

Solving Inventory Inefficiencies Using SQL

1. Overview

Urban Retail Co. is a rapidly growing mid-sized retail chain with operations spanning physical stores and online platforms across multiple cities. With a diverse inventory of over 5000 SKUs ranging from groceries to electronics, the company has been facing critical challenges in managing inventory effectively. The root issues include frequent stockout, excess inventory in slow-moving items, unreliable supplier performance, and a lack of real-time visibility across products and stores.

The goal of this project is to design and implement a **SQL-driven inventory monitoring and optimization system** that utilizes available sales, inventory and forecasting data to create actionable insights. This project simulates the real-life responsibilities of a data analyst in the retail sector, focusing on using data to drive smarter business decisions.

2. Objective

- Normalize raw inventory data into a clean, efficient relational database schema.
- Write optimized SQL queries to analyze, monitor, and forecast inventory behavior.
- Identify inefficiencies and generate recommendations for stock adjustments.
- Develop power BI dashboards to present data clearly to decision-makers.
- Deliver a complete suite of technical and analytical outputs, including KPIs, schema designs and actionable insights.
- I have worked with first 10000 values of provided data.

3. Key SQL Tasks & Outputs

1. Database optimization

- Raw CSV data was normalized into a relational schema with clear entity relationships.
- Tables created include: products, stores, inventory, pricing conditions.
- Best practices like indexing, primary keys, foreign keys, and window functions were used for performance.

2. Inventory Analytics Queries

- **Stock Level Calculation across Stores:** This helps analyze current stock levels grouped by product and region. Helps identify real time stock position to support operational decisions.
- **Low Inventory Detection Based On Reorder Threshold:** It will show the inventory level by assuming reorder point=100. Prevents stockout by highlighting items needing urgent replenishment.
- **Reorder Point Estimation using Historical Trend:** This calculates the average units sold over the past 30 days per product store combination. Automate restocking logic using past consumption patterns.
- **Inventory Turnover Ratio:** This will show how fast inventory is moving. The higher, the better. Measures how efficiently inventory is being utilized.
- **KPI Summary Report:** Shows average stock and stockout rate.
- **Inventory Aging Report:** Shows how long stock has been sitting without movement (simulated via low recent sales).
- **Overstock Detection:** Products with high stock levels and low recent sales.
- **Forecasting Demand By Week:** Group total demand forecast by week and product to detect trends.
- **Holiday and Promotion Impact On Sales:** This will checks if holiday/promotion periods boost sales or not.
- **Store Performance Comparison:** It will measure total sales and forecast accuracy by store.

- **Pricing vs. Sales Sensitivity:** It will give the correlation between price and sales.
- **Recommend Stock Adjustments to Reduce Holding Cost:** Recommended stock = average weekly sales * coverage weeks (e.g., 3 weeks). This will flag products that are overstocked or understocked based on their average sales and target inventory level. Drives cost reduction by suggesting transfer, markdown or reorder actions.
- **Forecast Demand Trends Based on Seasonal/Cyclical Data:** This will analyze forecasted demand over time and aggregate it by season. Supports demand forecasting and seasonal inventory adjustments
- **Highlight Supplier Performance Inconsistencies:** This will flag potential supplier reliability issues by identifying high forecast demand, low units order, persistence low inventory. Improves supplier management and contract negotiation.
- **Fast vs. Slow Moving Products:** Categorize SKUs by speed of movement. Helps in decision making for promotions, pricing and clearance.

4. Power BI Dashboard

To translate the technical SQL outputs into meaningful business insights, a comprehensive Power BI dashboard was built. It includes:

- **SKU-Level Performance Metrics:** Visuals for top/bottom performing products across stores and categories.
- **Supplier Reliability:** Bar and line charts highlighting average delivery time and fulfillment accuracy.
- **Seasonal Demand Trends:** Forecast lines and trend visuals showing demand changes overtime.
- **KPI Overview:** Tiles for stockout rate, inventory turnover, supplier performance, forecasting demand.

This dashboard is designed for stakeholders like store managers, inventory planners, and supply chain analysts.

5. Key Insights

1. Stockouts & Overstocking

- Several fast-moving products experienced frequent stockouts (as per inventory thresholds).
- Simultaneously, some SKUs remained overstocked, leading to increased warehousing costs.

2. Inventory Turnover Performance

- The average inventory turnover rate varied significantly across product categories, highlighting uneven stock circulation.

3. Demand Trends

- Clear seasonal and monthly demand cycles were identified (e.g., spikes in electronics during holidays and monsoons affecting personal care item demand).

4. Stock Adjustments Recommendations

- Based on forecast vs. actual sales, specific products were identified that needed immediate restocking or reduction.

5. Supplier Inconsistencies

- Where data permitted, certain suppliers showed delivery delays impacting reorder timelines.

6. Recommendations

- **Implement automated reorder triggers** for high-turnover SKUs to prevent stockouts.
- **Review and reduce inventory** of slow-moving products to cut holding costs.
- **Adopt seasonal stocking strategies** using historical demand trends for key product categories.
- **Improve forecast accuracy** by refining the demand model based on recent sales and promotions.

- **Use this dashboard regularly** for cross-functional decision-making across logistics, procurement, and store operations.

7. Business Impact

By implementing this data analytics solution, **Urban Retail Co.** can expect the following benefits:

- **Smarter Inventory Decisions:** Data-backed restocking and order policies.
- **Reduced Stockouts & Overstocks:** Improved balance of supply and demand.
- **Efficient Use of Capital:** Lowered holding costs and fewer obsolete SKUs.
- **Higher Customer Satisfaction:** Better product availability.
- **Improved Supplier Relationships:** Visibility into performance drives accountability.

8. Tools Used

- **Excel** for intermediate data processing.
- **MySQL** for database querying and transformation.
- **Power BI** for data visualization and dashboard creation.

9. Conclusion

This project successfully demonstrates how SQL-driven data analytics, when integrated with business intelligence tools like Power BI, can address real-world retail inventory challenges. By uncovering inefficiencies, trends, and hidden risks, this solution empowers Urban Retail Co. to move from reactive operations to proactive, strategic inventory management. With continued focus on analytics, this approach can be extended to real-time dashboards, predictive algorithms, and machine learning for dynamic demand forecasting. Urban Retail Co. is now well-positioned to scale smarter, improve supply chain resilience, and enhance customer experience through optimized inventory systems.