Comparative Analysis of Z-Score and Alternative Pairs Trading Strategy

Introduction:

Pairs trading is a form of mean-reversion that has a distinct advantage of always being hedged against market movements. It is generally a high alpha strategy when backed up by some rigorous statistics. The strategy is based on mathematical analysis.

The prinicple is as follows. Let's say you have a pair of securities X and Y that have some underlying economic link. An example might be two companies that manufacture the same product, or two companies in one supply chain. If we can model this economic link with a mathematical model, we can make trades on it. In this report, we compare the performance of two pairs trading strategies: the Z-Score Trading Strategy and an alternative approach. The Z-Score Trading Strategy utilizes statistical measures to identify trading opportunities, while the alternative approach employs a linear regression, IV ratio, window length parameter for trading opportunities.

Z-Score Trading Strategy:

The Z-Score Trading Strategy utilizes the z-score of the spread to identify the trading opportunities which measure the deviation of a pair's spread from its mean. The spread here is simply calculated as difference of Implied Volatilities (IV) i.e., (Bank Nifty IV - Nifty IV). Pnl is calculated as $\text{Spread} * \text{TTE}^{0.7}$.

Alternate Trading Strategy:

Based on the research thesis provided it is evident that both the equity index options have significant overlap in it's constituents and weights. Using this I assumed there is some linear dependency between both the Implied volatilities rather than a simple difference. So, using a linear regression to get the coefficient for the linear combination to construct between our two securities. And then used used similar rolling z score mean and ratios of the implied volatilites to to generate the trade signals.

Findings:

	Z Score Strategy	Alternate Strategy
Sharpe Ratio	0.03446057732272088	0.04177324385570167
Maximum Draw Down	-3.1019275556217307 %	-0.31827360876665045 %
Cumulative Returns	7.605357876865204 %	84.22406904725709 %

Summary of Findings:

1. **Sharpe Ratio:** The alternative pairs trading approach demonstrates a slightly higher Sharpe ratio (0.041773) compared to the Z-Score Trading Strategy (0.034461). This indicates that the alternative approach generates relatively better risk-adjusted returns per unit of risk.

2. **Maximum Drawdown:** The Z-Score Trading Strategy experienced a maximum drawdown of -3.1019%, while the alternative approach had a significantly lower maximum drawdown of -0.3183%. Lower maximum drawdown suggests better risk management and resilience during adverse market conditions for the alternative approach.
3. **Cumulative Returns:** The cumulative returns of the alternative pairs trading approach are substantially higher (84.224%) compared to the Z-Score Trading Strategy (7.605%). This indicates that the alternative approach generated significantly higher profits over the evaluation period.
4. **Window Length Parameter:** The alternative pairs trading approach utilizes a parameter for pair selection, with the best window length identified as **177**. This suggests that the performance of the strategy is sensitive to the selection of this parameter, highlighting the importance of parameter optimization in pairs trading strategies.

Conclusion:

The comparative analysis indicates that the alternative pairs trading approach outperforms the Z-Score Trading Strategy in terms of risk-adjusted returns, maximum drawdown, and cumulative returns. However, further analysis and parameter optimization are necessary to validate the robustness and effectiveness of both strategies in different market conditions.

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