

Problem Statement

Optimizing inventory and sales performance is pivotal for driving profitability in the retail and wholesale sectors. Inefficiencies such as misaligned pricing strategies, slow-moving inventory, and vendor over-reliance can significantly erode margins.

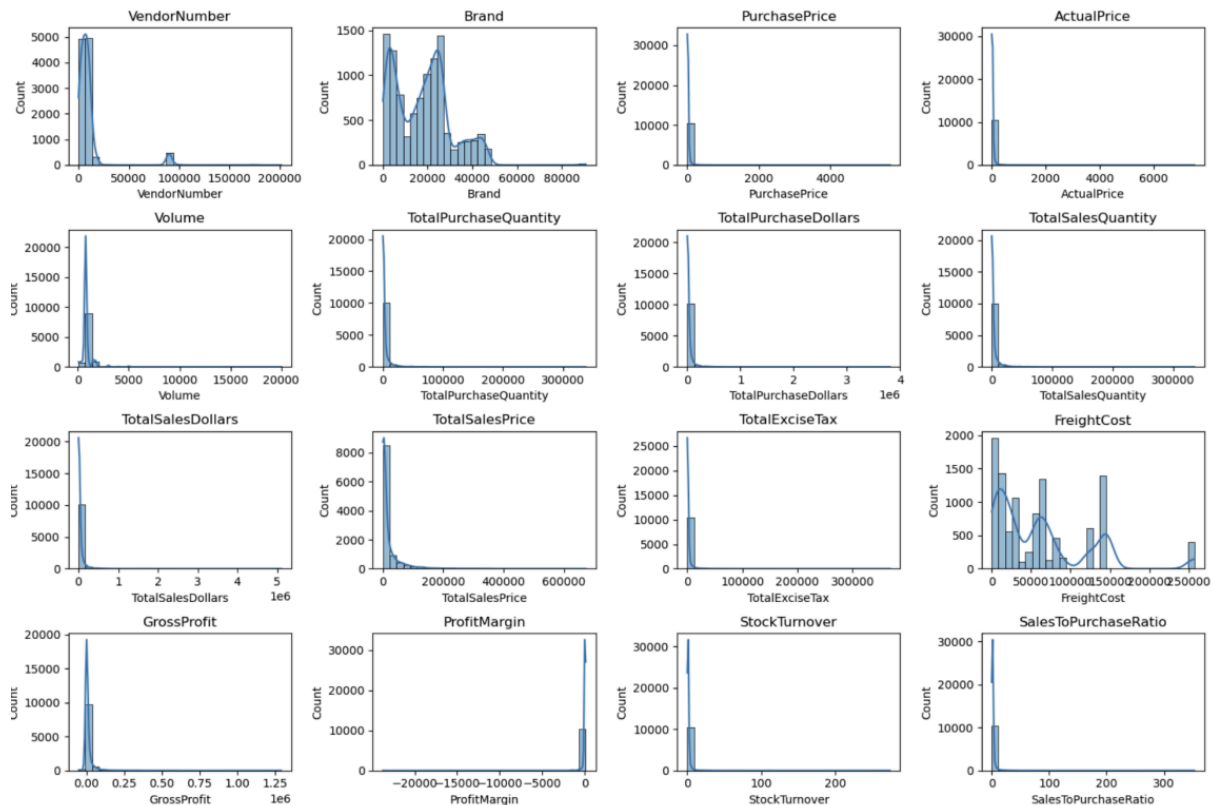
This analysis is designed to:

- Detect underperforming brands through sales and margin data to inform targeted pricing or promotional interventions.
- Identify high-impact vendors contributing disproportionately to overall sales and gross profit.
- Quantify the cost benefits of bulk purchasing by analyzing its effect on unit economics.
- Evaluate inventory turnover ratios to uncover holding cost inefficiencies and improve stock flow.
- Benchmark vendor performance by comparing profitability metrics across top and bottom-tier suppliers.

Exploratory Data Analysis

Summary Statistics

	count	mean	std	min	25%	50%	75%	max
VendorNumber	10692.0	1.065065e+04	18753.519148	2.00	3951.000000	7153.000000	9552.000000	2.013590e+05
Brand	10692.0	1.803923e+04	12662.187074	58.00	5793.500000	18761.500000	25514.250000	9.063100e+04
PurchasePrice	10692.0	2.438530e+01	109.269375	0.36	6.840000	10.455000	19.482500	5.681810e+03
ActualPrice	10692.0	3.564367e+01	148.246016	0.49	10.990000	15.990000	28.990000	7.499990e+03
Volume	10692.0	8.473605e+02	664.309212	50.00	750.000000	750.000000	750.000000	2.000000e+04
TotalPurchaseQuantity	10692.0	3.140887e+03	11095.086769	1.00	36.000000	262.000000	1975.750000	3.376600e+05
TotalPurchaseDollars	10692.0	3.010669e+04	123067.799627	0.71	453.457500	3655.465000	20738.245000	3.811252e+06
TotalSalesQuantity	10692.0	3.077482e+03	10952.851391	0.00	33.000000	261.000000	1929.250000	3.349390e+05
TotalSalesDollars	10692.0	4.223907e+04	167655.265984	0.00	729.220000	5298.045000	28396.915000	5.101920e+06
TotalSalesPrice	10692.0	1.879378e+04	44952.773386	0.00	289.710000	2857.800000	16059.562500	6.728193e+05
TotalExciseTax	10692.0	1.774226e+03	10975.582240	0.00	4.800000	46.570000	418.650000	3.682428e+05
FreightCost	10692.0	6.143376e+04	60938.458032	0.09	14069.870000	50293.620000	79528.990000	2.570321e+05
GrossProfit	10692.0	1.213238e+04	46224.337964	-52002.78	52.920000	1399.640000	8660.200000	1.290668e+06
ProfitMargin	10692.0	-inf	NaN	-inf	13.324515	30.405457	39.956135	9.971666e+01
StockTurnover	10692.0	1.706793e+00	6.020460	0.00	0.807229	0.981529	1.039342	2.745000e+02
SalesToPurchaseRatio	10692.0	2.504390e+00	8.459067	0.00	1.153729	1.436894	1.665449	3.529286e+02



Negative & Zero Values Analysis:

- **Gross Profit:** The minimum value of -₹52,002.78 indicates potential financial losses, likely driven by elevated procurement costs or aggressive discounting strategies. This suggests that certain items may have been sold below cost price.
- **Profit Margin:** A minimum of negative infinity ($-\infty$) points to scenarios where revenue is zero or negative, implying severe pricing inefficiencies or complete lack of sales despite incurring costs.
- **Total Sales Quantity & Sales Revenue:** Instances of zero sales for certain SKUs indicate unsold inventory, which may be slow-moving or obsolete, contributing to increased holding costs and inventory stagnation.

Outlier Detection via High Standard Deviation

- **Purchase Price & Actual Selling Price:** Maximum values of ₹5,681.81 and ₹7,499.99, compared to means of ₹24.39 and ₹35.64, highlight outlier or premium products, possibly skewing averages and requiring separate analysis.
- **Freight Costs:** A wide range from ₹0.09 to ₹2,57,032.07 suggests significant inconsistencies in logistics costs, potentially caused by bulk shipments, supplier variability, or inefficient freight management.
- **Stock Turnover Ratio:** Spanning 0 to 274.5, this metric reveals sharp contrast in product movement—while some items churn quickly, others stagnate. A turnover ratio above 1 indicates that sales exceeded recent purchases, likely due to the utilization of older inventory.

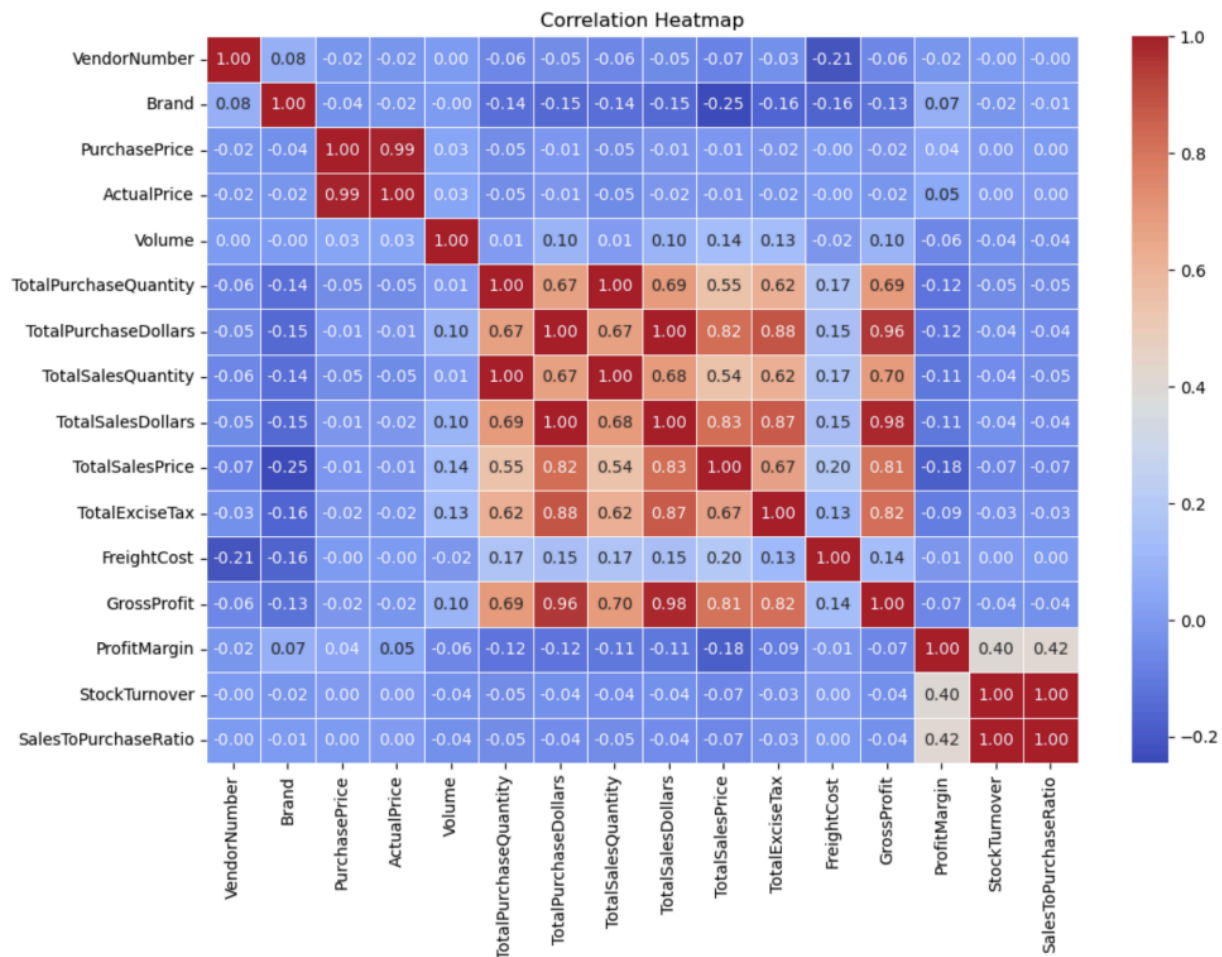
Data Filtering for Insight Accuracy

To ensure a more reliable and actionable analysis, the dataset was refined by excluding non-contributing or misleading records based on the following criteria:

- **Gross Profit ≤ 0 :** Transactions resulting in zero or negative profit were excluded to eliminate loss-making entries that could skew profitability insights.

- **Profit Margin ≤ 0 :** Entries with non-profitable or breakeven margins were filtered out to focus on revenue-generating performance.
- **Total Sales Quantity = 0:** Products with no recorded sales were removed, as they do not contribute to sales analysis and may represent dead or obsolete stock.

Correlation Insights



- **Purchase Price vs. Sales Revenue & Gross Profit:** Exhibits very weak negative correlations (-0.012 and -0.016), indicating that fluctuations in purchase price have minimal impact on total sales or profitability. This suggests pricing strategy may not be a primary driver of revenue performance.

- **Purchase Quantity vs. Sales Quantity:** Shows an extremely strong positive correlation (0.999), validating that procurement closely aligns with sales volume, indicating efficient inventory turnover and minimal overstocking.
- **Profit Margin vs. Sales Price:** The moderate negative correlation (-0.179) implies that higher selling prices are associated with lower profit margins, likely due to competitive market forces or cost-based pricing constraints.
- **Stock Turnover vs. Gross Profit & Profit Margin:** Displays weak negative correlations (-0.038 and -0.055), suggesting that rapid inventory movement doesn't directly translate into higher profitability, potentially due to discount-driven sales or high operational costs.

Research Questions & Key Findings

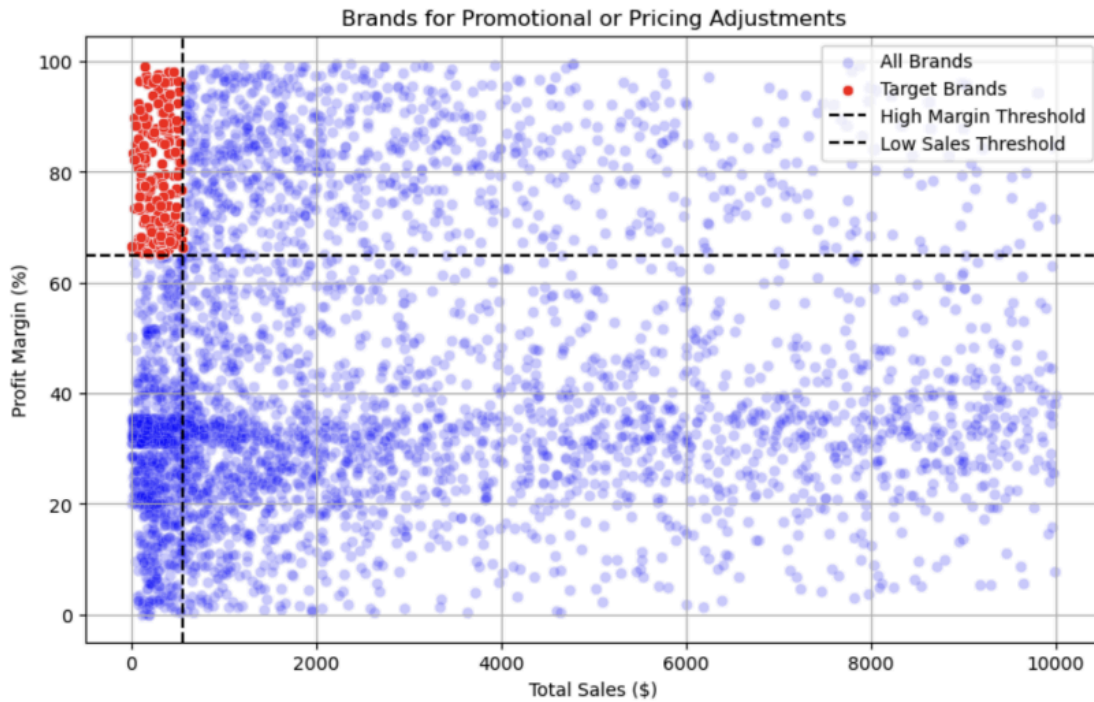
1. Brands for Promotional or Pricing Optimization

Brands with Low Sales but High Profit Margins:

	Description	TotalSalesDollars	ProfitMargin
6199	Santa Rita Organic Svgn Bl	9.99	66.466466
2369	Debauchery Pnt Nr	11.58	65.975820
2070	Concannon Glen Ellen Wh Zin	15.95	83.448276
2188	Crown Royal Apple	27.86	89.806174
6237	Sauza Sprklg Wild Berry Marg	27.96	82.153076
...
5074	Nanbu Bijin Southern Beauty	535.68	76.747312
2271	Dad's Hat Rye Whiskey	538.89	81.851584
57	A Bichot Clos Marechaudes	539.94	67.740860
6245	Sbragia Home Ranch Merlot	549.75	66.444748
3326	Goulee Cos d'Estournel 10	558.87	69.434752

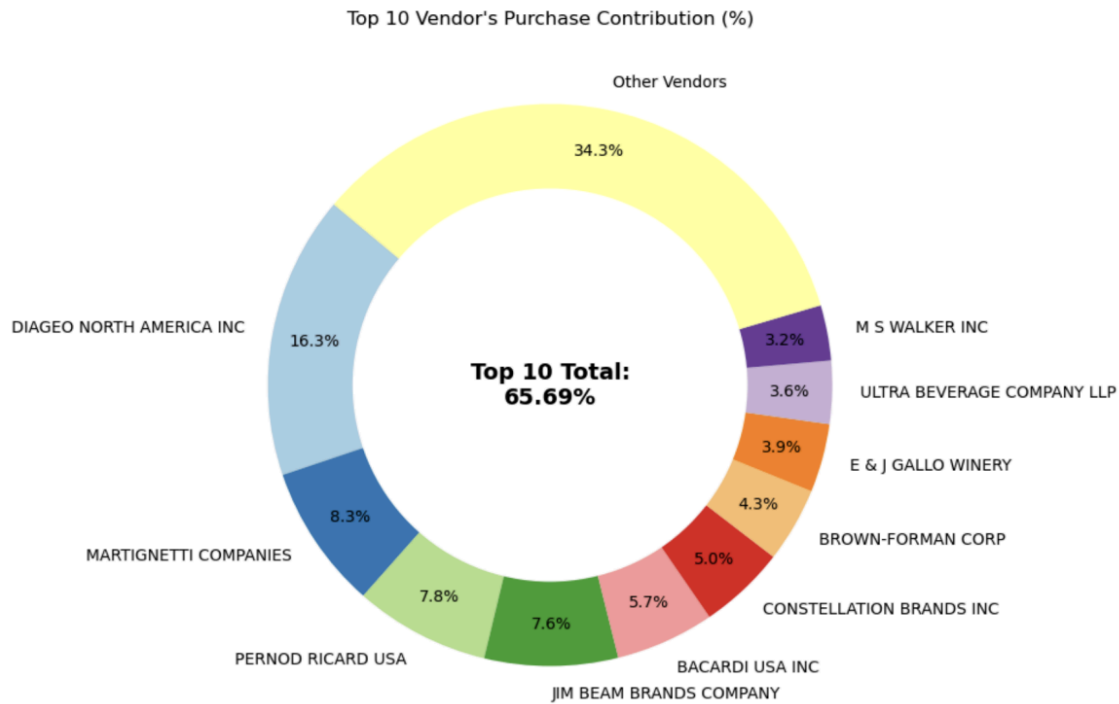
198 rows × 3 columns

Analysis reveals that 198 brands demonstrate low sales volumes but maintain high profit margins. These brands present strong opportunities for targeted marketing, promotional campaigns, or pricing strategy refinements aimed at boosting sales volume without significantly impacting margins.



2. Vendor Concentration Risk

The top 10 vendors account for 65.69% of total purchase volume, while all remaining vendors contribute just 34.31%. This disproportionate dependency increases vulnerability to supply chain disruptions and suggests a strategic need for vendor base diversification to mitigate risk and improve resilience.



3. Cost Benefits of Bulk Purchasing

Vendors placing high-volume orders benefit from significantly reduced unit costs—averaging \$10.78 per unit, representing a 72% cost savings compared to smaller orders. This demonstrates the effectiveness of bulk pricing strategies, which not only incentivize larger purchases but also contribute to higher total sales without compromising profit margins.

OrderSize	UnitPurchasePrice
Small	39.057543
Medium	15.486414
Large	10.777625

4. Vendors with Low Inventory Turnover

The analysis reveals \$2.71 million worth of unsold inventory, indicating significant capital tied up in slow-moving stock. This leads to increased holding costs, reduced cash flow efficiency, and diminished overall profitability.

By identifying vendors associated with low inventory turnover, businesses can make more informed procurement decisions, implement stock optimization strategies, and minimize financial overhead.

VendorName	StockTurnover	VendorName	UnsoldInventoryValue
ALISA CARR BEVERAGES	0.615385	DIAGEO NORTH AMERICA INC	722.21K
HIGHLAND WINE MERCHANTS LLC	0.708333	JIM BEAM BRANDS COMPANY	554.67K
PARK STREET IMPORTS LLC	0.751306	PERNOD RICARD USA	470.63K
Circa Wines	0.755676	WILLIAM GRANT & SONS INC	401.96K
Dunn Wine Brokers	0.766022	E & J GALLO WINERY	228.28K
CENTEUR IMPORTS LLC	0.773953	SAZERAC CO INC	198.44K
SMOKY QUARTZ DISTILLERY LLC	0.783835	BROWN-FORMAN CORP	177.73K
TAMWORTH DISTILLING	0.797078	CONSTELLATION BRANDS INC	133.62K
THE IMPORTED GRAPE LLC	0.807569	MOET HENNESSY USA INC	126.48K
WALPOLE MTN VIEW WINERY	0.820548	REMY COINTREAU USA INC	118.60K

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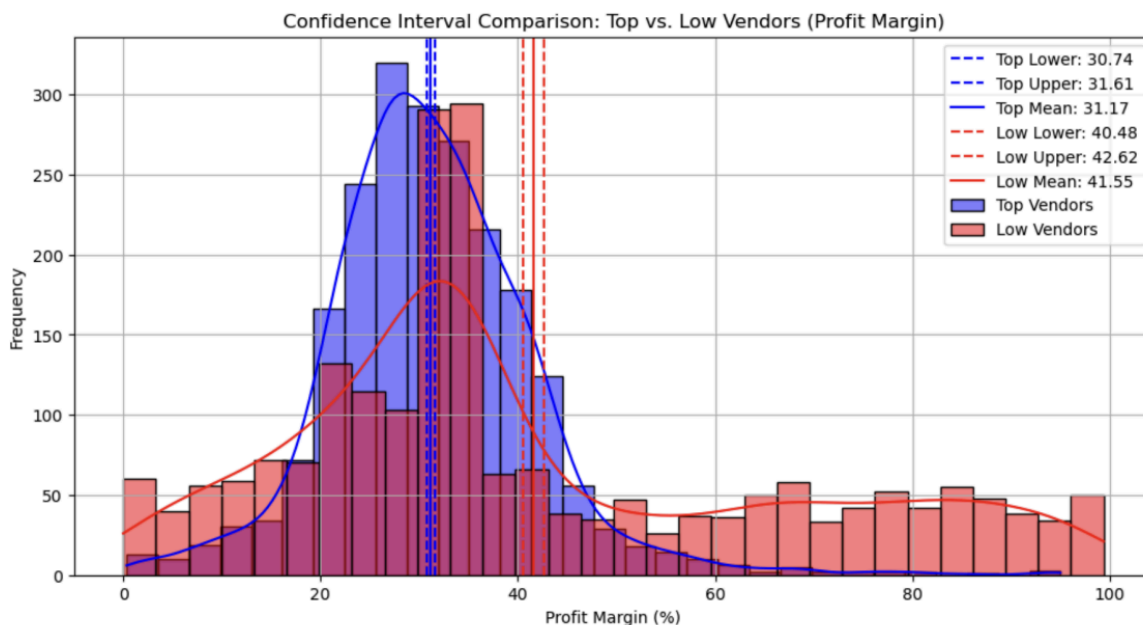
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5. Profitability Comparison: High vs. Low-Performing Vendors

- Top-performing vendors maintain a mean profit margin of 31.17% (95% CI: 30.74% – 31.61%), driven by stronger sales volume.
- Low-performing vendors, while contributing less to total sales, show a higher average profit margin of 41.55% (95% CI: 40.48% – 42.62%), highlighting potential issues with pricing inefficiencies, limited market penetration, or weak demand.

Actionable Insights:

- **Top Vendors:** Focus on maximizing profitability by refining pricing strategies, lowering operational costs, or introducing value-driven promotions and bundling.
- **Low Vendors:** Target sales growth by enhancing marketing outreach, revisiting pricing structures, and strengthening distribution and channel visibility to better align with market demand.



6. Statistical Validation of Profit Margin Differences

Hypothesis Testing

- **H₀ (Null Hypothesis):** No significant difference in profit margins between top and low-performing vendors.
- **H₁ (Alternative Hypothesis):** A significant difference exists in profit margins between the two vendor groups.
- **Result:** The null hypothesis is rejected, confirming that the two groups operate under distinctly different profitability models.
- **Implication:** High-margin vendors may benefit from better pricing strategies, while top-selling vendors could focus on cost efficiency.

7. Final Recommendations

- **Reassess Pricing for High-Margin, Low-Sales Brands:** Adjust pricing strategies to stimulate demand while preserving margin strength, leveraging the existing profitability cushion.
- **Expand and Diversify Vendor Base:** Reduce over-reliance on top suppliers by onboarding additional vendors, thereby strengthening supply chain resilience and minimizing risk exposure.
- **Maximize Bulk Purchasing Benefits:** Continue leveraging volume-based pricing to reduce unit costs, while aligning bulk orders with demand forecasts for optimal inventory control.
- **Address Slow-Moving Inventory:** Implement strategic actions such as adjusting purchase volumes, launching clearance campaigns, or optimizing warehousing practices to reduce carrying costs and free up working capital.
- **Strengthen Low-Performing Vendor Performance:** Enhance sales potential through improved marketing initiatives, refined pricing models, and more effective distribution strategies.