# Project Objective:

- This project was designed to analyze vendor performance across sales, purchases, and freight data. The goal was to provide clear, data-driven insights into vendor efficiency, profitability, and contribution to business growth. A complete data pipeline was developed in Python using SQLite and Pandas, followed by the creation of an interactive dashboard for visualization.

Exploratory Data Analysis Insights

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
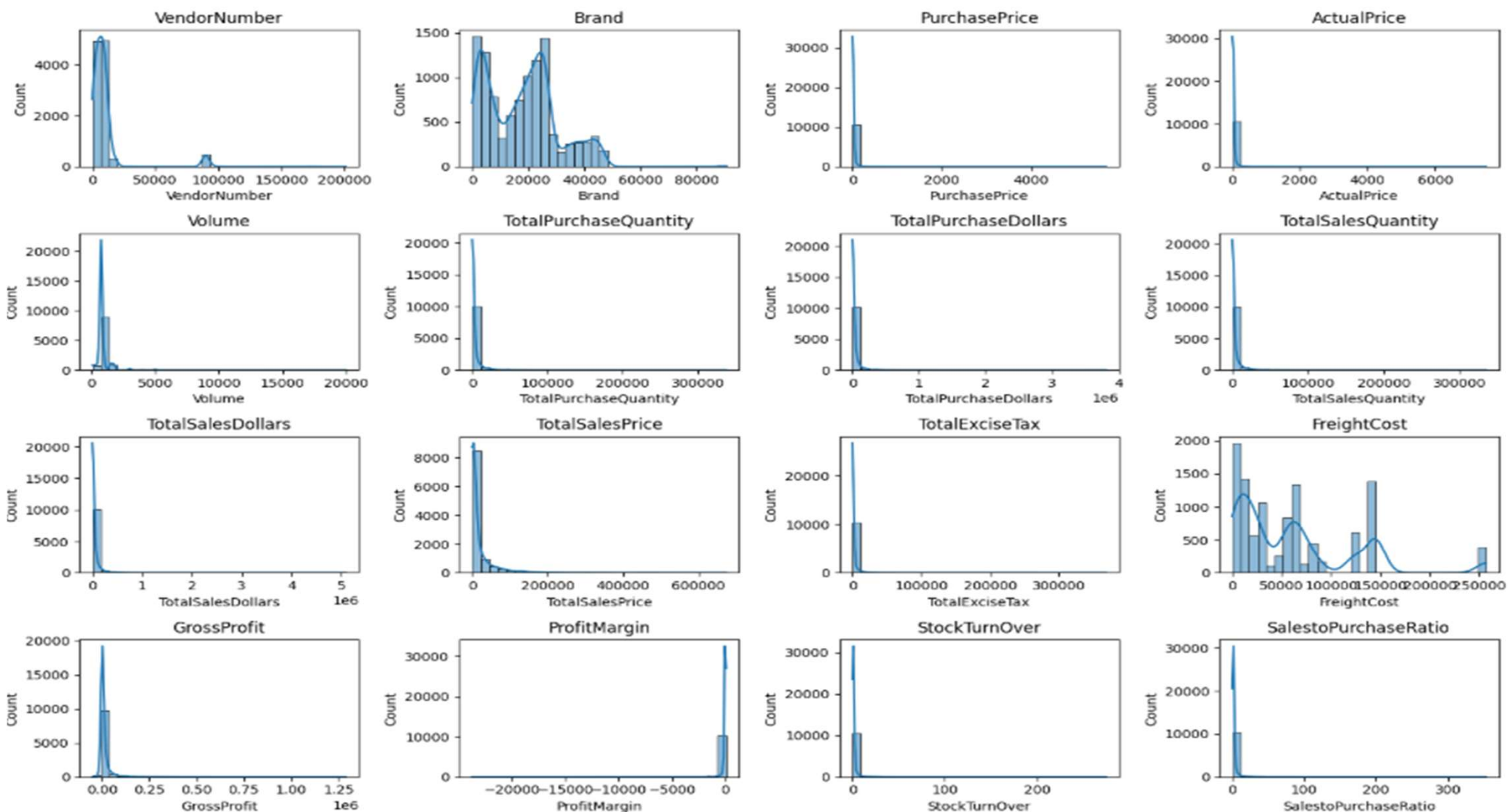
Negative & Zero Values:

- **Gross Profit:** Minimum of -52,002.78, indicating potential losses due to high costs or heavy discounts. This could be due to selling products at lower prices than their purchase costs.

- **Profit Margin:** Has a minimum of –inf, which suggests instances where revenue is zero or even lower than the total cost ,leading to extreme negative profit margins.

- **Total Sales Quantity & Sales Dollars:** Some products show zero sales, indicating they were purchased but never sold. These may be slow-moving or obsolete stock, leading to inventory inefficiencies.

Outliers Detected by High Standard Deviations:

Purchase & Actual prices: The maximum values (5,681.81 & 7,499.99) are significantly higher than the mean (24.39 & 35.64), indicating premium product offerings.

Freight Cost: Extreme variation from 0.09 to 257,032.07 suggests logistics inefficiencies, bulk shipments, or erratic shipping costs across different products.

Stock Turnover: Ranges from 0 to 274.5, suggesting some products sell rapidly while others remain unsold for long periods. A value greater than 1 indicates that sales for a product exceed the purchased quantity due to older stock fulfilling orders.

Data Filtering

To enhance the reliability of the insights , we removed inconsistent data points where:

 1) Gross Profit <=0 (to exclude transactions leading to losses

 2) Profit Margin <=0 (to ensure analysis focuses on profitable transactions)

 3)Total Sales Quantity =0(to eliminate inventory that was never sold)

Correlation Insights

Correlation Heatmap
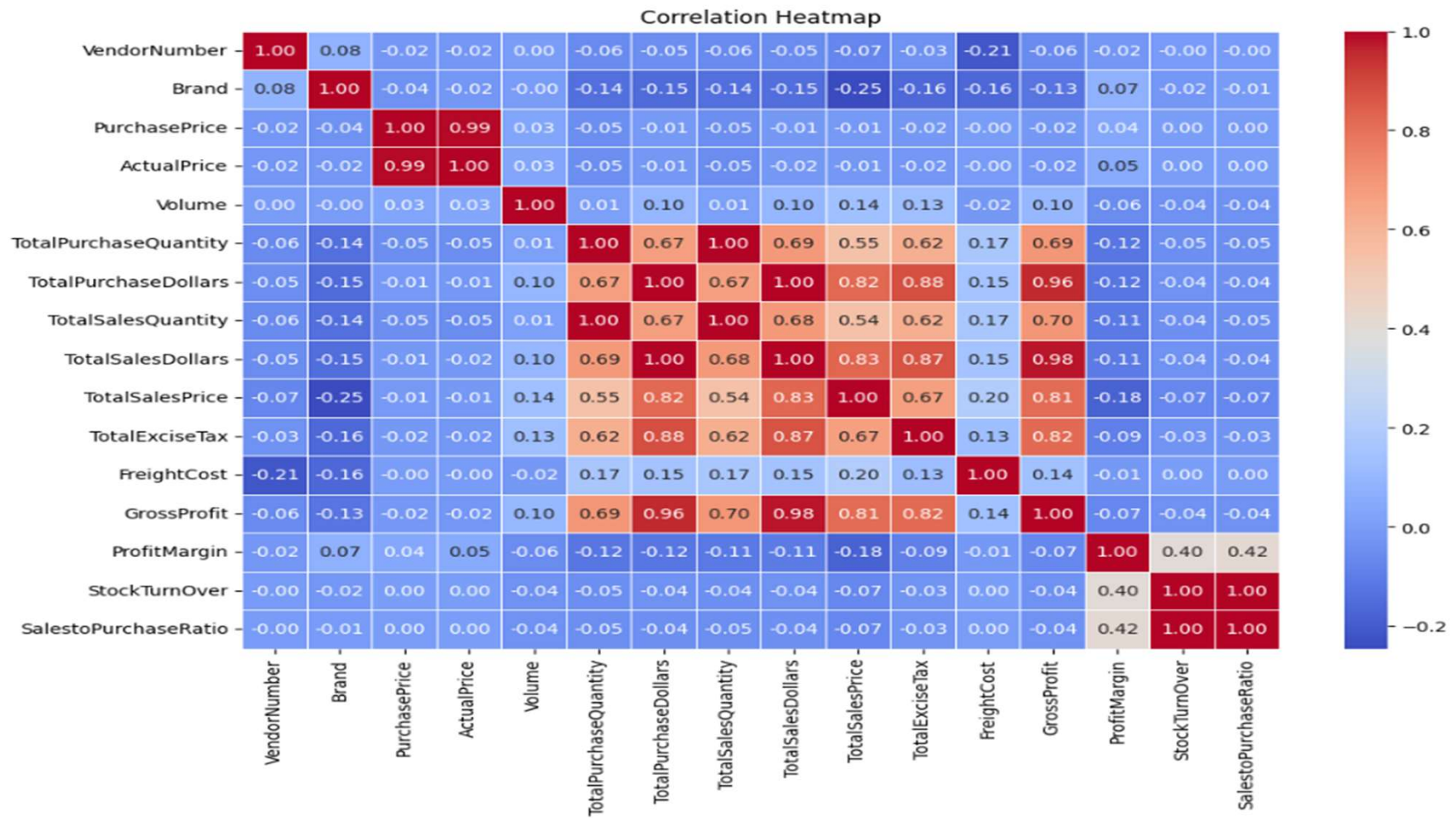
Purchase Price vs Total Sales Dollars & Gross Profit: weak correlation (-0.012 and -0.016), indicating that price variations do not significantly impact sales revenue or profit.

Total Purchase Quantity vs Total Sales Quantity: Strong Correlation (0.999), confirming efficient inventory turnover.

Profit Margin vs Total Sales Price : Negative correlation (-0.179), suggesting increasing sales prices may lead to reduced margins, possibly due to competitive pricing pressures.

Stock Turnover vs Gross Profit & Profit Margin: Weak negative correlation (-0.038 & -0.055), indicating that faster stock turnover does not necessarily equate to higher probability.

# Research Questions and Key Findings

1) Brands for Promotional or Pricing adjustments

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

198 brands exhibit lower sales but higher profit margins ,which could benefit from targeted marketing , promotions, or price optimizations to increase volume without compromising profitability.

Brands for Promotional or Pricing Adjustments
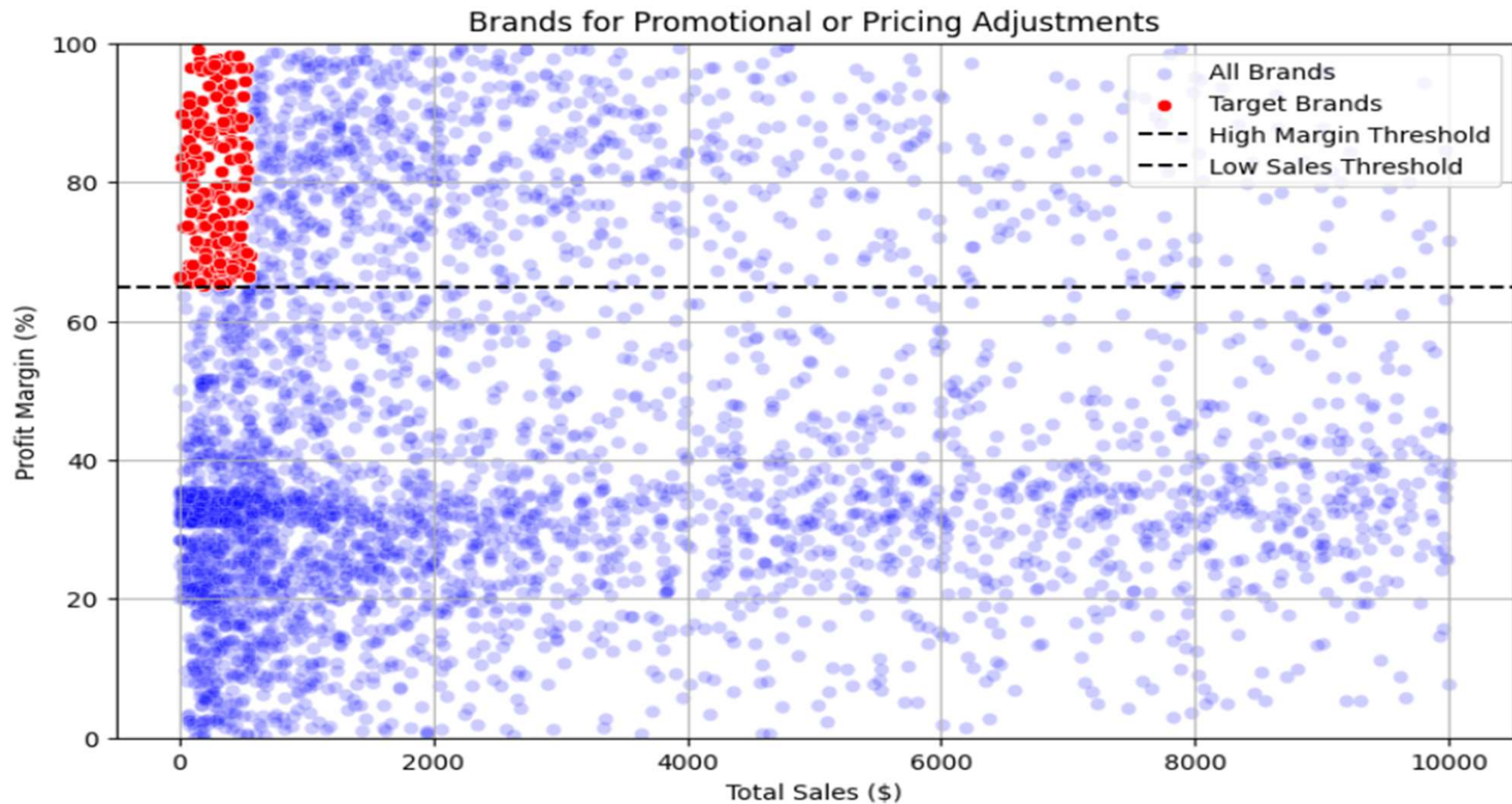
2)Top Vendors by Sales & Purchase contribution

The top 10 vendors contribute 65.69% of total purchases , while the remaining vendors contribute only 34.31%. This over-reliance on a few vendors may introduce risks such as supply chain disruptions, indicating a need for diversification

Top 10 Vendor's Purchase Contribution (%)
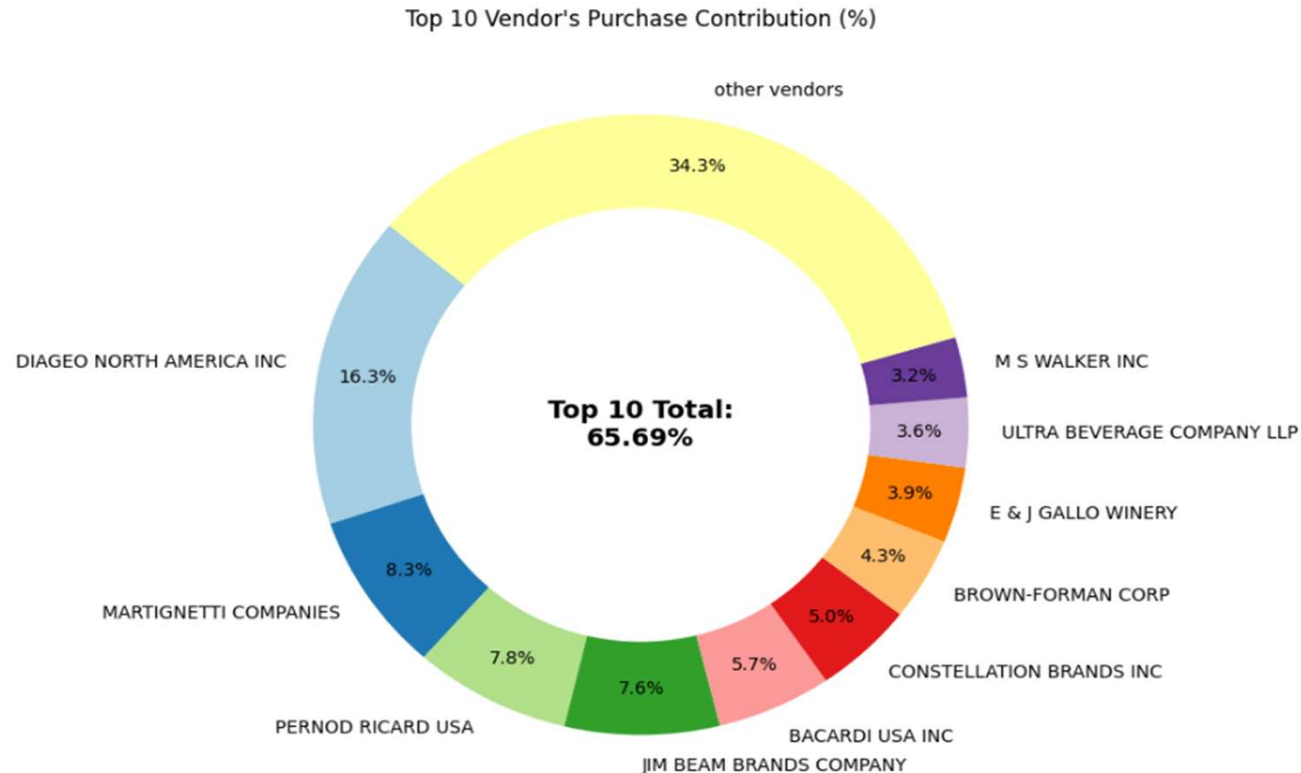
3)Impact of Bulk Purchasing on cost Savings

Vendors buying in large quantities receive a 72% lower unit cost ($10.78 per unit vs higher unit costs in smaller orders).

Bulk pricing strategies encourage larger orders, increasing total sales while maintaining profitability

OrderSize	UnitPurchasePrice
small	39.068186
Medium	15.486414
Large	10.777625

4) Identifying Vendors with Low Inventory Turnover

Total Unsold Inventory Capital : $2.71M

Slow-moving inventory increases storage costs, reduces cash flow efficiency , and affects overall profitability

Identifying vendors with low inventory turnover enables better stock management ,minimizing financial strain.

VendorName	StockTurnOver
ALISA CARR BEVERAGES	0.615385
HIGHLAND WINE MERCHANTS LLC	0.708333
PARK STREET IMPORTS LLC	0.751306
Circa Wines	0.755676
Dunn Wine Brokers	0.766022
CENTEUR IMPORTS LLC	0.773953
SMOKY QUARTZ DISTILLERY LLC	0.783835
TAMWORTH DISTILLING	0.797078
THE IMPORTED GRAPE LLC	0.807569
WALPOLE MTN VIEW WINERY	0.820548

	VendorName	UnsoldInventoryValue
25	DIAGEO NORTH AMERICA INC	722.209050K
46	JIM BEAM BRANDS COMPANY	554.665630K
68	PERNOD RICARD USA	470.625610K
116	WILLIAM GRANT & SONS INC	401.960830K
30	E & J GALLO WINERY	228.282610K
79	SAZERAC CO INC	198.436410K
11	BROWN-FORMAN CORP	177.733740K
20	CONSTELLATION BRANDS INC	133.617620K
61	MOET HENNESSY USA INC	126.477700K
77	REMY COINTREAU USA INC	118.598150K

5. Profit Margin Comparison: High vs Low-Performing Top Vendors

Top vendors' Profit Margin (95% CI): (30.74%, 31.61%), Mean: 31.17%

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

Low-performing vendors maintain higher margins but struggle with sales volumes, indicating potential pricing inefficiencies or market reach issues.

Actionable Insights:

 1)Top-performing vendors: Optimize profitability by adjusting pricing, reducing operational costs, or offering bundled promotions.

 2)Low-performing vendors: Improve marketing efforts , optimize pricing strategies, and enhance distribution networks

Confidence Interval Comparision: Top vs Low Vendors (Profit Margin)
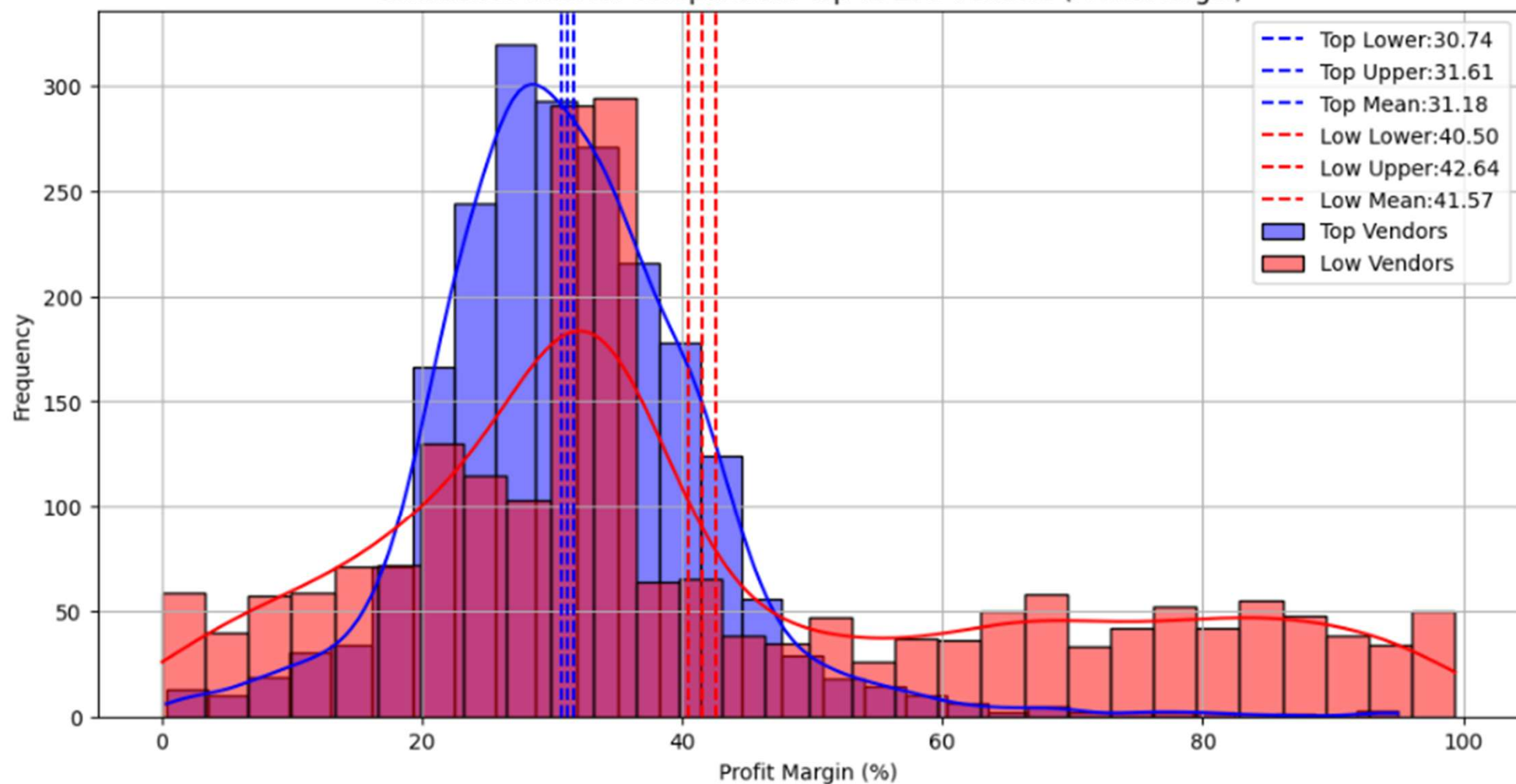
6. Statistical Validation of Profit Margin Differences

Hypothesis Testing:

Ho (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.

Final Recommendations

- Re-evaluate pricing for low-sales , high-margin brands to boost sales volume without sacrificing probability.

- Diversify vendor partnerships to reduce dependency on a few suppliers and mitigate supply chain risks.

- Leverage bulk purchasing advantages to maintain competitive pricing while optimizing inventory management.

- Optimize slow-moving inventory by adjusting purchase quantities, launching clearance sales, or revising storage strategies.

- Enhance marketing and distribution strategies for low-performing vendors to drive higher sales volumes without compromising profit margins.

- By implementing these recommendations, the company can achieve sustainable profitability, mitigate risks, and enhance overall operational efficiency.