# Abstract

This project presents a comprehensive approach to demand forecasting using advanced data analytics and machine learning techniques. We explore various models, including SARIMA, Random Forest, XGBoost, and LSTM, to predict future product demand using the Walmart Store Sales dataset. Our findings demonstrate the strengths and limitations of each model, providing insights into their practical applications.

# Introduction

Demand forecasting is essential for effective inventory management and operational efficiency. Traditional methods often fail to capture complex patterns in sales data, leading to inaccuracies. This project aims to develop a more robust and adaptive forecasting model using Python, leveraging historical sales data and advanced analytical techniques.

# Methods

We collected historical sales data and preprocessed it to handle missing values and create additional features. Several models were trained and evaluated, including time series, machine learning, and deep learning models. We optimized inventory levels using linear programming based on the forecasted demand.

# Discussion

The Random Forest and XGBoost models outperformed traditional time series models, demonstrating lower MAE and RMSE. The LSTM model showed promise but required extensive computational resources and tuning. Feature engineering and hyperparameter optimization significantly impacted model performance, highlighting the importance of these steps in the forecasting process.

# Conclusion

This project demonstrates the effectiveness of machine learning models, particularly Random Forest and XGBoost, in demand forecasting. While deep learning models like LSTM offer potential, they require more resources and tuning. Future work could involve integrating additional data sources, such as economic indicators and customer behavior data, to further improve forecast accuracy.