Project Title: SmartStock Inventory Optimization for Retail Stores

Internship Platform: Infosys Springboard

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Milestone: 3 – Inventory Optimization Logic & Interactive Dashboard

1. Introduction

This milestone builds upon the forecasting models developed in Milestone 2. It focuses on translating the sales predictions into an actionable inventory management strategy. The primary objective was to implement core inventory optimization logic to calculate key metrics and to develop an interactive dashboard using Streamlit. This tool enables dynamic analysis and strategic planning by allowing users to simulate different business scenarios and visualize their impact on inventory levels.

2. Objectives

- Develop a Python script to calculate critical inventory metrics, including Economic Order Quantity (EOQ), Safety Stock (SS), and Reorder Point (ROP), using the forecasted sales data.
- Create an interactive and user-friendly dashboard with Streamlit for visualizing the inventory plan.
- Allow users to dynamically adjust key business parameters such as lead time, ordering costs, holding costs, and desired service level to see their real-time impact.
- Generate a comprehensive inventory plan for all products that can be downloaded as a CSV file for operational use.

3. Implementation & Code

The following Python script was developed to ingest the forecast data and build the interactive dashboard. The script reads the 'forecast_results.csv' file, calculates inventory metrics based on user inputs from the dashboard's sidebar, and displays the results in an organized layout with metrics and graphs.

Code:

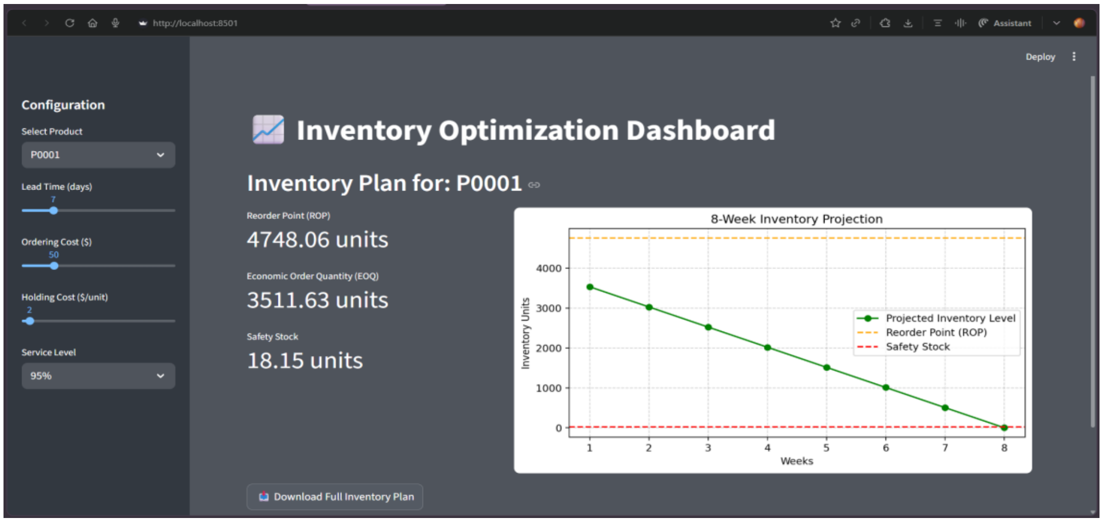
```
# inventory.py - Milestone 3: Inventory Optimization Logic
import pandas as pd
import numpy as np
import streamlit as st
import matplotlib.pyplot as plt

st.set_page_config(page_title="Inventory Optimization", layout="wide")
st.title("📈 Inventory Optimization Dashboard")

try:
  df = pd.read_csv("data/forecast_results.csv")
except FileNotFoundError:
  st.error("Error: 'data/forecast_results.csv' not found.")
  st.stop()

st.sidebar.header("Configuration")
products = df['Product_ID'].unique()
selected_product = st.sidebar.selectbox("Select Product", products)
```

```
lead_time = st.sidebar.slider("Lead Time (days)", 1, 30, 7)
ordering_cost = st.sidebar.slider("Ordering Cost ($)", 10, 200, 50)
holding_cost = st.sidebar.slider("Holding Cost ($/unit)", 1, 20, 2)
service_levels = {"90%": 1.28, "95%": 1.65, "99%": 2.33}
z = service_levels[st.sidebar.selectbox("Service Level", list(service_levels.keys()), 1)]

inventory_plan = []
for product in products:
    prod_df = df[df['Product_ID'] == product]
    avg = prod_df['Forecasted_Sales'].mean()
    std = prod_df['Forecasted_Sales'].std()
    annual_demand = avg * 365
    eoq = np.sqrt((2 * annual_demand * ordering_cost) / holding_cost)
    ss = z * std * np.sqrt(lead_time)
    rop = (avg * lead_time) + ss
    inventory_plan.append({
        "Product": product,
        "AvgDailySales": round(avg, 2),
        "TotalDemand": round(annual_demand, 2),
        "EOQ": round(eoq, 2),
        "SafetyStock": round(ss, 2),
        "ReorderPoint": round(rop, 2)
    })

inv_df = pd.DataFrame(inventory_plan)

st.header(f"Inventory Plan for: {selected_product}")
row = inv_df[inv_df["Product"] == selected_product].iloc[0]

col1, col2 = st.columns([1, 2])
with col1:
    st.metric("Reorder Point (ROP)", f"{row['ReorderPoint']:.2f} units")
    st.metric("Economic Order Quantity (EOQ)", f"{row['EOQ']:.2f} units")
    st.metric("Safety Stock", f"{row['SafetyStock']:.2f} units")

with col2:
    fig, ax = plt.subplots(figsize=(8, 4))
    max_inventory = row["EOQ"] + row["SafetyStock"]
    depletion_over_period = row["AvgDailySales"] * 56
    end_inventory = max(0, max_inventory - depletion_over_period)
    weeks = np.arange(1, 9)
    inv_level = np.linspace(max_inventory, end_inventory, 8)
    ax.plot(weeks, inv_level, label="Projected Inventory Level", marker='o', color='green')
    ax.axhline(y=row["ReorderPoint"], color="orange", linestyle="--", label="Reorder Point
(ROP)")
    ax.axhline(y=row["SafetyStock"], color="red", linestyle="--", label="Safety Stock")
    ax.set_xlabel("Weeks")
    ax.set_ylabel("Inventory Units")
    ax.set_title("8-Week Inventory Projection")
    ax.legend()
    st.pyplot(fig)

st.download_button("📥 Download Full Inventory Plan", inv_df.to_csv(index=False),
"inventory_plan.csv")
```

4. Dashboard & Results

The implemented script generates an interactive dashboard that serves as the primary interface for the inventory optimization model.

Dashboard Interface & Key Metrics:
The dashboard is designed with a sidebar for user inputs and a main panel for results. For any selected product, it instantly calculates and displays the three key inventory metrics: Reorder Point (ROP), Economic Order Quantity (EOQ), and Safety Stock.



Configuration

Select Product: P0001

Lead Time (days): 7

Ordering Cost ($): 50

Holding Cost ($/unit): 2

Service Level: 95%

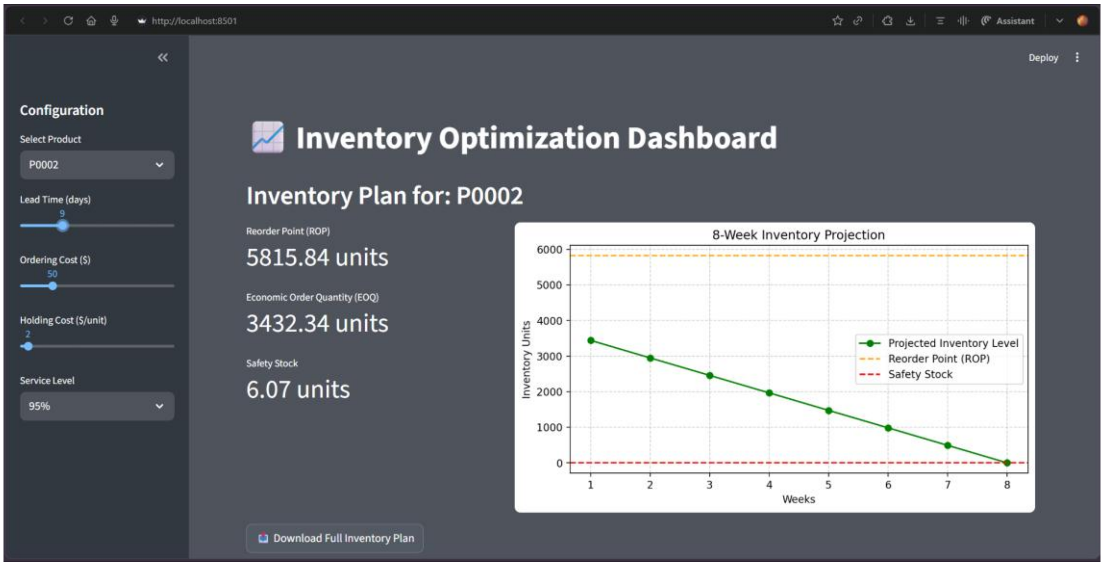
📈 Inventory Optimization Dashboard

Inventory Plan for: P0001

Reorder Point (ROP)
4748.06 units

Economic Order Quantity (EOQ)
3511.63 units

Safety Stock
18.15 units



Configuration

Select Product: P0002

Lead Time (days): 9

Ordering Cost ($): 50

Holding Cost ($/unit): 2

Service Level: 95%

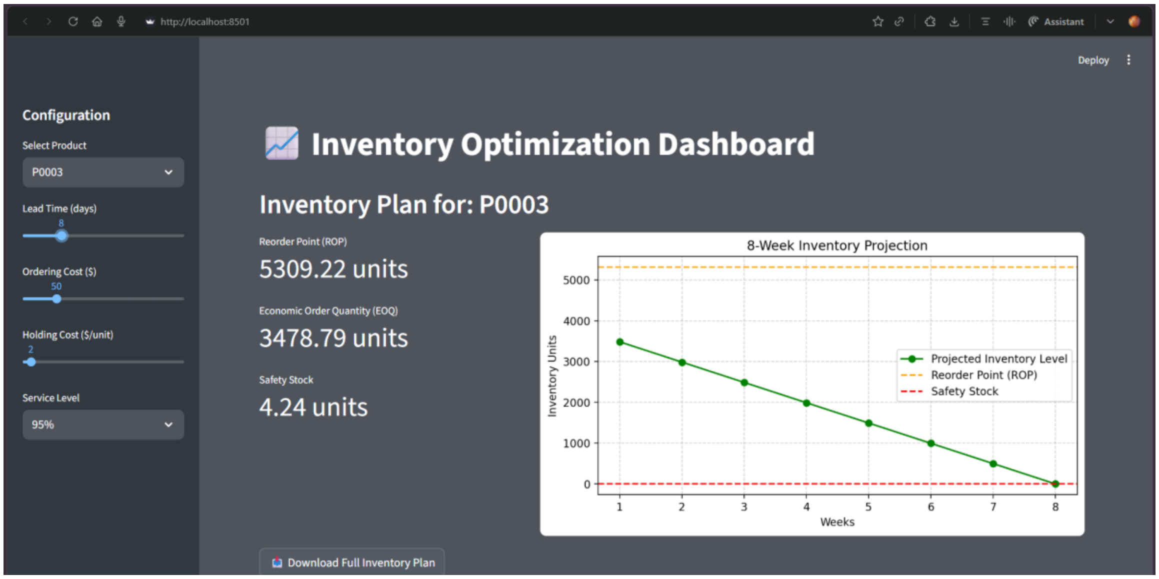
📈 Inventory Optimization Dashboard

Inventory Plan for: P0002

Reorder Point (ROP)
5815.84 units

Economic Order Quantity (EOQ)
3432.34 units

Safety Stock
6.07 units



Configuration

Select Product: P0003

Lead Time (days): 8

Ordering Cost ($): 50

Holding Cost ($/unit): 2

Service Level: 95%

📈 Inventory Optimization Dashboard

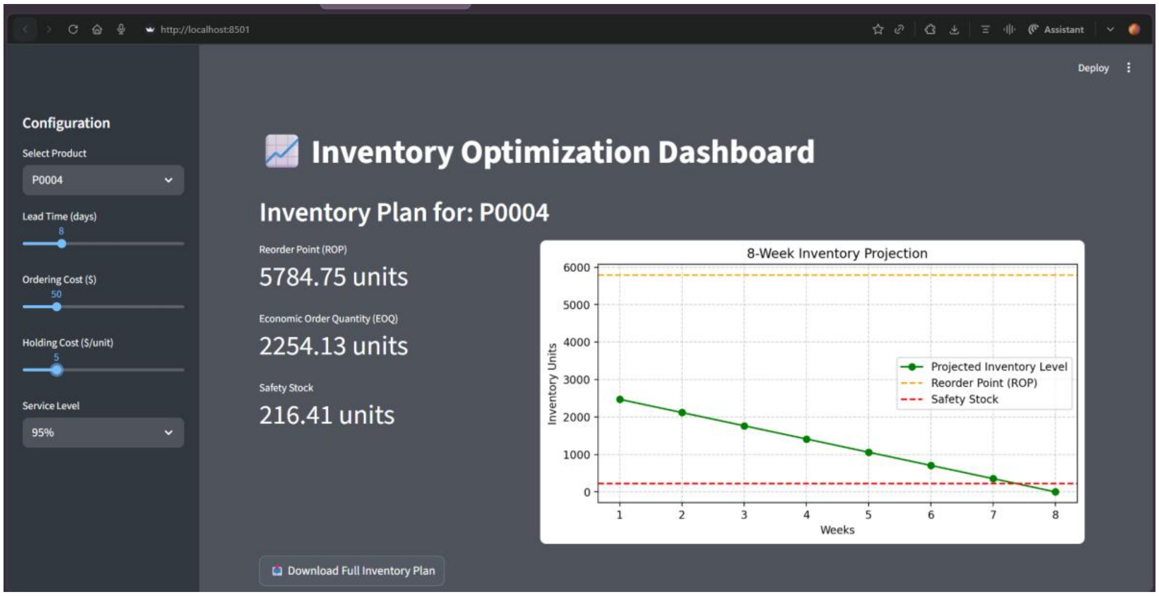
Inventory Plan for: P0003

Reorder Point (ROP)
5309.22 units

Economic Order Quantity (EOQ)
3478.79 units

Safety Stock
4.24 units

Download Full Inventory Plan



Configuration

Select Product: P0004

Lead Time (days): 8

Ordering Cost ($): 50

Holding Cost ($/unit): 5

Service Level: 95%

📈 Inventory Optimization Dashboard

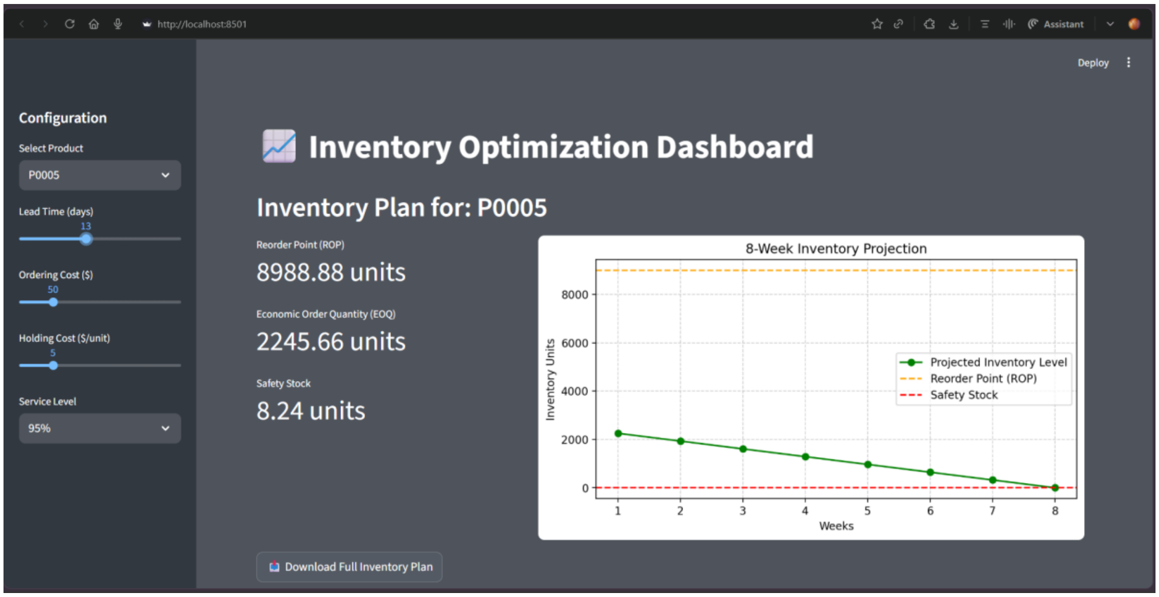
Inventory Plan for: P0004

Reorder Point (ROP)
5784.75 units

Economic Order Quantity (EOQ)
2254.13 units

Safety Stock
216.41 units

Download Full Inventory Plan



Configuration

Select Product: P0005

Lead Time (days): 13

Ordering Cost ($): 50

Holding Cost ($/unit): 5

Service Level: 95%

📈 Inventory Optimization Dashboard

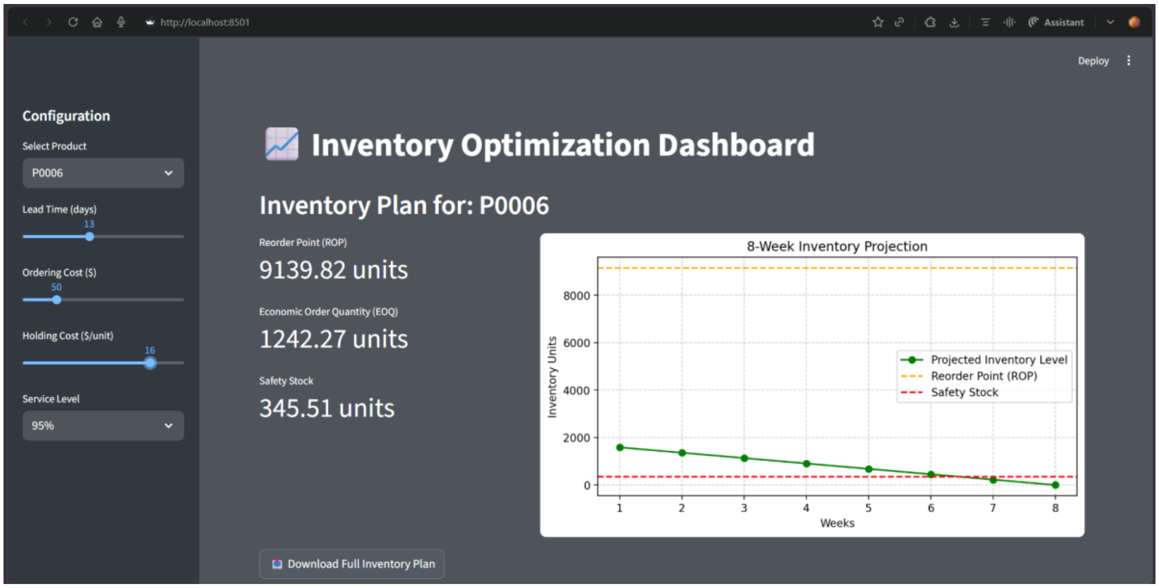
Inventory Plan for: P0005

Reorder Point (ROP)
8988.88 units

Economic Order Quantity (EOQ)
2245.66 units

Safety Stock
8.24 units

Download Full Inventory Plan



Configuration

Select Product: P0006

Lead Time (days): 13

Ordering Cost ($): 50

Holding Cost ($/unit): 16

Service Level: 95%

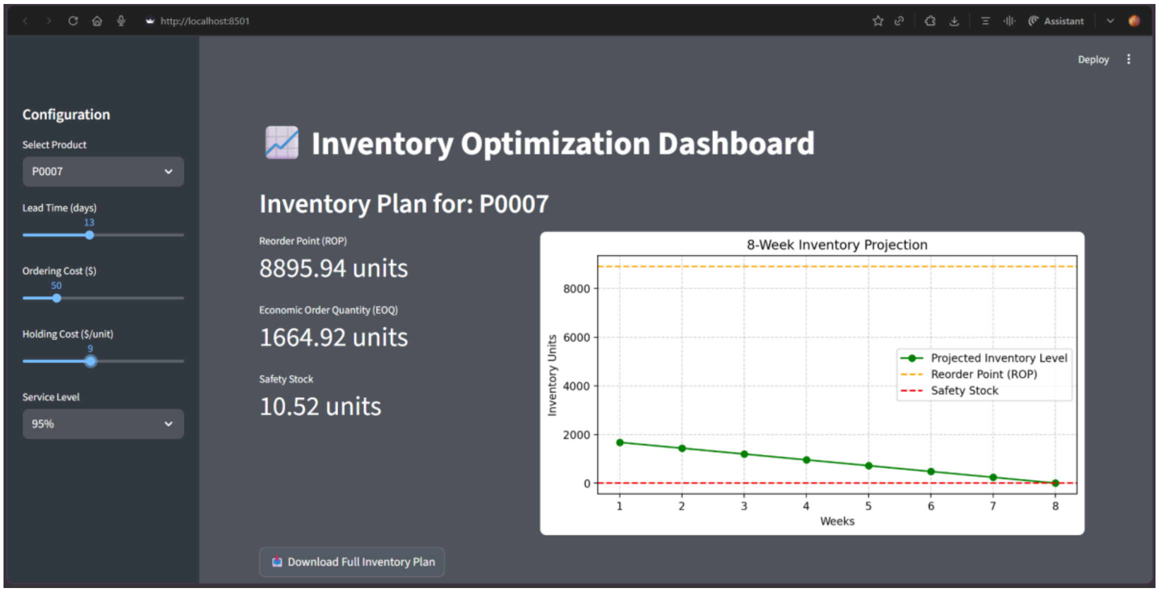
📈 Inventory Optimization Dashboard

Inventory Plan for: P0006

Reorder Point (ROP)
9139.82 units

Economic Order Quantity (EOQ)
1242.27 units

Safety Stock
345.51 units



Configuration

Select Product: P0007

Lead Time (days): 13

Ordering Cost ($): 50

Holding Cost ($/unit): 9

Service Level: 95%

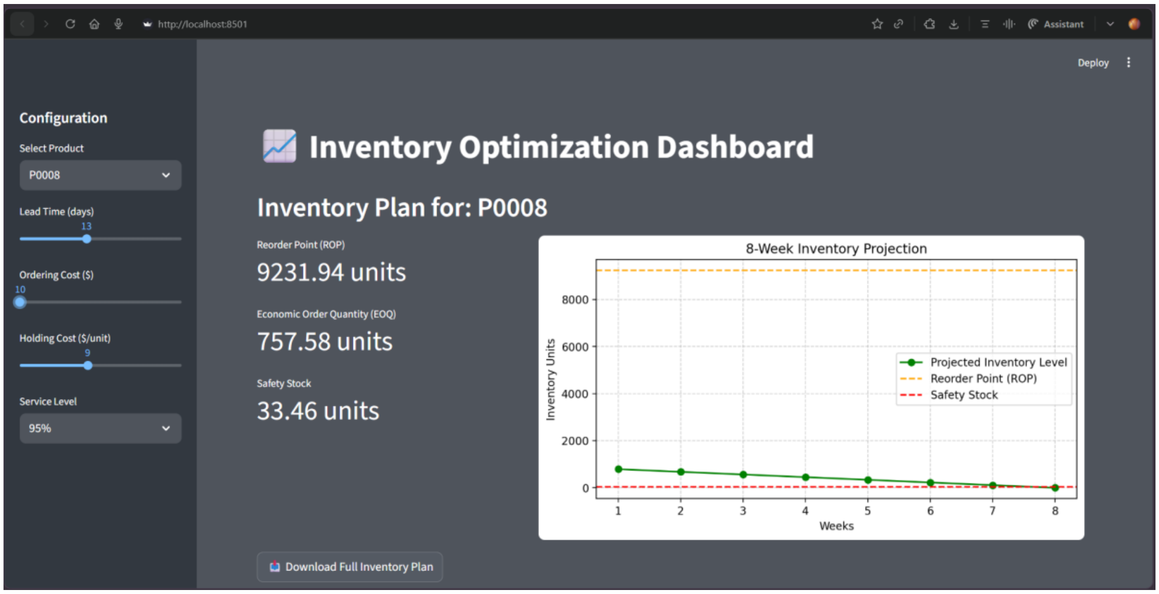
📈 Inventory Optimization Dashboard

Inventory Plan for: P0007

Reorder Point (ROP)
8895.94 units

Economic Order Quantity (EOQ)
1664.92 units

Safety Stock
10.52 units



Configuration

Select Product: P0008

Lead Time (days): 13

Ordering Cost ($): 10

Holding Cost ($/unit): 9

Service Level: 95%

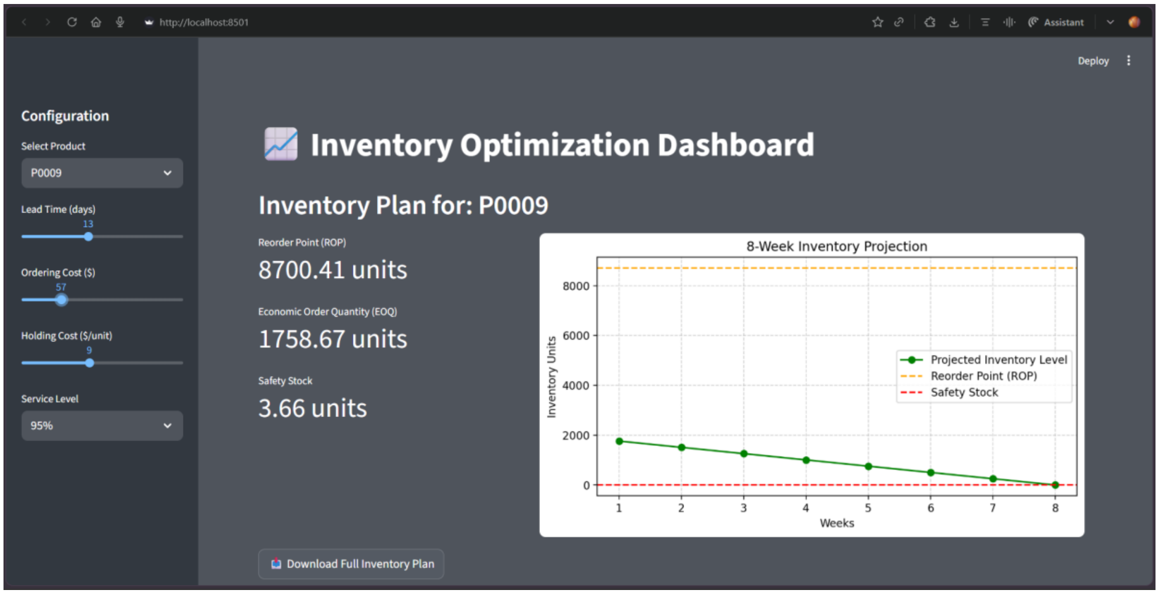
📈 Inventory Optimization Dashboard

Inventory Plan for: P0008

Reorder Point (ROP)
9231.94 units

Economic Order Quantity (EOQ)
757.58 units

Safety Stock
33.46 units



Configuration

Select Product

P0009

Lead Time (days)

13

Ordering Cost ($)

57

Holding Cost ($/unit)

9

Service Level

95%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0009

Reorder Point (ROP)

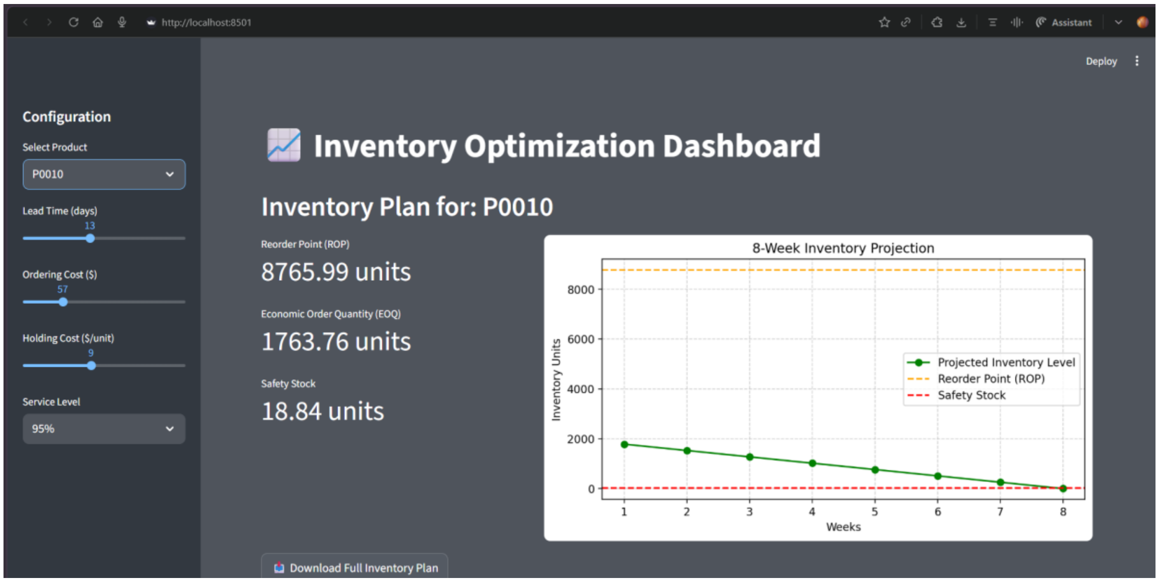
8700.41 units

Economic Order Quantity (EOQ)

1758.67 units

Safety Stock

3.66 units



Configuration

Select Product

P0010

Lead Time (days)

13

Ordering Cost ($)

57

Holding Cost ($/unit)

9

Service Level

95%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0010

Reorder Point (ROP)

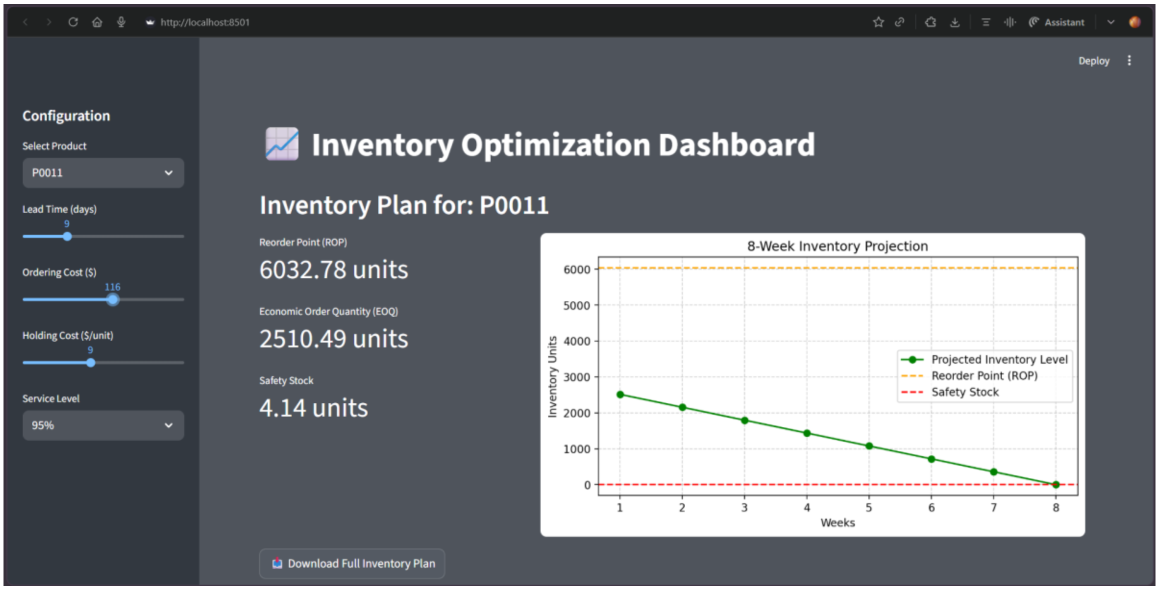
8765.99 units

Economic Order Quantity (EOQ)

1763.76 units

Safety Stock

18.84 units



Configuration

Select Product

P0011

Lead Time (days)

9

Ordering Cost ($)

116

Holding Cost ($/unit)

9

Service Level

95%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0011

Reorder Point (ROP)

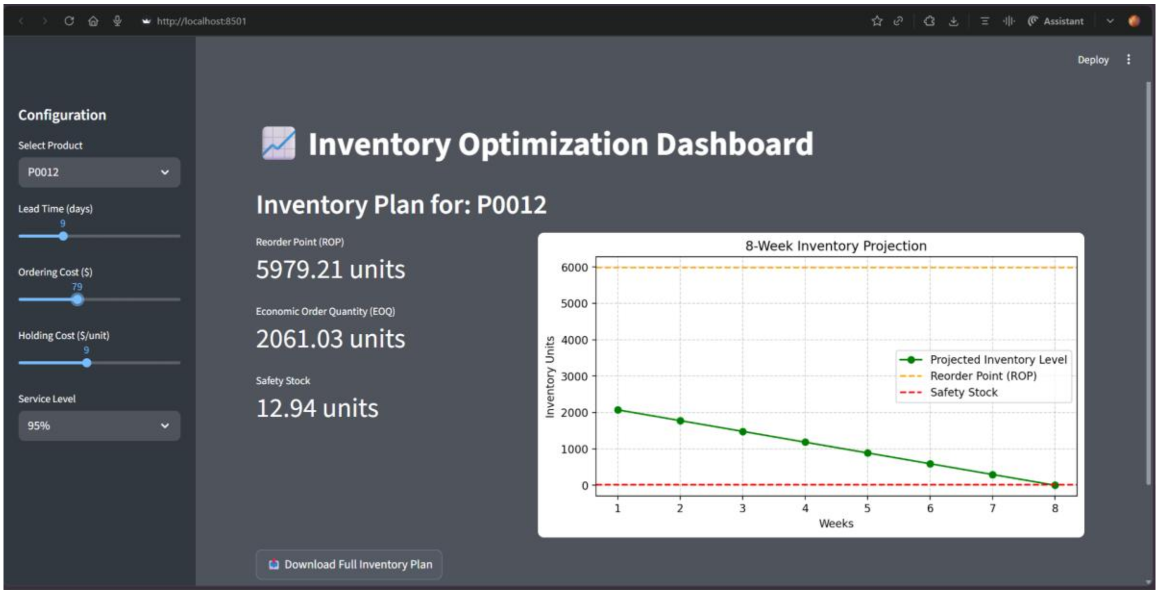
6032.78 units

Economic Order Quantity (EOQ)

2510.49 units

Safety Stock

4.14 units



Configuration

Select Product: P0012

Lead Time (days): 9

Ordering Cost ($): 79

Holding Cost ($/unit): 9

Service Level: 95%

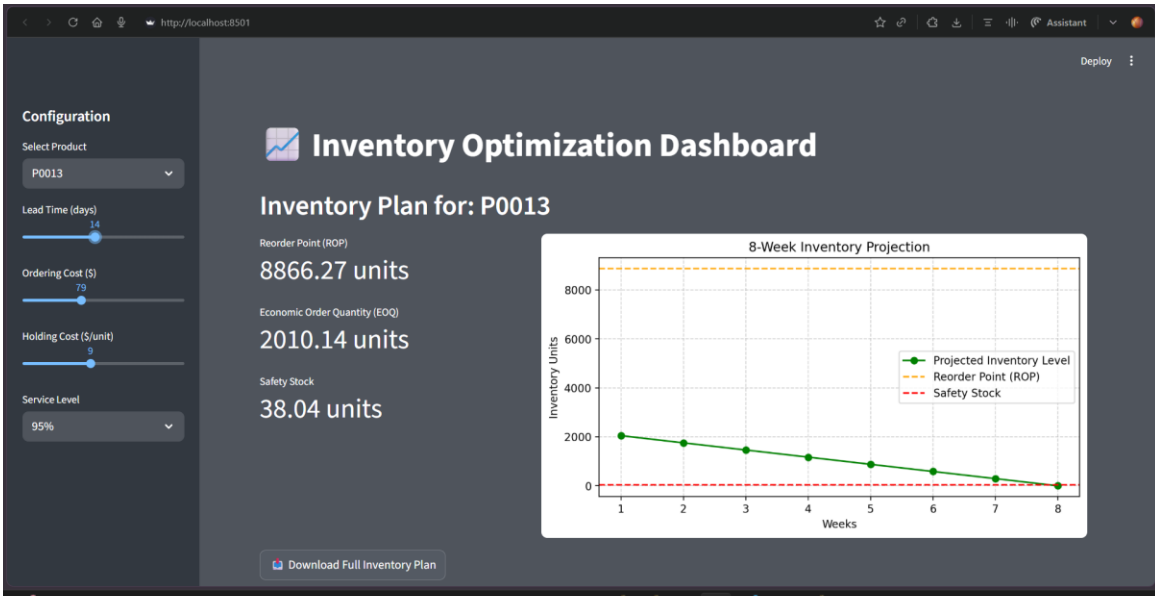
📈 Inventory Optimization Dashboard

Inventory Plan for: P0012

Reorder Point (ROP)
5979.21 units

Economic Order Quantity (EOQ)
2061.03 units

Safety Stock
12.94 units



Configuration

Select Product: P0013

Lead Time (days): 14

Ordering Cost ($): 79

Holding Cost ($/unit): 9

Service Level: 95%

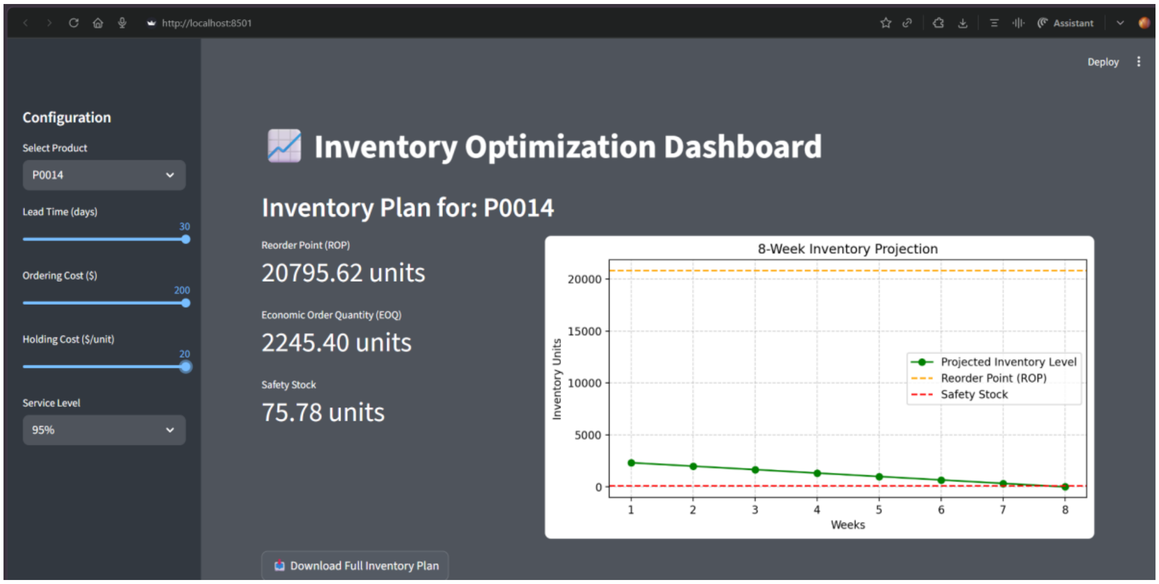
📈 Inventory Optimization Dashboard

Inventory Plan for: P0013

Reorder Point (ROP)
8866.27 units

Economic Order Quantity (EOQ)
2010.14 units

Safety Stock
38.04 units



Configuration

Select Product: P0014

Lead Time (days): 30

Ordering Cost ($): 200

Holding Cost ($/unit): 20

Service Level: 95%

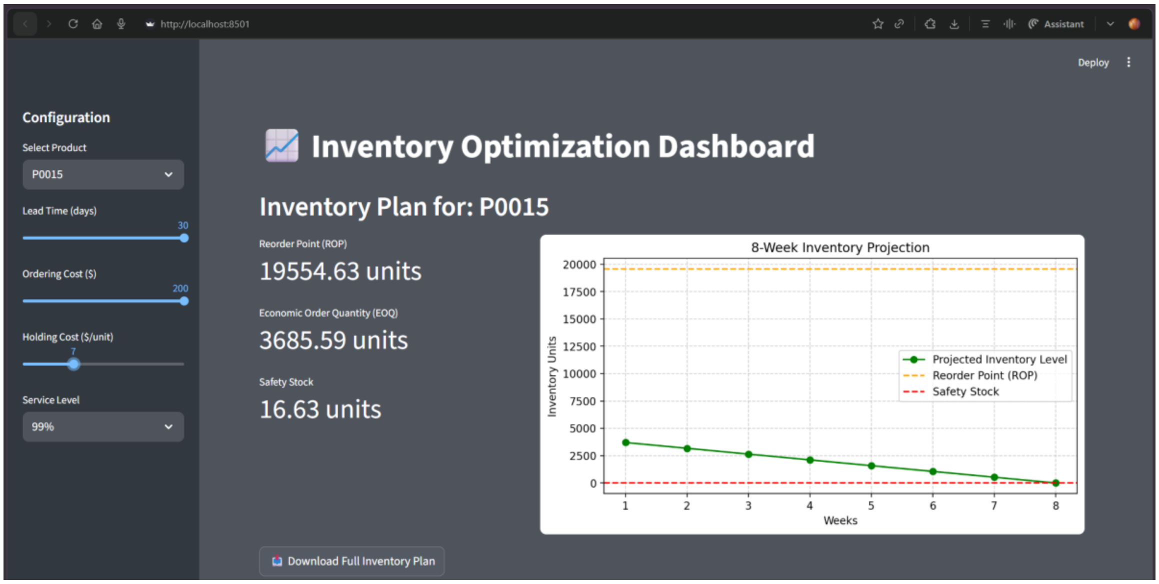
📈 Inventory Optimization Dashboard

Inventory Plan for: P0014

Reorder Point (ROP)
20795.62 units

Economic Order Quantity (EOQ)
2245.40 units

Safety Stock
75.78 units



Configuration

Select Product: P0015

Lead Time (days): 30

Ordering Cost ($): 200

Holding Cost ($/unit): 7

Service Level: 99%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0015

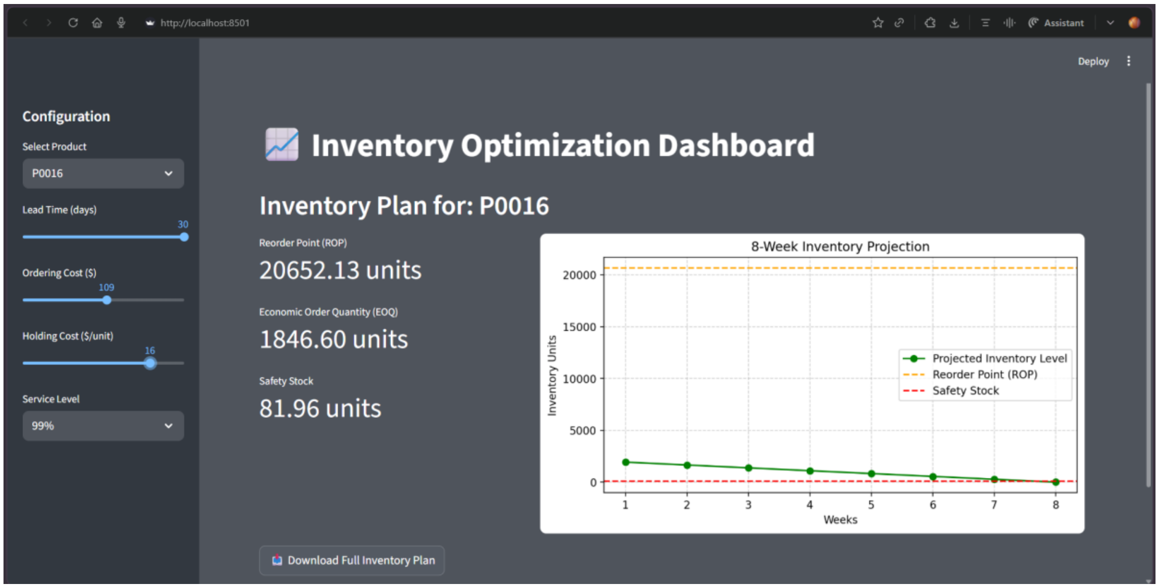
Reorder Point (ROP)
19554.63 units

Economic Order Quantity (EOQ)
3685.59 units

Safety Stock
16.63 units

8-Week Inventory Projection

Download Full Inventory Plan



Configuration

Select Product: P0016

Lead Time (days): 30

Ordering Cost ($): 109

Holding Cost ($/unit): 16

Service Level: 99%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0016

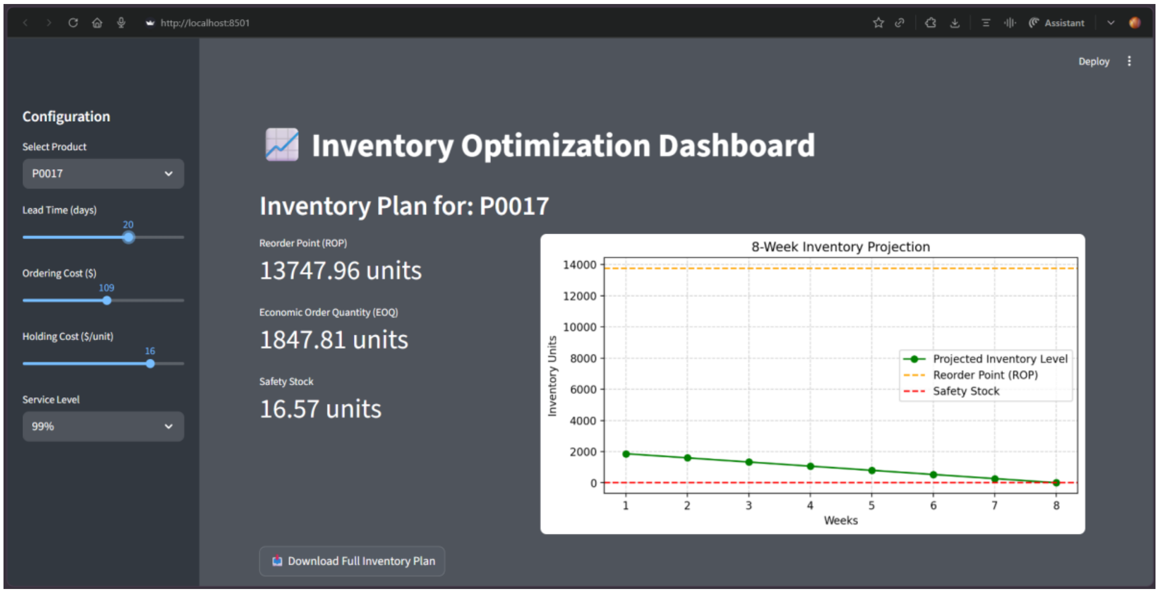
Reorder Point (ROP)
20652.13 units

Economic Order Quantity (EOQ)
1846.60 units

Safety Stock
81.96 units

8-Week Inventory Projection

Download Full Inventory Plan



Configuration

Select Product: P0017

Lead Time (days): 20

Ordering Cost ($): 109

Holding Cost ($/unit): 16

Service Level: 99%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0017

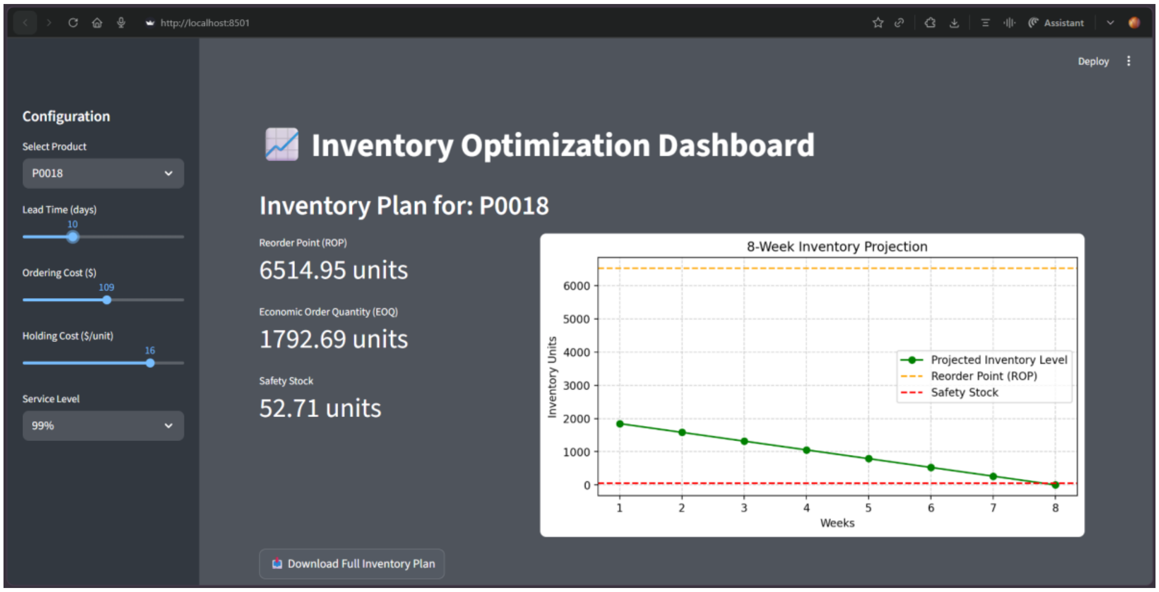
Reorder Point (ROP)
13747.96 units

Economic Order Quantity (EOQ)
1847.81 units

Safety Stock
16.57 units

8-Week Inventory Projection

Download Full Inventory Plan



Configuration

Select Product: P0018

Lead Time (days): 10

Ordering Cost ($): 109

Holding Cost ($/unit): 16

Service Level: 99%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0018

Reorder Point (ROP)

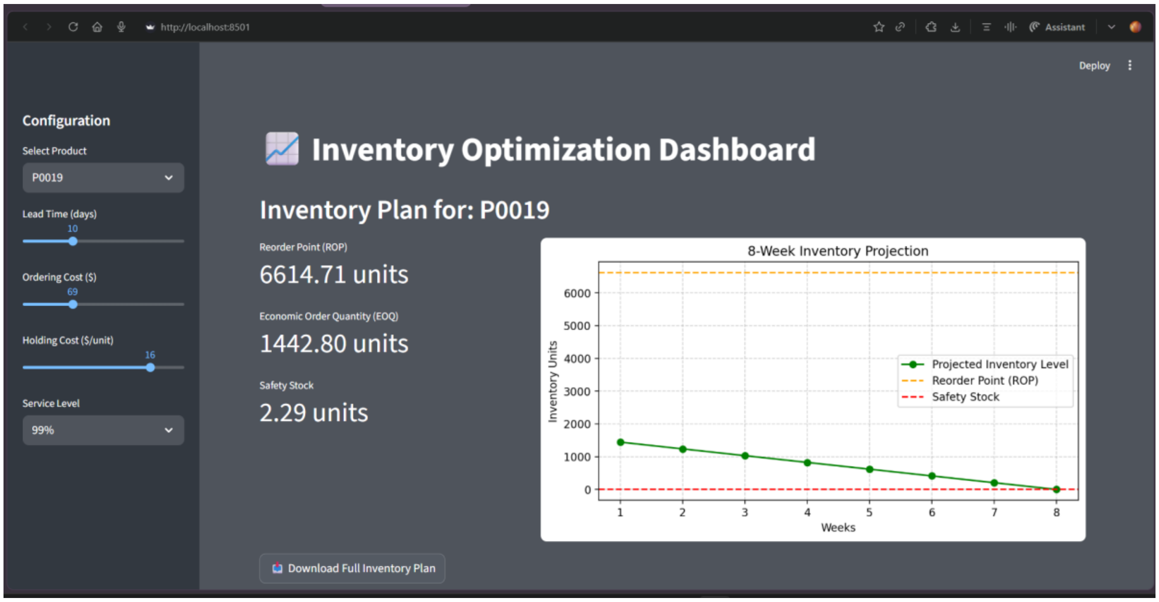
6514.95 units

Economic Order Quantity (EOQ)

1792.69 units

Safety Stock

52.71 units



Configuration

Select Product: P0019

Lead Time (days): 10

Ordering Cost ($): 69

Holding Cost ($/unit): 16

Service Level: 99%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0019

Reorder Point (ROP)

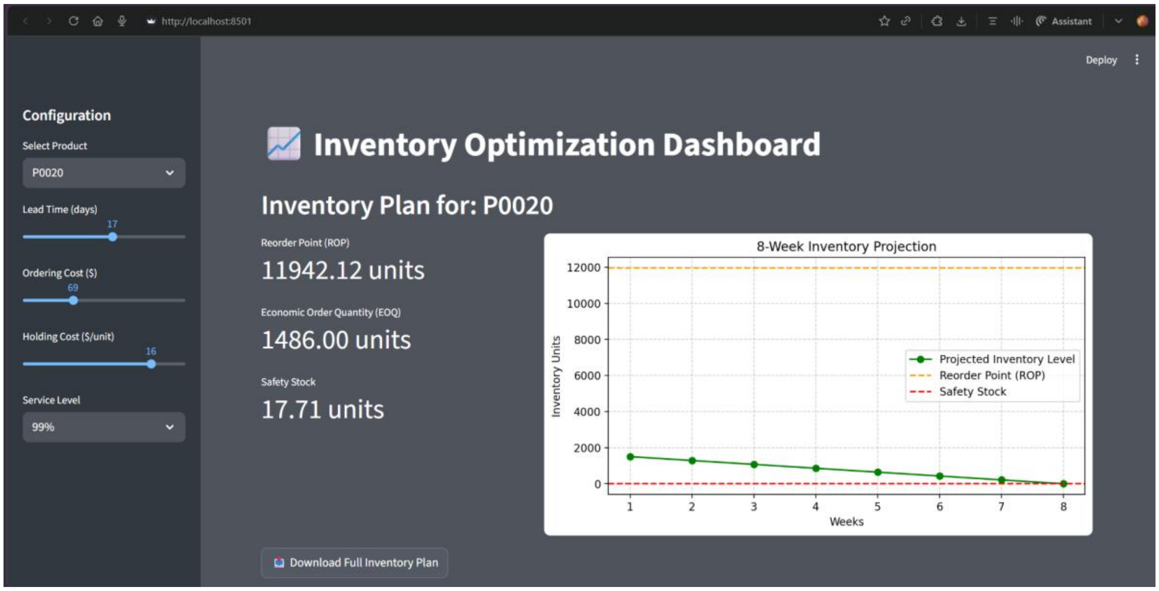
6614.71 units

Economic Order Quantity (EOQ)

1442.80 units

Safety Stock

2.29 units



Configuration

Select Product: P0020

Lead Time (days): 17

Ordering Cost ($): 69

Holding Cost ($/unit): 16

Service Level: 99%

📈 Inventory Optimization Dashboard

Inventory Plan for: P0020

Reorder Point (ROP)

11942.12 units

Economic Order Quantity (EOQ)

1486.00 units

Safety Stock

17.71 units

5. Observations

- The interactive nature of the dashboard allows for powerful 'what-if' scenario analysis.
- The model clearly demonstrates the trade-off between service level and inventory cost.
- The EOQ calculation provides a data-driven recommendation for order sizes, balancing ordering and holding costs.

6. Outputs

- An Interactive Streamlit Dashboard: A web-based application for real-time inventory analysis and planning.
- A Comprehensive Inventory Plan (inventory_plan.csv): A downloadable CSV file containing calculated metrics.

7. Conclusion & Next Steps

Milestone 3 successfully created a functional and interactive tool for inventory optimization. By leveraging the sales forecasts from the previous milestone, the system provides data-driven insights for stock management. The dashboard and downloadable plan equip decision-makers with information to minimize costs, prevent stockouts, and improve efficiency. Future enhancements could include cloud deployment, integration with live databases, and ABC analysis for inventory categorization.