Part 1

Stock Price Prediction Challenge

Challenge Description

Using the provided historical stock price dataset, develop a machine learning model that predicts the stock's closing price 5 trading days into the future. Your solution should demonstrate both predictive accuracy and practical trading value.

Key Requirements

1. Perform exploratory data analysis to identify relevant patterns and features.
2. Engineer meaningful features from the time series data.
3. Develop and train a prediction model.
4. Evaluate your model using both statistical metrics and simulated trading performance.
5. Present your approach, including feature importance and model limitations.

Evaluation Criteria

- Exploratory Data Analysis (50%): Quality of data visualization and insights.
- Prediction accuracy (10%): Measured by RMSE and directional accuracy.
- Documentation and insights (30%): Clear explanation of approach, findings, and limitations.
- Limitation analysis and improvement strategies (20%): Identification of model/data limitations and thoughtful proposals for addressing them with additional time/data.

Deliverables

1. **Jupyter notebook** with well-documented code showing your complete workflow from data analysis to prediction
2. **Comprehensive EDA report** that includes:
    - Visualizations of key patterns and relationships in the data.
    - Analysis of trends, seasonality, and anomalies.
    - Justification for feature selection choices.
    - Clear documentation of data preprocessing decisions.

3. **Model selection documentation** that includes:

- Comparison of different modeling approaches tested.
- Explanation of evaluation metrics used for selection.
- Justification for your final model choice.
- Analysis of model limitations and potential improvements with additional time/data.

4. **CSV file** with predictions for the test period.

5. **README file** summarizing your approach, key findings, and instructions to reproduce your results.

Part 2

Challenge Extension: End-to-End System Design

Prompt

Now that you've built a prediction model, imagine your solution is being adopted by a financial analysis firm. Design an end-to-end system that would take your model from a one-time analysis to a production-ready solution that continuously delivers value.

Task

Design a complete system architecture that addresses the following components.

1. **Data Collection & Ingestion:** How would you source data (market data, additional features) and bring it into your system?

2. **Data Processing Pipeline:** What would your data preprocessing, feature engineering, and storage architecture look like?

3. **Model Operations**: How would you handle model training, evaluation, deployment, and monitoring?

4. **Insight Delivery:** How would you present predictions and insights to end-users (analysts/brokers)?

5. **System Considerations:** Address scalability, reliability, latency requirements, and cost considerations.

Deliverables

1. **System Architecture Diagram**: Create a visual representation of your proposed system (hand-drawn diagrams are acceptable - take a photo)

2. **Component Justification**: For each major component in your design:

- What technology/approach would you use?
- Why did you choose this particular solution?
- What are the tradeoffs of your choice?

3. **Data Flow Explanation**: Describe how data would flow through your system

- Batch vs. streaming decisions and reasoning
- Data transformation stages
- System interaction points

4. **Challenge Analysis**: Identify 3-5 potential challenges in implementing your design and propose mitigation approaches.

Evaluation Criteria

- Completeness of solution (25%): Addresses all required components
- Technical feasibility (25%): Realistic design given current technologies
- Design justification (30%): Clear reasoning for architectural choices
- Challenge awareness (20%): Identification of implementation hurdles and thoughtful solutions

Note to Participants

This is an open-ended design exercise. We're not looking for a single "correct" answer, but rather evaluating your ability to:

- Design practical systems that solve real business problems.
- Make informed technology choices with clear justifications.
- Think critically about implementation challenges.
- Communicate technical concepts effectively.