Dynamic Pricing and Stochastic Demand Forecasting for Efficient Inventory Management in the Fashion Industry

Sohan Bandary (2020IMG-016)

Supervisor: Prof. Gyan Prakash

ABV-Indian Institute of Information Technology and Management Gwalior



Outline

- Introduction
- Research Questions
- Problem Statement
- 4 Literature Review
- Research Gaps
- 6 Objectives (Tentative)
- References

Introduction

Dynamic Pricing for Inventory Management 2

- Businesses face unpredictable demand, especially during seasonal or promotional periods. Dynamic pricing helps adjust prices in real-time based on demand variations.
- The main goal of dynamic pricing is to maximize profits and optimize inventory levels by responding to market changes in real-time.

Stochastic Demand Forecasting

- Forecasting future demand under uncertain and fluctuating market conditions is challenging.
- A stochastic approach takes randomness and volatility into account, helping to develop better models for future demand predictions.

Exponential Smoothing Method

- Exponential smoothing assigns exponentially decreasing weights to past demand data to generate a forecast, balancing recent demand trends with historical patterns.
- It allows businesses to adjust inventory strategies and pricing quickly as new data becomes available

Research Questions

- How can dynamic pricing strategies be integrated with stochastic demand forecasting to optimize inventory management for seasonal sales environments?
- What is the impact of using exponential smoothing in demand forecasting on profit margins and inventory replenishment strategies in a dynamic pricing framework?
- How can businesses effectively manage safety stock and buffer inventories while responding to real-time demand fluctuations using stochastic demand models?

Problem Statement

Challenge of Demand Uncertainty A

 Businesses struggle to predict demand accurately, leading to either overstocking or stockouts. These inefficiencies increase operational costs and reduce profitability.

• Static Pricing Limitations **Ö**

 Traditional pricing models are static and fail to respond to real-time demand changes, which leaves businesses unable to capitalize on peak demand periods or reduce losses in low-demand times.

Need for Integrated Demand and Pricing Strategy

 There is a need for a unified framework that combines accurate demand forecasting with flexible pricing strategies, allowing businesses to make data-driven decisions.



Research Summary

Title	Author(Year)	Key Findings
A comprehensive inventory management model with weibull distribution deterioration, ramp-type demand, carbon emission reduction, and shortages	Palanivel et al. (2024)	A comprehensive inventory management model incorporating Weibull distribution deterioration, ramptype demand, carbon emission reduction, and various shortage scenarios.
A sustainable vendor-buyer inventory model with incentives, green investment, and energy usage under stochastic demand	Jauhari et al. (2023)	Implementing green policies, such as carbon tax, green incentives, and green technology investment, significantly improves both the economic and environmental performance of supply chains.

Research Summary

Title	Author(Year)	Key Findings
A new key performance indicator model for demand forecasting in inventory management considering supply chain reliability and seasonality	Tadayonrad and Ndiaye (2023)	(KPI) model for demand forecasting in inventory management, focusing on incorporating supply chain relia- bility and seasonality factors to op- timize safety stock levels
A note on forecasting demand using the multivariate exponential smoothing framework	Poloni and Sbrana (2015)	Proposes a novel estimation method for multivariate exponential smoothing, which simplifies the forecasting of demand by down complex high-dimensional models into more manageable univariate ones.

Research Summary

Title	Author(Year)	Key Findings
Dynamic pricing model with logarithmic demand	Shukla and Khedlekar (2013)	Proposes an adjustment factor to correct the underestimation of the standard deviation in lead time demand when using simple exponential smoothing, offering a more accurate formula that accounts for both the smoothing constant and lead time length, which is essential for effec-
Forecasting aggregate demand: analytical comparison of top-down and bottom-up approaches in a multivariate exponential smoothing framework	Sbrana and Silvestrini (2013)	tive inventory control. Provides an analytical comparison of top-down and bottom-up approaches to forecasting aggregate demand within a multivariate exponential smoothing framework.

Research Gaps

Lack of Integrated Approaches

 Existing studies often examine components like dynamic pricing or demand forecasting individually. Few explore an integrated model combining stochastic demand modeling, exponential smoothing, and dynamic pricing for profit maximization.

Limited Focus on Sustainability

 The intersection of inventory management, dynamic pricing, and sustainability is underexplored. More research is needed on integrating eco-friendly practices with pricing strategies.

Opportunities in Data-Driven Decision Making

 There is potential to leverage machine learning for more accurate demand forecasts and dynamic pricing strategies that respond to real-time data.



Objectives (Tentative)

Optimize Inventory Management

 Develop a comprehensive model that integrates demand forecasting and dynamic pricing strategies to ensure efficient inventory replenishment.

Improve Demand Forecasting Accuracy @

 Use stochastic demand models and exponential smoothing to enhance the accuracy of demand predictions, which will allow for better decision-making.

Maximize Profitability with Dynamic Pricing \$

 Introduce pricing mechanisms that adjust according to real-time demand, helping businesses capitalize on high-demand periods and mitigate losses during low-demand periods.

Adaptation to Market Changes

 Ensure that the model can continuously adapt to fluctuating demand trends by leveraging real-time data analytics.

References I

- Wakhid Ahmad Jauhari, Ivan Darma Wangsa, Hawa Hishamuddin, and Novrianty Rizky. A sustainable vendor-buyer inventory model with incentives, green investment, and energy usage under stochastic demand. Cogent Business & Management, 10:2158609, 2023.
- Muthusamy Palanivel, Murugesan Venkadesh, and Selvaraj Vetriselvi. A comprehensive inventory management model with weibull distribution deterioration, ramp-type demand, carbon emission reduction, and shortages. Supply Chain Analytics, 7:100069, 2024.
- F. Poloni and G. Sbrana. A note on forecasting demand using the multivariate exponential smoothing framework. *Int J Prod Econ*, 162:143–50, 2015.
- G. Sbrana and A. Silvestrini. Forecasting aggregate demand: analytical comparison of top-down and bottom-up approaches in a multivariate exponential smoothing framework. *Int J Prod Econ*, 146(1):185–98, 2013.
- D. Shukla and U. K. Khedlekar. Dynamic pricing model with logarithmic demand. OPSEARCH, 50(1):1–13, 2013.
- Yasin Tadayonrad and Alassane Balle Ndiaye. A new key performance indicator model for demand forecasting in inventory management considering supply chain reliability and seasonality. *Supply Chain Analytics*, 3: 100026, 2023.

Thank you!