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Solution Design Document

Project: Enhancing pair trading strategies for currency pairs using Deep Learning models: A focus on synthetic spread prediction

Objective

Improve pair trading for currency pairs (e.g., EUR/USD) to increase profits and reduce risks in unpredictable financial markets using advanced machine learning and deep learning. This provides a modern, competitive trading tool.

Problem

Traditional pair trading struggles because: 1. Markets move in complex, unpredictable ways; 2. Rapid changes make old methods less reliable; and 3. Noisy, fast data hides useful signals.

This project uses deep learning to spot patterns and make smarter trades.

Solution architecture

A Jupyter notebook solution, divided into 11 distinct steps

1. **Data Acquisition and Preparation (Steps 1–3)**
   - **Purpose**: Set up the system, define parameters, and collect 10 years of EUR/USD price data, ensuring it's clean and reliable.
   - **Justification**: Accurate, well-organized data is essential for building trustworthy predictions and trading decisions.
2. **Feature Engineering and Analysis (Steps 4–6)**
   - **Purpose**: Transform raw data into meaningful indicators (e.g., trends, volatility) and ensure the target price difference is stable for prediction.
   - **Justification**: Relevant features and a stable target enhance the system's ability to detect profitable trading opportunities.
3. **Model Development and Tuning (Steps 7–8)**
   - **Purpose**: Build and optimize predictive models, including deep learning (e.g., LSTM) and traditional methods (e.g., Random Forest), to forecast price differences.
   - **Justification**: Accurate forecasts drive effective trading signals and maximize profits.
4. **Strategy Execution and Backtesting (Steps 9–10)**
   - **Purpose**: Generate buy/sell signals, apply risk controls (e.g., stop-losses), and test the strategy on historical data to evaluate performance.
   - **Justification**: Rigorous testing and risk management ensure the strategy is viable and minimizes losses before real-world deployment.
5. **Final Performance Analysis, Comparison, & Visualization (Step 11)**
   - **Purpose**: Evaluate model accuracy and financial results, comparing AI models and visualizing performance.
   - **Justification**: Confirm the system's effectiveness and guide future improvements

Business Benefits

- **Higher returns**: Precise predictions increase profitable trades.
- **Reduced risks**: Safety measures limit losses.