Executive Summary: Enhancing Inventory & Supply Chain Performance for Urban Retail Co.

Project Goal: To transform **Urban Retail Co.'s** extensive sales, inventory, and warehouse data into actionable insights through SQL-driven analytics. Our core mission was to address critical challenges like frequent stockouts of fast-moving products, the burden of overstocked slow-moving items, a lack of real-time SKU performance insights, and general operational opaqueness across our diverse product categories and five stores spread across the East, West, North, and South regions.

Solution Approach: This project deployed robust SQL-based analytical methods across four critical domains: **Inventory Performance & Optimization, Sales & Demand Analysis, the Impact of External Factors, and Inferred Supplier Performance.** The resulting insights are now accessible via a concise, intuitive dashboard, empowering continuous monitoring and data-driven strategic decisions.

Key Outcome: Our comprehensive analysis has pinpointed crucial areas where inventory management and supply chain efficiency can be significantly improved. The report outlines clear, data-backed recommendations designed to reduce holding costs, minimize lost sales opportunities, and ultimately boost profitability and customer satisfaction.

Key Findings

A. Inventory Performance & Optimization

Our deep dive into inventory levels reveals distinct patterns of inefficiency, highlighting both missed sales and unnecessary costs:

- **Stock Level Dynamics:** Across our **30 distinct Product IDs and 5 stores**, we observed varied inventory behaviors. Product **P0061** consistently maintained the highest average inventory levels, while **P0175** typically held the lowest. Regionally, the **Clothing category in the North region** consistently held the maximum total inventory value, whereas **Groceries in the West region** maintained the minimum. This provides a clear baseline for understanding stock distribution.

- **Inventory Turnover Insights:** The efficiency of our stock movement, measured by average inventory turnover, showed slight improvements from **2022** to **2023**. In 2022, **Clothing** led with a turnover of 103, followed by **Groceries** (101), **Toys** (99), **Furniture** (99), and **Electronics** (97). By 2023, these rates modestly increased to 104 for Clothing, 102 for Groceries, 100 for Toys, 100 for Furniture, and 98 for Electronics. While positive, these figures still highlight areas for targeted improvement, especially for categories with lower turnover.
- **Low Inventory Detection & Reorder Point Estimation:** By applying a lead time of 1 day and aiming for a 90% service level (Z-score = 1.28), we identified specific products and stores at higher risk of stockouts. Products like **P0069 (Store 3 East), P0133 (Store 1 East), P0178 (Store 4 North), P0125 (Store 2 North), and P0016 (Store 3 East)** showed a higher propensity for stockout events, necessitating urgent reevaluation of their reorder points. Conversely, **P0183 (Store 1 South), P0031 (Store 2 West), and P0031 (Store 4 North)** experienced fewer stockout events, indicating more stable inventory management.
- **Stockout and Overstock Analysis (Specific Cases):**
  - **Max Overstock: P0031 (Store 2 East), P0126 (Store 2 West), P0057 (Store 1 West), P0017 (Store 2 North), P0066 (Store 2 East)** were identified as having the maximum times overstock.
  - **Min Overstock: P0166 (Store 5 South), P0085 (Store 5 South), P0094 (Store 3 South)** had the minimum times overstock.
  - **Max Stock Out: P0153 (Store 4 East), P0083 (Store 5 West), P0175 (Store 1 West), P0178 (Store 2 North), P0126 (Store 4 West)** experienced the maximum time stock out.
  - **Min Stock Out: P0096 (Store 2 East), P0094 (Store 2 South)** had the minimum times stock out.
- **Actionable Stock Adjustment Recommendations:**
  - **For Frequent Stockouts:** Products like **P0178 (Clothing)**, **P0149**, and **P0153** are frequently selling well but running out of stock. **P0178 in Clothing** was particularly challenging, showing 11 stockout events, yet also 93 overstock events in its off-season. For these, we recommend **increasing order quantities** and revisiting their reorder points and safety stock levels.
  - **For Consistent Overstocking:** Items such as **P0070 (Electronics), P0171, P0183, P0031, P0159, P0175, P0116, P0083, P0016, P0069** are tying up capital due to slow movement. **P0070 in Electronics** stands out with the highest overstock value and low turnover. For these, **reducing future order quantities significantly** and exploring liquidation strategies is crucial.
  - **For Mixed Signals:** Products like **P0066** and **P0126** exhibit a complex pattern of both stockouts and overstocking, demanding **deeper, product-specific investigations** to uncover the root causes of their erratic inventory behavior.

B. Sales & Demand Analysis

Understanding what sells and how demand fluctuates is fundamental for proactive inventory strategies:

- **Product Performance by Category:**
  - **Clothing:** P0057, P0046, P0133, P0187, P0125 are our <u>bestsellers</u>.
  - **Electronics:** P0171, P0183, P0031, P0159, P0175 are <u>top performers</u>.
  - **Furniture:** P0067, P0153, P0079, P0116 are <u>key products</u>.
  - **Groceries:** P0094 is a <u>standout performer</u>.
  - Toys: P0017 leads the <u>category</u>.
    This granular view allows for tailored stocking and marketing efforts.
- **Seasonal Demand Dynamics:** Our analysis confirms clear seasonal patterns: **Winter and Summer are peak seasons**, while **Autumn and Spring are off-peak**. The general trend shows sales strongest in Winter, then Summer, followed by Autumn, and weakest in Spring. An interesting exception is **P0094 (Groceries)**, which uniquely peaks in Summer before Winter, highlighting the need for product-specific seasonal planning.

C. Impact of External Factors

External conditions significantly influence sales, and incorporating these into planning offers a competitive edge:

- **Promotions & Holidays Uplift:** Holiday and promotion periods consistently drive sales, with an **average uplift of approximately 20%**. This confirms their effectiveness. Notably, the **maximum units were sold when discounts were between 0-10%**, suggesting an optimal discount range for maximizing volume without excessive price cuts.
- **Weather-Driven Sales:** Weather conditions have a distinct impact on sales by category:
  - **Clothing:** Sales tend to **increase in both Snowy and Rainy seasons**.
  - **Electronics & Furniture:** Sales generally remain strong but show a **decrease specifically during Rainy seasons**.
  - **Groceries:** Experience a **slight decrease during Snowy seasons** but perform well otherwise.
  - **Toys**: Sales remain approximately **similar** across all seasons.
    This detailed understanding of weather influence enables more precise inventory positioning and localized promotions.

D. Supplier Performance (Inferred)

While direct supplier performance data (like delivery lead times or direct delivery reports) was not explicitly available, we inferred critical inconsistencies in order fulfillment by making common assumptions about inventory flow:

- **Order Fulfillment Discrepancy:** By analyzing the relationship between Units_Ordered, subsequent Inventory_Level changes, and Units_Sold, we calculated the **Calculated_Inflow** (estimated actual units delivered to inventory). This allowed us to determine if the units received from suppliers were less than, equal to, or more than what was ordered. This gives us crucial insights into Order Fulfillment Status and Stockout Status.
- **Key Observations:** This analysis helps us understand specific Stockout and Overstock events potentially tied to supplier inconsistencies. For instance, **PO153 (Store 4 East), PO083 (Store 5 West), PO175 (Store 1 West), PO178 (Store 2 North), PO126 (Store 4 West)** experienced the maximum times stock out, suggesting potential under-fulfillment issues from their suppliers.

My Recommendations

Leveraging these comprehensive findings, we recommend the following actionable strategies:

1. **Implement Targeted Inventory Adjustments:** Act immediately on the specific product-level recommendations for increasing or reducing order quantities, as outlined in the findings. Prioritize investigations for "Mixed Signal" products to resolve their erratic behavior.
2. **Adopt Dynamic Reorder Point System:** Move away from static thresholds. Integrate demand forecasts, lead times (e.g., 1 day), and desired service levels (e.g., 90% Z-score = 1.28) into a dynamic reorder point calculation to proactively prevent stockouts.
3. **Enhance Forecasting with External Factors:** Incorporate seasonal patterns, promotion schedules, and quantified weather impacts into your demand forecasting models. This will significantly improve forecast accuracy and align inventory with true market demand.
4. **Strengthen Supplier Dialogue:** Utilize the inferred supplier performance data (Order Fulfillment Discrepancy) to engage in data-driven discussions with suppliers. Focus on products and regions showing consistent under-fulfillment to improve delivery reliability.
5. **Automate Performance Monitoring:** Set up automated alerts within your dashboard for critical metrics like low inventory thresholds, significant fulfillment discrepancies, and major forecast deviations, enabling swift intervention.

Expected Business Impact

By systematically implementing these data-driven recommendations, **Urban Retail Co.** is strongly positioned to realize significant business benefits:

- **Smarter Inventory Decisions:** Transition from reactive, manual decision-making to a proactive, data-informed approach, optimizing every aspect of inventory flow.
- **Drastically Reduced Stockouts and Overstocks:** This will directly minimize lost sales opportunities due to unavailability and substantially cut warehousing costs while freeing up locked working capital.
- **Improved Supply Chain Efficiency:** Enhanced visibility and control over the flow of goods, leading to more predictable and reliable replenishment.
- **Heightened Customer Satisfaction:** Consistent product availability, particularly for popular items, will significantly improve the overall customer shopping experience.
- **Boosted Profitability:** The cumulative effect of reduced costs, maximized sales, and improved operational efficiency will directly contribute to a healthier bottom line for Urban Retail Co.