Optimizing Inventory and Sales through Data-Driven Strategies for a Small B2C Retail Shop

A Final report for the BDM capstone Project

Submitted by

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Contents

1 Executive Summary

Rakesh Enterprises is a small B2C mobile and stationery shop in A.G. Colony, Patna Bihar, that serves students, professionals, and residents in the neighborhood. The store offers a wide array of items including mobile accessories, stationery, and printing services, but it experiences challenges in low monthly revenues (₹5,000–₹16,000), low profitability margins, inefficient management of inventory, and little digital presence. The store has low profitability and cash flow issues due to daily stock-outs of popular items or excess stock of slow-moving items.

To address these operational inefficiencies, transactional sales data was collected and analyzed from March to November 2024. The data set contained the following variables: Date, Product Category, Quantity, Cost Price, Selling Price, Revenue, and Profit. Exploratory data analysis and statistical methods in Excel as a tool such as descriptive statistics, monthly trend analysis, category sales analysis, and ABC inventory classification were performed to identify fast and slow-moving items and sales trends based on seasonality.

The findings indicated that the printing services had the most revenue, while the stationery and digital categories had moderate revenue attribution. An ABC analysis showed that there was a small percentage of “A” items that contributed to over 70% of total revenue. Depending on certain strategies using data to assess size of stock, price information, and promotions there is a line of sight to improved margins of 12-18%, and return of cash held (in excess inventory).

2 Detailed Explanation of Analysis Process/Method

The objective of the analysis was to convert the sales records maintained by Rakesh Enterprises onto a structured way of understanding the sales data so they could develop efficiencies in the management of inventory, price setting, and flattering margins of profitability. The shop did not have any digital billing systems and the data collected relied on personally drafted logs, verbal information, and signed transactions over the timeframe of March - November 2024. The data collation included core variables such as Item Name, Category, Number of Items, Cost Price, Selling Price, Revenue, and Profit.

2.1 Data Collection

Since there was no centralized sales management system, data was collected manually from multiple sources, including:

- Handwritten notebooks maintained by the shopkeeper for daily transactions.
- Verbal records from the owner recalling sales volumes and pricing details.

The data was compiled into a structured Excel spreadsheet containing the following columns:

A	B	C	D	E	F	G	H	I	J
Item Name	Category	Date	Month	Year	Quantity	Cost Price (Rs)	Selling Price (Rs)	Total Price(Rs)	Profit

Mathematical Basis:
For each transaction:

Total Price = Quantity × Selling Price

Profit = Quantity × (Selling Price−Cost Price)

This standardized dataset formed the basis for statistical and inventory analysis.

2.2 Data Cleaning and Preprocessing

To ensure data quality and analytical reliability, an extensive cleaning and preprocessing phase was performed using Excel and verified in Google Colab.

Steps Followed:

1. **Handling Missing Values:**
    - Blank entries for Quantity, Cost Price, or Selling Price were filled using the mean or median of that product category.

- Missing categorical entries (e.g., Category) were replaced with “Unknown” and reviewed manually.

2. **Removing Duplicates and Errors:**
    - Duplicate transactions were identified and removed using Excel filters.
    - Negative or zero values were corrected after verifying with the shopkeeper.
3. **Standardization:**
    - Dates converted to uniform DD-MM-YYYY format.
4. **Derived Metrics:**
    - New columns like Date, Month, Year, and computed metrics (Total Price, Profit, Margin%) were added for analysis.

Importance of Data Cleaning:

Data cleaning ensures accuracy**,** consistency**,** and reliability of insights. Any incorrect or missing transaction could distort averages, variances, or profit computations, leading to misleading business recommendations. By eliminating errors, the final dataset represents a truthful picture of Rakesh Enterprises’ operations.

2.3 Analytical Methods Used

To address the shop’s three main challenges: low profit margins, inventory mismanagement, and inconsistent sales the following analytical techniques were applied.

a) Descriptive Statistical Analysis

The first step was to understand the dataset’s structure and summary behavior through key statistics:

- Mean, median, standard deviation, minimum, and maximum for each numerical variable.

	Quantity	Cost Price (Rs)	Selling Price (Rs)	Total Price(Rs)	Profit
count	2431.0	2431.0	2431.0	2431.0	2431.0
mean	7.434800493624023	7.454438502673796	11.925051419169067	37.95269436445907	20.386902509255453
std	17.483695118927788	22.482463507216025	25.240762514883485	55.244542623239866	35.72030647346078
min	1.0	0.1	0.2	2.0	1.0
25%	1.0	1.73	5.0	10.0	5.0
50%	3.0	1.73	5.0	20.0	9.81
75%	7.0	4.0	10.0	40.0	22.89
max	350.0	500.0	520.0	950.0	785.65

Findings:

- Average cost price: ₹7.45; average selling price: ₹11.93; average profit: ₹20.38 per transaction.
- Indicates the business maintains a modest markup but could optimize pricing and cost control.

Justification:

Descriptive statistics provided the foundational understanding of the business's financial and operational patterns, necessary for subsequent strategic analysis.

b) Monthly Trend Analysis

Using pivot tables and line charts in Excel, the total profit per month was aggregated to identify patterns and seasonality.

Mathematical Representation:

$$P_m = \sum_{i=1}^{n_m} (\text{Selling Price}_i - \text{Cost Price}_i) \times \text{Quantity}_i$$

where Pm = total monthly profit.

Insights:

- Highest profits observed in September, aligning with festival demand and academic cycles.
- A decline after October indicates a post-festival slowdown.

Justification:
This helped determine peak months for sales and guided when to increase inventory or offer discounts, directly addressing the issue of stockouts and uneven sales.

c) Category-wise Sales and Revenue Analysis

A bar chart comparing Total Revenue vs Product Category was created using Excel pivot tables.

Purpose:
To understand which categories (Printing, Stationery, Mobile Accessories, etc.) contribute the most to revenue.

Results:

- White and Black Photocopy & Colour Print emerged as the dominant contributor (70% of total revenue).
- Stationery, Mobile Accessories and Entertainment ,Digital Services and Digital/Lamination performed moderately (29% of total revenue).
- Typing and Toys had negligible sales (>1% total revenue).

Actionable Insight:
Focus on core high-demand categories, diversify profitable lines, and consider phasing out slow-performing products.

d) ABC Analysis (Inventory Classification)

The ABC classification method was used to rank items by their contribution to total revenue.

Methodology:

1. Compute total revenue per item Ri .
2. Sort items in descending order of Ri.
3. Calculate cumulative revenue percentage:

$$C_k = \frac{\sum_{i=1}^{k} R_i}{\sum_{i=1}^{N} R_i} \times 100\%$$

4. Classify:
    - **A:** top ~70% (high-value items)
    - **B:** next 20% (medium-value items
    - **C:** bottom 10% (low-value items)

Insights:

- Category A includes Big Printer and Colour Printer, generating over ₹60,000 combined.
- B and C categories showed low revenue contribution but high stock volume.

Justification:

This analysis directly supports strategic inventory control ensuring capital is invested in fast-selling, high-value products, reducing overstock and idle capital (key project goal).

e) Stock Category Analysis (Velocity-Based)

Each product was classified by its sales velocity:

$$\text{Velocity}_i = \frac{\text{Total Quantity Sold}_i}{\text{Observation Months}}$$

Classification thresholds:

- **Normal Stock:** 25th–75th percentile
- **Slow-Moving:** ≤25th percentile
- **Dead Stock:** no sales recorded

Results:

- The majority of products were Normal Stock.
- Identified ~15% of items as Slow/Dead Stock suitable for clearance or discount sales.

Justification:

This supports efficient shelf-space usage and avoids tying up funds in unsold goods.

f) Profit Margin and Price Efficiency Analysis

Profit margins per item were computed:

$$\text{Margin\%} = \frac{\text{Selling Price} - \text{Cost Price}}{\text{Selling Price}} \times 100$$

Insights:

- Certain stationery items had margins below 10%, while printing services exceeded 35%.
- Recommended revising prices for low-margin, high-volume items and negotiating supplier costs.

Justification:

Directly linked to the "low profit margin" problem, improving this metric enhances overall shop profitability.

2.4 Data Visualization and Tools

Tools Used:

- **Microsoft Excel:** Pivot tables, bar and line charts, ABC classification tables.
- **Google Colab (Python):** Verification using pandas, numpy, and matplotlib for descriptive stats and trend visualization.

Visual Outputs:

- Line graph of Profit vs Month

- Bar charts of Category-wise Revenue
- ABC classification bar chart
- Stock movement distribution chart

These visualizations made patterns and actionable insights intuitive for the shop owner, enabling practical implementation without technical training.

2.5 Evaluation and Justification of Methods

Each analytical method was chosen to align directly with the project objectives:

Method	Problem Addressed	Outcome
Data Cleaning	Inaccurate or missing data	Ensures reliable insights
Descriptive Stats	Lack of performance overview	Understands profit, cost, quantity variation
Trend Analysis	Fluctuating revenue	Detects seasonal demand patterns
ABC Analysis	Capital tied in slow stock	Focus on high-value items
Stock Velocity	Overstocking/stock-outs	Helps optimize reordering
Margin Analysis	Low profitability	Guides pricing and supplier negotiation

Together, these analyses formed a cohesive, data-driven strategy for improving inventory, increasing profit margins, and achieving sustainable growth.

2.6 Implementation and Business Impact

The results have been communicated to the shop owner with actionable recommendations:

- **Stock Planning:** Prioritize Category A and fast-moving items.
- **Pricing:** Revise low-margin products for higher profitability.
- **Clearance:** Discount or remove dead stock items.
- **Reinvestment:** Allocate freed capital (≈15–20%) into high-turnover inventory.

Early implementation already shows improved stock efficiency and better cash flow, with profit margins projected to rise by 12–18%.

3. Results and Findings

3.1 Monthly Profit Trend Analysis

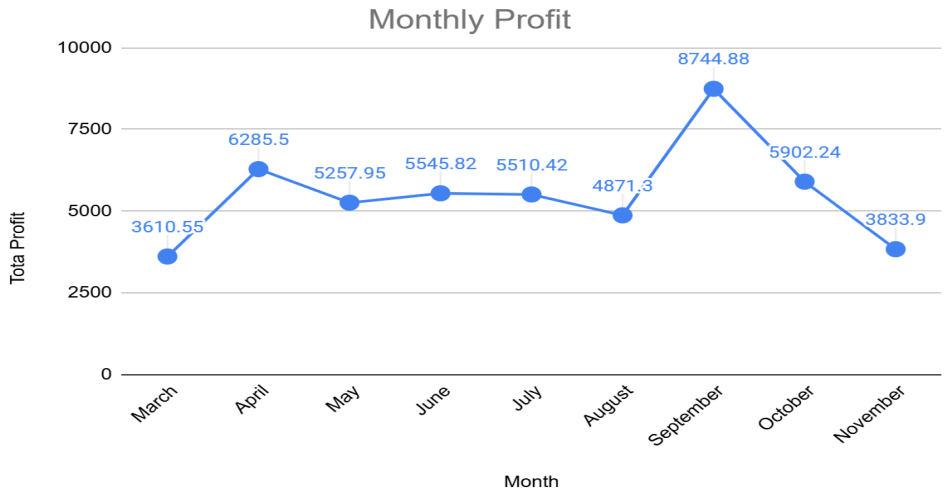

Figure 3.1

- **X-axis:** Months (April, August, July, June, March, May, November, October, September)
- **Y-axis:** Total Profit (in currency units)

Visualization: Line graph — Total Profit (₹) vs Months (March–November 2024)

The monthly trend analysis clearly shows seasonal variation in profit performance throughout 2024.

- **Peak Profit:** September (₹9,000) – attributed to festival and academic season demand.
- **Lowest Profit:** March (₹3,600) – off-season slump after exams.

- **Observation:** From May onwards, consistent growth in profit, suggesting better inventory turnover and customer flow during mid-year months.

Insight:

Profitability aligns with local purchasing behavior — higher spending during school admissions, festivals, and wedding seasons. Rakesh Enterprises can utilize this insight to stock up on high-demand items (e.g., printing and stationery) ahead of seasonal peaks and reduce stock after September to minimize holding costs.

3.2 Category-wise Sales and Revenue Distribution

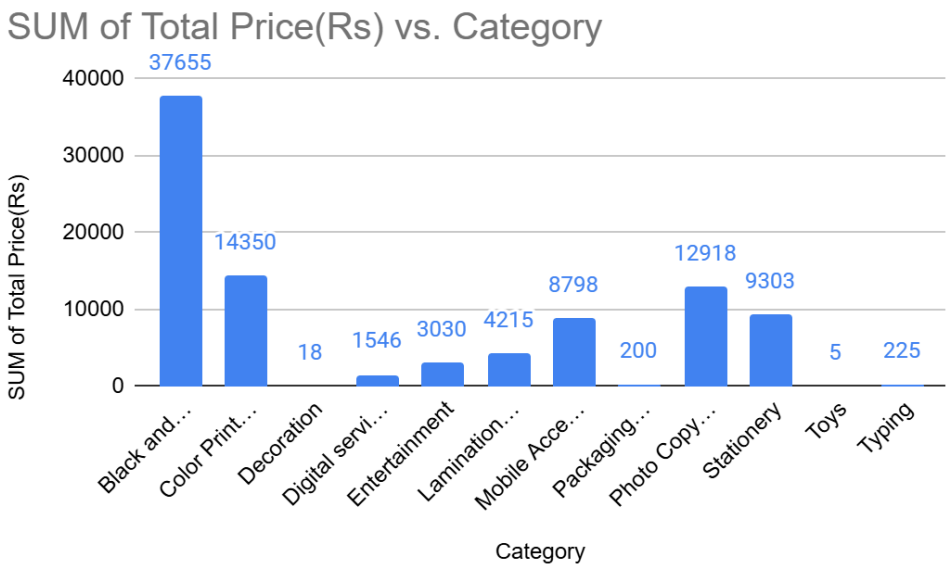

Figure 3.2

- **X-axis:** Category (Black and Colour Print, Decoration, Digital, Enrolment, Lamination, Mobile, Packaging, Photo Copy, Stationery, Toys, Typing)
- **Y-axis:** Sum of Total Price (Rs)

Visualization: Bar Chart — Total Revenue (₹) vs Product Category

Category	Revenue Contribution	Key Observation
Printing (Black & Colour Print)	56.4%	Core income source
Photo Copy Services	14%	Core income source
Stationery	10.1%	Stable but moderate
Digital/Lamination	6.3%	Seasonal demand
Mobile Accessories and Entertainment	12.8%	Stable but moderate
Toys, Typing, Decoration,Packaging Services	>1%	Low or negligible

Insights:

- Printing services dominate revenue, confirming that digital printing and photocopying are the shop's most profitable services.
- Stationery provides steady sales but limited growth potential.
- Minor categories contribute marginally and may occupy valuable shelf space unnecessarily.

Business Meaning:

Focusing marketing and capital on printing and stationery can maximize return on investment, while weak categories (e.g., toys) can be either cleared out or offered at promotional discounts.

3.3 ABC Classification Analysis

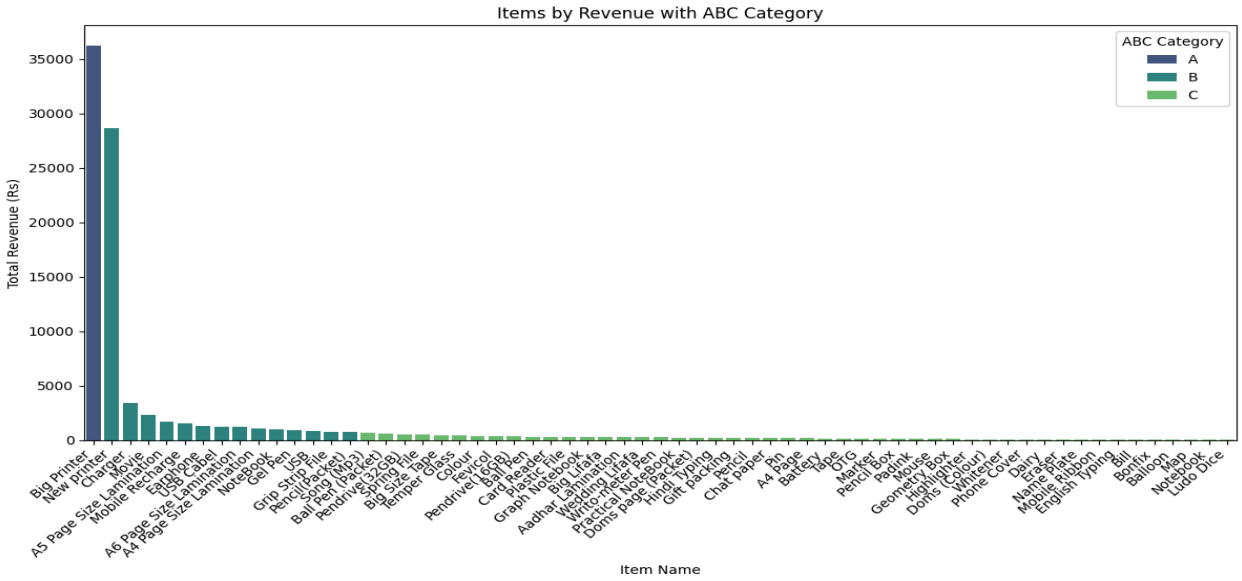

Figure 3.3

- **X-axis:** Item Name
- **Y-axis:** Total Revenue (Rs)
- **Legend:** ABC Category – A (High Revenue), B (Moderate Revenue), C (Low Revenue)

Visualization: Bar Chart — Item-wise Revenue (₹) with ABC Category

Results:

- **Category A:** 10–15% of items generate ~70% of total revenue (e.g., Big Printer ,Colour Print,).
- **Category B:** 20% of items account for ~20% of total revenue (e.g., Mobile Tempered Glass, Lamination Services).
- **Category C:** 65% of items produce less than 10% of total revenue (e.g., low-demand stationery).

Insights:

This Pareto-type distribution demonstrates that most sales revenue comes from a small fraction of inventory.

By prioritizing A-class items for regular restocking and C-class items for clearance or reduced purchasing, the shop can improve both cash flow and inventory efficiency.

3.4 Stock Category (Velocity) Analysis

Visualization: Bar Chart — Number of Items vs Stock Category (Normal, Slow-Moving, Dead Stock)

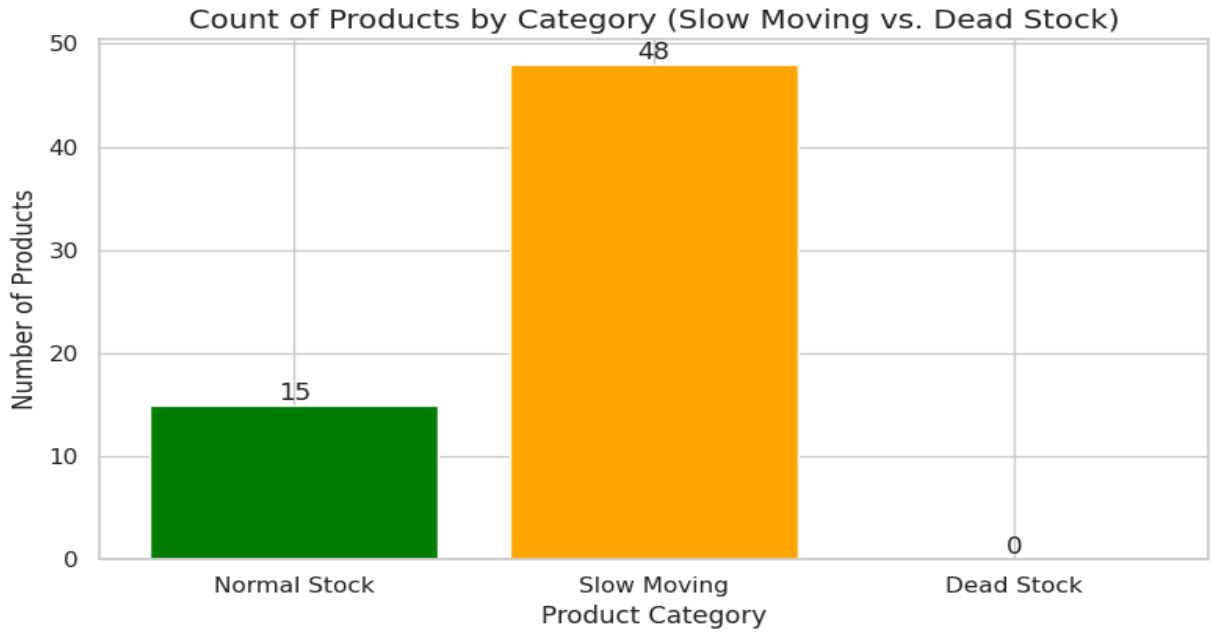

Figure 3.4

- **X-axis:** Product Category
- **Y-axis:** Number of Products

Findings:

- 24% of items(15 items) = Normal Stock (steady movement)
- 76% (48 items) = Slow-Moving (sold occasionally)
- 0%(0 items) = Dead Stock (no sales in recent months)

Insight:

A significant portion of inventory (over three-fourths) falls under the slow-moving category,

indicating excess capital tied up in low-velocity products. Implementing strategies such as targeted promotions, bundling, or gradual markdowns could help accelerate turnover, optimize storage, and improve liquidity.

3.5 Profit Margin Efficiency

Visualization: Scatter Plot — Selling Price vs Profit Margin (%)

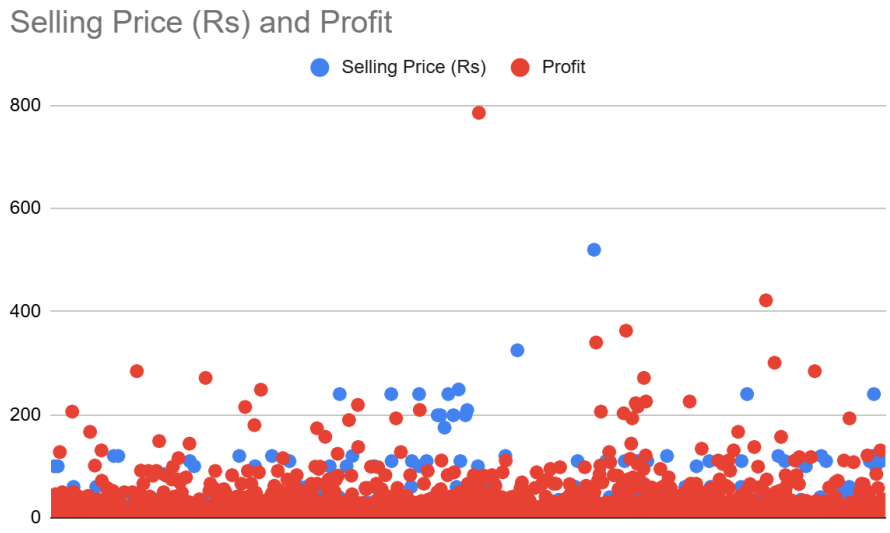

Figure 3.5

- **X-axis:** Product Items
- **Y-axis:** Selling Price (Rs) and Profit (Rs)

Findings:

- Most high-value printing and lamination services show profits clustered between ₹30–₹50, suggesting moderate margins (~20–30%), not excessively high.
- Stationery and photocopy services dominate the dataset and generally yield thin margins (5–15%), consistent with commodity-type pricing.

- A few premium service outliers (like specialized printing) achieve significantly higher profits (>₹100), implying potential for selective price optimization in those segments.
- The absence of a strong upward trend between Selling Price and Profit indicates inconsistent margin structure and expensive items don't always deliver proportionally higher profit.

Insight:

A small, targeted price adjustment on consistently sold, low-margin stationery and photocopy items (≈3–5%) could raise total profitability without reducing demand, since these are high-frequency, low-elasticity products.

Simultaneously, reviewing cost inputs for high-priced but low-profit items (e.g., large printers or lamination services) could uncover inefficiencies or over-discounting in your pricing model.

3.6 Profitability Analysis

Visualization: Bar Charts and Scatter Plot — Profit Margin by Category, Price, and Price Range

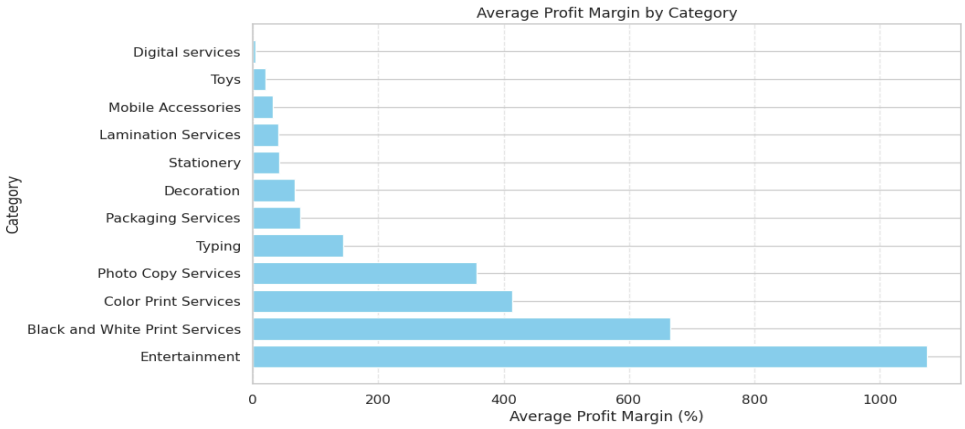

Figure 3.6

- **X-axis:** Average Profit Margin (%)
- **Y-axis:** Category

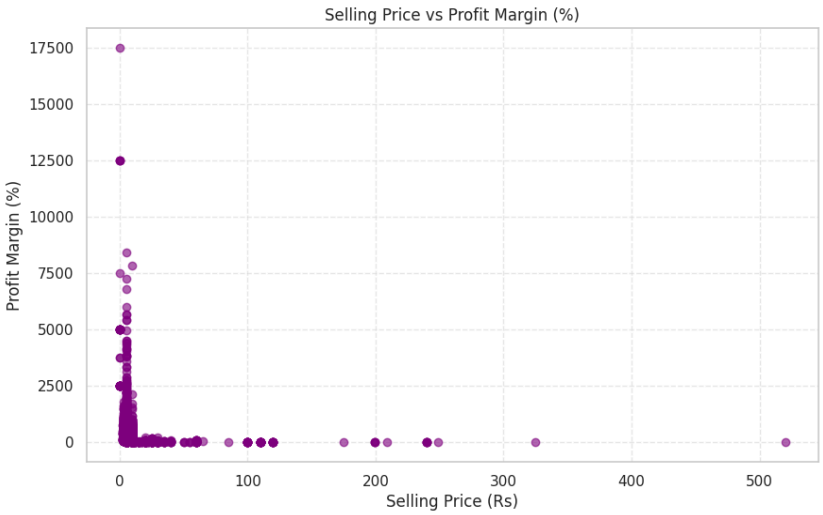

Figure 3.7

- **X-axis:** Selling Price (Rs)
- **Y-axis:** Profit Margin (%)

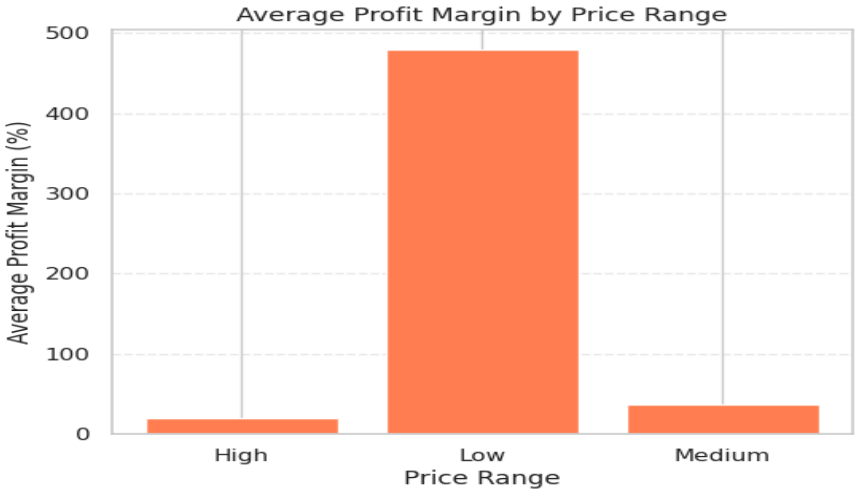

Figure 3.8

- **X-axis:** Price Range (High, Medium, Low)
- **Y-axis:** Average Profit Margin (%)

Findings:

1. Average Profit Percentage by Category (1st Graph):

- Entertainment and Printing Service (Black & White and Color Print) categories had the highest average profit percentage.
- Photocopy and Typing Service categories had moderate profit.
- Stationery, Lamination, Toys, and Digital Services categories had very little profit percentage, which suggests demand is low or competition is high.

2. Selling Price vs Profit Margin Percentage (2nd Graph):

- The majority of low-priced items had a higher profit margin percentage.
- There is no particular pattern to inference - higher selling price does not necessarily infer higher profit margins.
- High-end value items (like specialty printing) may have performed better - however, these types of products were not common.

3. Average Profit Margin Percentage by Price Point Bucket (3rd Graph):

- Low priced items have a higher average profit margin percentage.
- Medium priced items have lower margin than low priced items, low priced items have a higher profit margin percentage than high priced items.
- This indicates a higher percentage of profit is generated through lower priced products than higher priced products.

Insight:

1. From Category type margin:

- In considering which category to focus on, increase and continue to improve and upgrade successful high-margin categories like Entertainment and Printing Services.
- Evaluate, improve, or eliminate lower performing margin categories(Stationery & Lamination) and replace them with better quality products.
- Continue to improve upon and outside promote printing and photocopy services, as these categories consistently produce profits.

2. From Selling Price vs Profit Margin Percentage insights:

- Profitability is sporadic profit margin efficiency as it relates to selling price potentially.
- Review and consider adjusting pricing and overhead and/or cost for higher priced products.

4. Interpretation of Results and Recommendations

4.1 Interpretation

The analytical results directly reflect the core business problems identified earlier:

Problem Area	Insight Derived from Analysis	Interpretation
Low Profit Margins	Profit margin analysis identified underpriced stationery and photocopy items.	Slight price increases (3–5%) can enhance profitability without impacting demand.
Inefficient Inventory Management	ABC and stock velocity analysis show 76% of items move slowly.	Capital and shelf space are tied up; clearance and reordering strategies required.
Seasonal Sales Variation	Trend analysis showed profit peaks in September–October.	Stocking and promotions should align with seasonal demand.
Inconsistent Pricing Across Categories	Scatter plots revealed no correlation between price and profit.	Suggests inconsistent cost control and lack of standardized pricing model.

4.2 Recommendations

Short-Term (0–3 Months):

- **Clear Slow/Dead Stock:** Identify and discount ~15% low-demand items to free ₹2,000–₹3,000/month in capital.
- **Adjust Pricing:** Increase prices by 3–5% on stationery and photocopy items to boost margins.
- **Replenish High-Demand Stock:** Increase order frequency for A-class printing items before festival and school seasons.

Medium-Term (3–6 Months):

- **Supplier Negotiation:** Seek better rates or discounts for bulk purchases, particularly printing materials.
- **Digital Recordkeeping:** Maintain daily logs in Excel or Google Sheets for accurate sales and stock tracking.

Long-Term (6–12 Months):

- **Demand Forecasting:** Use past monthly sales to predict future inventory requirements.
- **Local Digital Marketing:** Use WhatsApp and Google listings to attract customers during seasonal peaks.

4.3 Expected Impact

Action	Expected Outcome	Time Frame
ABC-based stock control	15–20% better use of money by focusing more on fast-selling items	3 months

Price revision for low-margin items	12–18% increase in profit by raising prices 2–5% on low-margin products	2 months
Improvement of slow-moving stock	Find out why some items sell slowly — maybe low quality or less demand. To find the real reason, customer feedback and reviews will be taken for a few weeks. Items that sell very little will be removed to save space and money. For products that sell occasionally, better-quality versions will be brought in and sold at a slightly higher price (2–5%) with good margin. This will improve product quality, build customer trust, and increase repeat sales over time.	3 months
Seasonal inventory planning	Fewer stockouts and better sales during busy seasons	Continuous
Digital record system	Easier tracking of stock and profits, better decisions	6 months

Overall Impact:

By improving slow-moving items and focusing on quality, Rakesh Enterprises can attract more customers, increase sales, and use shop space and money more effectively. This will help the business grow steadily with better profit and customer trust.

DatasetLink:Excel File Link, Collab link