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Predictive Analytics for Demand Forecasting in Supply Chain Using Neural Network Toolbox

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ABSTRACT

This study focuses on demand forecasting in supply chain management using the Neural Network Toolbox of MATLAB. In today's dynamic business environment, organizations need accurate demand predictions to make effective decisions regarding production and inventory control. However, fluctuations in product consumption often reduce forecasting accuracy and create challenges in predicting future requirements. To overcome this, a large volume of consumption data is analyzed, and learning algorithms are applied to improve time series predictions. The proposed forecasting model utilizes artificial neural networks, which are capable of adapting to changing patterns without altering the model structure. This makes them highly suitable for supply chain applications where capital utilization and efficiency are crucial. In this work, a case study on Maral Overseas Ltd. has been conducted, where supply chain data was used to train and test the model. The performance of the ANN-based approach has been evaluated through simulations with time series data, demonstrating its effectiveness in enhancing forecast accuracy. The main objective of this project is to propose an AI-driven forecasting technique using MATLAB's Neural Network Toolbox. Furthermore, a comparative analysis of different ANN training methods has been carried out to validate the results and identify the most effective approach for demand forecasting in real-world supply chain scenarios.

Keywords- Demand Forecasting, Supply Chain Management, MATLAB Neural Network Toolbox, Artificial Neural Network (ANN)

1. INTRODUCTION

Demand forecasting is the ability to predict future demand based on past patterns and available data. In stable environments with consistent data, forecasting is relatively simple and accurate, as the future often resembles the past. However, when demand patterns shift due to human actions, market uncertainties, or external influences, forecasting becomes far more complex and critical. It serves as a way to measure the transition between different states of supply and demand, but the unpredictability of demand drivers makes accurate forecasting a challenge. In such cases, forecasting is not only a science but also an art that requires both analytical insight and practical wisdom. Demand forecasting plays a vital role in supply chain management, as it ensures product availability while maintaining balance between supply and demand. Inaccurate forecasts can lead to overproduction, resulting in excess inventory and higher costs, or underproduction, leading to lost sales and reduced customer satisfaction. This makes forecasting a key activity for manufacturers, distributors, and trading firms seeking to improve profitability and service levels. Traditional forecasting techniques often fail when faced with non-linear or highly variable data, which reduces their effectiveness in dynamic business environments. Artificial neural networks (ANNs) provide an effective alternative due to their ability to learn complex patterns, handle non-linear relationships, and adapt to changing conditions without requiring predefined models. ANN-based approaches have been successfully applied in demand forecasting across various industries, including manufacturing, where demand fluctuations are common. This study focuses on applying ANN techniques for demand forecasting in a valve manufacturing company, which typically operates in a make-to-order environment. Different training methods of neural networks are explored and compared to evaluate their effectiveness in predicting demand. The results demonstrate that ANN-based forecasting can significantly improve accuracy compared to traditional methods, thereby helping organizations manage inventories more efficiently, reduce costs, and enhance responsiveness to market changes.

2. PROBLEM IDENTIFICATION

Forecasting consumer product consumption is often challenging, as future demand is difficult to predict and traditional forecasting methods frequently suffer from poor accuracy. Accurate forecasting is essential for effective decision-making in manufacturing and inventory management, making it a critical milestone for any organization. In this project, the focus is on forecasting the raw material consumption of Maral Overseas Limited. To address this problem, a neural network-based data modeling system is applied for demand prediction. Different learning algorithms are tested to evaluate their effectiveness in predicting future time series data. It was observed that due to the influence of several factors on demand in a retail trading system, shorter forecasting periods provide more accurate results, where the ANN approach proves to be particularly efficient. In today's competitive and constantly changing business environment, demand forecasting plays a vital role in gaining commercial advantage. It enables organizations to make informed

decisions related to production planning and inventory control, ultimately improving cost efficiency and customer satisfaction. The main objective of this project is to develop a forecasting technique using artificial intelligence, specifically artificial neural networks, to improve the accuracy of demand prediction. The effectiveness of the proposed ANN-based approach is demonstrated using real-world data from Maral Overseas Limited, a company located in Khalghat.

3. RESEARCH OBJECTIVES

Based on the discussion, the following objectives have been formulated for this work:

1. To collect and analyze the consumption data of the past three years from Maral Overseas Limited.
2. To select an appropriate neural network model from the MATLAB toolbox for analyzing the base year data in relation to the target data.
3. To perform demand forecasting and evaluate the results by calculating forecasting error and percentage error through the application of supply chain management principles using the neural network toolbox in MATLAB.

4. RESULT AND DISCUSSION

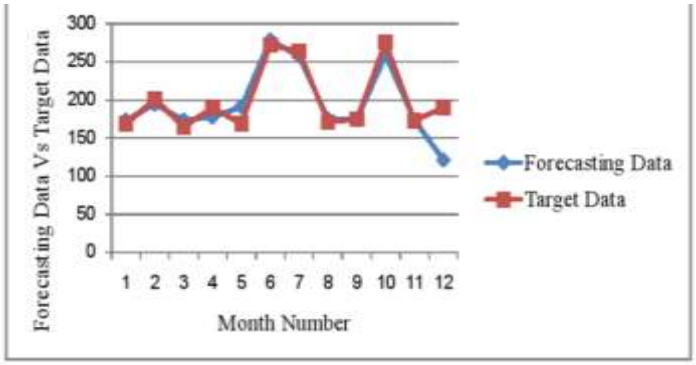

Figure 4.1 Demand Forecasting

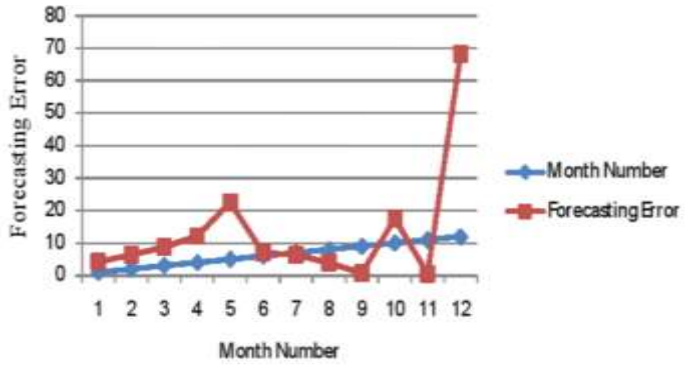

Figure 4.2 Demand Forecasting Error

S. No.	Name Of Material	Mean Percentage Error With The Manual Management	Mean Percentage Error With Forecasting
1	Raw Cotton	14.54%	6.73 %
2	Cotton Yarn Single	9.82%	7.07 %
3	Dyed Fabric	10.45%	4.75 %
4	Knitted Fabric	6.67%	3.36 %
5	Yarn Dyeing	12.23%	3.99 %
6	Cotton Yarn Double	8.36%	5.67 %

The results of the study indicate that the TrainLM method performs more effectively than other training methods applied in the analysis. It provides a more reliable forecast for the case of Maral Overseas Limited. The methodology adopted in this work demonstrates its potential as a successful decision support tool. It highlights the importance of neural networks in handling demand forecasting problems. The improved accuracy achieved strengthens the reliability of predictions. Such reliable forecasts can support better manufacturing and inventory decisions.

This contributes to reducing uncertainties in supply chain management. The outcome confirms that artificial neural networks are a valuable tool for time series forecasting. It also emphasizes the role of selecting appropriate training algorithms. Enhanced forecasting accuracy can lead to significant commercial advantages. The study opens opportunities for adopting similar approaches in other industries. Future research may explore advanced neural network models to further improve prediction accuracy.

5. CONCLUSION

The aim of this investigation was to perform demand forecasting using supply chain management principles and neural network toolbox of MATLAB. The study focused on analyzing the effectiveness of forecasting demand signals with the help of artificial neural networks. Different training methods were examined to identify the most suitable and efficient approach. The Train LM algorithm emerged as the most reliable method for accurate demand prediction. The proposed methodology demonstrated the strength of ANN in handling complex forecasting tasks. A cooperative forecasting mechanism was developed through the integration of ANN and training methods. The case study on Maral Overseas Limited provided practical validation of the approach. The results confirmed that ANN-based forecasting significantly improves prediction accuracy. Such improvements can enhance decision-making in manufacturing and inventory planning. The approach also helps to reduce uncertainties and risks in supply chain operations. This establishes ANN as a powerful decision support tool in real-world forecasting. The research contributes to bridging the gap between theory and industrial practice. It also opens opportunities to apply similar models across different sectors.

Future studies may refine the methodology further by exploring advanced ANN models and hybrid techniques.

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