

Demand Forecasting Under Uncertainty: Evaluating the Robustness of Statistical and Machine Learning Models

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Abstract. Exactly forecasting needs is essential for the recovery of the supply chain (SC), under uncertainty. This study assessed the strength of three forecast models - ARIMA (statistics), Prophet (hybrid), and LightGBM (automatic learning) - using a retail data set from the real world to be segmented into a stable and a disturbed period. Models are evaluated using Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), and efficiency indicators, highlighting trade-offs between accuracy and practicality. The results showed that the prophet achieved the lowest absolute errors, Arima provided a relatively better accuracy, and LightGBM brought more expansion and efficiency, but with reduced accuracy without external characteristics. In addition to digital results, research contributes to decisions in uncertainty by framing the strength of the model as a major element of the SC recovery ability. Results are provided for researchers and students to choose the methods of forecasting the balance of accuracy, adaptability, and efficiency in a dynamic environment.

Keywords: Demand Forecasting; Uncertainty; Time Series Prediction; Machine Learning; ARIMA; Prophet; LightGBM