PRICE TREND ANALYSIS & DEMAND FORECASTING FOR A WHOLESALE BUSINESS

A Final report for the BDM capstone Project

Submitted by

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Declaration Statement

I am working on a Project titled “Price Trend Analysis & Demand Forecasting for a wholesale business”. I extend my appreciation to mr. Saday Shankar for providing the necessary resources that enabled me to conduct my project.

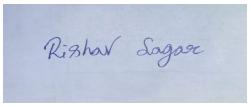
I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered from primary sources and carefully analyzed to assure its reliability.

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 principles 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 understand that all recommendations made in this project report are within the context of the academic project taken up towards course fulfillment in the BS Degree Program offered by IIT Madras. The institution does not endorse any of the claims or comments.

Signature of Candidate: 

Name: RISHAV SAGAR

Date: 15/09/2024

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1 Executive Summary

Mr Saday Shankar started the operations in 2000, it is a local level wholesale store located near Arwal more, Jehanabad, Bihar. He is serving the local community of the city over the radius of approx 3 to 4 Km, with his wholesale business which has products like sugar, edible oil, Rice and flour etc .It is a B2B business. He runs the store by himself, every morning at 9 a.m he opens the store and closes it at around 5 to 6 p.m. He mostly deals with the local Kirana stores, Hotels, Sweet shops, and Ice-cream factories etc.

Some few years ago, many people started similar businesses around him which were approximately 5 to 6 shops, leading to an increase in competition around him, but in the current time due to limited capital and price volatility of product(sugar) which fluctuate daily. They are not able to maintain the profit margin and stocks at the right level, which is affecting their revenue and also their growth. The business is struggling a lot, Which is affecting the management of the business. From the start, he was selling only sugar, he added other products last year due to increased business competition. So he has difficulties running the business sustainably.

To address the issue, I have collected Sales and Revenue data over a period of 111 days for 5 different types of products and noted it all on Google sheets for analysis. I also took the data of when he is ordering the stock to fill inventory in a month and noted that as he doesn't have any analysis apart from experience. He used to order the products only when the stocks were out.

With The help of historical sales data, helps in analyzing methods like pareto chart through which we got to know about top performing products in terms of quantity and revenue, which relies heavily on past price data. With the help of a bar chart we can analyze the profit of each product and prioritize the investment and to identify which products have low capital investment and high profit. Identifying Trends, patterns by using tools like trend lines, Moving average and then forecasting the future demand of products through Demand forecasting, using Time Series Analysis methods. In that way the problem of business is addressed and some important insights would come. This analysis helps maintain optimal stock levels and pricing. For this analysis we took sales data for calculating the average inventory days to maintain the inventory with the right amount of products.

This will help the business to make the right decision to maintain the right product stock up, grow, run efficiently and profitably with limited resources and capital, and not facing problems of profit margins and stock up and focus on growing the business sustainably.

2 Analysis Process and Method

I have used Google Sheets to analyze the data.

I have collected and updated 111 days of sales data on G-Sheets and done the analysis.

before that, i have cleaned the data by using some process like:-

- updating all null or empty cells with zero. or
- Updating all empty & zero cells with the average of two nearest integers.

After that, I run the exploratory data analysis, to take brief details of statistics and visualization of the data.

After EDA, to know the % contribution of the total revenue of each product, Firstly I took join of the sales and Revenue table where column “Date” is foreign key, then I took the product(*) of sales and revenue of each product. In this way I got the total revenue of each product sold each day.

Then I have done Revenue pareto analysis, In the new table by taking the summation of 111 days revenue of each product in column 2nd aligned with products name in column 1st, then take the cumulative revenue in 3rd column as we move from product 1 to product 5. Then for % distribution in column 4 I took the division of cumulative revenue of each product by total cumulative revenue. Through this I got to know the contribution of the product in total revenue.

I have also done Sales Volume Pareto to know about the % distribution of sales volume, to analyze which products have high sales potential and demand in the market. For this process I took the summation of 111 days of sales quantity of each product, then took the cumulative sales and divided it to total cumulative sales. Now I have the % distribution column.

Now how much revenue is generated from all the products monthly, I have calculated and plotted a chart of monthly revenue by taking the product of daily sales quantity and revenue of each product and taking the summation of all in a group of 30 days .

Now for how much the product quantity is sold in a month, I have calculated and plotted a chart of monthly Sales volume by taking the summation of product quantity sold of each product and grouped it in 30 days. Now we have monthly Sales volume which shows us which product has high demand in the market.

After analyzing the monthly Revenue and monthly sales volume, i have calculated the profit margins of all products to know, which product having high or low revenue and high or low sales volume making good profit margins or not, does it worth to invest the capital into

them or not, does it doing justice to invested capital or not, to run the business sustainable over a long period of time.

For profit margins calculation, I took the monthly capital invested in each product from the Stock up data table, then took the monthly total revenue previously calculated, of each product, put it all in the new table and made a subtraction between revenue and capital which resulted in profit.

While analyzing I observed that the sales of sugar is low in a few months and high in others which is affecting the profit margin.So for proper analysis i calculated the units economics of sugar by taking breaking down of the capital investment into several parts and categories it accordingly in this way i can know where it costing unwantedly and can control it.

After that I calculate the economics of sugar for 111 days and it's making losses in a few months and profits and another due to the unreliable price fluctuation which reduce the profit margin significantly.

This fluctuation of price is caused by various factors like production of sugar, Government regulations, climate change, sugarcane yield, level of groundwater in the area of sugarcane which is a very water hungry crop. So the prediction of price is very difficult.

I also observed the increment in the sales of products like Mustard Oil, Refined Oil, wheat flour and rice but the profit isn't that high. So I calculated the unit economics of products by breaking down the capital investment so I reduce the unwanted cost or expense from it and append it to profit.

After this for the Forecasting of products sales for upcoming 15 to 20 days, i use the forecasting method like graph-trendline. For this I took the sales data for 111 days and plot a best fitting trend line by placing the model which fits the trend line as close as actual sales and using that pattern I forecast the upcoming sales for 15 to 20 days. I also calculated the weekly moving average of the products which give us the accurate estimation or Through which we have an approximation of how much quantity we should stock up for upcoming demand.

After all that, I make a table which contains how much order quantity should be needed for upcoming sales and breakdown of total capital investment over all the products, which can give us high profit margins to maintain and grow the business sustainably.

3 Results and Finding

In the analysis process while analyzing I plot various charts and get results, here are some charts and their analysis.

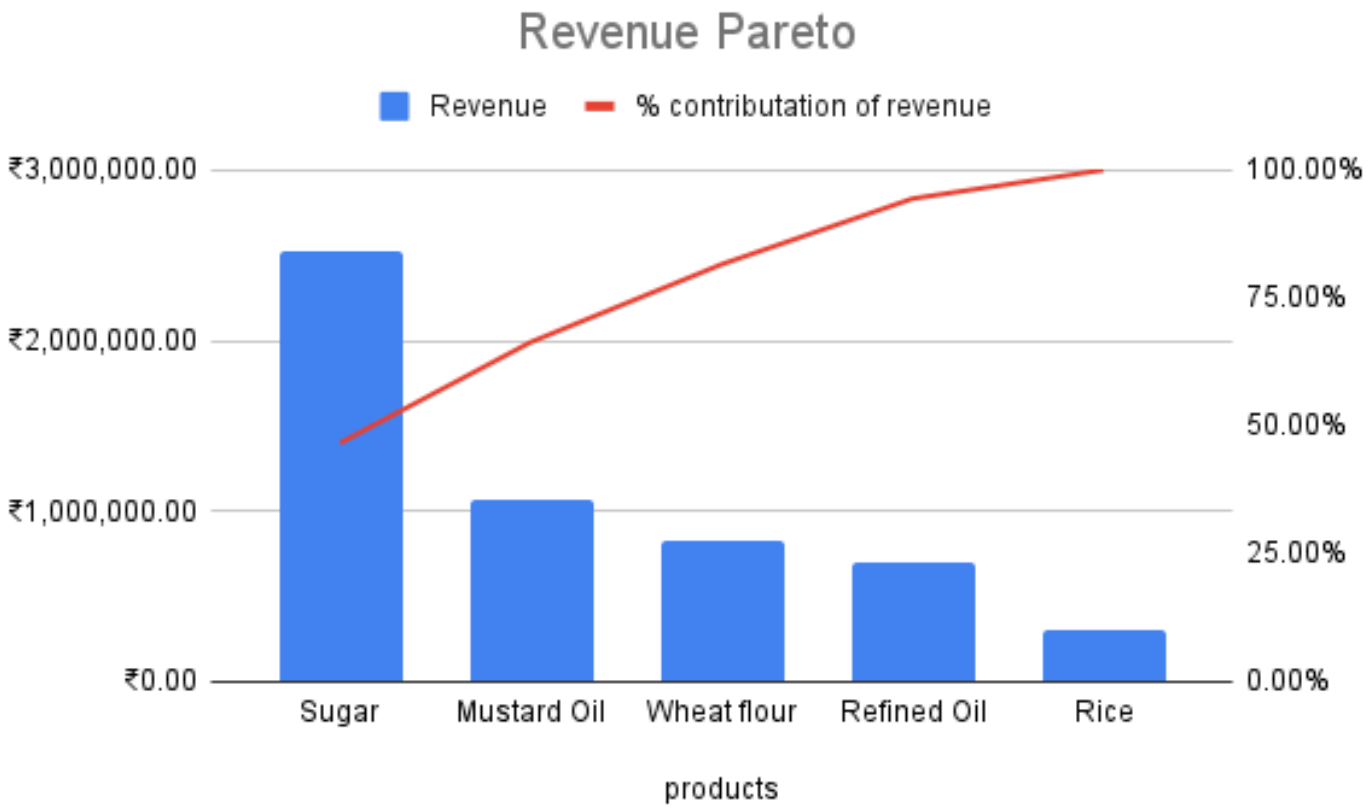

Figure 3.1 Pareto chart of products in terms of Revenue over 111 days

- After analyzing, I found sugar contributes **46.68%** of the total revenue followed by mustard oil **19.72%**, wheat flour **15.20%**, Refined Oil **12.83%** and the rest from Rice **5.61%** .
- The case is not as it seems. As per Stock up data the stock up cycle of the products are different, which is not giving us a clear stats of revenue, like sugar stock up cycle period is monthly and rest of the product is weekly.

- Sugar holds **73%** of the total capital, followed by mustard oil **08.87%**, wheat flour **07.94**%, Refined Oil **06.96%** and lastly Rice holds **02.63%** .

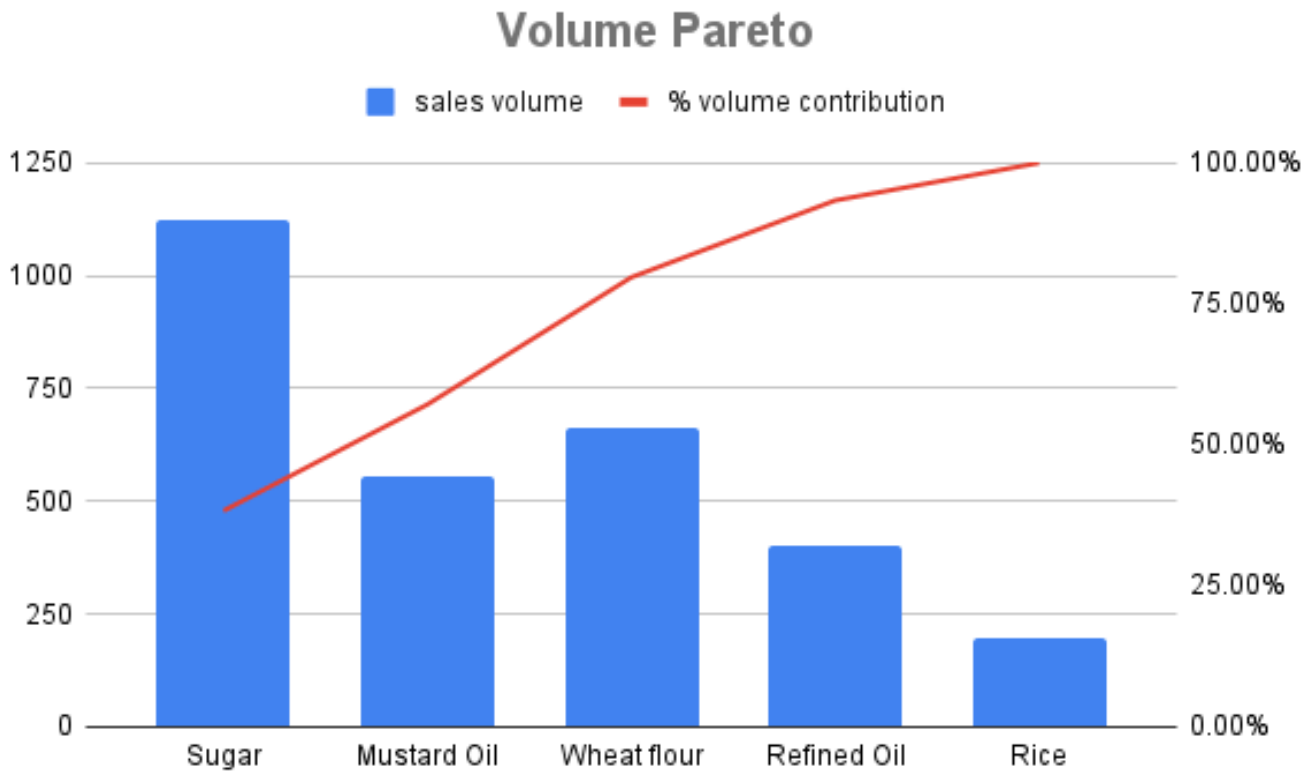

Figure 3.2 Volume pareto of products in terms of Sales volume over 111 days

- Sugar has **38.32%** of total sales volume where wheat flour has **22.54%** followed by Mustard Oil **18.85%**, Refined Oil **13.64%** and the rest goes with Rice **6.65%** .

I also do the analysis of monthly sales Revenue and volume of different products to know about the sales pattern over the time period of 111 days.

Here is the monthly distribution of sales revenue which I plotted from 15th of march to 3rd of july.

We can see that from figure 3.3, Sugar Sales revenue is increasing monthly, this is due to the seasonal month where the sales are high. Other products also have some peaks but sugar revenue is more than 2 times of the others.

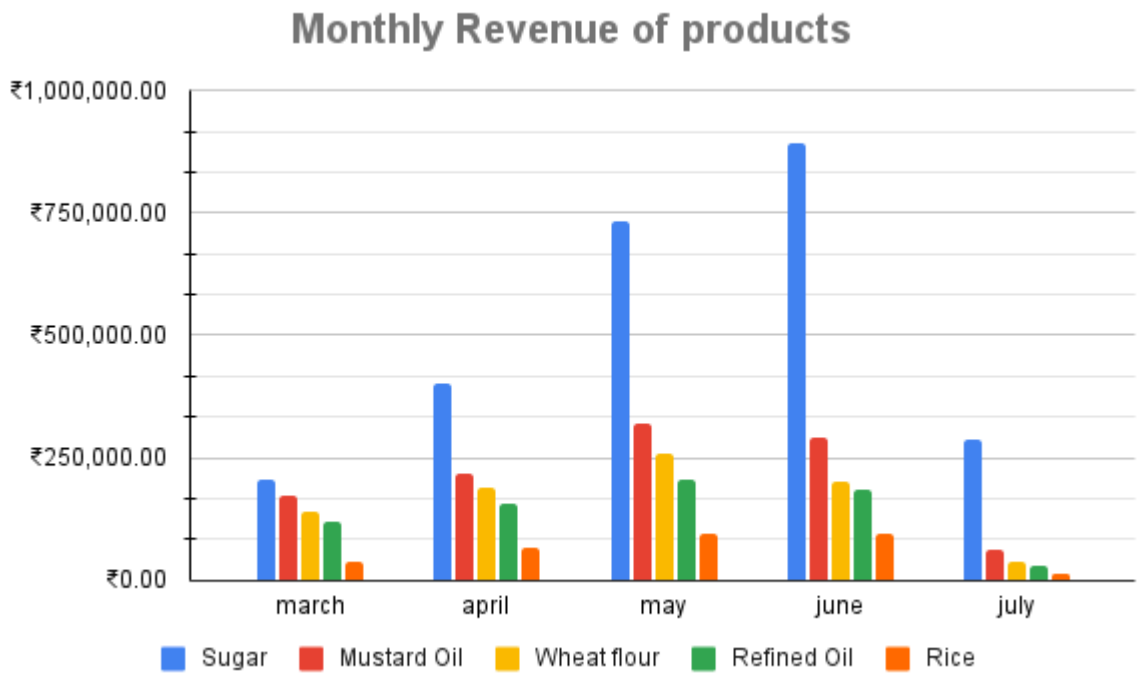

Figure 3.3 Column chart of monthly distribution of sales revenue over 111 days

Here is the monthly distribution of sales Volume which I plotted from 15th of march to 3rd of july.

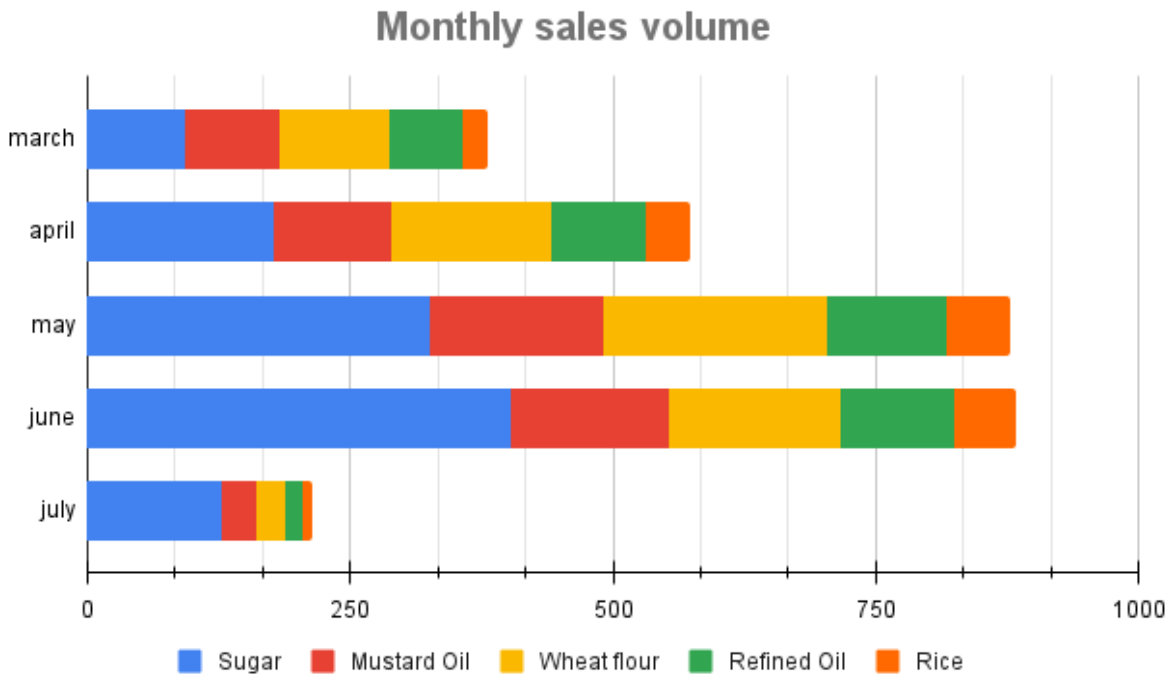

Figure 3.4 Stacked bar chart of monthly distribution of sales Volume over 111 days

- From figure 3.4 we can see that the sales volume of Wheat flour is quite good, little less than sugar followed by Mustard oil has some potential. Means! It has high market demand while having low revenue.

Here is the profit chart from which we can see which product is more profitable and investable

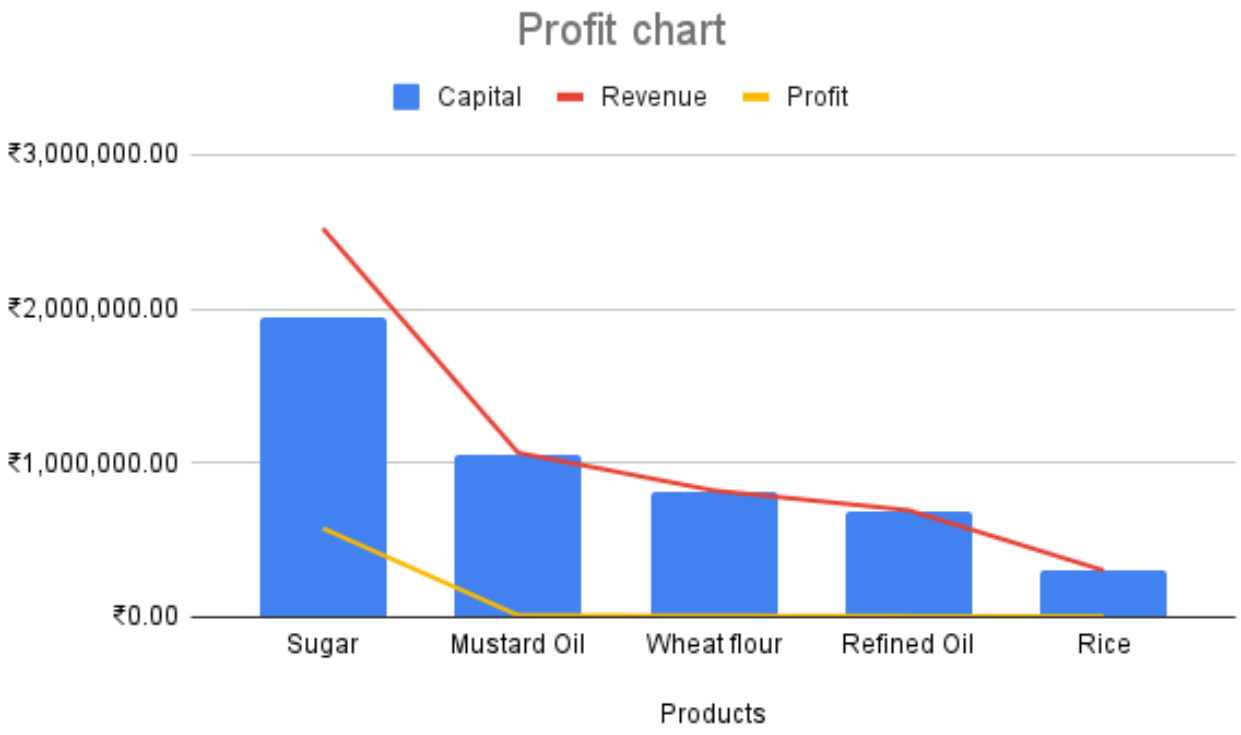

Figure 3.5 Bar and line chart which depicts Profits from products over period of 111 days

- From Figure 3.5, it shows Sugar has a good profit as compared to other products. Products like Mustard Oil, Refined Oil, wheat flour and rice have very low profit while having good sales volume. This is due to low profit margins of the products.

I also plot a monthly profit distribution chart of all products, which give us some helpful insights

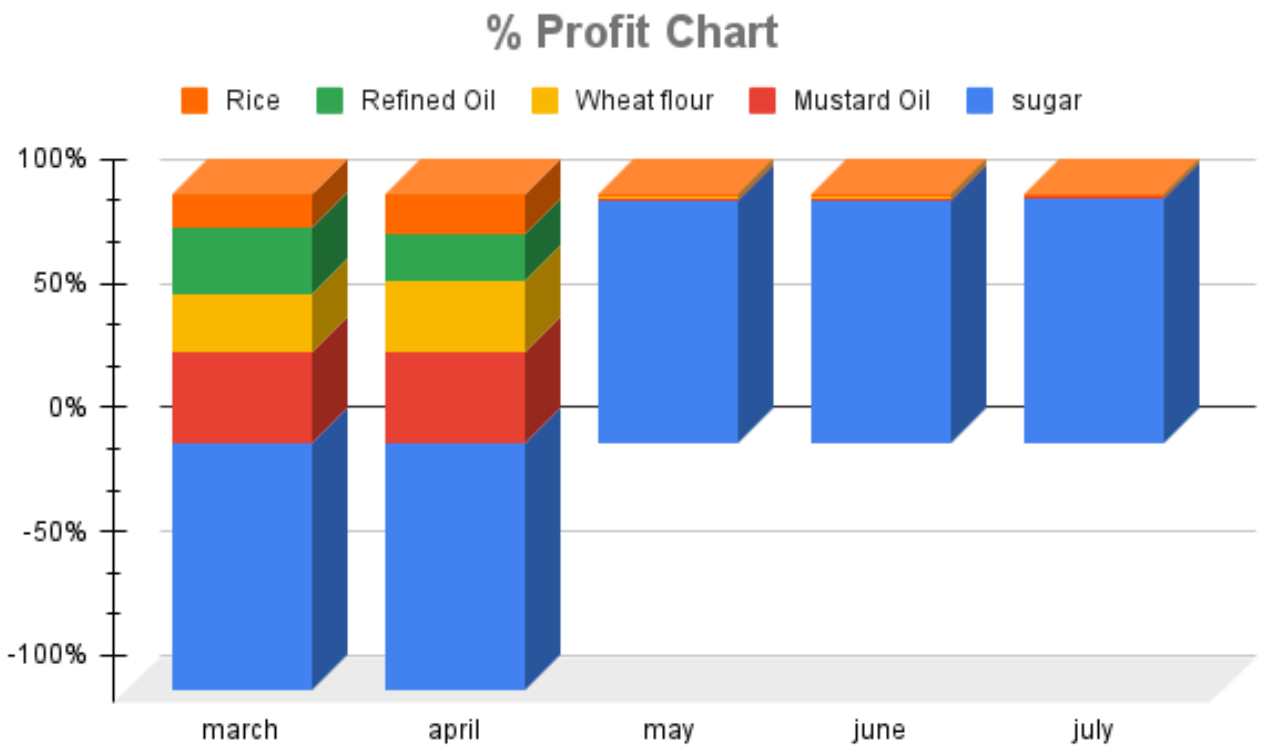

Figure 3.6 Stacked column chart which depicts monthly % Distribution Profit of the products

As we see from fig 3.6 products like Rice, Refined Oil, wheat flour, Mustard Oil has almost constant profit every month. while Sugar has not.

- By analyzing sales and Revenue data Sugar has the highest sales volume **38.32%** and revenue **46.68%** but its profit isn't reliable.

  Some times of the month the profit is negative and during seasonal & occasional time the profit gets high. That unreliability makes the business unsustainable over a long period of time.

Here I plot a line chart, which shows the Economics of Sugar.

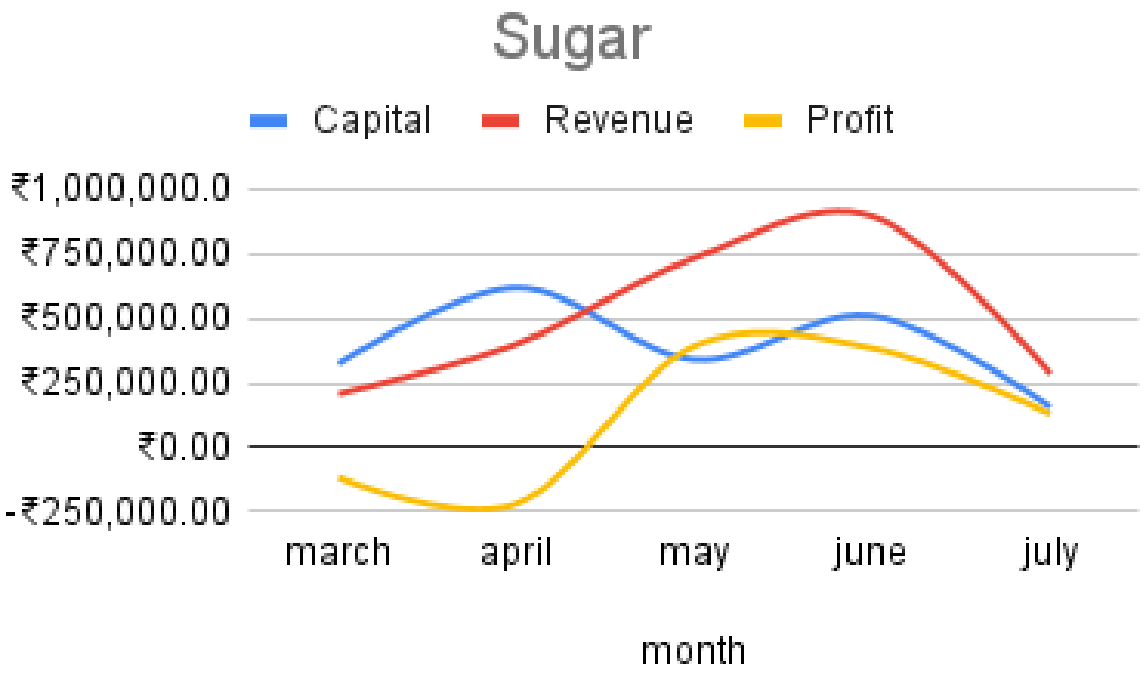

Figure 3.7 Line chart of Economic of Sugar

To avoid a situation like that,we have to balance the capital accordingly, like investing more capital in the seasonal sale to recover the losses which occur during different months.

or shift the investment into other products by investing less in sugar, during the non seasonal period of the months.

- During the sales data analysis I found out that products like Wheat flour have a good amount of sales volume considering its Capital and the other products also like Mustard Oil and Refined Oil. During the Research, i got to know there are 3 levels of market. type-1 factory warehouse which manufacture & distributes the product to type-2 where type-2 is big level wholesale which deals over cities & states and only supplies large order and then comes type-3 which can process a small order of products from which the current supply of the products like Mustard Oil, Refined Oil and Wheat flour is going on. As we move from type-1 to type-3 the profit margins are getting lesser. So to increase the profit margins we have to place a large order minimum of 150 units. Which also leads to further reduction in transportation cost. Considering the high volume sale, tuning with a high profit margin is good. And there are no losses in these products unlike sugar.

  For example, I plot some graphs of current and predicted graph, if we achieve the required profit margin at the same sales volume.

Economics of Mustard oil at present

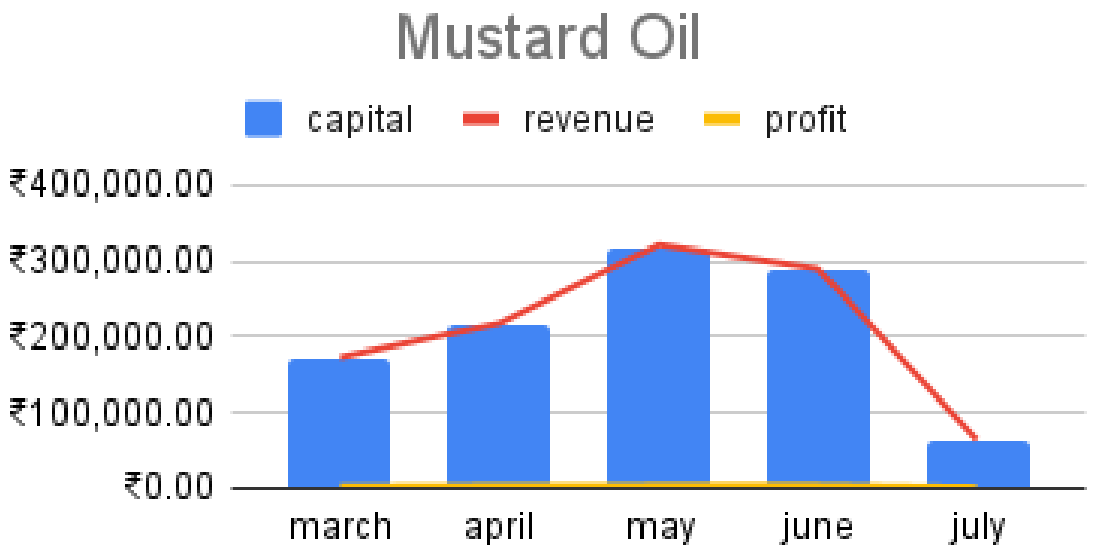

Figure 3.8 Bar & Line chart of Economic of Mustard Oil

Economics of Mustard Oil after implementation at same Sales volume

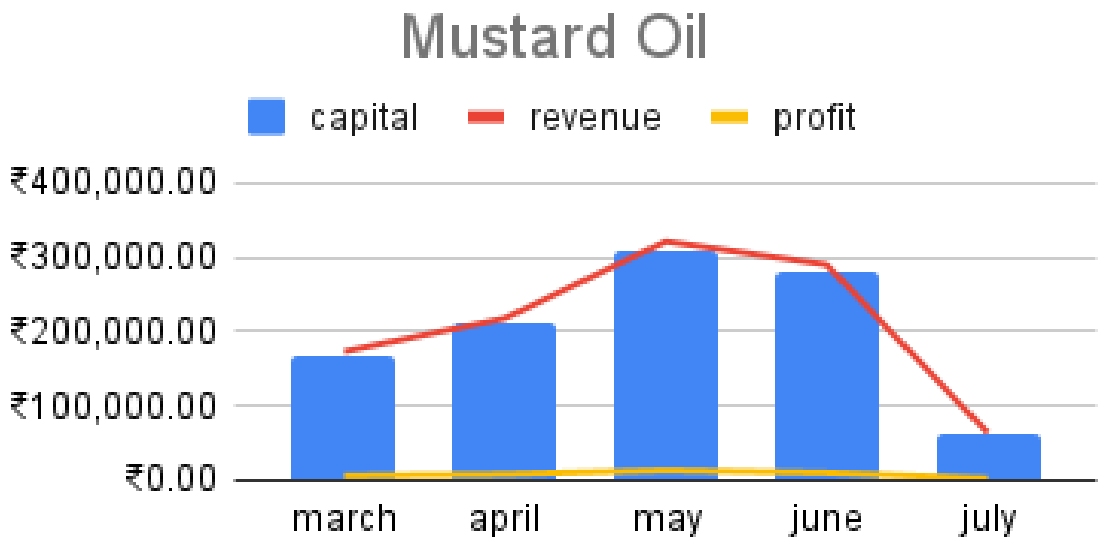

Figure 3.9 Bar & Line chart of Economic of Mustard Oil

In figure 3.9 the profit margins have increased from ₹12,900 to ₹37,120 **204%** increment in profit which is satisfying, and have scope to increase the business .

After analyzing the sales data, I use the forecasting method and plot a trend line which helps to forecast the sales for the next 15 to 20 days of all products separately.

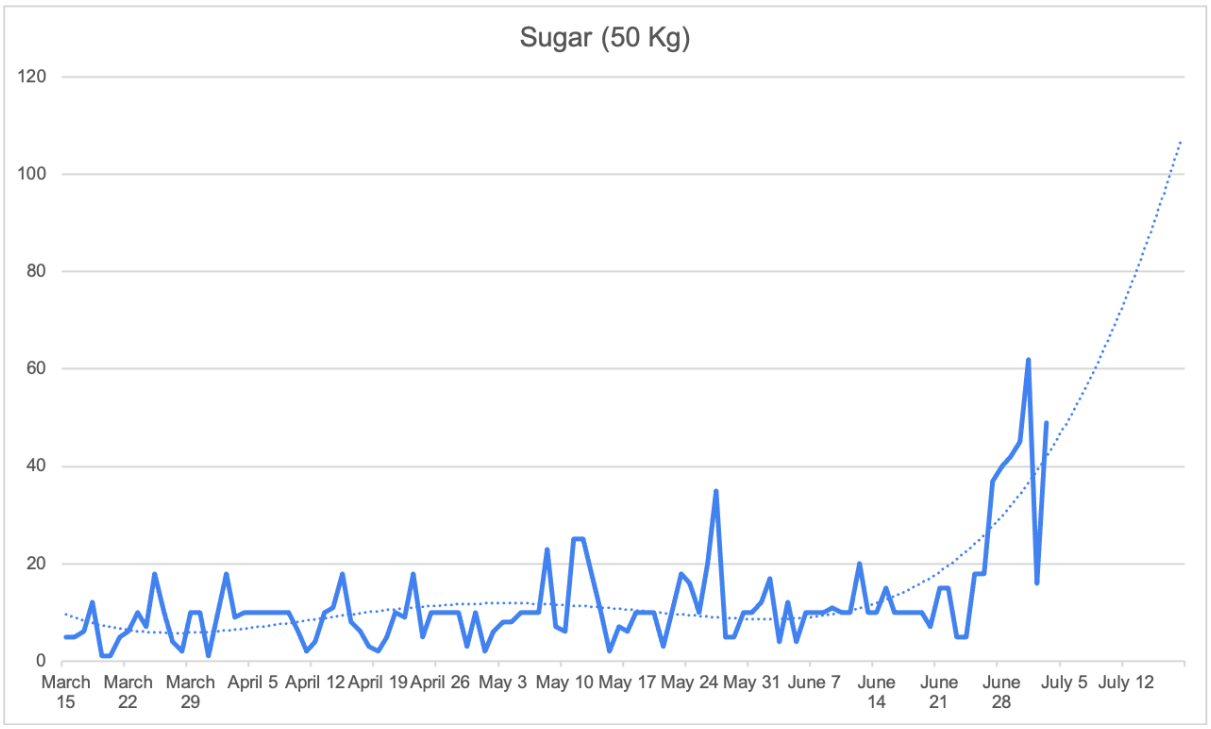

Figure 3.10 Line chart with Trend line forecasting sales of sugar

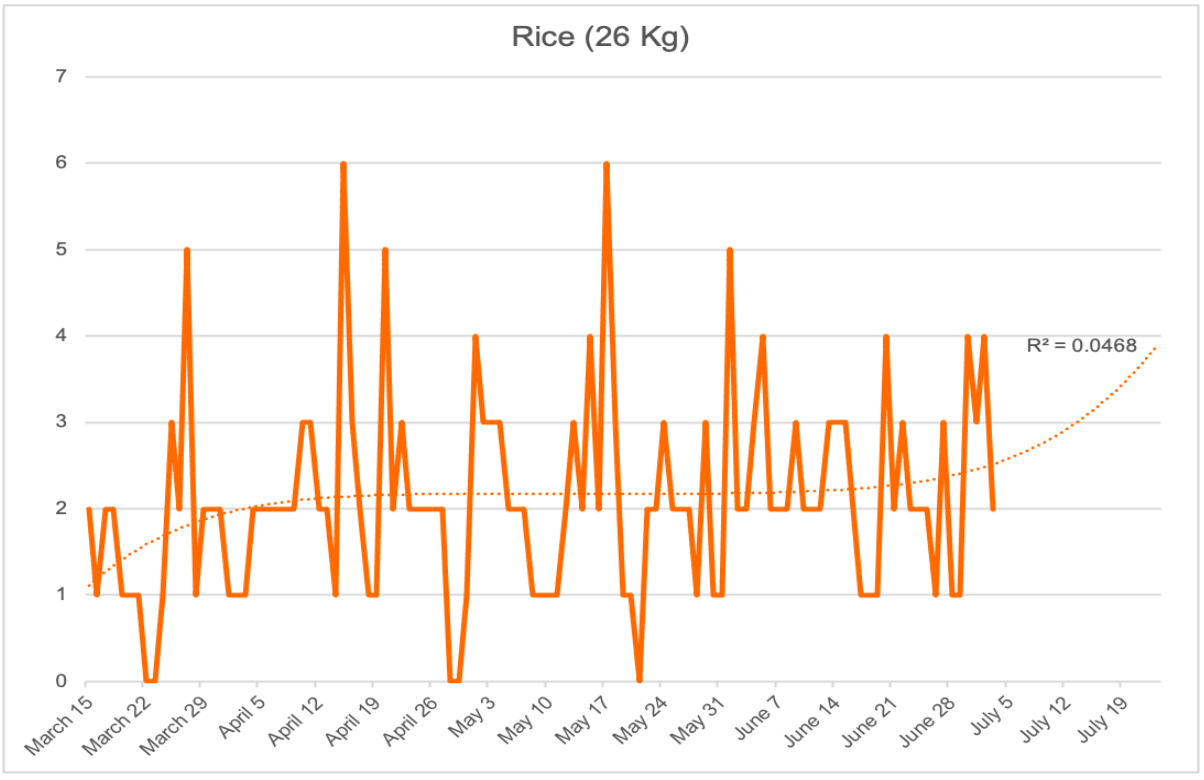

Figure 3.11 Line chart with Trend line forecasting sales of Rice

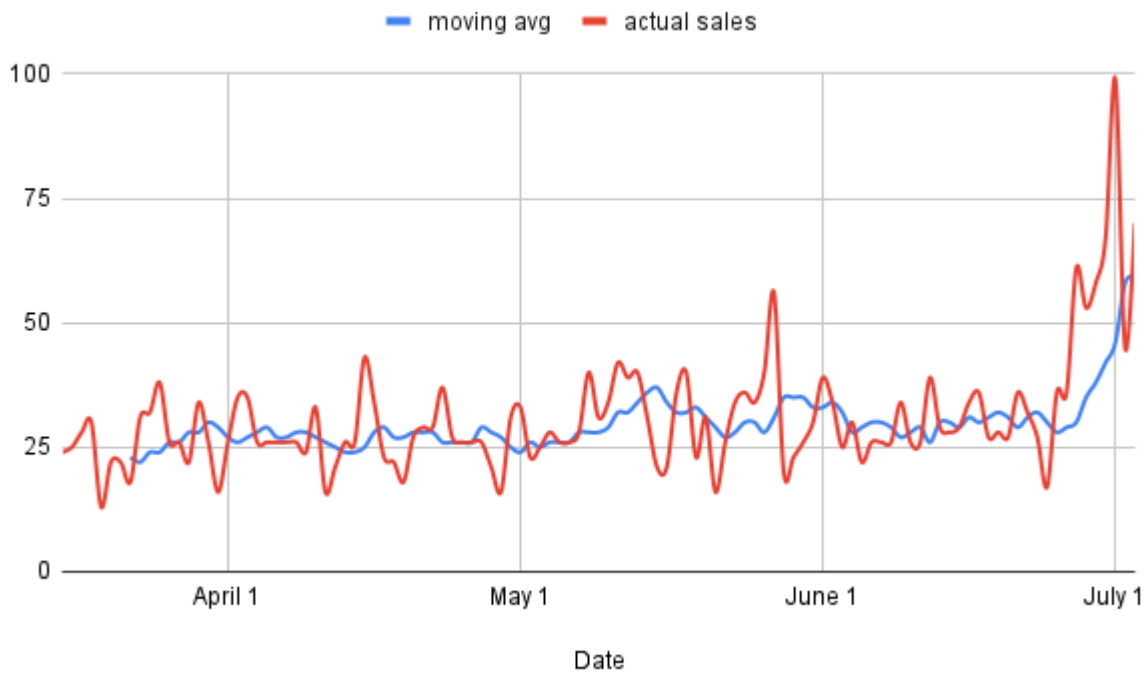

Figure 3.12 Line chart forecasting moving average of products

- In figure 3.10 the forecasted sales of sugar is high due to the upcoming seasonal sales which started from late june. In this period of time the sales go unexpectedly high.

- From figure 3.11 we can see that the forecasted sale of Rice is more or less constant.

- From the above figures 3.12 we can observe that the Moving average of all products sale is increasing. That means, Mustard Oil, Refined Oil, and Wheat flour is going to increase at this pace so we have to increase our stocks.

After looking at the forecast we can invest in products like **Mustard Oil, Refined Oil, and Wheat flour** because the sales are going to increase. and these products have no losses which is an advantage.

Investing more in these products can help to break the threshold and achieve the minimum order quantity which unlock high profit margin.

Ordering a large quantity can also help to reduce the transaction costs eventually.

Now here is the proper breakdown of capital investment for increasing the profit margins with high sales.

- Sugar with order Quantity of 150, because it's the minimum threshold for making a purchase order. Due to unreliability of price fluctuation which causes losses this order quantity makes sense.
- Mustard Oil with order Quantity of 200, because the Moving Average of the product is increased from 5 to 8.
- Refined Oil with order Quantity of 150, because the Moving Average of the product is increased from 4 to 6.
- Wheat flour with order Quantity of 210, because the Moving Average of the product is increased from 6 to 8.
- Rice with order Quantity of 60, because the Moving Average of the product is increased from 6 to 8.

Products	Stock up days	Order quantity	Purchase cost (each)	Transport cost	Labour cost	Cost price	Total Capital
Sugar (50 Kg)	monthly	150	₹2,016.78	₹117.00	₹16.00	₹2,149.78	₹322,467.00
Mustard Oil (15 lit)	monthly	200	₹1,851.67	₹7.00	₹3.00	₹1,861.67	₹372,334.00
Refined Oil (15 lit)	monthly	150	₹1,648.33	₹7.00	₹3.00	₹1,658.33	₹248,749.50
Wheat flour (50 Kg)	monthly	210	₹1,144.33	₹10.00	₹5.00	₹1,159.33	₹243,459.30
Rice (26 Kg)	monthly	60	₹1,495.33	₹12.00	₹3.00	₹1,510.33	₹90,619.80
							₹1,277,629.60

Figure 3.15 Table showing the Breakdown of total Capital

If we follow the above order Quantity, the profit for products like Mustard Oil, Refined Oil, and Wheat flour and Rice should become ₹45,070 monthly which is currently ₹8,860. **408.69%** Increment which is quite satisfying.

Previously the total Capital investment of the store owner was approx ₹8,92,974 now he has to increase the total investment to ₹12,77,629 to achieve the sales and profit. The owner can fulfill this increment of capital of ₹3,84,655 by taking credit at standard 12% rate interest considering the minimum profit of ₹45,070 monthly he can repay it over the time of two years.

4 Interpretation of Results and Recommendations

After analyzing all the data what i interpreted is, the sales of products like Mustard Oil, Refined Oil, Wheat flour and Rice is good and it's gone increase due to its high demand in market, So the Store owner should increase the stocks, While profit of sugar is very unreliable due to its several fluctuation of price, which cause losses, so for reducing this losses the owner have to reduce the capital investment in sugar and he can recover the losses by investing in sugar at seasonal or festive sale where the profit and sales are unexpectedly high.

Previously the store owner stocked up the products like Mustard Oil, Refined Oil, Wheat flour and Rice weekly with limited stocks and had a small investment and he purchased it from local vender(type-3) which leads to small profit margin. To increase the profit margin he has to make a large order of minimum 150 units, considering the increasing sales volume in these products he can make the investment . ordering large quantities can also help to reduce transportation costs which is an advantage.

So for a proper breakdown of total capital investment I plot a table which shows how many minimum units the store owner has to in order to fulfill the market demand including safety stocks so he never faces stock out and how much capital is required in each product to invest.

Products	Stock up days	Order quantity	Purchase cost (each)	Transport cost	Labour cost	Cost price	Total Capital
Sugar (50 Kg)	monthly	₹150.00	₹2,160.55	₹117.00	₹16.00	₹2,293.55	₹344,032.50
Mustard Oil (15 lit)	monthly	₹150.00	₹1,906.67	₹7.00	₹3.00	₹1,916.67	₹287,500.00
Refined Oil (15 lit)	monthly	₹150.00	₹1,713.33	₹7.00	₹3.00	₹1,723.33	₹258,500.00
Wheat flour (50 Kg)	monthly	₹150.00	₹1,238.33	₹10.00	₹5.00	₹1,253.33	₹188,000.00
Rice (26 Kg)	monthly	₹60.00	₹1,523.33	₹12.00	₹3.00	₹1,538.33	₹92,300.00
							₹1,170,332.50

Now he have two investment plans:-

- Invest more capital in products like Mustard Oil, Refined Oil, Wheat flour and Rice during non seasonal and festive sales and reduce the sugar investment for overall good profit.
- invest more capital in sugar in seasonal and festive sales by cutting down the investment in Rice which has not very good sales volume as compared to others products and reduce the order quantity of other products like Mustard Oil, Refined Oil, and Wheat flour to 150 units, because of the unexpectedly high sales of sugar.

Recommendations:

- He needs to focus on the products like Mustard Oil, Refined Oil, Wheat flour and Rice which generates high profit margins.

- He needs to maintain the minimum order quantity of 150 units to stay in profit and try to increase the order quantity.

- He has to reduce the capital investment in sugar in non seasonal and festive sales and increase the investment in other products. and increase the investment in sugar in seasonal and festive sales to achieve the high profit and sales volume.

- He needs to focus more on the product categories like edible oil, essential oil, different types of flours, Rice with lower price of daily consumable rather than occasional and similar products which have high profit margins or high sales volume.

- He can also invest money in some system which will record the data and provide better insights and planning in a continuous run. Which will give much relief.