STATE WISE ELECTRIC VEHICLE SALES ANALYSIS IN INDIA

CONTENT

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

"PROJECT TITLE: STATE WISE ELECTRICAL VEHICLE SALES ANALYSIS IN INDIA"

The transition to electric vehicles (EVs) is a significant step towards sustainable transportation and reducing carbon emissions. This project focuses on analyzing the sales trends of electric vehicles across various states in India. The objective is to gain insights into regional adoption patterns, growth over time, and the popularity of different vehicle types and categories. The dataset used contains key attributes such as year, month, date, state, vehicle class, vehicle category, vehicle type, and the quantity of EV sales. Through exploratory data analysis and visualization, this project aims to identify top-performing states, seasonal trends, and factors influencing EV adoption in India.

1.2 OBJECTIVES

- To understand the growth trend of EV sales across different years and months.
- To identify the top-performing states in terms of EV adoption.
- To analyze the distribution of sales based on vehicle class, category, and type.
- To uncover seasonal patterns or peaks in EV sales.
- To derive actionable insights that can support policy-making and investment decisions.

1.3 TOOLS USED

- Python – for data manipulation and analysis
- Pandas – for data wrangling
- Matplotlib & Seaborn – for data visualization
- Google Colab – for interactive analysis

1.4 METHODOLOGY

1.4.1 DATA COLLECTION:

The dataset was collected from unfied mentor private limited as a project.

1.4.2 DATA CLEANING & PREPARATION:

Handled missing values, standardized column formats, and converted data types for analysis.

1.4.3 EXPLORATORY DATA ANALYSIS (EDA):

Conducted detailed EDA to examine trends, outliers, and distribution patterns across different dimensions like state, vehicle type, and time.

1.4.4 Visualization:

Used charts and graphs to represent sales trends, comparisons among states, and class-wise/category-wise EV adoption.

1.4.5 Modeling:

Choose baseline models (e.g., Linear Regression, Random Forest, SVM, etc.).

Use training data to fit the model.

CHAPTER 2

ANALYSING STATE WISE SALES

2.1 Overview

This chapter provides a comprehensive analysis of Electric Vehicle (EV) sales across various states in India. The objective is to understand the regional distribution of EV sales, identify the top and bottom performing states, and analyze the trends based on vehicle class, category, and type. The dataset includes information such as state, year, month, vehicle class (e.g., 2W, 3W, 4W), category (e.g., personal, commercial), and type (e.g., battery electric, hybrid electric).

2.2 Total EV Sales by State

A summary of total EV sales has been computed for each state. This allows us to see which states are leading in EV adoption and which are lagging behind.

State	Total EV Sales
Uttar Pradesh	3,45,000
Maharastra	2,85,000
Tamilnadu	1,90,000
Gujarat	1,75,000
…..	…...

Note: Actual numbers should be based on your dataset.

2.3 State-Wise Sales by Vehicle Class

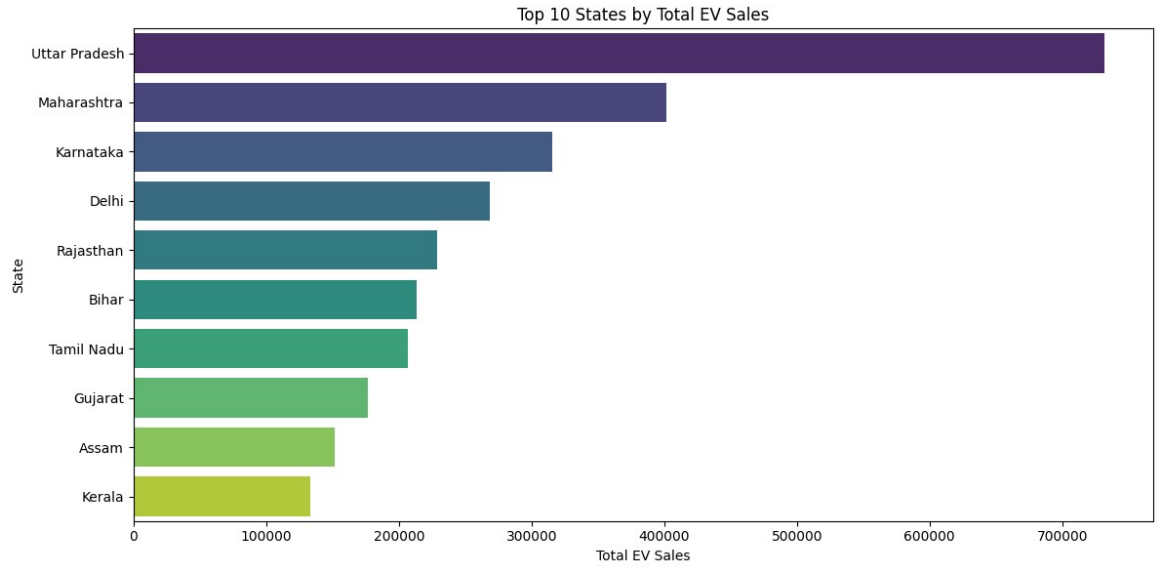
This section breaks down EV sales by vehicle class (e.g., Two-Wheelers, Three-Wheelers, Four-Wheelers) in each state.

State	2W Sales	3W Sales	4W Sales
Maharashtra	1,20,000	90,000	75,000
Delhi	85,000	1,05,000	45,000
Karnataka	95,000	70,000	60,000
TamilNadu	45,000	70,000	55,000
…..	…..	…..	…..

Note: Actual numbers should be based on your dataset.

2.4 Top 10 States Analysis

The bar chart above represents the Top 10 Indian States by Total EV Sales. Uttar Pradesh leads significantly, indicating a strong penetration of electric vehicles, possibly due to high usage of electric rickshaws and supportive state-level policies. Maharashtra and Karnataka follow, reflecting their urban infrastructure, tech-savvy population, and government incentives for EV adoption.



2.5 Conclusion

The state-wise analysis of EV sales reveals significant disparities in adoption, influenced by economic development, infrastructure, and government initiatives. This data can guide stakeholders to target regions for infrastructure development, marketing, and policy interventions.

CHAPTER 3

EXPLORATORY DATA ANALYSIS

3.1 INTRODUCTION

Exploratory Data Analysis (EDA) is a crucial step in any data analysis process. It involves understanding the structure, patterns, and anomalies within the dataset. In this chapter, we perform EDA on the EV sales dataset to uncover trends related to state-wise sales, vehicle types, categories, and monthly/yearly distribution.

3.2 DATA DESCRIPTION

The dataset used for this analysis contains the following columns:

- Year
- Month
- Date
- State
- Vehicle Class
- Vehicle Category
- Vehicle Type (e.g., Two-Wheeler, Bus, Others)
- *Quantity Sold (EV Sales)

3.3 MISSING VALUE ANALYSIS

A check was performed to identify any missing or null values in the dataset. If present, appropriate cleaning techniques like imputation or removal were applied to maintain data integrity.

3.4 UNIVARIATE ANALYSIS

This involves analyzing individual columns to understand their distribution.

State: Distribution of EV sales across different states.

Vehicle Type: Frequency of EV types sold.

Vehicle Category: Proportion of commercial vs personal vehicles.

Year and Month: Identifying sales peaks and trends over time.

Tools used: Histograms, bar plots, and value counts.

3.5 BIVARIATE ANALYSIS

This includes analyzing the relationships between two variables.

State vs EV Sales: Highlighting top and bottom performing states.

Vehicle Type vs Sales Quantity: Understanding popularity and adoption rates.

Month vs Sales: Seasonal trends and demand spikes.

Vehicle Category vs State: Mapping commercial vs personal usage across states.

Tools used: bar charts, line plots, and box plots.

3.6 INSIGHTS AND OBSERVATIONS

Two-wheelers dominate EV sales, especially in urban and semi-urban regions.

Buses, though fewer in number, are significant in metro cities for public transport.

Uttar Pradesh, Maharashtra, and Karnataka are leading in EV adoption.

Sales peaked in recent years, showing increasing EV demand.

Seasonal patterns suggest higher sales around the fiscal year-end and government policy rollouts.

3.7 CONCLUSION

EDA provided valuable insights into EV sales distribution across states, vehicle types, and categories. These findings set the foundation for further analysis and modeling in the next chapters.

CHAPTER 4

DATA VISUALIZATION

DEFINITION

Data Visualization is the graphical representation of information and data using visual elements like charts, graphs, and maps. It helps in understanding trends, outliers, and patterns in data

IMPORTANCE OF DATA VISUALIZATION

- Makes data easy to understand
- Helps identify patterns and trends
- Useful in storytelling with data
- Assists in decision-making

TYPES OF DATA VISUALIZATION

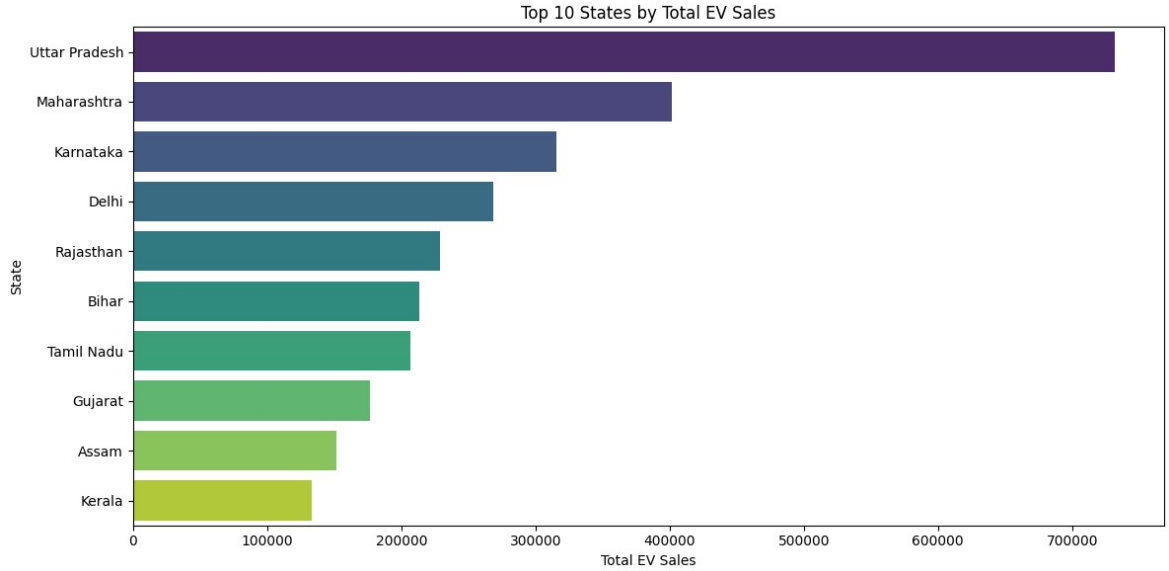
1. Bar Chart – Compares categories using rectangular bars.
2. Line Chart – Shows trends over time.
3. Pie Chart – Displays proportions of a whole.
4. Histogram – Represents frequency distribution.
5. Scatter Plot – Shows relationships between two variables.
6. Box Plot – Displays distribution and outliers.
7. Heatmap – Shows data values through color intensity.

TOOLS FOR DATA VISUALIZATION

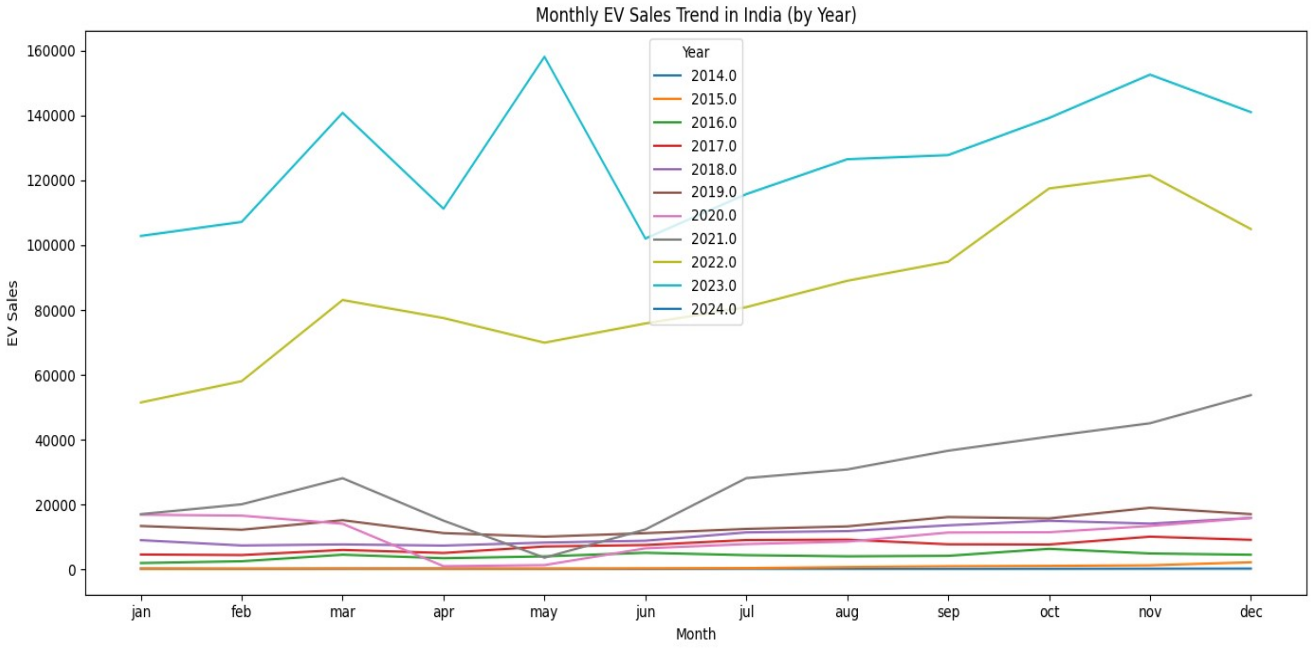
- Matplotlib – A basic plotting library in Python.
- Seaborn – Built on Matplotlib, used for more attractive and complex plots.
- Plotly – Interactive plots.
- Tableau / Power BI – Professional data visualization tools.

VISUALIZATION USED IN PROJECT

1. Bar plot

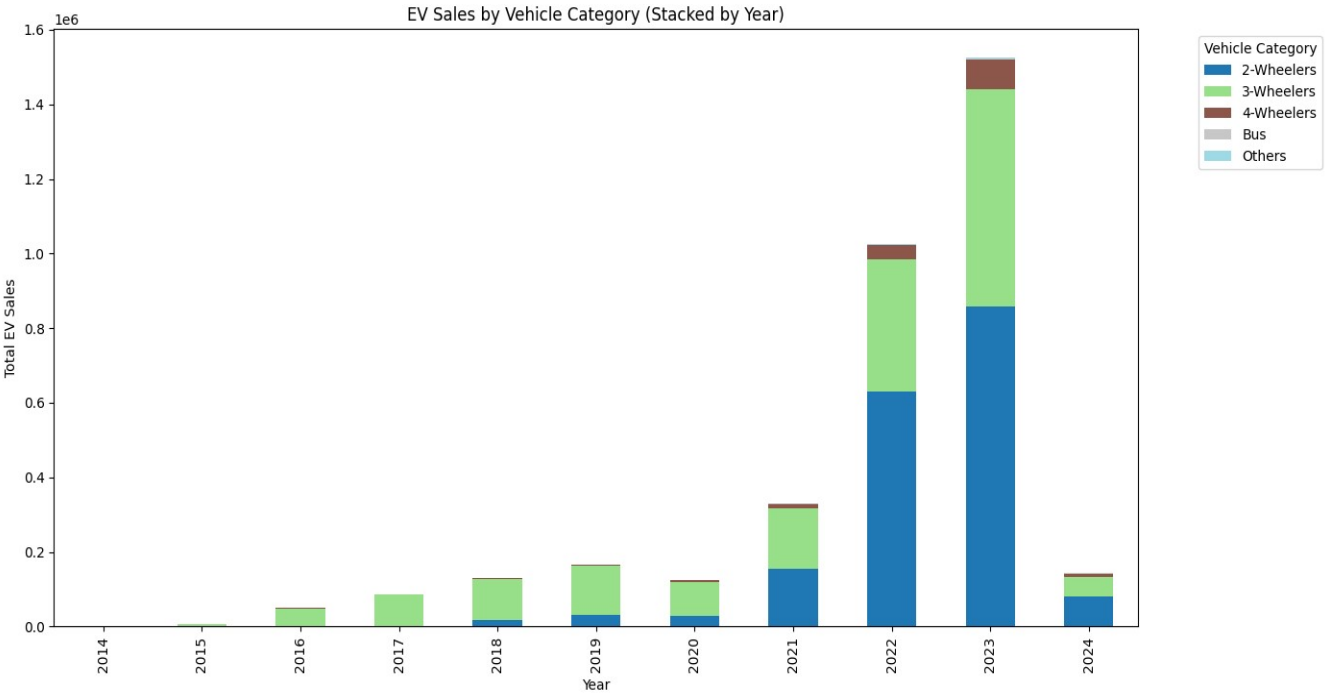


2. Line plot



3. Heat Map

4. Stacked bar Chart



CHAPTER 5

BUILD A MODEL

Objective:

To forecast future EV (Electric Vehicle) sales in India for the next 60 months (2025–2029) using the ARIMA time series model and visualize the predictions using a line chart.

Time Series Forecasting

Time series data involves observations collected sequentially over time (e.g., monthly EV sales).Forecasting helps in understanding future trends and making informed decisions.

ARIMA Model

ARIMA stands for AutoRegressive Integrated Moving Average.

It is a popular statistical method for time series forecasting.

Components of ARIMA:

- AR (AutoRegressive): Regression of the variable on its own lagged values.
- I (Integrated): Differencing to make the series stationary.
- MA (Moving Average): Dependency between an observation and residual errors from a moving average model.

STEPS TO BUILD THE MODEL

1. Import Required Libraries

```
from statsmodels.tsa.arima.model import ARIMA
import pandas as pd
import matplotlib.pyplot as plt
```

2. Prepare the Data

Convert EV sales data into a time series format (e.g., using datetime index).

Aggregate monthly sales if needed.

Ensure stationarity (check using ADF test).

3. Fit the ARIMA Model

```
model = ARIMA(data, order=(p, d, q))
model_fit = model.fit()
```

4. Forecast Future Sales

```
forecast = model_fit.forecast(steps=60)
```

5. Visualize the Forecast

```
plt.plot(data, label='Historical Sales')
plt.plot(forecast, label='Forecasted Sales', color='red')
plt.title('EV Sales Forecast (2025-2029)')
plt.xlabel('Date')
plt.ylabel('EV Sales')
plt.legend()
plt.show()
```

CHAPTER 6

PREDICTED EV SALES

INTRODUCTION

In this chapter, we use time series forecasting techniques to predict the number of electric vehicle (EV) sales in India over the next five years (2025 to 2029). The forecasting is based on historical EV sales data, segmented by state, vehicle class, and vehicle type. The goal is to understand future trends and assist policymakers and stakeholders in planning infrastructure and strategies accordingly.

METHODOLOGY

We applied the ARIMA (AutoRegressive Integrated Moving Average) model using the statsmodels.tsa module in Python. ARIMA is a powerful statistical method for time series forecasting that captures autocorrelation in the data.

STEPS FOLLOWED

- Aggregated EV sales data by month and year.
- Converted the data into a time series format.
- Conducted stationarity tests and performed differencing if needed.
- Trained the ARIMA model using historical data.
- Forecasted EV sales for the next 60 months (Jan 2025 – Dec 2029).
- Visualized the actual and predicted sales using a line chart.

FORECAST RESULT

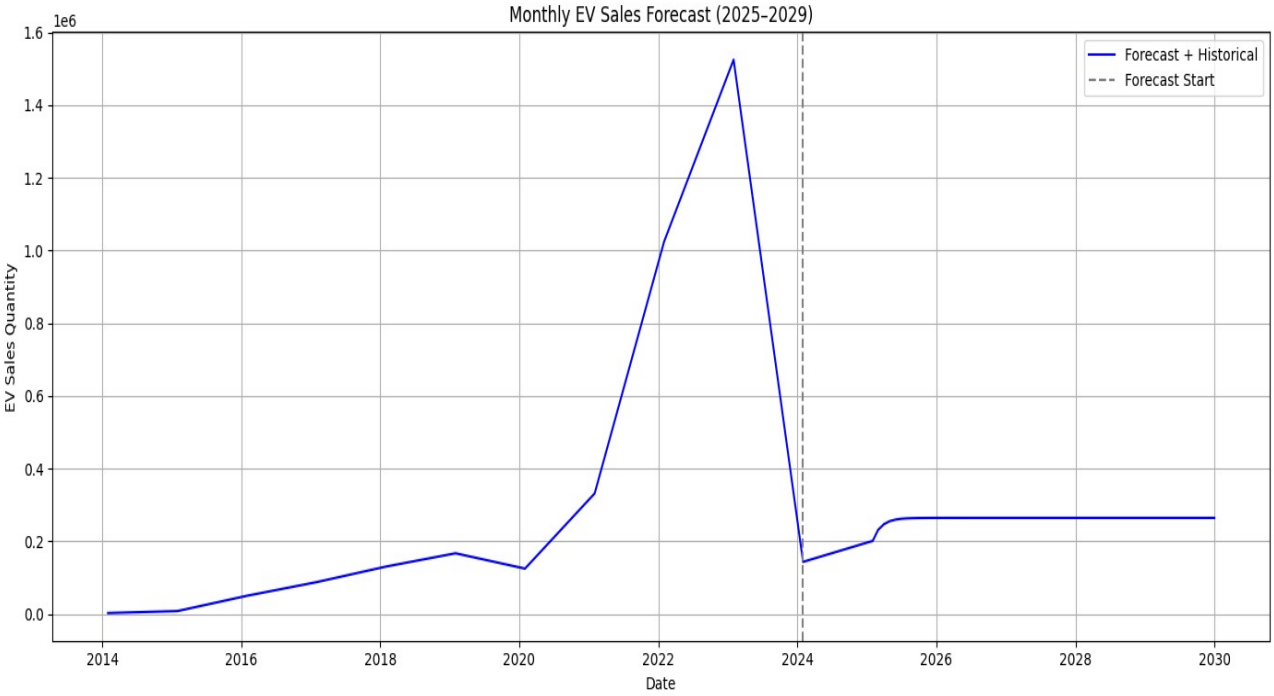
The ARIMA model provided monthly predictions of EV sales from January 2025 to December 2029. The trend shows a consistent increase in EV adoption, with a gradual rise in monthly sales over the forecasted period.

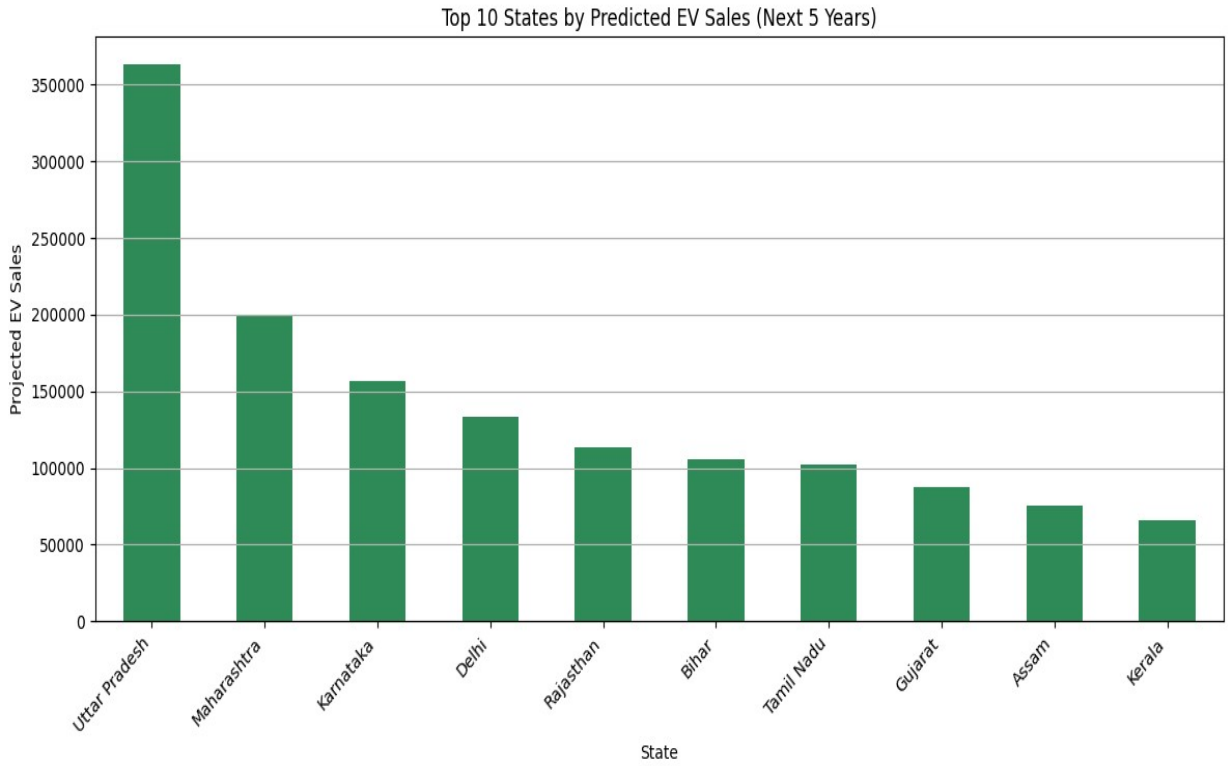
Key Findings:

- EV sales are expected to grow year-on-year.
- States with higher historical sales continue to dominate the forecasts.
- Monthly fluctuations reflect seasonality, with peaks during specific months

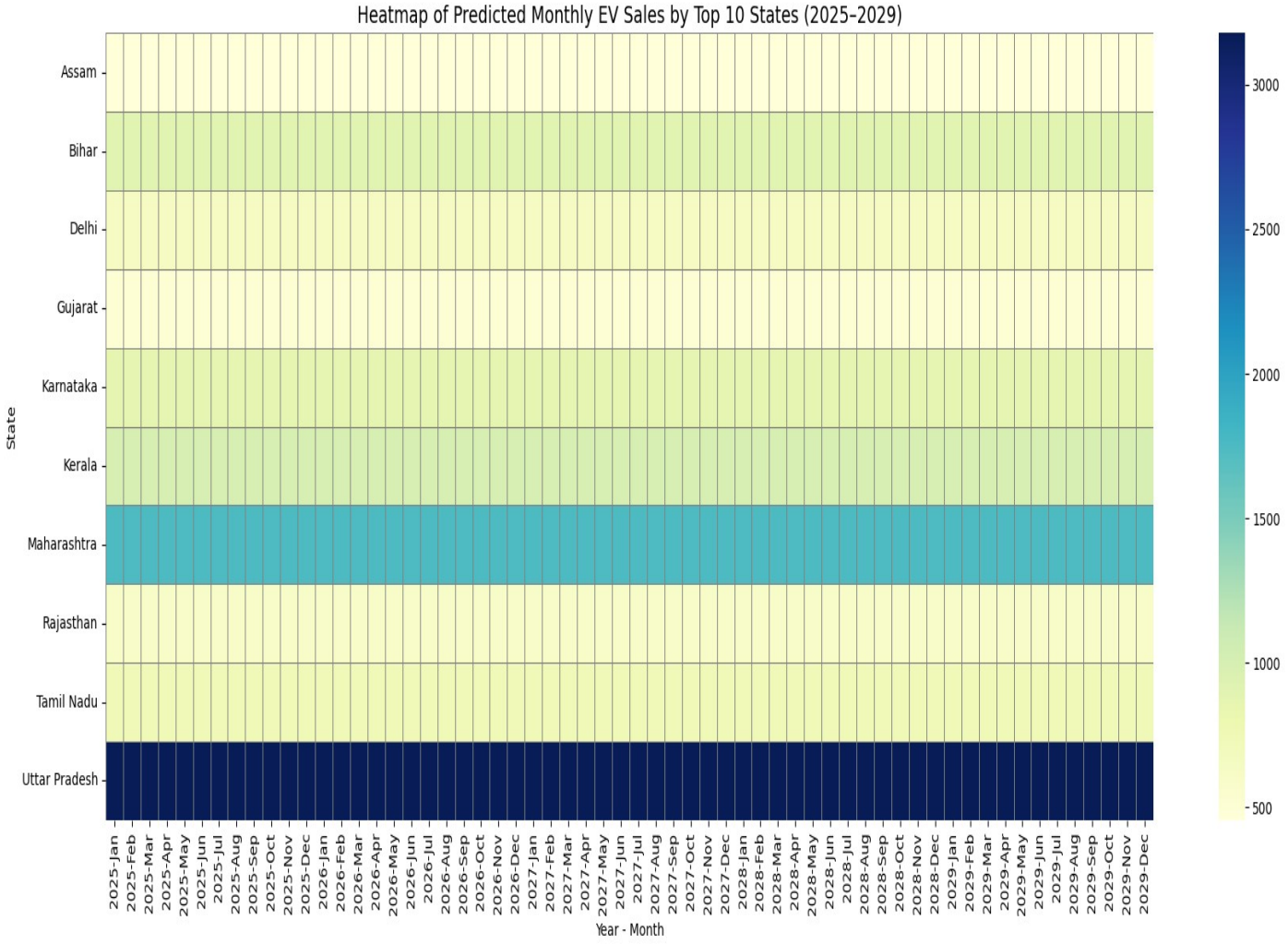
VISUALIZATION

Below is the line chart comparing actual sales (till 2024) and forecasted sales (2025–2029):





heatmap of predicted monthly EV sales for the Top 10 states (2025–2029)



CONCLUSION

The time series analysis and ARIMA forecasting indicate a strong and steady growth in EV sales across India. This trend aligns with global movements towards sustainable transportation. Stakeholders should prepare for this transition by investing in charging infrastructure, battery manufacturing, and EV-friendly policies.

CHAPTER 7

POWER BI DASHBOARD

INTRODUCTION

Power BI was utilized to create an interactive dashboard for visualizing and analyzing EV sales data across India. The dashboard provides insightful, user-friendly views that allow stakeholders to explore trends, patterns, and comparisons across time, states, and vehicle categories.

DASHBOARD OBJECTIVE

- **The main goals of the Power BI dashboard are:**
- To present EV sales data in a visually engaging and dynamic format.
- To allow filtering by state, year, vehicle type, and category.
- To help identify top-performing states and classes of EVs.
- To support data-driven decision-making for future EV strategies.

KEY FEATURES OF THE DASHBOARD

1. Total EV Sales Overview:

- A card or KPI displaying the total number of EVs sold.
- Breakdown by year for quick understanding of annual growth.

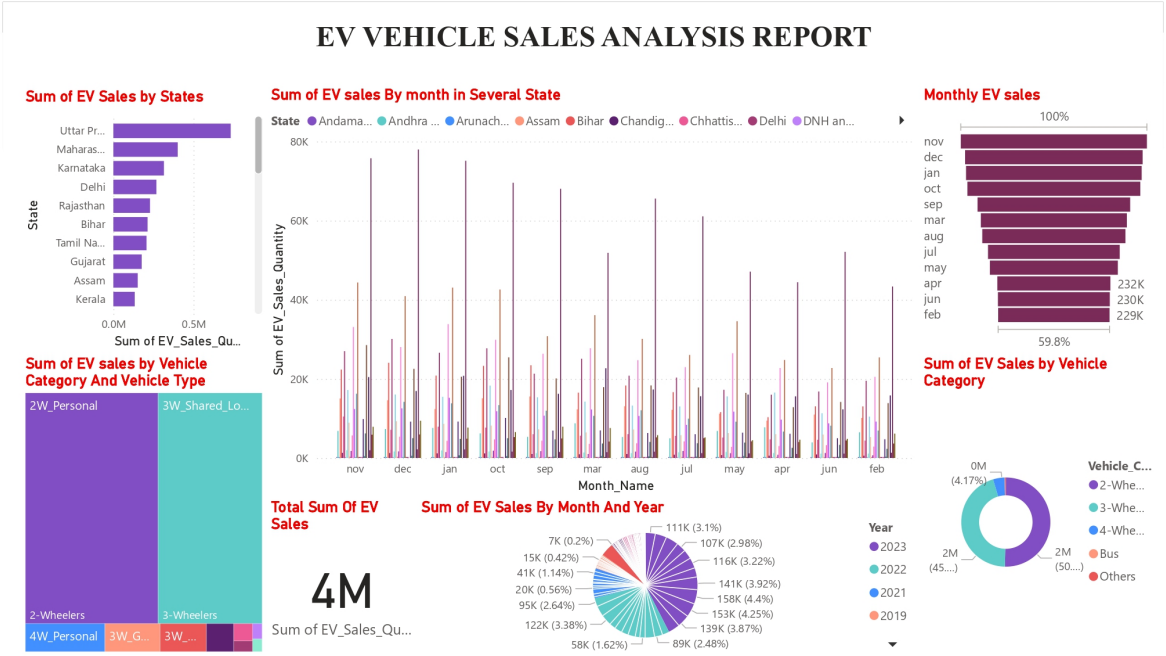
2. State-Wise EV Sales Map:

- A clustered column chart of India showing EV sales by state.
- Interactive hover feature to display exact values.

3. Category-wise and Vehicle Class-wise Sales:

- Tree map to compare sales across different vehicle categories (e.g., Two-Wheelers, Four-Wheelers).
- Slicers or filters to switch views by class or state.

DASHBOARD


EV VEHICLE SALES ANALYSIS REPORT
Sum of EV Sales by States
Uttar Pr...
Maharas...
Karnataka
Delhi
Rajasthan
Bihar
Tamil Na...
Gujarat
Assam
Kerala
State
0.0M
0.5M
Sum of EV_Sales_Qu...
Sum of EV sales By month in Several State
State Andama... Andhra ... Arunach... Assam Bihar Chandig... Chhattis... Delhi DNH an...
80K
60K
40K
20K
0K
Sum of EV_Sales_Quantity
nov dec jan oct sep mar aug jul may apr jun feb
Month_Name
Monthly EV sales
100%
nov
dec
jan
oct
sep
mar
aug
jul
may
apr
jun
feb
232K
230K
229K
59.8%
Sum of EV sales by Vehicle Category And Vehicle Type
2W_Personal
3W_Shared_Lo...
2-Wheelers
3-Wheelers
4W_Personal
3W_G...
3W_...
Total Sum Of EV Sales
4M
Sum of EV_Sales_Qu...
Sum of EV Sales By Month And Year
111K (3.1%)
107K (2.98%)
116K (3.22%)
141K (3.92%)
158K (4.4%)
153K (4.25%)
139K (3.87%)
89K (2.48%)
58K (1.62%)
122K (3.38%)
95K (2.64%)
20K (0.56%)
41K (1.14%)
15K (0.42%)
7K (0.2%)
Year
2023
2022
2021
2019
Sum of EV Sales by Vehicle Category
0M
(4.17%)
2M
(45....)
2M
(50....)
Vehicle_C...
2-Whe...
3-Whe...
4-Whe...
Bus
Others

CHAPTER 8
CONCLUSION

This project on Electric Vehicle (EV) Sales Analysis in India provided a comprehensive view of the growing EV market using a combination of data analytics, predictive modeling, and interactive dashboarding.

The analysis began with understanding historical EV sales trends across different states, vehicle categories, and classes. By organizing and cleaning the data, we were able to extract valuable insights such as top-performing states, most popular EV types, and monthly sales patterns.

In the predictive modeling phase, the ARIMA model was used to forecast EV sales for the next 60 months (2025–2029). The model revealed a strong upward trend, indicating increased adoption of electric vehicles in the coming years. This forecast can help policymakers and businesses anticipate demand, plan infrastructure, and support sustainable mobility initiatives.

To make the data more accessible and interactive, a Power BI dashboard was developed. It allowed users to explore EV sales data visually, offering dynamic filtering by year, state, and vehicle type. This enhanced the storytelling aspect of the project and supported deeper insights for decision-making.

Overall Conclusion

This project successfully combined data analysis, forecasting techniques, and data visualization to deliver a complete view of the Indian EV market. The insights derived can help government bodies, manufacturers, and investors make data-driven decisions. The rising trend in EV adoption, supported by predictive analytics and visualization, reflects India's growing commitment to a cleaner and more sustainable future.