Market Segmentation

Segmentation analysis for Electric Vehicle Start-up in India's market

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Overview

An electric vehicle (EV) is one that operates on an electric motor, instead of an internal-combustion engine that generates power by burning a mix of fuel and gases. Therefore, such as vehicle is seen as a possible replacement for current-generation automobile, in order to address the issue of rising pollution, global warming, depleting natural resources, etc. Though the concept of electric vehicles has been around for a long time, it has drawn a considerable amount of interest in the past decade amid a rising carbon footprint and other environmental impacts of fuel-based vehicles.

In India, the first concrete decision to incentivise electric vehicles was taken in 2010. According to a Rs 95-crore scheme approved by the Ministry of New and Renewable Energy (MNRE), the government announced a financial incentive for manufacturers for electric vehicles sold in India. The scheme, effective from November 2010, envisaged incentives of up to 20 per cent on ex-factory prices of vehicles, subject to a maximum limit. However, the subsidy scheme was later withdrawn by the MNRE in March 2012.

In 2013, India unveiled the 'National Electric Mobility Mission Plan (NEMMP) 2020' to make a major shift to electric vehicles and to address the issues of national energy security, vehicular pollution and growth of domestic manufacturing capabilities. Though the scheme was to offer subsidies and create supporting infrastructure for e-vehicles, the plan mostly remained on papers. While presenting the Union Budget for 2015-16 in Parliament, then finance minister Arun Jaitley announced faster adoption and manufacturing of electric vehicles (FAME), with an initial outlay of Rs 75 crore. The scheme was announced with an aim to offer incentives for clean-fuel technology cars to boost their sales to up to 7 million vehicles by 2020.

In 2017, Transport Minister Nitin Gadkari made a statement showing India's intent to move to 100 per cent electric cars by 2030. However, the automobile industry raised concerns over the execution of such a plan. The government subsequently diluted the plan from 100 per cent to 30 per cent.

In February 2019, the Union Cabinet cleared a Rs 10,000-crore programme under the FAME-II scheme. This scheme came into force from April 1, 2019. The main objective of the scheme is to encourage a faster adoption of electric and hybrid vehicles by offering upfront incentives on purchase of electric vehicles and also by establishing necessary charging infrastructure for EVs.

India offers the world's largest untapped EV market, especially in the two-wheeler segment. With several automakers rolling out EV vehicles at a rapid pace, the penetration of these vehicles has increased significantly in the past few years. As per a recent study, electric vehicles (EVs) market is expected to be worth around at least ₹475 billion by 2025. The penetration of electric two-wheelers is projected to reach up to 15% by 2025 from 1% currently.

Market Overview

The Indian electric vehicle market was valued at USD 1,434.04 billion in 2021, and it is expected to reach USD 15,397.19 billion by 2027, registering a CAGR of 47.09% during the forecast period (2022-2027).

The COVID-19 pandemic had limited domestically produced electric vehicles due to the shutdown of manufacturing facilities and lockdowns. However, as restrictions eased, EV witnessed optimistic growth as consumers became inclined toward affordable eco-friendly transportation supported by government incentives.

The automotive sector in India is dominated by two-wheelers (scooters, motorbikes) and three-wheelers (autos and rickshaws) that play a significant role in last-mile mobility in the country. Rising government emphasis and focus on private and government players partnership to enhance EV ecosystem in the country. Increasing investments and product launches by major OEMs into the country and their focus on localizing supply chain facilities are expected to create a positive outlook in the market.

Moreover, in India, the level of market maturity also varies according to the state depending on factors, including demographics, income levels, regulatory landscape, and urbanization. For instance, the state of Uttar Pradesh, with one of the lowest urbanization rates, has seen significant uptake of electric two-wheelers. Maharashtra, on the other hand, with a higher urbanization rate, has the highest penetration of electric three-wheelers and passenger cars. Delhi is home to the largest electric commercial vehicle fleet due to a higher demand for electric buses and trucks.

Current Market Trends

Growing Adoption of Electric Buses

The government of India has undertaken multiple initiatives to promote the manufacturing and adoption of electric vehicles in India to reduce emissions pertaining to international conventions and develop e-mobility in the wake of rapid urbanization.

- The National Electric Mobility Mission Plan (NEMMP) and Faster Adoption and Manufacturing of Hybrid & Electric Vehicles in India (FAME I and II) helped create the initial interest and exposure for electric mobility. For instance, in phase two of FAME, the government announced an outlay of USD 1.4 billion through 2022. This phase focuses on the electrification of public and shared transportation through subsidizing 7,090 e-buses, 500,000 electric three-wheelers, 550,000 electric passenger vehicles, and 1,000,000 electric two-wheelers.

To promote the domestic electric vehicle industry, the Indian government has provided tax exemptions and subsidies to EV manufacturers and consumers. As per the phased manufacturing proposal, the government has imposed a 15% customs duty on parts that are used to manufacture electric vehicles and 10% on imported lithium-ion cells. The revised duty under PMP has been proposed from April 2021.

States have also launched policies that support powertrain electrification by stimulating the demand, local manufacturing, research and development (R&D), and infrastructure development. Several states, like Delhi, Kerala, Karnataka, Telangana, and Andhra Pradesh, have formulated their electric vehicle policies, while others are in the process of doing so. For instance,

- According to the Delhi Electric Vehicle Policy 2020, the government plans to have at least 50% e-buses for all new stage carriage buses and aims for 25% of the new vehicles to be electric by 2024. In March 2021, the Delhi government announced its

plans to introduce an interest subvention of up to 5% for electric vehicle (EV) purchases in the state. This initiative has been taken to promote the Delhi government's EV policy offering financial incentives on all categories of e-vehicles, i.e., two-wheelers, three-wheelers, four-wheelers, goods carriers, and electric rickshaws.

- In February 2021, the Delhi government announced a subsidy of INR 30,000 for promoting e-rickshaws as last-mile connectivity in Delhi. This, in turn, has led to the proliferation in their demand in the city, further benefiting the market.

Owing to the above-mentioned instances and developments, rising government initiatives are expected to enhance demand in the market over the forecast period.

India Electric Vehicle (EV) Market, Revenue Share (%), By Vehicle Type, 2021

- Passenger Cars
- Commercial Vehicles
- Two Wheelers
- Three Wheelers
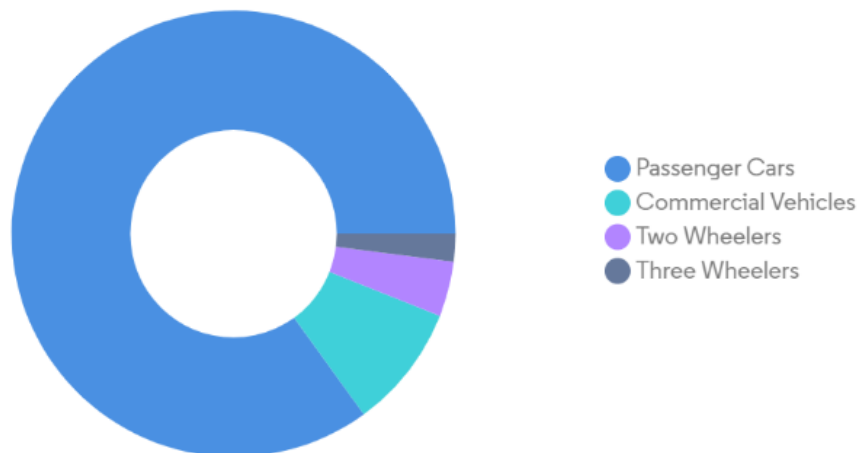
Electric Two-wheeler Vehicles Expected to have Optimistic Growth

Though the COVID-19 pandemic resulted in lockdowns and supply chain disruptions, increasing petrol and diesel prices, government incentives, and an increase in spending for setting up charging infrastructure in the country are expected to drive demand. For instance, In FY 2020, around 152,000 units of electric two-wheelers were sold in the country compared to 126,000 units sold in FY 2019.

In the electric two-wheeler segment, electric motorcycles and scooters are popular modes. Like conventional two-wheelers, they are easier to navigate through congested roads. From a speed point of view, low-speed (up to 25 km/hr.) and medium-speed electric two-wheelers (up to 40 kmph) with conventional lead-acid batteries are projected to dominate the market over the forecast period.

This is mainly because, in terms of upfront cost, they are already on par with ICE vehicles. However, with more companies becoming eligible for FAME-II incentives, several new models are expected to be operated in the market in the coming years. Some of the key two-wheeler rental companies have already started investing heavily in expanding their fleet of vehicles to cater to the rising demand in the country. For instance,

In February 2021, Bounce, a bike rental startup in the country, made an announcement that it was planning to launch its electric scooter in the country. However, the expected launch date has not been declared. Price is expected to be around INR 55,000 and an additional INR 1,450 per month for maintenance, including battery maintenance.

Several local major players in the country are investing heavily to enhance their production capacity of electric two-wheelers in the country to cater to enhancing the demand in the country. For instance,

In February 2021, Ampere Electric made an announcement that it would be investing INR 700 crore in setting up a new electric two-wheeler plant in Tamil Nadu. It is expected to have the potential to start manufacturing 100,000 units in its first year of operation.

Thus, with such growing advancements and developments, the passenger cars segment is expected to witness steady and consistent growth during the forecast period.

India Two Wheeler Market - Volume Share (%), By Manufacturer, 2021

Legend:
- Hero Electric
- Okinawa
- Ampere Vehicles
- Ather Energy
- Revolt Intellicorp Pvt Ltd.
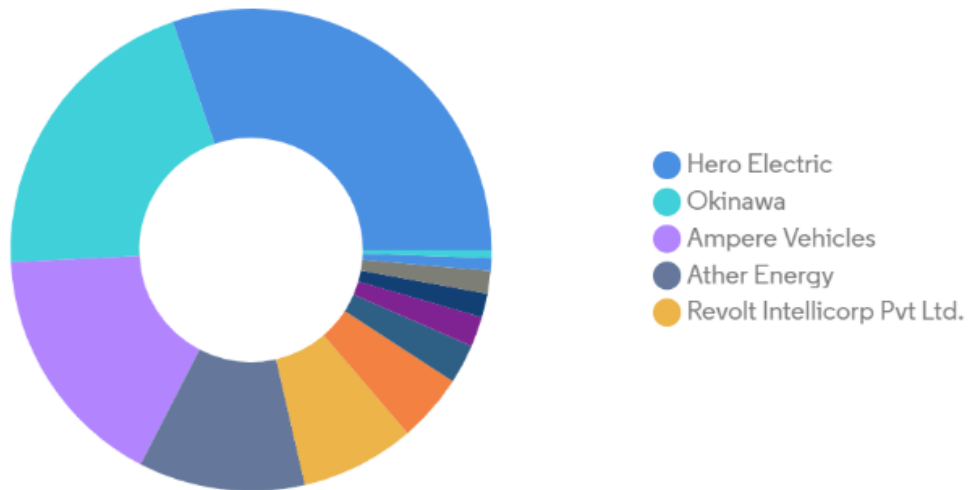
Major Players

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

- In August 2021, Tata Motors launched the new Tigor EV, which uses Tata's advanced Ziptron high-voltage architecture that uses a permanent magnet synchronous electric

motor producing 75hp and 170Nm. These output figures allow for a 0 to 60kph time of 5.7 seconds.

- In July 2021, Audi launched 2 EVs: e-tron SUV and e-tron Sportback . The e-tron SUV is available in e-tron 50 variant with a 71 kWh battery and two electric motors. This configuration puts out 308 bhp with 540 Nm and claims a driving range between 264 km and 379 km (WLTP) on a single charge.
- In February 2021, Ampere Electric, the wholly-owned electric mobility subsidiary of Greaves Cotton Ltd, announced a phased investment potential of INR 700 crore over 10 years to set up a world-class e-mobility manufacturing plant in Ranipet, Tamil Nadu. A Memorandum of Understanding (MoU) to this effect was signed by the company with the Government of Tamil Nadu.

Some of the Major Players include **Tata Motors Limited, Mahindra & Mahindra Limited, MG Motor India, Maruti Suzuki Limited, Ather Energy (2 wheeler Segment), Okinawa (2 wheeler Segment)**.

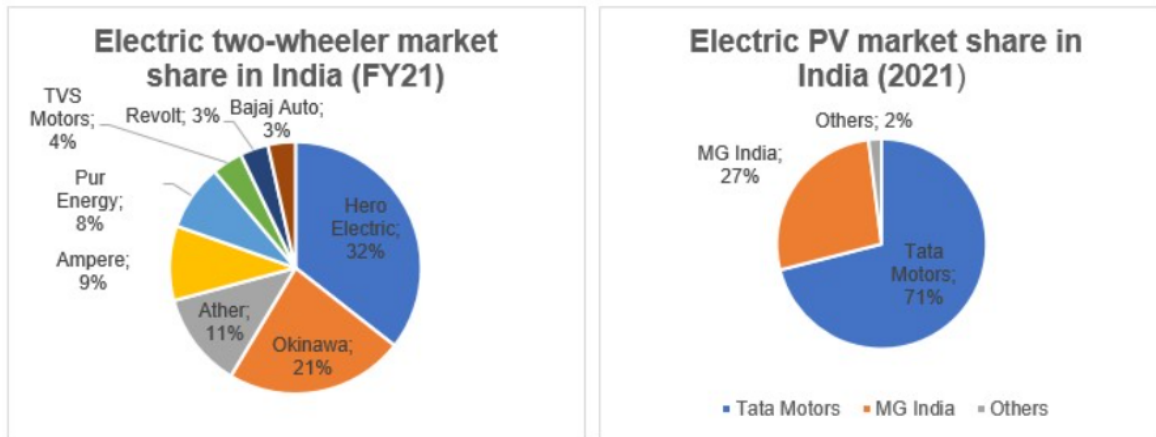## Electric Vehicle Sales Trend in India (2020-21)
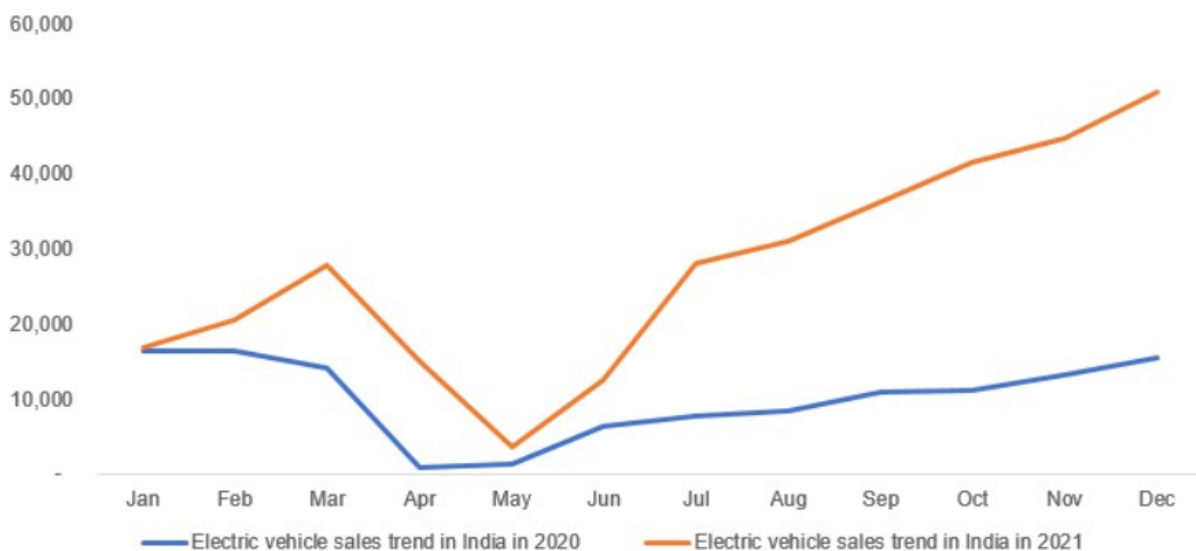
Source: EV reporter

State -Wise-EV Sales Trend in 2021

Source: EV Reporter

Hero Electric, Okinawa and Ather Energy controls the electric two-wheeler market in India with a combined market share of 64%. Hero Electric has a market share of 36% followed by Okinawa with 21%. Ather Energy with an 11.1% market share is slowly gaining market share, as the company is currently expanding its distribution network across India. In the passenger vehicle segment, Tata Motors enjoys a commanding position in electric vehicle space with a market share of 71%, led by their two key models, Nexon and Tigor EV. MG Motors India enjoys the second position and offers the longest-range EV (MG EZS provides 439 KM range on a single charge). Other Indian manufacturers have announced their models and is expected to be launched in the future.

Electric two-wheeler market share in India (FY21)

- Hero Electric; 32%
- Okinawa; 21%
- Ather; 11%
- Ampere; 9%
- Pur Energy; 8%
- TVS Motors; 4%
- Revolt; 3%
- Bajaj Auto; 3%

Electric PV market share in India (2021)

- Tata Motors; 71%
- MG India; 27%
- Others; 2%

Source- Cardekho, gaadiwaadi, e-vehicle info.,Rushlane.

Business Opportunities

The EV push in India opens a plethora of business opportunities across three key segments – mobility, infrastructure and energy. These include opportunities in EV franchising, EV OEM market, battery infrastructure, solar vehicle charging and battery swapping technology among several others. According to NITI Aayog, the complete transition to EVs requires a total investment of US$ 267 billion (Rs.19.7 lakh crore) in EVs, battery infrastructure and charging infrastructure.

According to the Ministry of Skill Development and Entrepreneurship (MSDE), the EV industry could add 10 million direct jobs by 2030 which would create 50 million indirect jobs in the sector. Several automobile companies have plans to participate in the EV industry as listed in the table below:

- FAME India Scheme: Faster Adoption & Manufacturing of (Hybrid &) Electric Vehicles (FAME) India was launched in 2015 for promoting growth and early adoption of hybrid and electric vehicles in the country. FAME-II scheme was launched in India with a budget outlay of US$ 1.3 billion (Rs. 10,000 crore) to support 1 million e-two-wheelers, 0.5 million e-three -wheelers, 55,000 e-passenger vehicles and 7,000 e-buses. The government extended the scheme until 2024, as announced in Union Budget 2022-23.
- PLI Scheme: The government introduced Production Linked Incentive for Advanced Chemistry Cell Battery Storage (PLI-ACC) scheme. The scheme is expected to boost India's battery infrastructure. As per the Union Budget, the total outlay for the scheme is US$ 2.45 billion (Rs 18,100 crore), which would be disbursed to beneficiaries over five years once the manufacturing facility is set up.

- Battery Swapping Policy: A wide-spread charging infrastructure is essential for EV adoption. In this regard, on April 22, 2022, NITI Aayog released a draft battery swapping policy which will be valid until March 31, 2025. The policy will be implemented over a period of 1-2 years from the date of launch of the policy and will cover all metropolitan cities with a population greater than four million. The second phase will be implemented over 2-3 years from date of launch of the policy and will cover all UT's and major cities with a population greater than 5,00,000.
- Other Initiatives-
    - Tax exemption of up to Rs.1,50,000 (US$ 1,960) under section 80EEB of income tax while purchasing an EV (2W or 4W) on loan.
    - Reduction of customs duty on nickel ore (key component of lithium-ion battery) from 5% to 0%.
    - State- wise reduction of road tax and other incentives.

Moves of Some Major Players

- In January 2022, Tata Motor Company announced its plans to mainstream EV and target 50,000 annual sales in FY 2023. The company has sounded out vendors on an assured production plan of 50,000 EVs in fiscal 2023 and scaled it up to 125,000-150,000 units annually in the following two years.
- In January 2022, MG Motor India officially announced to launch an electric vehicle before the end of FY 2022-23, before March 2023. It will be priced between INR 10 lakh and INR 15 lakh. This all-electric crossover will be based on a global platform, which is customized for the Indian market. It will be a sub-4-meter crossover and could offer an electric range of over 300kms. It will be positioned against the best-selling Tata Nexon EV. The company aims to localize some of the components for its new electric vehicle to meet the government's guidelines for a product-linked incentive scheme.
- In December 2021, Hyundai Motor India announced its plans stating the company plans to invest INR 4,000 crore to launch half a dozen electric vehicles (EV) by 2028 in a series of targeted product interventions, underscoring increasing consumer preference in the country for mobility solutions of the future. The company is also in talks with six private and state-run companies in India to boost vehicle charging infrastructure and alleviate a key concern among EV buyers.

- In July 2021, Olectra Greentech announced that along with its sister company Evey Trans Pvt. Ltd, it won the bid for 100 electric buses. The consortium of both the companies won the bid to supply 100 electric buses to a State Transport Corporation (STC) in the country under the Government of India's FAME-II scheme, on an OPEX model basis for 12 years. These 100 electric buses are going to be used for inter-city operations.
- In April 2021, Mahindra & Mahindra announced its plans to launch 16 electric vehicles (EVs) by 2027 across SUV and light commercial vehicle categories to strengthen its leadership position in India's electric mobility segment. The company, which has set a cumulative revenue growth target of 15-20% by 2025, is keeping its options open to either private investors or plans to crave EV as a separate entity.

Libraries Used

- Pandas : Used for reading csv and preprocessing the data.
- Seaborn and Matplotlib : Used for drawing various plots and data visualization.
- Scikit Learn :Used for data transformation/scaling and making KMeans clustering model.

Data Preprocessing

In [1]:
```python
# Importing Libraries

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```python
# Reading the CSV

df = pd.read_csv('Indian automoble buying behavour study 1.0.csv')
```

In [3]:
```python
# Inspecting first 5 rows

df.head()
```

Out[3]:

	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

In [6]:
```python
# inspecting size of dataset

len(df)
```

Out[6]: 99

```
In [4]:  # inspecting the features

         df.columns

Out[4]:  Index(['Age', 'Profession', 'Marrital Status', 'Education', 'No of Dependents',
                'Personal loan', 'House Loan', 'Wife Working', 'Salary', 'Wife Salary',
                'Total Salary', 'Make', 'Price'],
               dtype='object')
```

```
In [21]:  # checking if the dataset have some missing values

          df.isna().sum()

Out[21]:  Age                 0
          Profession          0
          Marrital Status     0
          Education           0
          No of Dependents    0
          Personal loan       0
          House Loan          0
          Wife Working        0
          Salary              0
          Wife Salary         0
          Total Salary        0
          Make                0
          Price               0
          dtype: int64
```

```
In [5]:  # inspecting number of unique values for every feature

         for x in df.columns:
             print(x, ':', df[x].nunique())

         Age : 22
         Profession : 2
         Marrital Status : 2
         Education : 2
         No of Dependents : 4
         Personal loan : 2
         House Loan : 2
         Wife Working : 3
         Salary : 24
```

```
In [7]:   # Wife working should be binary (must contain only Yes and No) but it has 3

          df['Wife Working'].unique()

Out[7]:   array(['No', 'Yes', 'm'], dtype=object)
```

```
In [8]:   # inspecting rows with Wife Working = 'm'

          df[df['Wife Working'] == 'm']
```

Out[8]:

	Age	Profession	Marrital Status	Education	No of Dependents	Personal loan	House Loan	Wife Working	Salary	Wife Salary	Total Salary	Make	Price
11	35	Salaried	Married	Graduate	4	Yes	Yes	m	1400000	0	1400000	Baleno	700000

```
In [9]:   # We can see Wife Salary == 0 so we must replace 'm' with 'No'

          df['Wife Working'] = df['Wife Working'].replace({'m' : 'No'})
```

```
In [10]:  df['Wife Working'].unique()

Out[10]:  array(['No', 'Yes'], dtype=object)
```

```
In [23]:  # dividing the features into categorical and continous features for easy visualisations

          col_cat = ['Profession', 'Marrital Status', 'Education', 'Personal loan', 'House Loan', 'Wife Working']

          col_con = []
          for x in df.columns:
              if x not in col_cat and x != 'Make':
                  col_con.append(x)

          print('Categorical Features:', col_cat)
          print('Continous Features', col_con)

          Categorical Features: ['Profession', 'Marrital Status', 'Education', 'Personal loan', 'House Loan', 'Wife Working']
          Continous Features ['Age', 'No of Dependents', 'Salary', 'Wife Salary', 'Total Salary', 'Price']
```

```
In [46]:  # lets view describption of our dataset

          df.describe()
```

Out[46]:

	Age	No of Dependents	Salary	Wife Salary	Total Salary	Price
count	99.000000	99.000000	9.900000e+01	9.900000e+01	9.900000e+01	9.900000e+01
mean	36.313131	2.181818	1.736364e+06	5.343434e+05	2.270707e+06	1.194040e+06
std	6.246054	1.335265	6.736217e+05	6.054450e+05	1.050777e+06	4.376955e+05
min	26.000000	0.000000	2.000000e+05	0.000000e+00	2.000000e+05	1.100000e+05
25%	31.000000	2.000000	1.300000e+06	0.000000e+00	1.550000e+06	8.000000e+05
50%	36.000000	2.000000	1.600000e+06	5.000000e+05	2.100000e+06	1.200000e+06
75%	41.000000	3.000000	2.200000e+06	9.000000e+05	2.700000e+06	1.500000e+06
max	51.000000	4.000000	3.800000e+06	2.100000e+06	5.200000e+06	3.000000e+06

```
In [20]:  # inspecting distribution of categorical variables by count plot

          for x in col_cat:
              plt.figure(figsize = (10, 2))
              sns.countplot(y = df[x])
```
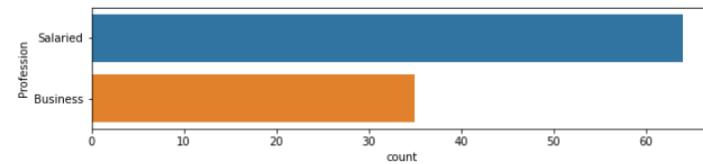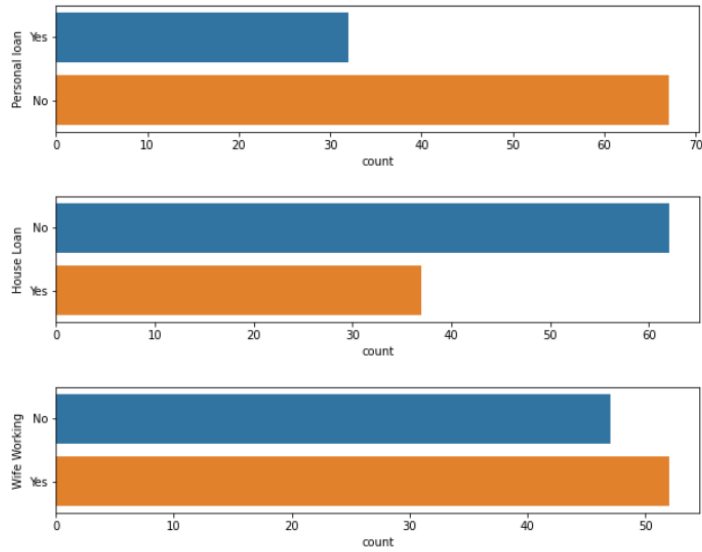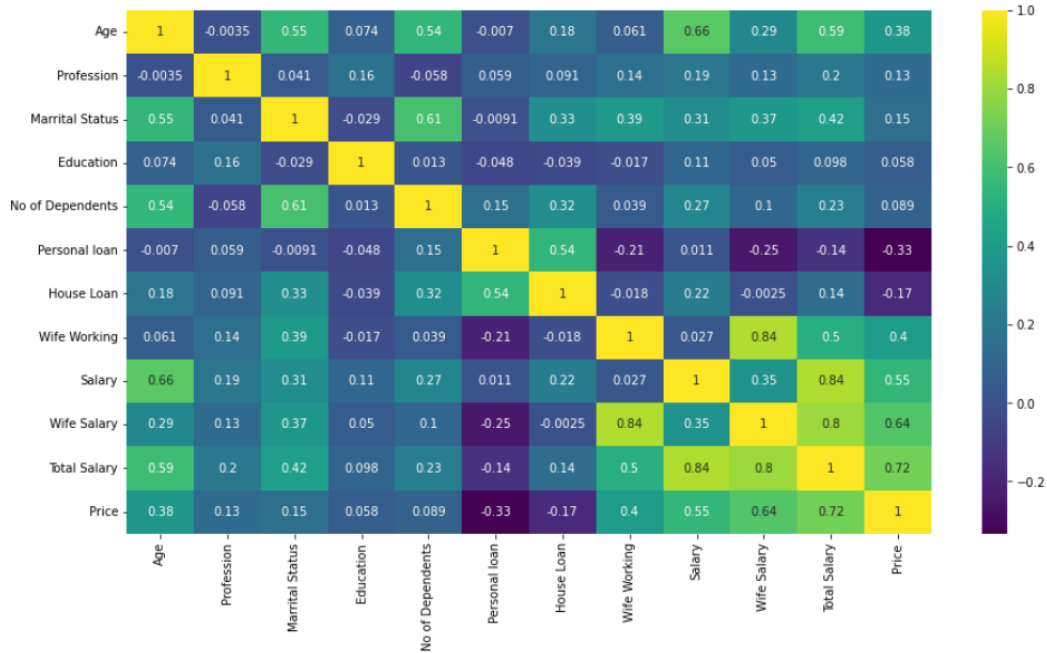
From above count plots we get intuition above the categorical variables

1) Salaried Class is more probable to buy a Car than Business one (this makes sense because moslty cars are bought on EMI and banks tend to give EMI scheme to salaried class more beacuse of their fixed monthly income unlike business class whose fixed monthly income is hard to evaluate).

2) Married people is more probable to buy a Car than Single People.

3) People with no House loan or Personal Loan is more probable to buy a Car than people who have Loans (this also makes sense because banks tend to give EMI to those people who don't have any loans pending.

```
In [99]: # Plotting a heatmap to see the correlation between variables

         plt.figure(figsize=(15, 8))
         sns.heatmap(df_encoded_scaled.corr(), annot = True, cmap = 'viridis')

Out[99]: <AxesSubplot:>
```

	Age	Profession	Marrital Status	Education	No of Dependents	Personal loan	House Loan	Wife Working	Salary	Wife Salary	Total Salary	Price
Age	1	-0.0035	0.55	0.074	0.54	-0.007	0.18	0.061	0.66	0.29	0.59	0.38
Profession	-0.0035	1	0.041	0.16	-0.058	0.059	0.091	0.14	0.19	0.13	0.2	0.13
Marrital Status	0.55	0.041	1	-0.029	0.61	-0.0091	0.33	0.39	0.31	0.37	0.42	0.15
Education	0.074	0.16	-0.029	1	0.013	-0.048	-0.039	-0.017	0.11	0.05	0.098	0.058
No of Dependents	0.54	-0.058	0.61	0.013	1	0.15	0.32	0.039	0.27	0.1	0.23	0.089
Personal loan	-0.007	0.059	-0.0091	-0.048	0.15	1	0.54	-0.21	0.011	-0.25	-0.14	-0.33
House Loan	0.18	0.091	0.33	-0.039	0.32	0.54	1	-0.018	0.22	-0.0025	0.14	-0.17
Wife Working	0.061	0.14	0.39	-0.017	0.039	-0.21	-0.018	1	0.027	0.84	0.5	0.4
Salary	0.66	0.19	0.31	0.11	0.27	0.011	0.22	0.027	1	0.35	0.84	0.55
Wife Salary	0.29	0.13	0.37	0.05	0.1	-0.25	-0.0025	0.84	0.35	1	0.8	0.64
Total Salary	0.59	0.2	0.42	0.098	0.23	-0.14	0.14	0.5	0.84	0.8	1	0.72
Price	0.38	0.13	0.15	0.058	0.089	-0.33	-0.17	0.4	0.55	0.64	0.72	1

Segment Extraction

K Means Clustering

K-Means Clustering is an Unsupervised Learning algorithm, which groups the unlabeled dataset into different clusters. Here K defines the number of predefined clusters that need to be created in the process, as if K=2, there will be two clusters, and for K=3, there will be three clusters, and so on.

It is an iterative algorithm that divides the unlabeled dataset into k different clusters in such a way that each dataset belongs to only one group that has similar properties.

The below diagram explains the working of the K-means Clustering Algorithm:
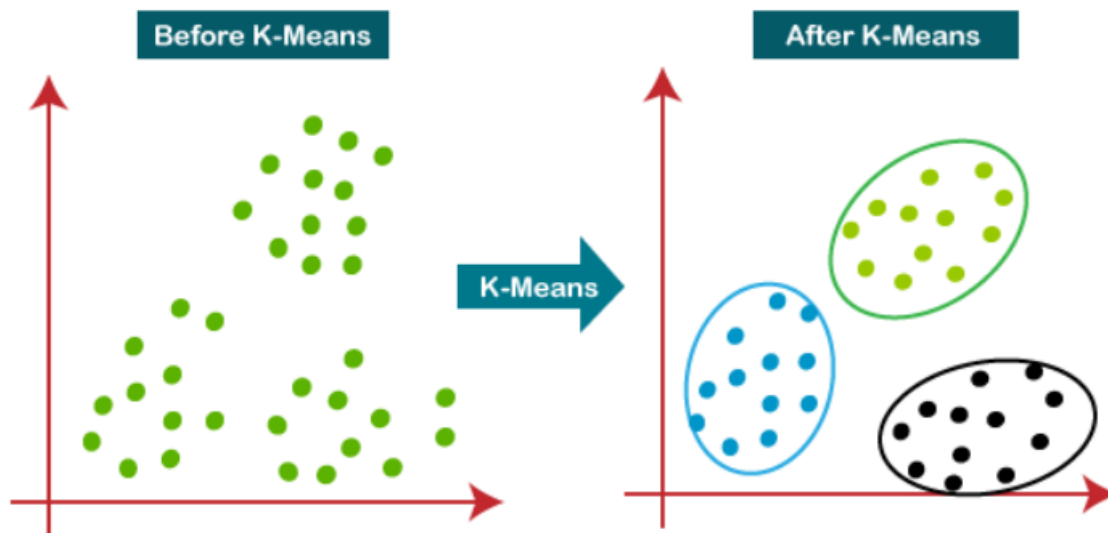
The working of the K-Means algorithm is explained in the below steps:

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.

Segment Extraction in the dataset

Using Age and Total Salary as segmentation variables

```
In [157]: plotElbow(['Age', 'Total Salary'], df_encoded_scaled)
```

```
C:\Users\akshay\anaconda3\envs\pytorch\lib\site-packages\sklearn\cluster\_kmeans.py:1037: UserWarning: KMeans is known to have
a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environme
nt variable OMP_NUM_THREADS=1.
  "KMeans is known to have a memory leak on Windows "
```
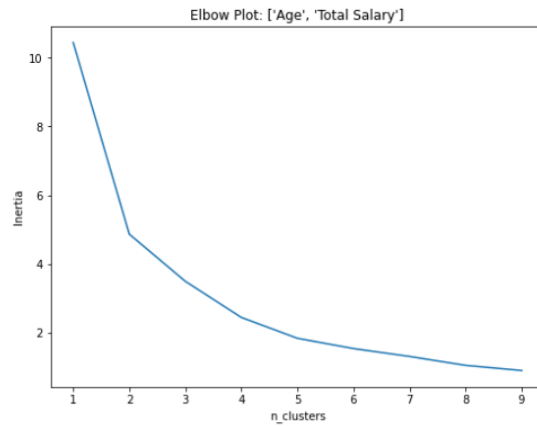


```
In [161]: # From the above plot we see at K = 2 and K = 4 there is a slope change so we can choose any value between 2-4.
          # Here I am choosing K = 3 as optimal
```

```
In [161]: # From the above plot we see at K = 2 and K = 4 there is a slope change so we can choose any value between 2-4.
          # Here I am choosing K = 3 as optimal
```

```
In [162]: plotSegments(['Age', 'Total Salary'], df_encoded_scaled, 3)
```
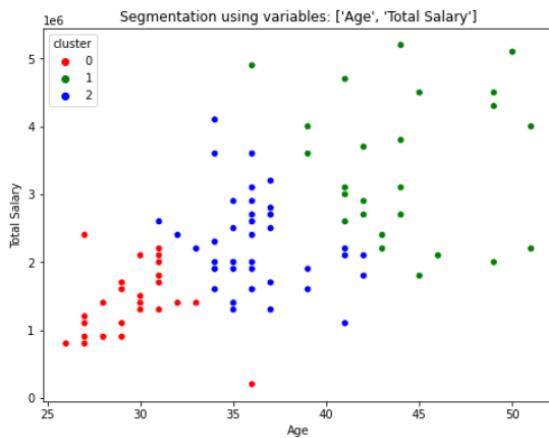
From the above segmentation plot we can see that we can easily divide market into 3 segments using Age and Total Salary.

1st segment is people with Age <= 33 and have salaries < 20 lakhs.

We can make vehicles that **priced very aggresively** (targeting low salaried, young group). The vehicles can be marketed as sporty with many colors. This may be the first car of many people in this segment due to low price, and due to **different color variants and sports appeal** many new young customers will be attracted. Hatchbacks can be ideal Vehicle Category.

2nd segment is people Annual Salary in between 20-30 lakhs and are have age in between 35-45.

The car can be made including all necessary features. As this is the mid range segment and large customers audience will be attracted towards it. Car can be marketed as Comfort Car with high economy and Good looking. Small SUV's and Sedans can be a ideal vehicle Category.

**3rd segment is people with Annual Salary > 30 lakhs and have Age above 40 years.**

This will be niche segment and the price of the car will be high. The car must have Luxury feel, full safety and comfort as target audience is of higher age and higher income group. The Car can be marketed to have good interiors, top class safety and utmost comfort. Luxury Coupes, LMV's(Large Motor Vehicle) can be a ideal Vehicle Category.

Using Age, Total Salary, Price as segmentation Variables

In [163]: `plotElbow(['Age', 'Total Salary', 'Price'], df_encoded_scaled)`

```
C:\Users\akshay\anaconda3\envs\pytorch\lib\site-packages\sklearn\cluster\_kmeans.py:1037: UserWarning: KMeans is known to have
a memory leak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environme
nt variable OMP_NUM_THREADS=1.
  "KMeans is known to have a memory leak on Windows "
```


Elbow Plot: ['Age', 'Total Salary', 'Price']
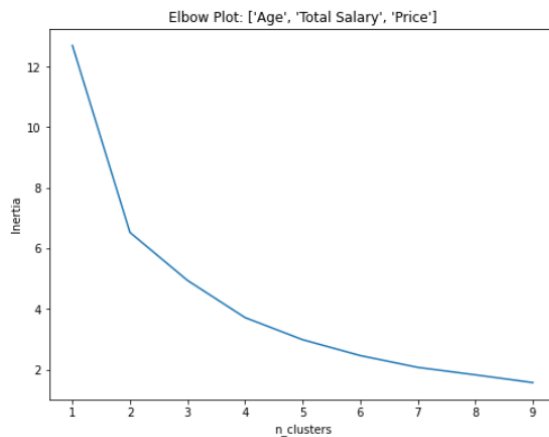
```python
In [178]:  # helper function to plot 3d segmentation plots

           def plotSegments3D(feature, x):
               x1 = df_encoded_scaled.loc[:, feature]

               kmeans = KMeans(n_clusters=3)
               x['cluster'] = kmeans.fit_predict(x1)

               # plotting the segments

               fig = plt.figure(figsize = (15, 15))

               ax = fig.add_subplot(111, projection='3d')
               ax.scatter(x[x['cluster'] == 0][feature[0]], x[x['cluster'] == 0][feature[1]], x[x['cluster'] == 0][feature[2]], c = 'green')
               ax.scatter(x[x['cluster'] == 1][feature[0]], x[x['cluster'] == 1][feature[1]], x[x['cluster'] == 1][feature[2]], c = 'blue')
               ax.scatter(x[x['cluster'] == 2][feature[0]], x[x['cluster'] == 2][feature[1]], x[x['cluster'] == 2][feature[2]], c = 'red')
               ax.view_init(30, 185)

               ax.set_xlabel(feature[0], fontweight ='bold')
               ax.set_ylabel(feature[1], fontweight ='bold')
               ax.set_zlabel(feature[2], fontweight ='bold')
               plt.title('Segmentation using variables: ' + str(feature))
               plt.show()
```
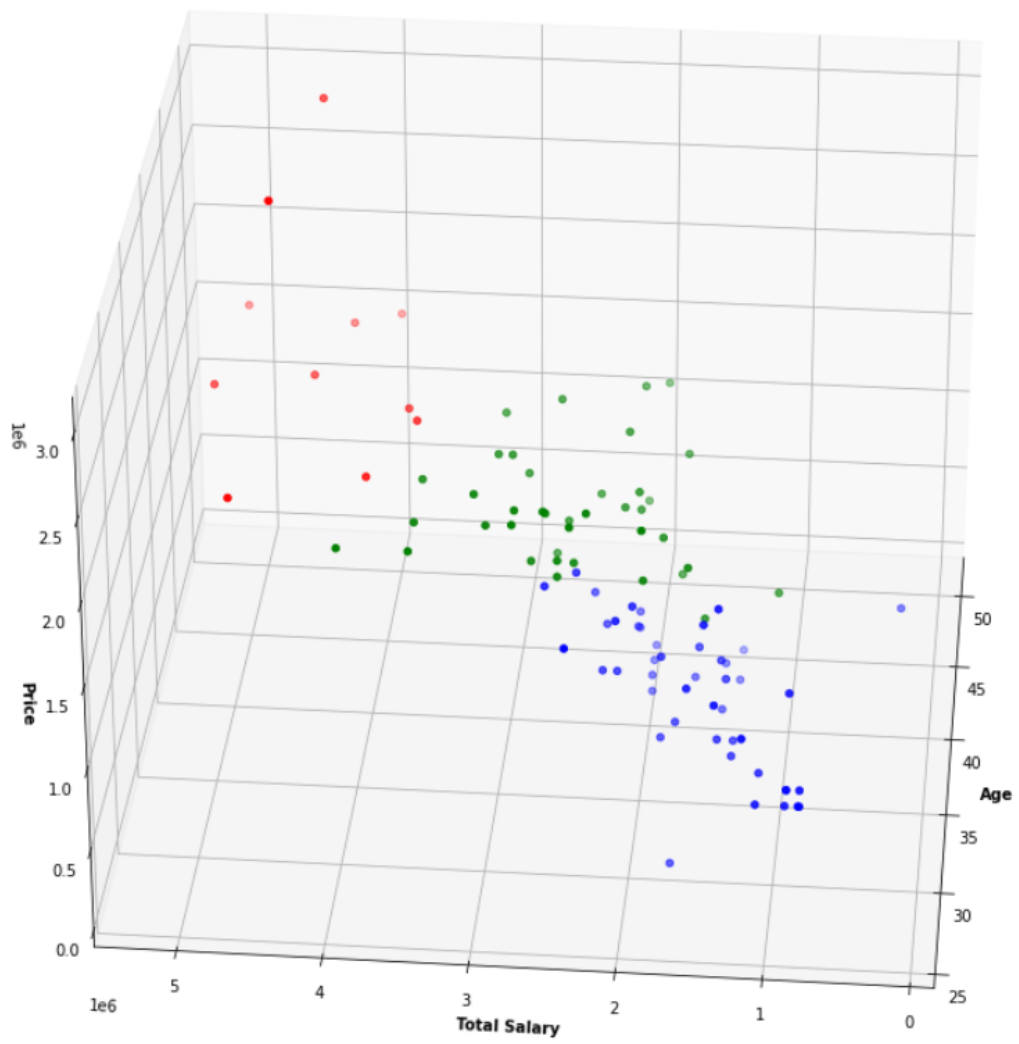
```python
In [179]:  plotSegments3D(['Age', 'Total Salary', 'Price'], df)
```

Segmentation using variables: ['Age', 'Total Salary', 'Price']

From above segmentation plot we can see that we can easily divide the market into 3 segments.

The Segments will be similar to the 2d segmentation using variable Age and Total Salary.

The segments were:-

1st segment is people with Age <= 33 and have salaries < 20 lakhs.

We can make vehicles that **priced very aggresively** (targeting low salaried, young group). The vehicles can be marketed as sporty with many colors. This may be the first car of many people in this segment due to low price, and due to **different color variants and sports appeal** many new young customers will be attracted. Hatchbacks can be ideal Vehicle Category.

2nd segment is people Annual Salary in between 20-30 lakhs and are have age in between 35-45.

The car can be made including all necessary features. As this is the mid range segment and large customers audience will be attracted towards it. Car can be marketed as Comfort Car with high economy and Good looking. Small SUV's and Sedans can be a ideal vehicle Category.

3rd segment is people with Annual Salary > 30 lakhs and have Age above 40 years.

This will be niche segment and the price of the car will be high. The car must have Luxury feel, full safety and comfort as target audience is of higher age and higher income group.The Car can be marketed to have good interiors, top class safety and utmost comfort. Luxury Coupes, LMV's(Large Motor Vehicle) can be a ideal Vehicle Category.

The price for the car of each segments can be decided by reading the above 3D segmentation Plot.

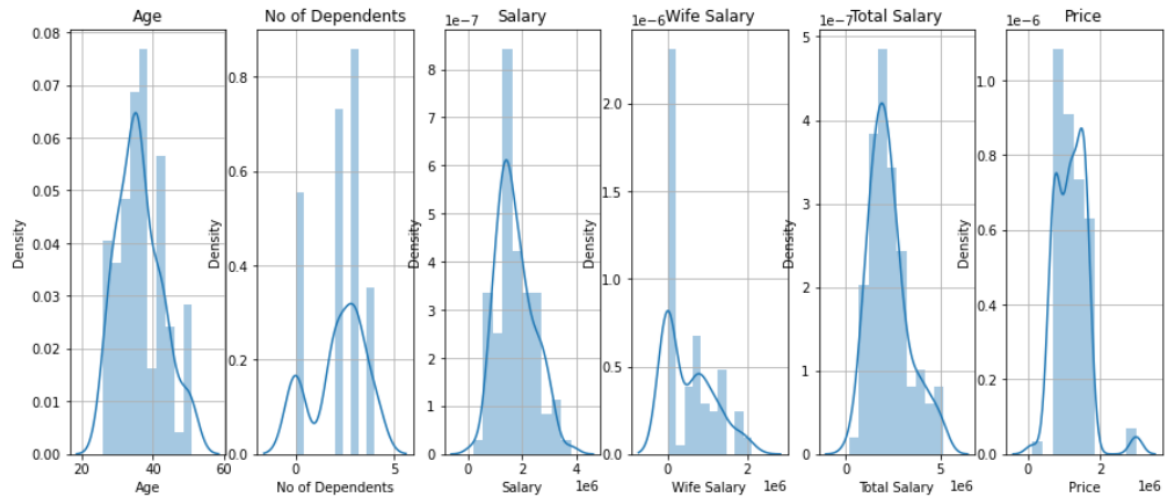# Market Segmentation

1. Demographic segmentation: The who

Demographic segmentation might be the first thing people think of when they hear 'market segmentation'

This is perhaps the most straightforward way of defining customer groups, but it remains powerful.
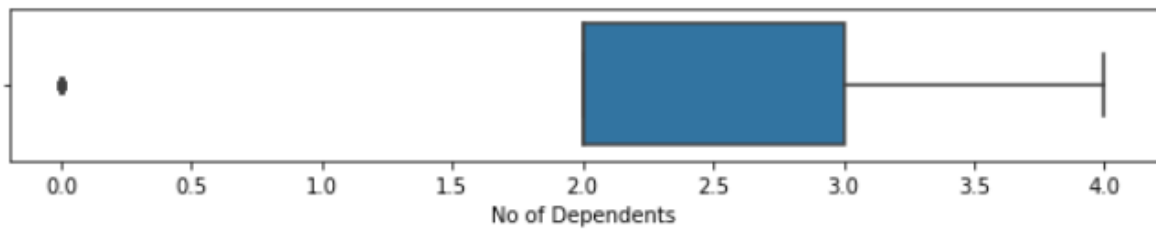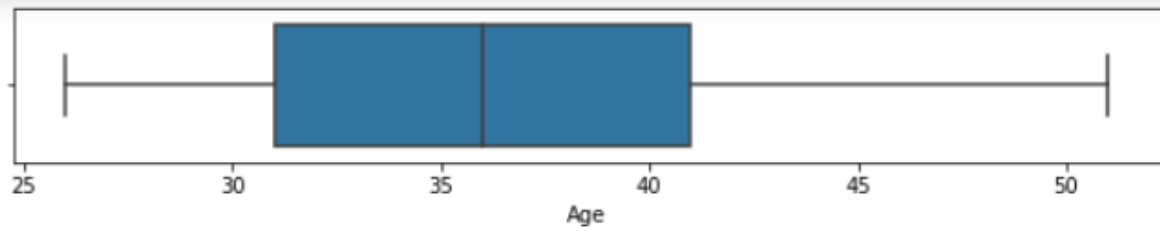
Demographic segmentation looks at identifiable non-character traits such as:

- Age
- Gender
- Ethnicity
- Income
- Level of education
- Religion
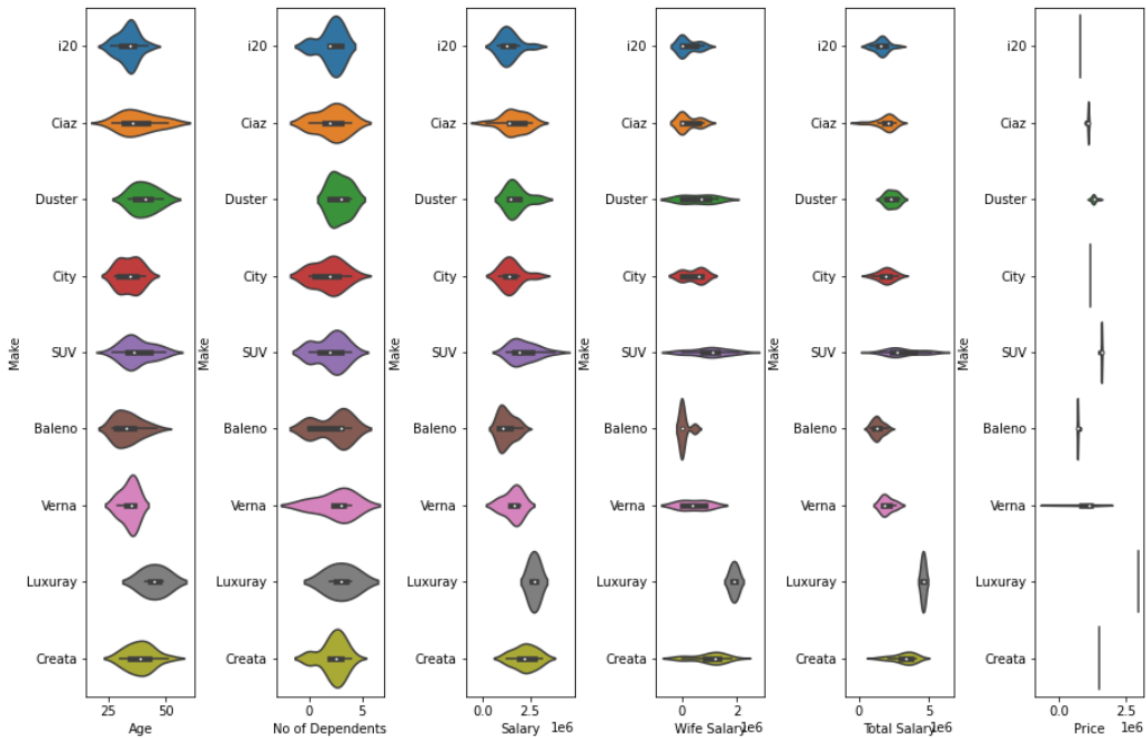- Profession/role in a company

Distribution plot of various Demographic factors

Boxplot of various Demographic factors

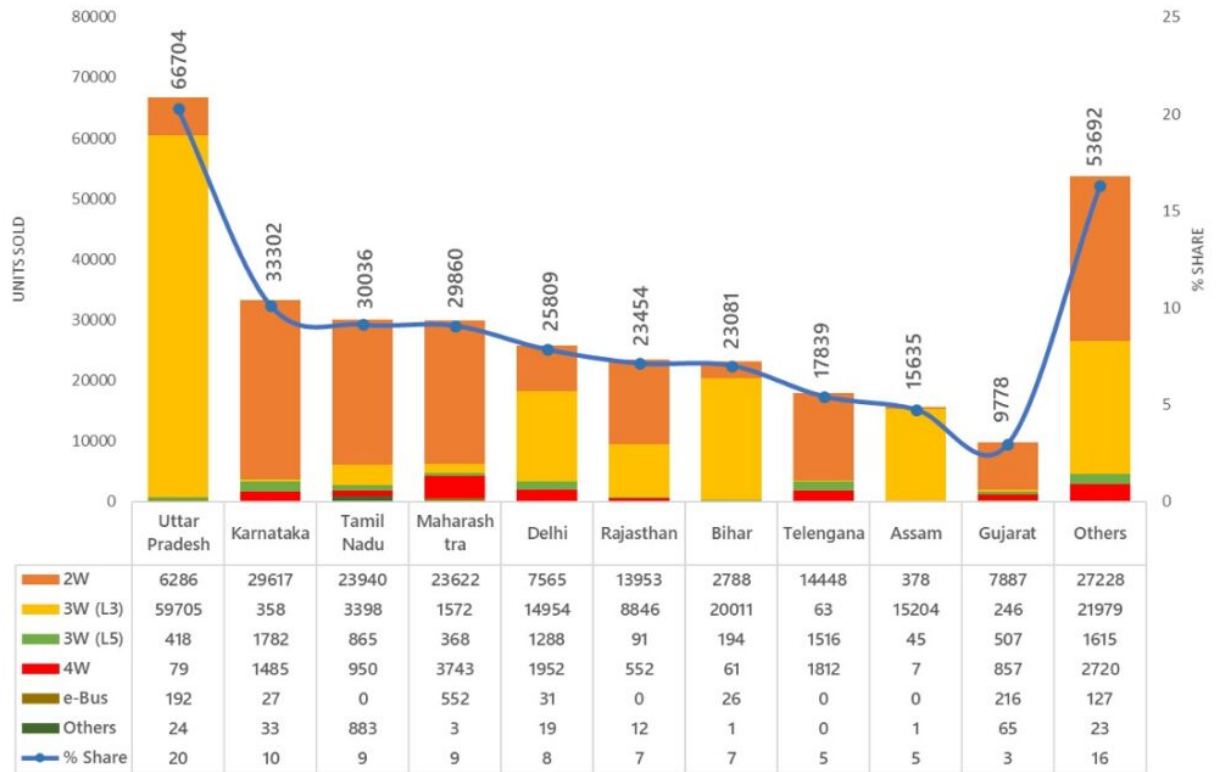**Violin plot of various Demographic factors**

2: Geographic segmentation: The *where*

By comparison, geographic segmentation is often one of the easiest to identify, grouping customers with regard their physical location. This can be defined in any number of ways:
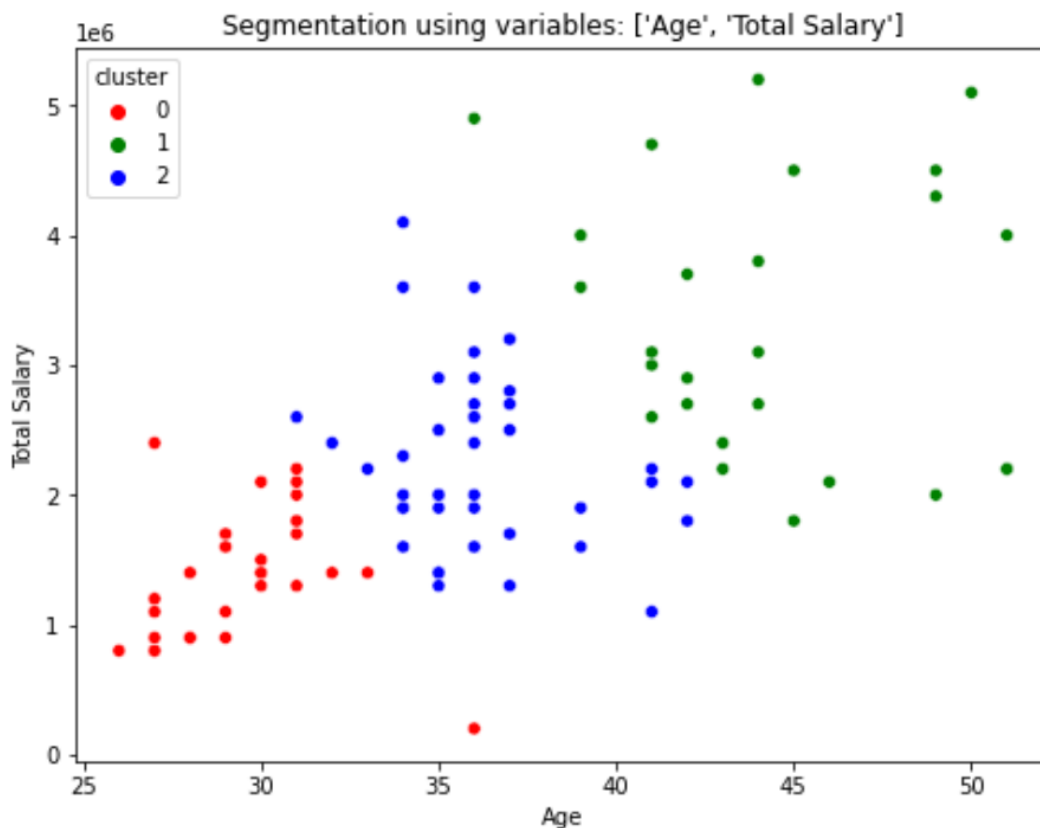
- Country
- Region
- City
- Postal code

For example, it's possible to group customers within a set radius of a certain location – an excellent option for marketers of live events looking to reach local audiences. Being aware of your customers' location allows for all of considerations when advertising to consumers.

State Wise Electric vehicle sales trend, 2021

	Uttar Pradesh	Karnataka	Tamil Nadu	Maharashtra	Delhi	Rajasthan	Bihar	Telengana	Assam	Gujarat	Others
2W	6286	29617	23940	23622	7565	13953	2788	14448	378	7887	27228
3W (L3)	59705	358	3398	1572	14954	8846	20011	63	15204	246	21979
3W (L5)	418	1782	865	368	1288	91	194	1516	45	507	1615
4W	79	1485	950	3743	1952	552	61	1812	7	857	2720
e-Bus	192	27	0	552	31	0	26	0	0	216	127
Others	24	33	883	3	19	12	1	0	1	65	23
% Share	20	10	9	9	8	7	7	5	5	3	16

Target Segments and Customizing Marketing Mix

Segmentation using variables: ['Age', 'Total Salary']

From the above segmentation plot we can see that we can easily divide the market into 3 segments using Age and Total Salary.

- **The 1st segment is people with Age <= 33 and have salaries < 20 lakhs.**

We can make vehicles **that are priced very aggressively (**targeting low salaried, young group). The vehicles can be marketed as sporty with many colors. This may be the first car of many people in this segment due to low price, and due to **different color variants and sports appeal** many new young customers will be attracted. Hatchbacks can be an ideal Vehicle Category.

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References

https://www.ibef.org/blogs/electric-vehicles-market-in-india#:~:text=According%20to%20EV%20volumes%2C%20overall,of%20108%25%20as%20of%202020.

https://www.mordorintelligence.com/industry-reports/india-electric-vehicle-market

https://www.alliedmarketresearch.com/electric-vehicle-market

Github Link

EV Market Segmentation Analysis