Introduction

Urban Retail Co. is a mid-sized, fast-growing retail chain operating across multiple cities via physical outlets and e-commerce platforms. With over 5,000 Stock Keeping Units (SKUs) spanning groceries, electronics, personal care, and more, the company relies on regional warehouses to supply its stores.

However, increasing operational complexity has revealed inefficiencies in inventory management. While sales transactions, product catalogs, and warehouse logs exist, they are underutilized. This has led to stockouts of high-demand products and overstocking of low-demand items. The absence of real-time insights further hampers decision-making, costing both revenue and customer satisfaction.

To address these issues, this project leverages SQL-based analytics to transform raw inventory data into actionable insights for optimized stock management.

Objective

The goal of this project is to:

- Build a data-driven inventory monitoring and optimization solution using SQL.

- Provide key performance insights such as inventory turnover, stockout/overstock risk, and demand forecasting accuracy.

- Design a relational schema for better data management.

- Visualize inventory performance metrics in an intuitive dashboard.

Data Modeling: Entity Relationship Diagram (ERD)

The project uses three core tables:

- stores: Contains store ID and region.

- products: Contains product ID and category.

- inventory_transactions: Transactional data capturing inventory level, units sold, demand forecast, discounts, pricing, promotions, and external factors like weather and seasonality.

These are connected via foreign keys on store_id and product_id, enabling robust and normalized data analysis.

SQL Scripts & Key Analytical Outputs

- Stockout Rate

Calculating the percentage of days a product's demand forecast exceeded its inventory level per store-product pair.

- Average Inventory Age

Estimates how long a product remains in stock before being sold, based on the ratio of average inventory to total units sold.

- Average Stock Level

Provides the average inventory held per store-product pair, useful for evaluating overstocking or understocking trends.

- Inventory Turnover Ratio

Measures how efficiently inventory is being sold, calculated as: Total Units Sold / Average Inventory Level

- Reorder Point Estimation

Calculates the reorder threshold for each product using 2-day lead time assumptions.

- Seasonality-Based Demand Forecasting

Groups monthly sales by category and tags each month with a seasonal label (Winter, Summer, Monsoon, Festive) to identify cyclical patterns.

- Stock Adjustment Recommendation

Flags overstocked (inventory > 1.5x forecast) and stockout-prone (inventory < 0.5x forecast) products for each day tracked.

- Window Function Analysis

Ranks monthly sales performance of each product within its store to identify top and bottom performers.

Performance Optimization

Indexes were created to improve query performance.

Index Name	Columns	Purpose
idx_product_id	product_id	Speeds up product-level joins and lookups
idx_store_id	store_id	Optimizes store-level filtering
idx_date	date	Enhances time-series analysis
idx_demand_vs_inventory	demand_forecast, inventory_level	Optimizes queries for stockout/overstock detection

Dashboard Insights

A Power BI dashboard was created to visualize the KPIs and trends.

- **Top Indicators**:
    - Stockout Days: 90
    - Overstock Days: 170
    - Inventory Turnover: 25.90
- **Visual Comparisons**:
    - Inventory Turnover by Product ID
    - Category vs Forecast Accuracy
    - Category vs Average Demand
    - Category vs Stockout vs Overstock Days

Conclusion

The SQL-driven solution provides a scalable and efficient inventory intelligence layer. It not only highlights inefficiencies (e.g., overstocked dairy, high-demand snacks with frequent stockouts) but also informs actionable decisions like adjusting reorder points and reallocating inventory.

Urban Retail Co. can now shift from reactive inventory handling to proactive, data-backed decision-making, improving both customer experience and operational profitability.