1. **Problem Statement**

Walmart wants to improve its weekly inventory management and stock planning across its 45 stores. The challenge is to forecast weekly sales for each store using historical data, enabling data-driven decisions to optimize operations and meet customer demand effectively.

2. **Project Objective**

To develop a robust time series model capable of forecasting the next 12 weeks of weekly sales for each store. The project specifically aims to:

- Understand historical sales patterns,
- Analyze seasonality and trends,
- Build predictive models using ARIMA and SARIMAX,
- Evaluate model performance,
- Provide actionable sales forecasts for future planning.

3. **Data Description**

Dataset Information:
The walmart.csv contains 6435 rows and 8 columns.

Feature Name	Description
Store	Store number
Date	Week of Sales
Weekly_Sales	Sales for the given store in that week
Holiday_Flag	If it is a holiday week
Temperature	Temperature on the day of the sale
Fuel_Price	Cost of the fuel in the region
CPI	Consumer Price Index
Unemployment	Unemployment Rate

4. **Data Pre-processing Steps and Inspiration**

- Converted `Date` to datetime format and set as index.
- Grouped data store-wise using a loop to generate separate DataFrames for each store.
- Filled missing values using forward/backward fill.
- Differenced data if non-stationary (checked via ADF test).
- Selected a univariate model, keeping only `Date` and `Weekly_Sales` columns.
- Resampled to weekly frequency and ensured no missing weeks.

5. **Choosing the Algorithm for the Project**

We used:

- **ARIMA** for initial modeling to understand autoregressive (AR), moving average (MA), and trend (differencing).
- **SARIMAX** to capture **seasonality**, which ARIMA alone could not handle.

6. **Motivation and Reasons for Choosing the Algorithm**

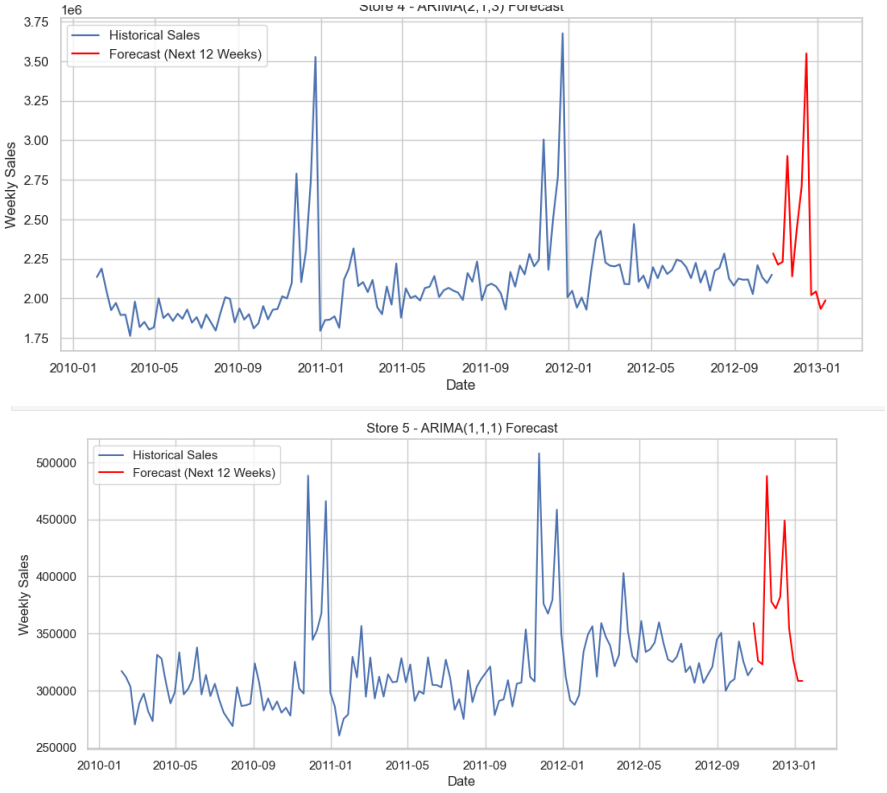
- ARIMA provides a solid base for univariate time series forecasting.
- SARIMAX supports **seasonal decomposition** and **repeating patterns**, ideal for retail where sales fluctuate during holidays and year-end.
- These models are interpretable and customizable, making them great for business use cases.

7. **Assumptions**

- Weekly seasonality is consistent over years (s=52).
- Past sales patterns repeat and are predictive of future trends.
- Economic indicators are excluded in this phase (SARIMAX without exogenous inputs).
- Forecasting window is 12 weeks.

8. **Inferences from the Same**

- Forecasts for stores with high seasonal spikes (e.g., Store 2 and Store 4) were better handled by SARIMAX than ARIMA.
- SARIMAX captures year-end and holiday surges, visible in the forecast plots.
- Some stores (e.g., Store 5) showed relatively stable patterns, while others had large fluctuations, possibly due to promotions or regional behavior.



10. **Future Possibilities of the Project**

- Integrate **exogenous variables** like holiday flags, fuel prices, and CPI into SARIMAX or XGBoost models.
- Explore **deep learning** models (LSTM, GRU) for more dynamic sales prediction.
- Deploy a dashboard for Walmart management to view live forecasts.
- Include store categorization (urban vs rural) for segmented forecasting.

11. **Conclusion**

The project successfully developed a forecasting system using SARIMAX for the first 5 Walmart stores, demonstrating clear improvements over plain ARIMA in terms of capturing seasonality. Forecasts can now guide business decisions, optimize inventory, and enhance customer satisfaction.

12. **References**

- Walmart Sales Dataset (Provided)
- Statsmodels ARIMA/SARIMAX documentation
- pmdarima auto_arima library
- ADF Test – Dickey-Fuller stationarity check

- Seaborn & Matplotlib for plotting