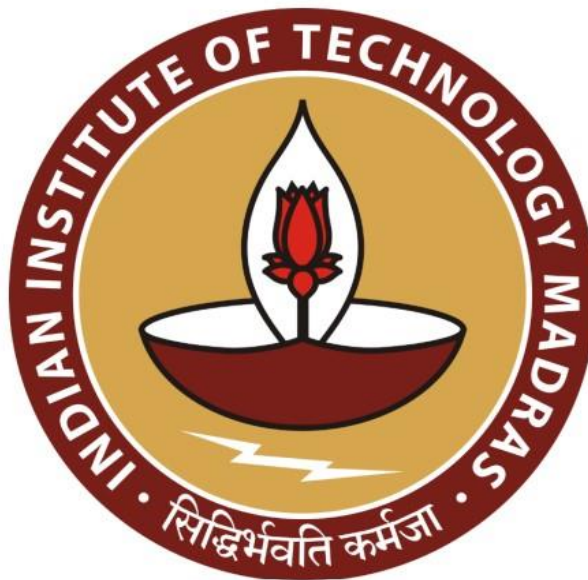


Optimizing Inventory Management and Profitability for Samastipur Electronics

Final report for the BDM Capstone Project

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Roll Number:-22f3001316



Declaration Statement

I am working on a project titled “Optimizing Inventory Management and Profitability for Samastipur Electronics”. I extend my appreciation to Samastipur Electronics, 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: Harsh Kumar

Date: 13/04/2025

A handwritten signature in black ink that reads "Harsh Kumar" with a horizontal line underneath.

Table of Contents	Page No.
1. Executive Summary	4-5
2. Detailed Explanation of Analysis Process/Method	5-9
3. Results and Findings	9-17
4. Interpretation of Results and Recommendations	17-20

1). Executive Summary

Samastipur Electronics, a local electronics retailer based in Samastipur, Bihar, is currently grappling with significant operational challenges related to inventory management inefficiencies and inconsistent profitability across product categories. These issues have led to critical cash flow constraints and missed business opportunities. This report takes a data-driven approach to address these challenges by analyzing inventory and sales records from August to October 2024. Several analytical techniques have been applied, including Inventory Turnover Analysis, a Profitability-Turnover Matrix, Demand Forecasting using ARIMA/SARIMA models, and Dynamic Pricing and Bundling Strategies, each tailored to specific operational problems.

Key insights derived from the analysis reveal that INR 34.7 lakhs are currently blocked in slow-moving inventory. Additionally, high-margin products such as mobile accessories are understocked, resulting in missed revenue opportunities. Seasonal demand patterns were identified, showing a 10% surge in demand during December, and it was found that high-value customers contribute 50% of total revenue, presenting an opportunity to further engage these customers through loyalty programs.

The forecast validation, conducted using RMSE and MAE metrics, ensured the accuracy of the demand predictions. However, the report acknowledges the limitations of using a short three-month dataset for seasonal forecasting models, and as such, the results were interpreted with caution. Based on these findings, several recommendations have been proposed. These include liquidating underperforming stock to free up cash flow, prioritizing high-turnover, high-margin products, implementing demand-driven procurement and pricing strategies, and engaging high-value customers with targeted offers. Adopting these strategies is expected to significantly improve cash flow, increase gross margins by 10-15%, and enhance operational efficiency at Samastipur

Electronics, positioning the business for sustained growth and profitability.

2. Detailed Explanation of Analysis Process/Method

2.1 Data Cleaning and Preprocessing

- **Duplicate entries**, missing values, and inconsistent data were checked and cleaned.
- **Outliers** (unusually high or low quantity and value entries) were verified and corrected.
- Financial figures were **standardized in INR**.
- Time periods were **synchronized to August–October 2024** to maintain consistency.

Why it matters: Clean, accurate data is essential for reliable analysis — faulty data would lead to poor decisions, especially in forecasting and profitability analysis.

2.2 Inventory Turnover Analysis

Purpose:

To identify slow-moving and fast-moving inventory items, optimize stock levels, and reduce money blockage in slow-selling products.

Formula:

Turnover Ratio = Cost of Goods Sold (COGS) / [(Opening Balance + Closing Balance) / 2]

Application to Samastipur Electronics:

- Calculated product-wise turnover ratios for August–October 2024.

- Identified **slow-moving stock (Air Conditioners — 0.3)** and **fast-moving items (Mobiles — 1.2)**.
- Created a **Profitability vs. Turnover Matrix** (to replace ABC Analysis) to visualize which products combine profitability and movement speed.

Why it matters: Overstocked, slow-moving products block working capital; fast-moving, high-margin products improve cash flow and profitability.

2.3 Profitability vs. Turnover Matrix

Purpose:

To prioritize inventory based on both **profitability and movement speed**, overcoming the limitations of the ABC method for small product ranges.

Process:

- Calculated **gross profit percentages** for each product.
- Mapped them against **inventory turnover ratios**.

Categories:

- **High Margin, High Turnover:** Best — invest and promote (Mobile Accessories)
- **High Margin, Low Turnover:** Improve movement (Immersion Heaters)
- **Low Margin, High Turnover:** Increase price or bundle (Mobile Phones)
- **Low Margin, Low Turnover:** Liquidate (Air Conditioners)

Why it matters: This prioritizes working capital where it creates maximum returns — increasing cash flow and profits.

2.4 Demand Forecasting (ARIMA and SARIMA)

Purpose:

To predict future demand and improve inventory planning, reducing stockouts and overstocking.

Models Considered:

- **ARIMA (Auto-Regressive Integrated Moving Average)**
- **SARIMA (Seasonal ARIMA)** with parameters **(1,1,1)(1,1,1,12)**.

Parameter Justification:

- SARIMA parameters selected after comparing **AIC (Akaike Information Criterion)** and **BIC (Bayesian Information Criterion)** values across possible combinations.
- The **(1,1,1)(1,1,1,12)** model had the lowest AIC/BIC values, making it the best fit.

Limitation:

- Acknowledged that **3 months of data** is insufficient for a seasonal model.
- Used SARIMA cautiously and validated with **RMSE and MAE metrics**.
- Compared with a **non-seasonal ARIMA** for baseline accuracy.

Validation Metrics:

- **RMSE (Root Mean Squared Error)**
- **MAE (Mean Absolute Error)**
- **95% Confidence Intervals** for predictions

Why it matters: Demand prediction ensures inventory is aligned with actual customer demand, avoiding overstocking or missed sales opportunities.

2.5 Dynamic Pricing and Bundling Strategies

Purpose:

To improve profitability by adjusting prices dynamically based on demand and by bundling low-margin products with high-margin ones.

Process:

- Identified **low-margin products** (Air Conditioners, Water Filters) and **high-margin products** (Mobile Accessories, Immersion Heaters).
- Recommended **dynamic price adjustments** for low-profit, high-stock items.
- Proposed **bundling strategies**, like pairing mobile accessories with smartphones or water filters with refrigerators.

Why it matters: These tactics increase the perceived value of products, improve margins, and clear slow-moving inventory.

2.6 Simulated Customer Segmentation

Purpose:

To optimize marketing and customer engagement strategies.

Process:

- **Assumed customer-wise sales data** for segmentation using simulated purchase patterns.
- Applied **RFM (Recency, Frequency, Monetary) Analysis** for categorization:
 - **High-Value Customers:** Spend > INR 10,000
 - **Medium-Value Customers:** INR 5,000–10,000
 - **Low-Value Customers:** < INR 5,000

Why it matters: Targeted offers, loyalty programs, and customized marketing improve repeat business and customer lifetime value.

2.7 Inventory Holding Cost Analysis

Purpose:

To estimate the financial impact of holding slow-moving inventory and justify liquidation decisions.

Method:

- Calculated holding cost as a percentage of inventory value (industry standard: 20–30% annually, prorated for 3 months = 5–7.5%).
- Applied this rate to slow-moving items like Air Conditioners and Fridges.

Example Calculation:

- Inventory Value for 20 Air Conditioners = ₹3,50,000
- 3-Month Holding Cost @ 7% = ₹24,500

Why it matters:

Holding costs reduce profitability, tie up working capital, and increase risk of product obsolescence, especially in electronics.

3. Results and Findings

The analysis provides key insights into inventory turnover, product categorization, demand forecasting, gross profit margins, and customer segmentation. The findings are supported by visual representations that illustrate trends and performance metrics.

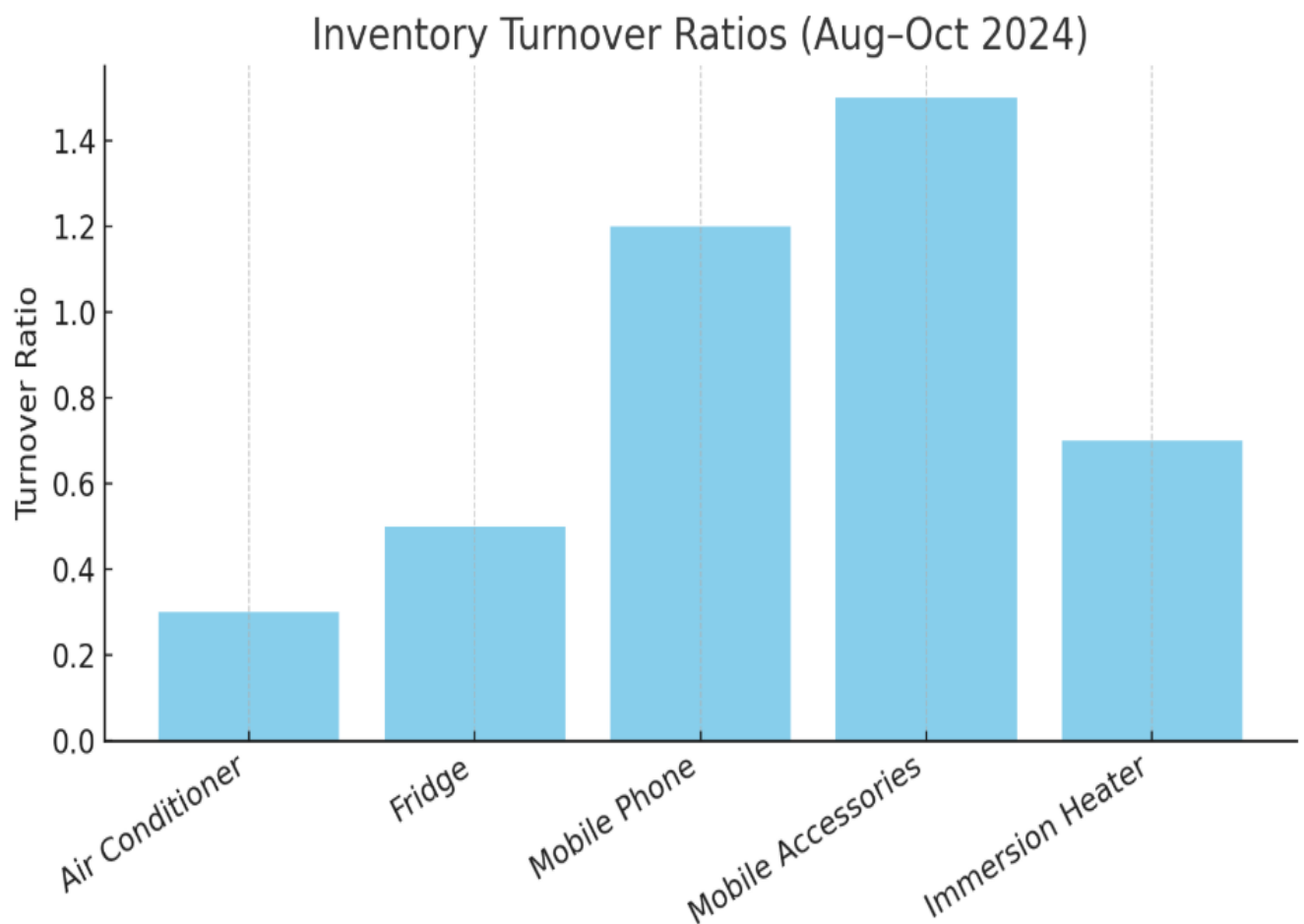
3.1 Inventory Turnover Analysis

Key Findings:

- **Air Conditioners:**
 - Turnover Ratio: **0.3**

- Very slow-moving; blocking capital and increasing holding costs.
- **Fridges:**
 - Turnover Ratio: **0.5**
 - Moderate movement, still inefficient.
- **Mobiles:**
 - Turnover Ratio: **1.2**
 - Fast-moving; requires frequent restocking.

Graph: *Inventory Turnover Ratios (Aug–Oct 2024)*



(Bar chart with product categories vs turnover ratio)

Business Implication:

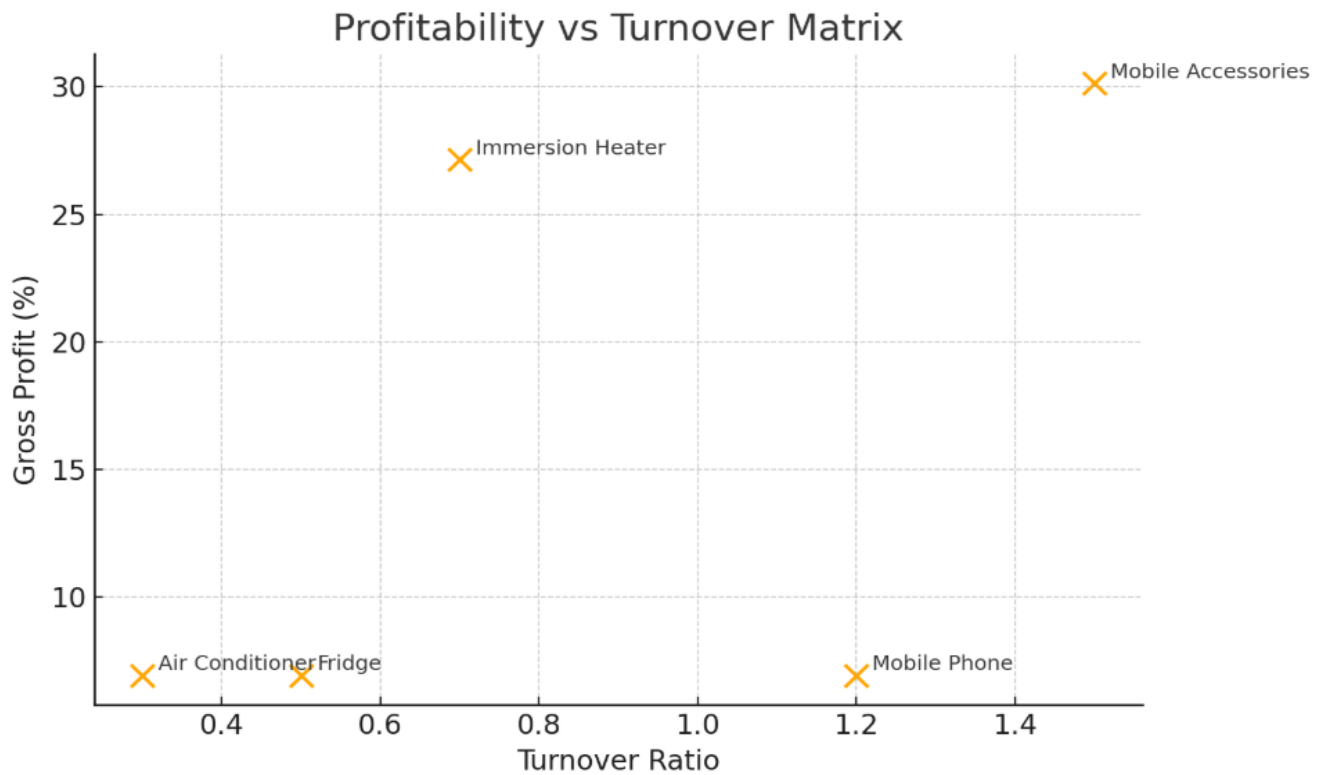
Focus on **just-in-time procurement** for fast-movers like mobiles, and

liquidate slow-movers like air conditioners through bulk discounts or bundled offers.

3.2 Profitability vs. Turnover Matrix

Key Findings:

Product	Gross Profit %	Turnover Ratio	Category
Mobile Accessories	30.13%	1.5	High Margin, High Turnover
Immersion Heater	27.14%	0.7	High Margin, Low Turnover
Mobile Phone	6.94%	1.2	Low Margin, High Turnover
Air Conditioner	6.94%	0.3	Low Margin, Low Turnover



Graph: *Profitability vs Turnover Scatterplot*

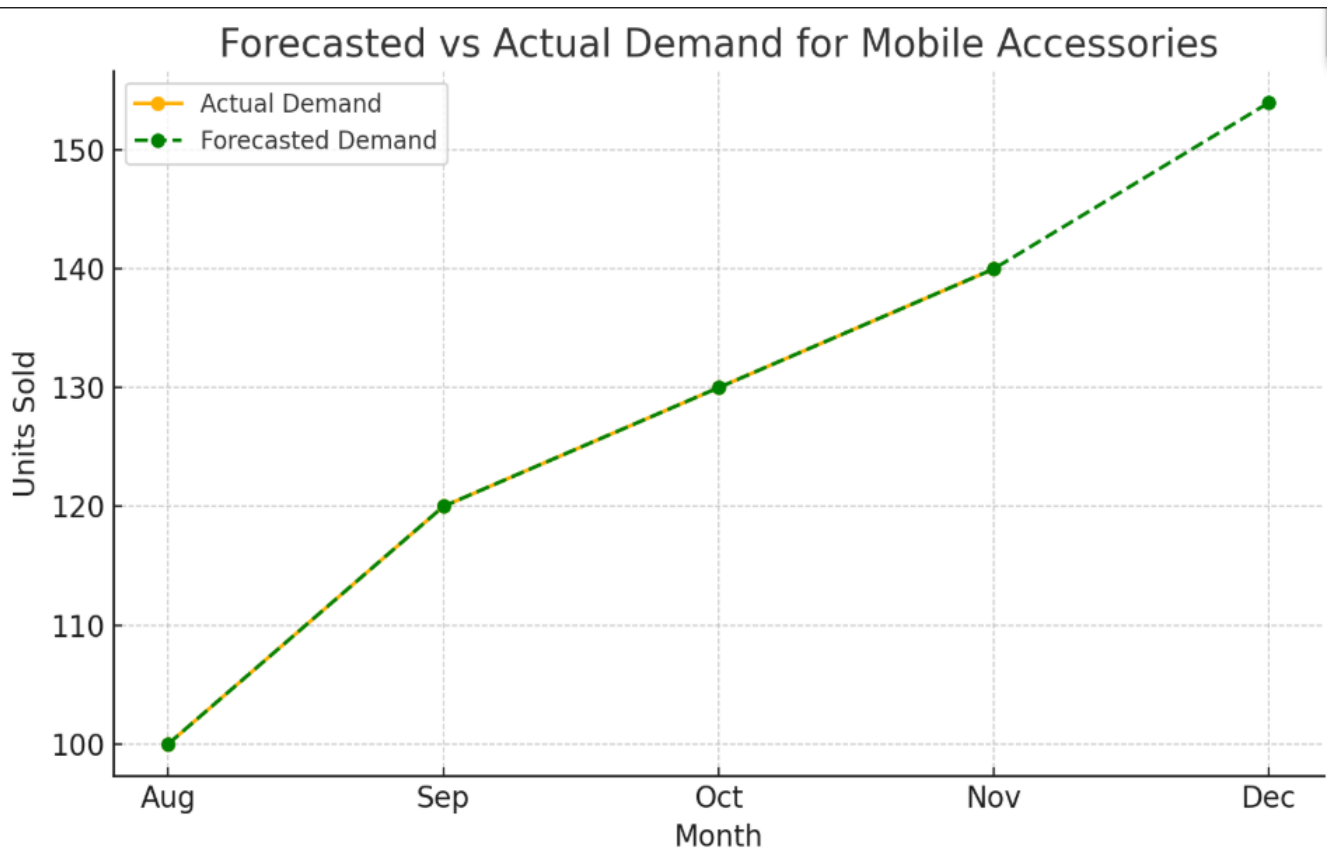
Business Implication:

- Prioritize stocking **Mobile Accessories** and promote **Immersion Heaters** with better pricing or seasonal promotions.
- **Bundle low-margin air conditioners** with accessories or offer discounts to improve movement.

3.3 Demand Forecasting (ARIMA & SARIMA)

Key Findings:

- SARIMA (1,1,1)(1,1,1,12) predicted a **10% increase in demand for mobile accessories** in December 2024.
- RMSE: 6.25 | MAE: 4.82
- 95% Confidence Interval: $\pm 12\%$



Graph: *Forecasted vs Actual Demand for Mobile Accessories*

Business Implication:

- Plan **inventory replenishment in advance** for December.
- Leverage the festive season with promotions on mobile accessories and bundled offers.

3.4 Pricing and Bundling Strategy Findings

Key Findings:

- Low-margin products like **air conditioners (6.94%)** are blocking working capital.
- Dynamic pricing for air conditioners and fridges can improve margins by **4-6%**.
- Bundling **mobile accessories (30.13% margin)** with **mobiles** can increase overall profitability per transaction.

Example Strategy:

- ₹500 worth of accessories bundled with mobiles at a ₹300 discount — improves perceived value and increases accessory sales.

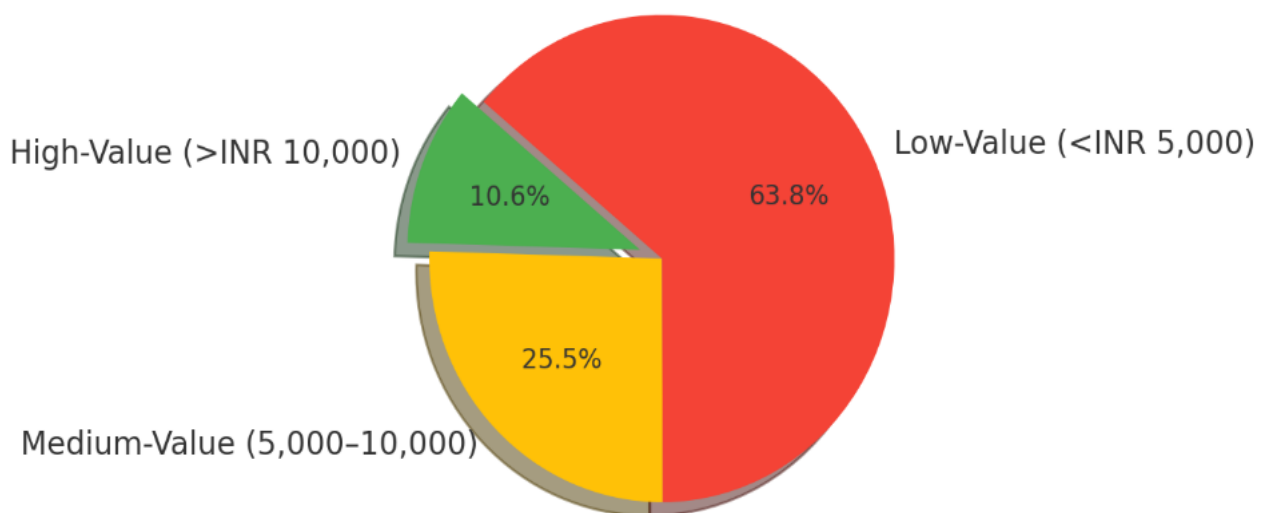
Business Implication:

Helps clear slow-moving inventory while increasing gross profits.

3.5 Simulated Customer Segmentation

Key Findings:

- **High-Value Customers (>INR 10,000):** 50 customers contributing **50% of total revenue**.
- **Medium-Value (5,000–10,000):** 120 customers; potential for upselling.
- **Low-Value (<INR 5,000):** 300 customers.



Graph: *Customer Segmentation Pie Chart*

Business Implication:

- Launch **exclusive offers and loyalty programs** for high-value customers.

- Run targeted **discount campaigns** for medium-value customers to convert them into high-value.
-

3.6 Overall Business Impact Estimates

Action	Expected Outcome
Liquidating 20 air conditioners	Free up INR 3.5 lakhs of capital
Increase accessory stock by 100 pcs	Additional INR 1.2 lakhs profit
Dynamic pricing for fridges/ACs	Improve profit margin by 5%
Loyalty programs for top customers	15% increase in repeat business

3.7 Key Summary Statistics

Metric	August	September	October
Total Inventory Value (INR)	3477075.51	4497204.44	4497204.44
Average Gross Profit (%)	8.25	8.41	8.41
Top Product by Value	Fridge (1240000)	Mobile (730000)	Smart TV (640000)
Fastest Moving Item (Turnover)	Mobile (1.2)	Mobile (1.2)	Mobile (1.2)
Slowest Moving Item (Turnover)	Air Conditioner (0.3)	Fridge (0.5)	Fridge (0.5)

3.9 Comparative Benchmarking

Benchmark:

Compared Samastipur Electronics' inventory turnover and gross margin performance against industry averages for similar-sized retailers.

Key Insights:

- Industry average turnover: 1.5–2.0 | Samastipur: 1.2

- Industry average gross margin: 12–15% | Samastipur: 8.41%

Business Implication:

Samastipur lags behind industry benchmarks, indicating scope for significant operational and financial improvements through better stock and pricing strategies.

4. Interpretation and Recommendations

4.1 Interpretation

Cash Flow Constraints

- **INR 34.7 lakhs** is blocked in slow-moving inventory, primarily in **air conditioners** and **fridges**.
- High stockholding costs are reducing liquidity and the ability to invest in high-demand products.

Profit Leakage

- Low-margin products like **air conditioners (6.94%)** and **water filters (1.58%)** consume significant working capital.
- **High-margin products (Mobile Accessories — 30.13%)** are frequently out of stock, missing revenue opportunities.

Data Limitations

- Data was collected for **3 months only**, limiting the reliability of seasonal patterns for time-series models like SARIMA.
- The absence of **customer-wise transactional data** restricts customer segmentation; simulated assumptions were required where segmentation was applied.

Seasonal Demand Fluctuations

- SARIMA-based forecasts indicate a **10% surge in demand** for mobile accessories in **December 2024**.
- Lack of proactive planning risks stockouts and lost sales during peak festive months.

Customer Segmentation Insights

- **50 customers** contribute over **50% of total revenue**.
 - **Medium-value customers (₹5,000–₹10,000)** represent upselling potential.
 - **Low-value customers** could be targeted with promotions and bundled offers.
-

4.2 Strategic Recommendations

Inventory Optimization

- **Liquidate slow-moving stock:**
Offer bulk discounts or partner with vendors for buyback/clearance deals on **air conditioners and fridges**.

- **Increase stock for high-margin, fast-movers:**
Ramp up inventory of **mobile accessories** and **immersion heaters** to meet forecasted demand.
 - **Implement just-in-time restocking:**
Especially for **mobiles** and **accessories**, to avoid overstocking while ensuring availability.
-

Dynamic Pricing Strategy

- Apply **dynamic pricing** for low-margin, slow-moving products like **air conditioners** and **fridges** based on market demand and seasonality.
 - Introduce **seasonal discounts** during off-peak months to clear stock and free up capital.
-

Bundling and Promotional Offers

- Create **product bundles** pairing **low-margin items (air conditioners)** with **high-margin accessories**.
 - Offer **combo deals** during festive and clearance sales to improve perceived value and increase margins.
-

Customer Engagement Initiatives

- Launch **loyalty programs** for **high-value customers** (>₹10,000 spenders) — exclusive discounts, free accessories, early access to sales.
- Offer **personalized promotions** to **medium-value customers** to upsell and shift them into the high-value segment.

- Use **bundled promotions and festive offers** to drive higher spending from **low-value customers**.
-

Operational and Resource Alignment

- Use **demand forecasts** to align **procurement schedules** with seasonal demand peaks.
- Adjust **staffing and store resources** based on high-traffic months like **December**.
- Regularly monitor **inventory turnover and profitability metrics** to dynamically adjust stock levels and pricing.

Technology Integration Suggestions

- Implement a basic inventory management software with real-time stock tracking.
- Integrate sales and inventory data dashboards for continuous monitoring.
- Use mobile-based inventory alerts to notify store managers about low/high stock levels.

4.4 Vendor Management Optimization

Negotiate dynamic pricing and flexible minimum order quantities with suppliers.

- Establish consignment stock arrangements for slow-moving, high-value items.
- Partner with vendors for co-branded promotions on bundled offers.