

# Business Problem

Effective inventory and sales management play a key role in improving profits in both retail and wholesale businesses. Companies must avoid losses caused by incorrect pricing, slow-moving stock, or relying too much on a few suppliers.

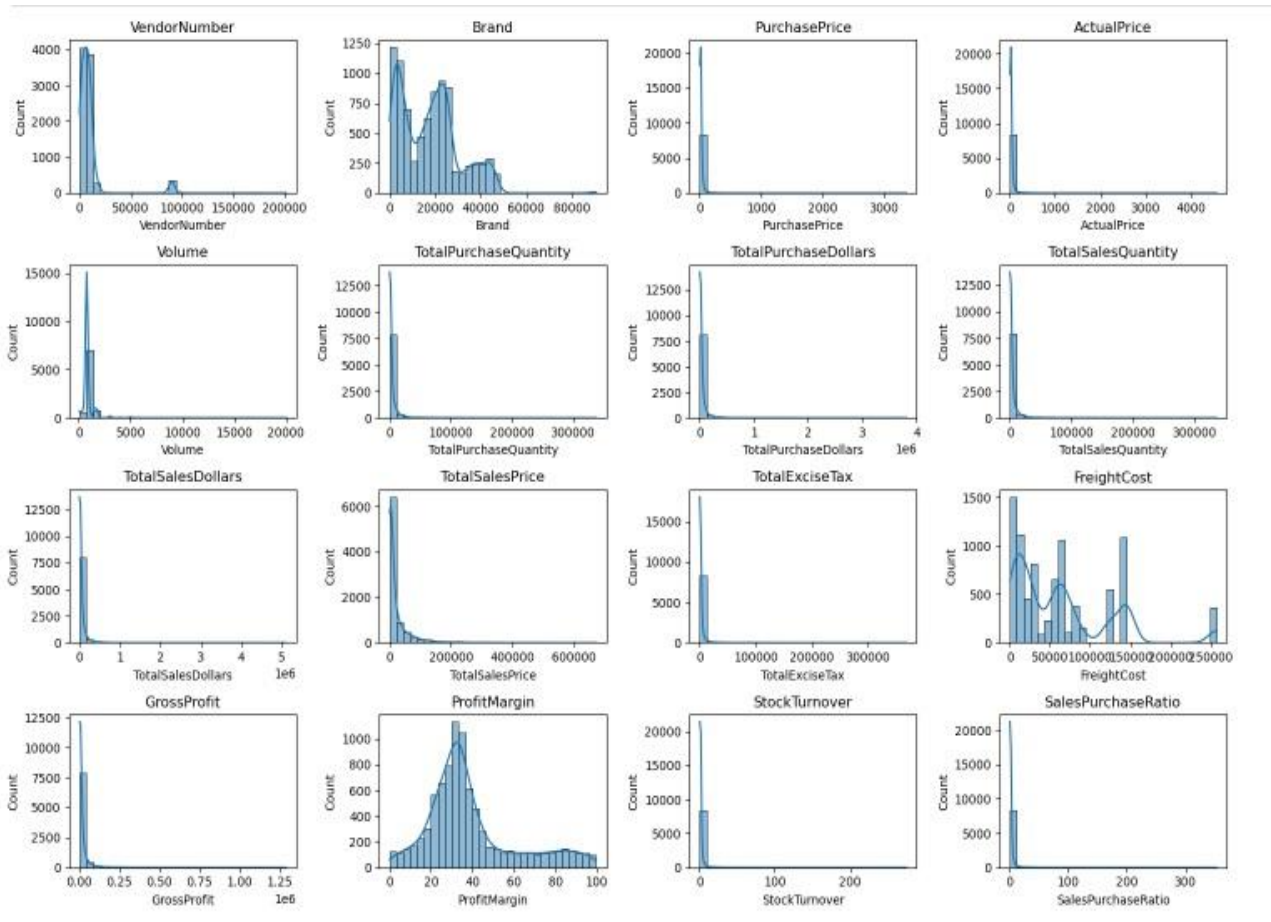
This analysis aims to:

- Spot low-performing brands that may need promotions or pricing changes.
- Identify top suppliers who drive the most sales and profit.
- Understand how bulk buying affects cost per unit.
- Review inventory turnover to lower storage costs and boost efficiency.
- Compare the profit margins between well-performing and poorly-performing suppliers.

## 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
SalesPurchaseRatio	10692.0	2.504390e+00	8.459067	0.00	1.153729	1.436894	1.665449	3.529286e+02



## ▼ Negative & Zero Values

- **Gross Profit:** The lowest gross profit recorded is -52,002.78, which shows some products are being sold at a loss—either due to high purchase costs or heavy discounts below cost price.
- **Profit Margin:** A minimum value of negative infinity ( $-\infty$ ) indicates that in some cases, revenue is either zero or even less than the cost, which is a critical issue.
- **Sales Quantity & Sales Value:** Minimum values are zero, meaning some products were **purchased but never sold**. These items may be slow-moving or obsolete stock.

## ⚠ **Outliers (High Variation in Values)**

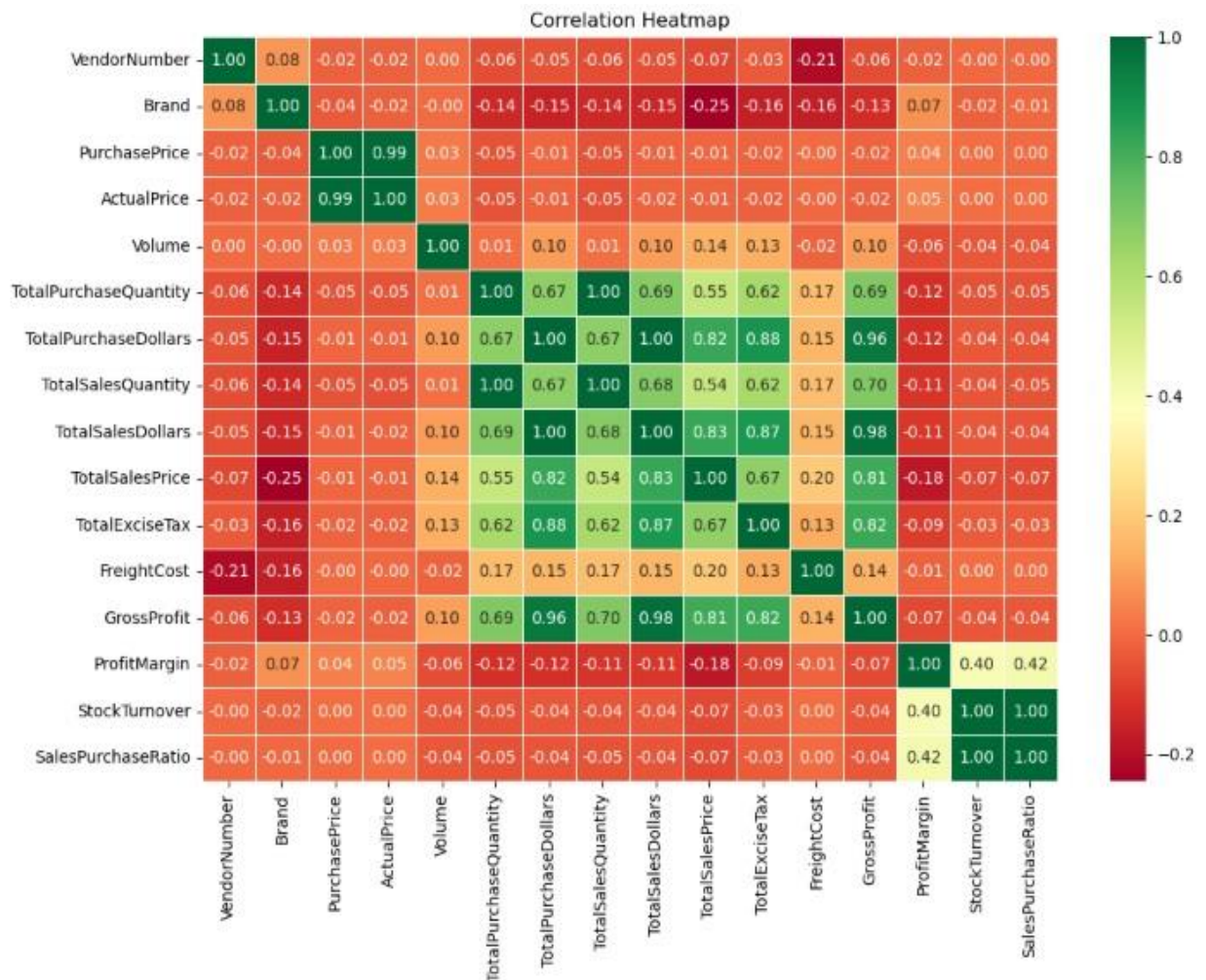
- **Purchase Price & Actual Selling Price:** The maximum purchase and selling prices (5,681.81 and 7,499.99) are much higher than the average (24.39 and 35.64), suggesting the presence of premium or high-value products in the inventory.
- **Freight Cost:** Ranges from 0.09 to 257,032.07, indicating huge variation. This could point to logistical inefficiencies or bulk shipments affecting cost control.
- **Stock Turnover Ratio:** Varies from 0 to 274.5. A ratio above 1 means some products are selling more than the quantity purchased, possibly because sales are being fulfilled from previous stock. On the other hand, a ratio of 0 signals no movement, suggesting dead stock.

## **Data Filtering**

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

- $\text{Gross Profit} \leq 0$  (to exclude transactions leading to losses).
- $\text{Profit Margin} \leq 0$  (to ensure analysis focuses on profitable transactions).
- $\text{Total Sales Quantity} = 0$  (to eliminate inventory that was never sold).

## Correlation Insights



**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 profitability.



# Research Questions & Key Findings

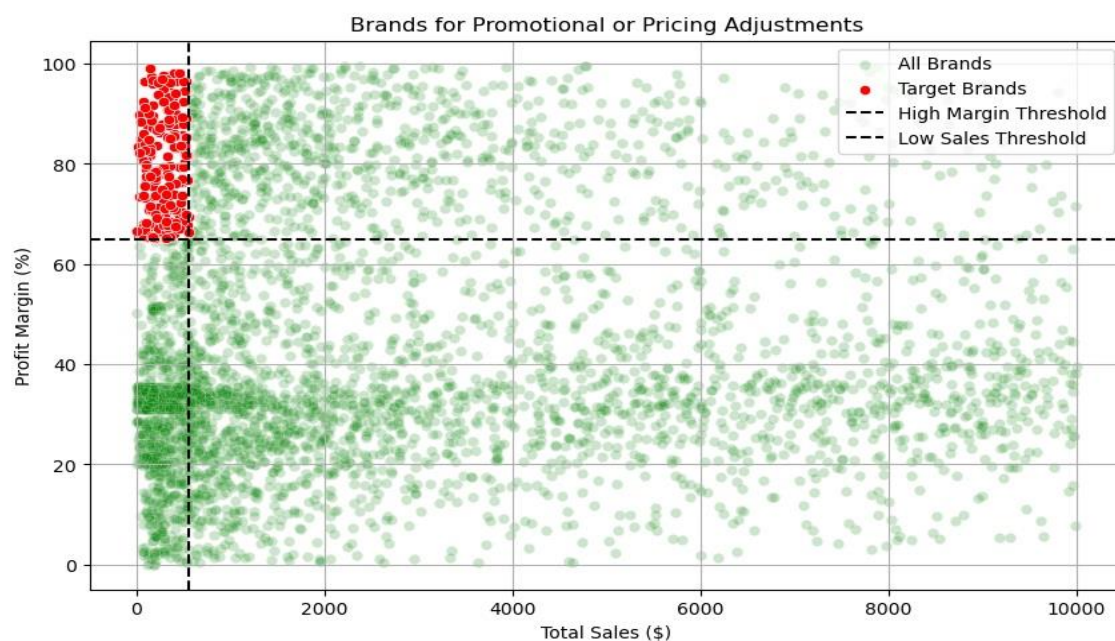
## 1. Brands for Promotional or Pricing Adjustments

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

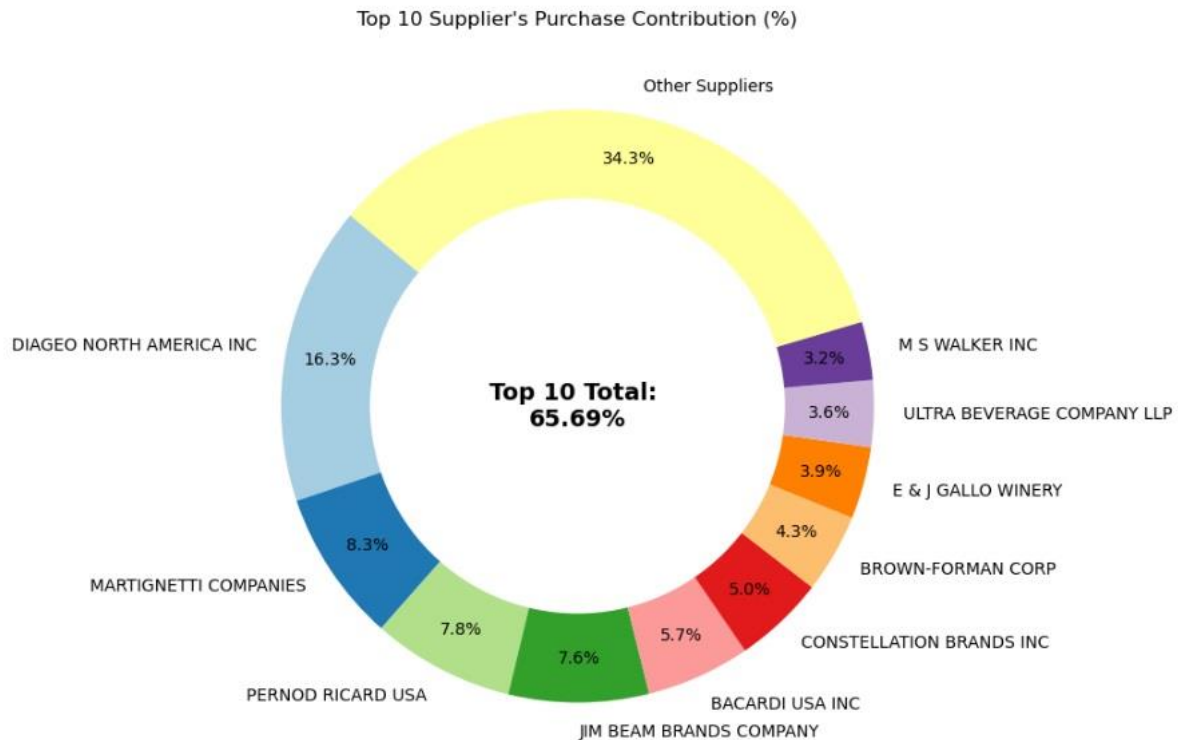
198 rows × 3 columns

There are 198 brands with low sales volumes but high profit margins. These brands have the potential to grow through targeted marketing, promotional campaigns, or price adjustments—helping to increase sales without reducing profitability.



## 2. Top Suppliers by Sales & Purchase Contribution

The top 10 suppliers account for 65.69% of total purchases, while the remaining suppliers contribute just 34.31%. This level of concentration creates a supply chain risk—any disruption with these key suppliers could significantly impact operations. Diversifying the supplier base can help reduce this risk and improve supply stability.



## 3. Impact of Bulk Purchasing on Cost Savings

Suppliers who purchase in larger quantities enjoy significantly lower unit costs—72% less, averaging just \$10.78 per unit.

This demonstrates the success of bulk pricing strategies in motivating higher-volume orders, which helps increase overall sales without compromising profitability.

UnitPurchasePrice	
OrderSize	
Small	39.057543
Medium	15.486414
Large	10.777625

## 4. Identifying Suppliers 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 suppliers with low inventory turnover enables better stock management, minimizing financial pressure

StockTurnover	
VendorName	
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

## 5. Statistical Validation of Profit Margin Difference

### Hypothesis Testing:

- **H<sub>0</sub> (Null Hypothesis):** There is no significant difference in profit margins between top-performing and low-performing suppliers.
- **H<sub>1</sub> (Alternative Hypothesis):** There is a significant difference in profit margins between the two supplier groups.

**Result:** The null hypothesis is rejected, confirming that top and low-performing suppliers follow different profitability patterns.

**Implication:** High-margin suppliers may be using more effective pricing strategies, while top-selling suppliers could focus on cost efficiency.

## Key Recommendations

- **Adjust pricing** for high-margin, low-sales brands to increase sales without losing profit.
- **Work with a wider range of suppliers** to reduce dependency and supply chain risks.
- **Use bulk buying** to maintain competitive pricing while optimizing inventory management.
- **Optimize slow-moving inventory** by adjusting purchase quantities, launching clearance sales, or revising storage strategies.
- **Improve marketing and distribution strategies** for low-performing suppliers to boost sales without compromising profit margins.

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