## Project Overview: Inventory Optimization for Athers Food Inc.

As part of a supply chain audit initiated by the incoming COO, I led the development and simulation of inventory strategies for Athers Food Inc., a major shelf-stable food manufacturer facing rising revenues but declining profits. The goal was to assess and improve the company's inventory policies to support sustainable growth and profitability.

### My Role and Contributions

**1. Demand Analysis and Forecasting**

- Modeled daily demand using a Negative Binomial distribution adjusted for seasonality (holiday peaks) and year-over-year growth.
- Used Python (Pandas, NumPy, SciPy) to simulate demand for four consecutive years (2019–2022), incorporating business-specific trends such as holiday surges (+70 units/day) and annual demand growth (+10 units/day).
- Produced demand visualizations to help the executive team understand demand variability and seasonality.

**2. Reverse Engineering of Existing Inventory Policy**

- Analyzed historical inventory data to infer the existing policy, discovering that the company followed a fixed-time, fixed-quantity monthly ordering system with a 9-day lead time.
- Demonstrated that the current approach was not demand-responsive and led to excessive holding costs despite minimizing stockouts.

**3. Development and Simulation of EOQ-Based Policies**

- Applied the classical Economic Order Quantity (EOQ) model to historical demand data for 2019–2022.
- Simulated the EOQ policy using custom Python functions, accounting for setup, holding, production costs, and stockouts.
- Evaluated trade-offs using “stockouts vs. profit” and “stockouts vs. cost” plots, revealing that while EOQ reduced costs, it led to unacceptable service-level issues due to high stockouts.

**4. Cost-Profit-Risk Trade-Off Analysis**

- Integrated safety stock into the EOQ model to improve resilience.
- Simulated and visualized various service levels to quantify the relationship between safety stock, total cost, and profit.
- Recommended a buffered EOQ policy as a temporary middle-ground for improving reliability without excessive cost.

**5. Design of a Flexible, Continuous-Review Inventory Policy**

- Proposed and implemented a dynamic inventory control model based on real-time monitoring.
- Used statistical reorder points incorporating demand mean, standard deviation, lead time, and Z-score for service level.
- Simulation showed this policy produced superior profitability ($2.42M) with significantly fewer stockouts compared to fixed or EOQ-based systems.

**Tools & Technologies Used**

- Python (Pandas, NumPy, SciPy, Matplotlib)
- Statistical Modeling: Negative Binomial distribution, trend/seasonality adjustments
- Operations Research: EOQ modeling, safety stock calculation
- Inventory Simulation: Discrete event simulation with lead time and demand variability
- Visualization & Reporting: Risk-return plots, cost breakdowns, policy comparison tables

## Outcome

The project provided Athers Food Inc. with a data-driven roadmap for improving inventory performance. The flexible inventory model I proposed balanced profitability, responsiveness, and resilience, and was well-aligned with the new COO's objective of building a modern, agile supply chain.

This project demonstrated my ability to combine quantitative analysis with business strategy, transforming complex data into actionable decisions.