Systematic Investing
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PAIRS/SPREADS Trading Assignment

In this assignment you will build a pairs trading strategy using the two instruments provided, called, Black and White. These have been picked to "factor out" their common factors such as industry, size, etc., so that we can focus on their "residuals" as a basis for trading decisions.

I. Start by determining the suitability of the two instruments for pairs trading using cointegration analysis. Specifically, using the Dickey-Fuller test, analyze whether the difference in prices of the two series is stationary using the data for the first 1,000 days (roughly 4 years). Remember, you are testing not whether Black and White prices are stationary but whether their DIFFERENCE is stationary. To do this, first construct the difference series (of prices) and then calculate the daily deltas of this differenced series. As per the handout of the Dickey-Fuller test, regress the deltas (y_t) against the previous values of the difference series (X_{t-1}) and interpret your result.

    Does this look like a promising pair based on the stationarity test? Why or why not?

II. Independent of the result you get in part 1 above, use the two instruments' data on the class website to build a pairs trading strategy that relies on their "spread" to be mean reverting. In our case we calculate three spreads based on lookback windows of 5, 10, and 20 days. The spread will be a difference of trailing N-day normalized returns between the two instruments. Do this as follows:

    a. Compute the normalized N-day returns (z-scores) as usual for the two instruments (where you choose N to be say, 5, 10, and 20 days) for each stock based on 60 trailing values.
    b. Compute the differences of the calculated normalized returns (i.e., zdiff5 = zret5_White minus zret5_Black). These will be used to specify the entry and exit levels for each trade. (As stated above, use the trailing 60 values for normalizing returns, that is, for calculating zPEP5, zPEP10, etc., and then calculate the differences of the normalized returns between White and Black, which are designated as zdiff5, zdiff10, and zdiff20.
    c. Apply the following decision rule: If zdiff5 (do the same for zdiff10 and zdiff20), exceeds some positive threshold, you "**short the spread**," that is, short the outperformer and go long the underperformer with the expectation that the spread will revert. Similarly, if the spread is below

some negative threshold, do the opposite, namely, go **long the spread**.
Use the spreadsheet template provided to do the assignment.

Calculate your forward one-day return by sizing the two positions in inverse proportion to their 20-day trailing volatility, as in the previous assignments. That is, you scale the forward return of the respective instruments on day T+1 by their relative weights calculated at the end of day T based on the trailing 20-day volatility of their respective returns.

As parameters in your system, use the following five as defaults:
- holding period (i.e. 5 days) after which the trade is exited by default
- long and short entry thresholds (i.e. -1sigma for going long the spread and +1sigma for going short the spread)
- profit targets for long and short signals where you exit (i.e. +1 sigma for a long and -1 sigma for a short)

You can also extend the assignment by using a stop loss, but this isn't a requirement for this assignment.

Calculate the Sharpe ratios of the three trading strategies – based on the 5, 10 and 20 day spreads) with a default holding period (such as 5 days) and a profit target (such as 1 sigma). Plot the equity graphs of the strategies.

Would you trade any of them? If so, which one or which combo and why?