Problem Statement

PROBLEM 1

Price volatility in agricultural commodities, such as potatoes, creates uncertainty for farmers, traders, and policymakers. Traditional statistical models often struggle to capture the complex fluctuations in the wholesale price index (WPI). This challenge calls for developing more accurate and reliable forecasting models using advanced statistical and machine-learning techniques.

Objective:
Participants are required to analyze price index data, compare different predictive models, and identify the most effective approach for forecasting price fluctuations with high accuracy.

Data type:
A simulated data of WPI of potatoes is provided from 1990-2024 for forecasting price fluctuation to identify the most effective approach.

PROBLEM 2

Decoding Stochastic Growth: Estimating Population Dynamics with MLE:

A biological population follows a stochastic logistic growth model:

$$\frac{dP}{dt} = rP\left(1 - \frac{P}{K}\right) + \sigma W_t$$

where:

- $P(t)$ is the population at time t
- K is the carrying capacity
- P_0 is the initial population
- r is the intrinsic growth rate
- W_t is a Wiener process (introducing stochasticity)
- σ is the noise intensity

Your tasks are:

1. Simulate noisy population growth data with some initial values of (choose by yourself) K, r, σ for 100 time points.
2. Estimate parameters K, r, σ by using MLE by optimizing the likelihood function
3. Compare the stochastic logistic model with the standard deterministic logistic model using AIC/BIC.

PROBLEM 3

In today's globalized market, efficient supply chain management is essential for minimizing costs and ensuring timely deliveries. Companies face challenges in optimizing freight costs, warehouse utilization, and plant-port assignments while meeting customer demands. To enhance logistics efficiency, businesses must make data-driven decisions on selecting the optimal plant, port, and transportation mode for each order.

Objective:

Develop a data-driven supply chain optimization model that:

1) Identifies Key Plant-Port Connections – Analyzes supply chain networks to determine the most efficient facility-port relationships.
2) Optimizes Order Fulfillment – Selects the most cost-effective plant and port for each order, ensuring timely deliveries.
3) Improves Freight Cost Estimation – Aggregates and compares transportation costs across different modes to enhance pricing accuracy.
4) Enhances Warehouse Efficiency – Evaluates storage and manufacturing costs per plant to improve capacity utilization.
5) Delivers Actionable Insights – Provides interactive visualizations and network graphs for data-driven decision-making.