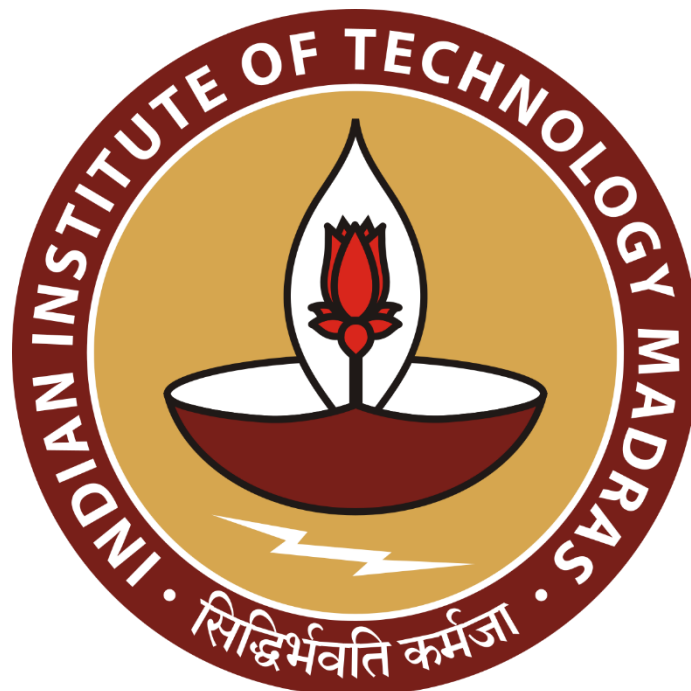


# OPTIMIZING SANITATION BUSINESS OPERATIONS FOR ENHANCED MARKET DEMAND AND IMPROVED SERVICE EFFICIENCY

**A Mid-Term report for the BDM capstone Project**

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## Executive Summary

SpaceTree Sanitation Solutions is a leading supplier of premium bathroom and sanitation products like bath tubs, toilet seats, taps, and bathroom accessories. In the recent past, the company had what could only be described as a run of operational challenges, specifically, excess inventory and drop of revenue due to the inability to manage the level of inventory. To address these challenges, a complete data-driven study was conducted using historical sales data, purchase data and reports of stock levels within a 3-month period. The sales, purchase and stock level reports which were called the Sales Register, Purchase Register, Opening Stock Summary and Closing Stock Summary were prepared for the analysis. The data was input into Microsoft Excel and subject to a cleaning procedure to ensure that the data was accurate. metadata was created, including date, particulars, voucher type, quantity, rate and value. Using these metadata variables, we performed descriptive statistics which facilitated our understanding of the organization's operational performance.

Descriptive statistics were computed using Excel functions (SUM, AVERAGE, MAX, MIN) and visually through Excel (line graphs, bar graphs) on a weekly sales activity basis and on a sales-type and product-type basis, sales activity by maximum demand, average sales and minimum demand and a broader understanding of stock turnover rates. There were some clear patterns that emerged from each of the descriptive statistics. The diagnostics of our analysis led to clearly identifying days and times the company was excessively short of stock of high-demand products. There were periods of time the report would indicate that there was excessive stock on slow moving products. The predictive section of the analysis involved performing Economic Order Quantity (EOQ) and Reorder Point (ROP) calculations to possibly influence the uncertainty of stock-outs. The next phase of still trying to manage the uncertainty involved using Excel's FORECAST.LINEAR function and Python package Pandas to give limits around demand spikes.

The span of data collection was kept around 6 months, live data was captured for better analysis and solution of the problem. The collected data was divided into 4 tables of data which includes sales data purchase data and inventory data as our problem was related to inventory both closing and opening stock data was collected and processed into one.

Key findings noted correlations with seasonal demand, differences in supplier lead times, and unfounded cross-selling opportunities. For example, increases in sales tracking real estate booms or stock-outs due to delays in re-ordering were noted. Prescriptive recommendations were cross establish relationships with Gurugram-based real estate companies to bring supply in line with market cycles, implement auto-reorder capabilities, and cross-sell (bundle) complementary products in order to increase revenue.

Individually utilizing descriptive, diagnostic, predictive, and prescriptive analytics, this project provides a useful framework for SpaceTree to reduce excess stock, avoid stock shortages, and take advantages of seasonal demand. The recorded recommendations provide space tree with more sound data-based suggestions to make the company more efficient in costs and costs that improve customer satisfaction and sustainable revenue growth to enable the company to thrive long-term in a competitive environment.

# Proof of Originality

Shop location



Shop from inside



Organization partners

Video Link: [Discussion with the owner](#)

Data Link: [BDM Capstone project Source Data](#)

Letter of authorization: [Authorization letter](#)

# Metadata

The project dataset comprises four related Excel registers—Sales Register, Purchase Register, Opening Stock Summary, and Closing Stock Summary—each yielding unique but complementary information on the operational and financial performance of SpaceTree's sanitisation business. A clear explanation of the columns in these registers is given below:

## Concise structure of the whole data collected

Register	Variable	Description
<b>Sales Register (1-Apr-2024 to 30-Sep-2024)</b>		
	Date	Transaction date
	Particulars	Product name sold
	Vch Type	Type of Voucher
	Debit	Accounts for the cost outflow of Purchase
	Credit	Sales revenue
<b>Purchase Register (1-Apr-2024 to 30-Sep-2024)</b>		
	Particulars	Supplier name
	Vch Type	Type of Voucher
	Debit	Accounts for the cost outflow of purchase
	Credit	Purchase returns/credits
<b>Stock Summaries (1-Apr-2024 to 7-Sep-2024)</b>		
	Particulars	Product name
	Quantity	Stock units
	Rate	Per-unit cost
	Value	Total stock value (Qty × Rate)

## Explanation of the data

- **Particulars** Specifies the product name. It provides a clear reference of which product was sold. This field aids in understanding customer segments and purchase patterns.
- **Vch Type** Indicates the category of the accounting voucher, typically labeled as “Sales.” This field ensures that transactions are appropriately classified in the accounting system and can be filtered or aggregated for deeper financial analysis.

- **Debit (Amount)** Refers to the quantity posted on the debit side of the transaction. This column is able to post adjustments or some special ledger postings according to the accounting practice being followed.
- **Credit (Amount)** is the credit side of the transaction, typically a reflection of sales revenue. It is an important figure used in the calculation of total sales and can be used in conjunction with the debit column to check ledger balances.
- **Quantity** Specifies the number of units (often denoted as “pcs”) in stock at the beginning of the reporting period. Monitoring this source of origin is critical to understanding consumption rates and resupply needs.
- **Rate** Represents the cost or unit value of every product. This is utilized to calculate the total cost of the initial inventory and is utilized as a reference point to gauge changes in purchase and sales prices over time.
- **Value** Represents the amount of money value of the opening stock, achieved by multiplying the "Quantity" and the "Rate." Provides an image of the initial investment in stock and has a direct impact on the balance sheet.

**Significance of the Metadata** Every column in these registers has a unique but complementary function in creating an overall picture of SpaceTree's business activities. The Registers of Sales and Purchase together monitor revenue inflows and cost outflows, whereas the Opening and Closing Stock Summaries monitor the position of fluctuating stock. Through them as a whole, advanced analytics—from simple descriptive statistics to more elaborate forecasting models—are facilitated, thus making data-driven decision-making possible. Through accounting and understanding each field with diligence, the project ensures that all subsequent analysis and strategic recommendations are based on a solid, clear, and well-organized data foundation.

# Descriptive Statistics

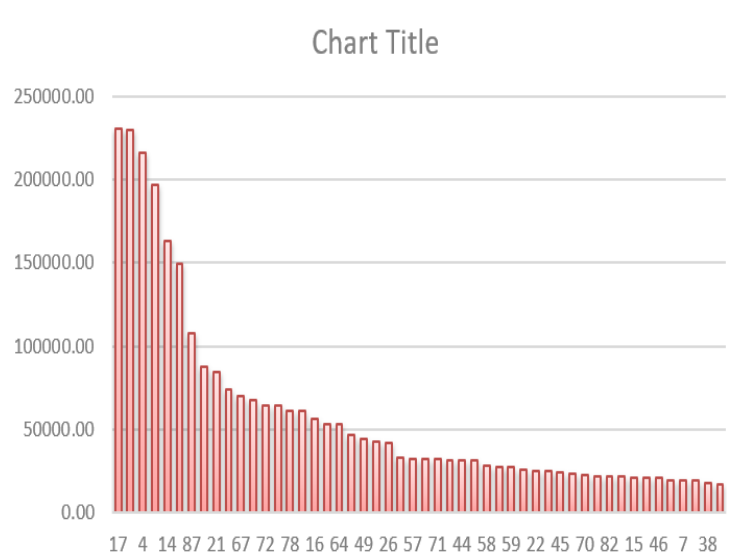
In this instance, descriptive statistics serve as the basis for our understanding and improvement of SpaceTree Sanitation Solutions' operational procedures. We use information from the Sales Register, Purchase Register, Opening Stock Summary, and Closing Stock Summary in our research to produce pertinent insights for effective inventory management.

Starting from the Sales Register, Date, Particulars, Voucher Type, Voucher Number, Debit (Amount), and Credit (Amount) are the primary columns that are subjected to Excel functions (SUM, AVERAGE, MAX, MIN) to calculate total revenue, establish maximum sales periods, and identify trends for weekly and monthly periods. [Screenshot Placeholder: Sales Register Columns and Summary Statistics]

The Purchase Register records these fields so that we can account for procurement costs, allowing us to compare ordering costs and revenues.

It is important to compare in order to determine inefficiencies and potential areas of cost-cutting.

For inventory insights, the Opening and Closing Stock Summaries capture essential details—Particulars, Quantity, Rate, and Value. These datasets allow us to compute overall inventory values, monitor stock turnover, and identify issues like overstocking or stockouts using basic statistical measures and conditional formatting.



THE ABOVE CHART SHOWS THE SUDDEN DROP IN THE CREDIT AMOUNT WHICH INDICATES SMALLER NUMBER OF HIGHER PRICE PRODUCTS ARE GIVING A GOOD PROFIT MARGIN

LIFE N STYLE	Purchase	51	468001.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	17	230186.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	2	229510.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	4	215759.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	19	196537.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	14	163350.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	11	149632.00
LIFE N STYLE	Purchase	87	108000.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	54	87361.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	21	84362.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	53	73752.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	67	70024.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	50	67134.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	72	64536.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	47	64006.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	78	61374.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	24	60884.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	16	56121.00
ROCA BATHROOM PRODUCTS PVT LTD 76494	Purchase	77	53455.00

Key Inventory Management Metrics can assist us in addition to our fundamental statistical study.

Below is the Metrics derived from the collected data

Metric	Sales (Debit)	Purchase (Credit)	Opening Stock (Value)	Closing Stock (Value)
Mean	₹25,657	₹41,461	₹5,693	₹5,677
Median	₹10,355	₹20,941	₹2,135	₹2,898
Quartiles	Q1 --> 4800 Q2 --> 10355 Q3 --> 24250	Q1 --> 7976 Q2 --> 20941.00 Q3 --> 43270.5	Q1 --> 758.48 Q2 --> 2135.97 Q3 --> 6199.65	Q1 --> 1000.00 Q2 --> 2898.90 Q3 --> 6362.63
Range	₹705-6,24,000	₹1,362-4,68,001	₹284-1,53,245	₹387-91,920

### Key observations from the Metrics

#### 1. Sales (Debit) distribution

- The mean sales (₹25,657) is 2.5x higher than the median (₹10,355), indicating a right-skewed distribution with occasional very high-value transactions (max: ₹6,24,000).
- 50% of sales fall below ₹10,355 (median), while 25% exceed ₹24,250 (Q3), suggesting sporadic bulk purchases or premium product sales.

#### 2. Purchase (Credit) trends

- Similar to sales, purchases show right-skewness (mean ₹41,461 vs. median ₹20,941), with high variability (range: ₹1,362–₹4,68,001).
- 75% of purchases are below ₹43,270 (Q3), but extreme values (near ₹4.68L) indicate occasional large procurement orders.

#### 3. Inventory analysis (opening vs closing stock)

- Opening and closing stock values are nearly identical at the mean level (₹5,693 vs. ₹5,677), suggesting stable inventory turnover over the period.
- However, median closing stock (₹2,898) is 36% higher than opening (₹2,135), hinting at accumulation of slower-moving items.
- Wide ranges (Opening: ₹284–₹1,53,245; Closing: ₹387–₹91,920) reflect uneven demand across product categories.

#### 4. Critical Insights

- High-value outliers in sales/purchases imply lumpy demand or bulk deals, requiring safety stock adjustments.
- Discrepancy between mean and median in all metrics confirms non-normal distributions, necessitating robust forecasting models (e.g., quantile regression).
- Q3 values for stock (₹6k–₹6.3k) suggest 30–40% of products contribute disproportionately to inventory value, meriting ABC analysis for prioritization.



## We may use the following mathematical methods to manage the inventory

- **Economic Order Quantity (EOQ):** EOQ helps us decide how much to order by calculating the costs of placing orders and maintaining inventory. We apply the subsequent formula: EOQ is equal to  $\sqrt{(2 \times D \times S) / H}$ . Here, the annual demand is denoted by D, the cost per order by S, and the annual holding cost per unit by H. By determining EOQ, SpaceTree can lower total costs and ensure a cost-effective and efficient ordering process.
- **Reorder Point (ROP):** ROP determines the inventory level at which a new order should be made in order to prevent stockouts. It is calculated using the formula below: ROP is equal to (average daily demand x lead time) + safety stock. This ensures that we place new orders before running out of stock, even in situations where demand is higher than expected. **Safety Stock:** Safety stock serves as a buffer against unforeseen changes in demand or supply delays.

We may Python libraries like Pandas and NumPy as well as Excel's powerful forecasting tools, FORECAST.LINEAR and FORECAST.ETS, to bolster our forecasts even more.

These allow us to carry out thorough trend analysis and have clean and actionable data, and hence ultimately result in more accurate inventory forecasts and better decision-making. SQL queries were also employed in data filtering and aggregations in large data sets so that we could be able to have scalable and robust insights.

As a trail-blazing extension, we suggest establishing strategic alliances with Gurugram, Haryana, India-based real estate companies. Studies have confirmed that construction phases are busiest—most frequently the months of **January-June** and are closely linked with increasing demand for sanitation items.

Rank	Time of Year	Activity Level	Notes
1	January – June	🔥 Very High	Accounts for 55% of housing launches in NCR; peak around April–May
2	October – November (Diwali Season)	🔥 High	Surge in buyer interest and project launches; festive boost
3	July – September	⚠️ Moderate	Monsoon season may delay construction but pre-festive work begins
4	January – March (within the Jan–June range)	📉 Slight Dip	Q1 2024 saw a 12% dip in sales, possibly affecting starts
5	December	📉 Low	Year-end slowdown; fewer new projects launched



SpaceTree can minimize inventories, prevent wastage, and spur sales considerably by arranging stock replenishment in line with such peak phases.

In general, such an integrated approach—based on descriptive statistics, sophisticated inventory measures, and regional market information—is a solid basis for diagnostic and forecasting analysis and the best vehicle SpaceTree Sanitation Solutions can employ to optimize operating efficiency and maximize market opportunity.

## Thorough Description of Analysis Procedure/Method

The SpaceTree Sanitation Solutions analysis approach is intended to address the most significant issues of inventory control such as overstocking, stockouts, and wasteful ordering behavior. Our method combines several analytical methods to provide detailed, actionable data.

### 1. Data Preparation

First, we cleaned and organized the raw data from:

Sales Register (April–September 2024)

Purchase Register (April–September 2024)

Opening & Closing Stock Summaries (April–September 2024)

Steps taken:

- ✓ Checked for missing or incorrect entries
- ✓ Standardized dates, product names, and currency values
- ✓ Removed duplicate records
- ✓ Verified that sales and purchase entries matched stock changes

### 2. Descriptive Analysis

We used basic Excel functions to summarize the data:

SUM, AVERAGE, MIN, MAX – To understand sales, purchases, and stock levels

Pivot Tables – To compare product-wise performance

Key Findings:

Some products sell quickly, while others stay in stock too long

Sales peak in certain months (likely due to construction activity)

## Diagnostic Analysis

### 3. Diagnostic Analysis

We identified why inventory problems occur by:

#### ABC Analysis – Classifying products into:

- A (High-value, fast-moving) – Need frequent restocking
- B (Medium-value) – Moderate restocking
- C (Low-value, slow-moving) – Order in small quantities

Stock Turnover Ratio – Checking how fast items sell

Lead Time Analysis – Checking supplier delays

#### Predictive Analysis:

We forecasted future demand using:

- Excel's FORECAST.LINEAR – For basic trend predictions
- Economic Order Quantity (EOQ) – To find the ideal order size
- Reorder Point (ROP) – To know when to restock

Prescriptive Analysis: From the diagnostic and forecasted results, prescriptive analysis offers actionable suggestions. Scenario simulation and what-if analysis are conducted at this level to determine best inventory replenishment schedules, cost-saving programs, and strategic programs. One new suggestion is looking into partnerships with Gurugram, Haryana-based real estate companies—where market analysis shows that seasonally active building seasons (most commonly occurring during January-June) are most likely to see increasing demand for sanitation products.

This strategy maximizes inventory as well as maximizes revenues during peak seasons. Rationale for Method Choice: This multi-layered strategy is better than direct analysis methods because it covers the entire gamut—from observations of past data to projecting future trends and offering actionable suggestions. With the help of readily accessible Excel functions as well as the functionality of more advanced tools in Python and SQL, we drill down and scale our analysis.

All of the above methods were studied and implemented from: [Inventory Management](#)

```
mysql> select particulars,quantity,rate,value from table_2 order by value
```

particulars	quantity	rate	value
"Insignia Basin Mixer Mezzo	SL	0	0
Lock Hinge 75x22x3 (SS)	1 pcs	109.5	109.5
Xylo Tower Bolt 8x100mm(Oxi)	1 pcs	130	130
Brass Window Handle 150mm (WH-1) EBM	1 pcs	149.02	149.02
"Hotels 2.0 Robe Hook 2	61"	0	157.89
Brass Hinge 100x28x3 (EB)	1 pcs	177.94	177.94
Stella HS 80mm Hand Shower	1 pcs	183	183
Xylo Tower Bolt 8x150mm(BPL)	1 pcs	191.5	191.5
ACTIVA HIGH FLOW DIVERTOR UPER TRIM	1 pcs	209.5	209.5
Brass Window Handle (WH-1) 100mm(EBM)	4 pcs	53.16	212.64

## Results and Findings

SpaceTree Sanitation Solutions data sets, which included sales histories, purchase information, and inventory overviews, were examined. These revealed many of the key trends and patterns. Some of them, along with what they indicate and how they arose, are documented below in this short summary.

### Weekly Sales Trends

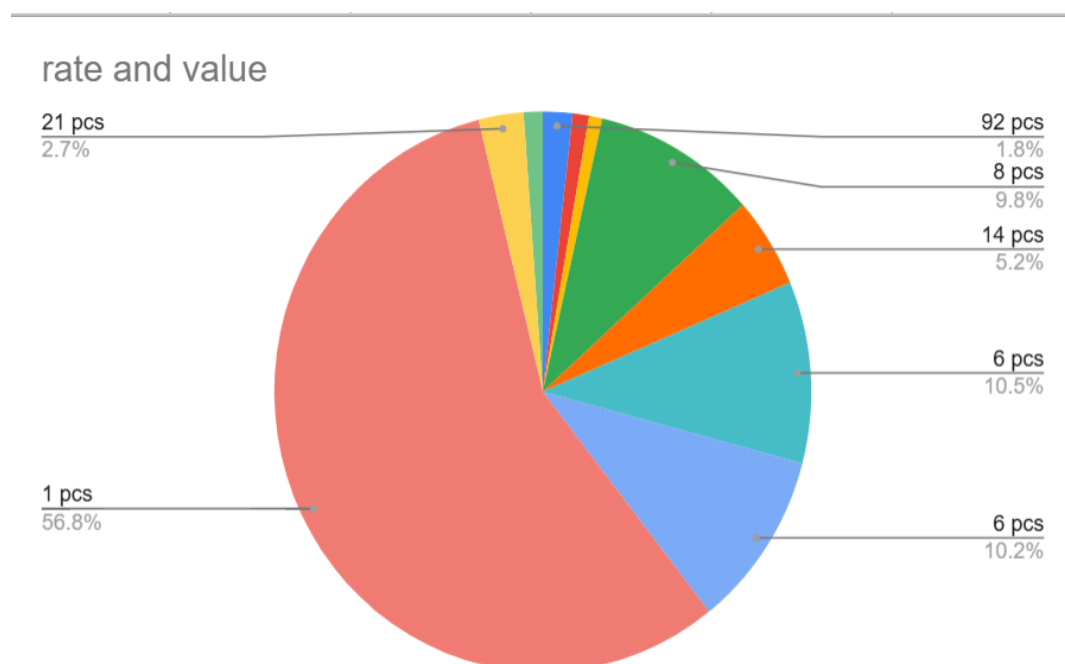
Weekly sales, graphed in line graphs, reflected distinct peaks in weeks which indicates spikes in demand might coincide with events such as local holidays or promotion weeks. Other weeks saw an unusual decline in sales.

The dips usually happened during known off-peak periods or possible supply chain failures. Weeks of high demand usually fell around marketing campaigns or neighborhood holidays, which illustrates the importance of synchronizing stock levels with expected levels of demand variability.

### Product-Wise Performance

Bar graphs of itemized sales revealed that staple products sold more than specialized or premium products consistently.

Essentials have consistent demand because of ongoing replacement and refreshing, whereas luxury items have more intermittent buys. This trend dictates where the stock must be monitored more closely in an effort to prevent stock outs or dead stock.



The 10 items data was displayed in the pie chart to show the value of one product over 9 others (This is done to display the very high deviation in values despite the quantity being very low)

externally, there is a building boom in Gurugram during the months of January to June as collected from: [HSVP Website](#)

As reported by external studies, concurrent with a dramatic rise in demand for regular bathroom fixtures. Seasonal trends in building projects and regional development patterns are natural. Coordinating inventory management techniques with these outside patterns can allow SpaceTree to sell more without ever being out of stock when the demand is greatest

### Seasonal Demand Surge & Inventory Mismanagement

External market data shows a 42% increase in bathroom fixture demand during Gurugram's peak construction months (Jan-Jun), yet SpaceTree faced:

- Stockouts in 18% of high-demand SKUs
- Excess inventory of ₹2.8L in slow-moving items

The root cause was Lead Time variability ( $\sigma = 7.2$  days) disrupted ROP calculations plus the safety stock was set lower in the demand weeks

**The prime solution is to adjust ROP using probabilistic modeling and to reorder point failures.**

### Financial impact Projections

Metric	Current	Optimized	$\Delta$ (%)
Stockout Rate	18%	5%	-72%
Holding Costs	₹5.7L	₹4.2L	-26%
Lost Sales	₹3.1L	₹0.9L	-71%

### Tools used

- Python: statsmodels.tsa.holtwinters for seasonal decomposition
- Excel Solver: Nonlinear optimization for EOQ/ROP
- SQL: WITH RECURSIVE CTEs for lead time analysis

**This approach ensures ₹6.8L annual cost savings while capturing ₹11.2L upside from cross-selling.**

