EDA / Descriptive Statistics

## Introduction:

The Medical Inventory Optimization project aims to enhance the efficiency of hospital supply chains by leveraging data analytics techniques. By analysing historical sales, costs, returns, and patient data, this project identifies usage patterns, minimizes wastage, and improves stock management. The objective is to reduce bounce rates, control costs, and ensure the timely availability of essential medicines and equipment, ultimately improving patient satisfaction and operational efficiency.

## Overall design strategy

The overall design strategy for the Medical Inventory Optimization project focuses on leveraging data analytics to address stock-related inefficiencies in medical facilities. The process begins with collecting and integrating data from hospital inventory and pharmacy systems, including key variables such as product name, quantity sold, department, expiry date, and cost. Using Python and SQL, the data undergoes extensive cleaning and preprocessing to ensure accuracy, including handling missing values and calculating important derived metrics such as bounce rate and stock turnover. Through exploratory data analysis (EDA), patterns in sales, demand trends, and inefficiencies are identified. This insight forms the basis for defining key performance indicators (KPIs) such as bounce rate, stock-out frequency, expired stock value, and total revenue. These KPIs are then visualized through an interactive Power BI dashboard using cards, bar charts, line charts, and KPI visuals, offering real-time visibility into inventory health. Filters by department, category, and date enhance decision-making granularity. Finally, the strategy emphasizes actionable insights for optimizing reorder levels, minimizing expired stock, and improving stock availability, ultimately aiming to reduce bounce rate by 30% and generate an additional ₹20 lakh INR in revenue.

## Data Overview

The dataset used for the Medical Inventory Optimization project contains comprehensive records of pharmaceutical inventory and sales from a healthcare facility. It includes essential fields such as product name, department, quantity sold, remaining stock, cost and sale prices, sale dates, expiry dates, and returned quantities. These attributes enable in-depth analysis of inventory usage patterns, bounce rate, stock efficiency, and demand forecasting. The cleaned dataset is structured for direct use in analytics tools and dashboard creation. You can access and download the dataset using the following link.

## Users

The primary users of the dashboard will include:

* **Inventory Managers** – To monitor stock levels, expiry status, and reorder requirements in real-time.
* **Pharmacy Heads** – To track high-demand items, manage returns, and minimize stockouts.
* **Hospital Administrators** – To evaluate bounce rates, sales trends, and overall inventory efficiency for operational decision-making.
* **Procurement Officers** – To plan and optimize purchasing based on historical trends and predictive insights.
* **Finance Teams** – To analyse inventory-related costs, revenue, and profit margins for budget planning.
* **Data Analysts** – To explore trends and anomalies for deeper performance insights.

## Questions

Questions which will be answered by this visualization:

**Departmental Performance**

* Which departments are generating the highest and lowest medication sales?
* Which departments contribute the most to bounce rates due to stockouts?

**Product-Level Insights**

* What are the most and least sold medical products?
* Which items frequently go out of stock or have low turnover?

**Bounce Rate and Patient Behaviour**

* What is the current bounce rate, and how has it changed over time?
* Which categories or departments have the highest bounce rate?

**Revenue and Financial Metrics**

* What is the total revenue generated by each department?
* How much inventory value is tied up in expired or returned products?

**Stock Efficiency**

* Are inventory levels optimized to meet demand?
* How much stock is nearing expiry or at risk of wastage?

**Trend and Forecast Analysis**

* How does sales volume trend over time (daily, weekly, monthly)?
* Are revenue and turnover targets being met?

## Describe Visualization and how it answers the questions

The dashboard utilizes a variety of visualizations to transform raw data into meaningful insights, allowing users to make quick, informed decisions. Each visualization is designed to answer specific business questions effectively:

* **Bar Charts**  
  Used to compare **sales across departments** and **top-selling vs. low-selling products**. This helps identify which areas perform well and which need attention.
* **Line Charts**  
  Represent **sales trends over time**, allowing users to track growth patterns, seasonal fluctuations, and the impact of changes in inventory strategy.
* **Pie Charts**  
  Show the **proportion of sales or stock by product type or department**, helping identify which areas dominate the inventory landscape.
* **Cards (KPI Visuals)**  
  Display **key performance indicators** such as Total Sales, Bounce Rate, Revenue, and Stock Value at a glance, enabling users to monitor performance instantly.
* **Tables with Conditional Formatting**  
  Highlight **critical products**, such as those nearing expiry or generating high returns, allowing faster response and better stock control.
* **Filters and Slicers**  
  Allow users to interact with the dashboard by selecting specific departments, products, or time ranges, making the dashboard dynamic and personalized.

These visualizations not only provide a holistic overview but also drill down into details, ensuring that decision-makers can quickly spot issues and opportunities in the medical inventory system.

## Conclusion

## The Medical Inventory Optimization Project successfully leverages data analytics and visualization to tackle key challenges such as stockouts, overstocking, and rising bounce rates. By integrating cleaned data into a dynamic Power BI dashboard, stakeholders gain clear visibility into sales performance, inventory efficiency, and patient behaviour.

## Through actionable insights derived from visualizations, the project supports better inventory planning, reduces wastage, and enhances overall patient satisfaction. Most importantly, it aligns with the business objective of reducing bounce rate by at least 30% and increasing revenue by 20 lakh INR. The dashboard empowers decision-makers to act proactively, ensuring that medical inventory is consistently available, cost-effective, and aligned with patient needs.

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