Vendor Performance Dashboard

Project Overview & Business Problem

Effective management of inventory and sales is essential for maximizing profitability in the retail and wholesale sector. Businesses must avoid losses caused by ineffective pricing strategies, low inventory turnover, or over-reliance on specific vendors.

The purpose of the analysis is to:

1. Highlight underperforming brands that may need promotional support or pricing revisions.
2. Identify the top vendors % brands driving sales performance.
3. Evaluate how bulk purchasing influences unit costs.
4. Examine inventory turnover to minimize holding expenses and enhance efficiency.
5. Compare profitability differences between high-performing and low-performing vendors.

Exploratory Data Analysis

- The purchases table contains actual purchase data, including the date of purchase, products (brands) purchased by vendors, the amount paid (in dollars), and the quantity purchased.
- The purchase price column is derived from the purchase_prices table, which provides product-wise actual and purchase prices. The combination Of vendor and brand is unique in this table.
- The vendor_invoice table aggregates data from the purchases table, summarizing quantity and dollar amounts, along with an additional column for freight. This table maintains uniqueness based on vendor and PO
- The sales table captures actual sales transactions, detailing the brands purchased by vendors, the quantity sold, the selling price, and the revenue earned.

Initially, the various tables were examined in the database to identify key variables, understand their relationships, and determine which ones should be included in the final analysis.

In the phase of EDA, we will analyze the resultant table to gain insights into the distribution of each column. This will help us understand data patterns, identify anomalies, and ensure data quality before proceeding with further analysis.

As the data that we need for analysis is distributed in different tables, we need to create a summary table that contains:

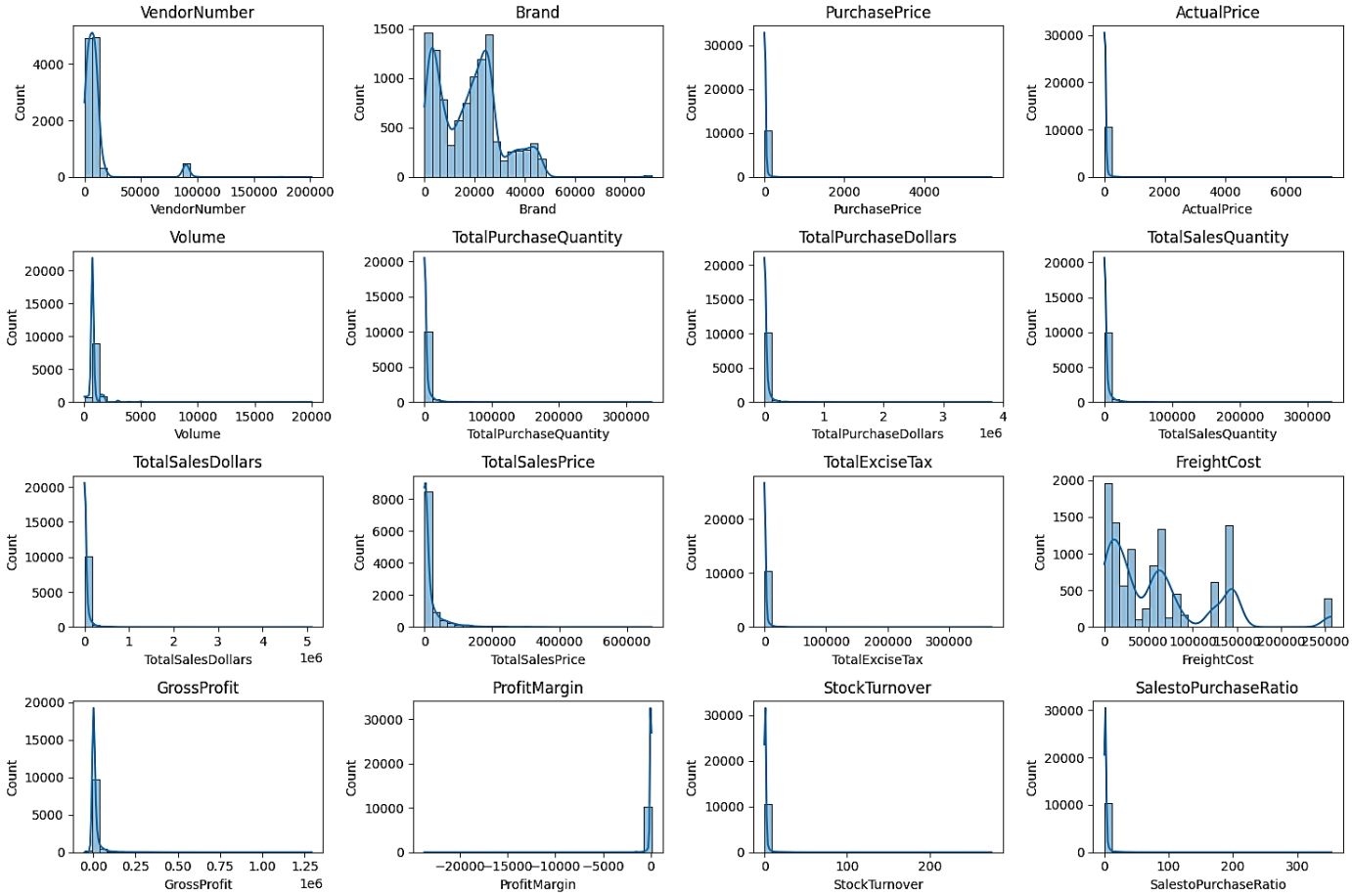
- purchase transactions made by vendors
- sales transaction data
- freight costs for each vendor
- actual product prices from vendors

A. Statistics of Summary Table

	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

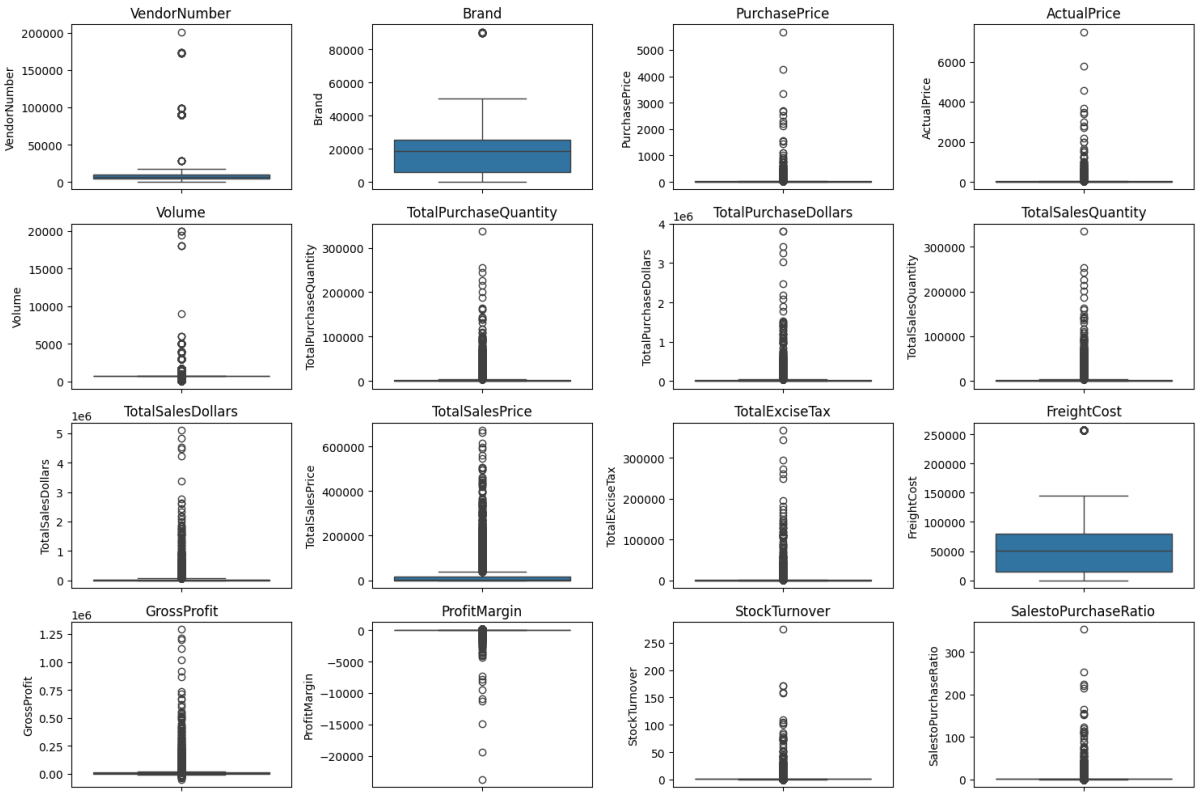
1. Negative and Zero Values

- **Gross Profit**: The minimum recorded value is -52,002.78, indicating potential losses. Such losses may result from high costs, excessive discounts, or products being sold below their purchase price.
- **Profit Margin**: The minimum value is -∞, which occurs in cases where revenue is either zero or lower than the total cost, leading to extreme negative margins.
- **Sales Quantity and Sales Dollars**: Certain products reflect zero sales, meaning they were purchased but never sold. This suggests the presence of slow-moving or obsolete inventory, highlighting inefficiencies in stock management.



2. Outliers Identified by High Standard Deviations

- **Purchase Price & Actual Price**: Maximum values (5,681.81 and 7,499.99) are significantly higher than the respective means (24.39 and 35.64). This indicates the existence of premium or specialized product categories within the dataset.
- **Freight Cost**: The range extends from 0.09 to 257,032.07, reflecting substantial variation. Such extremes could be attributed to logistics inefficiencies, bulk shipment costs, or inconsistent shipping practices across products.
- **Stock Turnover**: Values range from 0 to 274.5, showing that some products sell very quickly, while others remain unsold for extended periods. A turnover ratio greater than 1 suggests sales surpass purchased quantities, likely due to older stock being used to fulfil demand.



B. Data Cleaning – removing Inconsistencies

To improve the reliability and accuracy of the insights, inconsistent or non-representative data points were excluded from the analysis based on the following criteria:

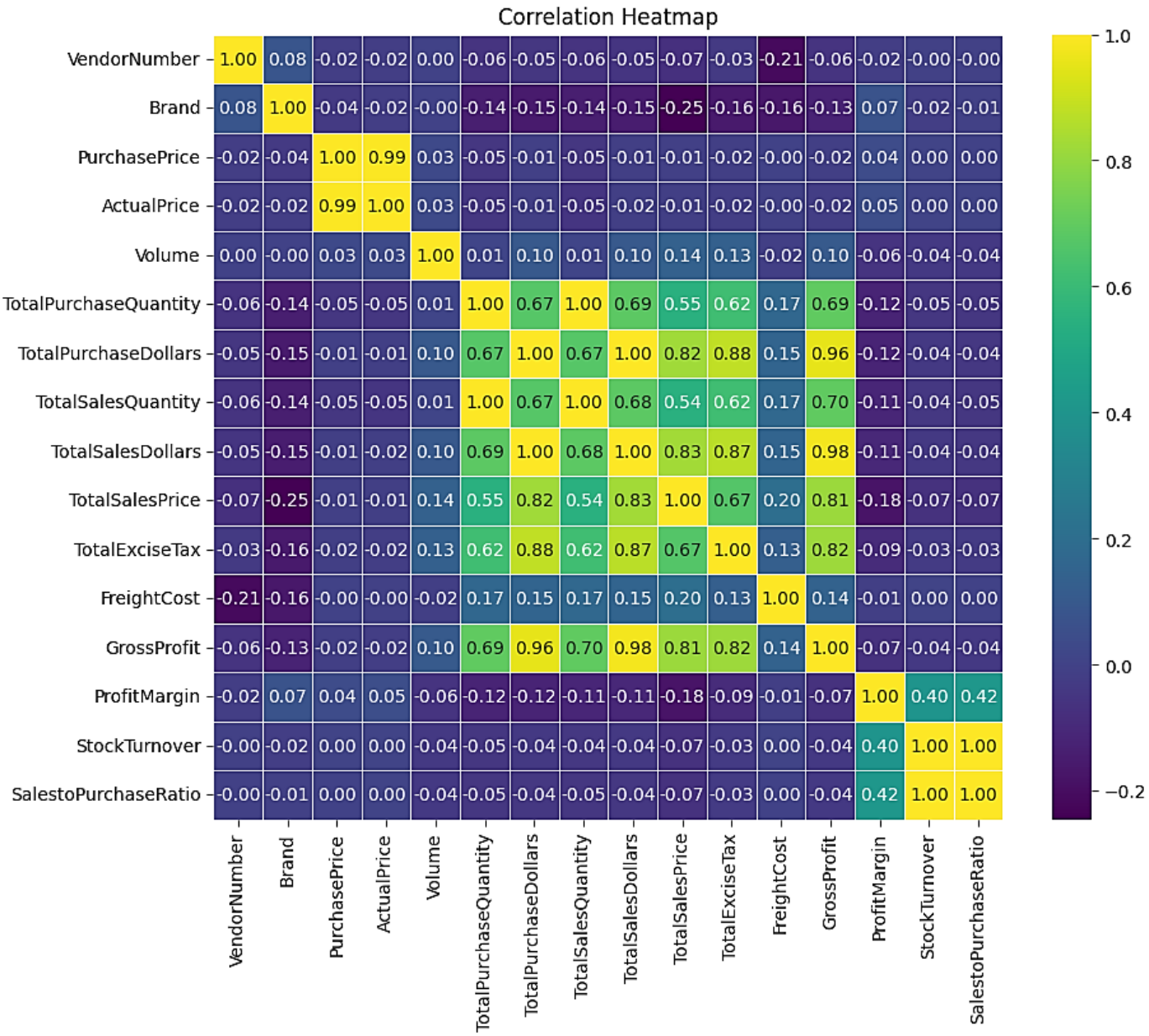
- **Gross Profit ≤ 0**: Transactions resulting in losses were removed to ensure the analysis focuses on profitable operations.
- **Profit Margin ≤ 0**: Entries with non-profitable or negative margins were excluded to highlight only value-generating transactions.
- **Total Sales Quantity = 0**: Products that were purchased but never sold were eliminated, as they do not contribute to sales performance analysis and may distort inventory insights.

C. Correlation Insights

- **Purchase Price vs. Total Sales Dollars & Gross Profit**: A weak correlation (**-0.012** and **-0.016**) was observed, suggesting that variations in purchase price have minimal impact on sales revenue or overall profitability.

- **Total Purchase Quantity vs. Total Sales Quantity**: A very strong positive correlation (**0.999**) confirms efficient inventory turnover, indicating that purchased quantities closely align with actual sales.
- **Profit Margin vs. Total Sales Price**: A negative correlation (**-0.179**) implies that higher sales prices may be associated with reduced margins, likely due to competitive pricing pressures or discounting strategies.

- **Stock Turnover vs. Gross Profit & Profit Margin**: Weak negative correlations (**-0.038** and **-0.055**) indicate that faster stock movement does not necessarily result in higher profitability or improved margins.


Correlation Heatmap
VendorNumber 1.00 0.08 -0.02 -0.02 0.00 -0.06 -0.05 -0.06 -0.05 -0.07 -0.03 -0.21 -0.06 -0.02 -0.00 -0.00
Brand 0.08 1.00 -0.04 -0.02 -0.00 -0.14 -0.15 -0.14 -0.15 -0.25 -0.16 -0.16 -0.13 0.07 -0.02 -0.01
PurchasePrice -0.02 -0.04 1.00 0.99 0.03 -0.05 -0.01 -0.05 -0.01 -0.01 -0.02 -0.00 -0.02 0.04 0.00 0.00
ActualPrice -0.02 -0.02 0.99 1.00 0.03 -0.05 -0.01 -0.05 -0.02 -0.01 -0.02 -0.00 -0.02 0.05 0.00 0.00
Volume 0.00 -0.00 0.03 0.03 1.00 0.01 0.10 0.01 0.10 0.14 0.13 -0.02 0.10 -0.06 -0.04 -0.04
TotalPurchaseQuantity -0.06 -0.14 -0.05 -0.05 0.01 1.00 0.67 1.00 0.69 0.55 0.62 0.17 0.69 -0.12 -0.05 -0.05
TotalPurchaseDollars -0.05 -0.15 -0.01 -0.01 0.10 0.67 1.00 0.67 1.00 0.82 0.88 0.15 0.96 -0.12 -0.04 -0.04
TotalSalesQuantity -0.06 -0.14 -0.05 -0.05 0.01 1.00 0.67 1.00 0.68 0.54 0.62 0.17 0.70 -0.11 -0.04 -0.05
TotalSalesDollars -0.05 -0.15 -0.01 -0.02 0.10 0.69 1.00 0.68 1.00 0.83 0.87 0.15 0.98 -0.11 -0.04 -0.04
TotalSalesPrice -0.07 -0.25 -0.01 -0.01 0.14 0.55 0.82 0.54 0.83 1.00 0.67 0.20 0.81 -0.18 -0.07 -0.07
TotalExciseTax -0.03 -0.16 -0.02 -0.02 0.13 0.62 0.88 0.62 0.87 0.67 1.00 0.13 0.82 -0.09 -0.03 -0.03
FreightCost -0.21 -0.16 -0.00 -0.00 -0.02 0.17 0.15 0.17 0.15 0.20 0.13 1.00 0.14 -0.01 0.00 0.00
GrossProfit -0.06 -0.13 -0.02 -0.02 0.10 0.69 0.96 0.70 0.98 0.81 0.82 0.14 1.00 -0.07 -0.04 -0.04
ProfitMargin -0.02 0.07 0.04 0.05 -0.06 -0.12 -0.12 -0.11 -0.11 -0.18 -0.09 -0.01 -0.07 1.00 0.40 0.42
StockTurnover -0.00 -0.02 0.00 0.00 -0.04 -0.05 -0.04 -0.04 -0.04 -0.07 -0.03 0.00 -0.04 0.40 1.00 1.00
SalestoPurchaseRatio -0.00 -0.01 0.00 0.00 -0.04 -0.05 -0.04 -0.05 -0.04 -0.07 -0.03 0.00 -0.04 0.42 1.00 1.00
VendorNumber
Brand
PurchasePrice
ActualPrice
Volume
TotalPurchaseQuantity
TotalPurchaseDollars
TotalSalesQuantity
TotalSalesDollars
TotalSalesPrice
TotalExciseTax
FreightCost
GrossProfit
ProfitMargin
StockTurnover
SalestoPurchaseRatio
1.0
0.8
0.6
0.4
0.2
0.0
−0.2

Research Questions & Key Findings

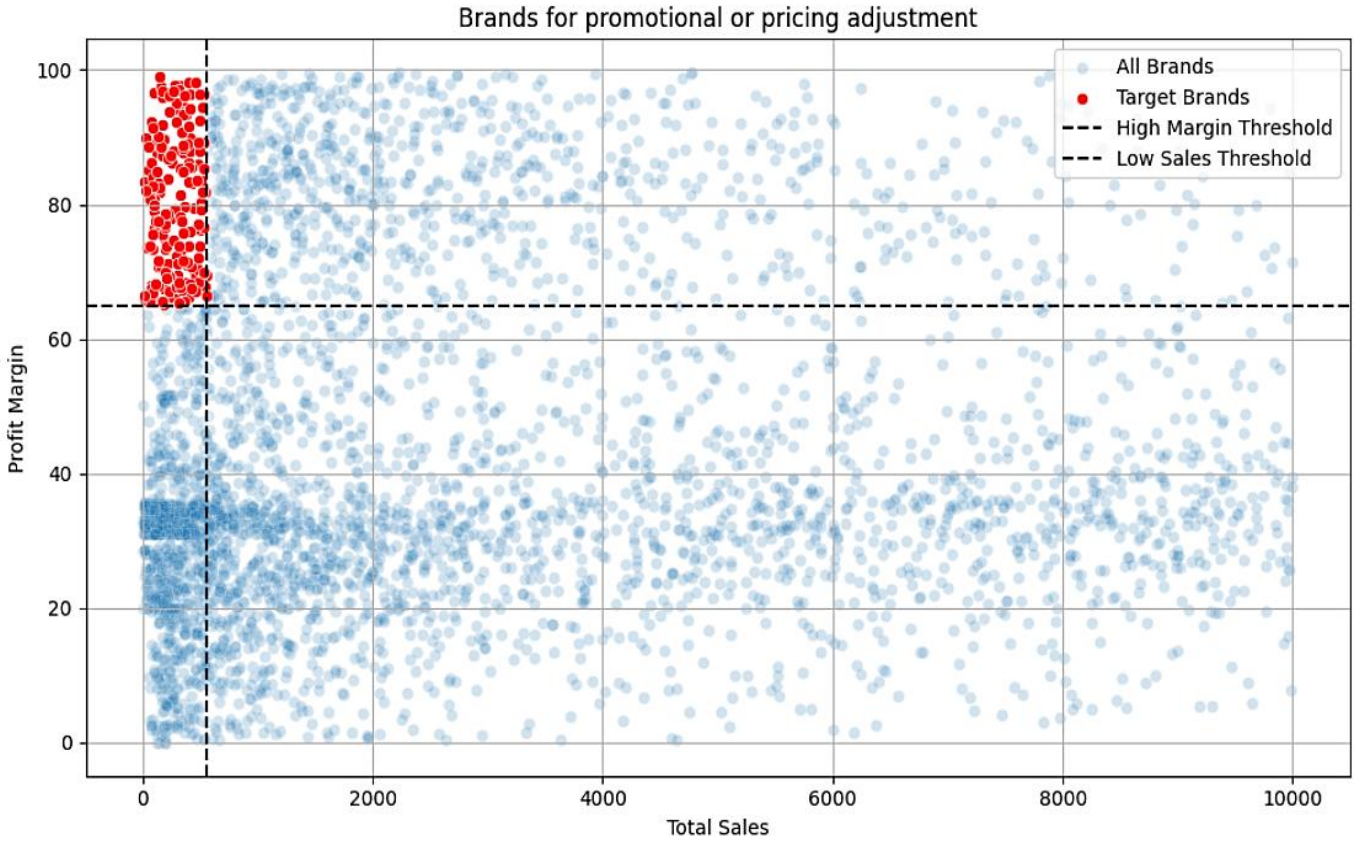
1. Underperforming brands that need promotional support or pricing revisions.

***** 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

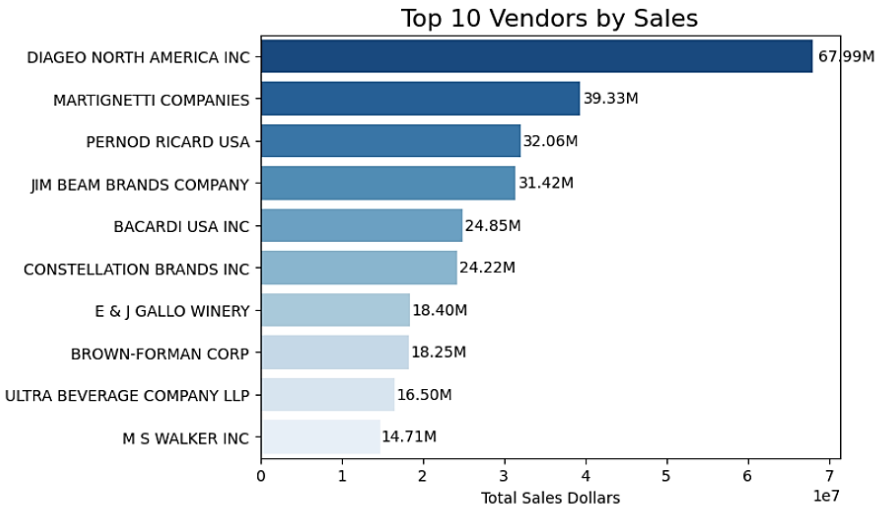
198 rows × 3 columns

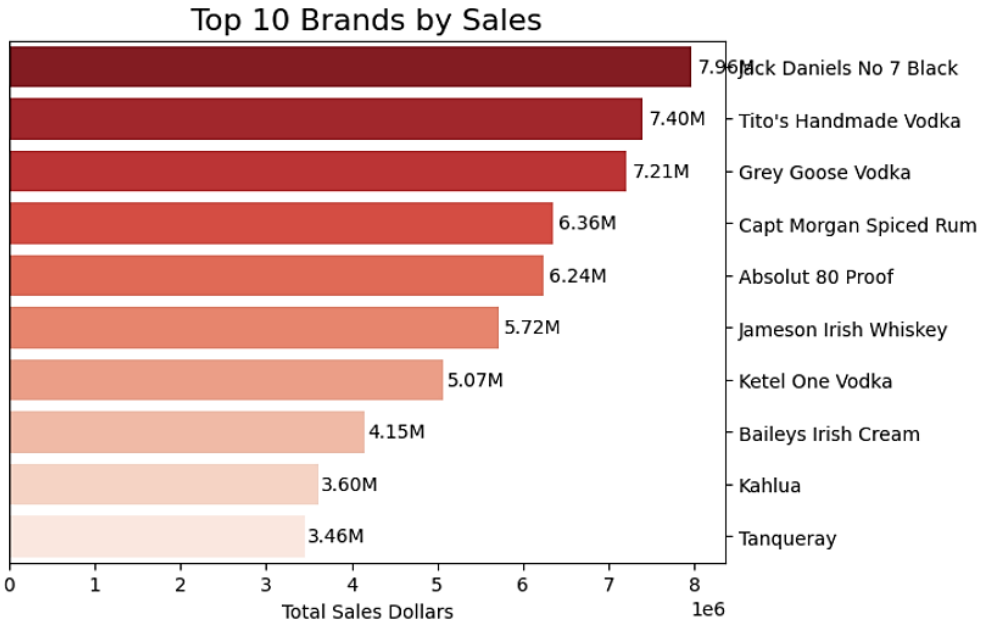
A total of **198 brands** were identified with lower sales but higher profit margins. These brands present an opportunity for growth through targeted marketing initiatives, promotional campaigns, or strategic price adjustments aimed at increasing sales volume while maintaining profitability levels.

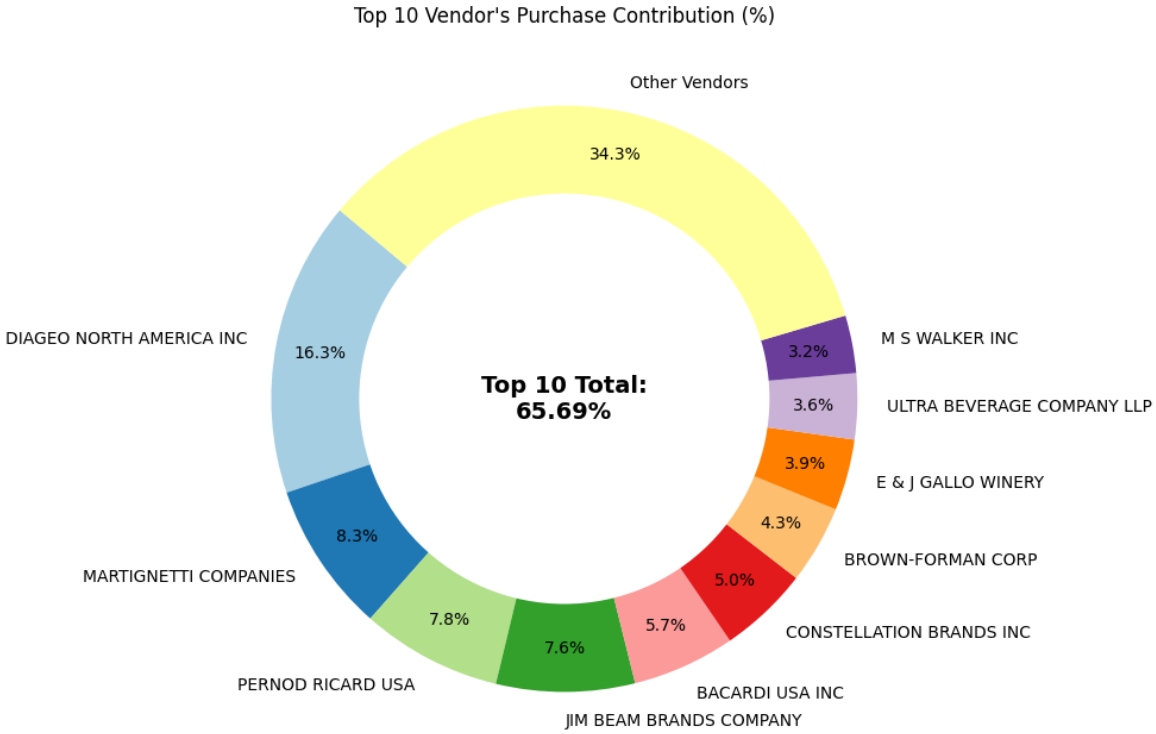


The scatter plot will show each brand as a dot with total sales on the x-axis and profit margin on the y-axis. Vertical and horizontal threshold lines will split the chart into four quadrants, distinguishing low vs. high sales and low vs. high margins.

2. Top Vendors & Brands driving Sales Performance.




Top 10 Brands by Sales
7.96M
7.40M
7.21M
6.36M
6.24M
5.72M
5.07M
4.15M
3.60M
3.46M
Jack Daniels No 7 Black
Tito's Handmade Vodka
Grey Goose Vodka
Capt Morgan Spiced Rum
Absolut 80 Proof
Jameson Irish Whiskey
Ketel One Vodka
Baileys Irish Cream
Kahlua
Tanqueray
0
1
2
3
4
5
6
7
8
1e6
Total Sales Dollars


Top 10 Vendor's Purchase Contribution (%)
Other Vendors
34.3%
DIAGEO NORTH AMERICA INC
16.3%
M S WALKER INC
3.2%
ULTRA BEVERAGE COMPANY LLP
3.6%
E & J GALLO WINERY
3.9%
BROWN-FORMAN CORP
4.3%
CONSTELLATION BRANDS INC
5.0%
BACARDI USA INC
5.7%
JIM BEAM BRANDS COMPANY
7.6%
PERNOD RICARD USA
7.8%
MARTIGNETTI COMPANIES
8.3%
Top 10 Total:
65.69%

3. Evaluate how bulk purchasing influences Unit Costs.

OrderSize	UnitPurchasePrice
Small	39.057543
Medium	15.486414
Large	10.777625

- Vendors placing large orders secure the lowest unit purchase price ($10.78 per unit), which can translate into higher margins, provided inventory is managed efficiently.
- The price gap between small and large orders is significant, reflecting a 72% reduction in unit cost for bulk purchases.
- This indicates that bulk pricing strategies are effective, incentivizing vendors to buy in larger volumes. While per-unit revenue may decline, overall sales and profitability are enhanced through increased purchase volumes.

4. Examine Vendors with low inventory turnover.

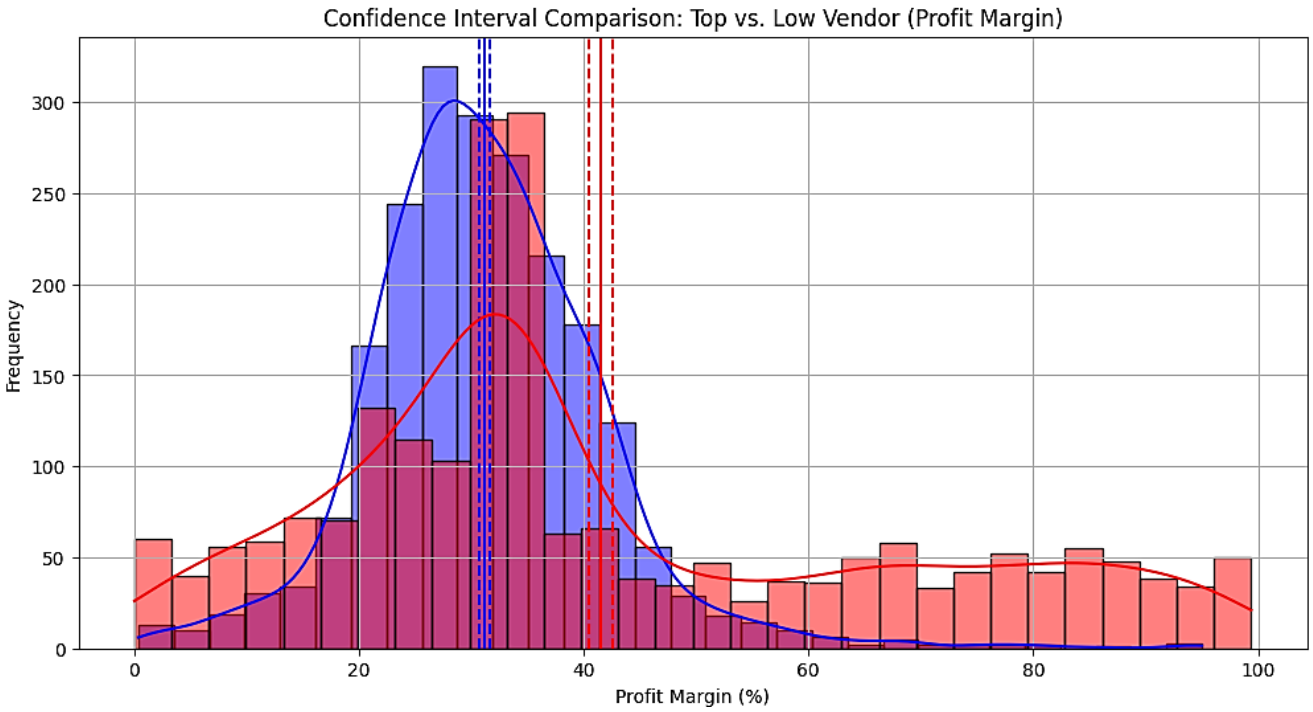
	VendorName	UnsoldInventoryValue
25	DIAGEO NORTH AMERICA INC	722.2K
46	JIM BEAM BRANDS COMPANY	554.7K
68	PERNOD RICARD USA	470.6K
116	WILLIAM GRANT & SONS INC	402.0K
30	E & J GALLO WINERY	228.3K
79	SAZERAC CO INC	198.4K
11	BROWN-FORMAN CORP	177.7K
20	CONSTELLATION BRANDS INC	133.6K
61	MOET HENNESSY USA INC	126.5K
77	REMY COINTREAU USA INC	118.6K

- The total value of **unsold inventory** amounts to **$2.71 million**, tying up significant capital.
- **Slow-moving stock** contributes to higher storage costs, reduced cash flow efficiency, and diminished overall profitability.
- Identifying **vendors with low inventory turnover** is essential for improving stock management practices and minimizing financial strain on operations.

5. Analyze the profitability gap between high-performing and low-performing vendors.

Top Vendors 95% CI: (30.74, 31.61, Mean: 31.17)

Low Vendors 95% CI: (40.48, 42.62, Mean: 41.55)



- The confidence interval for low-performing vendors (40.44% to 42.62%) is notably higher than that of high-performing vendors (30.74% to 31.61%).
- This indicates that vendors with lower sales volumes tend to sustain higher profit margins, potentially due to premium pricing strategies or reduced operational costs.

Implications:

- High-Performing Vendors: To enhance profitability, these vendors could consider selective price adjustments, cost optimization measures, or product bundling strategies.
- Low-Performing Vendors: While margins are relatively strong, the low sales volumes highlight the need for targeted marketing initiatives, competitive pricing adjustments, or improvements in distribution channels to drive growth.

6. Statistical Validation of Profit Margin Differences

Hypothesis Testing on Vendor Profitability

- H_o (Null Hypothesis): There is no significant difference in profit margins between high-performing and low-performing vendors.
- H_1 (Alternative Hypothesis): A significant difference exists in profit margins between the two vendor groups.

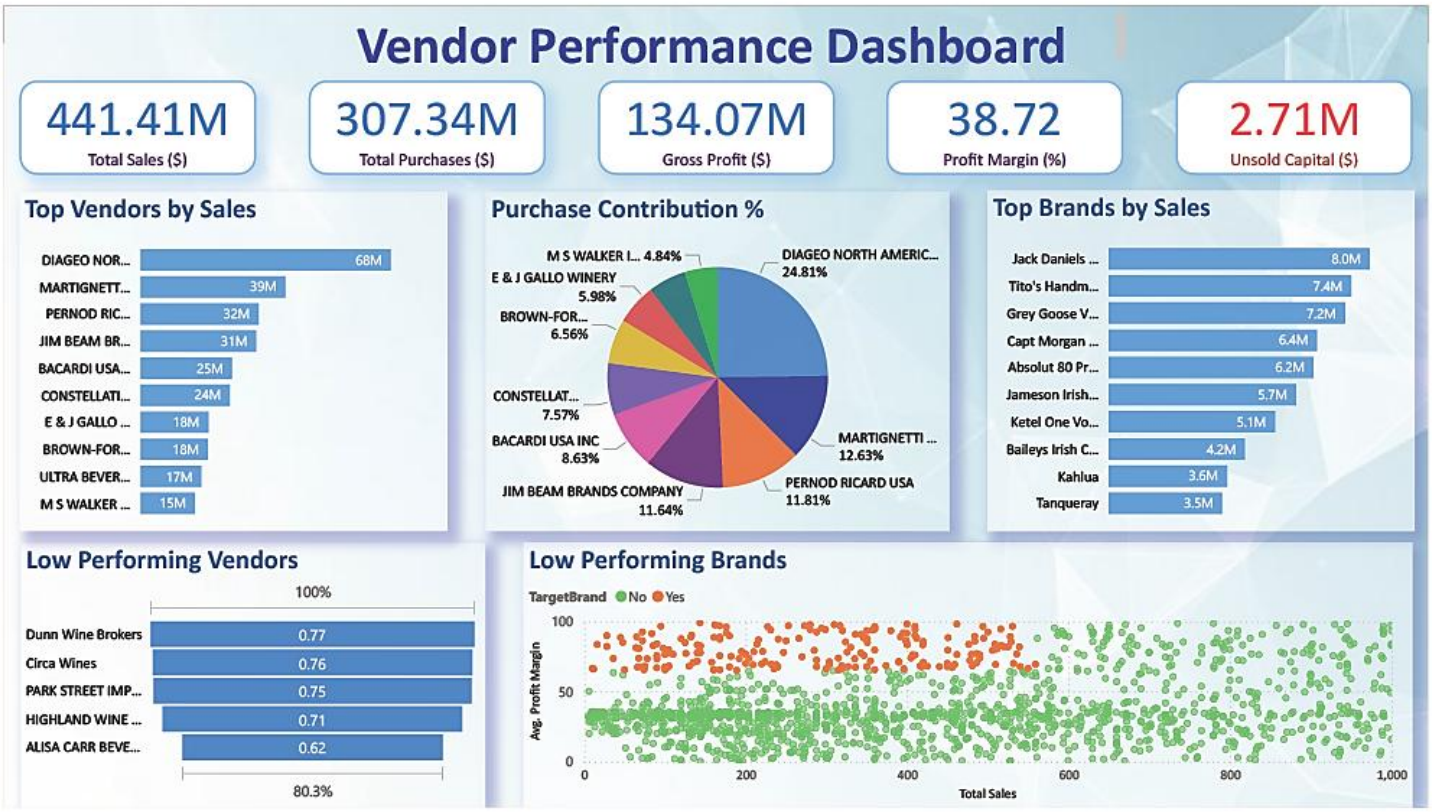
T-Statistic: -17.6440, p_value: 0.0000

Result: The null hypothesis is rejected, indicating that the two groups operate under distinctly different profitability models.

Implication:

- High-Margin Vendors: Likely benefit from strong pricing strategies and may sustain profitability despite lower sales volumes.
- Top-Selling Vendors: Could improve profitability further by focusing on cost efficiency, process optimization, or scale advantages.

Dashboard



Final Recommendations

- Re-evaluate Pricing Strategies: Adjust pricing for low-sales, high-margin brands to stimulate demand and increase sales volume while safeguarding profitability.
- Diversify Vendor Partnerships: Reduce dependency on a limited set of suppliers to mitigate supply chain risks and ensure greater stability.
- Leverage Bulk Purchasing: Maximize the benefits of bulk order discounts to maintain competitive pricing and improve inventory cost efficiency.
- Optimize Slow-Moving Inventory: Address unsold or slow-moving stock through adjusted purchase planning, clearance initiatives, or improved storage management.

- Strengthen Marketing & Distribution: Enhance visibility and accessibility of low-performing vendors through targeted marketing campaigns, competitive pricing, and expanded distribution channels.

By implementing these strategies, the company can achieve sustainable profitability, reduced operational risks, and improved overall efficiency across inventory and vendor management.

Conclusion

The Vendor Performance Analysis project demonstrates how data analytics can provide valuable insights into sales, profitability, and inventory management within the retail and wholesale sector.

By integrating multiple datasets through SQL and applying statistical analysis and visualization in Python, the study uncovered key patterns such as inefficient pricing, the impact of bulk purchasing, unsold inventory challenges, and distinct profitability models between high- and low-performing vendors.

The findings confirm that while high-performing vendors generate larger sales volumes, low-performing vendors often sustain higher profit margins through premium pricing or cost advantages.

Additionally, the analysis highlighted that inventory inefficiencies, such as slow-moving stock worth $2.71 million, directly affect cash flow and profitability. Hypothesis testing further validated the significant difference in profitability between vendor groups, reinforcing the importance of tailored strategies for each segment.

Overall, the project emphasizes the strategic value of combining SQL-based data engineering with Python-driven analytics to translate raw transactional data into actionable business insights. Implementing the recommended strategies—such as optimizing pricing, leveraging bulk purchasing, diversifying vendors, and improving marketing and distribution—can enable organizations to enhance profitability, reduce risks, and strengthen supply chain efficiency.

This project not only addresses critical business challenges but also demonstrates the potential of data analytics as a powerful tool for decision-making and performance optimization.