

Business Data Management

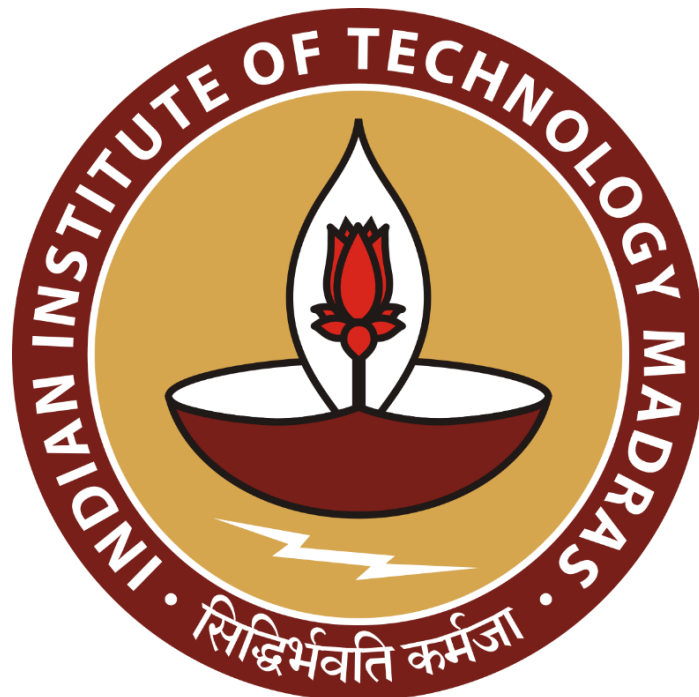
Capstone Project Proposal

Data-Driven Demand and Inventory Planning for a Rural Grocery Shop

Submitted by

Name : Sk Noor Alam

Roll No. : 23f1000205



IITM Online BS Degree Program,

Indian Institute of Technology, Madras, Chennai

Tamil Nadu, India, 600036

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Declaration Statement

I am working on a Project Title “**Data-Driven Demand and Inventory Planning for a Rural Grocery Shop**”. I extend my appreciation to **Mallick Bhandar**, for providing the necessary resources that enabled me to conduct my project.

I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered through primary sources and carefully analyzed to assure its reliability.

Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures.

I am dedicated to adhering to the information of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report.

I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority.

I agree that all the recommendations are business-specific and limited to this project exclusively, and cannot be utilized for any other purpose with an IIT Madras tag. I understand that IIT Madras does not endorse this.

Sk Noor Alam

Signature of Candidate: (**Digital Signature**)

Name: Sk Noor Alam

Date: 08/06/2025

1. Executive Summary :

The selected organization for this capstone project is **Mallick Bhandar**, a family-run grocery store situated in a village of **Khoriop, Howrah, West Bengal**. The store is managed by three family members—the owner, his brother, and his son. The son, **Mr. Muktar Ahmed Mallick**, primarily handles inventory management and financial operations.

Being a rural retail business, **Mallick Bhandar** faces key operational challenges, particularly in managing inventory efficiently and adapting to fluctuating seasonal demand. These issues lead to stockouts, missed sales opportunities, and inefficient stock handling, ultimately affecting both customer satisfaction and profitability.

To mitigate these problems, a **data-driven approach** will be implemented. Historical **sales data** will be systematically analyzed to uncover trends and patterns. This analysis will enable the business to forecast demand and find spikes during festivals like Eid, Durga Puja, Kali Puja and Shab-e-Barat to inform more effective stock replenishment. The project will use a **hybrid approach** combining **Microsoft Excel** for initial record-keeping and **Python** for deeper data analysis and visualization. The goal is to enable smarter demand forecasting, reduce stockouts, and support more responsive and efficient inventory planning.

2. Organization Background :

Mallick Bhandar is a family-owned grocery store located in the rural village of Khoriop, Howrah, West Bengal. The business is run by three family members—the head of the family, his brother, and his son—who collectively manage day-to-day operations. The store offers essential household and grocery items to the local community and operates as a **B2C** outlet. A small warehouse (godown) attached to their residence, located near the shop, supports their inventory storage and restocking needs. Around eight years ago, the store had a local competitor, but that rival shop shut down due to operational challenges. Since then, **Mallick Bhandar** has become the primary grocery source in the area. Despite its established presence, the store continues to face challenges in managing inventory and dealing with seasonal variations in demand, which this project aims to address using a data-driven approach.

3. Problem Statements :

- 3.1) Lack of Visibility into Seasonal Patterns :-** Mallick Bhandar struggles to monitor and analyze fluctuations in sales across different times of the year, especially during key festivals like Eid, Durga Puja, Kali Puja, and Shab-e-Barat. This lack of visibility limits their ability to anticipate periods of high or low demand, leading to stockouts during peak seasons and missed opportunities for maximizing sales.
- 3.2) Absence of Data-Driven Inventory Planning :-** The store's current inventory planning relies heavily on intuition and manual judgment rather than structured analysis of historical sales data. This results in inefficiencies in restocking decisions, particularly for seasonal and perishable items, and prevents the store from optimizing inventory levels to reduce shortages, overstocking, and waste.

4. Background of the Problem :

Mallick Bhandar is a small, family-owned grocery store situated in a small village of Khorip, Howrah, West Bengal. The store serves a community where many residents earn their livelihood as daily wage laborers under a “no work, no pay” system. This economic reality leads to highly unpredictable purchasing patterns, making it challenging for the store to forecast demand and manage inventory effectively. Adding to the complexity, customers frequently request goods on credit, which the store must factor into its financial and stock planning.

Space limitations present another major challenge. The shop lacks adequate storage capacity and is unable to install large refrigeration units. Perishable goods like milk and paneer are at risk of spoilage due to this constraint. Although a small refrigerator is available, it can only accommodate limited quantities, forcing the store to procure these items frequently from local vendors. These operational hurdles collectively hinder Mallick Bhandar's ability to maintain a consistent and efficient inventory, impacting customer satisfaction and profitability.

The demand for products is heavily influenced by agricultural cycles, local religious festivals (such as Eid, Durga Puja, Kali Puja, and Shab-e-Barat), and seasonal weather conditions. For instance, in winter, there is a noticeable rise in the consumption of items like tea, milk, sugar, wheat and flour. Conversely, during the monsoon season, the village's low-lying location often results in transport disruptions, affecting the timely delivery and replenishment of stock.

5. Problem Solving Approach :

5.1 Methods

The project will adopt a data-driven approach combining descriptive analytics and basic predictive techniques to address the challenges of seasonal demand visibility and inventory planning.

- Descriptive analytics will be used to summarize and interpret historical daily sales data. This method is justified because it provides clear, easy-to-understand insights into sales performance, helping the shop identify high-demand and low-demand periods without requiring advanced statistical knowledge.
- Time series analysis will be applied to detect patterns of seasonality and recurring demand cycles. Techniques such as moving averages and linear trend lines will be used. These models are simple yet effective for small retail businesses, enabling the identification of trends around festivals like Eid, Durga Puja, Kali Puja, and Shab-e-Barat. This approach is justified as it provides actionable forecasts using methods that match the scale of the shop's data and operational capacity.

The combined use of these methods ensures that insights will directly inform stock planning and ordering, helping reduce stockouts and avoid unnecessary inventory buildup.

5.2 Data Collection

Daily sales data will be collected for essential product categories in a structured, easy-to-maintain format. The dataset will include:

- Date of sale
- Quantities sold for products.

This format is justified as it is simple to record, requires minimal training, and is sufficient for identifying demand patterns over time. The data will be initially entered in Microsoft Excel to leverage the store's existing familiarity with basic tools and ensure ease of access. Periodically, data will be exported for deeper analysis using Python to generate more advanced insights.

5.3 Analysis Tools

Microsoft Excel will be used for data entry, cleaning, descriptive statistics (mean, median, mode, totals), and basic charts (e.g., line charts of monthly sales trends). This is justified because Excel is accessible and easy for store managers to use without specialized training.

Python (Pandas, Matplotlib, Seaborn) will support deeper analysis of sales trends, seasonality, and basic demand forecasting. Python is justified because it enables flexible data handling and high-quality visualizations while remaining cost-effective.

This hybrid toolset balances usability and analytical rigor, ensuring that the shop benefits from both practical day-to-day tools and more powerful data analysis techniques for long-term planning.

6. Expected Timeline :

6.1) WBS (Work Breakdown Structure) :-

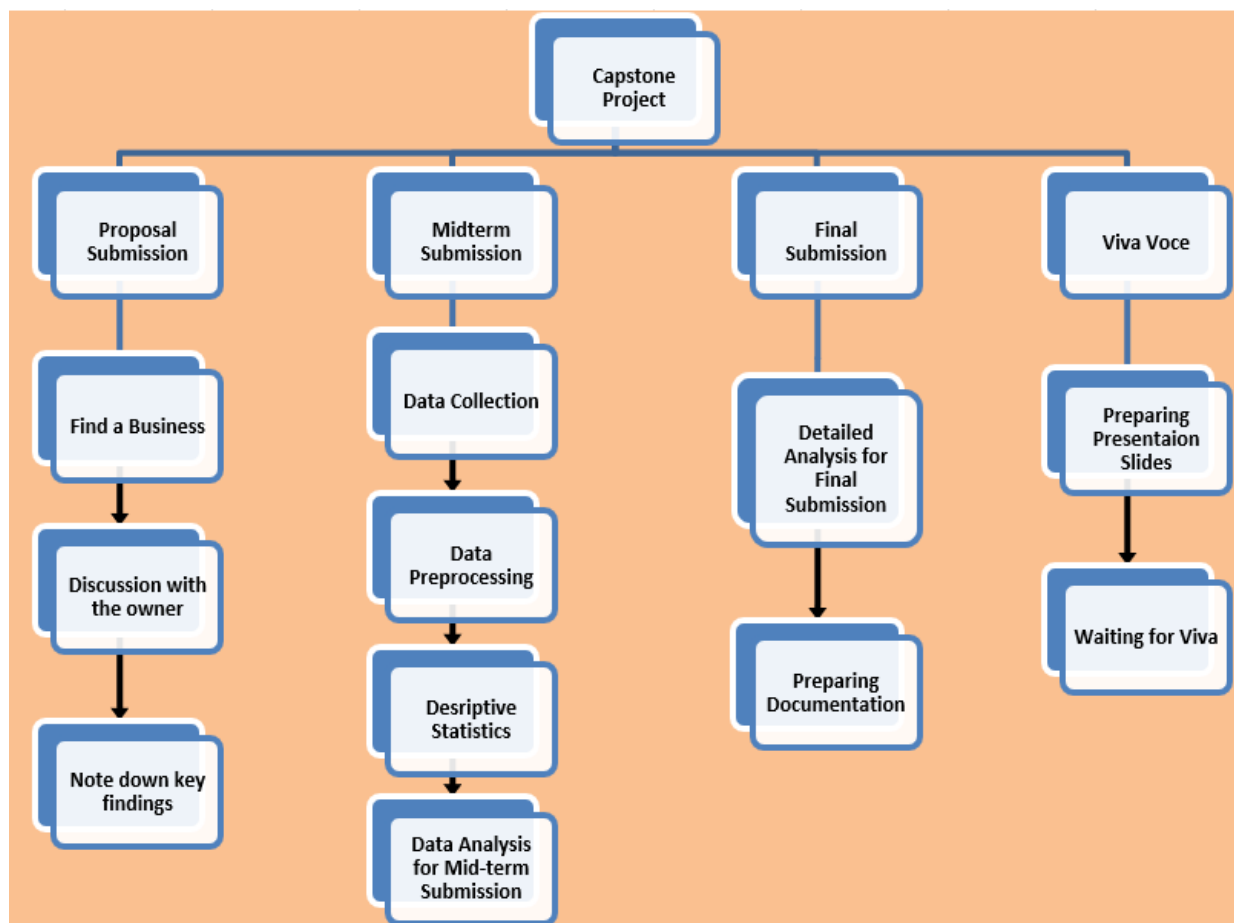


Figure 1 - Work Breakdown Structure

6.2) Gantt Chart :

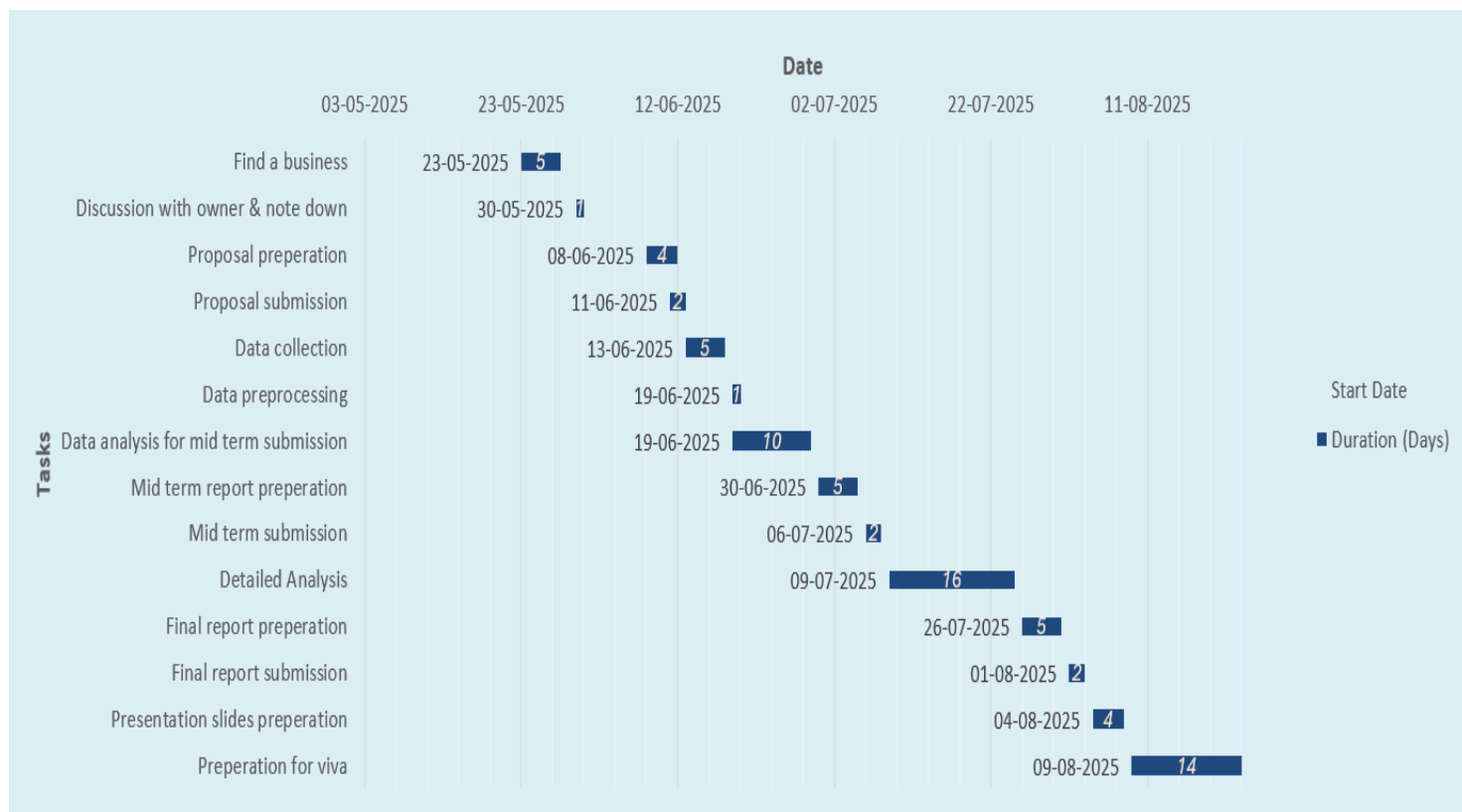


Figure 2 – Gantt Chart

7. Expected Outcome :

- **Improved Demand Forecasting:**

The project will help Mallick Bhandar identify seasonal and festival-driven sales patterns, allowing for more accurate demand predictions. This ensures better preparedness during peak periods and reduces the risk of stock imbalances.

- **Optimized Inventory Planning:**

With insights from data analysis, the store can maintain optimal stock levels. This minimizes stockouts and overstocking, leading to improved inventory efficiency and higher profitability.

- **Space Utilization:**

Based on insights derived from sales data analysis, the store will be able to optimize the use of available space, particularly for the efficient storage of refrigerable products.

- **Data-Driven Decision Making:**

Transitioning from intuition-based to data-driven strategies will enable smarter decision-making. Access to reliable data helps improve planning, reduce errors, and boost overall operational performance.

- **Increased Customer Satisfaction:**

Consistent product availability and timely replenishment will enhance the customer experience. This builds trust, encourages repeat purchases, and strengthens long-term customer loyalty and goodwill.