Payment Pattern Analysis & Optimization of Inventory for a Packaging Machine Supply Company

Business Data Management: Capstone Project

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About The Company

Founded in 2005 by Mr. Subrata Datta in Mahestala, Kolkata, S.S. Engineering Services grew from a modest start of INR 35,000 and one employee into a trusted supplier of semi and fully automatic packaging machines with service expertise. Overcoming early challenges, it now serves major clients like Khadims India Ltd., Tata Tea Group, and Indian Eastern Railway. The company operates with four trained employees, achieving a turnover of INR 80 lakhs and 18% EBITDA, while steadily expanding its client base.

Problem Statement:

*The company is **facing consistent payment delays from clients**, which leads to an accumulation of outstanding revenue and cash-flow disturbances. Meanwhile, it is forced to purchase **inventory in advance to meet sudden, just-in-time demand**, thereby becoming financially encumbered despite efforts to align purchases with actual demand.*

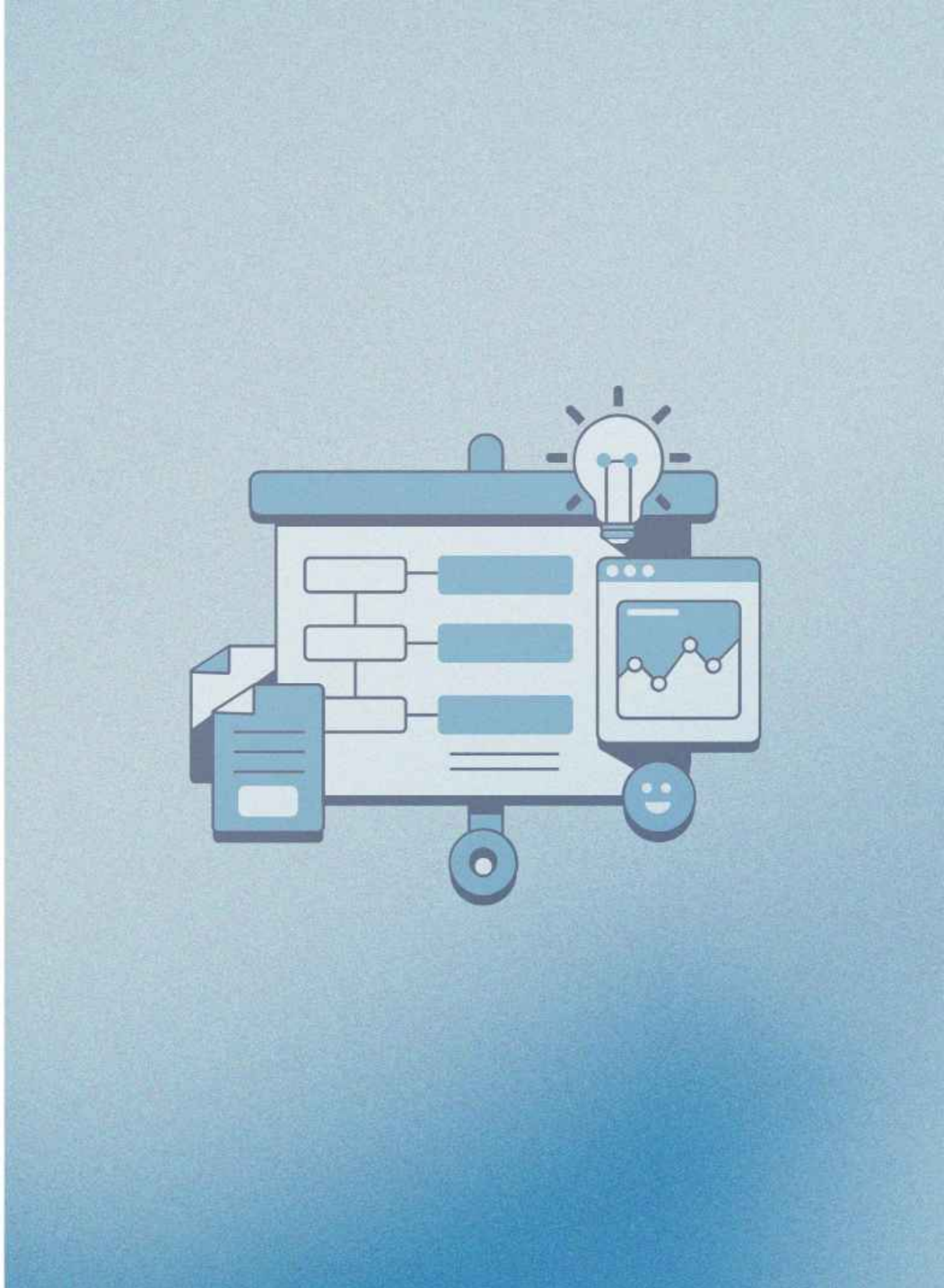
Datasets Collected:

- *Two datasets were provided by S.S. Engineering Services (via email) for the **FY 2024–25 (Apr–Mar)***
- ***Outstanding Sales Data**: 96 entries*

Invoice No (transaction ID), Invoice Date (date of sale), Product Name (item sold), Qty (quantity), Amount (net value), IGST/CGST/SGST (taxes), Freight (delivery cost), Total Amount (gross value), Due (outstanding), Cheque No/Date (payment details)

- ***Inventory Purchase Data**: 44 entries*

Invoice Date (purchase date), Item Name (inventory item), Quantity (units), Unit Price (rate), Subtotal (value before tax), IGST (tax), Total Amount (purchase value).



Data Cleaning & Preprocessing

1. Uploaded both to Google Sheets for cleaning.
2. Sales data: removed blanks, redundant columns, wrong year rows, fixed year in July, split Invoice Date into Month/Year.
3. Saved cleaned Sales data to new sheet.
4. Inventory data: removed blanks, subtotals, irrelevant and empty columns.
5. Fixed Item Code errors, added Product Name after meeting.
6. Saved cleaned Inventory data to new sheet for analysis.

Descriptive Statistics

Uploaded cleaned Sales and Inventory data to Colab.
Read with read_csv(), converted to pandas DataFrames.
Used describe() and info() to get stats

Outstanding Sales Data

1. Max order: 200, min: 1, avg: 61.
2. Max invoice: ₹3,30,400; avg: ₹73,856.
3. Max dues: ₹1,71,100; avg dues: ₹14,697 (high deviation).

Inventory Purchase Data

1. Avg quantity: 118; max: 230.
2. Avg rate: ₹5,883; range: ₹340–₹1,85,000.
3. Avg spend: ₹91,774; range: ₹7,658–₹2,18,300.

Data Analysis

Pareto Analysis

- Load sales CSV in Colab with read_csv().
- Group by customer, sum sales.
- Sort customers by sales (desc).
- Calculate cumulative % with cumsum().
- Pick top customers till 80% sales.
- Plot bar + trendline using Matplotlib.

Dues Analysis

- Load dues data in Google Sheets.
- Make pivot: Month-Year rows, Customer cols, dues values.
- Filter months with dues > ₹5000.
- Plot grouped bar chart (X: month, Y: dues).
- Color bars by customer.
- See key clients and high-dues months.

Correlation Analysis

- Add ‘dues’ and ‘balance’ columns.
- Balance = Sales – Dues – Purchases (+reserve if 0).
- Upload CSV in Colab with read_csv().
- Compute correlations using corr().
- Create a correlation matrix.
- Check if dues or purchases drain finances.

Purchase Analysis

- Made pivot table in Sheets.
- Rows: Month-Year; Cols: Customer; Values: dues.
- Filtered months with dues > ₹5000.
- Plotted grouped bar chart.
- Color bars by client.
- Found high-dues clients, monthly trends.

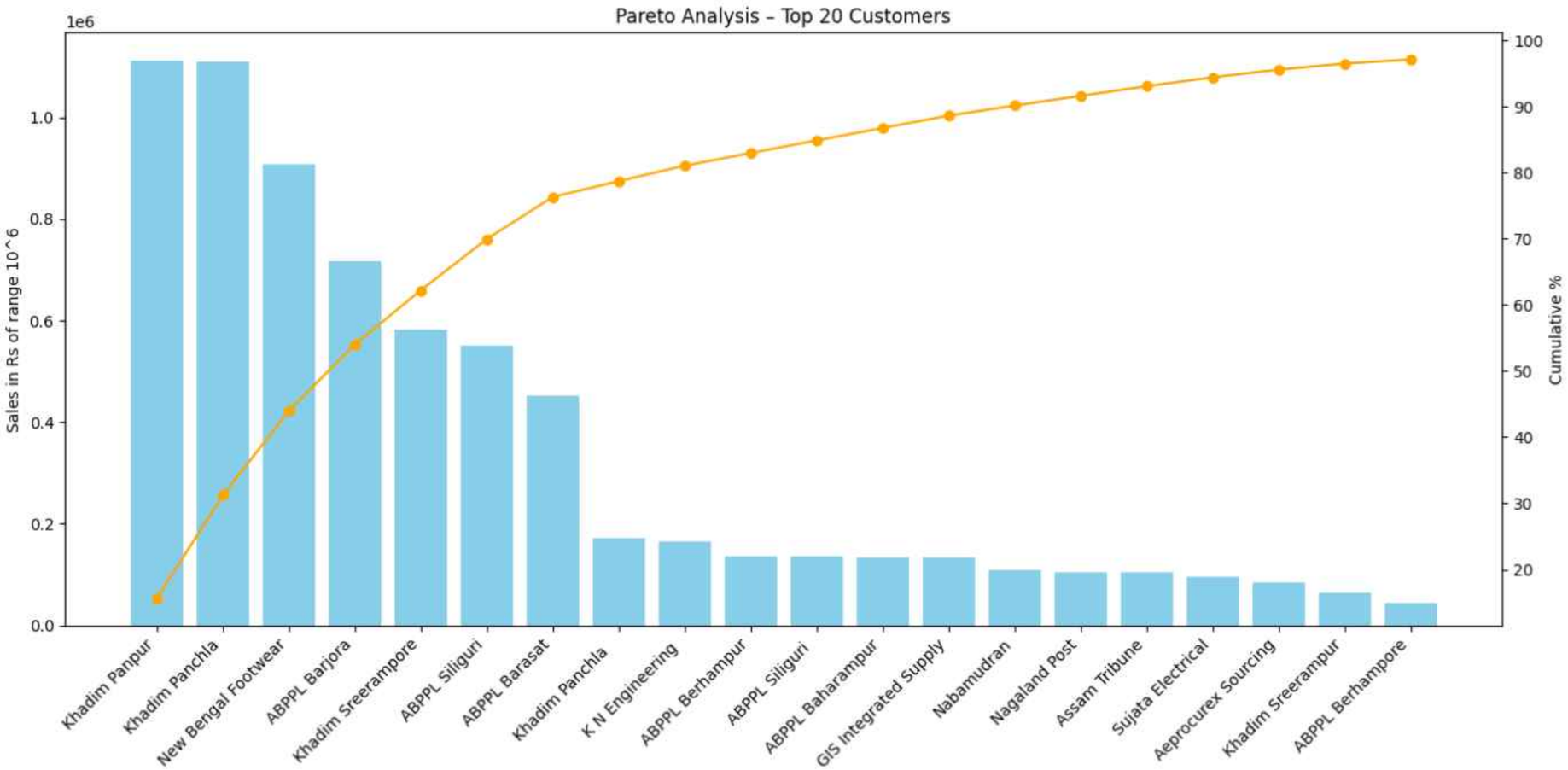
Timeline Analysis

- Fixed inconsistent customer names using a dictionary.
- Mapped all name variants to one label.
- Split analysis into Jan–Jun and Jul–Dec.
- Used Matplotlib to plot timeline.
- X: months, Y: customers, bars = order activity.
- Found frequent, sporadic, and low-activity clients.

Interest Over Dues

- Simulated 1% monthly penalty on defaulters.
- Filtered dues > 0 in Google Sheets.
- Added Extra Sales and Extra Gain columns.
- Made pivot of sales + extra, saved as CSV.
- Used Colab + cumsum() for cumulative gains.
- Plotted sales trend and extra revenue in subplots.

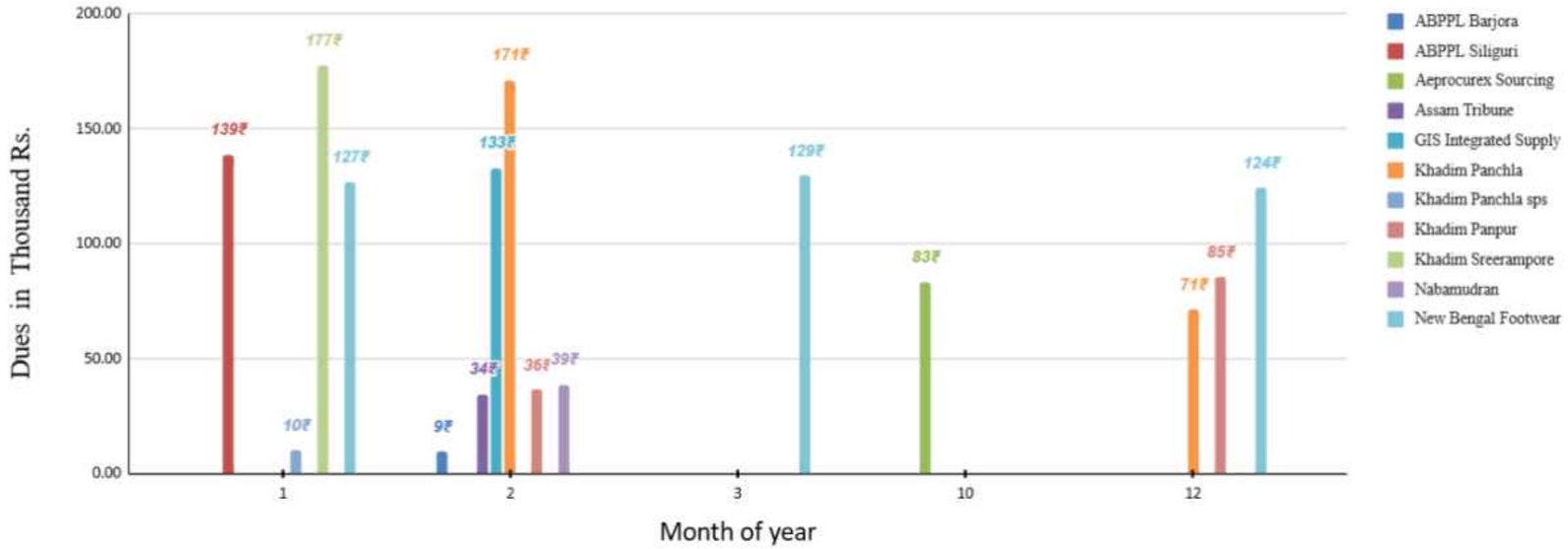
Pareto Analysis for customers



- *45% ie, 9 out of 20 customers, drive 80% of revenue, although it's not following the Pareto trend, but it shows that a small section of the customers exactly drives most of the revenue.*
- *Khadim Panpur, Khadim Panchla, New Bengal Footwear, ABPL Barjora, Khadim Sreerampore, and ABPL Siliguri are the major contributors.*
- *Khadim Panpur alone generates approximately ₹11 lakh annually, underscoring its strategic importance within the customer base.*

Dues Analysis

Months with Dues > Rs 5000 in FY 2024-25



- *January and February show the highest outstanding dues overall.*
- *New Bengal Footwear consistently maintains high dues across multiple critical months,*
- *The highest single-month dues are from Khadim Sreerampore (₹177k in January) and Khadim Panchla (₹171k in February)*
- *Gis Integrated Supply shows high dues in February (₹133k) despite having minimal impact*

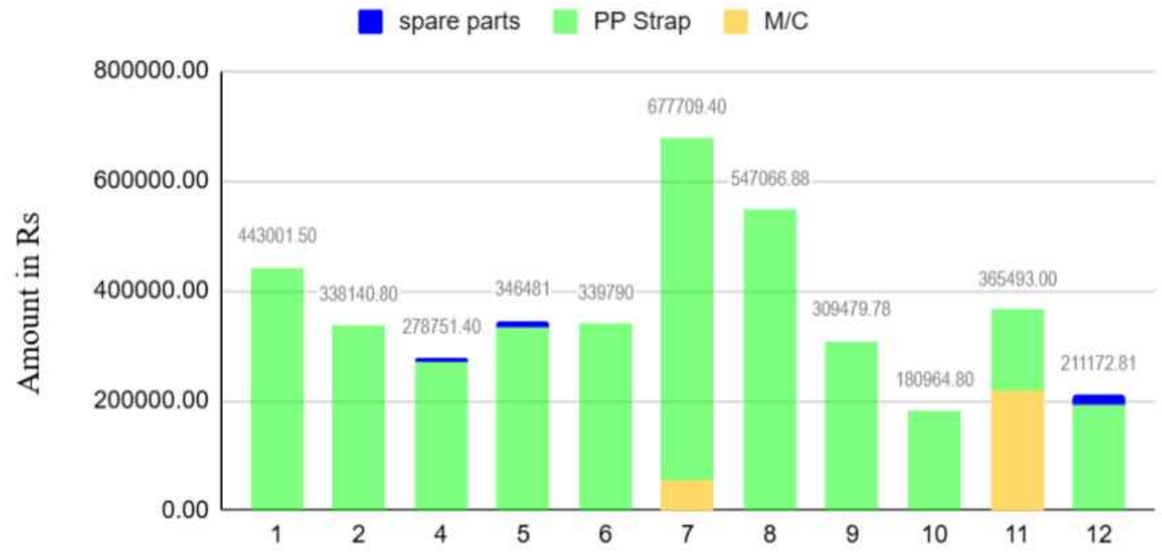
Correlation Analysis

- *No investment need — company still has sufficient funds.*
- *Purchasing power unaffected despite outstanding dues.*
- *Cash balance declining due to unpaid dues buildup.*

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

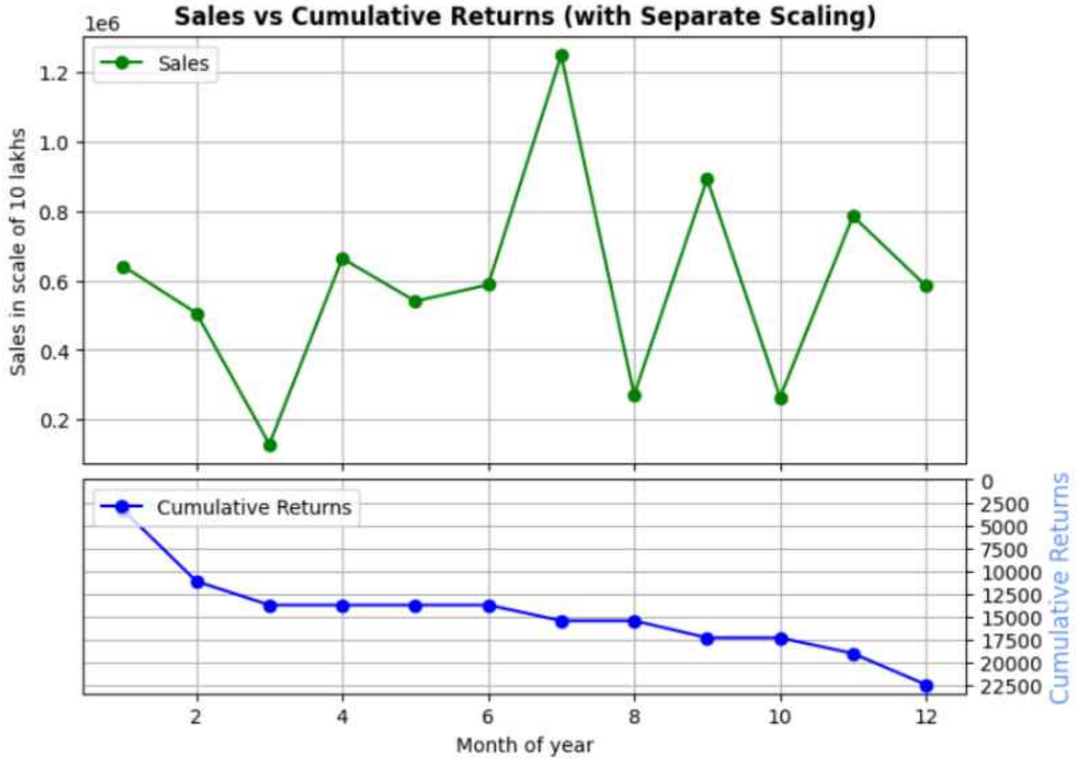
Product Purchase Analysis

Monthly purchase of products



- *PP straps account for the highest share of inventory purchases, peaking in July (₹677,709) and August (₹547,066)*
- *High inventory purchases (Nov–Dec) are followed by high outstanding dues (Jan–Feb) from the same customers.*

Interest Over Dues Analysis



- *Impact of applying a 1% cumulative interest on customers with previous-month dues. This strategy leads to a gradual and consistent increase in cumulative profit (up to ~₹22,500) over the year.*

Insights & Suggestions

01 **Since a few high-value customers generate most of the revenue and create a dependency risk, the company should actively diversify its customer base to reduce over-reliance.**

02 **As the same customers repeatedly delay payments during January, February, and December, a tiered(differential) interest policy should be applied to discourage these recurring payment deferrals.**

03 **Because New Bengal Footwear has high dues but low sales contribution, its credit terms should be tightened or capped to avoid unnecessary financial exposure.**

04 **Given that a 1% cumulative interest policy can generate steady additional revenue, this approach should be implemented immediately and scaled up if dues extend beyond 60 days.**

05 **As advance inventory purchases are followed by delayed payments, inventory should be aligned to order timing, and stricter credit controls should be introduced in September, when sales are high and dues are low.**

06 **Because interest penalties alone may seem punitive to loyal clients, they should be combined with a 1% early-payment discount to balance payment discipline with customer retention.**

Thank You

References

DATA SET LINK

SPREADSHEET LINK 1

SPREADSHEET LINK 2

COLAB LINKS 1

COLAB LINKS 2