

Case Study: Supply Chain and Inventory Management

Background:

ABC Supermarket is a retail chain with multiple stores across different cities. The company has been struggling with stock imbalances—some products run out too quickly (stockouts), while others remain unsold for months (overstocking). These inefficiencies are increasing costs and reducing profits.

The management has decided to use data-driven insights to optimize their inventory and supply chain operations.

Problem Statement:

ABC Supermarket wants to improve its inventory management by:

1. **Balancing stock levels** – Ensure products are neither understocked nor overstocked.
2. **Improving demand forecasting** – Use historical sales data to predict future demand.
3. **Optimizing reorder strategies** – Automate when and how much to reorder.
4. **Reducing waste and carrying costs** – Minimize holding costs while maintaining availability.

Dataset Description:

The company has a following tables:

1. Sales Data (sales)

Sale_ID	Product_ID	Store_ID	Sale_Date	Quantity_Sold	Revenue
1001	P001	S101	2024-02-15	30	4500
1002	P002	S102	2024-02-25	3000	

2. Inventory Data (inventory)

Product_ID	Store_ID	Warehouse_ID	Stock_Level	Reorder_Level	Last_Updated
P001	S101	W001	50	100	2024-02-15
P002	S102	W002	200	150	2024-02-15

3. Supplier Data (suppliers)

Supplier_ID	Supplier_Name	Product_ID	Lead_Time (days)	Order_Frequency
SUP001	ABC Ltd	P001	5	Weekly
SUP002	XYZ Co	P002	7	Biweekly

4. Purchase Orders (purchase_orders)

Order_ID	Product_ID	Supplier_ID	Order_Date	Quantity	Arrival_Date
PO1001	P001	SUP001	2024-02-01	100	2024-02-06
PO1002	P002	SUP002	2024-02-05	200	2024-02-12

Tasks for Students:

1. SQL Tasks (Inventory Analytics & Reporting)

- Identify slow-moving and fast-moving products – Query products with the highest and lowest sales in the past 3 months.
- Find products below reorder level – Generate a report listing products that need restocking.
- Supplier lead time analysis – Find suppliers with high lead times and suggest alternatives.

2. Python Tasks (Forecasting & Optimization)

- **Demand Forecasting:**
 - Use Python (Pandas, NumPy, Matplotlib, Scikit-L) to perform time-series analysis and to predict demand for the next month.
- **Reorder Point Calculation:**
 - Implement a formula to calculate the optimal reorder point for each product.
- **Supplier Performance Analysis:**
 - Use clustering (K-Means or Hierarchical) to classify suppliers based on lead time and order frequency.

3. Data Warehousing Concepts

- **Star Schema Design** – Build a warehouse schema to optimize queries for inventory and supply chain management.
- **ETL Pipeline** – Design an ETL process to extract sales and inventory data, transform it, and load it into a data warehouse.
- **Aggregation Strategy** – Implement aggregated tables for fast reporting.

Expected Outcome:

By completing this case study, students will:

- Learn to track and optimize inventory using SQL queries.
- Use Python for demand forecasting and supplier evaluation.
- Apply data warehousing techniques for better decision-making.
- Improve supply chain efficiency using data-driven insights.