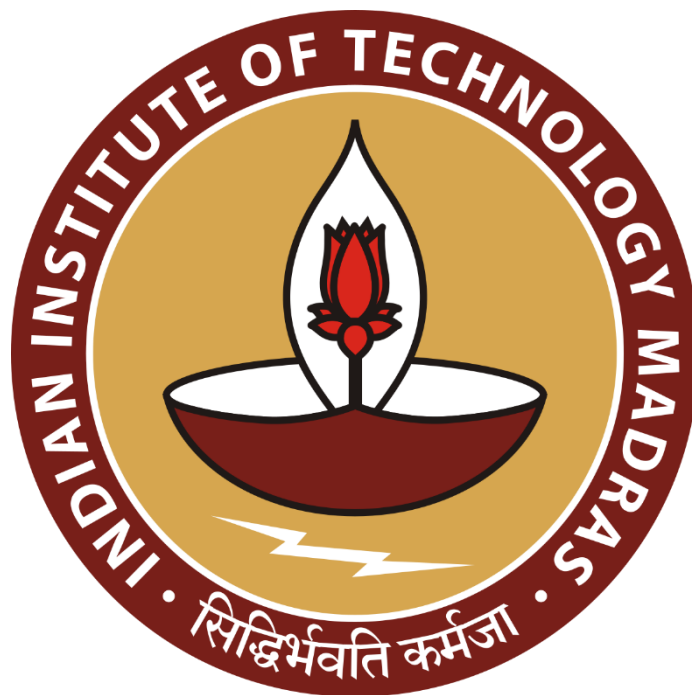# Optimizing Inventory Management and Service Efficiency for an Automobile Parts Trading and Service Company

A Mid Term report for the BDM capstone Project

Submitted by

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Contents

1 Executive Summary and Title

This mid-term report addresses the operational challenges faced by New Supreme Auto Engineering Works, with an initial focus on inventory management inefficiencies. The goal of the current analysis is to establish effective inventory control methods that can support operational optimization and cost-effective resource management. Service efficiency improvements will be explored further in the final report.

To ensure data authenticity, verification was conducted through a formal letter from the organization, site photographs, and an interaction with the founder. The dataset, collected directly from New Supreme Auto's records, covers stock data over six months, including variables like item name, opening and closing balances, rates, quantities, and values. Metadata analysis confirms a structured and comprehensive dataset that forms a solid foundation for this project.

Descriptive statistics reveal a substantial variability in item costs and values across New Supreme Auto's inventory. Notable insights include a wide range in opening and closing balance rates and values, with high-value outliers that significantly impact financial metrics. Key findings show a concentration of lower-turnover items and positively skewed cost distributions.

The methods applied in the analysis include descriptive statistics to evaluate central tendencies and dispersion, visualization techniques like bar, box, and pie charts to depict cost distributions and value proportions, and inventory management calculations like Economic Order Quantity (EOQ) and Safety Stock. The key insights from these methods aim to identify trends in inventory management, providing actionable insights for stock control and cash flow optimization.

In summary, this report reflects our commitment to leveraging data-driven analysis to enhance New Supreme Auto's business functions, contributing to operational optimization, and better resource management.

2 Proof of Originality of the Data

To establish the authenticity of the data, the supporting evidence as listed below:
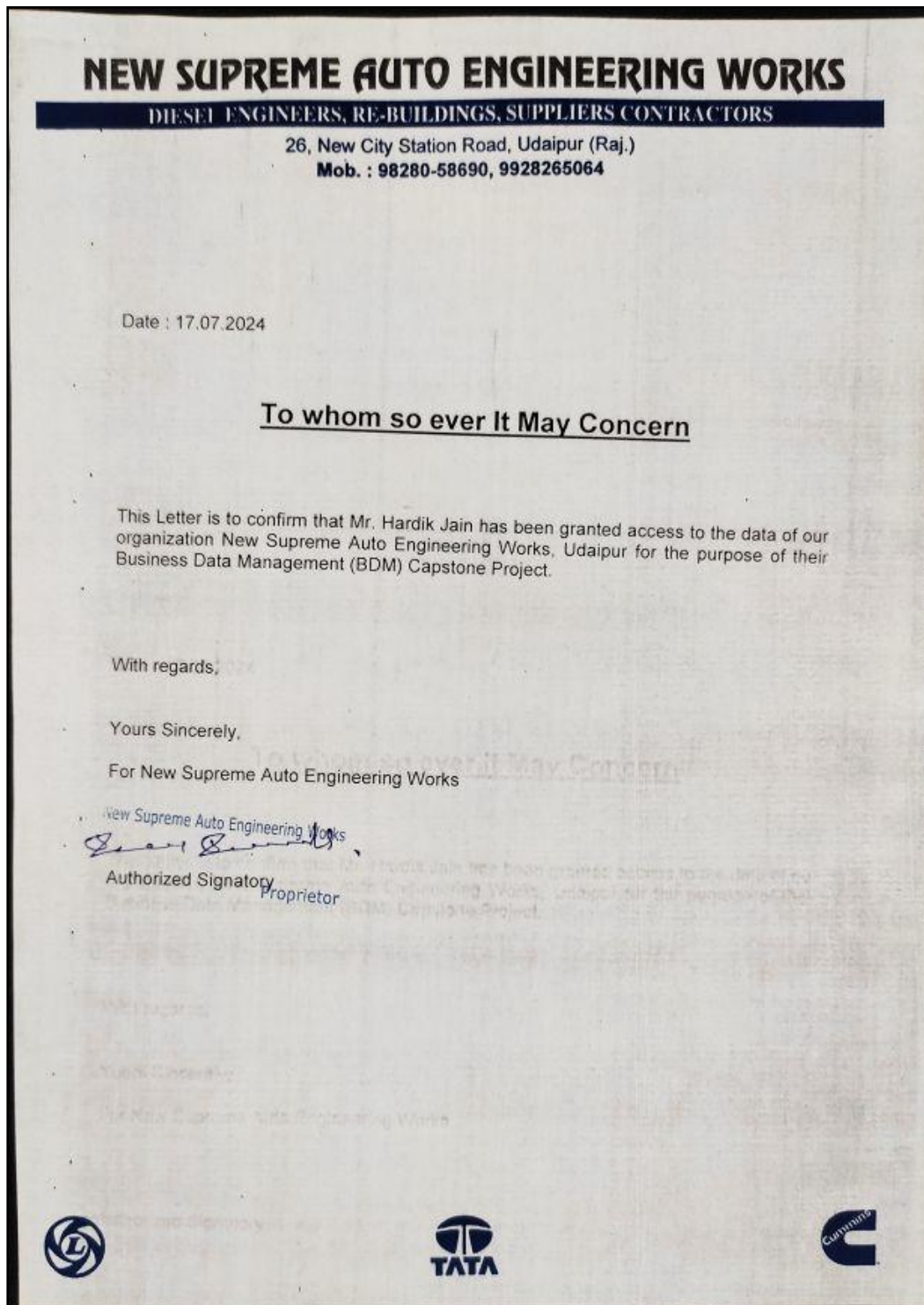
a) Photographs of Organization:

Photograph of Outlet

Photograph with Founder

Photograph of Internal Area

b) Letter from Organization:

NEW SUPREME AUTO ENGINEERING WORKS

DIESEL ENGINEERS, RE-BUILDINGS, SUPPLIERS CONTRACTORS

26, New City Station Road, Udaipur (Raj.)

Mob. : 98280-58690, 9928265064

Date : 17.07.2024

To whom so ever It May Concern

This Letter is to confirm that Mr. Hardik Jain has been granted access to the data of our organization New Supreme Auto Engineering Works, Udaipur for the purpose of their Business Data Management (BDM) Capstone Project.

With regards,

Yours Sincerely,

For New Supreme Auto Engineering Works

New Supreme Auto Engineering Works

Authorized Signatory Proprietor

c) Link to the Conversational Video:

https://drive.google.com/file/d/1isUxVl6loM-k0rqKlLYMcIYeoYI9vf6a/view?usp=drive_link

3   Metadata and Descriptive Statistics

The dataset comprises primary data gathered directly from New Supreme Auto's internal records, verified with the company founder. Following formal permission, structured stock data was provided for analysis.

This data is sourced from New Supreme Auto's inventory management system, covering a six-month period (from January 2024 to June 2024).

The stocks dataset includes 742 individual records with the following key variables used in the project:

Variable Name	Description
Particulars	The specific item or part name, often including the model or identification number.
Quantity_Opening_Balance	The quantity of the item available at the beginning of the period.
Rate_Opening_Balance	The per-unit cost of the item at the beginning of the period.
Value_Opening_Balance	The total value of the opening balance, calculated as Quantity * Rate.
Quantity_Inwards	The quantity of the item received during the period.
Rate_Inwards	The per-unit cost of the item received during the period.
Value_Inwards	The total value of inwards stock, calculated as Quantity * Rate.
Quantity_Outwards	The quantity of the item sold during the period.
Rate_Outwards	The per-unit price of the item sold during the period.
Value_Outwards	The total value of the outwards stock, calculated as Quantity * Rate.
Quantity_Closing_Balance	The quantity of the item available at the end of the period.
Rate_Closing_Balance	The per-unit cost of the item at the end of the period.
Value_Closing_Balance	The total value of the closing balance, calculated as Quantity * Rate.

Table 1: Stocks Data Fields

Particulars	Quantity_Opening_Balance	Rate_Opening_Balance	Value_Opening_Balance	Quantity_Inwards	Rate_Inwards	Value_Inwards	Quantity_Outwards	Rate_Outwards	Value_Outwards	Quantity_Closing_Balance	Rate_Closing_Balance	Value_Closing_Balance
00542/1 (Liner Kirlosker -1040....	12 Nos	651.43	7817.14	4 Nos	715.41	2861.62				16 Nos	667.42	10678.76
006002830A1 MAIN OIL SEAL(M&M AVL)...	4 Nos	242.83	971.31				1 Nos	220.33	220.33	3 Nos	242.83	728.48
02.422.40.00 Valves for Ha-294....	2 Set	414.19	828.37	4 Set	419.09	1676.34				6 Set	417.45	2504.71
0311aa Oil Seal Flywheel				1 Nos	938.03	938.03				1 Nos	938.03	938.03
05274/1(Piston Koel 4rv 1040)..	14 Nos	1038.50	14539.04	8 Nos	1199.20	9593.60	4 Nos	2109.38	8437.50	18 Nos	1096.94	19744.89
05277/1 Piston Jcb 106mm...	1 Set	9870.00	9870.00	1 Set	8772.59	8772.59				2 Set	9321.30	18642.59
06.631.02.0.00 Valve Seal. Ha-494...	42 Nos	71.76	3013.79	16 Nos	80.83	1293.30	8 Nos	84.25	674.00	50 Nos	74.26	3713.01
10021 /6 Piston Ring Bs 1v....				3 Set	4232.78	12698.33	1 Set	5312.50	5312.50	2 Set	4232.78	8465.55
1002 Tata 692 Sealing Ring ....(407)	15 Nos	119.32	1789.86				1 Nos	164.00	164.00	14 Nos	119.32	1670.54
1003 SEALING RING GLENN DORI (1612)...	24 Nos	94.00	2256.10	10 Nos	134.08	1340.80	3 Nos	214.85	644.54	31 Nos	105.79	3279.53
1003 Tata 697 Sealing Ring...	64 Nos	99.18	6347.64				3 Nos	195.31	585.92	61 Nos	99.18	6050.09
1003 Tata 697 Sealing Ring (1612)...	46 Nos	124.87	5744.14	19 Nos	131.25	2493.74	3 Nos	196.60	589.80	62 Nos	126.74	7857.67

Snapshot of Stocks Data

The company has not provided structured data on its servicing activities. However, through discussions with the company, I gathered information on the primary services they offer:

1. Dismantling and Cleaning: This involves disassembling parts or systems for detailed inspection, followed by the removal of grease, oil, and grime using specialized cleaning solutions or equipment.
2. Machining and Resurfacing: Precision tools such as lathes, grinders, or CNC machines are used to repair or resurface critical components like brake rotors, engine blocks, and crankshafts, restoring them to optimal specifications.
3. Parts Replacement and Rebuild: This focuses on replacing essential parts, such as bearings, seals, gaskets, valves, and springs, to restore components to full functionality.
4. Surface Treatment and Coating: This includes processes like painting and coating to protect parts from corrosion, as well as polishing and buffing to enhance the visual appeal and performance of visible components.
5. Assembly and Installation: This involves reassembling repaired or reconditioned parts with precision and installing them back into the vehicle to ensure they operate seamlessly within the system.

Each service has a variable duration, but a complete vehicle service, including full engine reconditioning, typically takes around 6-8 hours. The company employs four laborers, and the labor cost for servicing is ₹10,000.

Descriptive Statistics

The following descriptive statistics explores the key characteristics of the inventory data:

Metric	Rate_Opening_Balance	Value_Opening_Balance	Rate_Inwards	Value_Inwards	Rate_Outwards	Value_Outwards	Rate_Closing_Balance	Value_Closing_Balance
Mean	1823.599444	17232.95952	1968.339444	9218.864841	2486.610754	10802.08905	1727.779603	18410.02564
Standard Dev	3460.176822	39232.63198	3896.201226	17642.61869	3753.71586	27618.24144	3304.38507	35602.06616
Min	6.92	74.88	10.5	53.39	18.98	75	0	0
25% (Q1)	194.5075	1705.0375	235.82	1128.9975	471.3925	1557.355	206.1125	2371.53
50% (Median)	787	5111.365	853.775	3402.56	1525.435	3864.885	797.59	5961.24
75% (Q3)	2269.095	17136.8125	2140.795	9566.7575	3204.0975	10000	2062.1225	19725.6975
Max	33240.65	329903.44	33633.45	197508.64	39453.13	279155.74	33166.54	281618.69

Descriptive Statistics Measures

1. Wide Range in Item Costs
   The dataset reveals a broad range of item costs, from affordable parts to high-value components. For instance, Rate_Opening_Balance has a median of ₹787 but reaches a maximum of ₹33,240.65. This suggests that managing diverse inventory effectively is crucial for balancing cash flow and meeting customer demands.

2. Variation in Transaction Rates
   Rates across different transaction types reveal notable differences. Rate_Inwards has a mean of ₹1,968.34 and Rate_Outwards is higher, averaging ₹2,486.61, with standard deviations of ₹3,896.2 and ₹3,753.72, respectively. These high standard deviations suggest that rates for incoming and outgoing stock are not consistent, potentially due to fluctuating market conditions, supplier pricing, or variations in product categories.

3. Stock Value Variability
   The stock values show significant dispersion, as seen with Value_Opening_Balance, which has a mean of ₹17,232.96 and a high standard deviation of ₹39,232.63. The median (₹5,111.37) lies far below the mean, indicating a positively skewed distribution with some items carrying substantial value. The wide interquartile range (from ₹1,705.04 to ₹17,136.81) reinforces the need to manage higher-value items carefully, as they can disproportionately affect financial outcomes.

4. Outliers and High-Value Influences
   The maximum values for both Value_Opening_Balance (₹329,903.44) and Value_Closing_Balance (₹281,618.69) point to the presence of high-value outliers. With the relatively large spread observed in standard deviation, these outliers can significantly impact the inventory's total value and require regular monitoring. Focusing on these outliers may help optimize inventory turnover and improve cash flow management.

4 Detailed Explanation of Analysis Process and Method

The data analysis process began with data collection and preparation, utilizing New Supreme Auto's internal records from January to June 2024. The initial step involved thoroughly examining the data for inconsistencies, missing values, and outliers, which were addressed through data cleaning to ensure accuracy and consistency. This process created a reliable foundation for a deeper analysis of the inventory.

To gain a comprehensive understanding of New Supreme Auto's inventory management, descriptive statistics such as mean, median, standard deviation, and quartiles were calculated. These measures highlighted typical inventory levels, transaction rates, and variations in stock value over time, enabling us to identify fields with high variance that may indicate volatility in rates or stock values. This statistical overview provided an essential context for identifying trends and areas requiring further optimization.

A variety of visualization techniques were employed to facilitate data interpretation. Bar, box, and pie charts were chosen to represent key inventory metrics effectively. The bar chart compared average rates across different inventory stages (opening, inwards, outwards, and closing), offering insights into the organization's pricing strategy and potential areas for optimizing cash flow. Box plots displayed the distribution and variability in item costs and stock values, highlighting high-value outliers that disproportionately affect the inventory's financial value. The pie chart illustrated the proportions of inventory value across low, medium, and high-rate categories, emphasizing that a significant portion of inventory value resides in medium-priced items. Together, these visualizations offer meaningful insights into inventory composition and cost, guiding decision-making for more efficient inventory management.

To streamline inventory management, it is recommended that the organization regularly calculate key metrics like Economic Order Quantity (EOQ) and Safety Stock, especially during significant shifts in demand or changes in costs. EOQ helps determine the optimal order quantity that minimizes total inventory costs, including holding and ordering expenses, thereby reducing excess stock and avoiding stockouts. Safety Stock calculation, on the other hand, establishes an ideal buffer level to account for fluctuations in demand and supply chain delays, ensuring product availability and minimizing stockout risks.

During my conversation with the organization representative, we inferred that due to the high variety of products in the automobile parts industry, it is challenging to calculate and maintain EOQ and Safety Stock for each specific SKU. As a solution, the company plans to apply these calculations at the category level (e.g., based on product types or product families) rather than for individual items. This will allow New Supreme Auto to simplify inventory management while still maintaining optimal stock levels for each product category. By grouping products with similar demand patterns or characteristics, the company can ensure that their inventory remains responsive to fluctuations in demand, without overcomplicating the process of managing a diverse range of SKUs. This strategy helps reduce the risk of stockouts, optimize warehouse space, and streamline the ordering process—ultimately driving greater efficiency in their overall supply chain management.

5   Results and Findings

The analysis conducted on the stock data of New Supreme Auto Engineering Works revealed several important insights that have direct implications for the company's operations. The following sections summarize the key findings till now:
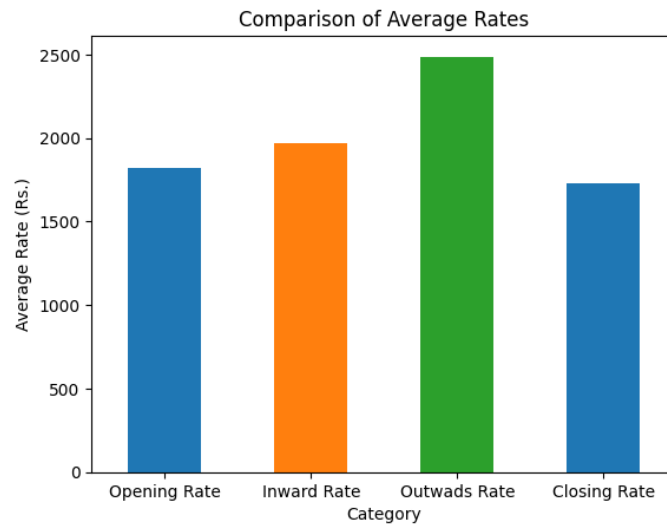
1. Comparison of Average Rates

Figure 1 Bar Chart for Rate Comparison

The outgoing (sales) rate is significantly higher than both the opening and inward rates, as illustrated in the bar chart (Figure 1), primarily because it includes the profit margin. This does not necessarily indicate an increase in market prices but reflects the organization's pricing strategy. For inventory management, this underscores the need to maintain an optimal balance between competitive pricing and profit margins.

The closing rate, which reflects the cost of unsold inventory based on opening and inwards rates, helps assess inventory value and cash flow. By reviewing this rate, the organization can identify slow-moving high-cost items and adjust procurement or pricing strategies to improve turnover and free up cash flow.
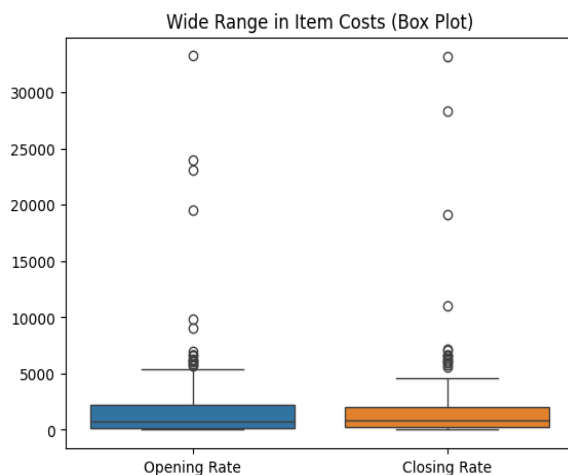
2. Item Cost Distribution and Stock Value Variability

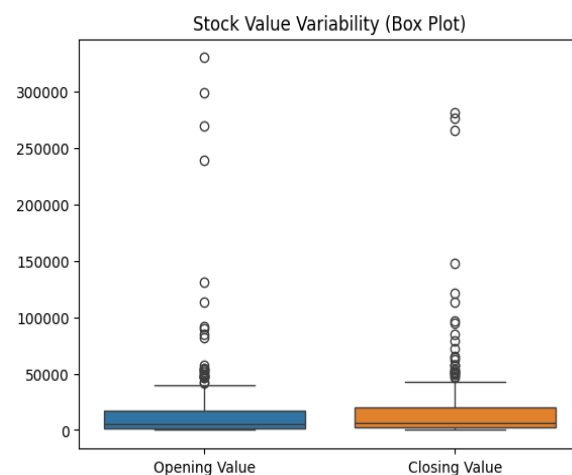*Figure 2 Box plot for Item Cost Distribution*   *Figure 3 Box plot for Stock Value Distribution*

The box plots for item costs (Opening and Closing Rates) in Figure 2 and stock values (Opening and Closing Values) in Figure 3 reveal significant variability within the inventory. For item costs, we observe a wide range with numerous high-value outliers, where some rates exceed 30,000. This indicates that the inventory includes both affordable and premium items. Similarly, the stock value distribution exhibits considerable variability, with a few high-value items that exceed 300,000, indicating that a small subset of items accounts for a substantial portion of the inventory's financial value.

3. Proportions of Value by Rate Category
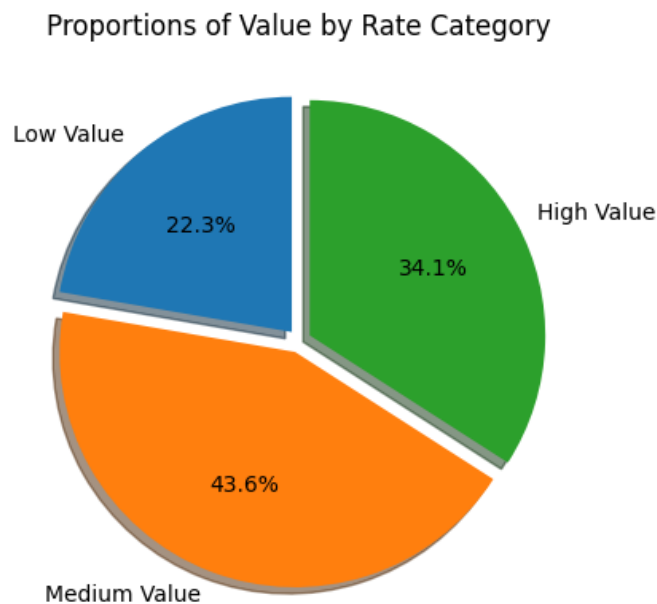
Figure 4 Proportions of Value by Rate Category

The pie chart (Figure 4) showing the "Proportions of Value by Rate Category" highlights the distribution of stock values across three rate categories: Low, Medium, and High.

1) **Low Value (22.3%)**: Items in this category are priced below 1,000, representing a smaller portion of the total inventory value. While they may not contribute significantly to the total value, these items could have higher turnover and may be essential for meeting day-to-day customer demands.

2) **Medium Value (43.6%)**: The majority of stock value falls within the medium rate range (1,000 to 5,000), indicating a balanced portfolio with moderately priced items. This category likely includes commonly purchased items that maintain a balance between affordability and profitability, serving as a core component of the inventory.

3) **High Value (34.1%)**: A substantial portion of the inventory value comes from items priced above 5,000. Although these items form a smaller portion of the overall inventory by count, they account for a significant share of the value. Effective management of these

10

high-value items is crucial for optimizing cash flow, as they may have lower turnover rates but greater financial impact.

In summary, the study revealed substantial variability in item costs and transaction rates, with high-value outliers playing a significant role in the inventory's financial structure. The rate analysis indicates an opportunity to optimize procurement and pricing strategies, particularly for high-cost, slow-moving items. Additionally, categorizing stock by value range highlighted that medium-value items form the core of the inventory, balancing affordability and profitability. Moving forward, the final report will delve deeper into optimizing order quantities and exploring other strategies to enhance inventory and service efficiency.