Retail Demand Forecasting: Project Summary Report

Objective

To evaluate how demand forecasting can improve inventory efficiency and reduce operational risk by analyzing demand behavior across retail stores with differing volatility profiles.

Data & Scope

- Weekly Walmart store sales data (2010–2012)
- Two representative stores selected:
  - Store 1: Stable demand pattern
  - Store 20: High volatility and demand spikes
- Included holiday and macroeconomic indicators to reflect real-world demand drivers

Methodology

- Conducted exploratory analysis to assess seasonality, volatility, and demand stability
- Built two forecasting models:
  - Exponential Smoothing (ETS) as a baseline
  - Prophet with holidays and macroeconomic regressors as the primary model
- Evaluated forecasts using MAPE, MAE, and forecast bias on a holdout test period

Key Insights

- Demand predictability varies significantly by store
- Stable demand environments benefit from smoothed forecasts and lean inventory policies
- Volatile demand environments require higher safety stock and risk-aware planning
- Models alone are insufficient during extreme demand spikes, reinforcing the role of managerial judgment

Business Recommendations

- Adjust safety stock levels based on demand volatility rather than average sales
- Use forecasting models as planning tools, not rigid decision rules
- Apply conservative inventory buffers in high-risk periods and locations
- Focus promotions on periods where incremental demand is likely to be sustained

Conclusion

This project demonstrates how demand forecasting, when combined with business judgment, can support better inventory and revenue planning decisions in retail environments characterized by uncertainty.