**Predictive Analytics for Inventory Demand in Supply Chain**

Retail organizations often face challenges in accurately forecasting customer demand, leading to several downstream issues such as distribution center capacity shortages, labor imbalances, stockouts, shipment delays, and increased Order-to-Delivery (OTD) time. These inefficiencies ultimately result in customer dissatisfaction due to late or cancelled deliveries. This study aims to develop a data-driven forecasting framework to estimate inventory demand based on historical sales and shipment data using advanced time-series techniques. The SARIMAX model is employed to capture seasonal patterns and trends influencing demand fluctuations. We utilize an e-commerce retail dataset to perform data preprocessing, model development, visualization, and performance evaluation through statistical error metrics. The proposedstatistical time series model– SARIMAX approach demonstrates improved forecasting accuracy when compared to traditional baseline models such as Moving Average and Simple Exponential Smoothing. By achieving more reliable demand forecasts, the study contributes to better inventory management, optimized distribution center operations, and enhanced customer satisfaction within the retail supply chain ecosystem.