Homework: Crypto Spread Trading

Wednesday 14th January, 2026

1 Introduction

A spread trading strategy checks a running estimate of the displacement between two related instruments, and makes bets that this displacement will decline whenever it gets large. Here, we define that displacement in price terms.

2 Data

The class website contains high-frequency crypto data. In this assignment, we will work with trade prices since they are easier to handle. Obtain trade prices for ETH-USDT at just 3 exchanges: Binance, Coinbase and OKX. Regularize the data down to the last trade prices observed as of the beginning of each 1-second window.

3 Spread Signals

We effectively have 3 pairs available: Binance to Coinbase, Binance to OKX, and Coinbase to OKX. Form 3 base spreads $s^b_{A,B,C}$ as the difference in your 1-second regularized trade prices. Form exponential moving averages $a_{A,B,C}$ of these base spreads with half-life 3 hours, and define *shifted* spreads $s_{A,B,C}$ as $s^b - a$.

You will want to do most of your work with a small subset of just one spread, until you are convinced your analysis and graphing routines are bug-free.

At any given timestamp t will try to find persistent $p^{S,L}_{A,B,C}$, by taking the N-th smallest and N-th largest observed shifted spread s over that most recent $M \geq N$ observations $t, t-1, \ldots, t-(M-1)$. Note $N = M = 1$ is a valid choice in which case $p^S = p^L$.

4 Entry and Exit Bands, Stop Loss Level

Define a stop-loss level ℓ, and define entry and exit bands at levels j and g. A short spread position of size 1 ETH will be initiated when $p^S > g$, a long one will be initiated when $p^L < -g$. A short spread position will be bought back when $p^S < j$ or the stop loss is reached, i.e. $p^S > \ell$. A long spread position will be bought back when $p^L > -j$ or the stop loss is reached, i.e. $p^L < -\ell$.

At the end of the data set, assume a position exit at prevailing prices.

Do not work with values of j, g, ℓ, N, M that result in fewer than 5 trades per day. Instead discard those cases when you find them.

4.1 Stop Loss Recovery

A stop loss from a spread exceeding $|\ell|$ in size results in a pause for the remainder of the day (using timestamps from the data provided).

4.2 Trading Costs

Assume a proportional trading cost parameter $\zeta \geq 0$ in your strategy analysis. On trade the immediate losses are ζ times the gross traded entry position value in USDT. On exit they are ζ times the gross traded exit position value in USDT. You will want to vary ζ in your analysis to understand the effects of trading costs.

4.3 Capital

Assume you begin with capital of \$80K in USDT. If capital at any point during the simulated trading time series gets down to \$40K, assume any position is closed and no more trading is done for the rest of the analysis period.

5 Analysis

Study the performance[1] of your strategy as you vary j, g, ℓ, ζ, N and M. You can choose a couple different values for ζ: make sure you include zero (costless opportunity) and as basis point $\zeta = 0.0001$. Pay attention to Sharpe ratio, drawdown, and raw return.

Include plots. You need not run a fancy nonlinear optimizer, but try to find which parameters work well, and explain how you did it.

[1] Because we are setting capital to such a high number, returns on capital are small. Do not be alarmed by that.