🏢 Inventory Data Analysis Project Report

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📄 Project Overview :

Inventory management is critical for minimizing operational costs while maintaining product availability. This project analyzes historical inventory, purchase, and sales data to identify inefficiencies such as excess stock, stockouts, poor turnover, and high carrying costs.

Using data analytics techniques like demand forecasting, ABC analysis, EOQ modeling, and inventory turnover analysis, the project provides actionable insights and strategic recommendations for optimizing inventory management.

🎯 Objectives :

- Analyze demand patterns using historical sales data
- Classify products based on sales contribution using ABC analysis
- Measure inventory efficiency using inventory turnover
- Calculate optimal order quantities using EOQ
- Analyze supplier lead time and procurement efficiency
- Evaluate inventory carrying costs
- Identify process improvement opportunities
- Propose inventory optimization strategies

🗂 Data Description :

The project uses six cleaned CSV datasets:

File Name	Description
Purchase_Price.csv	Product-wise purchase pricing
Beg_Inv.csv	Beginning inventory levels
End_Inv.csv	Ending inventory levels
Invoice.csv	Purchase invoice and procurement data
Final_Purchase.csv	Purchase transactions
Final_Sales.csv	Sales transaction data

🧹 Data Cleaning Summary :

- Standardized column names
- Removed missing and inconsistent values
- Cleaned product size & pack descriptions
- Converted date columns to proper datetime format
- Ensured numeric consistency in cost, quantity, and sales values

📊 Analysis & Insights :

1. Demand Forecasting Analysis :
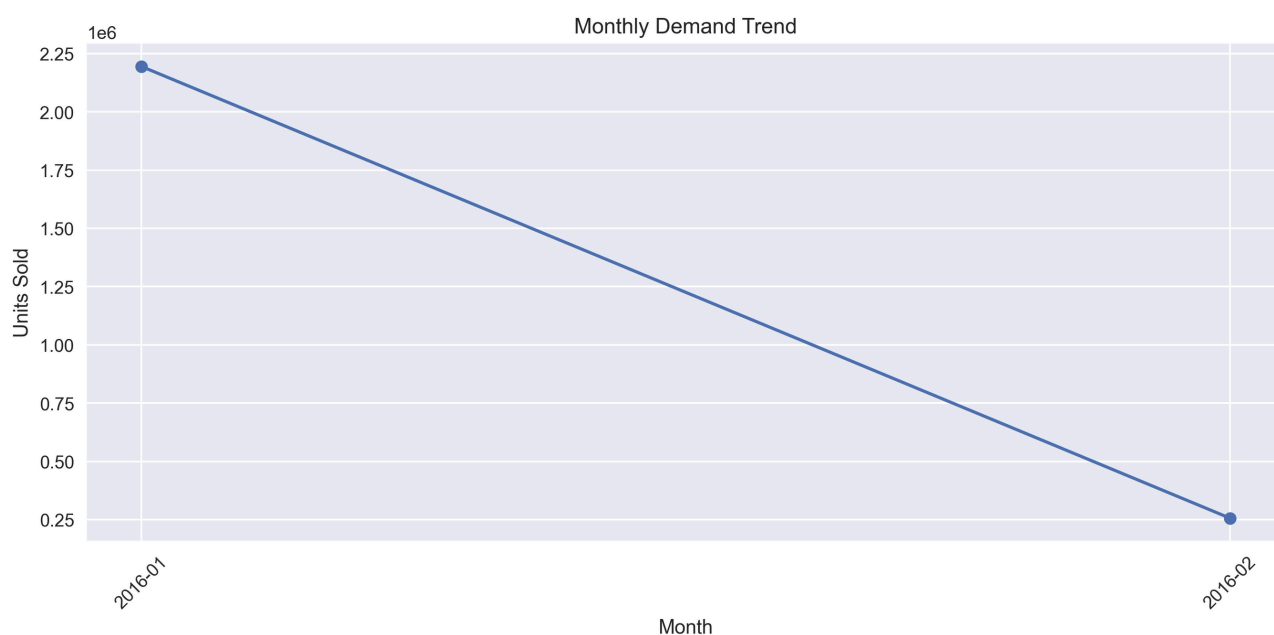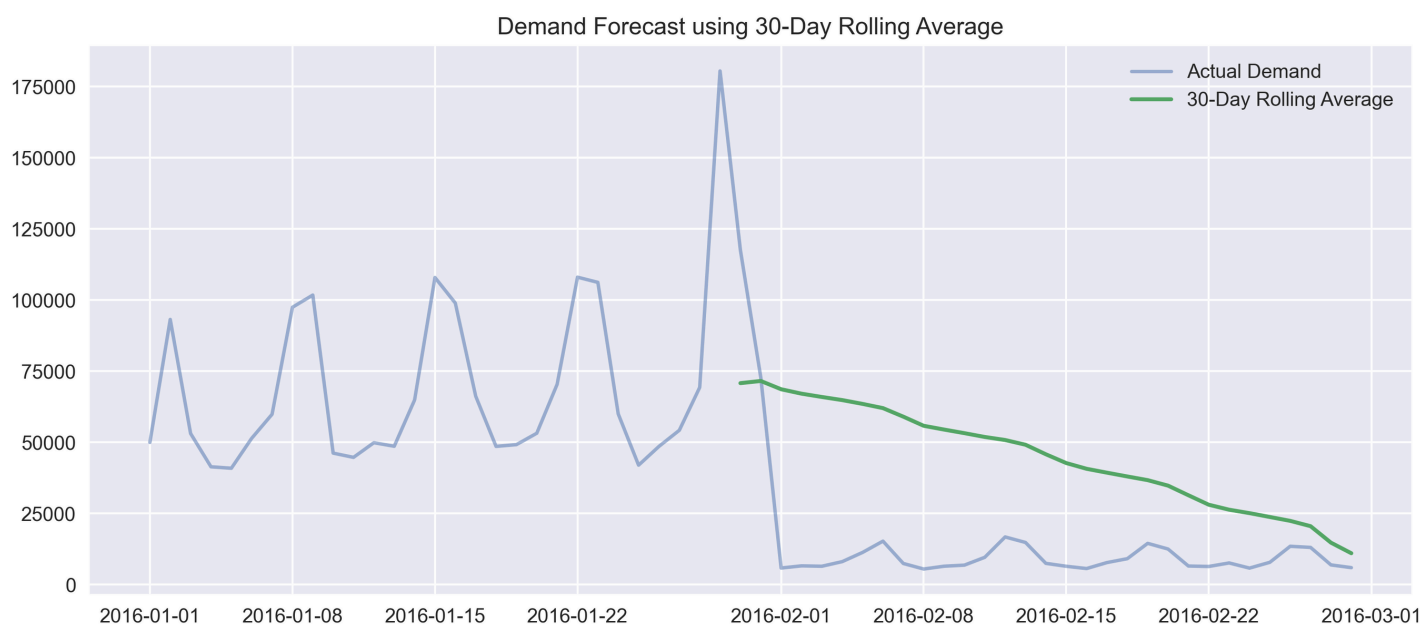
Chart: Monthly Sales Trend :

Chart: Actual vs Forecasted Demand :

Method Used :

- Time-series aggregation of monthly sales
- Trend and seasonality observation

Key Insights :

- Demand shows seasonal variation, with higher sales during specific months
- Certain products consistently outperform others
- Sales trend indicates moderate growth, useful for capacity planning

Business Impact :

- Helps in forecast-based purchasing
- Reduces stockouts and overstocking

2. ABC Analysis :

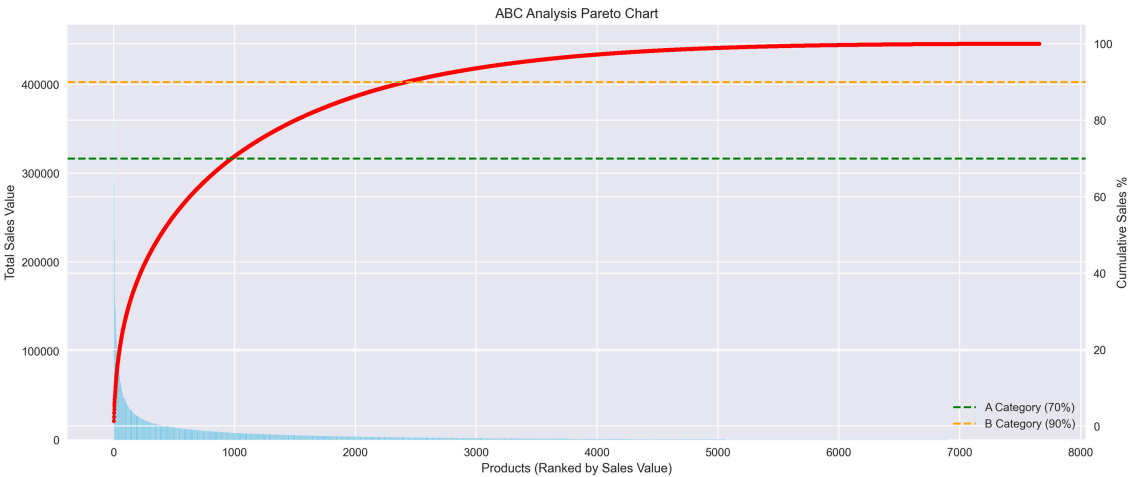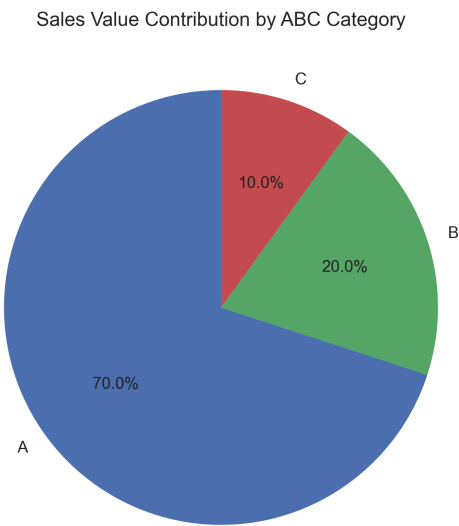## Chart : Pareto Chart (ABC Classification) :

Chart : ABC Category Distribution :

Method Used :

- Pareto principle (80/20 rule)
- Products classified into A, B, and C categories based on sales value

Key Insights :

- Category A items contribute ~70% of revenue with fewer SKUs
- Category B items have moderate sales contribution
- Category C items form a large portion of SKUs but low revenue

Business Impact :

- Focus inventory control on A-category products
- Reduce capital lock-in on C-category items

3. Inventory Turnover Analysis :
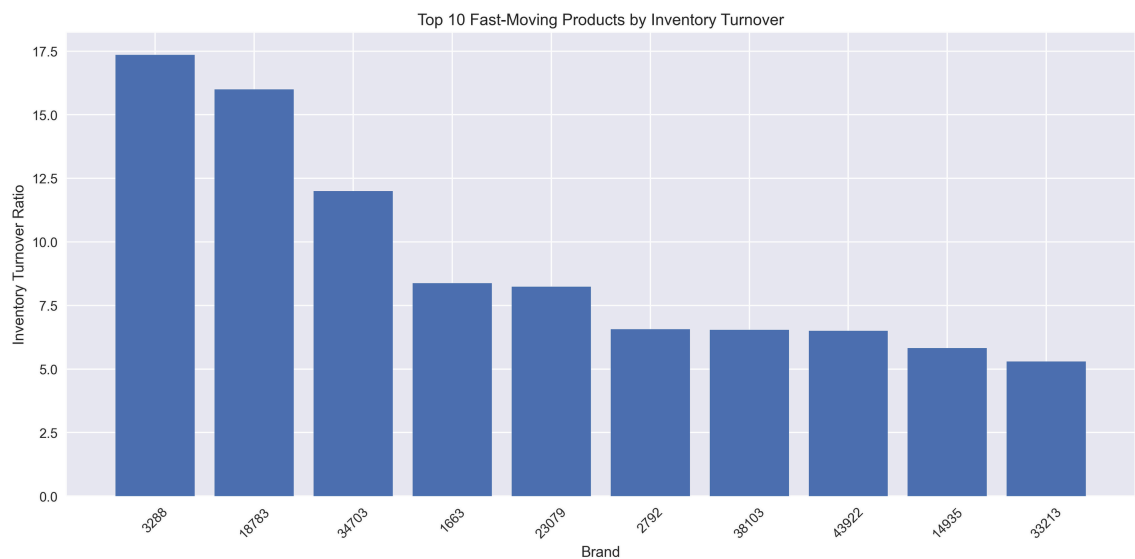
Chart : Top 10 Products by Inventory Turnover :

Top 10 Fast-Moving Products by Inventory Turnover

Chart : Bottom 10 Products by Inventory Turnover :

Bottom 10 Slow-Moving Products by Inventory Turnover

Method Used :

- Inventory Turnover = Cost of Goods Sold / Average Inventory

Key Insights :

- High turnover products indicate efficient inventory usage
- Low turnover products highlight slow-moving or obsolete stock

Business Impact :

- Improve cash flow by eliminating slow-moving inventory
- Supports rational stock level decisions

4. EOQ & Reorder Point Analysis :
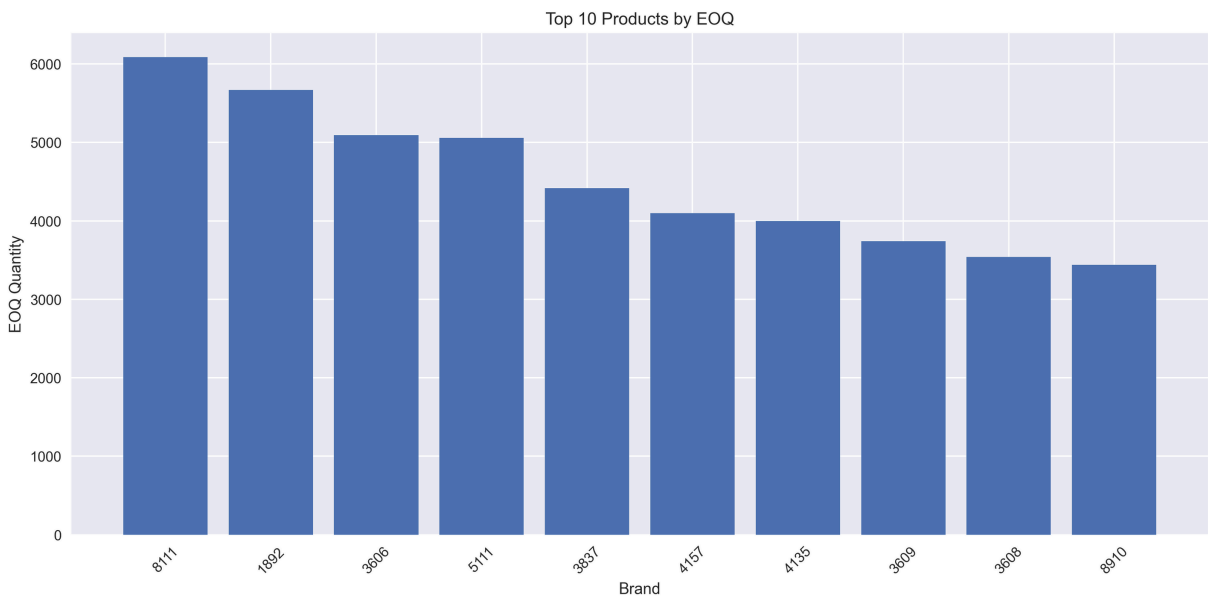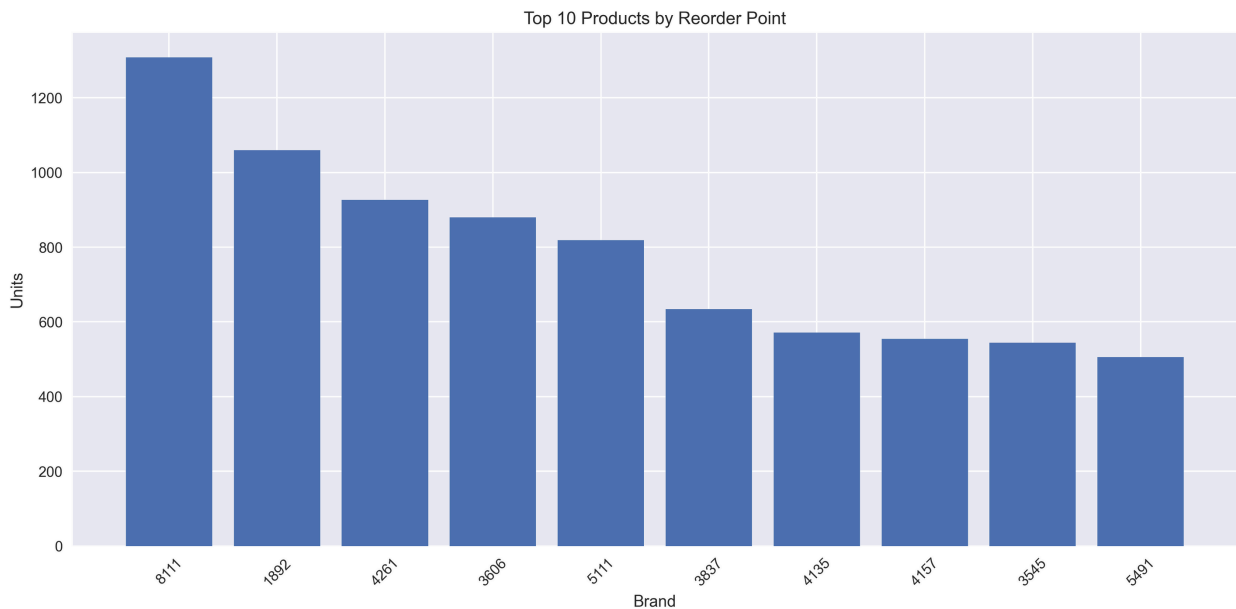
Chart : Top 10 Products by EOQ :

Top 10 Products by EOQ

Chart : Top 10 Products by Reorder Point :

Top 10 Products by Reorder Point

Method Used :

- Economic Order Quantity (EOQ) formula
- Reorder Point = Demand during lead time + Safety stock

Key Insights :

- Optimal order quantities significantly reduce ordering & holding costs
- Incorrect order sizes lead to unnecessary carrying costs

Business Impact :

- Minimizes total inventory cost
- Ensures timely replenishment without excess stock

5. Lead Time & Procurement Analysis :
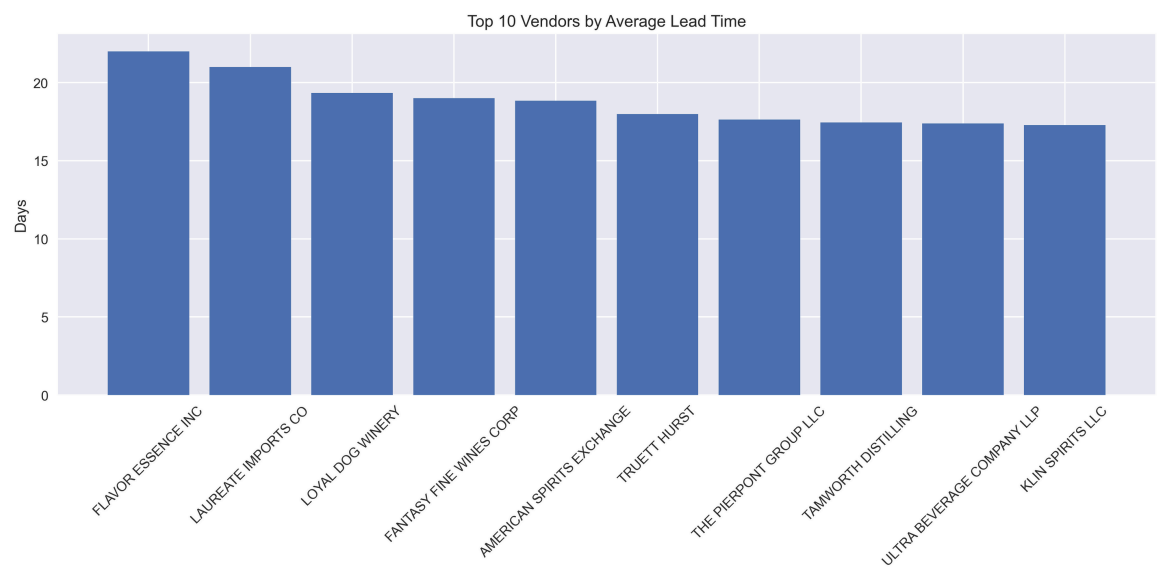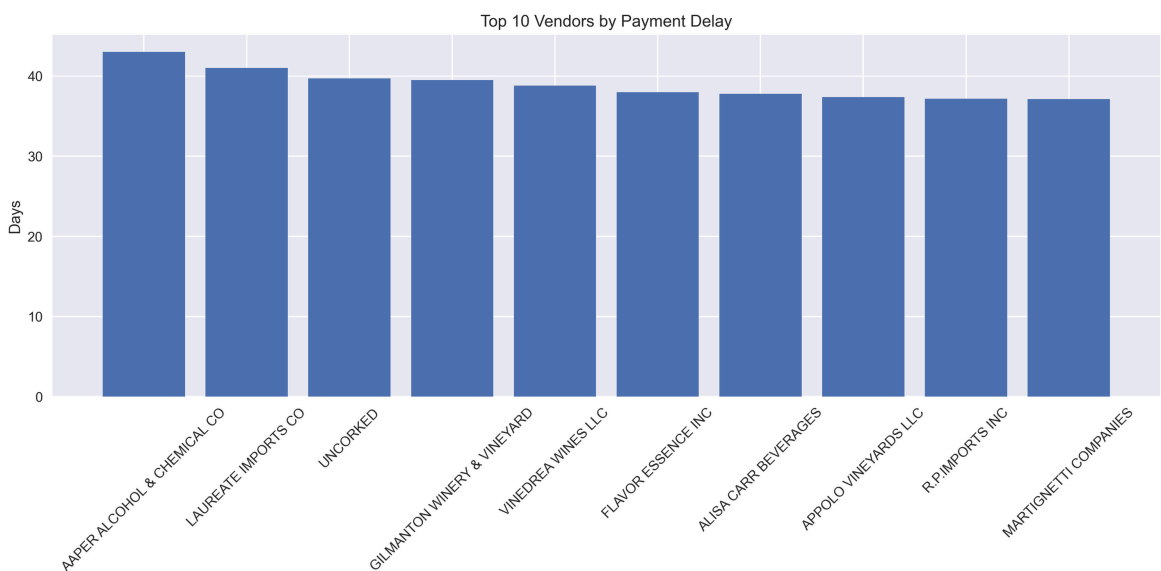
Chart : Top 10 Vendors by Average Lead Time :

Chart : Top 10 Vendors by Payment Delay :

Method Used :

- Supplier-wise lead time calculation
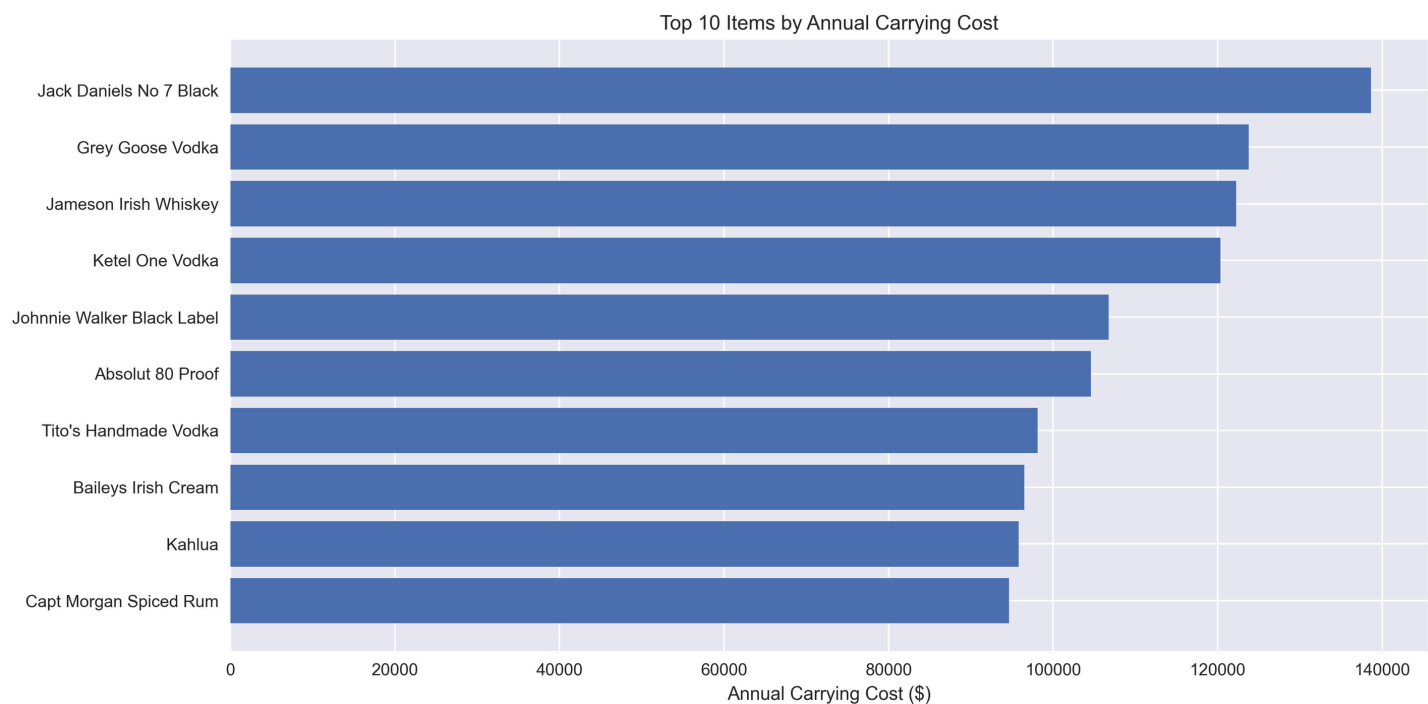- Procurement cycle analysis

Key Insights :

- Some suppliers show long and inconsistent lead times
- Delayed procurement increases risk of stockouts

Business Impact :

- Helps identify reliable suppliers
- Supports supplier negotiation and performance evaluation

6. Carrying Cost Analysis :

Chart : Top 10 Items by Annual Carrying Cost :

Top 10 Items by Annual Carrying Cost

Method Used :

- Carrying cost based on inventory value and holding rate
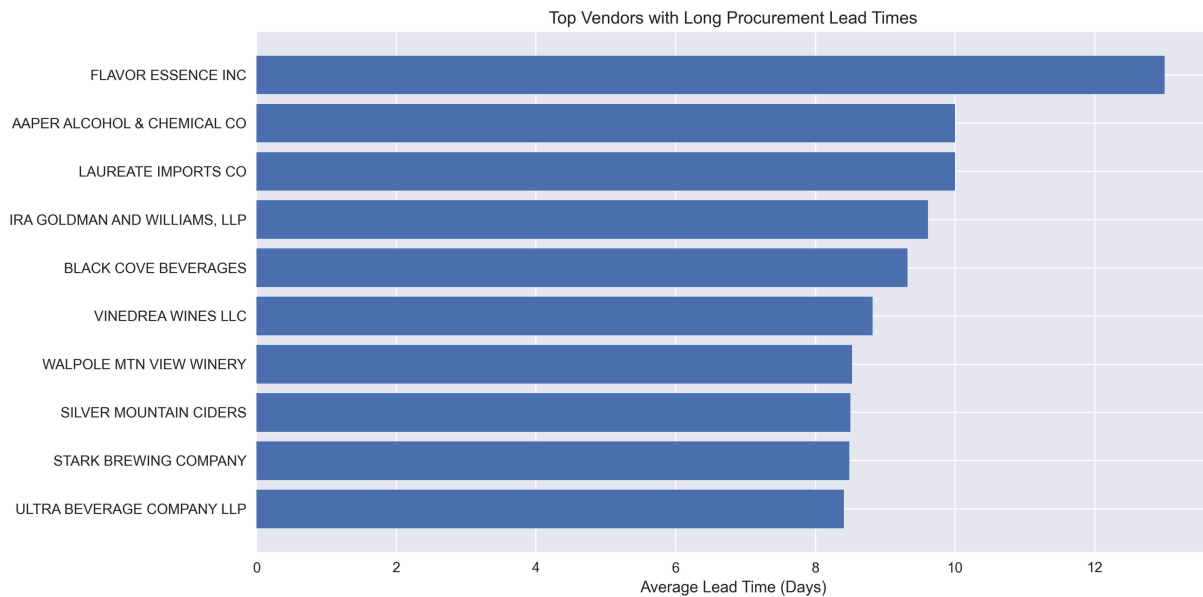
Key Insights :

- High inventory levels directly increase storage and capital costs
- A-category items have higher carrying costs but higher returns

Business Impact :

- Encourages lean inventory practices
- Improves profitability through cost control

7. Process Improvement Analysis :

Chart : Top 10 Vendors with Long Procurement Lead Times :

Top Vendors with Long Procurement Lead Times

Vendor	
FLAVOR ESSENCE INC	
AAPER ALCOHOL & CHEMICAL CO	
LAUREATE IMPORTS CO	
IRA GOLDMAN AND WILLIAMS, LLP	
BLACK COVE BEVERAGES	
VINEDREA WINES LLC	
WALPOLE MTN VIEW WINERY	
SILVER MOUNTAIN CIDERS	
STARK BREWING COMPANY	
ULTRA BEVERAGE COMPANY LLP	

Average Lead Time (Days)

Areas Identified :

- Overstocking of low-demand items
- Delayed procurement cycles
- Lack of demand-driven ordering

Recommendations :

- Implement demand-based replenishment
- Use ABC classification for inventory control
- Monitor supplier performance regularly

📦 Inventory Management Strategy :

🔹 Strategic Recommendations:

1. **ABC-Based Inventory Control**
   - Tight control for A items
   - Periodic review for B items
   - Minimize stock for C items
2. **Demand-Driven Replenishment**
   - Align procurement with forecasted demand
3. **EOQ & Reorder Point Implementation**
   - Standardize ordering processes
4. **Supplier Optimization**
   - Reduce lead time variability
   - Negotiate bulk discounts
5. **Continuous Monitoring**
   - Track turnover and carrying cost regularly

✅ Final Recommendations :

- Reduce excess inventory of low-performing products
- Improve forecasting accuracy using historical trends
- Focus working capital on high-value products
- Implement automated inventory alerts
- Establish periodic inventory performance reviews

🏁 Conclusion :

This inventory analysis successfully identified key inefficiencies in inventory management. By applying analytical techniques such as demand forecasting, ABC classification, EOQ modeling, and turnover analysis, the company can significantly reduce costs, improve service levels, and optimize working capital.

Adopting the proposed inventory strategy will enable sustainable growth, improved operational efficiency, and better customer satisfaction.

🛠️ Tools & Technologies Used :

- **Python (Pandas, NumPy, Matplotlib, Seaborn)**
- **Jupyter Notebook**
- **CSV Data Processing**
- **Data Visualization Techniques**