DATA DRIVEN ANALYSIS FOR OPERATIONAL IMPROVEMENT: TELANGANA BELLAM CHAI

An End-Term report for the BDM capstone Project

Submitted by

Name: KAMARA RAJARAMESH
Roll Number: 23F1003064

IITM Online BS Degree Program,

Indian Institute of Technology, Madras, Chennai

Tamil Nadu, India, 600036

Contents

1. Executive Summary

Data Driven Analysis for Operational Improvement: Telangana Bellam Chai

Organization and Problem:

The Telangana Bellam Chai is a small scale, single owner outlet located in Kadem, Nirmal district of Telangana. It is a rapidly grown into a preferred stop for students, workers and the road side walkers seeking for traditional Jaggery Tea, some other type of teas and milk-based items. The business is facing the three main challenges the first problem is Inconsistent Inventory management this leads to the stockouts of key items like milk and jaggery powder and overstocks of non-essential items. The second problem is Raising High Credit tracked manually makes poor cash circulation, the third one is Absence of additional workforce causing slow service and revenue leakage during peak hours. These issues are raised because of the manual processes, unstructured record keeping and inconsistent demand management.

Data Collected, Descriptive Statistics & Methods Used:

I collected four months of data (June-September 2025) directly from the owner, which covers daily sales, item wise inventory purchase and consumption and customer level credit and payment details. The Descriptive statistics includes the mean, median, standard deviation and range were generated by the spreadsheets and python (Pandas and NumPy) to understand the variability in sales, inventory cost and credit behavior. The ABC analysis applied for Inventory prioritization, RFM analysis used for credit segmentation and time series and trend analysis to study daily sales patterns and peak hour behavior.

Key Results & Findings:

From the results I found that milk, jaggery powder and sugar from Class-A inventory contributing to over 70% of total consumption value and causing recurring stockouts. Credit analysis showed that a small group of customers accounted for most outstanding dues with irregular repayment patterns affecting cash flow. Sales trends indicating clearly weekday peaks and revenue loss during high demand hours due to no extra workers at the shop.

Interpretation & Recommendations:

The results indicates that structured inventory planning, better credit governance and man power support can significantly improve daily operations. The recommendations include implementing reorder levels for Class-A items, applying RFM-based credit limits, digitizing credit tracking, and hiring a part-time helper during peak hours.

2. Detailed Explanation of Analysis Process/Method

2.1 Data Cleaning and Processing

Explanation

The raw data collected from the owner of Telangana Bellam Chai came from multiple sources 1. Notebooks (not a proper data for inventory and credits), 2. WhatsApp messages (When a milk vender sent milk with the other guy the owner texts milk vender with the quantity of milk he received and sometimes with the person who taken credit their) and 3. Verbal Inputs (The missed data which is not present in the notes taken from the owner) which is instructed and made it inconsistent. For the analysis the data was cleaned systematically by the standardized date formats, correcting inconsistent item names, removing duplicates, handling missing entries through owner verification and converting all quantities into uniform units. And derived variables such as daily consumption value, outstanding balance, and day-wise sales were created to support further analyses like ABC classification, RFM scoring, and sales trend analysis.

Importance

Data cleaning is a crucial step to ensure the accuracy and reliability across all analytical methods used in the project. Clean and consistent data enables precise ABC classification of inventory, correct RFM segmentation of the credit customers and meaningful descriptive statistics and trend analysis. Without proper cleaning the results may would have been misleading and could lead to incorrect decisions regarding stock planning, credit control and other results. Therefore, the data cleaning directly strengthened the validity of the insights and ensured that all recommendations were based on the trustworthy and high-quality information by the owner.

2.2 Descriptive Statistical Analysis

Explanation:

Descriptive statistics were used to understand the behavior of daily sales, inventory usage, and credit transactions. Measures such as mean, median, mode, standard deviation, minimum and maximum values were computed. These metrics helped identify fluctuations in milk usage, jaggery consumption, sales variation, and repayment frequency.

Some Descriptive Statistics are:

- Average daily sales – 2,293.07 Rs, and Standard Deviation – 384.96 Rs

- Milk consumption range daily – 4 to 8 liters, and mean 7.52 liters

- Jaggery powder usage median 2.0 kgs per day

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i, \qquad s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

Justification:

Since the tea shop records are handwritten and inconsistent, descriptive statistics were necessary to understand the true operational pattern. This gave the foundation to identify problem areas especially stockouts (inventory variation) and irregular credit payments.

2.3 Method for Inventory Analysis

ABC Analysis for Inventory Prioritization

Explanation:

	Item	Total_cost	Percentage	Cumulative %
1				
2	Milk	55020	46.98307516	46.98307516
3	Jiggery Powder	20400	17.42011511	64.40319027
4	Sugar	10200	8.710057555	73.11324783
5	Coffee Powder	10030	8.564889929	81.67813776
6	Tea Powder	9520	8.129387051	89.80752481
7	Biscits	5000	4.269636056	94.07716086
8	Water Tins	4416	3.770942565	97.84810343
9	Green Tea Bags	500	0.4269636056	98.27506703
10	Honey	500	0.4269636056	98.70203064

Fig 1: ABC Analysis Table

ABC Analysis categorized raw materials based on their consumption value:

Consumption Value = Quantity × Unit Cost

Items were sorted in descending order of the consumption value, cumulative percentage was computed and items were classified into:

- Class A: High value essentials (first 70% consumers)

- Class B: Medium Value items (next 20% consumers)

- Class C: Low value items (next 10% consumers)

For example, according to our data:

The items belonging to class A: Milk, Jaggery Powder and Sugar

Items belonging to Class B: Coffee Powder, Tea Powder, Biscuits and Water Tins

Items Belonging to Class C: all other items (12 items)

Justification:

The tea shop's biggest operational issue is frequent stockouts of milk and jaggery. ABC Analysis identifies which ingredients require strict monitoring and priority replenishment. This directly supports fixing Problem 1: Poor inventory planning.

2.4 Method for Credit Analysis

- **RFM Analysis for Credit Customer Classification**

Explanation:

RFM analysis was used to evaluate customer credit behaviour using:

- Recency (R): Days since last repayment
- Frequency (F): Number of credit transactions
- Monetary (M): Total credit amount taken

Each measure was scored 1–5 using quantile ranking:

$$\text{Score} = \text{Quantile Rank (R, F, M)}$$

Customers were grouped into Low-Risk, Medium-Risk and High-Risk categories.

Justification:

Credit is one of the shop's biggest challenges. RFM gives a structured way to identify customers who repay regularly versus those who delay payments or accumulate large outstanding balances. This directly addresses Problem 2: Irregular cash flow due to credit.

2.5 Method for Financial Overview

- **Time-Series and Trend Analysis for Sales & Peak Hours**

Explanation:

Daily sales and time-slot data (morning vs. evening) were analyzed to find demand patterns. This helped identify peak periods where sales are consistently higher. The customers are mostly students, workers and road side walkers so the rush is mostly at morning hours (7-10AM) and evening hours (4-7PM). I found this by observing the business for 2 days.

Justification:

The owner operates alone, leading to delays during rush hours. Time-series analysis revealed the exact peak times, supporting manpower recommendations. This directly supports Problem 3: Revenue loss due to over-workload at peak

hours.

- **Derived Metrics for Inventory & Credit**

Explanation:

Additional variables were created to support analysis:

- **Daily Consumption Value:**

$$\text{Value} = \text{Quantity} \times \text{Cost}$$

- **Outstanding Balance:**

$$\text{Outstanding} = \text{previous} + \text{Credit} - \text{Repayment}$$

- **Daily Sales Indicators:** weekday, month.

Justification:

These derived fields were necessary to calculate ABC values, RFM scores, daily trends, and credit behaviour accurately. Without these variables, the methods would not produce usable results.

- **Tools Used for Analysis**

Explanation:

- **Excel/Google Sheets:** Initial cleaning, pivot tables, summary calculations and ABC cumulative table.
- **Python (Pandas, NumPy, Matplotlib):** RFM scoring, descriptive statistics and Visualizations.

Justification:

Excel was chosen for manual data correction and validation since the owner's records were handwritten, used for accuracy and generating reliable analytical outputs. Python was used for automation, descriptive statistics and visualization. This combination ensured the analysis was both correct and efficient.

- **Profit Analysis**

	A	B	C	D	E	F	G
	Date	Inventory_Cost	Expences	Total_Cost	Total_Price	-3491.8 × ss	Margin
2	1-Jun-2025	4936	285.8	5221.8	1730	=E2-D2	-201.8381503
3	2-Jun-2025	1751	285.8	2036.8	2540	503.2	19.81102362
4	3-Jun-2025	516	285.8	801.8	2530	1728.2	68.3083004
5	4-Jun-2025	635	285.8	920.8	2310	1389.2	60.13852814
6	5-Jun-2025	456	285.8	741.8	2380	1638.2	68.83193277
7	6-Jun-2025	344	285.8	629.8	2390	1760.2	73.64853556

F2 fx =E2-D2

Fig 2: Profit Analysis

Explanation:

Profit was calculated for each day using the formula:

$$Profit = Total\ Price - Total\ Cost$$

The tea shop earns a consistent profit of 1,300–1,500 Rs on most days, with higher profits occurring on days with strong evening footfall. Loss-making days were exclusively due to bulk purchasing of Class A raw materials (milk, jaggery powder, sugar), not operational inefficiency.

Justification:

Profit analysis is essential for this project because it directly addresses Problem 3 (revenue loss due to operational pressure) and helps evaluate the financial impact of stockouts and credit irregularities. Seeing real profit trends helps the owner understand how inventory costs affect daily earnings and where improvements (better stock planning, helping staff during peak hours) can stabilize profit.

- **Margin Analysis:**

Explanation:

	A	B	C	D	E	F	G
G2	fx =(F2/E2)*100						
1	Date	Inventory_Cost	Expences	Total_Cost	Total_Price	Profit/Loss	-201.8381503 ×
2	1-Jun-2025	4936	285.8	5221.8	1730	-3491.8	=(F2/E2)*100
3	2-Jun-2025	1751	285.8	2036.8	2540	503.2	19.81102362
4	3-Jun-2025	516	285.8	801.8	2530	1728.2	68.3083004
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Fig 3: Margin Analysis

Margin measures how much profit is made from each rupee of sales. It was calculated as:

$$Margin = Profit\ /\ Total\ Daily\ Sales$$

This ratio helps understand pricing strength and cost efficiency.

The business achieves a margin of around 56% on average, with most days achieving over 60% margin. Margins drop sharply only when the owner purchases large quantities of milk or jaggery, temporarily increasing cost.

Justification:

Margin analysis is needed because it helps the owner understand how pricing, demand, and cost structure influence profitability. It directly supports the owner's decision-making in:

- Pricing optimization
- Quantity planning based on demand
- Evaluating how inventory spikes affect profitability

It also addresses the project objective of improving financial decision-making through data, especially by connecting operational choices (inventory, credit, stuffing) to profit outcomes.

2.6 Linking Methods to Problems

- **ABC Analysis → Inventory stockouts**

Helps prevent shortages of milk & jaggery by showing which items need priority attention.

- **RFM Analysis → Credit instability**

Identifies risky customers and supports controlled credit limits.

- **Time-Series Analysis → Staffing challenges**

Reveals peak hours so service delays and missed payments can be reduced.

- **Descriptive Statistics → Overall business clarity**

Provides accurate understanding of daily performance.

3. Results and Findings

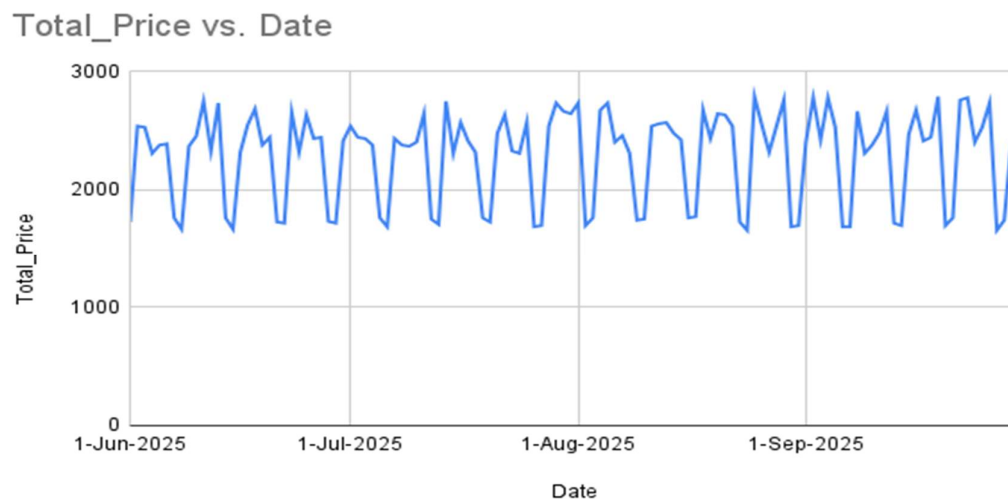**3.1. Financial Overview of the Business**

Daily Sales Trend:

Fig 4: Day wise Sales

The sales are remained constant, which is indicating the stable footfall and dependable customer demand. As the most of the customers are students, workers and the road walkers so the sales are more on weekdays compared to weekends.

The above analysis shows that:

- Mean Sales: Rs 2,293.07

  The average sales for the day amounts to approximately Rs 2,293.07, This figure serves as a central measure of the typical expenditure associated with daily procurement activities.

- Median Sales: Rs 2,415

  The median Sales, standing at Rs 2415, indicates the middle value in the dataset.

- Mode sales: Rs 1,675 The mode, representing the most frequently occurring value in the dataset, is recorded at Rs 1,675.

- Standard Deviation of Sales: Rs 384.95 With a standard deviation of Rs 384.95.

This metric provides a measure of the dispersion or spread of the 7 data points from the average cost, indicating the degree of fluctuation in procurement expenses.
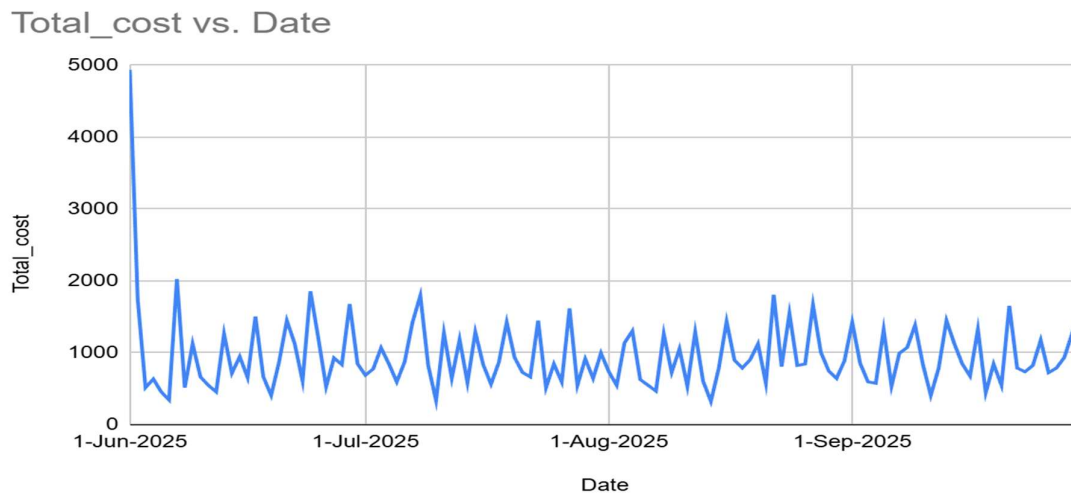
Daily Inventory Cost Trend:

Fig 5: Inventory cost variation

Daily cost averaged Rs 957.43, with a notable spike of Rs 4,936 on a single day. That one day is highest spike is noted because on that day the total inventory purchased (as per the owner information the old inventory was thrown out because of many days they were stored and fresh inventory was purchased on that day)

- Averaged Rs 957.43

- Median cost of inventory is Rs 844

- Mode inventory cost is Rs 548

The inventory cost Most of the times is less because the items which are in the shop is storable, those which are not storable they are purchased daily, like Milk it should be daily purchased item (as per the owner information the milk is taken very freshly, because if it is stored the taste of the jaggery tea will be changed).
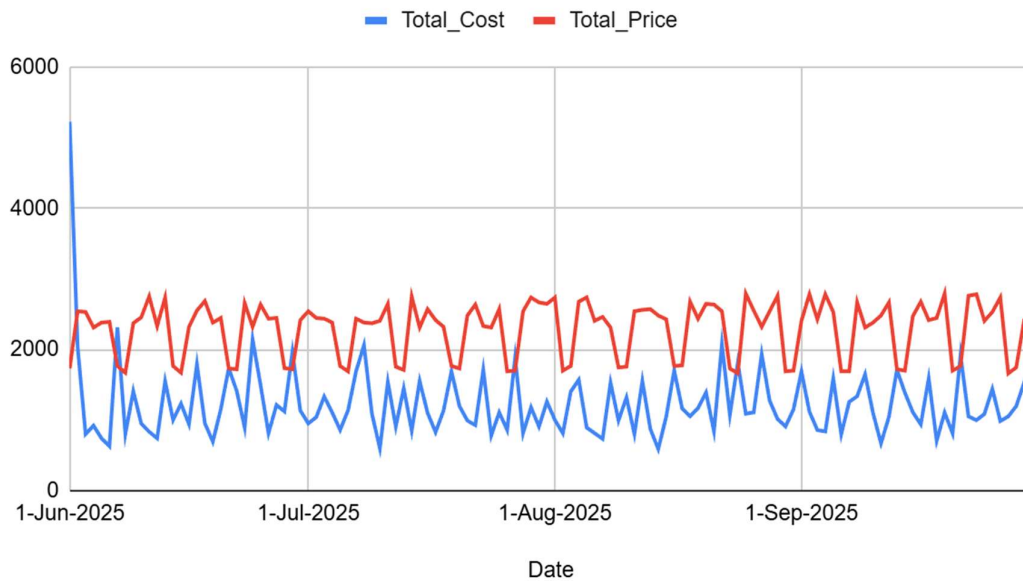
Revenue Trend:

Fig 6: Total Cost vs Total Sales

- Sales remain consistently higher than costs almost every day, indicating strong daily profitability.

- The only major exception is 1 June, where the cost sharply spikes above ₹5,000 due to a bulk purchase day, causing a temporary profit drop.

- Total Cost shows regular fluctuations between ₹500–₹1,700, reflecting day-to-day variation in raw material usage (especially Milk and Jaggery Powder).

- Total Sales stay relatively stable between ₹2,000–₹2,600, showing predictable customer demand.

- The gap between the red and blue lines represents the daily profit margin, which is positive on most days.

The correlation between total sales and total cost is –0.22, indicating a weak negative relationship. This suggests that higher daily costs are not associated with higher sales. Instead, cost spikes occur due to bulk procurement of raw materials rather than customer demand.

Sales remain stable, but unplanned high-cost days reduce profitability.
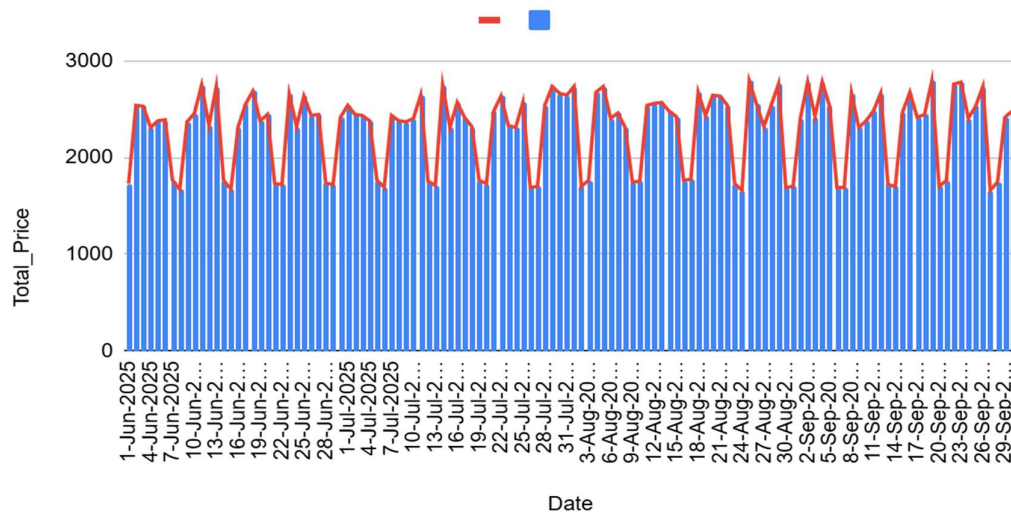
Daily Profit Trend:

Fig 7: Profits

Here the fluctuations are there because of the weekends, on the weekends there are very poor profit is occurred on week days the profit is better compared to weekends.

- Average Profit: ₹1,335.65
- Median Profit: ₹1,519
- Highest Profit: ₹2,204
- Lowest Profit: –₹3,206
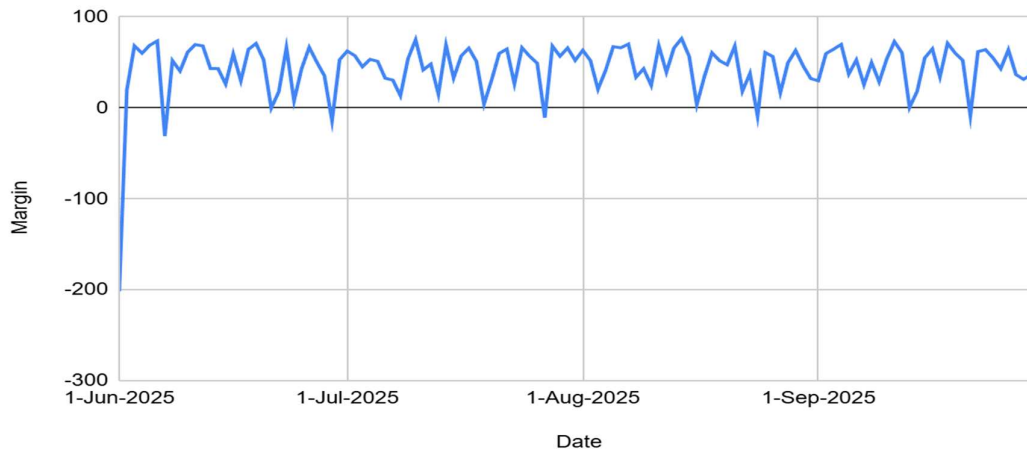
Daily Margin Analysis:

Fig 8: Daily Margin Trend

The chart shows that margins remained mostly stable from June to September 2025, fluctuating within a similar range throughout the period. Apart from an initial sharp dip, the values quickly returned to normal levels. Overall, there is no clear upward or downward trend, indicating consistent performance.

The Average Margin is: 43.74%

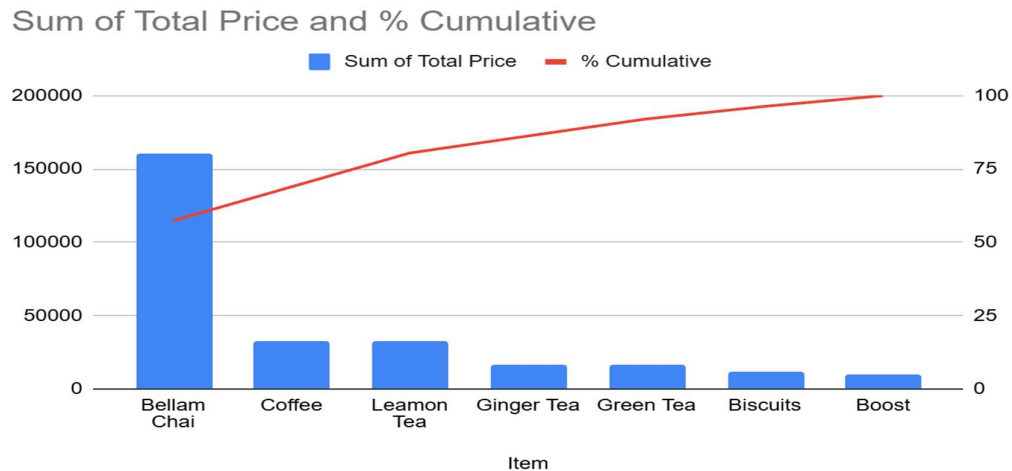The Median Margin is: 51.97%

Item-Wise Sales

Fig 9: Item wise sales in Rs

The chart compares the total quantity of each item with its cumulative percentage contribution. Bellam Chai has the highest quantity value, while the remaining items contribute much smaller amounts. The red cumulative percentage line steadily rises and reaches near 100%, showing how each item adds to the overall total. This helps identify which products contribute most to the total value in rupees.

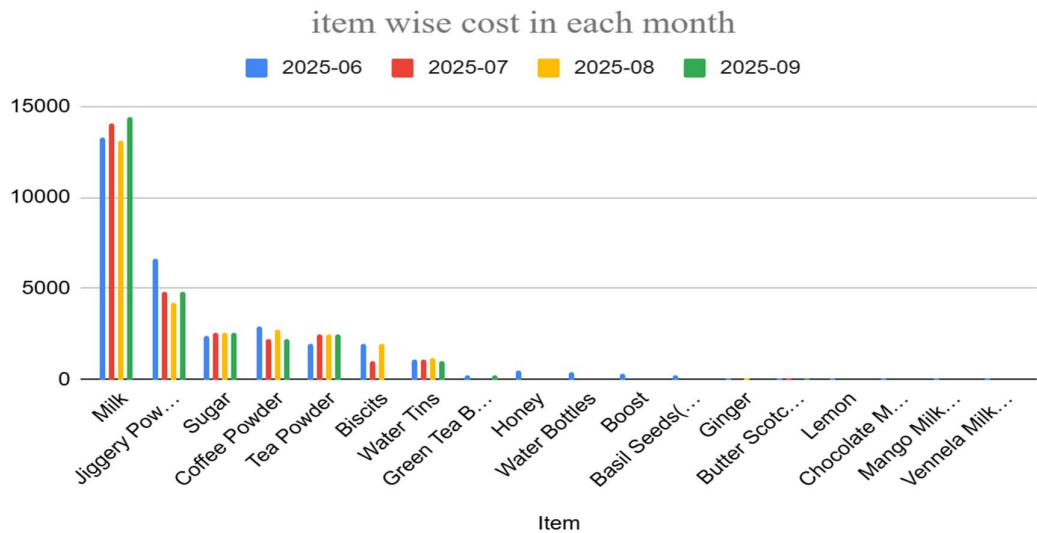|	
Bellam Chai	1,60,490Rs
Coffee	32,280 Rs
Leamon Tea	32,280 Rs
Ginger Tea	16,240 Rs
Green Tea	16,240 Rs
Biscuits	11,985 Rs
Boost	10,240 Rs

3.2. Inventory Findings (ABC Analysis)

Fig 10: Item wise inventory cost in each month

Fig 10 shows the item wise inventory cost of each month in all months the milk, Jaggery powder purchase is more so these are belonging to Class A items.

Milk — ₹55,020

Jaggery Powder — ₹20,400

Sugar — ₹10,200

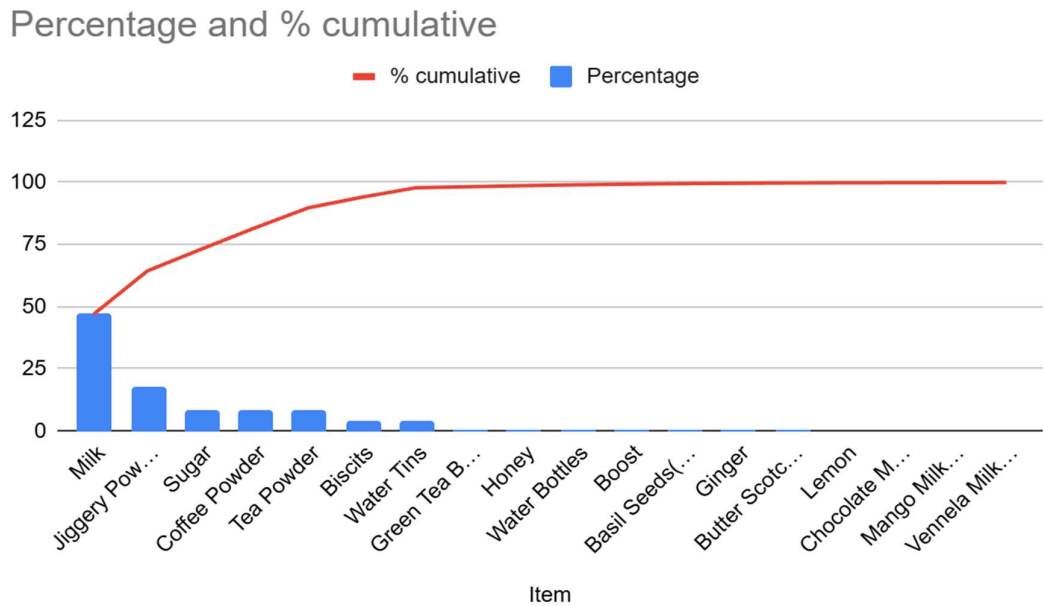These Items are belonging to the Class A.

Fig 11: ABC Analysis Inventory Chart

The ABC analysis you can see in Fig 11.

A-Class: ~70%

B-Class: ~20%

C-Class: ~10%

And Daily Usage Patterns:

Milk usage range: 4–8 litres/day

Jaggery median: 2 Kg/day

Sugar average: 4.9 Kg/day

(Note: I am not mentioned Units in the excel sheet, because while taking some calculations it is not recognizing the perfect values in the sheets that's why I used the numerical numbers as it is but I am mentioning units here, and the units of biscuits are more but price of biscuits is less but the unit consumption is more.)

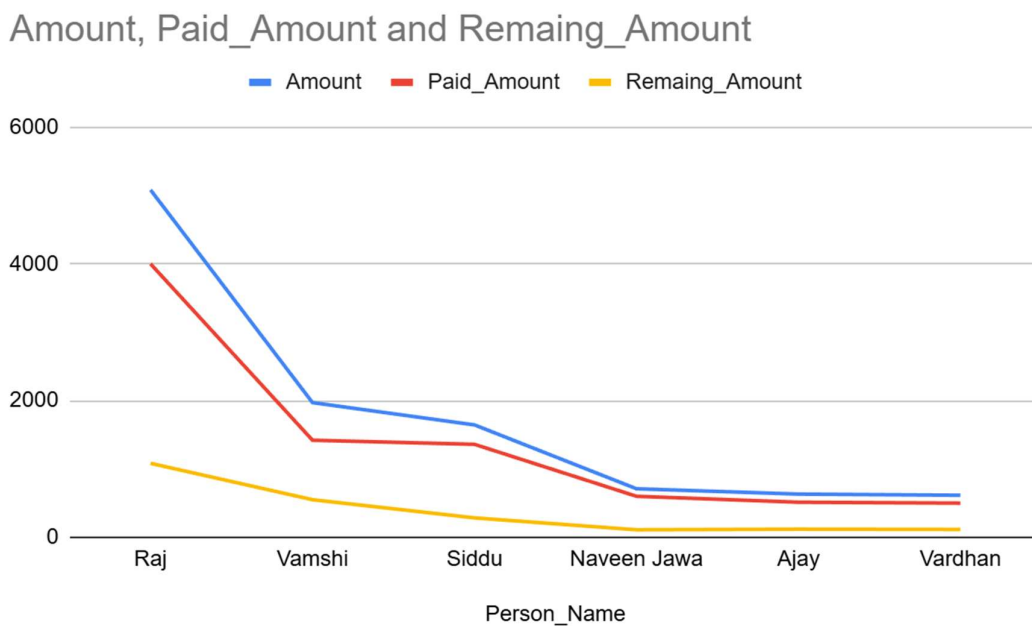### 3.3. Credit Analysis (RFM Method)

Fig 12: Credit, Paid Credits and Outstanding Balance

Customers like Raj and Vamshi show high monetary value but lower frequency of repayment, resulting in higher outstanding amounts. Customers toward the right of the chart display lower monetary transactions with faster repayment behavior. Overall, the pattern indicates that most customers maintain good credit discipline, with only a few requiring closer follow-ups due to larger dues.

Mean- 87.31 Rs

Median- 75 Rs

Max- 330 Rs

Min- 20 Rs

Standard Deviation- 57.02 Rs

Findings:

- Raj = Highest frequency (122) + highest monetary (₹4,932)
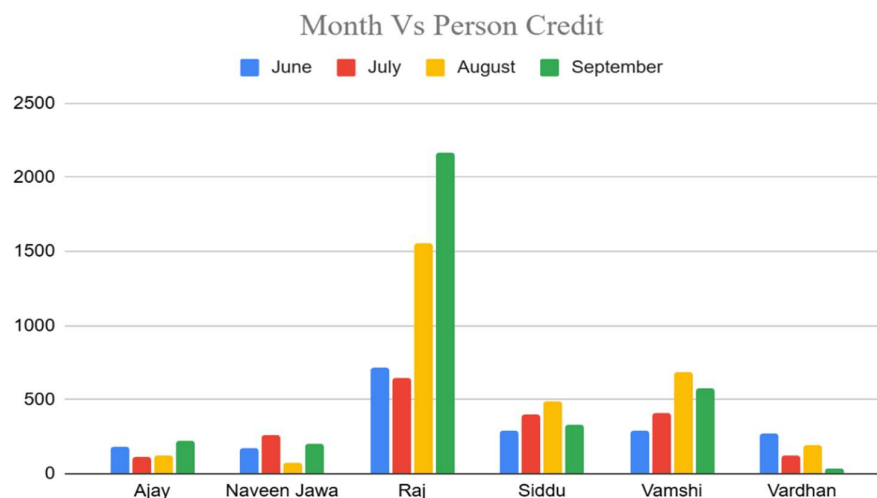- Vardhan = Worst recency (24 days)
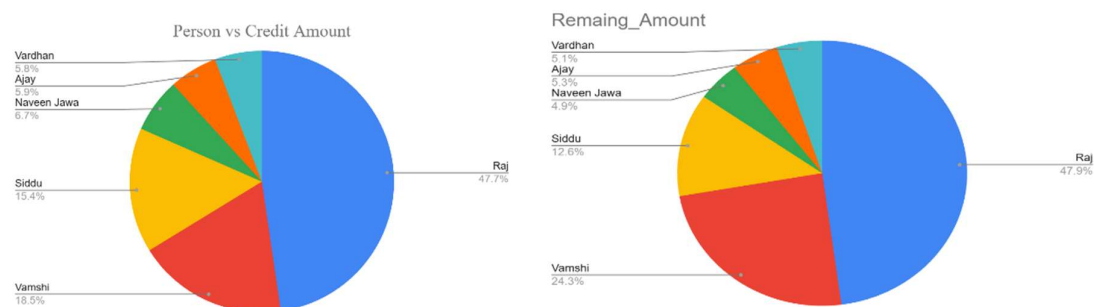

Fig 13: Person Wise Credit Data each month

Fig 14: Credit Amount and Outstanding Balance

The pie charts highlight how credit activity is distributed among customers. Raj
contributes the largest share of both total credit and outstanding balance,
indicating high monetary value and frequent engagement. Vamshi and Siddu
also show notable monetary contribution, suggesting moderate-value customers.
The remaining individuals hold smaller shares, representing lower-value

segments in the RFM model.
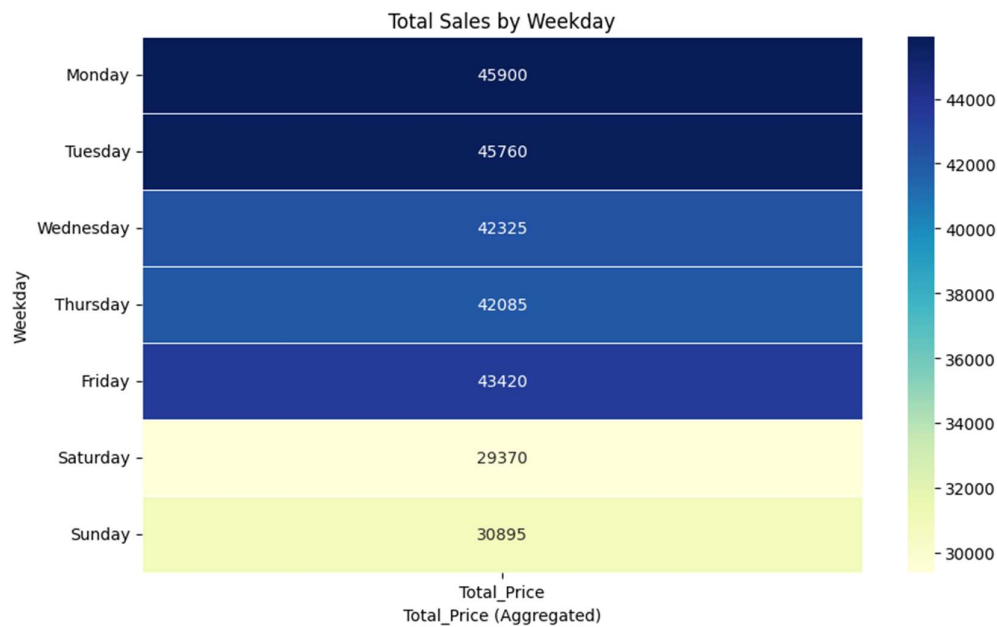
3.4.Peak Hour and Weekly Demand Patterns

Fig 15: Heatmap for the sales by weekday

In the sales as mentioned above the sales of weekdays are more compared to weekends, this is because of the absence of school, colleges and offices because the majority of the customers for the Telangana Bellam Chai are Students and workers in the surroundings. In the weekends the footfall is low compared to week days. And some observations and known from the business owner are listed below

- Telangana Bellam Chai experiences two clear peak hours: 7–10 AM and 4–7 PM, where customer footfall is the highest.
- A major share of daily revenue is generated during these two periods, especially from Bellam Chai and Coffee.
- Heavy workload during peak hours causes delays, longer waiting times, and missed sales opportunities.
- Weekly trends show higher sales on Monday, Wednesday, and Friday, indicating consistent mid-week and weekend demand.
- The concentrated rush increases operational pressure on the owner, who manages all activities alone.
- Allocating support staff or preparing key items in advance during peak hours can improve service speed and overall revenue.

4. Interpretation of Results and Recommendations

4.1 Financial Overview of the Business

Total Revenue	Rs 279755
Total Cost	Rs 149699.42
Total Profit Earned	Rs 129555.58
Average Margin	43.74%
Highest Profit	Rs 2204
Lowest Profit	Rs -3206

The 4 months income from the business amounts to Rs 2,79,755, monthly turnover of the business id Rs 68,792

expected annual turnover is Rs 8.25lacks

majority of days yielding positive returns. Losses occur exclusively during bulk-procurement days (primarily for Milk, Jaggery Powder, and Sugar), confirming that inventory spikes not demand fluctuations cause profit drops.

The weak negative correlation between cost and sales (**–0.22**) reaffirms that increased costs do not increase sales; instead, they reduce daily profit margins. This indicates a clear need to optimize procurement volumes and frequency.

4.2 Inventory & Consumption Interpretation (ABC Findings)

ABC classification revealed that:

- **Class A items (Milk, Jaggery Powder, Sugar)** contribute **~70% of total consumption cost**, making them critical for uninterrupted sales.
- Daily usage patterns confirm:
    - **Milk:** 4–8 litres/day
    - **Jaggery:** median 1.56 kg/day
    - **Sugar:** 4.63 kg/day

The repeated stockouts of these A-class items (particularly milk and jaggery) directly affect sales of the shop's flagship product Bellam Chai, which accounts for over 60% of total revenue.

Thus, inefficiencies in inventory planning directly reduce revenue and margins.

4.3 Credit Behavior Interpretation (RFM Analysis)

Most customers repay consistently a few individuals cause significant cash-flow strain.

- Raj: Highest frequency and highest monetary value.
- Vardhan: Worst recency (24 days without repayment).

The concentration of outstanding amounts among two or three customers increases working capital pressure, especially during peak days when inventory purchases are essential.

This affirms the need for credit caps, repayment schedules, and digital credit tracking, as unstructured credit directly affects the owner's ability to purchase daily milk and jaggery Powder.

4.4 Peak Hours, Demand Pattern & Operational Pressure

Sales analysis and owner observation confirm two heavy-demand windows:

- Morning: 7–10 AM
- Evening: 4–7 PM

A major share of daily revenue is generated during these periods. However, since the owner manages preparation, serving, billing, and credit tracking alone, delays occur during high footfall.

This results in:

- slower service
- missed orders
- premature customer drop-off
- daily revenue loss despite high demand

Thus, optimizing manpower or pre-preparation during these windows can significantly increase daily turnover.

4.5 Strengthen Inventory Planning and Purchase Management

- **Implement strict reorder levels for Class A items (Milk, Jaggery Powder, Sugar)** to prevent stockouts and avoid high-cost, bulk purchases that lead to negative profit days. Using ABC insights, plan smaller, more frequent purchases based on actual daily usage trends (Milk: 4–8L/day, Jaggery: 1.56kg/day), thereby stabilizing daily operating costs.
- **Maintain a 2–3day buffer stock for critical items** to ensure uninterrupted production of Bellam Chai, the shop's highest revenue generator. This reduces last-minute procurement pressure, improves cost control, and enhances operational predictability. But items like milk can't be store 2-3days except that we can procure every item.
- **Organize inventory storage and monitoring** using a simple checklist or digital app like Vyapar or Sortly (Which the owner can access freely) to track daily consumption

and remaining stock. This prevents wastage, helps forecast demand accurately, and supports profit-maximizing purchase decisions.

4.6 Strengthen Credit Management and Cash Flow Stability (RFM Method)

- **Set clear credit limits based on customer RFM scores**, limiting high-risk customers (e.g., Raj, Vardhan) to minimal credit and allowing moderate credit only to reliable customers. This reduces outstanding balances and ensures essential working capital is available for daily milk and jaggery purchases. (Actually, Raj is a government employ on his name the staff of his office takes credit that's why it is high credit and he pays that credit for every month), this delay making the owner to purchase next day inventory if Raj pays that credit weekly once it is better to manage the inventory for the owner.
- **Digitize credit tracking using mobile apps (Khatabook, OKCredit)** to eliminate manual errors, maintain real-time outstanding records, and send automatic reminders for pending payments. This ensures transparency, reduces repayment delays, and improves daily cash flow.
- **Review outstanding dues weekly** and enforce stricter credit policies during low-cash periods. Prioritizing repayment from high-frequency and high-monetary customers strengthens liquidity and reduces financial stress on the owner.

4.7 Reduce Workload Pressure During Peak Hours (Operational Efficiency)

- **Hire a part-time helper for morning (7–10 AM) and evening (4–7 PM) peak hours** to handle preparation, serving, and billing support. This increases serving speed, reduces waiting time, and helps capture additional sales currently lost due to delays.
- **Pre-prepare essential components like milk, jaggery syrup, and tea decoction** before peak windows to streamline workflow. This significantly reduces preparation time per order and increases total customers served per hour.
- **Organize the workstation for maximum efficiency**, keeping frequently used items (milk, jaggery powder, sugar, tea powder, cups) easily accessible. This minimizes movement and speeds up the service process during high-demand periods.

5 Additional Information: BDM_Project_Folder