Chapter 11

Optimization of Inventory Management Using Artificial Neural Networks and K-Means Clustering for Cost Reduction and Improved Customer Service

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ABSTRACT

This paper addresses the critical issue of optimizing inventory strategies using advanced machine learning techniques, particularly Artificial Neural Networks (ANN), to enhance customer service and reduce costs. Here's a brief summary and analysis of the concepts you mentioned: 1. Optimization of Stock Management: Inventory management plays a vital role in fulfilling customer demand while minimizing lead times and costs. Optimizing stock levels can balance supply with fluctuating market demand. 2. Artificial Neural Networks (ANN): ANN is employed to forecast the optimal stock levels. By analyzing past stock data, ANN models can predict the required

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inventory and reduce errors in forecasting, thus minimizing overstocking or under stocking. 3. K-Means Algorithm for Grouping Items: The k-means algorithm is used to classify raw materials and finished goods into homogeneous groups. These groups share similar characteristics, allowing for tailored inventory policies. For example, fast-moving items may have different inventory strategies than slow-moving ones.

INTRODUCTION

The key takeaway is that optimizing inventory levels and minimizing costs requires dynamic strategies and advanced algorithms to handle the stochastic and complex nature of inventory systems. Here's a breakdown of the major methods and ideas you discussed: (Radha Krishnan et al., 2009) focused on minimizing the total supply chain cost by optimizing the base stock level at each stage of the supply chain. Genetic algorithms (GAs) were used to find the most probable stock level, showing strong performance when implemented in MATLAB. GA helps navigate the complexity of dynamic inventory problems by evolving towards an optimal solution through iterative improvement. (White & Censlive, 2016) Applied control theory to manage production capacity emphasizes the need for timely acquisition of additional capacity to avoid shortages. This mathematical framework ensures a more proactive approach to inventory management, responding to fluctuations in demand and capacity efficiently.(Vladimir & Tasho, 2011) discussed mathematical models for inventory systems, implemented as software modules in MATLAB. These models handle basic inventory control problems and aim to provide robust solutions that adapt to varying company requirements. Further, they suggest that incorporating stochastic and dynamic factors into inventory models is essential for more accurate inventory control. Strijbosch & Moors, 1999 examined the periodic review system with stationary gamma-distributed demand and constant lead time. It takes into account two critical service-level constraints—stock-out probability and fill rate—and uses exact safety factors to model inventory behavior effectively. (Ramirez & Labadie, 2017) focused on minimizing costs and managing shortages and wastage in the blood supply chain. It optimizes the number of blood units processed by a blood center and ordered by hospitals, providing a tailored approach to managing sensitive, high-risk inventory like blood. (Eme et al., 2018) Eme et al. analyzed and improved the manual inventory system in a pharmaceutical store, showcasing the benefits of a computer-based system to enhance operational efficiency and accuracy. This system improved inventory accuracy, responsiveness, and management effectiveness.(Šustrová, 2016):Šustrová explored the construction of an artificial neural network model for optimizing order quantities based on current market demand. ANN was used to predict optimal order levels, improving inventory

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