

Solving Inventory Inefficiencies Using Advanced SQL Analytics

Urban Retail Co. — Summer Project '25

1 Introduction

Urban Retail Co., a mid-sized retail chain with a hybrid presence of physical stores and online platforms, faces challenges in managing inventory across regions. Inefficient stock handling leads to overstocking, stockouts, capital lock-ins, and customer dissatisfaction. This project applies advanced SQL analytics to diagnose inefficiencies, optimize inventory management, and guide data-driven decision-making.

2 Project Objectives

- Design a normalized schema for sales, inventory, products, and external data.
- Create advanced SQL queries to derive actionable KPIs and detect anomalies.
- Analyze pricing, supplier efficiency, stock performance, and demand forecasts.
- Generate recommendations and a mock KPI dashboard for real-time monitoring.

3 Entity Relationship Diagram (ERD)

Tables:

- **products:** Product ID, Category, Price
- **stores:** Store ID, Region
- **inventory_facts:** Date, Product ID, Store ID, Units Sold, Inventory Level, Demand Forecast, Discount, Units Ordered
- **environment_facts:** Date, Store ID, Weather Condition, Holiday Promotion, Seasonality, Competitor Pricing

4 Key SQL Insights

4.1 Inventory Performance

- **Turnover Ratio:** Units Sold / Average Inventory to identify SKU velocity.
- **Overstocking and Stockouts:** Based on Inventory vs. Forecasted Demand.

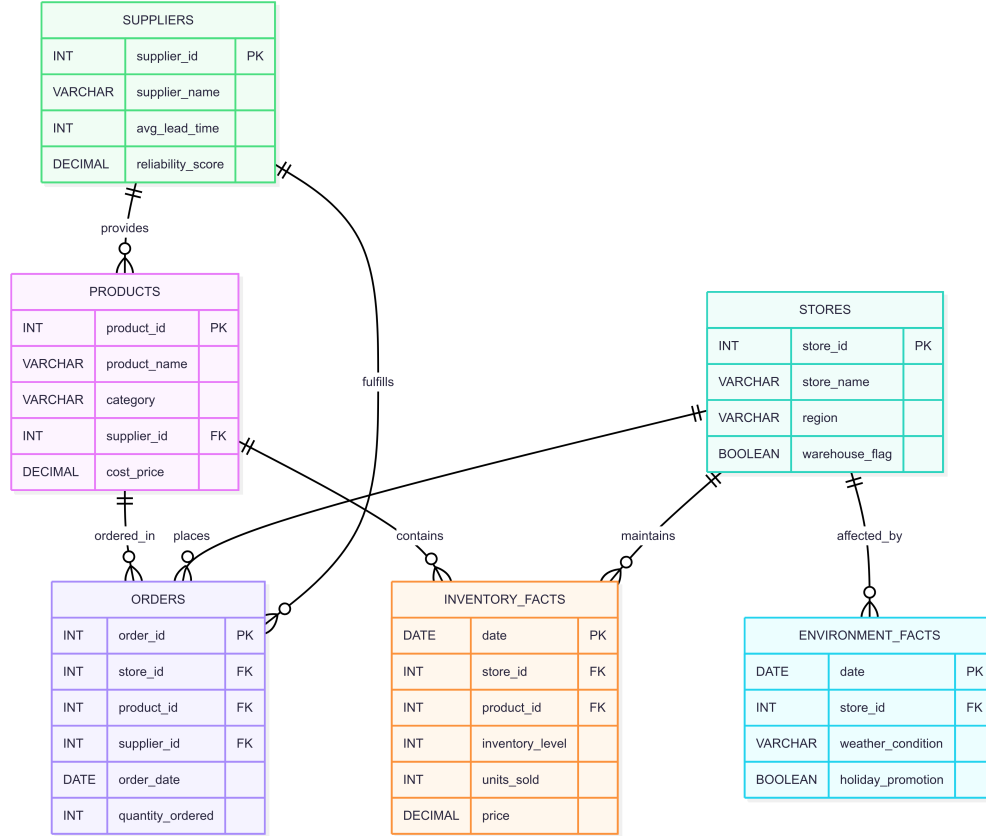


Figure 1: Entity Relationship Diagram for Urban Inventory Database

- **Reorder Points:** Calculated via 7-day rolling average demand.
- **Stockout Rate:** Percentage of days with zero inventory per SKU or store.
- **Average Stock Level:** Mean inventory per SKU over a given period.
- **Inventory Age:** Average days items remain in stock before sale or replenishment.

4.2 Demand Forecasting and Anomalies

- **Forecast Error:** Average deviation from actual sales.
- **Anomalies:** Sudden spikes or drops in inventory or units sold flagged using SQL window functions.

4.3 Supplier and Pricing Analysis

- **Delivery Lag:** Detected via delayed changes in inventory post order.
- **Elasticity:** Estimated using log-log regression on price vs demand.
- **Sweet Spot Pricing:** Revenue-optimizing prices identified for each SKU.

4.4 External Influences

- **Weather and Holiday Promotions:** Correlated with uplift in units sold.
- **Regional Trends:** Evaluated for stockout prevalence, overstocking, and sales performance.

5 KPI Summary Table (Based on Sample Data)

KPI Metric	Value
Total Unique SKUs	30
Total Units Sold	10,591,317
Inventory Turnover Ratio	72,689.66
Stockout Rate (%)	0.00
Overstock Rate (%)	36.05
Forecast Accuracy (%)	87.21
Promotion Impact on Sales (%)	20.48

Table 1: Summary of Key Inventory KPIs Derived from Sample Data

6 Recommendations

- Implement dynamic reorder thresholds per product-store using 7-day average demand.
- Establish alerting system for approaching stockout or overstock conditions.
- Use sweet spot pricing insights to maximize SKU-wise revenue.
- Improve forecast accuracy by integrating weather and promotional data.
- Rationalize slow-moving SKUs with markdowns or delisting strategies.
- Monitor supplier reliability and lead times using SQL-based lag detection.

7 KPI Dashboard (Mock-up)

- **Total SKUs:** Number of distinct SKUs tracked.
- **Total Units Sold:** Cumulative sales volume.
- **Inventory Turnover Ratio:** Ratio of units sold to average inventory.
- **Stockout Rate:** % days with zero inventory by region and SKU.
- **Overstock Rate:** % days inventory exceeded threshold (e.g., >150% forecast).

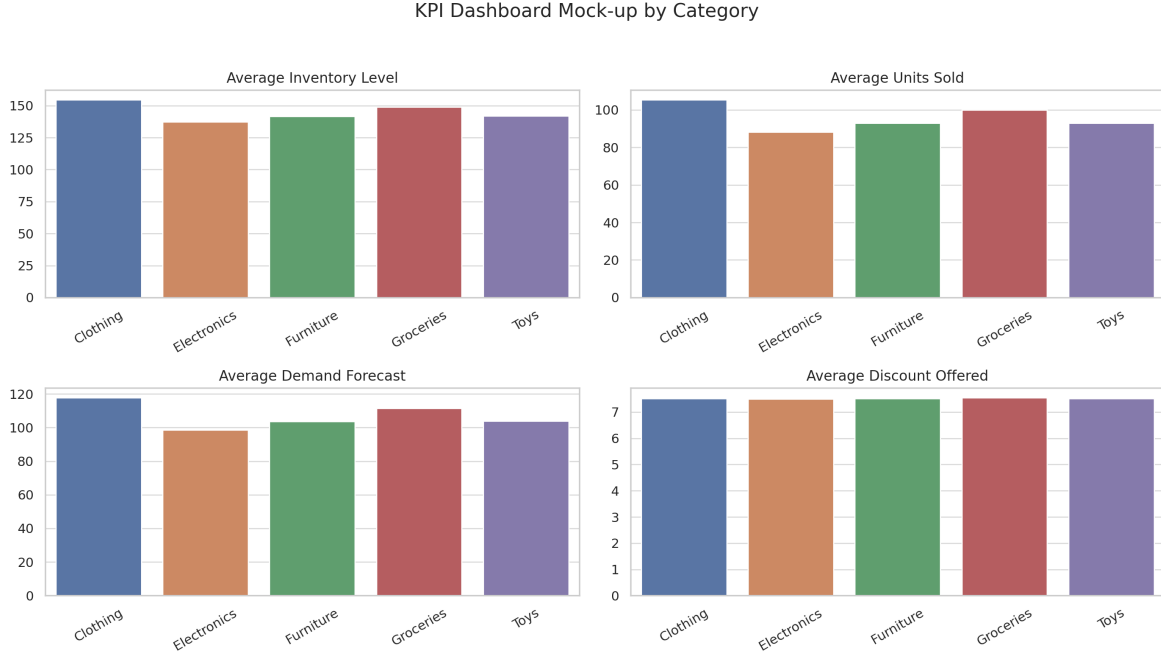


Figure 2: Category-wise KPI Dashboard Mock-up

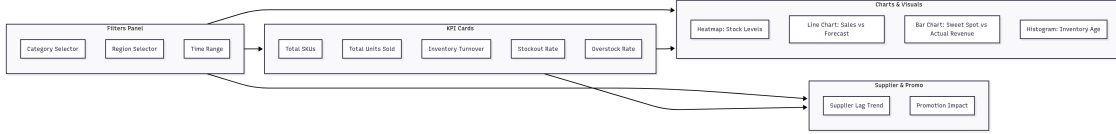


Figure 3: Mock-up: Inventory KPI Dashboard

- **Average Stock Level:** Mean inventory at month-end.
- **Inventory Age Distribution:** Histogram of days in stock.
- **Forecast Accuracy:** $1 - (|\text{Forecast} - \text{Actual}| / \text{Forecast})$.
- **Promotion Impact:** Sales uplift comparison during promotions vs normal days.
- **Sweet Spot vs Actual Revenue:** Estimated vs realized revenue per SKU.
- **Supplier Lag Trend:** Avg days between order and stock arrival.

8 Conclusion

Advanced SQL analytics has enabled Urban Retail Co. to transform raw inventory data into a structured decision-support system. From detailed KPI tracking to pricing strategies, our approach reduces inefficiencies and strengthens business operations. Future enhancements include real-time dashboards, ML-driven forecasts, and automated ETL workflows.