Solving Inventory Inefficiencies Using SQL

Introduction

Urban Retail Co. is a fast-growing mid-sized retail chain with both physical stores and an online presence. We operate in several cities and offer over 5,000 different stock keeping units (SKUs), ranging from daily groceries and home essentials to electronics and personal care items. Our logistics network relies on regional warehouses that supply inventory to individual retail outlets. With increasing complexity in our operations, we are finding it hard to keep optimal inventory levels. Although we have access to data from our sales transactions, product catalogs, and warehouse logs, we are not using it effectively. This leads to significant inefficiencies in our inventory management.

Objective

The goal of this project is to:

- Create a data-driven inventory monitoring and optimization solution using SQL.
- Provide key performance insights such as inventory turnover, stockout and overstock risk, and accuracy in demand forecasting.
- Design a relational schema for improved data management.
- Visualize inventory performance metrics in an easy-to-understand dashboard.

Data Modeling: Entity Relationship Diagram (ERD)

Main Entities:

1. Stores: Records daily store-level inventory activity. It connects to inventory, category, and captures store ID, region, and product ID.

2. Inventory: The main table includes product data such as inventory level, units sold, units ordered, demand forecast, price, discount, and competitor pricing.

3. External factor: Links inventory with contextual data like weather, seasonality, and whether there is a holiday or promotion.

4. Category: Defines product categories and connects to stores for classification.

5. Seasonality: Stores seasonal information (season ID, season) to assist in trend and demand forecasting.

6. Weather: Records weather conditions (weather ID, weather) that might affect product demand.

Database Optimizations

- Using 3NF to eliminate redundancy and support flexible querying.
- Normalized a raw inventory dataset into a relational schema.
- Applied best practices for query performance, such as indexing, joining, and window functions.

A brief executive summary

1. Key Insights

A. Fast-Selling vs Slow-Moving Products

- Products such as P0046 (Clothing) and P0096 (Toys) show high forecasted and actual demand, confirming they are fast-selling.
- Products with high average inventory age (>900 days), such as P0096, P0016, P0031, point to slow-moving items. This can lead to higher holding costs and potential obsolescence risk.

B. Stock out and Overstock Insights

- Several products have stock out rates above 95% (e.g., P0016, P0031, P0171, P0175) across stores. This indicates poor replenishment planning.
- Overstocks remain high (>370 days for many SKUs), which ties up working capital and increases the risk of markdown losses.

C. Supplier Performance & Inventory Turnover

- Average inventory turnover ratios for fast-selling items are around 24 to 25. However, products with low turnover and high stock age highlight underperforming suppliers or procurement issues.

D. Seasonal & Cyclical Demand Trends

- Categories like Clothing and Toys peak in autumn, matching forecasted demand spikes (for example, about 97,000 units forecasted for top Clothing SKUs).
- Inventory planning does not fully match these seasonal trends, leading to both stock outs and excess inventory at the same time.

2. Recommendations

Stock Adjustment Strategies

- Phase out slow-moving products (high stock age, low turnover) through targeted promotions or returns to suppliers. This will create warehouse space and lower holding costs.
- Increase reorder frequency and reduce batch size for fast-selling products to decrease stock outs and lost sales.

Supplier Performance Improvement

- Review suppliers responsible for high stock outs or long lead times. Implement penalties or improvement clauses to boost supply reliability.
- Look for alternative suppliers for underperforming SKUs to ensure consistent availability.

Demand-Driven Inventory Optimization

- Use seasonality-based ordering models to match the identified peaks in Clothing and Toys.
- Integrate rolling 3-month forecasts into procurement decisions to adjust quickly to market changes.

Additional Strategic Insights

- Set up automated dashboards to track turnover, stock age, and stock out rates weekly so we can intervene proactively.
- Examine price elasticity and the effect of promotions on slow-moving items. This will help us refine markdown strategies and speed up clearance.

3. Expecting Business Impact

By following these recommendations, Urban Retail Co. can:

- Reduce working capital tied up in outdated inventory.
- Minimize stock outs, enhancing customer satisfaction and loyalty.
- Improve supplier relationship management and overall supply chain efficiency.
- Boost profitability through optimized markdowns, better demand matching, and lower holding costs.