EV Market Analysis

1. **EV market analysis purpose and dataset introductions:**

This EV market analysis aims to identify the optimal vehicle category for EV production by examining key market trends, manufacturer data, and consumer demand patterns; I have got five datasets from Kaggle author by "Sai Raam". { Kaggle link: Detailed India EV Market Data 2001 - 2024 } These datasets provide a detailed overview of the electric vehicle (EV) market in India from 2001 to 2024. It includes monthly sales data, sales data categorized by manufacturer, and vehicle class-wise sales data for different manufacturers. Updated till Aug 2024.

EV Maker by Place:

List of popular EV Makers and their location of Manufacturing Plant.

Operational PC:

Total Operational Public Charging Station for EV available in each state.

Vehicle Class:

Total vehicles (includes electric and all other fuels) registered (manufactured) by category from 2001 - Aug 2024.

ev_cat_01-24:

Total electric vehicles manufactured from 2001 - Aug 2024 and vehicle category.

ev_sales_by_makers_and_cat_15-24:

Total electric vehicles manufactured by makers from 2015 - Aug 2024 with the vehicle class.

Note - The data for name of Manufacturers is only available from 2015.

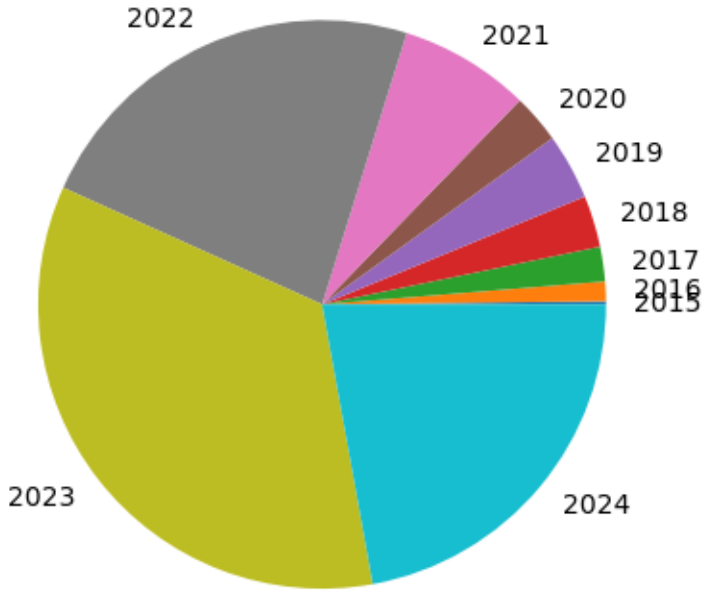
Acknowledgments

This dataset was compiled and web-scrapped from Vahaan4 Dashboard by Sai Raam

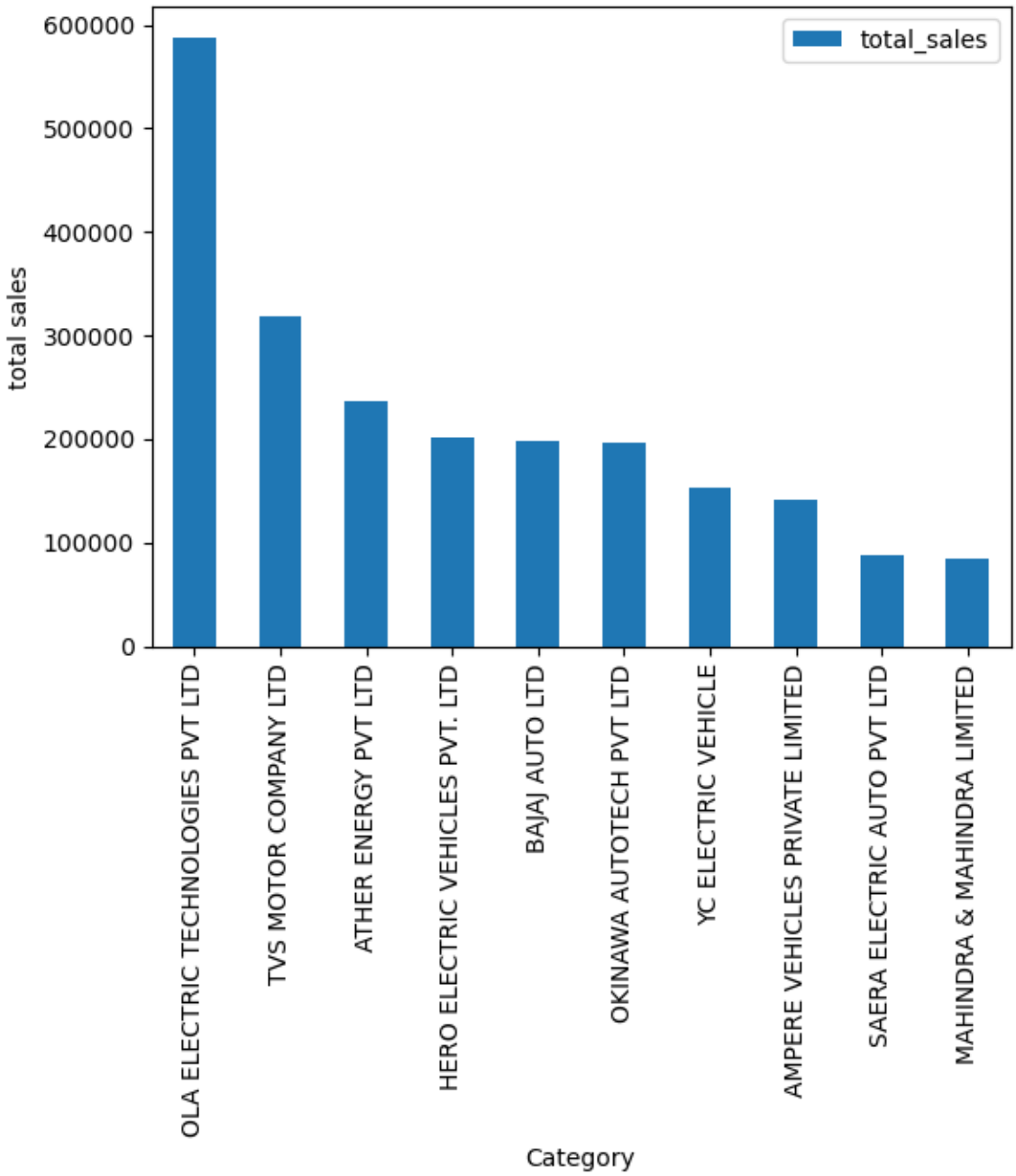
2. Understanding Datasets, Data exploration and prediction:

2.1. EV sales by makers from 2015 to 2024:

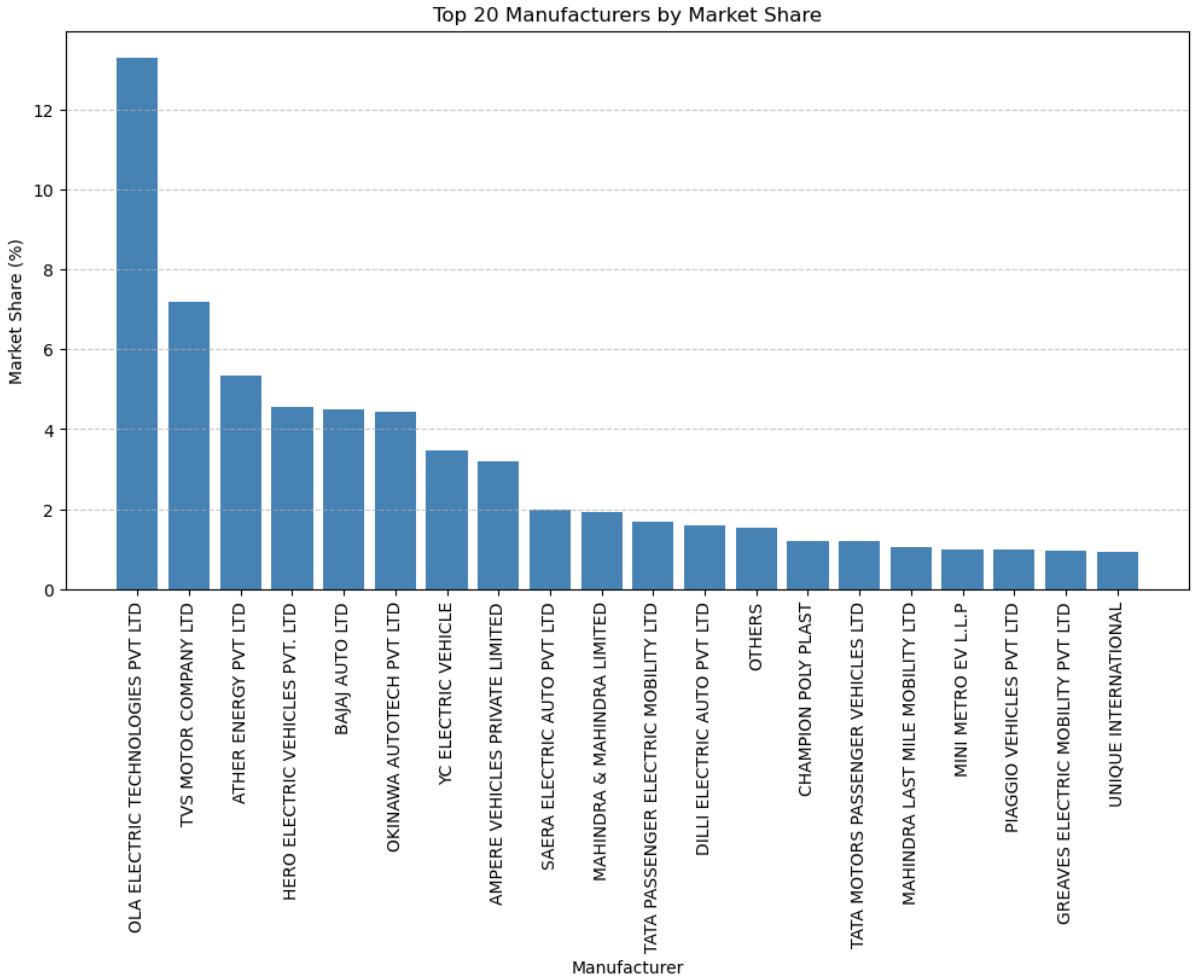
This Dataset has 12 columns. a category column(“cat”), a maker column (“maker”) and other columns are years 2015 to 2024



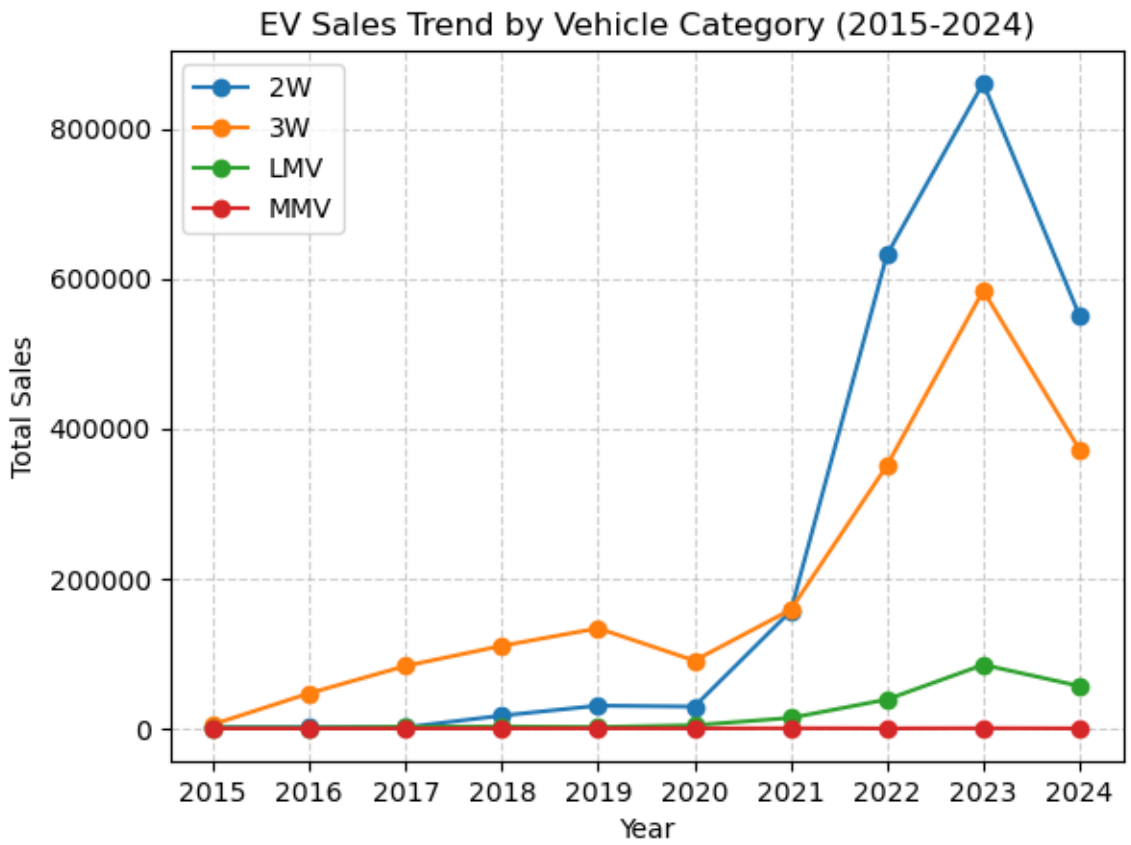
- This is EV sales year by year growth comparison
- Dataset starts with 2015 which has lowest sales
- And 2023 is having most EV sold in a year
- And we can see the trend, That EV sales have increased since 2015



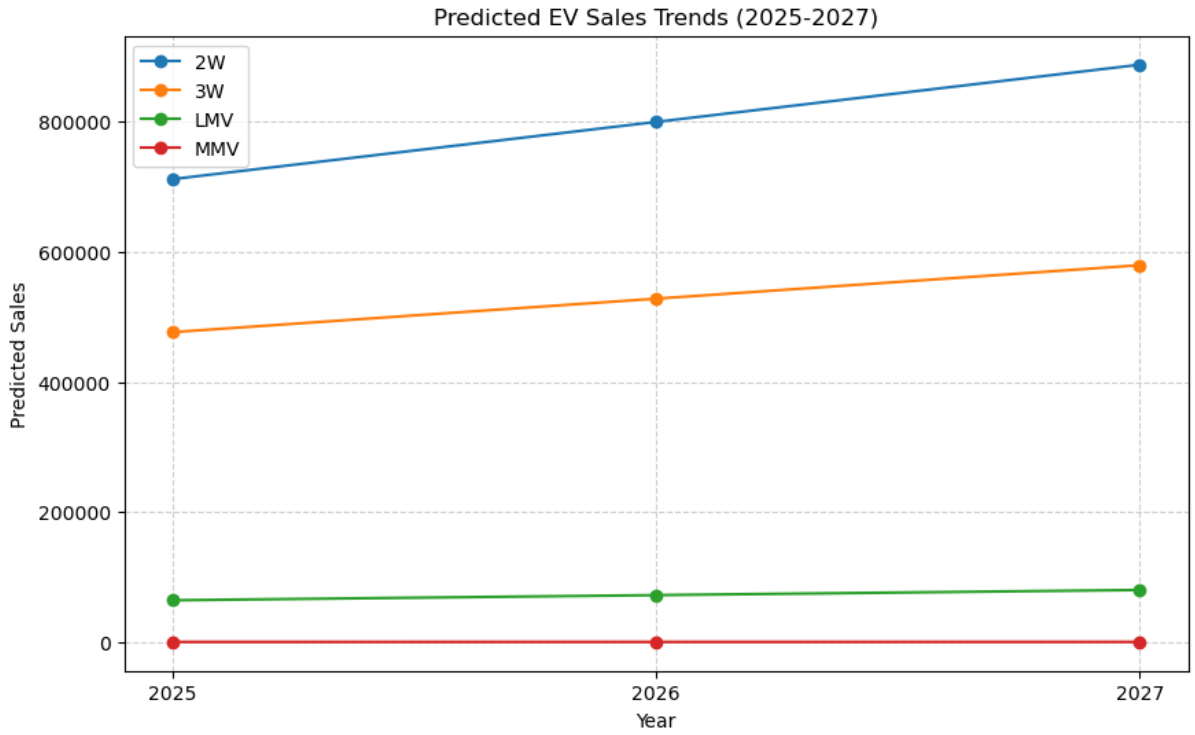
- This bar chart represents top ten companies based on EV sale.
- Ola electric is the first company on the basis of sale with 5,88,266 vehicles sold since 2015.
- TVS motor company ltd – 3,18,445
- Ather energy pvt ltd – 2,36,387
- Note: Top 10 are dominated by two-wheeler manufacturers.



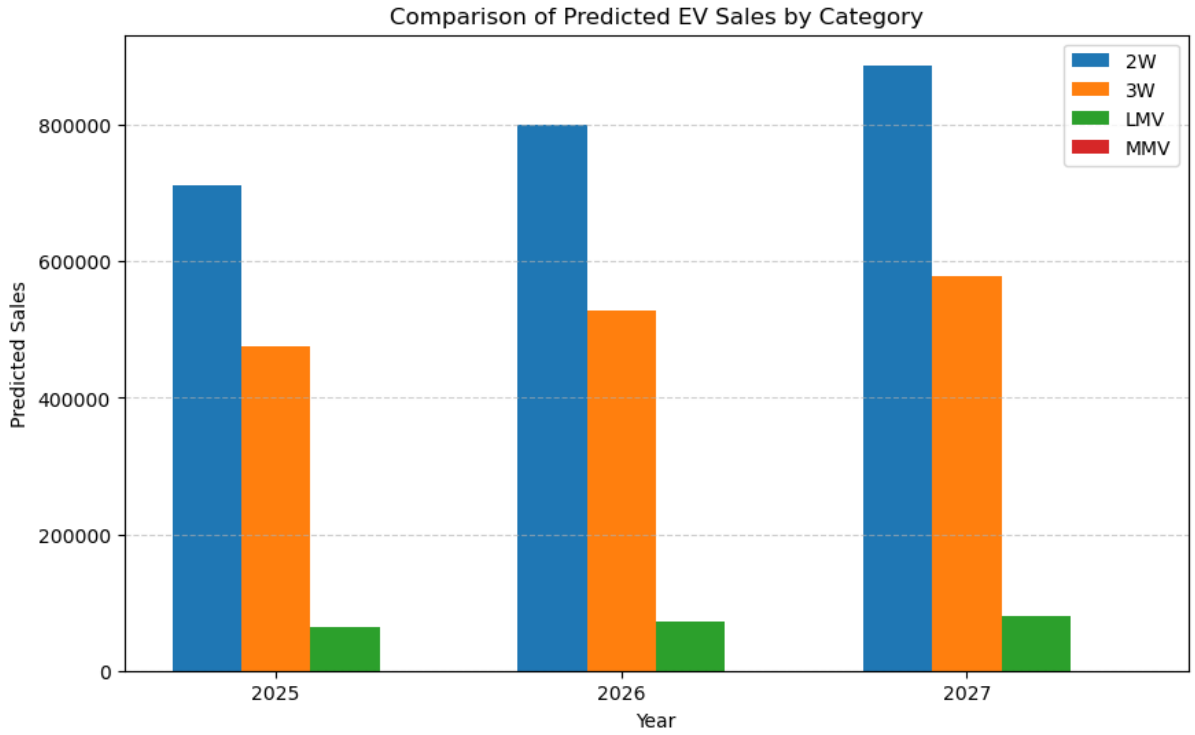
- Top 20 manufactures by market share in percentage
- And ola electric is on top with market share of 13.3%
- TVS motor company ltd - 7.2%
- Ather energy pvt ltd – 5.3%
- Note: Top 10 are dominated by two-wheeler manufacturers.



- EV sales trend by vehicle category (215-2024)
- 2W -- The sharp growth in electric two-wheeler sales highlights a strong consumer shift toward cost-effective and sustainable mobility, making this segment a key focus for future EV investments.
- 3W -- "Three-wheelers, a staple of India’s transport system, are rapidly electrifying to meet sustainability goals. Their role in urban commuting and commercial logistics, making them a critical pillar of urban mobility and last-mile logistics, which also makes them a prime target for EV adoption, promising strong growth ahead.



- Predicted EV sales Trends (2025-2027)
- This Prediction was done by using linear regression.
- Two-wheeler and Three-wheeler are showing good amount of growth in the next 3 years.
- LMV and MMV are showing almost a stagnant growth.



- Comparison of predicted EV sales by Category

- This Graph again tells us that growth of 2W and 3W is good according to the data that we have.

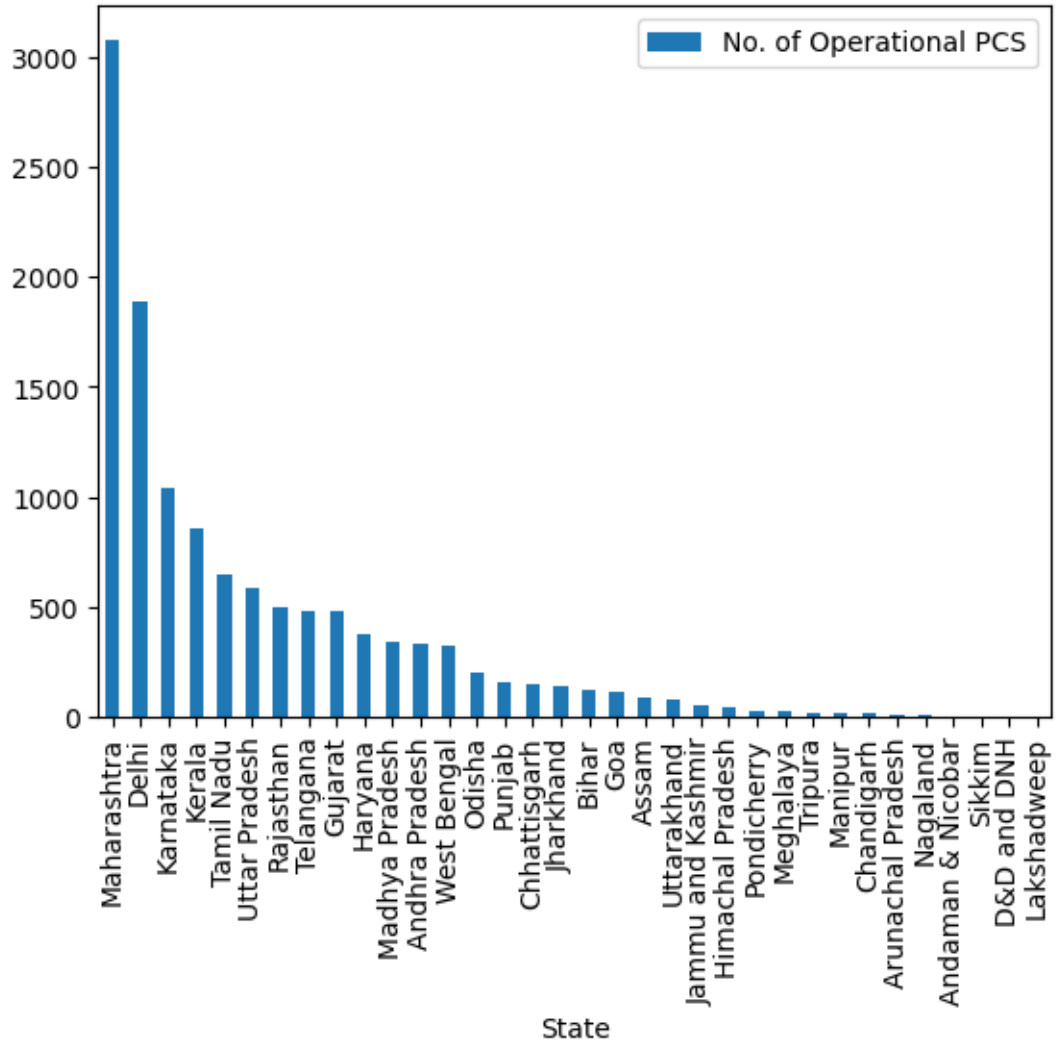
2.2. EV Maker by Place:

EV maker by place has 62 rows and 3 columns: EV maker, Place, State

- Maharashtra is on top with 15 EV makers

2.3. OperationalPC:

This has 2 columns: state and No. of Operational PCS (public charging station).



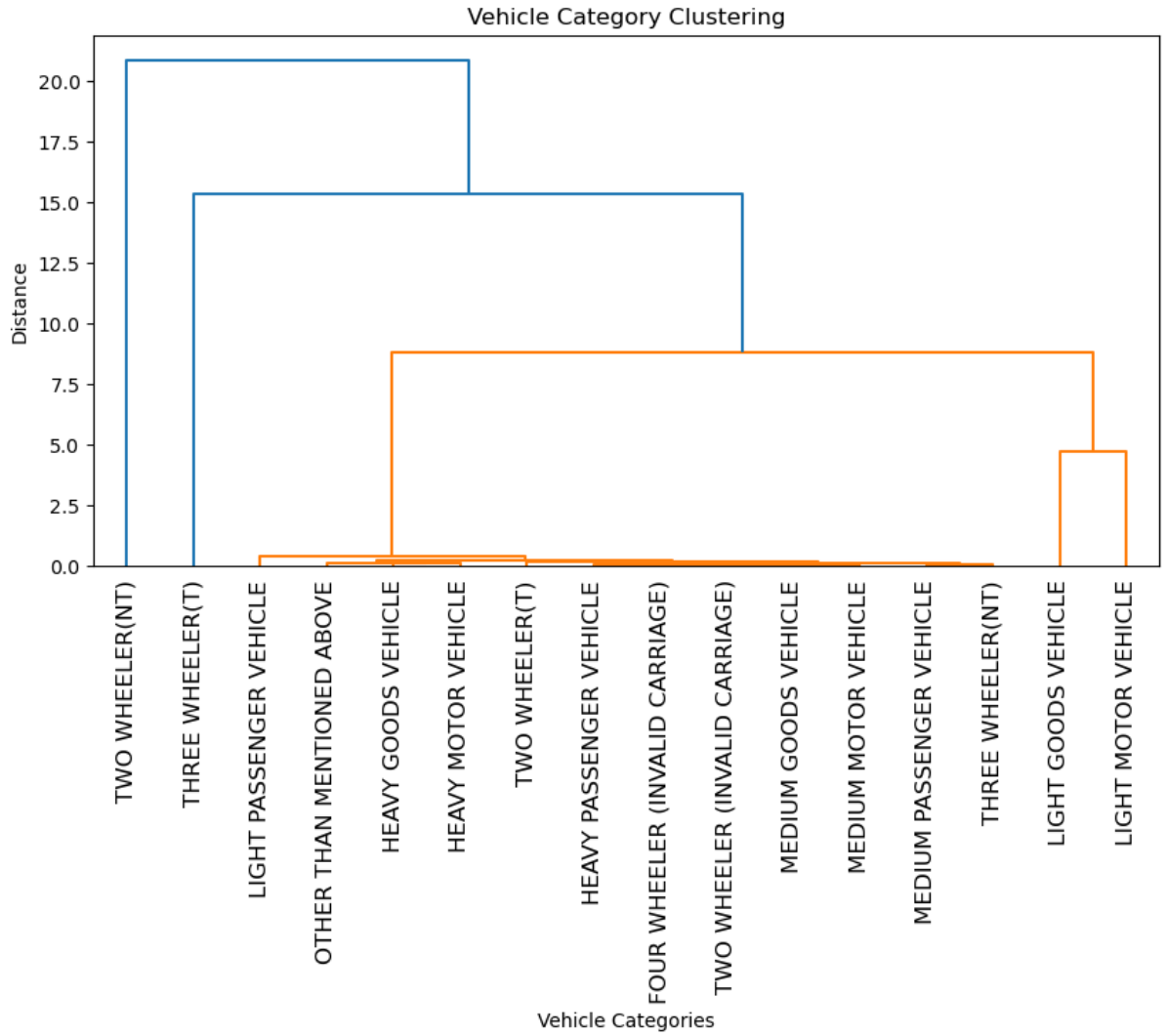
- Maharashtra has 3079 no of operational public charging stations
- Lowest on of pcs are “D&D and DNH” and “Lakshadweep” with 1 pcs each.

2.4. ev_cat_01-24:

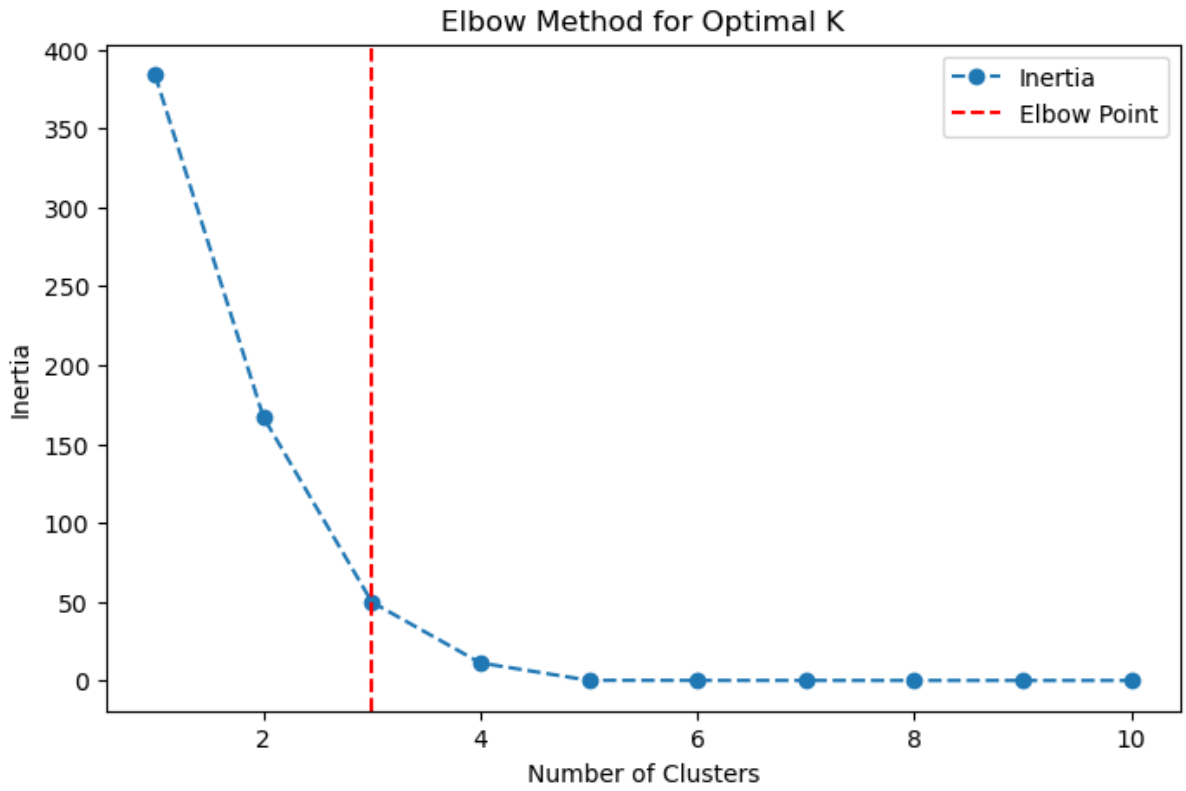
This has 283 rows and 17 columns a date column which has every month sale data from Jan 2001 to Aug 2024 and 16 other columns with different category of vehicles.

- Convert Data column into datetime which helps python recognise date column has date format
- Extract year and get total yearly sales data by category
- Transpose the data so that category came in rows and year in columns which will help make clusters out of vehicle category
- Scale the data by standardscaler

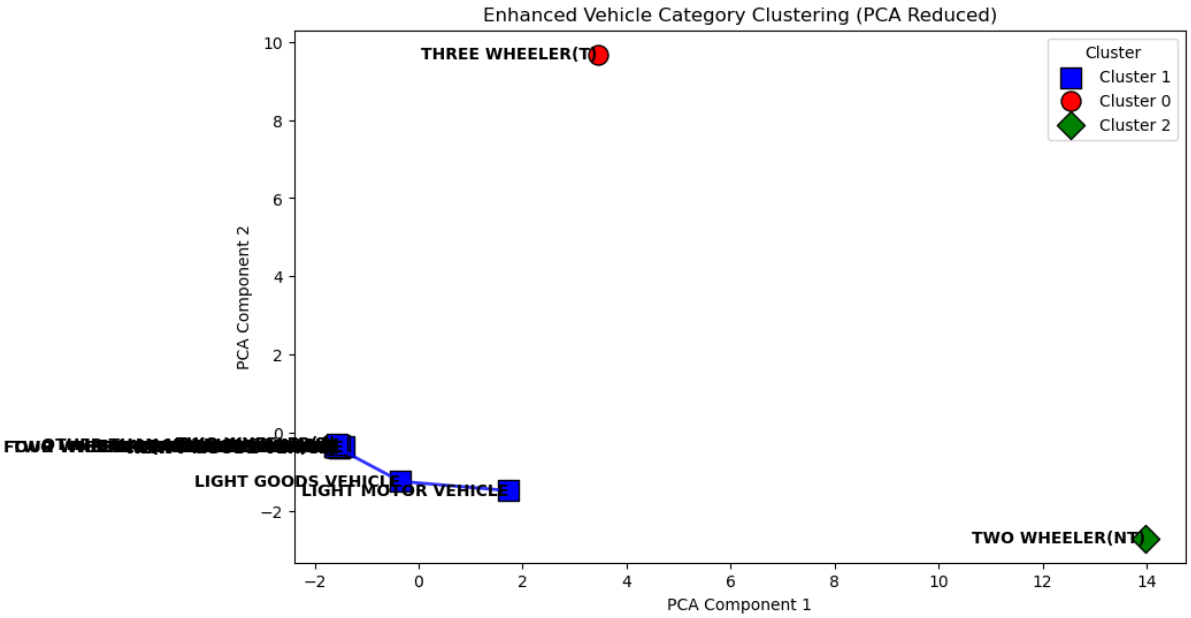
Perform Hierarchical Clustering



- Dendrogram for vehicle category clustering.
- It shows how many clusters can we make 3 clusters or more
- Let’s check Elbow graph k-means clustering

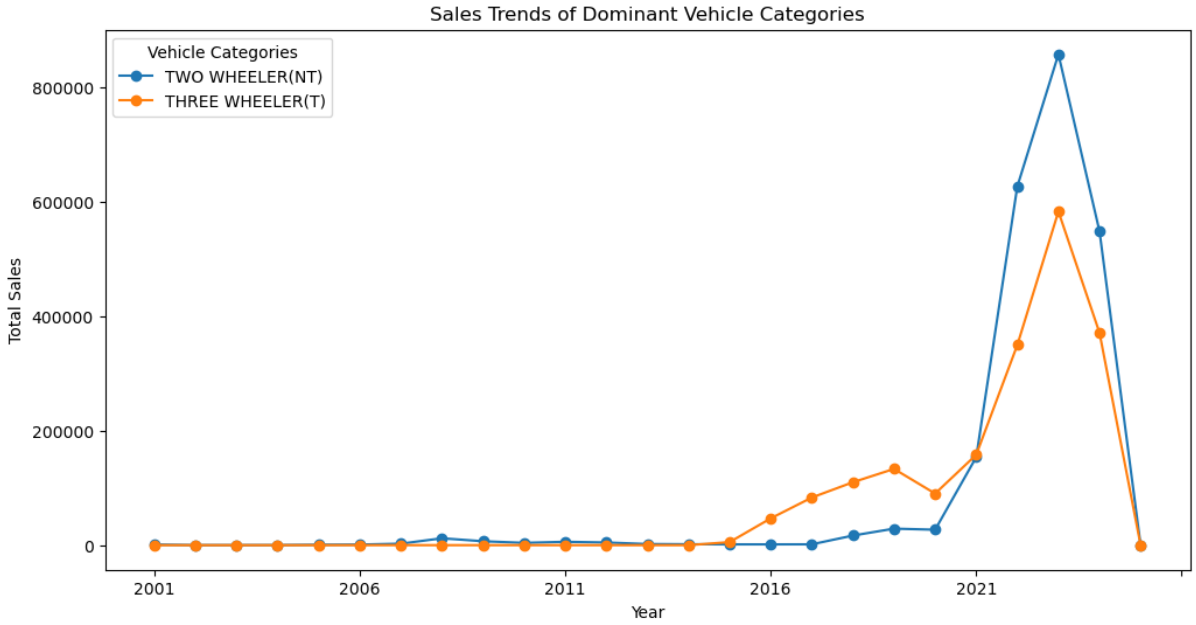


- Elbow method shows k=3 is the optimal clustering value
- Silhouette Score for 3 Clusters: 0.7593
- Silhouette Score for 4 Clusters: 0.7463
- According to Silhouette score 3 cluster silhouette score is more. Let's select k=3 for k-means clustering.

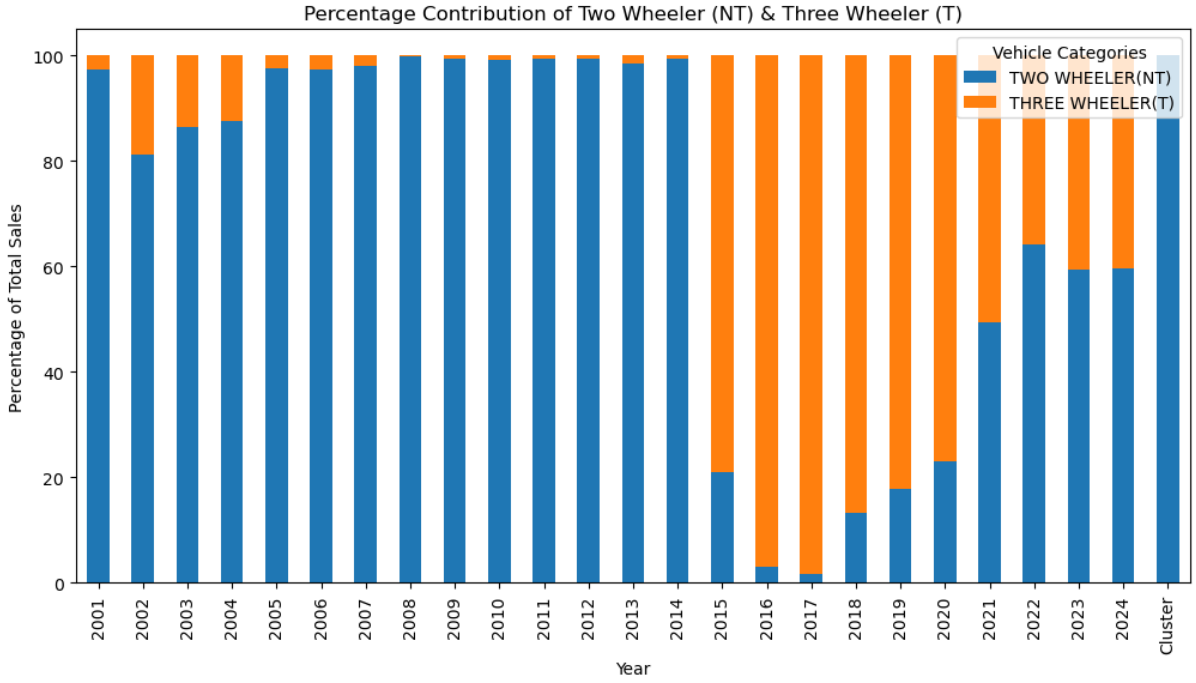


- K-means clustering gave us 3 clusters
- 1- Two wheeler non transport (non – commercial)
- 2- Three wheeler transport (For commercial use)
- 3- Other remaining vehicle categories

- we can see two main categories emerging two wheeler (NT) and Three wheeler(T)



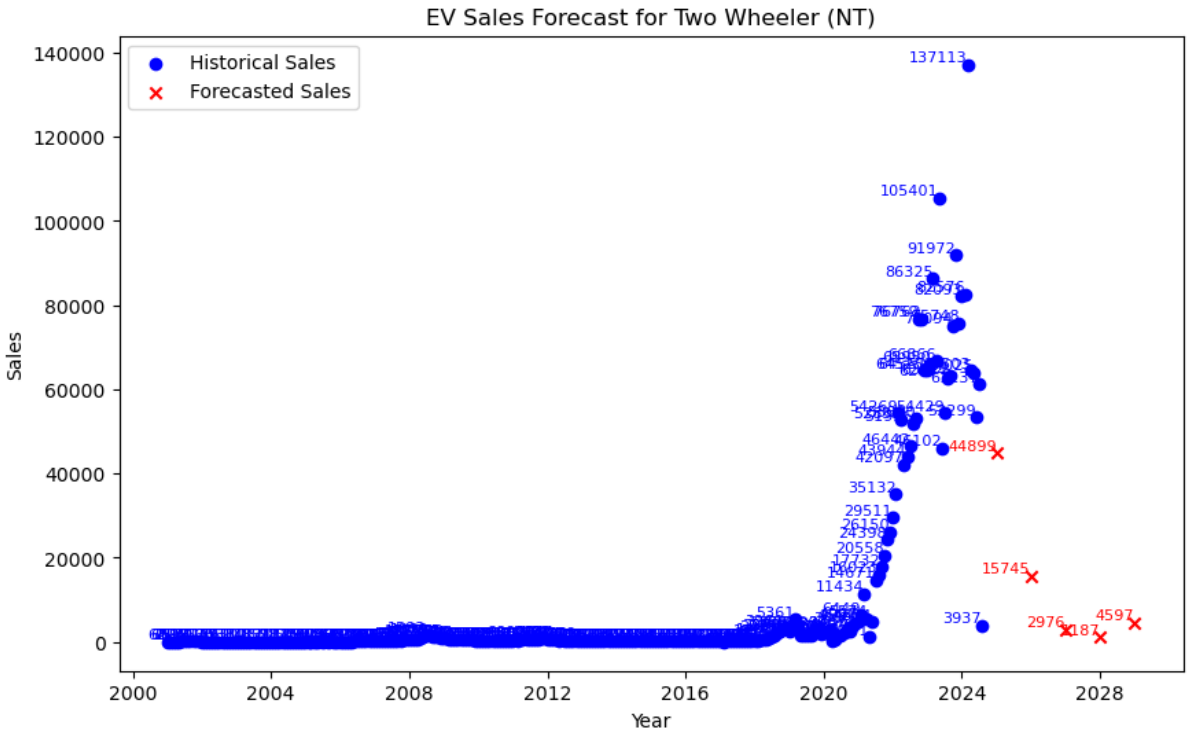
- Sales Trends Of two-wheeler and three-wheeler since 2001 to 2024.
- Intial adoptation EV was done by Three-wheeler transport vehicles.
- And then Two wheeler sales have dominated since 2021 onwords.



- Percentage contribution of 2w(NT) and 3w(T)
- This Graph show the sales percentage distribution clearly

For next sale prediction I am choosing only Two-Wheeler (NT)

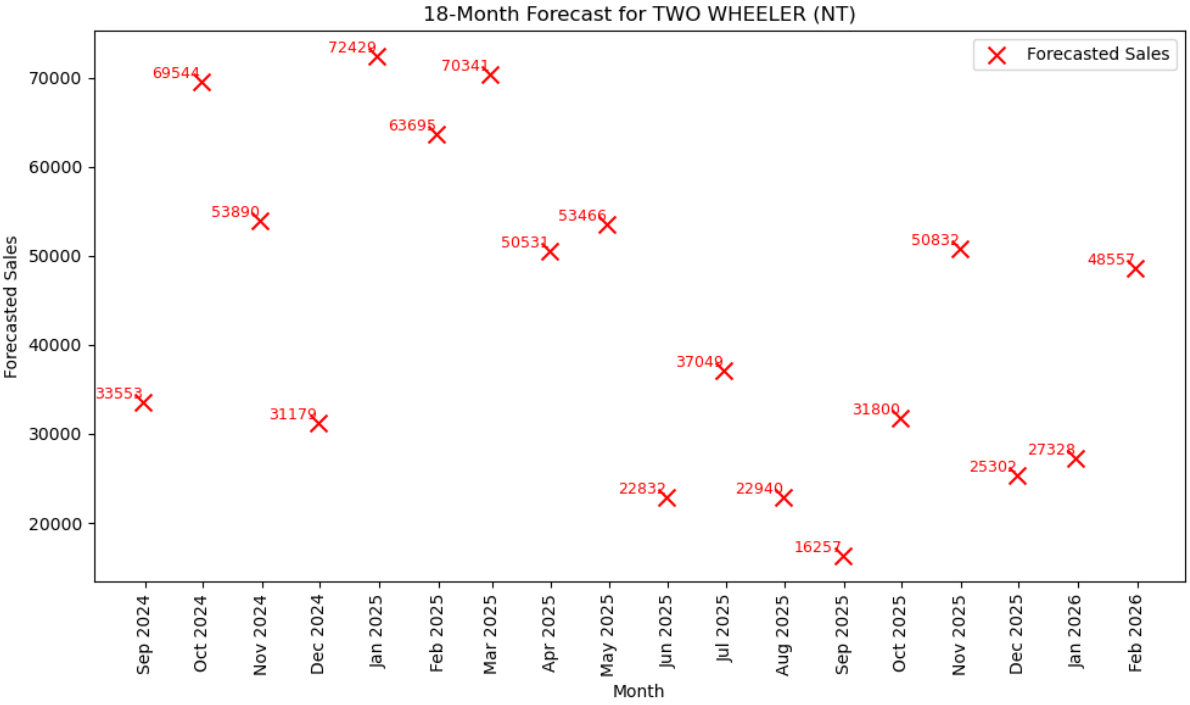
- Using arima model do predict next 5 years of sale



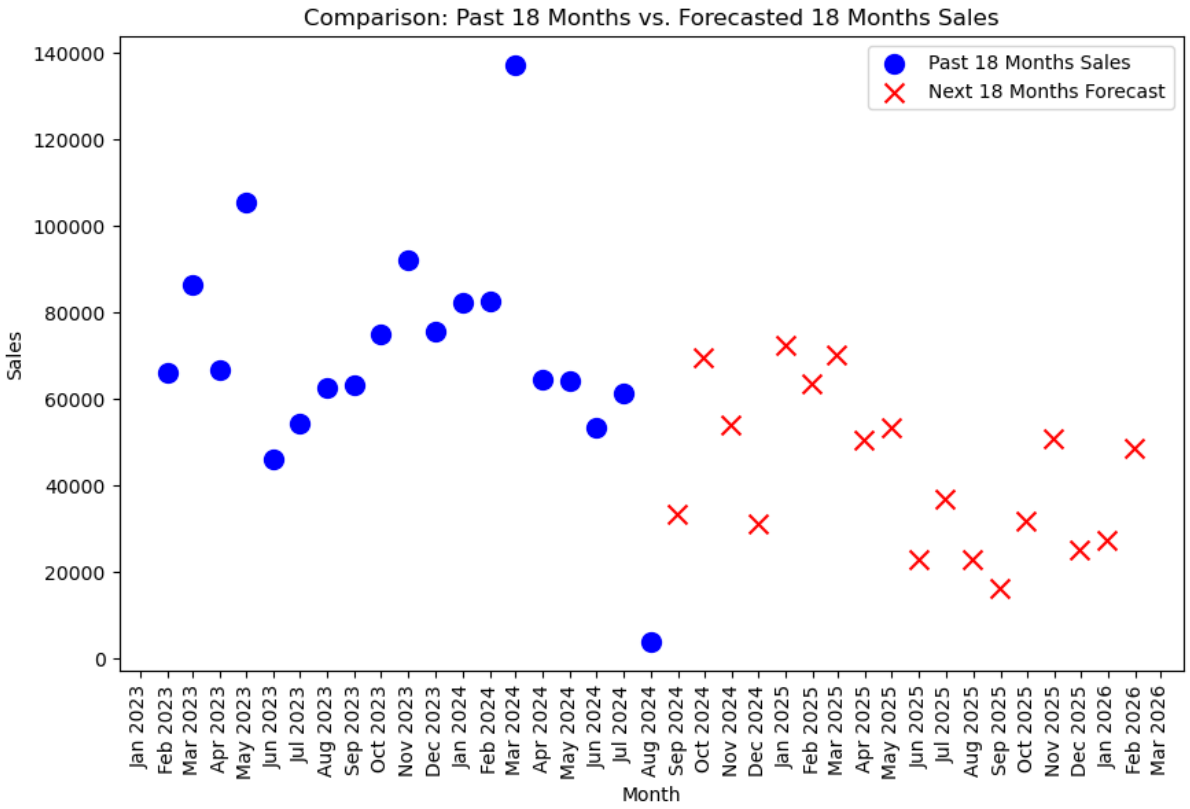
- EV sales Forecast for two-wheeler(NT)
- This graph shows next 5 year two-wheeler(NT) sales prediction which is not clear

So lets try next 18 months prediction using SARIMA model because this month will be in series

- Best model: ARIMA(2,1,3)(2,0,1)[12]



- This Graph shows next 18 months prediction of two wheeler (NT)



- Graph shows sales value from feb-2023 to march-2026

Conclusion:

Recommending Two-wheeler(NT) for any EV company acoording to these datasets that category of vehicle is doing well in EV market and second three-wheeler(T) is also good for those compaies which want a commerical customer.