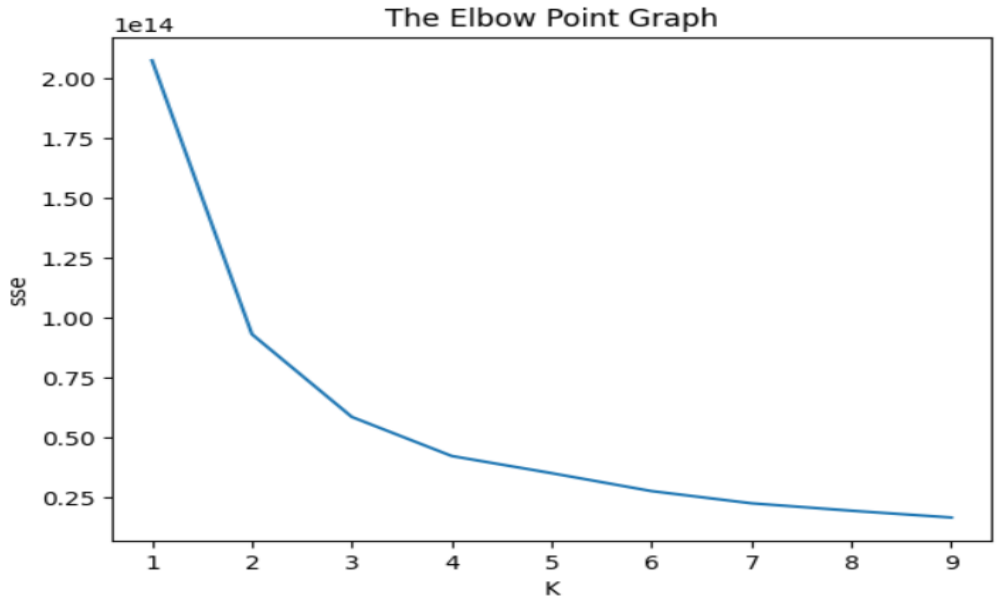
After the data is pre-processed, we can proceed with segmentation of population.
We calculate the number of clusters by using the elbow method.

:
```
from sklearn.cluster import KMeans
```

:
```
k_range = range(1,10)
#sum of squared error
sse = []
for k in k_range:
  km = KMeans(n_clusters=k)
  km.fit(df_Price)
  sse.append(km.inertia_)
```

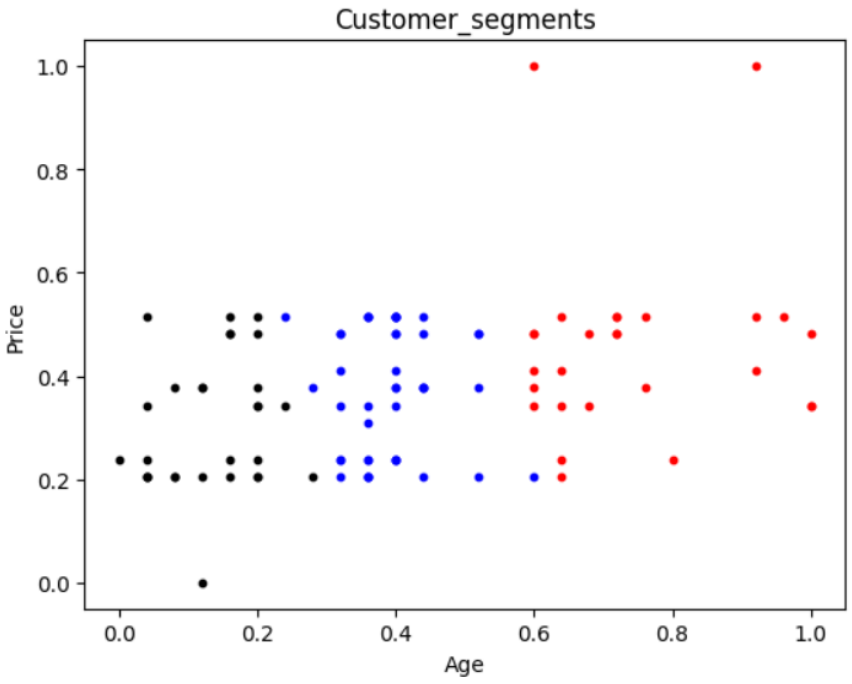
[14]:
```
plt.title('The Elbow Point Graph')
plt.xlabel('K')
plt.ylabel('sse')
plt.plot(k_range,sse)
```

[14]:
```
[<matplotlib.lines.Line2D at 0x133d21066a0>]
```



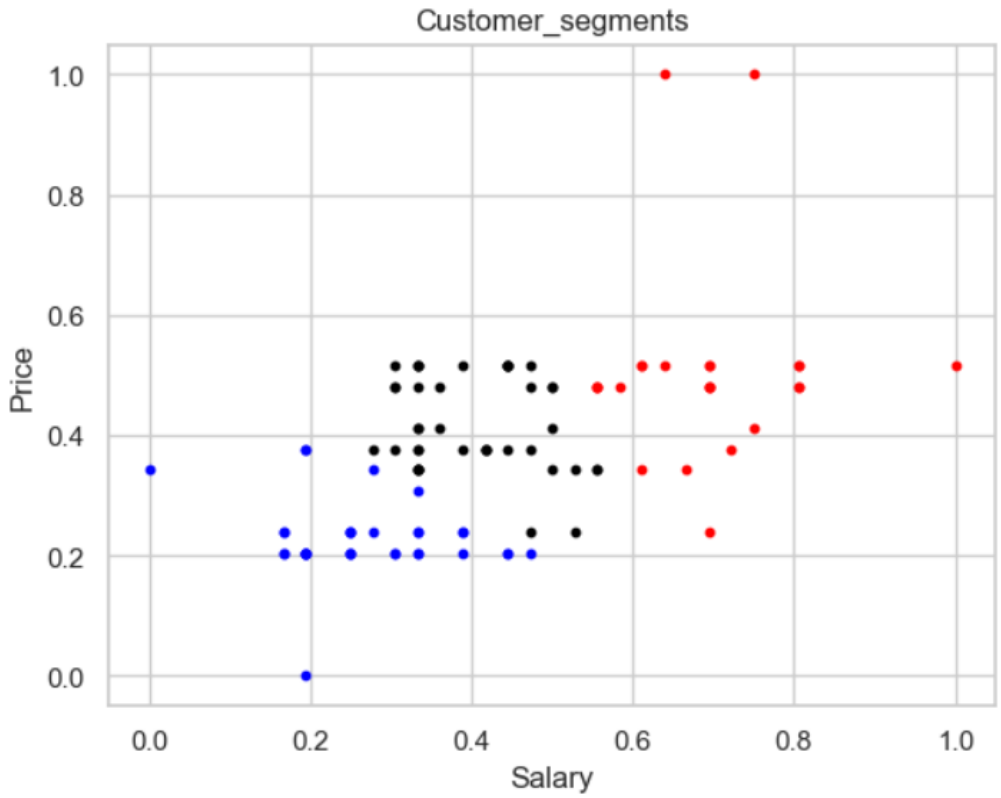

We get the number of clusters as 3.
The clustering of age vs price is as follows. As we can see that as age increases the price of the car also increases. This can be justifying as older people tend to be in high paying jobs.

[21]:
```
clus = df_Price.loc[:,["Age","Price"]].values
kmeans = KMeans(n_clusters=3, init='k-means++')
Y = kmeans.fit_predict(clus)
plotseg(clus, Y, ["Age","Price"])
```



Next, we compare salary and price, as we can guess the higher the salary the higher the price of the car is.

```
clus = df_Price.loc[:,["Salary","Price"]].values
kmeans = KMeans(n_clusters=3, init='k-means++')
Y = kmeans.fit_predict(clus)
plotseg(clus, Y, ["Salary","Price"])
```




## Observations:

• We found that 3 clusters groups can be formed from the data given (based on price of the vehicle) using the K-Means algorithm and Elbow Point Method

• While looking at the patterns, we find that as the Age increases the cost of the vehicle also rises.

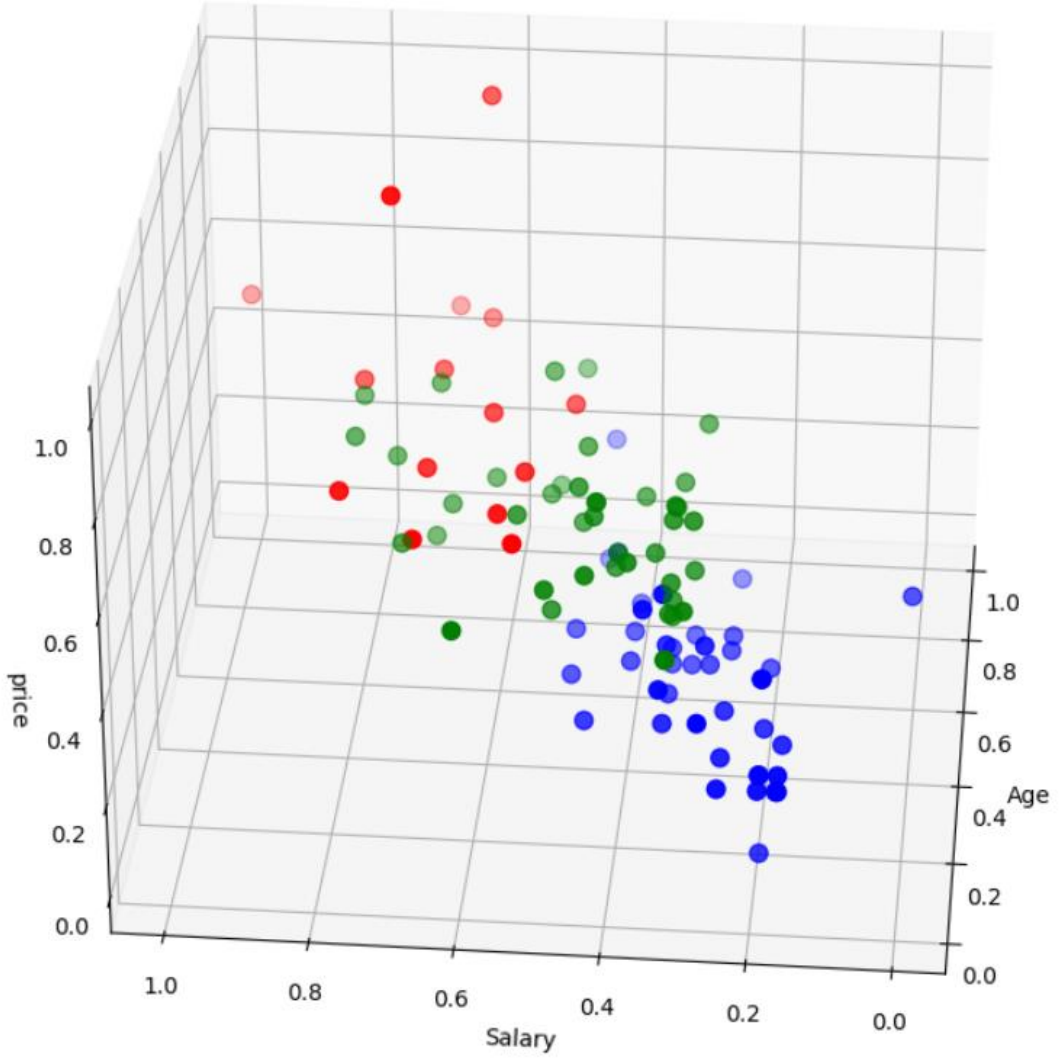
• Also, amount spent on the car goes up with the number of dependents. The same is true for salary field too.

• The visualizations provided gives a clear idea about the patterns.

Next, we have 3D plots to see how variables influence each other when they are not taken out of the context.
The 3D plot is between age, salary and price.

```
labels = clustering_kmeans.labels_
fig = plt.figure(figsize=(20,10))

ax = fig.add_subplot(111, projection='3d')
ax.scatter(df_Price.Age[labels == 0], df_Price["Salary"][labels == 0], df_Price["Price"][labels == 0],  c='blue', s=60)
ax.scatter(df_Price.Age[labels == 1], df_Price["Salary"][labels == 1], df_Price["Price"][labels == 1],  c='red', s=60)
ax.scatter(df_Price.Age[labels == 2], df_Price["Salary"][labels == 2], df_Price["Price"][labels == 2],  c='green', s=60)
ax.view_init(30, 185)
plt.xlabel("Age")
plt.ylabel("Salary")
ax.set_zlabel('price')
plt.show()
```




## Target Segment:

As the trend suggests, higher salaried, old people tend to buy cars in the range 10-20L. However, the sharp rise in awareness in younger segments about climate change influences their decision to buy electric cars. So, the recommended segment is the mid-tier, with significant marketing about the pros of electric vehicles to the environment is required.

# Marketing Mix:

A marketing mix includes multiple areas of focus as part of a comprehensive marketing plan. The term often refers to a common classification that began as the four Ps: product, price, placement, and promotion.

Effective marketing touches on a broad range of areas as opposed to fixating on one message. Doing so helps reach a wider audience, and by keeping the four Ps in mind, marketing professionals are better able to maintain focus on the things that really matter. Focusing on a marketing mix helps organizations make strategic decisions when launching new products or revising existing products.

## 4Ps of Marketing Mix:

The four Ps classification for developing an effective marketing strategy was first introduced in 1960 by marketing professor and author E. Jerome McCarthy.1

E. Jerome McCarthy. "Basic Marketing: A Managerial Approach," Page vi. R.D. Irwin, 1960.

It was published in the book entitled *Basic Marketing: A Managerial Approach*. Depending on the industry and the target of the marketing plan, marketing managers may take various approaches to each of the four Ps. Each element can be examined independently, but in practice, they often are dependent on one another.

## Product :

This represents an item or service designed to satisfy customer needs and wants. To effectively market a product or service, it's important to identify what differentiates it from competing products or services. It's also important to determine if other products or services can be marketed in conjunction with it.

## Price:

The sale price of the product reflects what consumers are willing to pay for it. Marketing professionals need to consider costs related to research and development, manufacturing, marketing, and distribution—otherwise known as cost-based pricing. Pricing based primarily on consumers' perceived quality or value is known as value-based pricing.

## Placement

When determining areas of distribution, it's important to consider the type of product sold. Basic consumer products, such as paper goods, often are readily available in many stores. Premium consumer products, however, typically are available only in select stores.

## Promotion

Joint marketing campaigns are called a promotional mix. Activities might include advertising, sales promotion, personal selling, and public relations. One key consideration is the budget assigned to the marketing mix. Marketing professionals carefully construct a message that often incorporates details from the other three Ps when trying to reach their target audience. Determination of the best mediums to communicate the message and decisions about the frequency of the communication also are important.

## Purpose of a Marketing Mix:

At its core, a marketing mix is focused on promoting a product or service to generate revenue for a company. On the whole, it integrates key marketing strategies that create brand awareness, build customer loyalty, and drive product sales.

## References:


- https://jmkresearch.com/annual-india-ev-report-card-fy2023/
- https://jmkresearch.com/electric-vehicles-published-reports/electric-2-wheeler-market-india/
- https://indiaesa.info/resources
- https://www.cbre.co.in/insights/reports/electric-vehicles-in-india-the-new-wheels-on-the-roads
- https://economictimes.indiatimes.com/industry/renewables/time-for-india-to-move-into-top-gear-with-an-eye-on-2030-ev-public-infra-goal/articleshow/106608886.cms?from=mdr
- https://www.investopedia.com/terms/m/marketing-mix.asp


## GitHub:

- https://github.com/shubhendersarowa/Marketsegmentation/blob/main/EV%20Market%20Analysis.ipynb