EV MARKET SEGMENTATION ANALYSIS

BY

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Abstract:

An **electric vehicle (EV)** is a vehicle that uses one or more electric motors for propulsion. It can be powered by a collector system, with electricity from extravehicular sources, or it can be powered autonomously by a battery (sometimes charged by solar panels, or by converting fuel to electricity using fuel cells or a generator).[1] EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft. 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.

This analysis explores the electric vehicle (EV) market segmentation through demographic, psychographic, and behavioral lenses, aiming to enhance targeted marketing strategies. Demographic segmentation examines variations in consumer preferences based on age, income, and gender, revealing distinct groups such as young professionals, families, and luxury seekers. Psychographic segmentation delves into lifestyle choices, values, and beliefs, identifying eco-conscious consumers, tech enthusiasts, and those seeking social status through brand loyalty. Behavioral segmentation investigates purchase behaviors and usage patterns, distinguishing between early adopters, cost-conscious buyers, and frequent travelers. By integrating these segmentation approaches, the analysis provides a nuanced understanding of the EV market, offering actionable insights for manufacturers to tailor their products and marketing efforts to meet the diverse needs of their target audience. This comprehensive segmentation framework underscores the importance of addressing consumer diversity to drive successful EV adoption and market growth.

Market Overview

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.

Our report mainly focuses on the Indian Electric Vehicle Market segmented by Vehicle Type. However, accessibility to Power Sources for Electric Vehicles affects the market and would be slightly discussed in the report. The Indian Electric Vehicle Market was valued at USD 5 billion in 2020, and it is expected to reach USD 47 billion by 2026, registering a compound annual growth rate (CAGR) of above 44% during the forecast period (2021-2026). 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 country. 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.

The Indian EV market is consolidated with the presence of major players in the market, owing to cheap and readily available manpower. However, established players in the market are introducing new models to gain a competitive edge over other players. The startups are expanding their presence by raising funds from investors and tapping into new and unexplored cities. Companies are investing a tremendous amount in R&D and launching new models to mark their presence in the market.

Market Challenges:

The electric vehicle (EV) market faces several challenges that need to be addressed for it to grow successfully. Firstly, the high initial cost of EVs is a significant barrier for many buyers, even though they are cheaper to run in the long term. Many people worry about "range anxiety," which is the fear that their EV will run out of power before they can recharge it. This concern is linked to the lack of widespread, reliable charging stations, especially in rural areas. Although battery technology is improving, concerns about battery life, the high cost of replacements, and environmental impacts of battery disposal remain. The limited variety of EV models available also makes it hard for some consumers to find a suitable option. Charging an EV still takes longer than filling up a gas tank, which can be inconvenient. Moreover, if the electricity used to charge EVs comes from non-renewable sources, the environmental benefits are reduced. Many consumers still have misconceptions about EV performance and costs, requiring better education and awareness. The industry also faces supply chain issues, particularly for essential battery materials like lithium and cobalt. Lastly, changing government policies can create uncertainty, affecting both manufacturers and consumers. Addressing these challenges will require joint efforts from the government, industry, and consumers to improve technology, expand infrastructure, and promote EV adoption.

Competitive Landscape:

The Indian EV market is consolidated with the presence of major players in the market, owing to cheap and readily available manpower. However, established players in the market are introducing new models to gain a competitive edge over other players. For instance,

- In 2019, Tata Motors announced its EV technology ZIPTRON, which will power all future Tata electric cars. It consists of a highly efficient permanent magnet AC motor, providing excellent performance. It will also offer a dust and waterproof battery system.
- In January 2020, Morris Garages Motor India launched its first electric internet SUV, and the car has a driving range of 340 km on a full charge.

The startups are expanding their presence by raising funds from investors and tapping into new and unexplored cities. Companies are investing a tremendous amount in R&D and launching new models to mark their presence in the market.

Market Segmentation:

As established in the beginning of this report, the Electric Vehicle market in India has just started to gain momentum, there are not a lot of statistics to provide an insight on Electric Vehicles consumers. So, we changed our approach and we have collected consumer data on existing fuel-based vehicles and we would perform simple behavioural and demographic analysis on this data and try to understand the market. Next, for geographic analysis we have used some state-wise statistics to understand which region is most likely to be a good market for which type of Electric Vehicle.

Following this analysis, we can understand important attributes of the segment we aim to target and use them for market segmentation using model-based algorithms.

Data Collection:

Data was extracted from the following website mentioned below for EV market segmentation Link

for data extraction:

https://drive.google.com/drive/folders/137KIMhwpB1bx5zx0hTaa486bEKe3kXaB?usp=share_link

Columns explanations:

1. 'Age' tells us the age of the person.

2. 'Profession' tells us their profession salaried / Business.

3. 'Marital statuses tells us married/single.

4.'Education' tells us Post graduate/Under graduate.

5.'No of Dependents tells us no. of persons dependent in a family.

6.'Personal loan' tells us whether the person has personal loan or not.

7.'House loan' tells us whether the person has house loan or not.

8.'Wife working' tells us the person's wife is working.

9.'Salary' tells us the person's salary.

10.'wife salary' tells us the salary of wife who is working.

11.'Total salary' tells us the sum of salary.

12. 'Make' tells us the various electric vehicles.

13.'Price' tells us the vehicles price.

Vehicle Market Data:

Indian automobile buying behaviour study 1.0.csv: This dataset Indian Consumers Automobiles (Cars) buying behaviour. By observing different brands and their sales pattern, we can predict customer demand and bring up new products that would reach customer satisfaction.

In [2]:
```
# Importing consumer buying behavior study dataset
df = pd.read_csv(r"C:\Users\Priya\Downloads\Indian automoble buying behavour study 1.0.csv")
df.head()
```

Out[2]:

	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

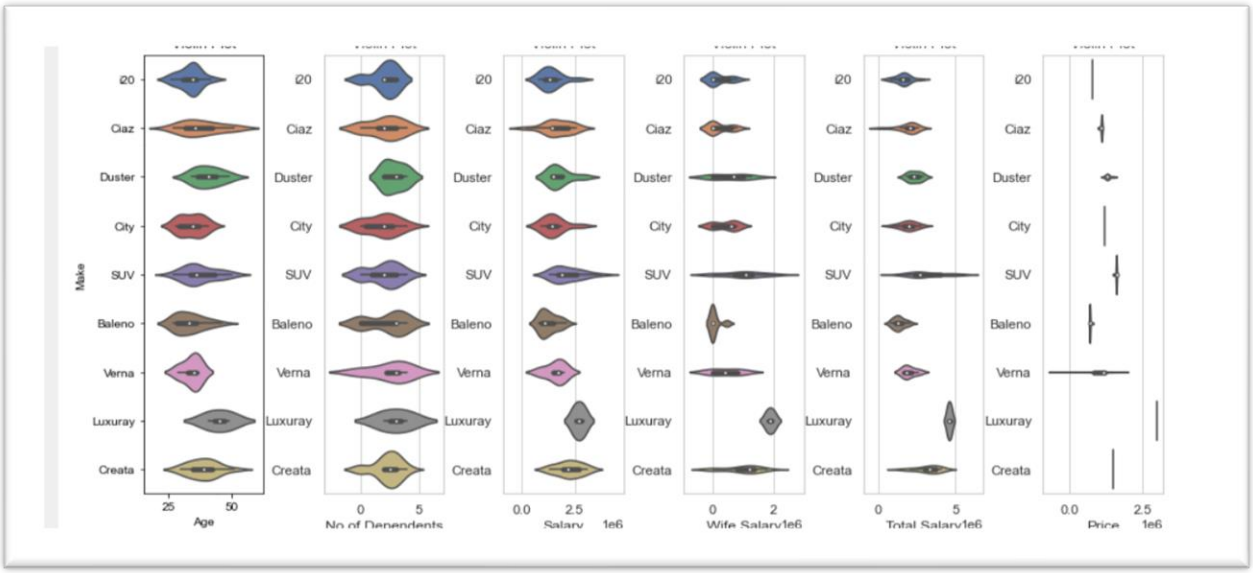
Behavioral And Psychographic Analysis:

The EV market is influenced by diverse consumer behaviors and lifestyles. Early adopters seek the latest tech, while cost-conscious buyers focus on long-term savings. Daily commuters need efficient city cars, long-distance travelers want extended range and fast charging, and occasional users prefer affordable options. Eco-conscious consumers prioritize sustainability, tech enthusiasts desire advanced features, and luxury seekers aim for premium models. People also buy EVs for environmental reasons and social status. Adventurers need rugged EVs, urban dwellers prefer compact cars, and families seek spacious, safe vehicles. Understanding these factors helps manufacturers tailor their products and marketing strategies.

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 dataset we have used is a survey of people who own particular brands of fuel-based vehicles and it contains some basic information such as their age, salary, loan status, marital status, number of dependents, education, occupation and the make of their car and its price.

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.



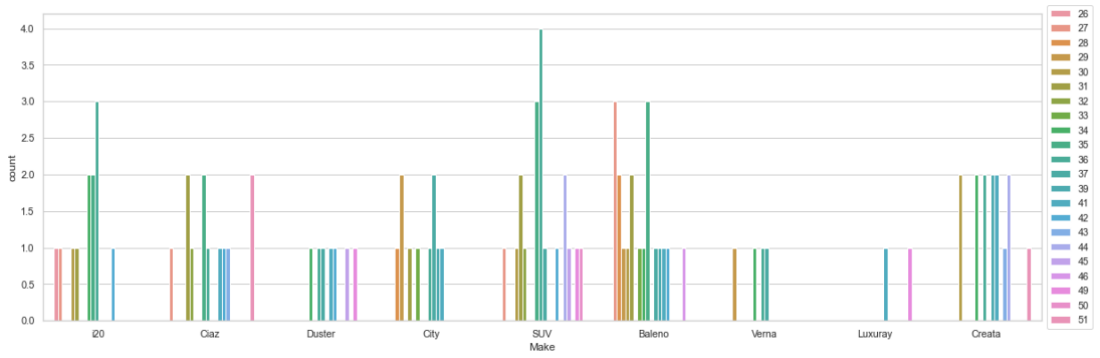
Demographic Analysis:

Demographic segmentation is based on the assumption that consumers in the same demographic group will have similar needs. Demographic customer segmentation helps organizations to develop market outreach for better marketing strategies. When an organization looks at the demographic segmentation, it focuses on the people who are most likely to buy a product. This helps in identifying the target market. We have used the same dataset we used for behavioural and psychographic analysis and the following plots help us understand the socio-demographic structure of the market:

• Plot for Relationship between consumers age and the vehicles they purchase

```
In [13]: plt.figure(figsize=(20,6))
         sns.countplot(x="Make", data=df, hue="Age")
         plt.legend(loc='center left', bbox_to_anchor=(1, 0.5))
```

```
Out[13]: <matplotlib.legend.Legend at 0x20736def070>
```

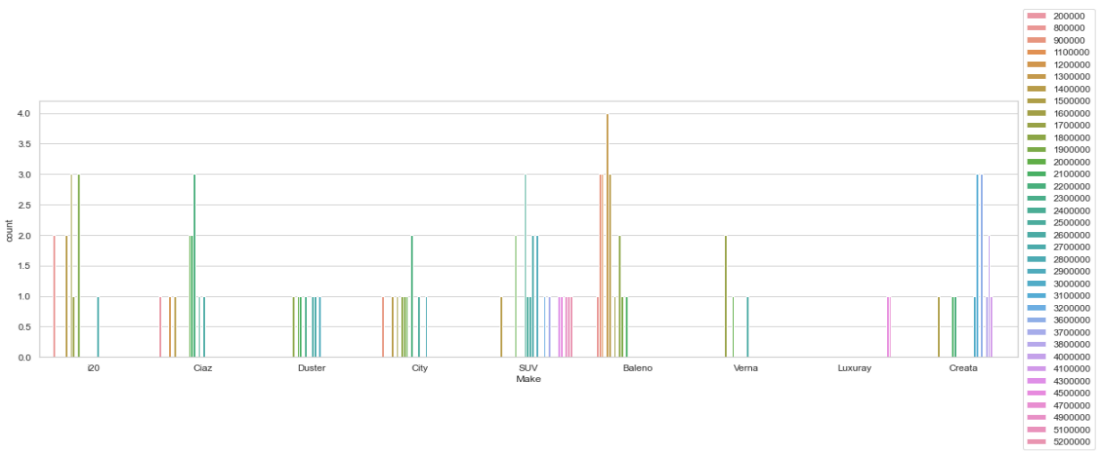


Observation: People in their 30s including early 40s and late 20s tend to buy electric vehicle comparatively than others.

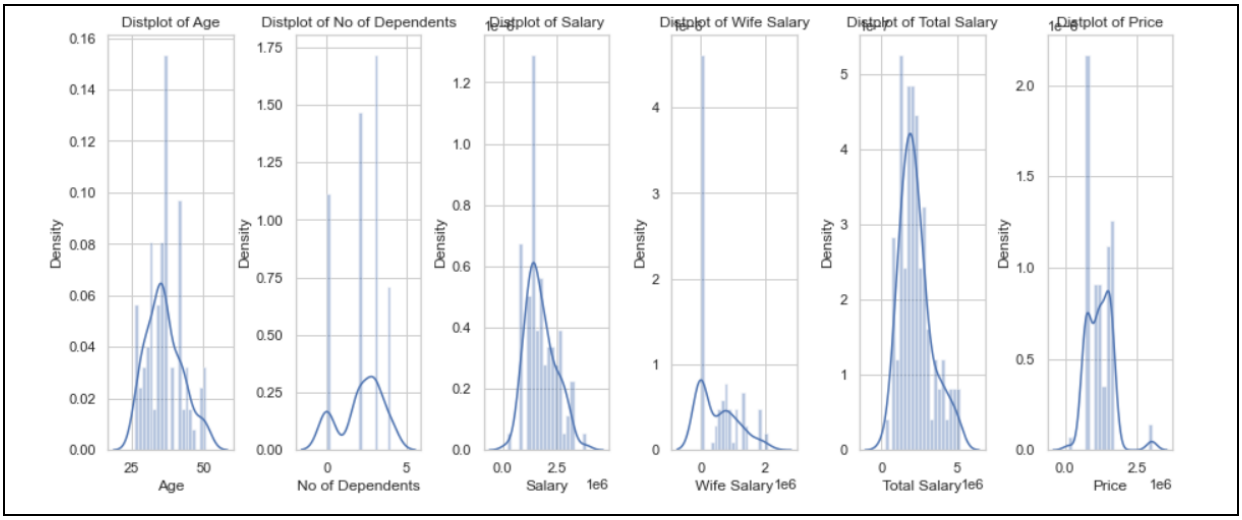
• Plot for Relation between consumers total salary and the vehicles they purchase

```
In [15]: plt.figure(figsize=(20,6))
         sns.countplot(x="Make", data=df, hue="Total Salary")
         plt.legend(loc='center left', bbox_to_anchor=(1, 0.5))
```

```
Out[15]: <matplotlib.legend.Legend at 0x2073693e610>
```



Observation: From the above plot we can analyse that salary is directly proportional to type of Electric vehicle a person tends to buy.

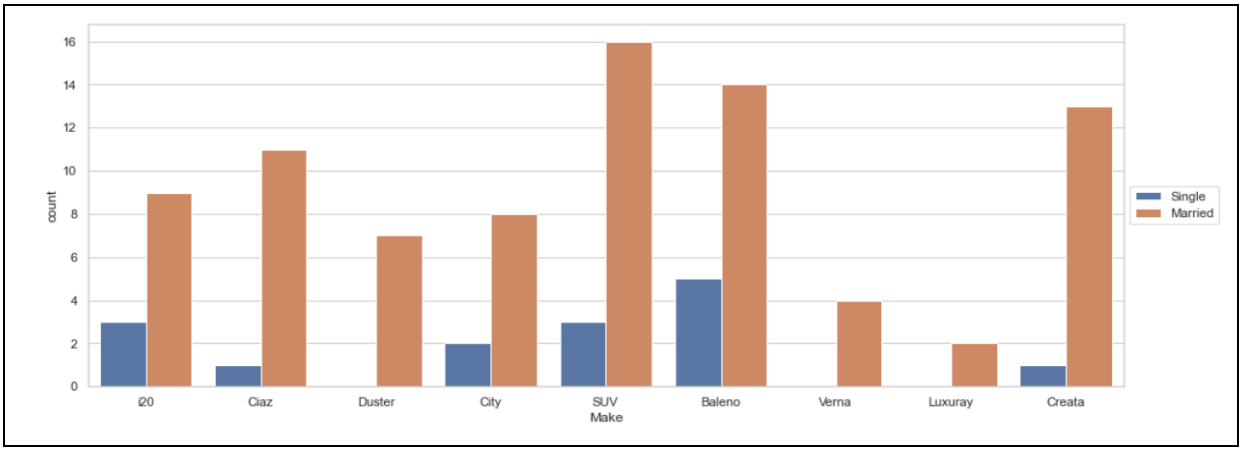


Observations from the distribution plot:

- People between the age group of 25 to 50 constitute most of the consumer market.
- Most people having an average total salary of around 30 lakh INR tend to purchase vehicles more.
- 3. Most people spent around 10 to 20 lakh INR for vehicles.

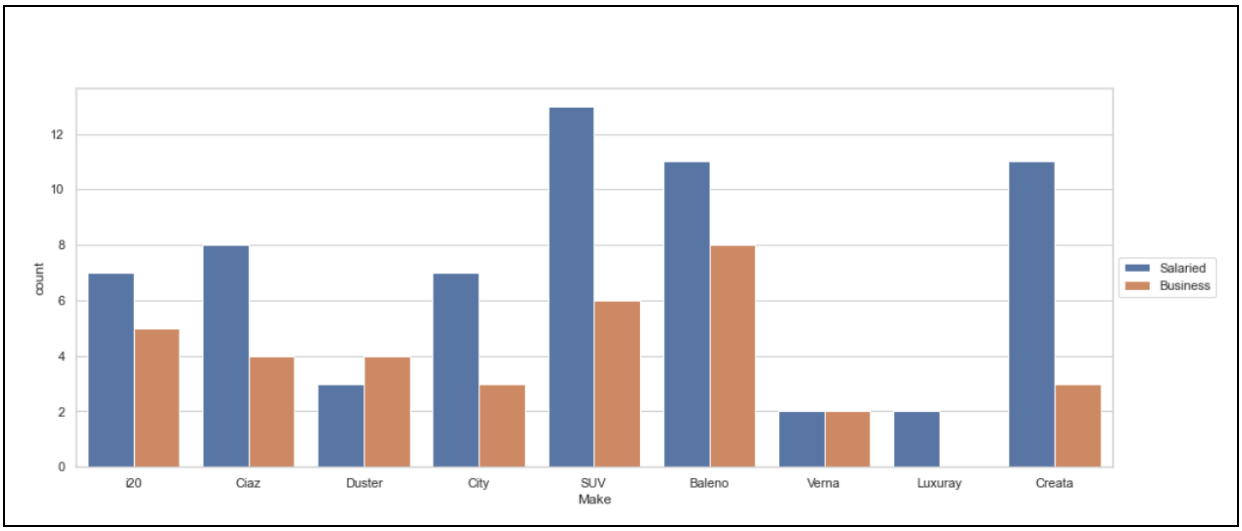
Dependency of make and price of vehicles on other descriptor variables:

• Plot the Relation between consumer's marital status and the vehicles they purchase.



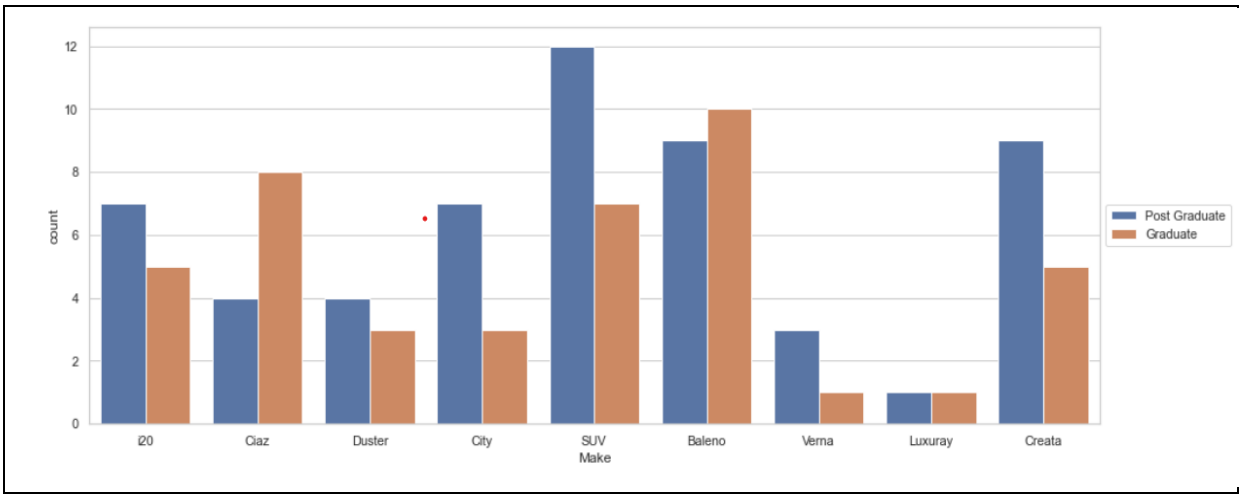
Observation: According to the data it is notable that the married persons are more likely to purchase an electric vehicle when compared to a single person.

• Plot for Relation between consumers' Profession and the vehicles they purchase.



Observation: Here it is notable that the salaried profession purchase EV more likely than Business profession.

• Plot for Relation between consumers' Education and the vehicles they purchase.



Observation: According to data given Both graduates and post-graduates have equal probability of buying electric vehicles.

We will visualize the dataset to gain knowledge on customer preferences.

Observations:

Age: Younger consumers typically choose less expensive vehicles due to:

- Lower income levels.
- Fewer financial responsibilities and dependents.
- Single status or minimal household obligations.

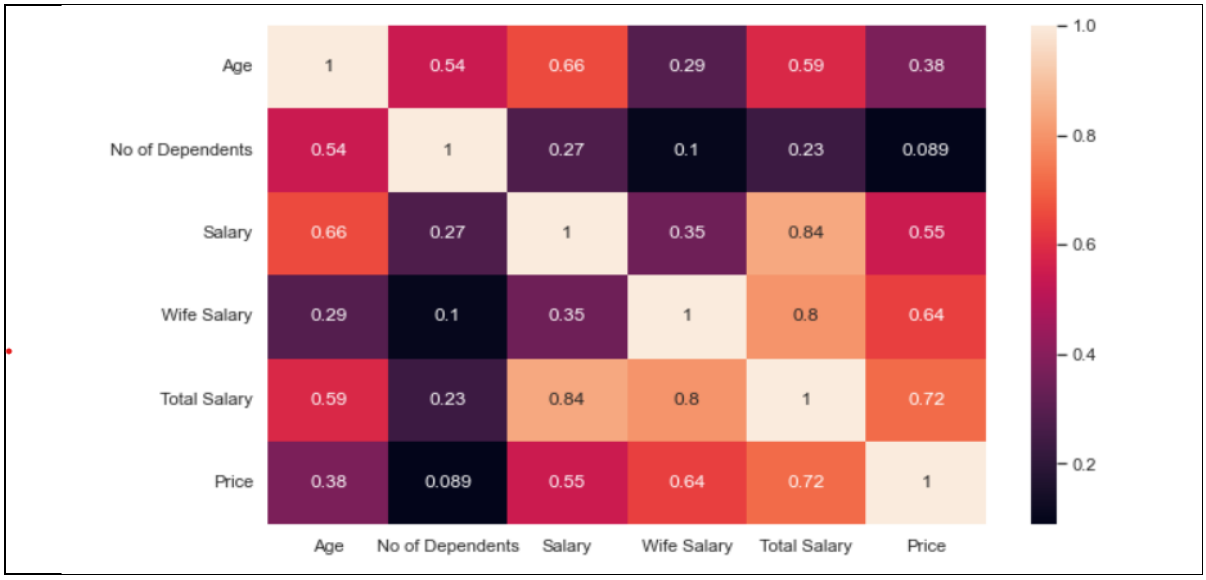
Number of Dependents: Consumers with more dependents often prefer vehicles with:

- More seating capacity, such as SUVs.
- Accommodation for family needs and activities.

Salary: Analysis of normalized salary plots alongside vehicle prices reveals:

- A direct correlation where median salary matches median vehicle price.
- Demonstrates consumers' tendency to purchase vehicles within their financial means.

• CORRELATION PLOT:



This correlation plot can clearly convey the attributes that affects the buying preference of any person.

Approaches Used for Segmentation

To perform market segmentation, we are using the population behavioural study where 100 people out of the entire population are selected and data relevant to our goal which is to know about the automobile purchase capability is noted. Since we are trying to find the ideal target segment for market penetration, we will classify the market into various segments. There are 2 general ways for classification: common sense classification and data-driven classification. Here we will be implementing one of the data-driven classification (i.e., KMeans Clustering).

Algorithm:

K-means clustering: K-means clustering is a type of unsupervised learning, which is used when you have unlabelled data (i.e., data without defined categories or groups). The goal of this algorithm is to find groups in the data, with the number of groups represented by the variable K. The algorithm works iteratively to assign each data point to one of K groups based on the features that are provided. Data points are clustered based on feature similarity.

The results of the K-means clustering algorithm are:

- The centroids of the K clusters, which can be used to label new data.
- Labels for the training data (each data point is assigned to a single cluster) the ‘means’ in the K-means refers to averaging of the data; that is, finding the centroid.

Code Implementation:

Github Link:

https://github.com/priya2928/Feynn-Labs-Projects/blob/main/Electric%20Vehicle%20Market%20Segmentation.ipynb**Model**

Deployment:

Initially we are trying to find the optimal K value using the Elbow Method wherein we will be finding the Within Cluster Sum of Square (WCSS) and try to find the point where it rapidly decreases which makes the graph look like an “elbow” there. The K value corresponding to that point is the optimal K value. After looking into the plot, we can find that there are 2 points at which elbows are formed (which can be seen with the slight bent at K=3 and K=5).

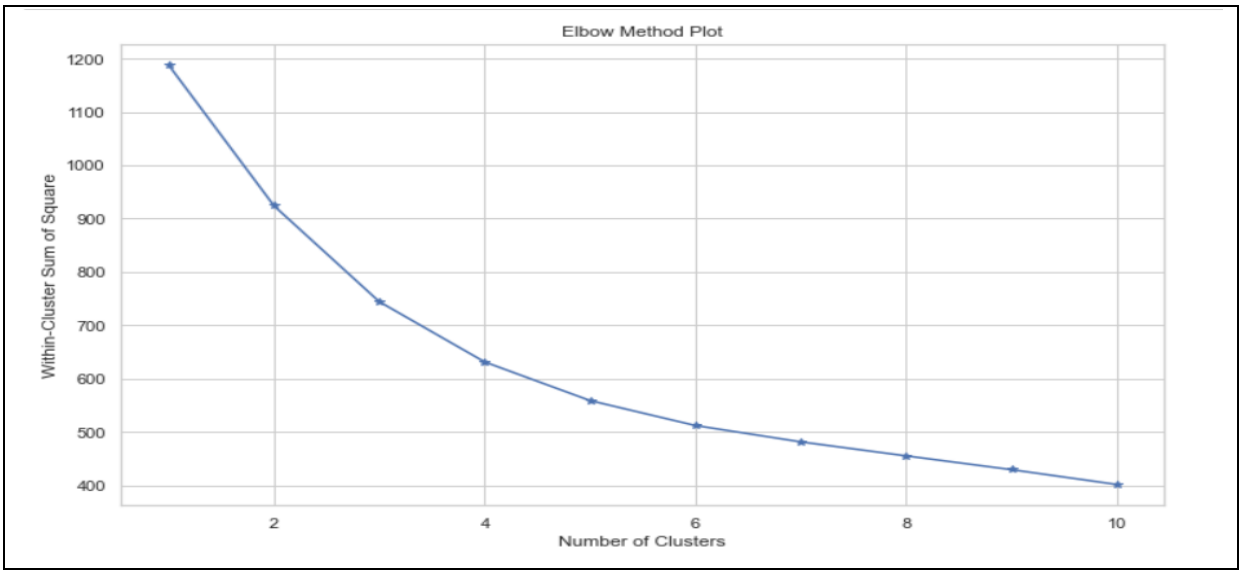
After finding the possible optimal K value, we will try to find the K value which provides us with the right clustering. Therefore, we will try to train K-Means Clustering by taking K = 3 and K = 5.

```
In [39]: wcss = []

         for i in range(1, 11):
             kmeans = KMeans(n_clusters = i, init = 'k-means++',
                             max_iter = 300, n_init = 10,random_state = 0)
             kmeans.fit(X_scaled)
             wcss.append(kmeans.inertia_)
```

```
In [40]: plt.plot(range(1, 11), wcss)
         plt.title('Elbow Method Plot')
         plt.xlabel('Number of Clusters')
         plt.ylabel('Within-Cluster Sum of Square') # Within cluster sum of squares
         plt.tight_layout()
         plt.show()
```

After looking into the plot, we can find that there are 2 points at which elbows are formed (which can be seen with the slight bent at K=3 and K=5). After finding the possible optimal K value, we will try to find the K value which provides us with the right clustering.



Therefore, we will try to train K-Means Clustering by taking K = 3 and K = 5.

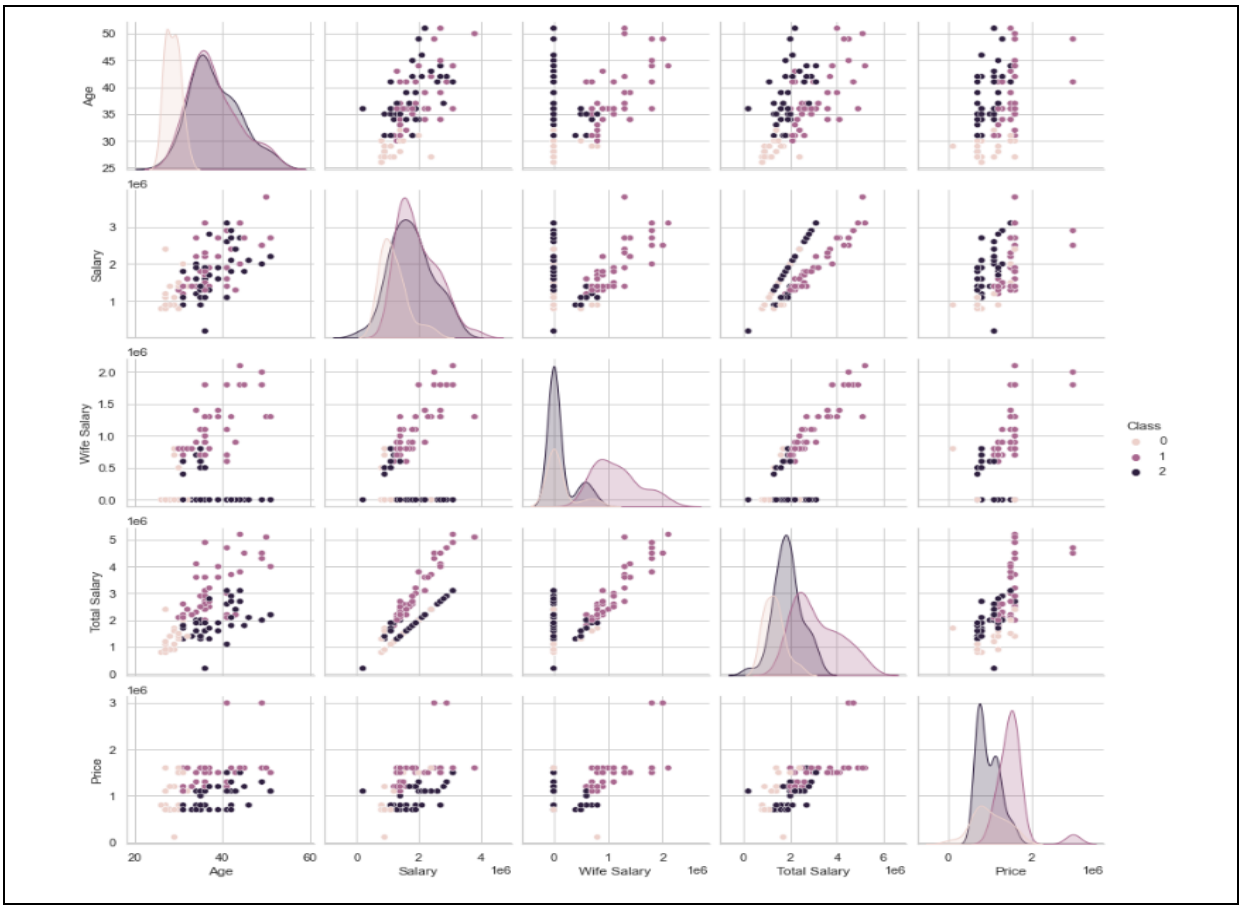
```
In [62]: kmeans = KMeans(n_clusters = 3, init = 'k-means++',
                         max_iter = 300, n_init = 10,random_state = 42)
         kmeans.fit(X_scaled)

Out[62]: KMeans(n_clusters=3, random_state=42)
```

```
In [114]: kmeans1 = KMeans(n_clusters = 5, init = 'k-means++',
                           max_iter = 300, n_init = 10,random_state = 42)
          kmeans1.fit(X_scaled)

Out[114]: KMeans(n_clusters=5, random_state=42)
```

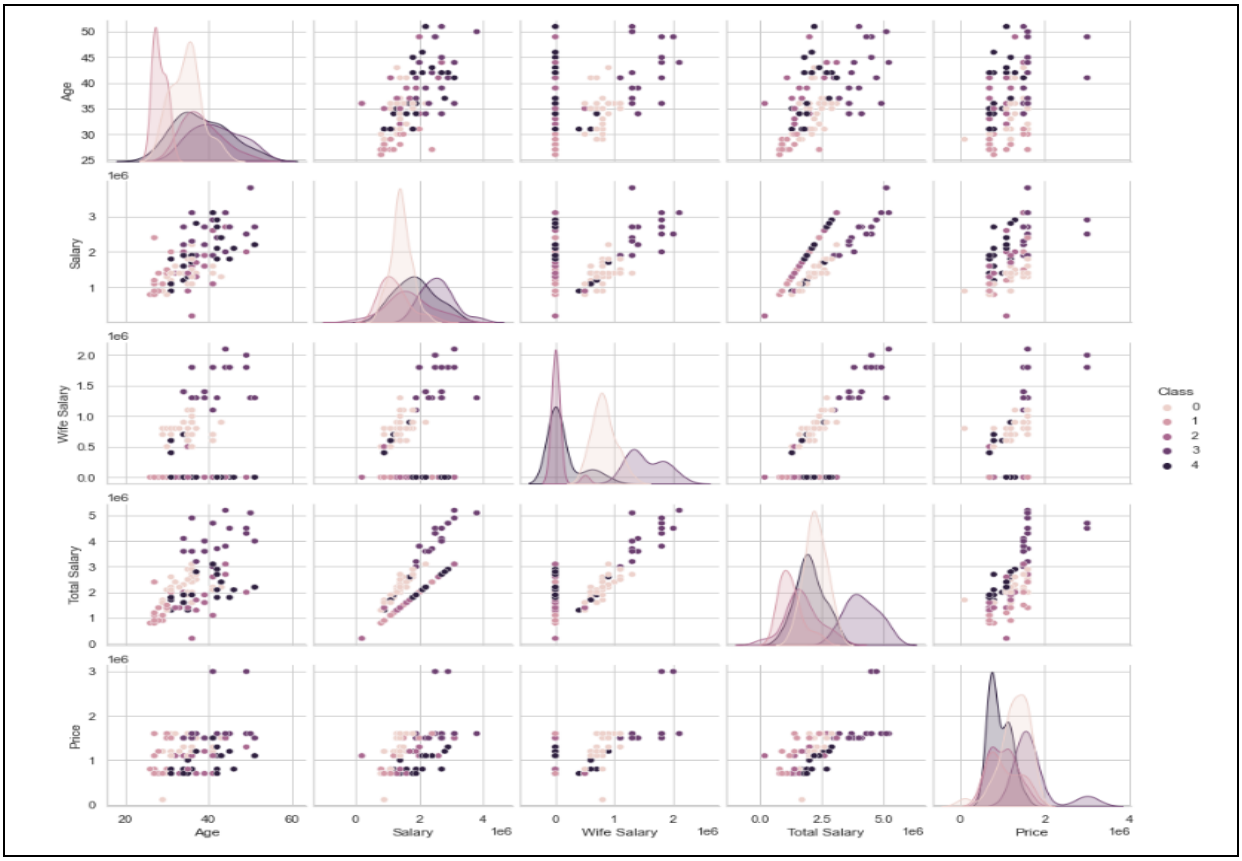
From the behavioural, psychographic, geographic and demographic analysis, we were able to see some attributes having an impact in the way of grouping consumers. However, while looking into the clustered dataset, we were able to find 5 attributes that contributed most to the clustering (i.e., Age, Salary, Wife Salary, Total Salary, and Price). This can be seen in the pair plot done below for both K=3 and K=5 conditions.



K = 3

In this case, we are able to see the dataset being clustered naturally. From here we are also able to see that the model is trying to cluster people on the basis of their total income wherein:

- Class 1 are the group of people who have Total Salary close to Salary (husband's salary)
- Class 2 is the group of people who have Total Salary higher than Salary (husband's salary)
- Class 0 are the group of people who have Total Salary close to Salary (husband's salary) but their total salary is relatively less compared to other people.



K = 5

In this case, we are able to see the dataset is being clustered into very small groups of people that the model recognizes as a trend which is however not the case. We don't want to lose the homogeneity between our segments, therefore, going with K=3 will give the best results in the clustering analysis that is being done.

Target Segment

The younger generation shows a strong inclination towards adopting new technologies, including Electric Vehicles (EVs), driven by awareness of environmental benefits and a desire to contribute positively. However, our findings indicate that younger consumers often opt for more affordable vehicle options, posing a challenge for EV adoption due to their higher initial costs. To address this, targeting consumers aged 30 to 40 years who are financially stable and open to embracing new technologies like EVs is recommended. This demographic, typically residing in urban areas with established infrastructure and a higher level of technology awareness, shows greater potential for EV adoption. Married individuals with dependents are also more likely to prioritize vehicle purchases, making them another viable target segment. Our data highlights that the average salary of vehicle buyers is around 30 lakh, with the majority of automobile purchases falling within the 10-20 lakh range, while purchases of two-wheelers are comparatively lower. These insights underscore the importance of targeting financially capable and technology-forward demographics to drive EV market growth effectively.

Marketing Mix

The marketing mix for Electric Vehicles (EVs) involves a strategic combination of elements tailored to promote and sell these innovative vehicles effectively. Here's a breakdown:

1. Product: EV manufacturers must offer a diverse range of models to cater to different consumer preferences and needs. This includes compact EVs for urban commuters, SUVs for families, and high-performance models for tech enthusiasts. Key features such as range, charging speed, safety, and connectivity options should be highlighted to showcase the benefits over traditional vehicles.

2. Price: Pricing strategies should consider the competitive landscape, production costs, and consumer affordability. Offering competitive pricing or leveraging government incentives and subsidies can make EVs more attractive to potential buyers. Clear pricing tiers and financing options should be communicated to facilitate purchase decisions.

3. Place (Distribution): Establishing a robust distribution network is crucial, focusing on locations with high consumer demand and supportive infrastructure. This includes partnerships with dealerships, online sales channels, and dedicated EV showrooms. Accessible charging stations and home charging solutions should complement the distribution strategy to enhance convenience for customers.

4. Promotion: Effective promotion of EVs involves raising awareness, educating consumers, and building brand credibility:

- **Advertising:** Utilize digital platforms, social media, and traditional channels to reach target demographics. Highlight environmental benefits, cost savings, and technological advancements.
- **Public Relations:** Engage in media campaigns, press releases, and partnerships with environmental organizations or influencers to enhance brand image and credibility.
- **Events and Sponsorships:** Participate in auto shows, sustainability events, and community initiatives to showcase EV technology and interact directly with potential customers.

5. People: Skilled sales personnel and customer service teams play a crucial role in guiding consumers through the EV purchasing process. Training staff to understand EV technology, address customer concerns about range and charging infrastructure, and provide efficient after-sales support enhances customer satisfaction and loyalty.

6. Process: Streamlining the purchasing process and ensuring a seamless customer experience are essential. This includes online booking platforms, transparent pricing, quick financing approvals, and efficient delivery or pickup options. Simplifying the transition to EV ownership and offering comprehensive warranties and maintenance packages further enhance customer confidence.

7. Physical Evidence: Tangible elements such as vehicle design, build quality, and showroom aesthetics contribute to the perceived value and trustworthiness of EV brands. Demonstrating reliability through user testimonials, safety ratings, and environmental certifications reinforces consumer confidence in choosing EVs over conventional vehicles.

By carefully integrating these elements into the marketing mix, EV manufacturers can effectively communicate the benefits of electric mobility, address consumer concerns, and capitalize on growing interest in sustainable transportation solutions.

References:

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- https://samples.mordorintelligence.com/69655/Sample%20-%20India%20Electric%20Vehicles%20Market%20(2020%20-%202025)%20-%20Mordor%20Intelligence.pdf
- https://jmkresearch.com/registered-ev-sales-in-india-in-2020-dropped -by-26-on-yoy-basis/