Enhancing Demand Forecasting Accuracy through Machine Learning: Analyzing Returns Data for Supply Chain Optimization

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Room: Engineering Building, R15

Zoom Link https://binghamton.zoom.us/j/93697284456

Abstract

Accurate forecasting in retail supply chains is vital for optimizing inventory levels, reducing costs, and improving customer satisfaction. While most forecasting efforts focus on forward demand, product returns are often overlooked despite their significant influence on operational planning and reverse logistics. This thesis focuses on analyzing and forecasting product returns by exploring a wide range of data-driven approaches, including classical statistical models, machine learning algorithms, and hybrid frameworks.

The study utilizes real-world data from a van-based retail supply chain where delivery and return transactions are recorded together. Various forecasting methods such as ARIMA, Ridge Regression, ElasticNet, Recurrent Neural Networks (RNN), and Multi-Layer Perceptron (MLP) are systematically evaluated. Additionally, hybrid models combining statistical and machine learning techniques are developed to capture both linear trends and complex nonlinear patterns. Feature engineering, including lagged values, rolling averages, and seasonality indicators, is applied to improve model accuracy.

Results reveal that hybrid models outperform individual approaches, offering substantial improvements in predictive performance. By systematically comparing these techniques, the study provides a comprehensive understanding of how integrating forward and reverse logistics data can enhance forecasting accuracy. This research demonstrates the value of adopting a data-driven and multi-model strategy to improve operational decision-making in modern retail supply chains.