

Problem Statement

Problem Area:

In times of tough market competition with many participating firms, it has become necessary for companies to gain a competitive advantage if they are to improve their performance and satisfy market needs. It has become common practice in the day-to-day operations of a business to have in place effective breathing techniques or strategies. This helps to forecast the demand and more accurately manage the day-to-day operations of a company so that the production costs can be minimized. It also facilitates faster customer response from the company, adds values to the offerings, and enhances the competitiveness of the organization.

Problem delineation:

Demand forecasting is an area that many firms have opted to employ basic statistical techniques such as linear regression. But such approaches have been proven to be ineffective as they fail to address the time series data which is inherently shaped with a lot of fluctuations and complexities. This has shaped a growing demand for the deployment of advanced methods such as machine learning methods that are noted for their robust response to unforeseen changes in the seasonal patterns. However, the situation of forecasting demand using these methods is complicated because many businesses are still ambiguous on the best method to adopt as the performance of machine learning algorithms depend on the industry within which data is adhered to. This makes ascent to the right model rather complex.

Importance of the Research:

The last few decades have seen machine learning being successfully leveraged for enhancing the assessment of demand in various specific industrial enterprises enabling such firms to better meet the needs of the market, absorb resources in a more efficient manner as well as reduce costs. However, there continue to be lacunae in practical and theoretical knowledge regarding the efficiency of different ML models, both in terms of the model selection particular to the data, thus emphasizing the requirement for a clear comprehensive investigation to identify the best suitable models for the varying sectors of the economy.

Current Solutions:

Machine learning models such as Deep Neural Networks (DNN), Convolutional Neural Networks (CNN), and most recently Long Short-Term Memory networks (LSTM), receive a lot of attention due to their high-performance statistically surpassing traditional models in terms of accuracy, speed and overall performance. Their practical use, however, seems to be difficult, especially in terms of the specific characteristics of the available data in each of the industries. Such challenges are experienced in practice and thus should be taken into consideration in the practice of model selection.

Justification for the Need for Research:

Due to differences in data characteristics across industries and variations in demand patterns, there is a need for a specialized study focusing on how to select the most suitable model for each sector based on data characteristics. Additionally, evaluating the stability of these models in real work environments is essential to ensure their effectiveness.

Sample Quotes:

- "Neural networks achieved 15% higher accuracy compared to traditional models" (Brown & Green, 2019).
- "The LSTM model achieved the highest accuracy, reaching 92%" (Taylor & Reed, 2021).
- "CNN models contributed to a 25% improvement in forecasting accuracy compared to models that did not use it" (Chen & Li, 2017).

Research Objectives

Main Objective: To evaluate the effectiveness of various machine learning models in demand forecasting across different manufacturing sectors and to suggest suitable models based on data characteristics within each sector.

Sub-Objectives:

1. Identify the strengths and weaknesses of common machine learning models used in demand forecasting, including neural networks, tree-based models, and CNNs.
2. Analyze the practicality and stability of these models in real manufacturing environments, considering factors like data variability and seasonal patterns.
3. Compare the performance of traditional statistical models with machine learning models in handling data complexities and industry requirements.
4. Propose a framework for selecting the most effective demand forecasting model based on specific industry needs and data characteristics

