DEVELOPING AN EOQ AND REORDER POINT MODEL FOR A FAST-GROWING E-COMMERCE WAREHOUSE

1. Background and Problem Statement:

A D2C e-commerce brand specializing in lifestyle and home products faced growing demand and SKU complexity. With over 500 active SKUs and monthly order fluctuations, the warehouse often experienced overstocking of slow-moving items and stockouts of high-demand products. The company used manual inventory planning with basic Excel sheets, resulting in inconsistent purchase cycles and high holding costs. To solve this, they sought a **custom EOQ and reorder point model** tailored to their scale and demand dynamics.

2. Objectives:

- To build an Economic Order Quantity (EOQ) model that minimizes total ordering and holding costs
- To calculate dynamic reorder points based on lead time demand and safety stock
- To classify SKUs based on volatility and integrate service level constraints
- To automate reorder calculations using a scalable model connected to live inventory data

3. Methodology:

Data Requirements:

- Historical sales volume for 12 months (weekly granularity)
- Supplier lead time (in days) and order cost per SKU
- SKU-wise storage cost, unit cost, and service level targets
- Stock on hand and daily consumption rates

Modeling Approach:

- **EOQ Calculation:**

$$EOQ = \sqrt{\frac{2DS}{H}}$$

Where:

$D = Annual\ demand,$

$S = Ordering\ cost\ per\ order,$

$H = Holding\ cost\ per\ unit/year$

- **Reorder Point (ROP):**

$$ROP = (Daily\ Demand \times Lead\ Time) + Safety\ Stock$$

Safety stock was calculated based on desired service level (z-score × σ of demand during lead time)

- **Tool Used:**
    - **Python (pandas, NumPy, matplotlib)** for model automation
    - **Excel interface** for SKU managers to review and trigger purchase decisions

4. Results:

- Calculated EOQ and ROP values for all 500+ SKUs
- Safety stock ensured a **95%+ service level** on high-demand SKUs
- Average inventory turnover ratio improved from 5.2 to 7.8
- Holding cost reduced by **18%** in the first quarter after model deployment
- Stockouts for top 50 products dropped by **42%**

5. Interpretation and Insights:

- High-margin products with low order frequency benefited most from EOQ optimization
- ROP calculations revealed inconsistencies in previous replenishment cycles
- Volatile SKUs required greater buffer stock, which was addressed with safety stock calculations
- Automating the model enabled SKU managers to rely on data-driven reorder decisions instead of intuition

6. Recommendations:

- Schedule weekly auto-refresh of the EOQ-ROP model from updated sales and stock files
- Train inventory team to monitor EOQ deviations and adjust for supplier changes

- Build supplier-specific lead time buffers into the ROP formula
- Set alerts when stock drops below calculated reorder point

7. Future Work:

- Integrate live Shopify and warehouse database APIs for real-time updates
- Extend model to include promotional uplift factors and price sensitivity
- Add constraint-based optimization for warehouse space and cash flow limits
- Introduce machine learning–based demand forecasting as a future upgrade

8. Stakeholder Relevance:

Academic:

- A practical demonstration of EOQ and ROP application in retail logistics
- Useful in operations research, supply chain analytics, and inventory management coursework

Corporate:

- Helps fast-growing e-commerce businesses reduce working capital stress and improve fulfillment
- Offers a replicable framework for inventory efficiency at scale