

**Payment Pattern Analysis and Optimization of Inventory  
for a Packaging Machines supply Company**

**Final Term report for the BDM capstone Project**

Submitted by

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### **Declaration Statement**

I am working on a Project Title “Payment Pattern Analysis and Optimization of Inventory for a Packaging Machines supply Company”. I extend my appreciation to **S.S. Engineering Services**, 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.

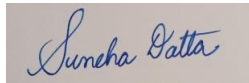
Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures.

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.

Signature of Candidate:



Name: Suneha Datta

Date: 3.3.2025

# 1 Executive Summary

SS Engineering Services is a packaging goods supplying company coordinated under the proprietorship of Mr. Subrata Datta. Since, 23 years, the company has supplied industrial packaging machines, polypropylene straps, and spare parts to various clients in eastern India. In the past few years, the company has faced major challenges of irregular customer payments, overdue outstanding increase as well as leading to imbalanced cash flow, especially at the time of inventory procurement. This impacts the operational efficiency of the company and creates a constrained flow of money; therefore, it demands impactful insights and effective data-driven strategies.

To handle these challenges, two datasets are collected from the company, where one is the 'Outstanding Sales Data', and another is the 'Inventory Purchase Data' for the financial year April 2024 to March 2025. At first, the two datasets are cleaned and restructured in Google Sheets to remove inconsistent rows and to change the data formats of columns, after which exploratory data analysis is performed in Python. Different processes like pareto analysis, correlation analysis, capturing expected cumulative return on interest, understanding purchase timeline, and outstanding dues behaviour are conducted. Resultant Visualizations like pareto charts, customer timeline graph, and stacked bar charts segregating the clients on the basis of dues have helped to gain insights.

One of the key findings includes that about 80% of the sales are actually being drawn by 30% of the clients, though many of those clients are the frequent defaulters. A cumulative interest of 1% on the sales for the defaulters as a punitive measure indicated a gain of Rs 22,413.57 which is about 4.7% of the total outstanding dues in the financial year 24'. It is also seen that the months having high inventory procurement often synchronize with the months having delayed credits which causes the operational stress.

The study suggests that the company should apply tiered interest policies on active defaulters, and also implement credit limits for lower contributing defaulters. Also, the company should synchronize demands with inventory purchase as per the customer timeline graph. These strategies ensure smother capital utilization and monetary risk management. This report showcases a detailed description of all the analysis and the results formulated from them in a consolidated manner to help SS Engineering Services make better data driven decisions.

## 2 Data Analysis

### 2.1 Data Cleaning and Preprocessing

Two datasets are received from S.S. Engineering Services through email as Excel files to perform remote data analysis for them. One dataset is named as Outstanding Sales data which contains records of all the sales invoice related data received by the company. Another is the Inventory Purchase Data, which has the records of all the transactions made by the company for purchasing stock goods for the financial year 2024 to 2025. The metadata of the Sales dataset is described in the Fig1 and the Inventory purchase data is described in the Fig 2. At first both the datasets are uploaded to Google Sheets, for data cleaning and preprocessing. The Outstanding Sales data has 96 entries in total. There are 14 blank rows which are scattered in the data, which has been removed along with a redundant index column. Some columns are cut out from this data like 'Status' and 'Freight' because the former is self explanatory from the

'Dues' column and the later column has all zero values. Some incorrect rows belonging to financial year 2023 of the month of May are there in this dataset, and since these rows are outside the period of analysis it is deleted. For the month of July, the year is marked as 2023, which is changed to 2024. Columns like 'Cheque No.', 'Cheque Date', 'Bank', 'Remarks' has just the headings without any values, so those are eliminated. From the 'Invoice Date' column, the month and the year part, are separated into two new columns in order to further perform trend analysis. This helps to do further grouping of the data as well as to perform filtering. This restructured outstanding sales data is saved into a new sheet.

The other dataset given from the company titled as 'Inventory Purchase data', also has several misconfigurations which are next handled to make analytically significant. This dataset contains the details about the packaging items purchased by the company in the financial year 2024 for inventory stock having a total of 44 entries. The dataset is uploaded to google sheets, and then a total of 9 blank rows are removed. There are some rows in the sheet which has intermediate subtotal values, hence those rows are deleted to maintain consistency. Since this dataset is used for stock analysis, therefore those columns which are not aligning to the stock directly, like the 'Invoice Number' and 'Party Name', that are already present in the sales dataset are excluded. Additionally, some redundant columns like two empty columns 'CGST' and 'SGST' and another extra 'Date' column are deleted from the dataset. Another column 'Cheque No.' holds no significant relevance with the stocks so it is removed. There is some typing errors and spelling mistakes in the 'Item Code' column, which created different labels for the same product item. This is resolved using the built-in look up table feature in the Google sheets. The name of the product is not mentioned in the dataset for the purchases, so a new column is added alongside the 'Item Code' named as 'Product Name' and is populated with the correct product names after consulting with the proprietor over a meeting. Finally after all the cleaning and refinements are made the data is copied to a new sheet in the same document. This clean and improved data serves as the source for the further analysis.

COLUMN NAME	DESCRIPTION	DATATYPE
Invoice No	It is the bill number for each transaction	string
Invoice Date	It contains the issued invoice date	date
Product	It gives details about the sold products.	string
HSN Code	It contains the alphanumeric code for taxation of products.	string
Qtn	It is the number of the product sold for that invoice	integer
Customer	It describes the details of the purchased customer in text format.	string
Party GST No.	It contains the buyer's GST identification number.	string
Amount	It is the numerical price value of the product before applying tax.	float
IGST	It is the applied tax amount for selling in the outer state.	float
CGST	It is the applied tax on the selling product inside the state by Central Government.	float
SGST	It is the applied tax on the product shared with the State Government.	float
Freight	It is a numeric value that deals with the shipping or delivery charges.	float
Total Amount	It is the final value of the product after adding taxation and shipping charges.	float
Due	It gives the details of remaining amount to be paid by the customer.	float
Status	It is a string value containing the current payment situation.	string
Cheque No.	It is the Cheque number used for payment.	string
Cheque Date	It is the date when the cheque was issued for the payment.	date

Fig 1. Metadata about Outstanding Sales data

COLUMN NAME	DESCRIPTION	DATATYPE
Invo Date	It contains the issued invoice date.	date
Item Code	It contains the alphanumeric code of products purchased.	string
Quantity	It is the number of the product sold for that invoice.	integer
Basic Rate	It is the cost price value of the product before applying tax.	float
Sub Total	It is the product of Basic Rate and Quantity.	float
IGST	It is the applied tax amount for selling in the outer state.	float
Total Amt in Rs	It is the final value of the product after adding taxation of IGST.	float
Product	The category of the product.	string

Fig 2. Metadata about Inventory Purchase data

## 2.2 Descriptive Statistics:

The descriptive statistics of the two datasets are performed using Python in Google Colab. At first, both the cleaned datasets are uploaded into Colab and read using the `read_csv()` function of pandas library of python. Then they are converted into pandas dataframe and using the `describe()` and `info()` functions of pandas on these dataframes, the statistical measures like average, median, maximum, and variance are computed for every column.

### 2.2.1 Outstanding sales data:

The numerical columns present in the outstanding dataset are 'Qtn', 'Total Amount', 'Dues' whose description is given in **Fig 1**. The number of products that are ordered by any customer is atmost 200, which is the Pp straps, and the minimum ordered product is only 1, which is quite certain since it is the fully automatic machine, which is generally ordered as a whole single item. The number of products ordered by the customers has an average value of 61 with a standard deviation of 59.63. The highest invoice value received by the company is Rs 3,30,400 in the financial year of 24. In general, the mean order value for any client is found to be Rs 73,856, having a standard deviation of around Rs 72,090. The maximum value of outstanding dues is Rs 1,71,100, which is very high and showcases financial overhead. Although the average value of outstanding dues is around Rs 14,697, there is significant deviation of about Rs 35714.

### 2.2.2 Inventory purchase data:

The columns present in the inventory purchase data set are 'Quantity', 'Basic Rate', 'Total Amt in Rs' whose description is given in **Fig 2**. It is found that the number of items purchased by the company for inventory is having a mean value of 118 with a standard deviation of 63.91. The maximum number of items purchased is around 230. The basic rate for inventory purchase has an average value of Rs 5883.33 and is spread with a wide tail, having a standard deviation of Rs 28,501. This is also evident from the fact that the lowest basic rate for inventory purchase is as low as Rs 340, whereas the highest is Rs 1,85,000. The final amount of money that is spent for the inventory purchase, though, is ranging between Rs 7658 to around Rs 2,18,300 with a mean of Rs 91773.92, having a high standard deviation of Rs 46,5964.

### 2.3 Pareto Analysis:

A Pareto analysis is executed on the outstanding sales data to understand the distribution of sales over the customers, by a structured data aggregation and visualization. The main objective behind this is to find out whether according to the pareto principle, the business of SS Engineering also follows a 80/20 rule of sales domination by the current customers.

Initially the outstanding sales data is read as a csv file into google colab by the `read_csv()` helper function, and then its grouped by the customers' name using the `groupby()` function with the help of the pandas library of Python. The dataset now being formatted as a pandas Dataframe is used to calculate the aggregate sales made by each of the customers in the grouped data, by summing the 'Total Sales Amount' column for every clients. This transformed the data into a customer summary and helped to understand the customer level contribution to the total sales made. This resultant grouped data is then sorted using the `sort_values()` function of the pandas library in the descending order of the sum of sales. This is required to bring the high prioritized customers in the top to get a better cumulative analysis. This is the main step for the pareto analysis since it ensures the evaluation of the most valuable customers at the first.

Thereafter the cumulative percentage of Sales for the customers is calculated. Each of the summed total sales value for each of the customers in the grouped dataframe is then divided by the total sales amount summed up for the whole financial year of 2024 to 2025. Then using the `cumsum()` function, the running cumulative aggregates is computed on these proportions.

To identify the cut off point where the cumulative sales nearly reached 80% of the net sales, the cumulative percentage column is hence filtered out to find the minimal subset of clients whose combined input reached the pareto threshold. Since from the final cumulative percentages it is seen that the last few clients have very less contribution to the sales which hardly has any effect on the sales, only the top 20 contributing customers are taken as candidate who have a relatively countable impact on the net revenue, for the next analysis.

Using the matplotlib library of python, this summarized data is then plotted in form of a bar graph, where the x axis denoted the customer names, and the y axis denoted their sales contribution in Rupees scaled by  $10^6$  for instant visual interpretation. Also a trendline is plotted on the same x axis with another y axis as the right axis of the plot depicting the cumulative percentage contribution of the customers. Label rotation, rotation of xticks by a semi quater angle and colouring of the bars is applied in the chart with the help of matplotlib's `plt.figure()` function for improved visual interpretation. This method provided a clear as well as repeatable process to segregate customers based on their financial significance in the company.

### 2.4 Dues Analysis:

To inspect which customers were highly responsible for creating the outstanding dues during the constrained months, a dues analysis has been done. The main aim is to find not only the months which has crossed the dues amount above a certain manageable limit but also to trace out the customers who were responsible for it. During one of the virtual meetings, the proprietor of the company said that on a monthly basis, a maximum dues of Rs 5000 is acceptable to him, but beyond that, it causes business stress. Therefore, in my analysis, I considered those months to be critical that has dues crossing the stated threshold.

At first, the cleaned 'Outstanding sales data' is loaded into Google Sheets. Then a pivot table is created of this data using the inbuilt tool of 'pivot' in Google Sheets, where in the two attributes 'Month' and 'Year' are put in the rows of the table in an ascending order. In the column field for the table, 'Customer Name' was put, so that each column would represent individual customers, and for the values field of the table, the aggregated sum of the outstanding dues amount per customer and per month is added. This structure efficiently creates a matrix format where in a cell denotes the due amount owed by that customer in a specific month.

In order to have a more focused result, a filter is applied on the pivot table to eliminate months which has a sum of due amounts less than Rs 5000. This helps to refine the dataset to have only those months that are relevant for the financial concern and to ensure that the visualization is conveying consolidated information.

Using this pivot table, I created a grouped bar chart within the same google sheet using the built-in tool of 'inserting charts'. In the X axis of this chart, the month number of the year is kept, and in the Y axis, the due amounts in Rs are kept. For better interpretation, the Y axis is scaled in thousands. In each month, vertical bars are plotted for only those company which has dues in that month and also that crosses the threshold. All the bars are colour-coded with a legend in order to segregate the amounts on the Y axis based on the different customer names. This chart can give a clear understanding and comparison of the contribution of clients in outstanding dues over the months.

This visual can help to analyse whether the financial pressure is based on some client-specific relationships. It will be able to put front if the dues are spread across the months equally or are sporadic in nature, also it can bring forward whether some customers are particularly keeping higher dues or all customers are keeping significant dues that collectively create a financial burden. It can also assist in targeted follow-ups, client evaluation improving the receivables management as a whole.

## **2.5 Correlation Analysis:**

To understand the relationship between the outstanding dues amount, the inventory purchase investments and the current balance amounts present to the company a correlation analysis is performed on the datasets provided. At first in the inventory purchase data, a new column named 'dues' is added to record the present dues upto that instant of inventory purchase order made for every row having purchase order entries. Next another column as 'balance' is added where the balance is calculated as Net Sales upto that month – Due Amount of that month – Sum of inventory Purchased Price upto that instant. This balance depicts the net income available at that instant which can be used for inventory procurement purposes. Whenever the balance became 0, the amount of money same as the purchase price for that order is re-added, to mimic capital injection from the company's own reserves. This is done to capture the real world scenario where the company needs to reinvest money from capital reserves to handle financial shortfalls.

After creating this augmented dataset, I uploaded the dataset and read it in google colab as a csv file using `read_csv()` function of the pandas library of python. It is aimed to understand whether the purchasing power is significantly or moderately affected by the high dues even in months where the company may have had healthy sales. To evaluate this, python's `corr()` function is used to statistically compute the correlation coefficients between the three variables - dues, purchase price, balance. The `corr()` function internally uses the Pearson's correlation



coefficient formula. This coefficient helps to understand the linear relationship between every two of the three variables present.

The Pearson correlation coefficient  $r$  is mathematically defined as:

$$r = [\Sigma(x_i - \bar{x})(y_i - \bar{y})] / \sqrt{[\Sigma(x_i - \bar{x})^2 * \Sigma(y_i - \bar{y})^2]}$$

Where  $\bar{x}$  and  $\bar{y}$  are the means of the respective variables. This formula normalizes the variables at first and then computes their linear dependency.

These coefficients are then converted into a correlation matrix where every cell of the matrix denotes the coefficient computed for the row label vs the column label. This analysis helps to decide whether it's the outstanding dues or the inventory purchases is causing the financial drain. Since the coefficient value ranges from -1 to 1, the more positive the value is, it will conclude that those variables are more strongly dependent on each other, and the more negative the value is, it will signify that those variables are more inversely dependent where the increase of one adversely affects the other.

## 2.6 Product Purchase Analysis:

For a detailed understanding of the outstanding dues and to recognize the clients responsible for it, I have created a focused analysis using Google Sheets. I have made a pivot table and a grouped bar chart from the given outstanding sales data which has ensured the inspection is less complicated. The objective is to outline client-wise monthly overdue payments, especially where cumulative dues crossed the manageable threshold limit. While discussing with the proprietor earlier, it is conveyed that the dues which are greater than Rs. 5000 in a given month began to pose functional loads. On the basis of this, I thought of designing the analysis to set apart those critical months and single out the client-wise contributions to tackle the problem.

The first step is to construct a pivot table. In this pivot, I placed the Month, Number and Year in an ascending order, as rows, so as to preserve the temporal orientation of the Fiscal Year. Under the columns, I have put the Customer Name field, so that each column represents an individual client. For the values, I used the sum of the "Due" amount, totalled per customer, per month. To redirect attention only on the critical months, i.e., where the due exceeded Rs 5000 limit, I applied a filter condition directly within the pivot table. The purpose of this filter is to keep record of only those months where the total sum of due amount exceeded for all customers. This sifted the dataset and kept only the months most relevant for our concerns, thus allowing me to concentrate only on the periods that require attention.

With the filtered table prepared, I have tried to create a grouped bar chart on Google Sheets. In this chart, I have put each bar cluster on the X axis, representing a specific month (filtered for dues > Rs 5000), and within each cluster, I have put colour-coded bars that represented the individual clients who has outstanding balances for the given month. I scaled the Y axis in thousands (Rs 000s) for easier representation and concise interpretation. It granted an easy comparison across clients and across time, clearly displaying the clients who frequently contributed to high levy and also showed how their balances fluctuated on a monthly basis.

This visual approach makes possible a more circumstantial apprehension of the problem. The bar chart, hence, makes it possible to allocate financial strain for specific clients and show whether a spike in dues is the result of a single, defaulting client or the linked outcome of a

number of smaller discrepancies in balances that arose from smaller individuals. This has two benefits, simultaneously: credit monitoring and client evaluation. Not only that, it also assists targeted follow-ups, improving the overall receivables' management in the process.

## **2.7 Order Timeline Analysis:**

To visualize the order placing behaviour of the different customers over the months in a financial year and to capture the most active months a custom timeline chart is plotted using matplotlib and patches library of Python. This plot is done in two separate charts one depicting the activities in the first half of the year from January to June whereas the other depicted the second half of the year from July to December. This examination is done to track the order placing trend which could potentially affect the accumulated outstanding dues, and to also help the inventory purchase planning in every month. This analysis has minimal computation but this visual has considerable impact in managing the operational flow of the business.

In the outstanding sales data the 'customer name' column has different versions of name for a single client, for example the client 'Khadim Panchla' is written sometimes as 'Khadim panchla', 'Khadim Panchla' and 'Khadim panchla sps'. The first step involved creating a dictionary data structure in python to store the names of the customers. The keys of the dictionary consist of a single correct version of the name of every client, and the values are a list consisting of all the different versions of name present in the dataset for the same customers. This helped in mapping the names of the customers to a single consistent label across the dataset. Any inconsistency in naming is thus removed using this lookup dictionary and string mapping in google colab.

Using python's matplotlib library a gyantt-chart like timeline plot is created of this consistent and coherent sales data, where the y axis in the left denoted the names of the customers, and the x axis denoted the month name. The core logic behind this plotting is done with the `plot_timeline()` function iterated over each customer and the months they are active, that is has made any invoice bill entry in the outstanding sales data. With the help of the `FancyBboxPatch` object present in the patches library of python, for each matching month a rectangular horizontal bar is plotted in the chart to give a clean Gyantt-style layout. To ensure proper legibility, some customizations are done which includes setting a background colour, inverting the y axis for maintaining a top-down order of clients, increasing font sizes of x and y labels.

The chart helps to find customers who have frequent ordering behaviours, sporadic customers, or customers with the minimum activity in a year. This analysis is highly important to set credit terms, to strategize inventory purchase cycles and for anticipating payment cycles.

## 2.8 Interest over Dues Analysis:

In order to evaluate the financial impact of incentivizing timely payments through a progressive penalty strategy, I developed an interest-based simulation that models how a 1% cumulative sales increase could be levied on defaulter clients across months. The core idea is twofold: to simulate how much additional revenue could be generated if habitual defaulters are subject to incremental price hikes, and to evaluate how such a pricing strategy might psychologically pressure them into more disciplined payment behaviour. This suggestion is discussed with the proprietor, who agreed that while clients may tolerate a maximum of 2% price hike, it would be operationally safe to model the effects of at least a 1% increase.

The workflow is started by loading the outstanding sales data into Google Sheets as a new file. Using the built-in filter tool present in the google sheets the 'dues' column is filtered out for only those rows having non zero values to capture the customers who are defaulters. In a separate region in the same sheet a separate three columns are introduced, them being -'Month': for the month number, 'Client Name': the customers name who are defaulters of that month, 'Interest rate': the cumulative rate of interest for that month and specific customer. Whenever any customer has dues in the previous month, the interest rate for the next month over the selling price is increased by 1% again and its carried forward for the next months. Using this intuition, a new column is added to the original outstanding sales data as the Extra Sales Amount which could have been gained if there is application of this interest policy. Another column is added to the original dataset named as 'Extra' which is calculated as the difference between the original invoice amount and the extra sales amount depicting the extra money which could have been received in this process.

This augmented dataset is now used to create a pivot table in google sheets itself where the 'Month' number is used as the rows, the sum of the actual sales and the sum of the extra money received for that month is added as values to this table. This pivot table is then converted to a csv file and loaded into google colab and read as a pandas library's dataframe in python for further analysis.

In colab, a cumulative aggregated extra receivable amount over the months is computed from the 'Sum of Extra amounts' column using the `cumsum()` function of pandas library. To visualize the long term return build up, a dual subplot chart is created using matplotlib library of python. In the top subplot, the monthly sales are plotted as a trend line such that the x axis denotes the month of the year and the y axis represent the sum of sales for that month in rupees scaled to the factor of 10 lakhs. The lower subplot is used to create another trendline depicting the cumulative extra gains that could have been received after application of the stated interest rates on the sales. The lower subplot uses the same x axis but the y axis is scaled at an interval of Rs 2500, since the two variables has very high difference in their scales.

This helps to understand that over the months how much extra money could have been procured against the sales in a single visual plot. It gives the representation of the limit of risk control under a minimal punitive policy on the defaulters.

### 3 Data Visualizations

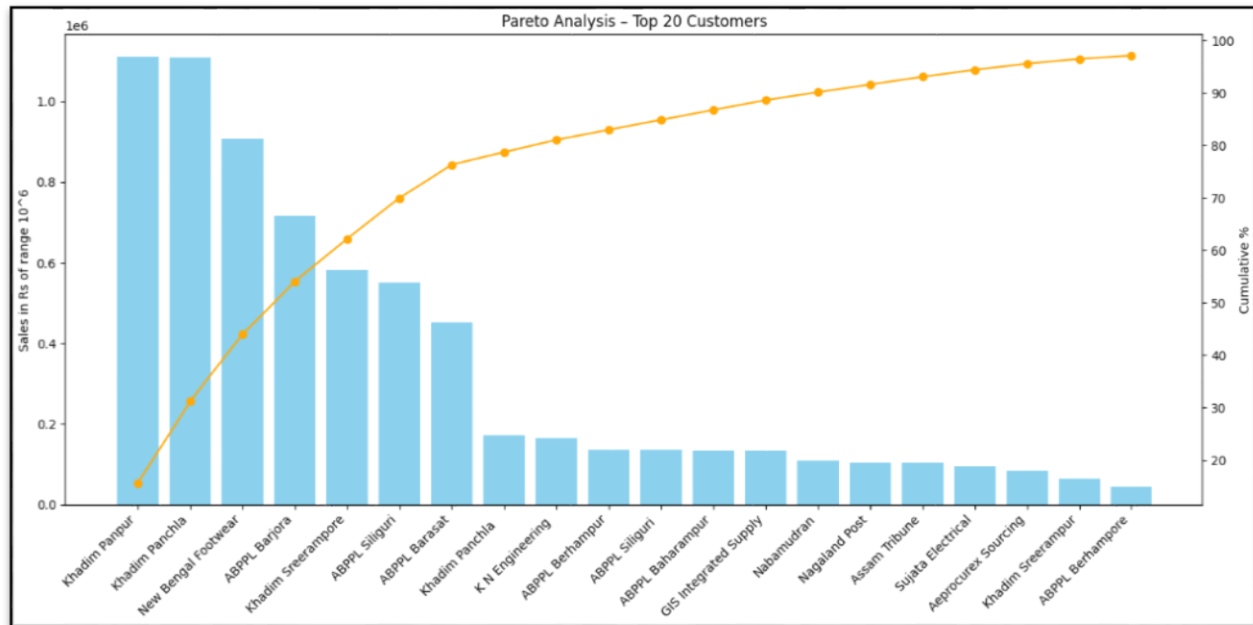


Fig 3. Pareto Analysis

In the **Figure 3** the vertical blue bars represent the total sale amount in rupees shown in the power of 10 lakhs for the top 20 highest sales having customers in the financial year of 2024 to 2025. The orange line depicts the cumulative contribution in the net annual sales by each of the customers. An exact pareto like distribution can be seen where in the main flow of revenue is drawn by the heavy volume customers like Khadim Panpur, Khadim Panchla, New Bengal Footwear, ABPL Barjora, Khadim Sreerampore and ABPL Siliguri contribute disproportionately in comparison to the remaining customers. Notably Khadim Panpur holds nearly an annual sales of Rs 11 lakhs, that signify its strategic importance. The initial sharp rise in the orange line symbolize that only about 25% of the customers are solely dominant to produce the about 80% of the revenue, where the flattening tail showcases a minor contribution by the rest of the customers though they are included in the top 20 range.

The distribution of sales is not spread uniformly hence it signifies that customer acquisition is also not uniform. The revenue depends either on the bulk sales by high institutional clients or on frequently ordering clients. The company is more focused on capturing big clients instead of looking on the uneven revenue collection. If the company keeps a more tight approach on maximizing revenue by different customer acquisition, it can approach towards a more balanced revenue distribution. Although the company should maintain good relationships with these big clients and may offer incentives, but it should also try to encourage the low tier clients to improve their purchase. The company can even put order thresholds to the low tier clients.

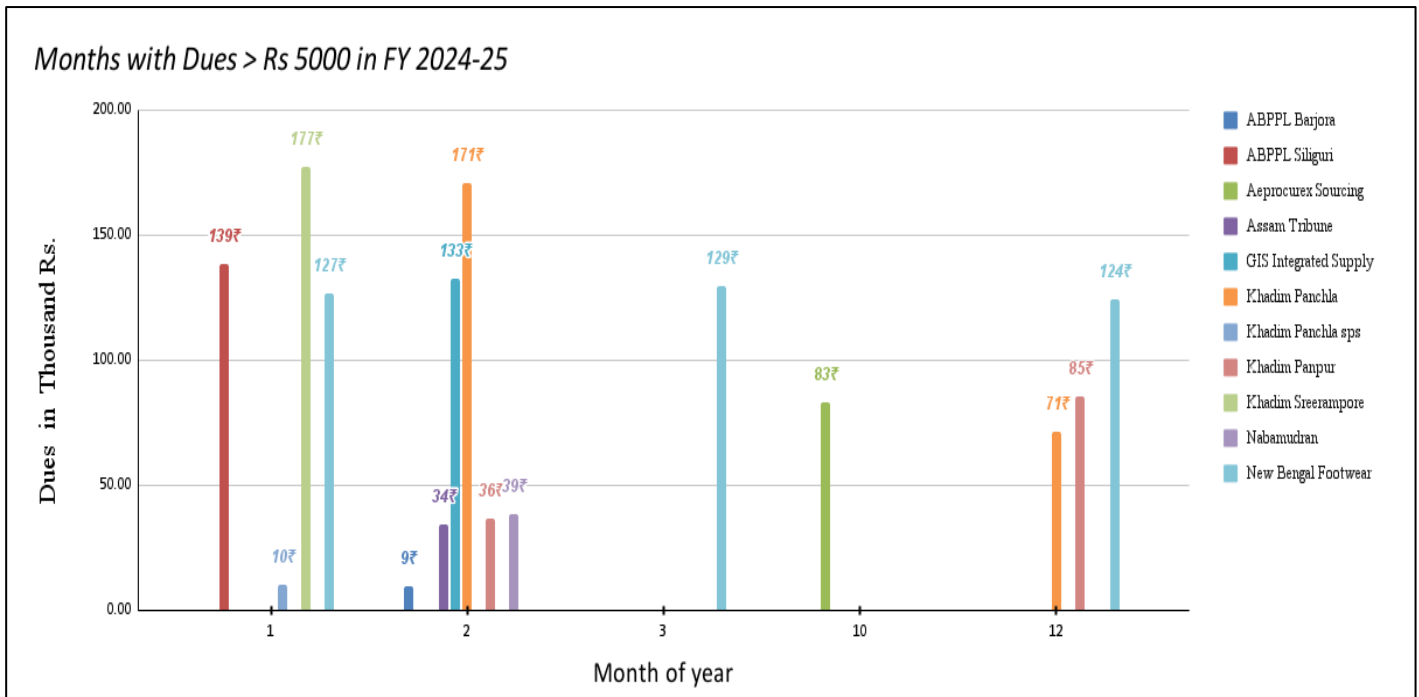


Fig 4: Grouped Chart for dues distribution over critical months

The **Figure 4** exhibits the months when the monthly total dues by a customer have reached a threshold of Rs 5000 and above. It is a grouped bar chart where each bar corresponds to one of the customers, and the annotation on the top of these bars denotes the amount of the dues on a scale of Rs 1000. The y axis represents the amount of dues, whereas the x axis denotes the month of the year. It can be seen that the critical months include January, February, March, October, and December. Among these months, the highest outstanding dues can be seen in the months of January and February. The customer, New Bengal Footwear, is seen to maintain high dues in almost every critical month which is very alarming, it suggests strict action against this client regarding credit transfer. The highest due amount is seen from the Khadim groups, where both the highest dues outstanding in the month of January and February are from Khadim Sreerampore and Khadim Panchla reaching as high as Rs 177 thousand and Rs 171 thousand respectively.

The graph shows that the outstanding dues are not uniformly distributed; rather, they surge during specific period of the year, especially causing a year-end delay. The gap from the month of April to September has no such critical dues, which suggests that this might be the fruitful period of the year for the business, during which it should focus on inventory procurement safely. Also, it is understood that the high-value customers who contribute the most to the sales are also the ones who maintain high outstanding payments. One notably striking thing to be observed is that the customer 'Gis Integrated Supply' has high dues of Rs 133 thousand in the month of February, but it has an insignificant influence on the total annual sales. Therefore, this customer should always be kept under either advanced payment terms or shorter credit window terms for stricter revenue management with this customer. The New Bengal Footwear is repeatedly keeping an average outstanding payment of Rs 127 thousand in fixed time windows, which suggests that it might be maintaining internal operational deposits for itself until the order values to S.S. Engineering Services reach a calculated internal threshold.

	purchase	balance	dues
purchase	1.000000	-0.177518	-0.147191
balance	-0.177518	1.000000	-0.654679
dues	-0.147191	-0.654679	1.000000

Fig 5: Correlation Matrix

The **Figure 5** shows the result of a correlation analysis between the variables 'current balance', 'purchase price of inventory' and 'current dues'. It can be seen that all the variables have a negative correlation coefficient therefore it can be stated that the increment in any one of them will cause decrement in the other. It is also noted that the relation between purchase price of inventory and the current dues is very weak having a correlation coefficient of less than 0.15. Hence this suggests that the dues have no such direct effect on the purchasing power although in case of higher purchases some effect can be seen due to the outstanding dues. Contrastingly, a strong correlation can be observed between the current balance and the dues amount with a correlation coefficient of 0.65. This signifies that the current balance is more affected by the outstanding dues overhead than the investments on purchases, which is a more serious challenge. So, it can be stated that the payment behaviour is much more in sync with the order volume than structured payment pattern.

There can be several factors which lead to this trend. Some of the clients may have been maintaining a flexible credit scheme where they give the payments only after the order volume's price reaches a certain threshold, which not only drains the balance but simultaneously increases the dues. Also the company may have been reluctant to enforce strong payback time windows across every client which in return favours the clients having larger orders to take the advantage.

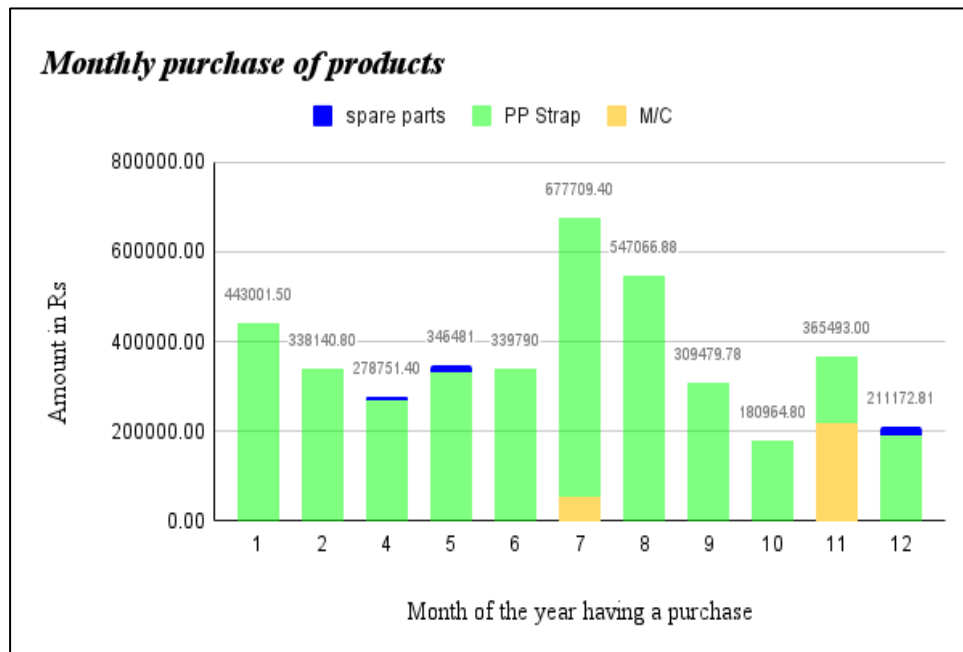


Fig 6: Monthly purchase of products

The **Figure 6** depicts the monthly investments of money in the procurement of inventory of various types in the financial year of 2024-2025. In this stacked bar chart, the x axis represents the month of the year, the y axis denotes the sum of all investments made for inventory purchases in a particular month. The bars also show the proportion of money spent on each of the individual products, including polypropylene straps (PP straps), packaging machines (M/C), and spare parts in those months. From the graph, it is instantly evident that the expenditure on PP straps is the highest, with peak purchases occurring in July of Rs 677,709.40 and August of Rs 547,066.88. Comparatively, the purchase of spare parts is absolutely nominal. PP straps seem to dominate the overall volume of purchases by the company, largely followed by a very sporadic requirement of both packaging machines and spare parts.

If this trend is compared with the figure 4, an important aspect can be realized. The months like January and February, which showcase the maximum outstanding dues from the high-value customers are also being followed by the previous months of November and December, that has relatively higher inventory purchases. This signifies a possible sequence of events where in the company procures inventory with the expectation of large orders, but it gets a high overhead of dues from the same customers consuming that inventory. Also, the highest inventory purchasing months do not fall under the previously identified critical months, and hence, that's a safe operational plan followed by the company. The high inventory purchase peaks can directly evoke incoming risk since they might not be able to get back the investments as credits within a stipulated time period. This can cause severe strain on the liquidity of money.

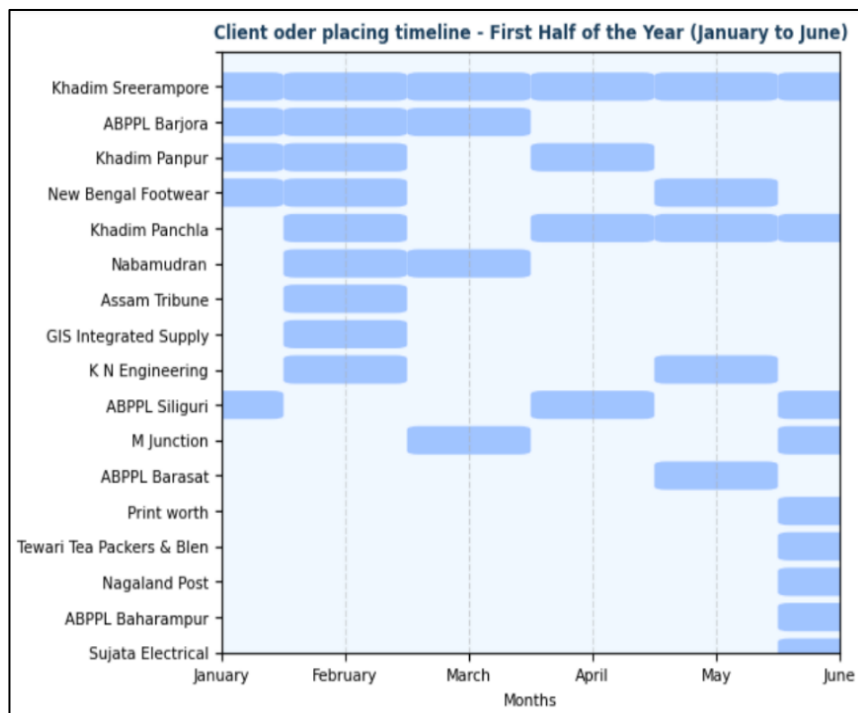


Fig 7: Incoming orders to company in first half of year

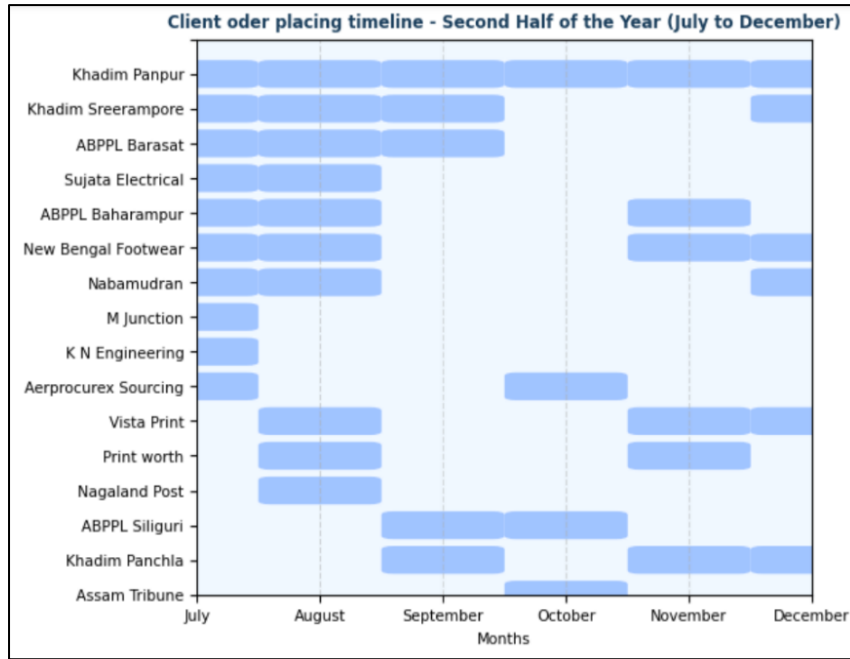


Fig 8: Incoming orders to company in second half of year

The two charts in **Figure 7** and **Figure 8** describe the breakdown of the order-placing timeline in the first half of the year (from January to June) and the second half of the year (July to December) by all the different customers handled by our concerned company. It can be noticed that the maximum revenue-generating customers like the Khadim Panpur, Khadim Sreerampore, New Bengal Footwear, and ABPPL Barasat are more likely to have a longer as well as frequent ordering window spread over most of the months. This kind of consistent involvement of these clients is highly aligned with our previous findings that the sales of the company are mostly dependent on a few influential clients. The highest revenue-generating client, Khadim groups, is seen from these charts to be the one who places an order every month, where the first half is dominated by Khadim Sreerampore and the second half is dominated by Khadim Panpur. This may be the main strategy followed by this client to keep outstanding dues in the promise of upcoming orders from them every month, which gives them an upper hand to control the business decisions. Since this company has its dominance in the concerned company's business, it will be difficult to readily put them on stricter credit terms, but they can be motivated to pay back a minimum threshold amount of money for their monthly purchases. On the other hand, the Khadim Panchla client seems to have a more irregular nature of placing orders, though they tend to maintain high dues in the next months of placing orders. Therefore, they can be rather put under stricter credit transfer terms as a punitive measure. It can also be observed that the months like July and August have received the highest number of orders, which aligns with our previous findings that, based on high order surge, the company has been making the highest inventory purchases during the same stated months.

The company is likely to tolerate the outstanding dues without any strong action over an extended period of time in order to satisfy the high volume orders procurement. There can be seen an imbalance in the financial drain for the operations management, since there are cash outflows before payments come in to handle the constant orders placed by important clients continuously. The outstanding dues are hence not randomly accumulated but systematically kept by those clients luring next orders.



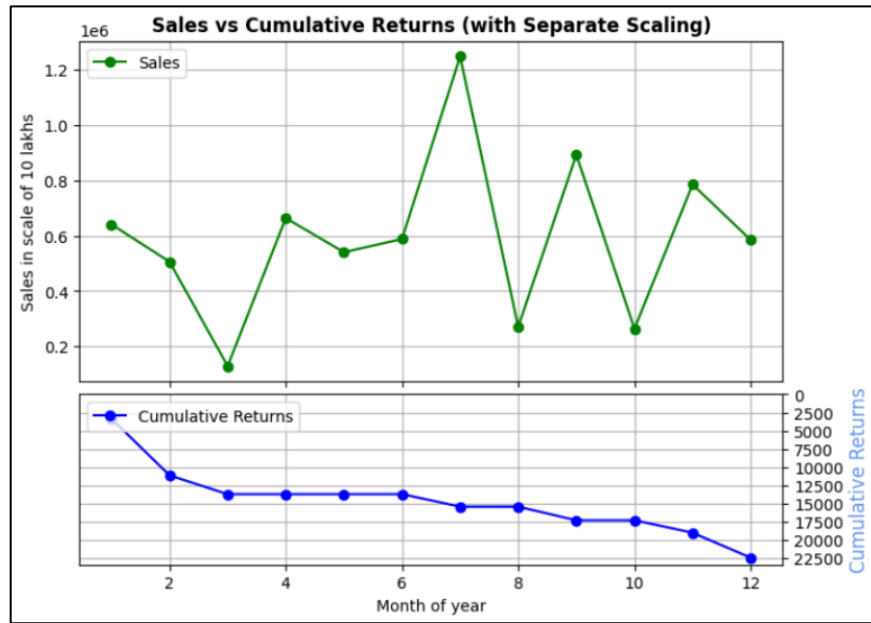


Fig 9: Sales vs Cumulative Returns

ACTUAL SALES	7115236.15
Expected Sales	7137649.89
GAIN	22413.75
Customer Name	FY 24' net due which is still left at end of Feb
-----	
Khadim Panchla	9917
ABPL	138650
Khadim Panpur	85258
Aerospex	23541
Sreerampore	54256
Nabamudran	38586
New Bengal	126850
SUM	477058
% gain on due/lessen due	4.698327989

Fig 10: Effect of cumulative interest on sales(All in Rs)

The **Figure 9** and the summary table in the **Figure 10** showcase the effect of the adoption of an interest-based policy to handle the load of outstanding overhead dues. It shows how a cumulative increase of interest on the sales order price by 1% for those who had dues in the previous month could potentially lessen the outstanding dues to some extent. The former figure shows the sales versus the cumulative gain because of the interest that may be applicable on the sales for that month if there have been outstanding dues in the previous months. While the later figure shows a tabular representation including the difference between the actual sales and the estimated sales in the stated process for the financial year of 2024-2025, also the year-end final remaining dues to be received from different clients in the month of February(since the financial year end in March 2025 and the March data is incomplete in the given data), and the average gain percentage on the dues if the strategy is followed.

In the **Figure 9**, the x axis denotes the month number of the year. The y axis of the upper subplot denotes the sales of the company in that specific month in rupees, scaled to Rs 10 lakhs, whereas the bottom y axis in the right denotes the extra gain in rupees if a cumulative interest is applicable on that particular month. It can be seen that the sales curve has quite an unstable trend with many ups and downs, with a peaking sales in the sixth(May) and ninth(September) months and the lowest sales seen in March. On the contrary, it can be realized that the blue curve below depicts a different trend. The cumulative gains remained constant from March to June, and in the other months, it has a slow but steady rise up to Rs 22500. From all the graphs stated before, it can be understood that the month of September is the most fruitful month for the company, which not only sees high sales, low inventory investments, no outstanding dues, but also a cumulative gain if an interest-based policy is applied on the sales. The company should take advantage of this month for suitable business risk implementation since that will have a low impact of any consequences.

The summary table demonstrates that there could be a significant increase in the actual sales of Rs 71,15,236.15 on the application of a minimum of 1% cumulative interest over the months, and the expected sales could potentially rise to 71,37,649.89 owing to a gain of Rs 22,413.75 at the end of the year. As seen from the table, at the end of February, towards the year-end, the total sum of unpaid dues is Rs 4,77,058; therefore, it is evident that there could possibly be a gain of approximately 4.7% on the net unpaid dues. The customers like ABPL, New Bengal Footwear, and Khadim Panpur is seen from the table to be responsible for the maximum unpaid dues at the year-end. If these customers repeatedly have to face an increase of 1% interest on the order price, then in the long run, they could understand the pressure to switch to a more timely payment activity. Also in this manner, the company can gain some % of the dues extra, which can be put into inventory purchases during the critical months. Since this cumulative 1% increase is in coherence with the maximum interest of 2% as discussed with the proprietor, this could signify a non-punitive yet effective measure to handle the current financial strain.

## 4 Results and Findings

An extensive analysis of the data provided by S.S. Engineering Services has been conducted, and it has resulted in various insights about the company's financial dealings. The two datasets received, namely 'Outstanding Sales Data' and 'Inventory Purchase Data', are the basis for carrying out the detailed exploration.

Among all the observations, the most important result that came out from the Pareto analysis is that the maximum revenue generated by the company is from a handful of customers. Only a small number of customers, including Khadim Panpur, Khadim Panchla, New Bengal Footwear, and ABPL Barjora are the ones among the top 20 customers to superfluously drive the annual revenue, while the remaining customers have a significantly low contribution. This trend signified that the company is reliant on institutional high-value clients for a stable source of revenue and has not been investing in better customer acquisition.

From the monthly chart showcasing the dues for those months exceeding Rs 5000, it is observed that January, February and December are the months which has the highest outstanding dues in the entire financial year of 2024-2025. Also it is noticed that the dues are repeatively kept by some fixed customers only. This includes the customers like Khadim Sreerampore, Khadim Panchla, New Bengal Footwear. Although the former two customers are high value customers contributing the most to the sales the New Bengal Footwear is not seen

to be contributing to the sales and therefore its default payments need strict action by the company. The dominant clients on the other hand can be realised to be implicitly keeping fixed due amounts in the promise of next big orders. Since this is evident from the fact that the company has relatively heavy inventory purchase trend during the months of January, February, and December. Although the highest inventory procurement can be seen in the months of June, July, which fall on a rather better phase of the year having lower outstanding, hence this timeline of inventory procurement is encouraged.

The correlation analysis revealed that the current balance of the company, the purchased price of inventory, the outstanding dues all have a negative correlation, stating that growth of one adversely affects the other. Whilst the current balance and the dues are highly correlated, the purchased price has no or significant relation between them. This proves the outstanding dues is causing a high financial drain and constraint on the current balance, though the company is forced to purchase stocks to suffice the current orders.

From the timeline graph it is evident that the high value customers are also the most punctual ones, hence it brings out the fact that they are not only the high volume ordering customers they are also the ones who put frequent requests for orders compelling the company to keep good terms with them, though they take undue advantage of this and constantly keep overhead dues. The low contributing customers to the sales are also the ones who have a sporadic spread of time periods when they place orders, suggesting lower attention given by the company to grow sales from these customers too.

The implementation of the cumulative increase of 1% interest on the sales for only the defaulting customers in the successive months of their default of keeping dues, showed a potential annual gain of Rs 22,413.75 which is roughly 4.7% of the net unpaid dues towards the year-end in the month of February. This affirms that even a minimal change of strategy by introducing a small rate of interest for defaulters could not only help in financial gains but also help in keeping the customers under pressure.

All these results put front the bottleneck of the business strategies withheld by the company. It shows a one-sided client behaviour trends, which needs improvement.

### **3 Recommendations:**

#### **1. Implement a Tiered Interest-Based Dues Policy:**

The mock-up of a 1% collective charge in every month on those clients who are to be treated as defaulter customer thus showed a gain of ₹22,413.75 during the said financial year—which is similar to 4.69% of the ₹4.77 lakh of total outstanding dues at the end of the said financial year. It may help a steady financial gain as well as adds to revenue and motivate the customer for disbursement of payments in time. It is shown that customer like Khadim Panpur plant with Rs. 85,258 dues, ABPPL with Rs. 1,38,650 dues, and New Bengal Footwear Rs. 1,26,850 dues should place under this policy due to their high dues according to their past payment collection history throughout said financial year, as shown in the “Months with Dues > ₹5000” chart. The policy may applicable as to start with 1% monthly interest for couple of months, and then increase by 2% beyond 60 days. The above function may be implemented within the proprietor’s capitation limit.

## **2. Credit Reassessment for Low-Contributing Defaulters:**

There are some clients like Assam Tribune, Vista Print, and Print Worth, which shows that they are giving purchase order quite seldom but they are not major contributor in sales which is found in the given chart. If these customers often maintain to keep with small dues, they would not be entitled for further credit assist. These clients should either be kept under minimum credit period or be considered for small invoice limits, because these clients does not have any impact on Return On Investment.

## **3. Forecasting Based on Order Timeline Behaviour:**

The order placement timeline charts shows that the customer like Khadim Panpur and Khadim Panchla gives orders regularly, in 9 months or more in the financial year under discussion payments. It's indicated their business is compatible in terms of purchase order value i.e. invoice value but it is found that their payment was irregular. These clients should be put in system like "payment-before-next-order" clause, if it's found that the dues exceed ₹50,000 from previous orders. This could be automated system via which it could be traced in the invoicing procedure.

## **4. Reframe Client Loyalty Policies with Payment Discipline:**

The client those who are high-revenue clients should be motivated for in time payment system. A discount of 1% on invoices basic value could be consider if they paid within 15 days from the date of invoice. On the other hand, the interest will be imposed as penalty for those who pay delay payment. It will balance the payment system. This dual function will improve buyer vs Salers friction less relation in future. As an example the clients like New Bengal Footwear, who invoice value goes up to Rs.11 lakhs in said financial year and held dues of Rs. 1.2 lakhs.

## **5. Using Timeline Visuals to Forecast Demand and Plan Inventory:**

It has been found that client order placement timeline plots divulge order placement nature. For example, clients like Khadim Panpur and New Bengal Footwear have very good placement of purchase order in a frequent manner of about 8 to 9 months of the year. This regular placement of purchase order and its pattern can help as a recommended guide to maintain proper inventory which may help to control from leakage of operating capital. It will help to understand when large clients are likely to place purchase orders, so that the company can plan accordingly for inventory purchases, like specially for polypropylene straps and packaging machineries to avoid sudden requirement of materials or stockouts of materials at the time of maximum demand so that supply chain could be maintained properly.