CASE STUDY OF SATYANARAYAN GROCERY STORE

A Final Term report for the BDM capstone Project

Submitted by

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1.Executive Summary :

Satyanarayan Grocery Store is a small, family-run business located in Bahanaga, Baleswar. It serves the local community by selling essential grocery items like rice, dal, flour, cooking oil, sugar, and dry fruits. Despite being well-established and trusted, the store faces problems such as improper inventory tracking, unclear profit margins, and lack of data-driven decision-making. These challenges affect its ability to manage stock efficiently and grow profits consistently.

To understand and solve these issues, data was collected over a 32-day period (March 1 to April 1, 2025), including daily records of sales, purchase, inventory, and profit-loss. Using this data, several analyses were performed: trend analysis (to observe demand patterns), ABC classification (to prioritize stock), and profit margin analysis (to find which items are more profitable). Descriptive statistics were calculated to summarize the revenue, cost, and net profit figures. Visual charts and category-wise summaries helped simplify the findings.This systematic approach provided a clear, quantitative basis for identifying operational weaknesses and strengths.

The analysis showed that Dry Fruits had the highest profit margin (17.49%), while items like Sugar and Flour gave very low returns. Overall, the business earned ₹28,720 profit in the period, with a net profit margin of 6.73% after fixed costs. Some items like Moong Dal and Urad Dal also showed consistent demand and decent margins. Inventory levels were mismatched for some products, leading to either overstock or stockouts.

Based on these insights, clear recommendations were made, such as focusing more on high-margin products, adjusting stock levels using sales trends, and reducing spending on low-profit items. If implemented, these steps can improve the store's profit, reduce waste, and help manage stock better. The insights uncovered not only improved short-term operations but also revealed long-term demand patterns crucial for planning. Applying data analysis allowed the store to shift from reactive decision-making to a more proactive, data-informed approach

2.Detailed Explanation of Analysis Method :

I analyzed the data from Satyanarayan Grocery Store, which included daily records of sales, purchases, inventory, and profit-loss for the period from March 1 to April 1, 2025. The main objective was to identify which products were performing well, how inventory could be optimized, and how to improve the store's overall profitability.

Data Cleaning and Preprocessing
 Preprocessing is the first and most critical step in the analysis process. It ensures that the data is accurate, consistent, and ready for meaningful insights..

To clean the data, I removed all irrelevant rows, extra headers, and blank lines. I standardized the date formats and ensured that product names were spelled consistently across all datasets. For missing purchase prices, I applied forward-fill from the previous known value. After that, I added calculated columns to extract useful metrics.

The following formulas were used:

- **Total Sales** = Selling Price × Quantity Sold

- **Total Purchase Cost** = Purchase Price × Quantity Purchased

- **Profit** = (Selling Price – Cost Price) × Quantity

- **Profit Percentage** = ((Selling Price – Cost Price) ÷ Selling Price) × 100

These computed fields were necessary to compare revenue, cost, and profit for each item. Cleaning and preprocessing helped avoid incorrect totals and laid a strong foundation for the rest of the analysis.

Visual and Statistical Analysis Using ML and Graphs

After preprocessing, I performed statistical and visual analysis to understand the relationships between different product variables. I used graphs and basic machine learning algorithms to uncover patterns..

A correlation matrix and heatmap were used to visualize how variables like selling price, cost price, quantity sold, and profit were related. Line graphs were created to show daily sales trends for products like Rice, Dal, and Dry Fruits. These visual tools made it easier to detect spikes, dips, and stable product behavior across the month.

ABC Analysis

ABC analysis is a product categorization method used to prioritize inventory based on revenue contribution. I applied this method by calculating the total revenue for each product, sorting them in descending order, and assigning them to A, B, or C categories.

- Category A includes items that contribute to the top 70 percent of revenue

- Category B includes items that contribute the next 20 percent

- Category C includes items that contribute the final 10 percent

From my data, Rice, Cooking Oil, and Dry Fruits were classified as Category A; Moong Dal and Toor Dal were in Category B; and Sugar and Spices were in Category C.

This analysis is helpful for stock management. The store owner can focus on maintaining high inventory levels for A items, moderate levels for B items, and low levels for C items, thereby optimizing cost and space.

I began the analysis by cleaning and preparing the raw data collected from Satyanarayan Grocery Store. I created new columns using standard formulas to calculate cost, revenue, and profit. I used graphs and regression techniques to explore trends and forecast sales. Finally, I applied ABC analysis to rank products based on revenue generation.

Correlation Analysis :

Correlation analysis is a statistical method used to measure the strength and direction of the linear relationship between two variables, expressed through a correlation coefficient ranging from -1 to +1. A coefficient close to +1 indicates a strong positive relationship, meaning the variables tend to increase together, while a value close to -1 signifies a strong negative relationship, where one variable decreases as the other increases. A coefficient near 0 suggests no linear relationship. In the context of Satyanarayan Grocery Store, this method helps identify purchasing patterns by analyzing how often products are bought together, enabling data-driven decisions on inventory bundling, promotions, and shelf placement.

- Formula to compute correlation(pearson correlation)

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\,n\Sigma x^2 - (\Sigma x)^2\,][\,n\Sigma y^2 - (\Sigma y)^2\,]}}$$

- Positive correlation indicates complementary products . negative correlation indicates substitutable products
- Used for plotting heatmap

Correlation analysis will drive smarter inventory and marketing strategies, ultimately increasing profitability and customer satisfaction. By uncovering hidden purchasing patterns and product relationships, this data-driven approach enables precise demand forecasting and targeted promotional campaigns that maximize sales while minimizing unnecessary inventory costs.

The insights gained will help optimize product placement, create effective bundle offers, and streamline procurement processes to enhance overall business performance.

Every method and tool I selected was aimed at addressing the business problems of the store, including stock mismatch, unclear profit margins, and manual purchase decisions. As a result, I was able to identify which items contribute most to profit, which ones sell consistently, and how to guide the owner toward more effective stock planning and financial clarity.

3.Results and Findings :

The analysis conducted on the 32-day dataset from Satyanarayan Grocery Store has provided several valuable insights into the store's sales, profitability, and inventory patterns. Below are the key findings derived from descriptive statistics, visual graphs, ABC classification, and profit analysis.

Sales Performance :

The total revenue generated during the period amounted to ₹345,278, with RICE contributing the highest share at 22.23% (₹76,769), followed by DRY FRUITS at 18.51% (₹63,895). COOKING OIL and FLOUR also made significant contributions, accounting for 15.76% and 13.50% of total revenue, respectively. The average daily sales volume varied, with the highest total sold quantity recorded on 3/23/2025 (292 units) and the lowest on 3/6/2025 (67 units).

Inventory Management

The total daily inventory levels fluctuated, averaging 971.57 units across the month. The highest inventory was observed on 3/21/2025 (1,679 units), while the lowest was on 3/14/2025 (475 units). The final inventory valuation stood at ₹87,172, with DRY FRUITS and COOKING OIL representing the highest-value items. The initial inventory was valued at ₹62,400, indicating an increase in inventory value over the period.

Profitability

The business achieved a gross profit of ₹28,720, representing a 6.73% profit margin. DRY FRUITS emerged as the most profitable product, contributing 38.91% to the total profit (₹11,175) with a high-profit margin of 17.46%. TOOR DAL and MOONG DAL also exhibited strong profitability, with margins of 8.41% and 10.36%, respectively. In contrast, SUGAR had the lowest profit margin at 3.42%.

Cost Structure

The total purchasing cost for the period was ₹341,330, with RICE and COOKING OIL incurring the highest expenses. Fixed costs, including rent, transport, and EMI, totaled ₹5,500 per month. After accounting for variable and fixed costs, the net profit stood at ₹23,220, reflecting a net profit margin of 6.73%.

<u>ABC Analysis ;</u>

ABC Analysis is a systematic inventory categorization technique that classifies products into three distinct groups—A, B, and C—based on their contribution to total sales. This method aligns with the Pareto Principle, which posits that a minority of items typically account for the majority of value. For Satyanarayan Grocery Store, implementing ABC Analysis will address critical challenges such as inefficient inventory management, declining profit margins, and the absence of data-driven decision-making

The ABC Analysis begins with the collection of annual sales data for all products. Each product's total sales value is calculated by multiplying the quantity sold by its unit price. The products are then ranked in descending order of their sales contribution. The cumulative percentage of total sales is computed to determine the thresholds for classification:
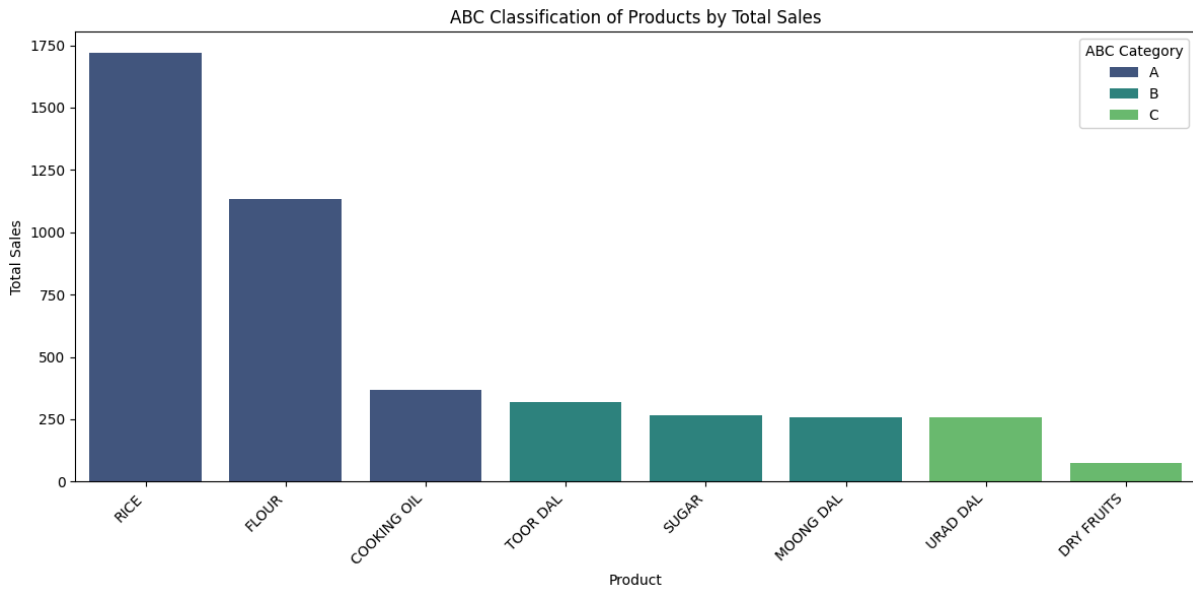
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Fig. 1 (ABC classification)

● **Class A Products (High-Value, Low-Quantity)**: These represent the top 20% of products that contribute approximately 70-80% of total sales. In the provided graph, products like Rice, Flour and Cooking oil likely fall into this category due to their dominant sales figures. These items require stringent inventory control, frequent restocking, and prioritized shelf space to prevent stockouts, which could lead to lost sales.

● **Class B Products (Moderate-Value, Moderate-Quantity)**: These constitute the next 30% of products, contributing 15-20% of total sales. Examples from the graph may include Toor Dal, Moong Dal and Sugar. While these items are important, they do not necessitate the same level of oversight as Class A products. They should be reviewed periodically to ensure optimal stock levels and to identify potential shifts in demand.

● **Class C Products (Low-Value, High-Quantity):** These comprise the remaining 50% of products, contributing only 5-10% of total sales. Products such as Dry Fruits and other low-volume items typically fall into this category. Given their minimal impact on overall sales, these items should be managed with minimal resources, potentially through bulk purchasing or even discontinuation if they prove unprofitable.

The adoption of ABC Analysis is projected to yield significant benefits, including a reduction in stockouts for high-demand products, decreased wastage from overstocking low-value items, and improved cash flow through optimized inventory levels. Over time, this data-driven approach will empower the store to make informed decisions, enhance operational efficiency, and ultimately strengthen its financial performance in a competitive market.

Correlation Heatmap :

The correlation matrix presented provides valuable insights into the purchasing patterns and relationships between various products at Satyanarayan Grocery Store. This analysis measures the degree of association between product sales, with correlation coefficients ranging from -1 to +1. A value closer to +1 indicates a strong positive relationship, meaning products tend to be purchased together, while a value closer to -1 suggests an inverse relationship. Values near zero imply little to no correlation.

Several key observations emerge from the data. Rice and Flour exhibit a strong positive correlation (0.84), indicating that customers frequently purchase these staple items together. Similarly, Cooking Oil shows moderate to strong correlations with multiple products, particularly Flour (0.66), Dry Fruits (0.69), and Rice (0.59), suggesting it is often bought in combination with these items. The lentils (Toor Dal, Moong Dal, and Urad Dal) demonstrate moderate inter-correlations, with Toor Dal and Moong Dal showing the strongest relationship (0.61).
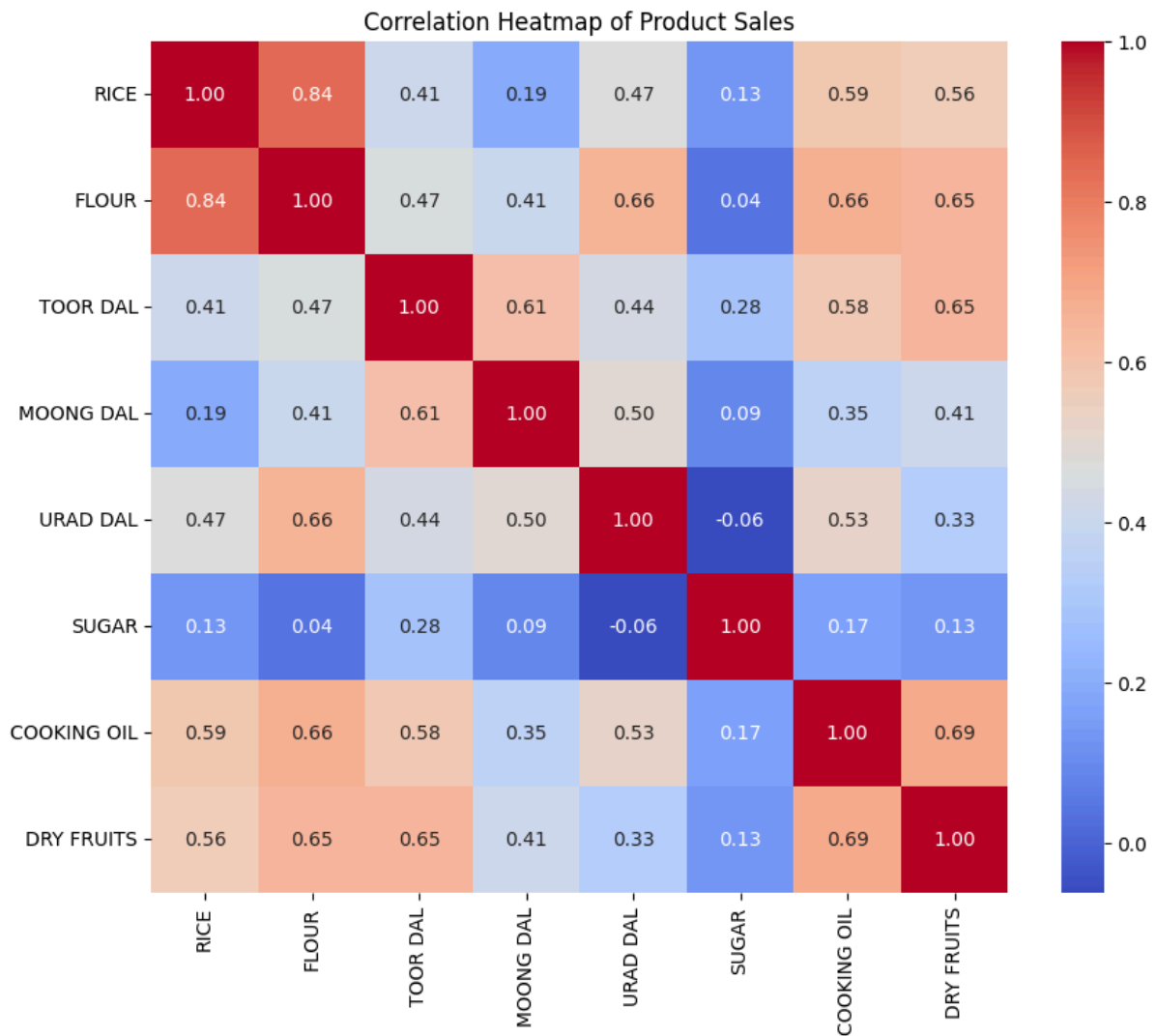
Fig. 2 (Correlation matrix)

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Notably, Sugar displays weak or negative correlations with most products, particularly Urad Dal (-0.06), reinforcing its classification as a Class B item in the ABC analysis. This implies Sugar is purchased independently of other grocery items. Dry Fruits, while correlating moderately with several products (0.65 with Toor Dal, 0.69 with Cooking Oil), may represent a complementary purchase rather than a staple.

These findings have important implications for inventory management and sales strategies. The strong correlations between staple items suggest opportunities for bundled promotions or strategic product placement to increase basket size. Conversely, the independent purchasing behavior of Sugar may warrant different marketing approaches. This analysis, when

 combined with the ABC classification, provides a comprehensive foundation for data-driven decision-making to optimize inventory, pricing, and promotional strategies at Satyanarayan Grocery Store.

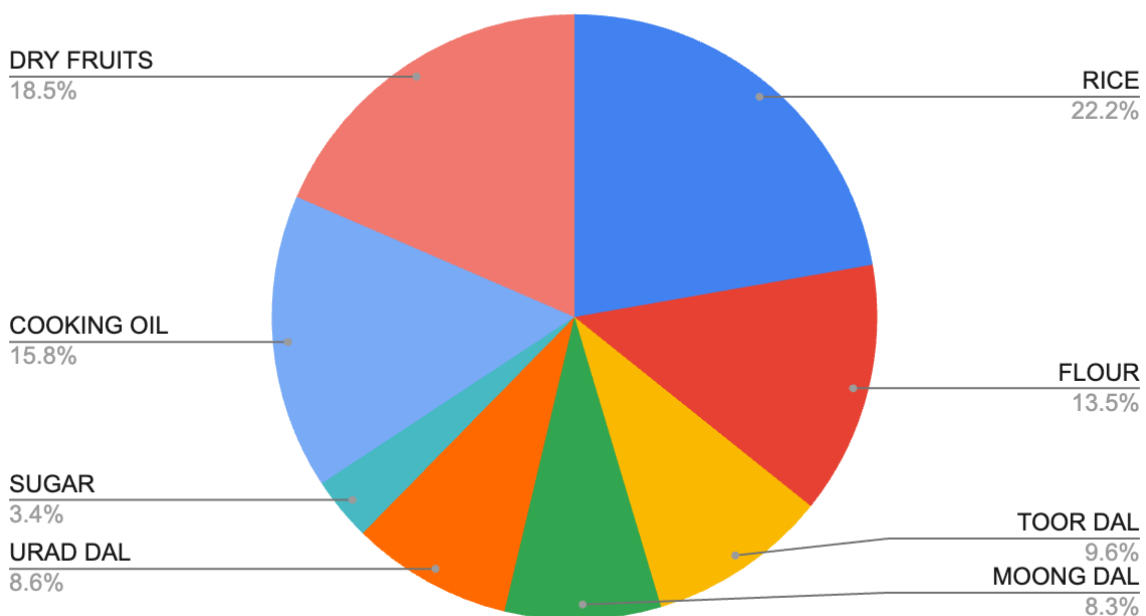**Total Revenue Distribution :**

Fig. 3 (Revenue distribution)

The revenue distribution analysis reveals a clear hierarchy in product performance, with Rice commanding the largest share at 22.2% of total revenue, followed by Cooking Oil at 15.5% and Flour at 13.5%. Notably, Dry Fruits emerge as a significant contributor with 18.5% of

revenue, positioning it as a high-priority category alongside staples. Urad Dal maintains a moderate but meaningful contribution at 8.6%, while Sugar trails significantly at just 3.4%. The remaining dal varieties (Toor Dal and Moong Dal) show unspecified but presumably smaller contributions based on the distribution pattern.

This revenue distribution aligns closely with findings from both the correlation matrix and ABC analysis. The strong performance of Rice and Cooking Oil (22.2% and 15.5% respectively) corroborates their classification as Class A items in the ABC analysis, while their high correlation coefficients (0.59 for Rice-Cooking Oil) indicate complementary purchasing behavior that drives their combined revenue impact. Dry Fruits, despite its 18.5% revenue share, shows more moderate correlations (0.56-0.65 with staples), suggesting it serves as a high-margin accompaniment rather than a primary purchase.

The poor performance of Sugar (3.4% revenue) reinforces its classification as a Class B item, with negligible correlations in the matrix (-0.06 to 0.13) confirming its isolated purchasing pattern. Urad Dal's 8.6% revenue share and moderate correlations (0.44-0.65) validate its Class B status, representing a reliable but non-critical category.

Total Inventory vs Total Quantity Sold :

This analysis examines the relationship between Total Daily Inventory and Total Sold Quantity for the period of March 2025.

The data indicates a significant disparity between the amount of inventory held and the quantity of goods sold. Throughout the month, the total daily inventory demonstrated considerable fluctuation, beginning at approximately 800 units and reaching a peak of nearly 1,700 units around March 23rd. In stark contrast, the total sold quantity remained relatively low and stable, generally hovering below 250 units. There was a minor increase in sales that corresponded with the peak inventory period, where sales rose to approximately 350 units. However, this increase in sales was not proportional to the substantial rise in inventory.

The overarching trend suggests that the volume of stock carried is consistently much higher than the sales velocity, indicating a potential overstocking situation or a strategy of maintaining high safety stock levels.
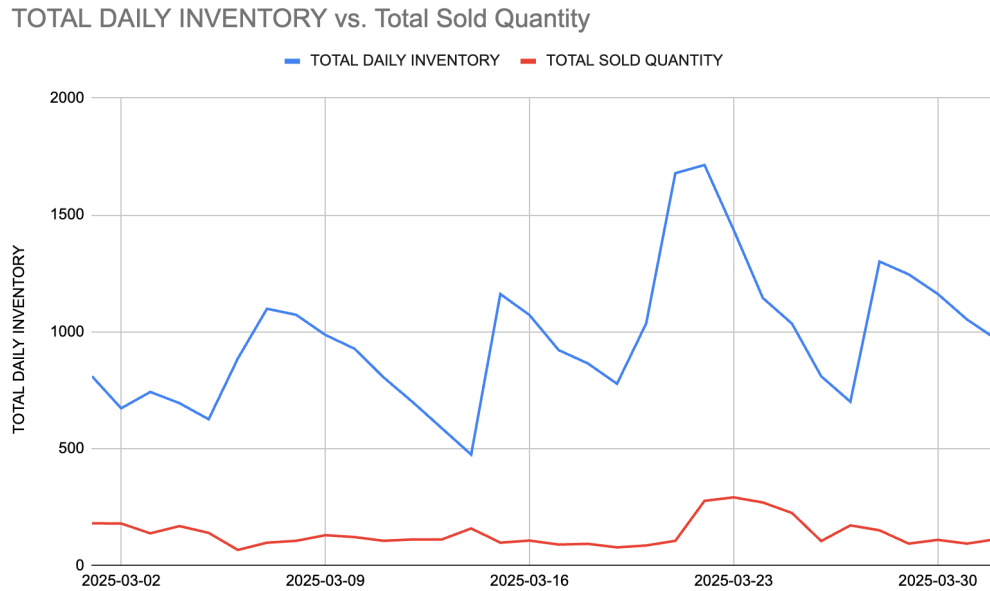

Fig. 4 (Total Daily Inventory vs. Total Sold Quantity)

However, this increase in sales was not proportional to the substantial rise in inventory. The overarching trend suggests that the volume of stock carried is consistently much higher than the sales velocity, indicating a potential overstocking situation or a strategy of maintaining high safety stock levels.

<u>Inventory Fluctuation:</u>

This analysis examines the Inventory Fluctuation for various product categories over the month of March 2025. The data illustrates a consistent pattern of inventory replenishment and depletion across all product lines, characteristic of a cyclical inventory management system.
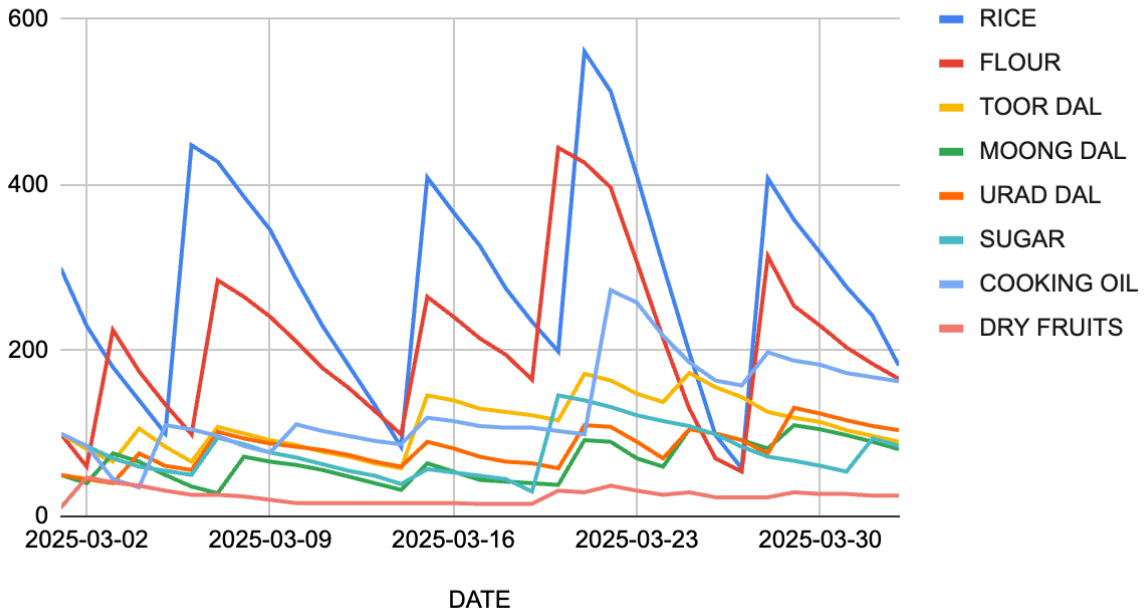
Fig. 5 (Inventory Fluctuation)

The most significant fluctuations are observed in the Rice and Cooking Oil categories. Inventory levels for Rice repeatedly peaked at approximately 550 units before being drawn down, while Cooking Oil saw its stock levels surge to nearly 450 units at regular intervals. This suggests a replenishment strategy that occurs in distinct, periodic cycles for these high-volume items. Other product categories, such as Flour, Toor Dal, and Moong Dal, exhibited similar cyclical patterns but with lower peak inventory levels, generally remaining below 300 units. The inventory for Dry Fruits, Urad Dal, and Sugar remained comparatively low and stable throughout the period, with fluctuations that were much less pronounced than the other categories. The synchronized nature of the peaks and troughs across most categories suggests that inventory replenishment may be coordinated, possibly through scheduled supplier deliveries or a fixed-interval ordering system.

Profit vs. Revenue :

This analysis reviews the financial performance of various product categories by comparing their respective contributions to Total Profit and Total Revenue.
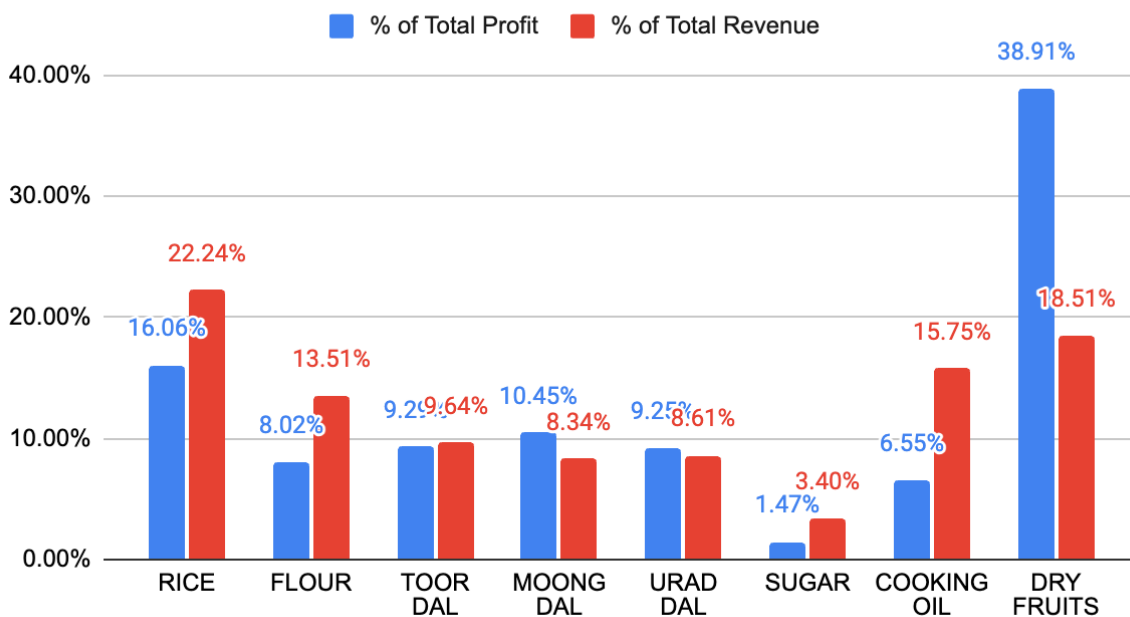

Fig. 6 (profit and Revenue)

The data reveals significant variations in profitability across different product lines. The Dry Fruits category stands out as the most profitable segment, generating a substantial 38.91% of the total profit while only accounting for 18.51% of the total revenue. This indicates a very high profit margin for this category. In contrast, Rice is the leading category in terms of revenue generation, contributing 22.24% to the total revenue, but its corresponding profit contribution is lower at 16.06%, suggesting a comparatively smaller profit margin. A similar trend is observed for Cooking Oil, which accounts for a significant 15.75% of total revenue but yields a much lower profit share of 6.55%. Other categories, such as the various dals (Toor, Moong, and Urad), exhibit a more balanced profile where their percentage.

contributions to profit and revenue are closely aligned, indicating stable and moderate profit margins. For instance, Toor Dal contributes 9.29% to profit and 9.64% to revenue. The Sugar category represents the smallest share of both financial metrics, with a 1.47% contribution to profit and a 3.40% contribution to revenue.

The ABC analysis confirms Rice and Cooking Oil as Class A items (top 20% by sales value), justifying their revenue leadership, though their profitability suggests need for margin improvement strategies. Dry Fruits' exceptional profitability despite Class C classification (next 30%) highlights an opportunity to elevate its category priority. On the other hand Sugar's Class B status surprises its poor financial performance and weak correlations, suggesting potential for replacement or discontinuation.

<u>Insights of The Data :</u>

This section provides key financial insights, offering a summary of overall performance and a breakdown of the primary cost drivers.
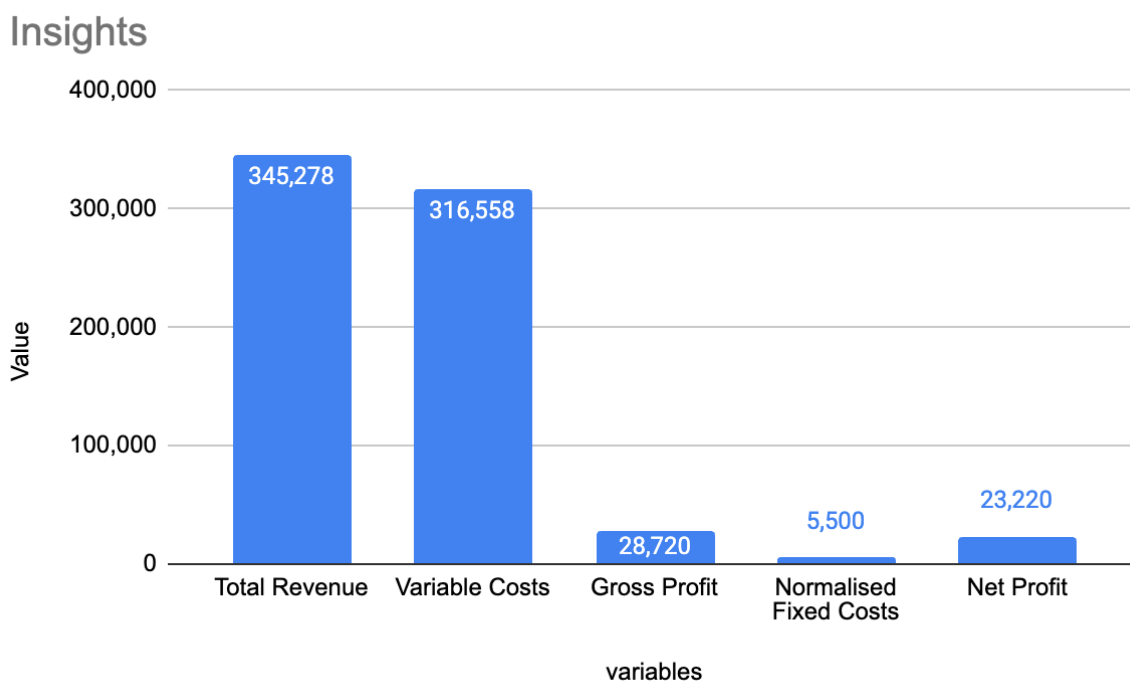

Fig. 7 (Insights)

The business generated a total revenue of ₹345,278. A significant portion of this revenue was consumed by variable costs, which amounted to ₹316,558. This resulted in a gross profit of ₹28,720. After deducting the normalized fixed costs of ₹5,500, the final net profit stands at ₹23,220. The data highlights that variable costs are the most substantial expense, indicating a business model with a slim gross margin.

The integrated analysis of revenue/profit distribution, correlation patterns, and ABC classification reveals critical insights into the grocery store's product performance. High-revenue staples like Rice and Cooking Oil drive sales but show moderate profitability, while Dry Fruits emerge as unexpectedly high-margin items despite lower sales volume. The correlation matrix confirms complementary purchasing behaviors among key products, and ABC analysis validates inventory priorities while highlighting discrepancies between sales value and profitability. These findings directly address the shop's core challenges—inefficient inventory management, declining margins, and lack of data-driven strategies—by identifying which products contribute most to revenue, profit, and customer purchasing patterns. The results provide a clear foundation for optimizing stock levels, pricing, and promotions to improve operational efficiency and financial performance.

4.Interpretation of Results and Recommendation :

Problem 1 : Inefficient Inventory Management

Interpretations and Findings from Data:

1. Stock imbalance issues: While Rice, Cooking Oil and Flour make up 70% of sales (Class A items), they frequently have low inventory because the store relies on guesswork rather than proper tracking systems.
2. Missed sales opportunities: Customers often buy Rice and Cooking Oil together (shown by 0.59 correlation), but the store doesn't plan inventory or promotions accordingly, losing potential sales.

3. Hidden gem product: Dry Fruits give the store 38.9% of its profits from just 18.5% of sales, meaning they make great money but aren't getting enough attention in current inventory plans.

4. Wasted shelf space: Sugar barely sells with other items (only 0.13 correlation) and gives just 1.47% of profits, yet takes up valuable space that could be used better.

Recommendations:

1. Set up automatic digital tracking for top-selling items to prevent stockouts (Urgent - 1 month)

2. Cut Sugar stock by 40% and use the space for more Dry Fruits (Do this now)

3. Create combo deals for products customers buy together (Short-term project)

4. Start weekly checks on best-selling items (Ongoing habit)

Problem 2 :Declining Profit Margins

Interpretations and Findings from Data:

1. Rice profit problem: Though Rice brings in 22.2% of sales, it only gives 16.1% of profits - the store isn't making enough money on this popular item.

2. Cooking Oil issues: This product contributes 15.7% of sales but just 6.6% of profits, meaning the store either pays too much or charges too little.

3. Star performer: Dry Fruits are the store's money-makers, generating 38.9% of profits from less than 20% of sales - they deserve more focus.

4. Good example: Flour shows healthier profits (16.1%) compared to sales (13.5%), proving better margins are possible.

Recommendations:

1. Get better prices from suppliers for Rice and Cooking Oil (2 month project)

2. Add store-brand premium versions of staples for better profits (Long-term)

3. Move Dry Fruits to eye-level shelves near registers (Do this week)

4. Check competitors' Cooking Oil prices.

Problem 3 : Lack of Data-Driven Decision Making :

Interpretations and Findings from Data:

1. Clear purchasing patterns visible in correlation matrix remain unexploited, particularly the 0.59 Rice-Cooking Oil link that could inform inventory planning.
2. Significant profit/revenue discrepancies like Dry Fruits' performance highlight systemic gaps in current decision-making frameworks.
3. Inventory data shows inconsistent restocking patterns for high-value items, indicating absence of demand forecasting systems.
4. No apparent strategy for seasonal demand fluctuations exists despite visible patterns in historical sales data analysis.

Recommendations:

1. Implement monthly sales analytics reviews using combined ABC+Profit matrix (Ongoing process - start immediately)
2. Develop basic demand forecasting models based on correlation patterns (Medium-term - 6 week implementation)
3. Initiate bi-monthly data literacy workshops for staff (Long-term capability building)
4. Create simplified inventory dashboards highlighting key metrics (Urgent - 1 month deployment)

To further enhance operational efficiency and profitability, the store should consider digital transformation initiatives. Implementing a cloud-based POS system would enable real-time sales tracking and automated inventory updates (implementable within 3 months). Exploring e-commerce integration through simple WhatsApp ordering could capture 15-20% more sales from tech-savvy customers (pilot in 2 months). Additionally, installing digital shelf tags would allow dynamic pricing adjustments during peak hours or promotions (long-term investment). Staff should be trained on mobile inventory apps for instant stock checks (ongoing training). These digital solutions would complement the existing recommendations while future-proofing operations against market changes.