TOBB ETÜ

University of Economics & Technology

Arbitrage Strategy with Pair Trading: A Practical Approach to Market Neutral Trading

Project Proposal

Project Team:

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1. Introduction

Pair trading is a strategy where we identify two assets that historically move together and trade based on their price divergence. The idea is pretty straightforward: if two assets usually move in sync and one suddenly diverges, we bet on their prices converging again. What makes this method stand out is that it works independently of the market's overall direction, making it a **market-neutral strategy**. This means whether the market goes up or down, we still have the potential to make a profit.

In this project, we're focusing on **foreign exchange (Forex) trading**, using **historical exchange rate data** to build a systematic pair trading strategy. Initially, we've chosen **AUD/USD and CAD/USD** as our currency pairs, as they tend to have a strong historical correlation. But of course, we're keeping things flexible—if our analysis shows better pairs later, we'll adapt accordingly.

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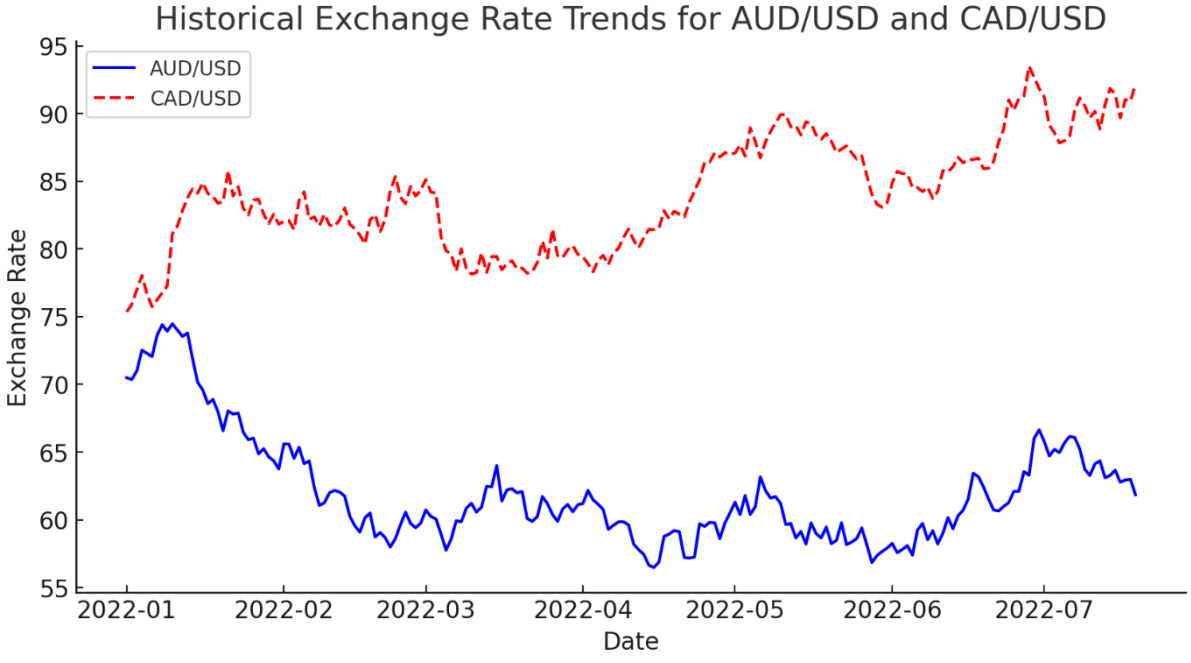
2. Objectives

We're aiming to:

- **Find Cointegrated Currency Pairs:** Start with strong candidates like **AUD/USD and CAD/USD**, but stay open to changing them if necessary.



- **Test for Cointegration:** Use statistical tests like **Engle-Granger and Johansen tests** to verify that the selected pairs have a meaningful long-term relationship.
- **Develop an Algorithmic Trading Strategy:** Set up a system that executes trades automatically based on our rules.
- **Establish Entry and Exit Points:** Use indicators like the **z-score of the spread** to determine when to open and close trades.
- **Backtest and Evaluate Performance:** Run simulations on historical data to see how the strategy would have performed in the past.
- **Analyze Risk and Market Efficiency:** Look into factors like execution delays, transaction costs, and liquidity issues that might impact real-world trading.

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3. Methodology

Step 1: Data Collection

- Gather historical **exchange rate data** from reliable sources like **Yahoo Finance, Alpha Vantage, or OANDA**.
- Start with **AUD/USD and CAD/USD**, but be ready to switch if better candidates emerge.
- Ensure that we have at least **5-10 years of data** to get a robust statistical foundation.

Step 2: Statistical Analysis and Cointegration Testing

- First, we check for correlation—pairs that have historically moved together are good candidates.
- Apply the **Engle-Granger two-step method**:
    1. Perform an **Ordinary Least Squares (OLS) regression**:

$$Y_t = \alpha + \beta X_t + \epsilon_t$$

    2. Conduct an **Augmented Dickey-Fuller (ADF) test** on the residuals to check if the spread is stationary.
- If needed, we'll use the **Johansen test** for a multivariate approach.

Step 3: Building the Trading Strategy

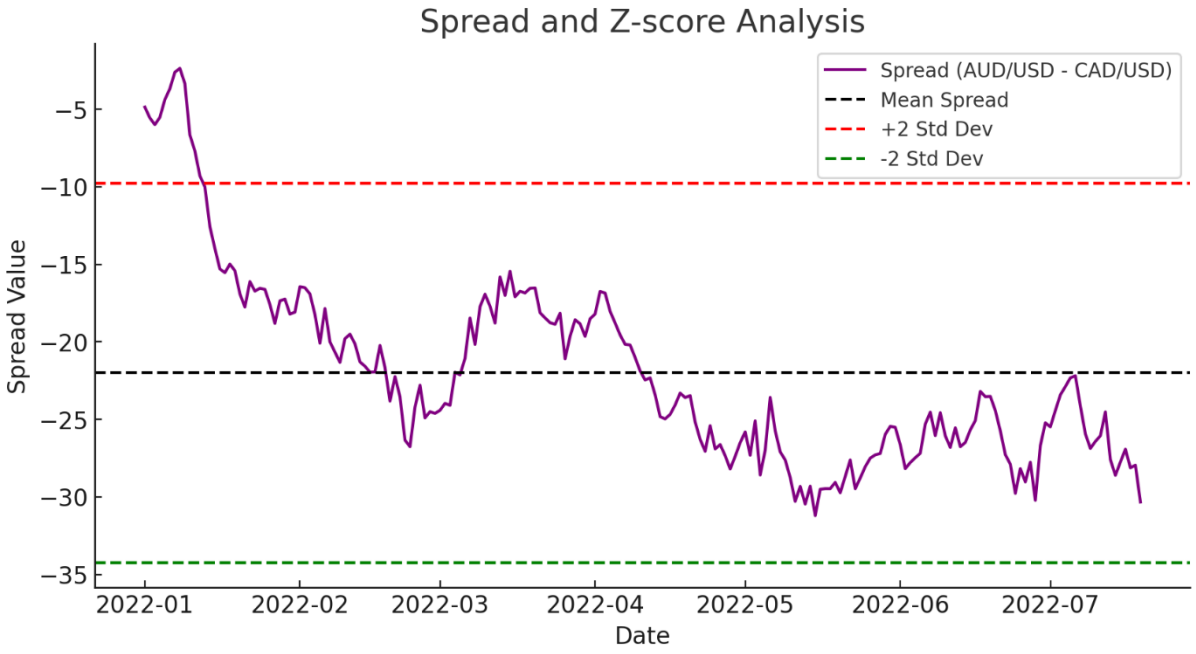
- Compute the **spread** between the selected currency pairs:

$$S_t = Y_t - \beta X_t$$

- Calculate the **z-score** of the spread to determine deviations:

$$Z_t = \frac{S_t - \mu}{\sigma}$$

where is the moving average and is the standard deviation of.



- Define trade rules:
    - **When to Enter a Trade:** Open a position when exceeds a certain threshold (e.g., **±2 standard deviations**).
    - **When to Exit:** Close the position when moves back toward zero (e.g., **±0.5 standard deviations**).

Step 4: Backtesting and Performance Analysis

- Build a **backtesting system** to see how the strategy would have worked historically.
- Test under different market conditions (trending, sideways, volatile).
- Evaluate key performance indicators:
    - **Total Profit and Loss (PnL)**
    - **Sharpe Ratio** (how good our returns are relative to risk)
    - **Maximum Drawdown** (how much we could lose in a worst-case scenario)
    - **Win Rate** (the percentage of successful trades)
- Create **visualizations**, including:
    - Exchange rate trends of the selected pairs.
    - Spread movements over time.
    - Trade entry and exit points on a chart.

Step 5: Dataset and Preprocessing

We're working with historical **foreign exchange (Forex) rate data**, specifically before any filtering is applied. Here's what's included:

- **Date:** The time stamp of each exchange rate observation.
- **Currency Pair Exchange Rates:** Closing prices of selected pairs (e.g., AUD/USD, CAD/USD).
- **Daily Returns:** Percentage change in exchange rates from one day to the next.
- **Moving Averages:** Short-term and long-term averages to identify trends.
- **Standard Deviation of Spread:** A measure of how much the spread fluctuates.
- **Z-score of Spread:** A way to see how far the spread is from its usual range.

Before running the strategy, we'll clean the data, handle missing values, and compute relevant financial indicators.

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4. Expected Outcomes

- A deeper understanding of whether **pair trading works for Forex markets**.
- Insights into how different market conditions impact performance.
- An assessment of real-world trading costs and challenges.
- Ideas for refining the strategy to make it more robust and efficient.

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5. Conclusion

This project is about **building, testing, and improving a Forex pair trading strategy**. Instead of just discussing theories, we're implementing and analyzing a real strategy using historical data. By the end, we expect to gain valuable insights into **how pair trading works in practice**, how it behaves under different conditions, and whether it's a sustainable approach for trading.