Pharmaceutical Inventory Optimization

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The Problem Statememts

Case 1: Stockouts -> Patient Risk

- A hospital pharmacy runs out of insulin, delaying treatment for disabetic patients
- Impact: Increased patient hospitalizations & mortality risks

Case 2: Stockouts -> Overstock example

- A pharmacy overorders flu vaccines, leading to expired stock
- Impact: Increased hospitalizations & regulatory waste disposal issues

01 Stockouts – Critical medications run out, risking patient health.

02 Overstocking & Expiration – Billions lost due to expired drugs.

03 Regulatory restrictions- FDA, DEA regulations require strict tracking

04 Supply chain disruptions increase risk & volatility

OUR OBJECTIVE

Our Data Driven Approach

Cleaned the data using Python Script
Monitor Stock Levels – Avoid overstock & stockouts.
Predict Demand – Using time series analysis, predict future demand (based on historical data)
Optimize Reorder Points – Reduce costs while maintaining availability

Tech Stack

Frontend & UI:

Streamlit → Built the interactive dashboard, displaying graphs, dropdowns, and tables.

Matplotlib → Rendered line charts, histograms, and time series plots within Streamlit.

Backend & Data Processing:

Pandas → Cleaned and structured pharmaceutical sales data from a CSV file.

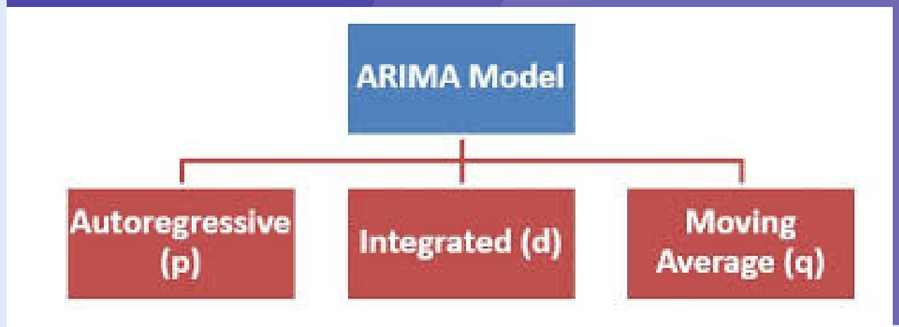
Datetime & Period Handling → Used pandas.to_datetime() and PeriodIndex for proper date conversions.

Time Series Forecasting:

Statsmodels (ARIMA) → Used AutoRegressive Integrated Moving Average (ARIMA) to model and forecast future sales.

pd.DateOffset() → Generated correct date ranges for the forecasted months.

Date Formatting (Matplotlib Dates) → Used AutoDateLocator() and DateFormatter("%Y-%m") for clear x-axis labels.



DEMO

Projected Plans for Pharmaceutical Inventory Optimization

1. Machine Learning for Demand Forecasting

- **Random Forest Regression** – Analyzes multiple factors affecting sales.
- **XGBoost (Gradient Boosting Trees)** – Captures nonlinear demand trends.
- **LSTM Neural Networks** – Best for deep-learning time-series forecasting.
- **Tools:** Scikit-learn, XGBoost, TensorFlow

2. Inventory Optimization Techniques

- **Economic Order Quantity (EOQ) –** Determines optimal order size to minimize costs.
- **Safety Stock Calculation –** Prevents stockouts by accounting for demand variability.
- **Reorder Point (ROP) –** Automates reordering when stock levels hit a threshold.

3. Multi-Echelon Inventory Optimization

- Balances stock across warehouses, hospitals, and pharmacies to reduce waste and improve efficiency.
- Ensures cost-effective distribution while maintaining medication availability.
- **Tools:** Gurobi, OR-Tools

Thank You!