Optimizing inventory management for improving resource mobilization, growth and profitability of a retail pharmaceutical business

A mid-term submission report for the BDM capstone Project

Submitted by

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Contents

Project Title:

Optimizing inventory management for improving resource mobilization, growth and profitability of a retail pharmaceutical business.

1. Executive Summary:

The ongoing business project analyzes the inventory management system of New Medica, based on data-driven insights from purchase and sales transactions made available for the period of April 2023 to September 2023 with the focus on understanding purchase and sales patterns, inventory turnover, and stock levels.

The metadata obtained from purchase and sales transaction data along with inventory data of the months of the review period comprises the following key variables:

a. **Purchase Value:** The net purchase value after considering discounts and GST.
b. **Sales Value:** The net sales value generated from the item.
c. **OB Qty:** The opening balance of an item at the beginning of each month. This helps track the starting stock levels.
d. **CB Qty:** The closing balance of an item at the end of each month. This indicates the remaining stock levels.
e. **Expiry Date:** Indicates the expiration date of the purchased items for minimizing losses due to expired products.

Analysis on the consolidated inventory data has been done wherein the inventory is segmented based on Inventory Turnover Ratio (ITR), which is critical for assessing stock movement, capital blockage, and purchase-sales discrepancy. Five categories (A, B, C, D, and E) have been created using ITR as the main variable. We find that Category A has the lowest turnover and highest capital blockage, while Category E has the highest turnover and capital efficiency.

The analysis also reveals significant insights into the relationship between stock movement and capital allocation. Category A items, comprising 52% of inventory, are found to tie up 91% of the capital, with a massive gap between purchase value (₹13.74 lakhs) and sales value (₹1.26 lakhs), leading to liquidity and cash flow challenges. Category B, accounting for 7% of inventory, also demonstrate a 77% capital blockage. Conversely, Categories C, D, and E showed healthier inventory turnover and minimal capital blockage, contributing positively to sales growth and profitability.

2. Proof of Originality of data:

A. Primary data collected:

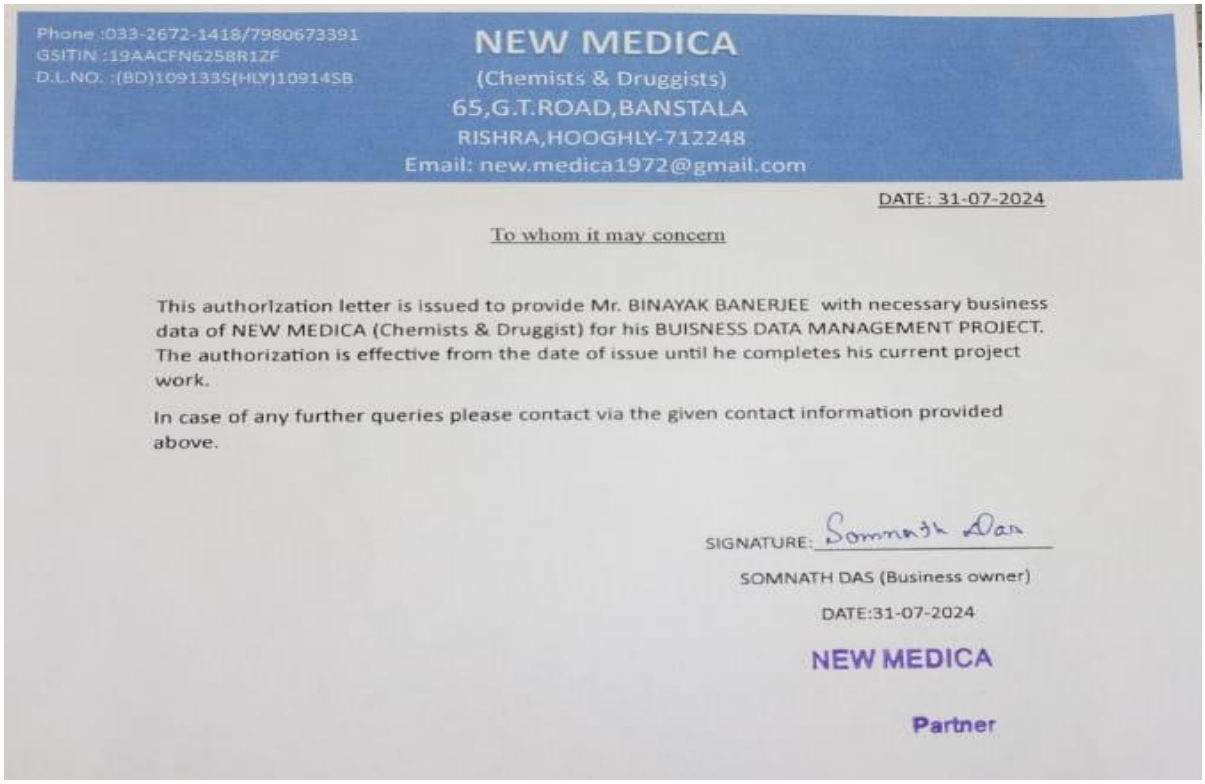
- Purchase records from 01-04-23 to 30-09-23.Link of image file :{Click here}
- Sales records from 01-04-23 to 30-09-23. Link of image file :{Click here}

B. Video Interaction with shop owner:

I have interacted with the owner of New Medica Mr.Somnath Das regarding business background, issues being faced in running the business, problem areas which, if sorted out, would help the business to compete better with local and online competitors etc.

Link of video file: Click here

A. Letter from the organization (New Medica): Link: {click here}



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NEW MEDICA
(Chemists & Druggists)
65,G.T.ROAD,BANSTALA
RISHRA,HOOGHLY-712248
Email: new.medica1972@gmail.com

DATE: 31-07-2024

To whom it may concern

This authorization letter is issued to provide Mr. BINAYAK BANERJEE with necessary business data of NEW MEDICA (Chemists & Druggist) for his BUISNESS DATA MANAGEMENT PROJECT. The authorization is effective from the date of issue until he completes his current project work.

In case of any further queries please contact via the given contact information provided above.

SIGNATURE: Somnath Das

SOMNATH DAS (Business owner)

DATE:31-07-2024

NEW MEDICA

Partner

B. Images of the retail shop (New Medica): Link: {click here}

FRONT VIEW OF NEW MEDICA

3. Metadata and descriptive statistics:

A. Metadata:

Please refer to the excel file for metadata and descriptive statistics: {Click here}

The primary data in the referred excel file is contained in the sheets 'Purchase_data', 'Sales_data', 'April_data', 'May_data', 'June_data', 'July_data', 'August_data' & 'September_data'

Table1:Metadata for the sheets 'Purchase_data', 'Sales_data', 'April_data','May_data','June_data','July_data','August_data' and 'September_data'

Sheet Name	Columns	Data type	Units	Description
Purchase_data (It contains all the purchase transaction data records during the period April 2023 to September 2023)	Item Name	varchar(50)	-	Represents the pharmaceutical items.
	Item MRP	float	Rupees	Represents the M.R.P of an item.
	Purchase Rate	float	Rupees	Rate provided by the supplier to purchase the item to the shop.
	Discount	int	-	Represents the discount provided on purchase rate of an item.
	Discount Value	float	Rupees	Total discount generated in value.
	GST	int	-	Represents the percentage of GST to be provided on effective purchase rate after adding discount value to purchase rate.
	GST Value	float	Rupees	Total GST charges represented as value.
	Purchase Amount	float	Rupees	Represents the purchase value of an item after inclusion of discount value and GST value.
	Quantity	int	-	Represents the number of units of an item in a transaction.Item in the form of packaged product (strip/bottle/kit etc.) as manufactured is considered as a unit.
	Expiry Date	date	-	Represents the expiry date of the particular item.
	Batch Number	varchar(15)	-	Represents the batch assigned by the item manufacturer.
	Purchase Value	float	Rupees	Net value of purchase in a transaction of a purchase bill.
	Billing Date	date	-	Represents the date of transaction.

Sheet Name	Columns	Data type	Units	Description
Sales_data (It contains all the purchase transaction data records during the period April 2023 to September 2023)	Item Name	varchar(50)	-	Represents the pharmaceutical items.
	Item MRP	float	Rupees	Represents the M.R.P of an item.
	Sales Rate	float	Rupees	Rate at which shop sells the item.
	Discount	int	-	Represents the discount provided on sales rate rate of an item.
	Discount Value	float	Rupees	Total discount generated in value.
	GST	float	%	Represents the percentage of GST to be provided on effective sales rate after providing discount value to sales rate.
	GST Value	float	Rupees	Total GST charges represented as value.
	Sales Amount	float	Rupees	Represents the sales value of an item after inclusion of discount value and GST value.
	Expiry Date	date	-	Represents the expiry date of the particular item.
	Quantity	int	-	Represents the number of units of an item in a transaction.Item in the form of packaged product (strip/bottle/kit etc.) as manufactured is considered as a unit.
	Sales Value	float	-	Net value of sales in a transaction of a sales bill.
	Bill Date	date	Rupees	Represents the date of transaction.
1.April_data 2.May_data 3.June-data 4.July_data 5. August_data 6.September_data (Contain all the inventory data of corresponding months during the period April 2023 to September 2023)	Item Name	varchar(50)	-	Represents the pharmaceutical items.
	OB Qty	int	-	Opening balance of the item
	Total purchase Qty.	int	-	Quantity of units purchased
	Purchase Amount	float	Rupees	Represents the purchase value of an item after inclusion of discount value and GST value.
	Purchase value	float	Rupees	Net purchase value for item procurement
	Total sales Qty	int	-	Quantity of units sold
	Sales Amount	float	Rupees	Represents the sales value of an item after inclusion of discount value and GST value.
	Sales value	float	Rupees	Net sale value generated from the item.
	CB Qty	int	-	Closing balance of the item

B. Descriptive statistics:

TABLE-2 : Descriptive statistics of purchase transaction data

Features(row-wise)/ Parameters(column-wise)	Item MRP (in Rs.)	Purchase Rate (in Rs.)	Discount (%)	Discount Value (in Rs.)	GST (%)	GST Value (in Rs.)	Purchase Amount(in Rs.)	Quantity (No.)	Purchase Value (in Rs.)
Count	22349	22349	22349	22349	22349	22349	22349	22349	22349
Mean	131.94	112.26	3.63	4.13	12.26	108.13	121.35	2.15	202.07
Standard deviation	117.34	101.34	0.78	3.93	1.94	97.62	107.98	3.49	228.73
Variance	13768.85	10270.66	0.6	15.45	3.77	9530.17	11658.97	12.2	52315.88
Minimimum value	1.64	1.41	3	0.06	5	1.35	1.51	1	6.25
Maximum value	3093.1	2809.28	10	84.28	18	2725	2861.25	175	6083
25th Percrcentile	64.26	54.77	3	1.86	12	52.93	59.28	1	84.29
Median	105.03	89.18	3	3.1	12	85.84	96.87	1	135.72
75th Percentile	160.34	136.01	4	5.12	12	131.3	147.64	2	241.14
Mode	96.43	127.55	3	1.26	12	85.22	95.45	1	89.29

TABLE-3: Descriptive statistics of sales transaction data

Features(row-wise)/ Parameters(column-wise)	Item MRP (in Rs.)	Sales Rate (in Rs.)	Discount (%)	Discount Value (in Rs.)	GST(%)	GST Value (in Rs.)	Sales Amount (in Rs.)	Quantity (No.)	Sales Value (in Rs.)
Count	23808	23808	23808	23808	23808	23808	23808	23808	23808
Mean	143.53	128.17	6.62	8.55	12.14	119.62	134.22	1.47	187.13
Standard deviation	160.24	144.98	2.23	9.05	1.78	137	150.51	1.11	214.6
Variance	25676.67	21019.85	4.96	81.84	3.17	18769.71	22654.1	1.22	46054.29
Minimum value	2.1	1.84	3	0.06	5	1.78	2	1	4.46
Maximum value	4211.16	3760.91	10	263.26	18	3497.65	3917.36	50	4349.72
25th Percentile	59.66	53.39	5	2.88	12	50	56	1	74.68
Median	106.715	95.56	7	6.3	12	88.65	99.29	1	131.99
75th Percentile	178.45	161.21	7	11.21	12	150	168	2	224.555
Mode	31.22	27.37	7	0.82	12	26.55	95	1	25.54

TABLE-4: Descriptive statistics of inventory data from April 2023 to September 2023

Features(row-wise)/ Parameters(column-wise)	Duration/Period	OB Qty (No.)	Total purchase Qty (No.)	Purchase amount (in Rs.)	Purchase value (in Rs.)	Total sales Qty (No.)	Sales amount (in Rs.)	Sales value (in Rs.)	CB Qty (No.)
Count	Apr-23	4797	4797	4797	4797	4797	4797	4797	4797
	May-23	4797	4797	4797	4797	4797	4797	4797	4797
	Jun-23	4797	4797	4797	4797	4797	4797	4797	4797
	Jul-23	4797	4797	4797	4797	4797	4797	4797	4797
	Aug-23	4797	4797	4797	4797	4797	4797	4797	4797
	Sep-23	4797	4797	4797	4797	4797	4797	4797	4797
Mean	Apr-23	3.95	2.19	117.46	184.86	1.35	153.67	142.52	4.8
	May-23	4.8	1.74	117.46	153.23	1.09	153.67	112.5	5.45
	Jun-23	5.45	1.7	117.46	154.45	1	153.67	105.2	6.15
	Jul-23	6.15	1.89	117.46	165.35	1.06	153.67	110.69	6.98
	Aug-23	6.98	1.66	117.46	158.85	1.03	153.67	109.08	7.61
	Sep-23	7.61	1.92	117.46	170.23	1.12	153.67	115.21	8.42
Standard deviation	Apr-23	36.31	7.13	113.19	426.67	6.22	148.79	511.78	32.16
	May-23	32.16	4.83	113.19	363.37	5.28	148.79	497.62	30.28
	Jun-23	30.28	5.44	113.19	445.51	4.17	148.79	399.95	27.89
	Jul-23	27.89	6.74	113.19	446.1	4.5	148.79	474.64	26.46
	Aug-23	26.46	4.12	113.19	367.3	4.48	148.79	513.99	24.11
	Sep-23	24.11	5.69	113.19	433.76	5.14	148.79	496.34	22.74

Variance	Apr-23	1318.74	50.82	12811.5	182047.05	38.63	22137.49	261916.86	1034.34
	May-23	1034.34	23.3	12811.5	132036	27.93	22137.49	247629.07	916.79
	Jun-23	916.79	29.63	12811.5	198483.16	17.41	22137.49	159961.4	777.6
	Jul-23	777.6	45.42	12811.5	199003.94	20.25	22137.49	225281.32	700.12
	Aug-23	700.12	16.94	12811.5	134909.19	20.05	22137.49	264184.44	581.52
	Sep-23	581.52	32.43	12811.5	188150.8	26.38	22137.49	246354.88	516.98
Minimum value	Apr-23	0	0	1.4	0	0	2	0	0
	May-23	0	0	1.4	0	0	2	0	0
	Jun-23	0	0	1.4	0	0	2	0	0
	Jul-23	0	0	1.4	0	0	2	0	0
	Aug-23	0	0	1.4	0	0	2	0	0
	Sep-23	0	0	1.4	0	0	2	0	0
Maximum value	Apr-23	886	181	2890.75	9124.5	136	3612	11305	754
	May-23	754	103	2890.75	5781.5	168	3612	14280	745
	Jun-23	745	181	2890.75	20235.25	116	3612	10836	677
	Jul-23	677	209	2890.75	17344.5	104	3612	18060	609
	Aug-23	609	132	2890.75	6069.12	109	3612	21672	536
	Sep-23	536	132	2890.75	14453.75	143	3612	18060	443
25th Percentile	Apr-23	0	0	52.64	0	0	68.97	0	0
	May-23	0	0	52.635	0	0	68.95	0	0
	Jun-23	0	0	52.635	0	0	68.95	0	0
	Jul-23	0	0	52.635	0	0	68.95	0	1
	Aug-23	1	0	52.635	0	0	68.95	0	2
	Sep-23	2	0	52.635	0	0	68.95	0	2
Median	Apr-23	0	0	91.43	0	0	119.4	0	1
	May-23	1	0	91.43	0	0	119.4	0	1
	Jun-23	1	0	91.43	0	0	119.4	0	2
	Jul-23	2	0	91.43	0	0	119.4	0	3
	Aug-23	3	0	91.43	0	0	119.4	0	4
	Sep-23	4	0	91.43	0	0	119.4	0	4
75th Percentile	Apr-23	0	2	146.15	212.86	1	191.05	108	2
	May-23	2	2	146.15	171.84	0	191.05	0	4
	Jun-23	4	2	146.15	171.86	0	191.05	0	5
	Jul-23	5	2	146.15	192	0	191.05	0	6
	Aug-23	6	2	146.15	181.74	0	191.05	0	7
	Sep-23	7	2	146.15	200	1	191.05	32.5	8
Mode	Apr-23	0	0	70.71	0	0	115	0	0
	May-23	0	0	70.71	0	0	115	0	0
	Jun-23	0	0	70.71	0	0	115	0	0
	Jul-23	0	0	70.71	0	0	115	0	0
	Aug-23	0	0	70.71	0	0	115	0	2
	Sep-23	2	0	70.71	0	0	115	0	4

4. Detailed explanation of analysis process:

The exercise of data analysis is sub-divided into the following sub-processes:

- **Data collection**: Primary data has been collected from the purchase and sales bills obtained in the database of ERP software used in the shop. The process has been executed using Python to extract and aggregate data over the given study period out of the bills and produced into a CSV format. Similarly, the monthly item-wise inventory data has been extracted from the stock item database in the software which was originally presented in CSV format. After collecting the above data in CSV format, it was added into respective sheets as mentioned in metadata (refer Table-1 at page 4 & Table-2 at page 5) of the excel file in xlsx format.

- **Data cleaning & preprocessing**: The primary data in each of the sheets had problems like white-spacing between strings, multiple space representation formats like character code -160 & character code-32, and improper datatype representation problems like date format represented in integer format. The quantity of items purchased / sold were represented in text format rather than integer format. All the above problems have been dealt with and column features have been converted into the required datatypes as mentioned in the metadata tables (refer Table-1 at page 4 & page 5). Furthermore, duplicate entries w.r.t. item name have been detected and deleted as part of the cleaning process.

- **Analysis process:**

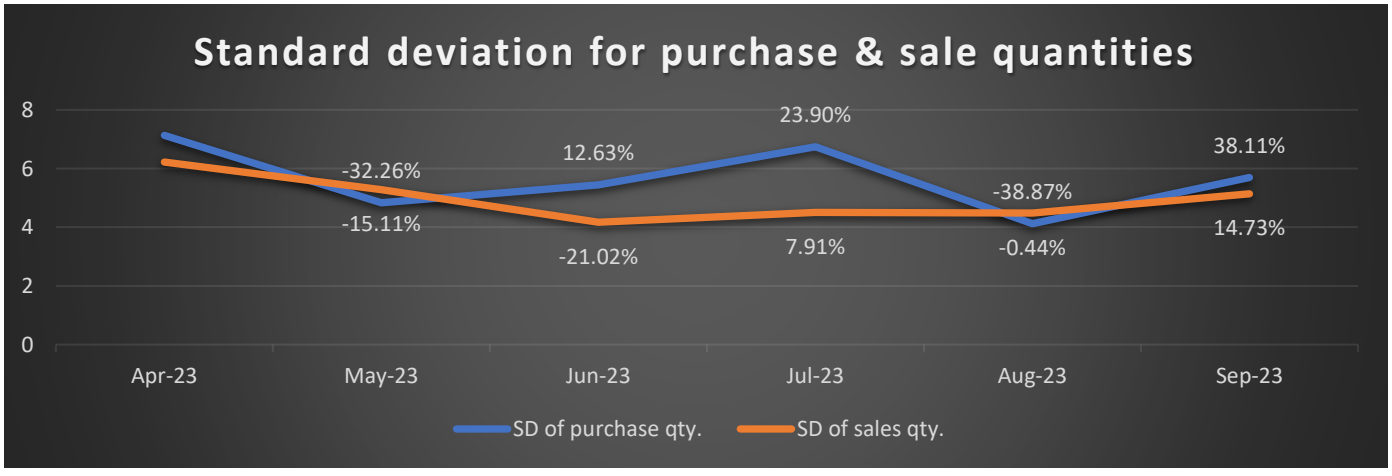
  The descriptive statistics obtained from the primary data when interpreted gives the following insights-

  a. The mean of purchase value (Rs 202.07) is greater than the mean of sales value (Rs 183.13) [refer Table 2 & 3 in page 6].This position indicates average cost of purchasing inventory is higher than the revenue generated from the sales and the scenario suggests for a need to reassess the purchasing strategy to achieve a better cost management.
  b. Median of purchase value (Rs. 125.72) is greater than median of sales value (Rs.121.99) [refer Table 2 & 3 in page 6] which indicates there could be potential pressure in profit margin. If the trend is consistent then the business might not be covering its purchasing cost effectively through sales alone.
  c. Mode of purchase amount (Rs. 95.45) and sales amount (Rs 95) [refer Table 2 & 3 in page 6] suggests that profit margin on frequently transacted items is very tight. A discount pricing strategy needs a review to increase the profit margins for frequently transacted items whose profit margin is tight.
  d. Standard deviation of Purchase quantity and Sales quantity for the months April to September are (7.13,4.83,5.44,6.74,4.12,5.69) and (6.22,5.28,4.17,4.50,4.48,5.14) respectively [refer Table 4 in page 6 and 7].
  Higher fluctuation in purchase quantities is observed in comparison to sales quantities over the review period. The trend suggests probable capital blockage and reduced profitability [refer table-5 &fig-1 in page-8].

TABLE-5: Percentage change in standard deviation for purchase and sale quantities during review period

Month	SD of purchase qty.	SD of sales qty.	% change in SD of purchase qty.	% change in SD of sales qty.
Apr-23	7.13	6.22		
May-23	4.83	5.28	-32.26%	-15.11%
Jun-23	5.44	4.17	12.63%	-21.02%
Jul-23	6.74	4.5	23.90%	7.91%
Aug-23	4.12	4.48	-38.87%	-0.44%
Sep-23	5.69	5.14	38.11%	14.73%

Fig-1: Standard deviation for purchase & sale quantities



The above interpretation of descriptive statistics summarizes up into high probabilities of excess item purchase compared to sales leading to capital blockage, shelf space mismanagement. Tight profit margin observed in frequently transacted items and there might be issues in generating profitability of the business due to improper capital management.

Analyzing **inventory turnover ratio** will lead to identification of stock items having longer shelf life entailing capital blockage and reducing overall profitability of the business.

For performing this analysis a item-wise inventory data over the review period is generated from the primary data in excel sheets [April_data, May_data, June_data, July_data, August_data and September_data] and has been consolidated into a single sheet named '**consolidated inventory data**'.The sheet contains opening balance, total items purchased, total purchase value, total items sold, total sales value and closing balance .Opening balance represents items in stock as on 1st April 2023 and closing balance represents as on 30th September 2023.total purchase and sales quantity data has been collected from primary data source using VLOOKUP and summation methods together. Purchase value is generated using product operation between purchase amount and purchase quantity for a particular item. The same procedure is followed in case of calculating sales value.

- **Inventory Turnover Ratio (ITR) Analysis:** The inventory turnover ratio is used to determine how quickly the shop sells and replaces its inventory over the study period. It reflects the efficiency of the inventory management system and provides insight into how well the shop is balancing its inventory with the customer demand.

  Formula for Inventory Turnover Ratio:

$$\text{ITR} = \frac{Cost\ of\ Goods\ Sold\ (COGS)}{Average\ Inventory}$$

  where, **COGS**: The total (cost) purchase value of the inventory sold during the review period.

  Average Inventory: The average amount of inventory held during the period. It can be calculated as-

$$\text{Average inventory} = \frac{Opening\ inventory + Closing\ inventory}{2}$$

Interpreting the Inventory Turnover Ratio:

a. High turnover ratio indicates strong sales or effective inventory management by reducing holding costs. However, if too high, it may indicate understocking, which could lead to missed sales opportunities or stockouts.
b. Low turnover ratio indicates slow-moving inventory, potential overstocking, or weak sales. The business may be holding excess inventory, which ties up capital and increases storage costs. This inter-alia suggests the need for better inventory control or discounting slow-moving items.

On carrying out analysis over the consolidated inventory data using inventory turnover ratio items were categorized with different ranges of ITR values. For the classified item categories data for item counts, percentage of inventory, purchase value, sales value ,capital blockage and percentage of capital blockage has been extracted and arranged in the form a table named "ITR Range Analysis by item Category".

5. Results and Findings:

Please refer to the excel file sheet named "**consolidated inventory data**" for finding tables and fig attached below. Link:{Click here}

The details of the inventory turnover ratio analysis on the consolidated inventory data is shown in Table-6.Using the data available from the table we have plotted the charts shown in Fig-2 & 3.

Table-6: ITR Range Analysis by Item Category

ITR range for item categories	ITR item categories	Item Counts	% of inventory	Purchase value	Sales value	Captial blockage	% Captial blockage
[0,0.25)	A	2503	52.00%	1374212.09	126057.6	1248154.49	91%
[0.25,0.5)	B	342	7.00%	369128.93	84623.87	284505.06	77%
[0.5,1)	C	797	17.00%	672500.26	771310.41	0	0%
[1,3)	D	763	16.00%	1205479.32	1140655.54	64823.78	5%
[3, very high values)	E	392	8.00%	1113193.2	1212193.17	0	0%

Fig-2: Item Distribution and Inventory Percentage

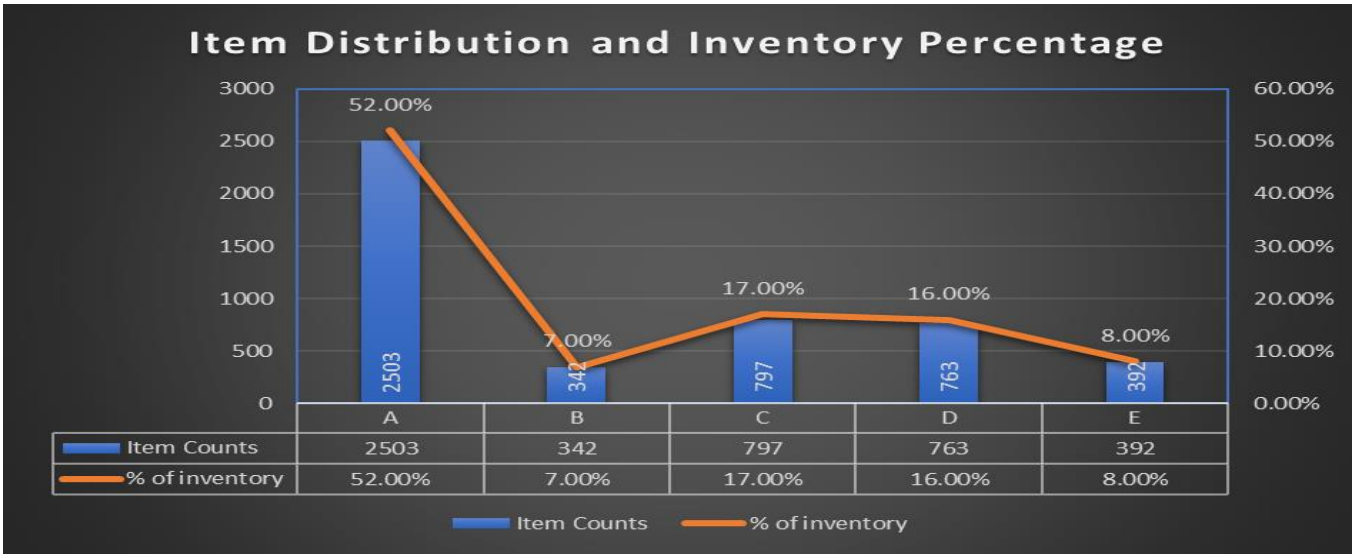
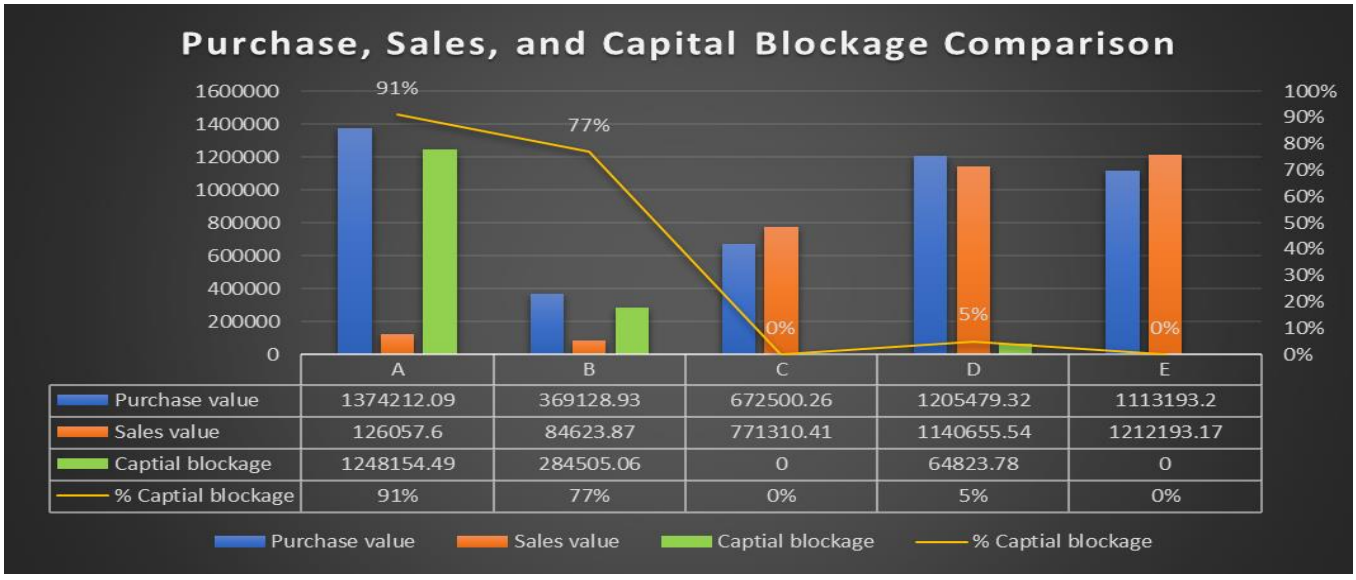


Fig-3: Purchase, Sales, and Capital Blockage Comparison



Results:

1. **Inventory Turnover Ratio (ITR) Range Categorization:**
    - Category A (ITR range [0,0.25)) contains 2503 items, making up 52% of the inventory. These items have a high capital blockage (₹12,48154.49), accounting for 91% blockage. This indicates slow-moving or stagnant inventory tying up significant capital.
    - Category B (ITR range [0.25,0.5)) has 342 items, which represent 7% of the inventory and face a 77% capital blockage. These items also pose a capital concern but to a lesser extent than Category A.
    - Category C (ITR range [0.5,1)) consists of 797 items, comprising 17% of the inventory, with 0% capital blockage. These items seem to perform well with no capital block.
    - Category D (ITR range [1,3)) holds 763 items, making up 16% of the inventory and has 5% capital blockage, a relatively healthier turnover ratio.
    - Category E (ITR range [3, very high value)) with 392 items forms 8% of the inventory and shows 0% capital blockage. These are fast-moving items with efficient capital utilization.

2. **Purchase and Sales Value:**
    - Category A shows a large gap between purchase value (₹13,74,212.09) and sales value (₹1,26,057.6), which highlights the low turnover and excessive stock holding.
    - Category B has a purchase value of ₹3,69,128.93 and a sales value of ₹84,623.87, which also shows a discrepancy but with a reduced blockage.
    - Categories C, D, and E display much more balanced purchase and sales values, indicating these items are contributing positively to turnover and profitability, with no major capital blockage.

3. **Capital Blockage Insights:**
    - Capital blockage is highest in Category A (₹12,48154.49) and Category B (₹2,84,505.06), which can severely affect liquidity and cash flow.
    - Categories C, D, and E have negligible or no capital blockage, suggesting efficient stock management and sales.

Key Findings:

1. **High Capital Blockage in Low ITR Categories (A and B):**
    - Items in Category A are holding up a significant portion of capital (91%), contributing to very slow movement and sales. These need urgent attention, such as promotional strategies, discounts, or even discontinuing less-demanded items.
    - Similarly, Category B items, though smaller in count and percentage, still exhibit a 77% capital blockage, demanding more efficient stock handling.
    -
2. **Healthy Performance in Categories C, D, and E:**
    - Categories C, D, and E reflect optimal inventory turnover and low or zero capital blockage. This suggests that these categories are driving profitability and efficient resource utilization. Special emphasis can be placed on ensuring stock availability in these categories to boost sales.

3. **Resource Mobilization and Profitability:**
    - The findings suggest that New Medica's profitability and resource mobilization are impacted primarily by overstocked and slow-moving items. Addressing these categories will significantly improve cash flow and reduce blocked capital.