INVENTORY MANAGEMENT AND FORECASTING SYSTEM USING ML

Business Data Management Project

By: Himanshu Arvind Savargaonakar

(22ds3000140@ds.study.iitm.ac.in)

Summary:

This project aims to enhance the accuracy and efficiency of inventory management processes within Nasan Medical Electronics Pvt. Ltd. The company is a medium-scale medical equipment manufacturer. Being a manufacturer having an established inventory management system is paramount to reducing overhead costs. Inventory management is a very complex problem. If we maintain too high of an inventory or overstock the inventory additional costs of storage and maintenance are incurred while if insufficient inventory is maintained it may lead to a reduction in manufacturing efficiency.

This project aims to formulate an algorithm to predict inventory needs and to identify outliers in the inventory management system. Using past data I aim to present a comprehensive analysis of the crucial factors that can contribute to maintaining ideal inventory volumes. Using Machine Learning (ML), I propose to automate the process by delivering a model that can be used by the company to check the inventory fitness against past data.

3. Contents

4. Organization Introduction and Background

Nasan Medical Electronics Pvt. Ltd is a bio-medical equipment manufacturer based out of Pune, India. The company was founded by Mr. Yashwant Samant in the year 1991. Through the business's prolific journey of the business, it has established itself as a leader in the medical device sector.

The company's product range includes medical equipment such as patient monitors, defibrillators, ECG machines, ventilators, and other critical care equipment. They boast expertise in the area of cardiology-centric devices with robust product lines for Intensive Care Units (ICU) and mobile stations for patient transport.

The company has its Research and Development (R&D) and manufacturing division located at its Pune headquarters in Warje. It has a total strength of 100+ employees and over 10K customer base. Nasan's R&D division has won multiple awards recognized by the Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India.

5. Problem Statement

The problem statement for this Business Data Management Project is:

"Ideal inventory quantity prediction and forecast based on historical data."

- Using historical data, plot inventory stock and identify trends displayed by the data.
- Identify overstocking and understocking scenarios
- Postulate potential reasons for under and overstocking
- Co-relate company sales with inventory movement and turnover
- Apply ML algorithms to attain a relationship between sales and inventory
- Optimize an ML algorithm
- Perform iterations on the ML algorithm based on inputs from the company
- Present a concise and implementable solution to the company to be used along with their current inventory management system.

6. Background of the Problem

Nasan Medical Electronics is a medium size electronics goods manufacturer. Thus, maintaining an adequate inventory at all times is of vital importance for the smooth functioning of the business.

The problem with inventory management is that it can be challenging to determine the ideal quantity of inventory to keep in stock at any given time. Overstocking can lead to additional overhead costs of storage and maintenance, while understocking reduces the efficiency of the manufacturing process thus harming the profitability of the company.

In an ordinary business, inventory planning is mainly done by using the business predictions and goals set by the company. But these goals and predictions can be biased and can lead to false ideal situations. To counter the bias introduced by the optimistic goals we use the historical data to regularize the ideal scenario.

The ultimate goal of this project is to propose an algorithmic solution for the company which can be used to forecast the ideal inventory stock needed. Such a result will lead to the optimization of the inventory management system and inventory acquisition system; leading to the minimization of overhead costs incurred due to incorrect inventory estimations.

7. Problem-Solving Method

This section elaborates on the proposed action plan to attain the objectives of this project.

7.1 Proposed Method

1. **Data collection and Pre-processing**: The database obtained from the company will be raw and will have a lot of un-filtered data. This step aims at filtering the data and normalizing it. The main aim of this step is to make the data ready for further logical analysis
2. **Graphical and Logical Analysis**: From a given data some rudimentary information can be drawn using graphs and statistical measures like mean, mode, and standard deviation. This step aims to postulate a primary hypothesis.
3. **Application of ML Algorithm**: The most efficient way to process large data is to fit an ML algorithm into the data. This step aims to fit a dummy classifier and identify an ML algorithm that will be apt for this problem
4. **Hyper-parameter Tuning:** After identification of the algorithm it is vital to optimize the parameters for the given data. This step aims to maximize the accuracy of the model by parameter tuning.
5. **Observations and Results**: In any data science project, one has to convert the output from the model to a real-world application. This step aims to propose a well-structured and implementable solution for the problem of inventory management.

7.2 Proposed Data and Data Collection Methods

- **Data Collection:** Data is going to be provided by the company. It will be collected by me in person from the contact person from the company for the project
- **Data**:
  - **Type of Datasets:** Three main datasets will be used for this project. A current inventory dataset; will give the stock of all items in the inventory on a given day. Secondly, a sales dataset; this dataset will outline the sales by the company. Thirdly, the Bill of Material (BOM) dataset; this dataset will contain the number and types of parts required to manufacture every product being sold.
  - **Duration:** The company has agreed to provide data for the past 3 years. Based on the output presented by me for this project, they may provide additional 2 years of data to further train and optimize my pipeline.
  - **Type of Data:** Data will be primarily collected and maintained in an Excel format. CSV format may be used to store processed data from Python.

7.3 Tools Being Used

1. Microsoft Excel: Used for data manipulation and basic analysis
2. Google Colabs: Used for training the ML algorithm for the data.

8. Project Timeline and Milestones

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INVENTORY MANAGEMENT AND FORECASTING SYSTEM USING ML
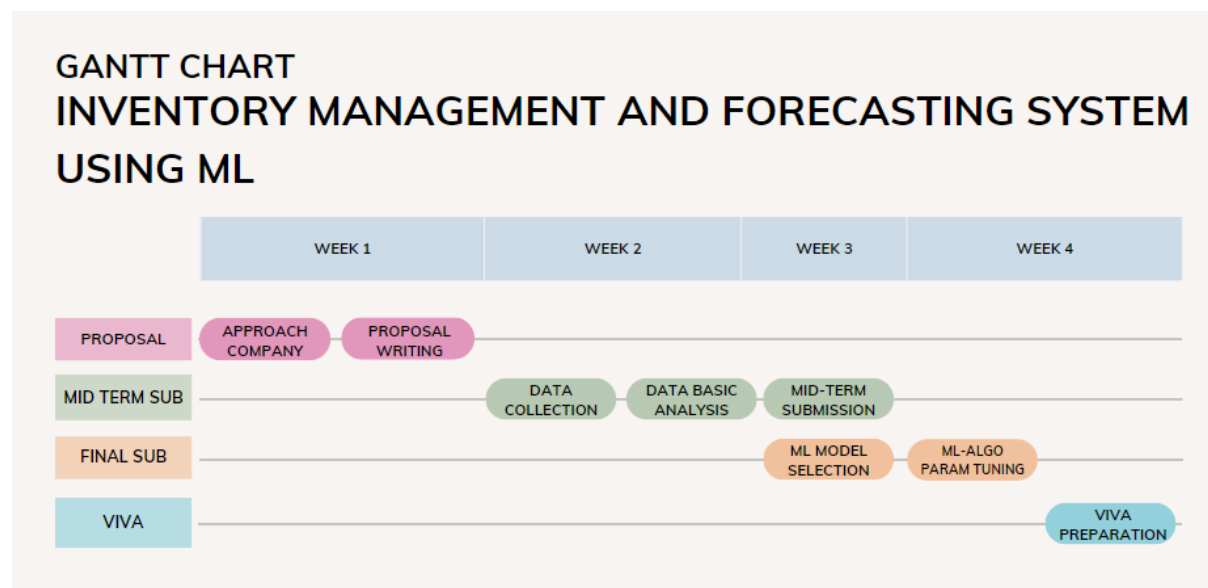
9. Expected Outcomes

1. Identification of incorrect inventory stock in provided data:
   The expected outcome of this task is to identify any discrepancies or inaccuracies in the inventory stock data provided. This can involve comparing the recorded inventory quantities with physical counts or other reliable sources of information. By conducting a thorough analysis, any incorrect or mismatched stock levels can be identified, helping to ensure the accuracy of the inventory records.

2. Proposed Ideal stock Quantity:
   Based on the analysis of historical data, sales forecasts, and other relevant factors, the expected outcome is to propose an ideal stock quantity for each item in the inventory. The ideal stock quantity represents the optimal amount of inventory that should be maintained to meet customer demand while minimizing costs and avoiding stockouts or excess inventory.

3. Presentation of Inventory and Supply Trends observed:
   The expected outcome here is to present the inventory and supply trends observed during the analysis. This can involve visualizing data through graphs, charts, or other visual representations to highlight patterns, fluctuations, or significant changes in inventory levels and supply over time.

4. Identification of Crucial Factors affecting inventory:
   The expected outcome is to identify and highlight the crucial factors that affect inventory levels and management. This involves analyzing various internal and external factors that influence inventory, such as demand variability, supplier performance, production capacity, lead times, economic factors, and customer behavior.