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Dynamic raw material ordering under demand uncertainty: A Markov chain–Newsvendor approach

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ABSTRACT

Raw material ordering under demand uncertainty is often hindered by inaccurate forecasts, resulting in excess inventory, stockouts, and increased operating costs. Traditional Newsvendor models typically assume static demand distributions and therefore have limited ability to capture dynamic changes in demand. To address this limitation, this study proposes a Markov chain–based Newsvendor decision framework incorporating an [*L*, *U*] inventory boundary policy. The main contribution of the proposed framework is the integration of state-transition-based probabilistic demand forecasting with inventory optimization. Specifically, raw material demand is classified into a finite set of states, and the transition probability matrix is estimated from historical demand-state observations. The resulting predicted demand distribution is then incorporated into the Newsvendor model to determine the optimal order-up-to level and the corresponding replenishment quantity. A simulation-based case study of an electronics manufacturing firm is conducted using a generated 52-week demand dataset. The results show that the proposed MC-NM model reduces the expected total ordering cost from 4887.68 yuan to 4269.92 yuan, corresponding to a cost reduction of 12.6 %. These findings indicate that the proposed framework can reduce inventory-related costs while maintaining responsiveness to demand fluctuations, thereby providing practical decision support for raw material procurement under uncertainty.

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