**Pairs Trading Algorithm User Guide**

**Introduction**

Pairs trading is a market-neutral trading strategy that involves taking a long position in one stock and a short position in another, highly correlated stock. The aim is to profit from the relative price movements of the two stocks, regardless of the overall market direction.

This guide outlines the logic behind a pairs trading algorithm that identifies suitable pairs, normalizes their spread, and generates trading signals based on predefined thresholds.

**Step-by-Step Explanation**

**1. Data Collection**

The algorithm starts by fetching historical price data for a list of stocks. This data is used to calculate the spread and perform further statistical analysis. So here the user needs to make a dataframe with the stocks’ data of the stocks they are interested in.

**2. Identifying the Best Pair**

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To find the most suitable pair for trading, the algorithm calculates the p-values of cointegration tests between each pair of stocks in the list. Cointegration tests determine whether two time series are likely to move together in the long term. The pair with the lowest p-value is selected as it indicates the strongest relationship, making it the best candidate for pairs trading.

**3. Calculating and Normalizing the Spread**

Once the best pair is identified, the algorithm calculates the spread between the two stocks. The spread is defined as the difference between the prices of Stock 1 and Stock 2. Here, the Engle-Granger method is used, linear regression is used to find the parameter, which is multiplied to Stock 2 while subtracting, then we find the difference, this is the spread.

To make the spread more interpretable and to generate trading signals, it is normalized using a 30-day moving average and standard deviation:

* **30-day moving average (mean)**: This smooths out short-term fluctuations and provides the average spread over the past 30 days.
* **30-day standard deviation**: This measures the spread's volatility over the past 30 days.

The normalized spread is calculated by subtracting the 30-day moving average from the spread and then dividing by the 30-day standard deviation.

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Figure 2: Moving averages (1day, 15day, 30day)

Figure 1: Normalized spread

**A screen shot of a computer program

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Trading signals are generated based on the normalized spread crossing predefined thresholds:

* **Buy Signal**: When the normalized spread crosses below -0.9, the algorithm triggers a buy signal for Stock 1 and a sell signal for Stock 2. This signal remains active until the spread crosses back above -0.5, at which point the position is closed.
* **Sell Signal**: Conversely, when the normalized spread crosses above 0.9, the algorithm triggers a sell signal for Stock 1 and a buy signal for Stock 2. This signal remains active until the spread crosses back below 0.5, at which point the position is closed.

**5. Backtesting the Strategy**

To evaluate the performance of the trading strategy, it is backtested on historical data. This involves simulating the trades that would have been made based on the generated signals and calculating the resulting profits and losses. Here key metrics have also been calculated so that we can analyze the performance of the algorithm, whether it is beneficial or not. More about this is mentioned in the backtesting report.

**Summary**

This pairs trading algorithm:

1. Collects historical data for a list of stocks.
2. Identifies the best pair of stocks based on cointegration tests.
3. Calculates and normalizes the spread between the two stocks.
4. Generates buy and sell signals based on the normalized spread crossing specific thresholds.
5. Backtests the strategy to assess its performance.

By following these steps, the algorithm aims to capitalize on the relative price movements of the identified pair, providing a systematic approach to pairs trading.