MARTIN-LUTHER-UNIVERSITÄT
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Moving Average-based Trading Strategy

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Introduction

The algorithmic trading is becoming more and more popular with the help of the information era. It basically refers to executing orders using pre-programmed trading conditions on a financial instrument. This method is not only accurate (based on the conditions) but also much more effective and fast.

This proposal outlines an algorithmic trading strategy based on two simple moving averages (MA) through generating buy and sell signals in financial markets. This strategy aims to capitalise on trends and price movements by taking into account the relationship between shorter-term moving average (MA(S)) and longer term moving average (MA(L)).

Implementation Details

The model is evaluated based on the Bitcoin Perpetual market, utilising minute-level data retrieved and trading executed through the Deribit Test API. The strategy is implemented using the Python programming language.

In addition, it is crucial to note that the model assumes that the trader is already in a long position. Therefore, before initiating the process, the `position` variable is set to `position = True`, which indicates that the trader is in a long position. On the other hand, if the trader is in a short position, `position = False`. Consequently, the model commence with buying order at the beginning, regardless of the stock price, to meet the position requirement.

Strategy and Trading Logic

There are several variations available for MA, such as Exponential Moving Average (EMA) and Weighted Moving Average (WMA). Those variations are also known highly responsive to the price movement compared to Moving Average. However, this model focuses on two moving averages (MA) strategy and it aims to improve the features of MA through introducing additional conditions. Shortly, MA is calculated by adding recent prices of asset and then diving that figure by the number of time periods in the calculation average (Hayes, 2022).

$$\text{MA}(T) = \frac{1}{T}\sum_{t=1}^{T} P(t)$$

The formula above indicates the moving average formula, here $t = 1$ corresponds to the most recent time in the time series of historical stock prices $P(t)$ while T is the length of the MA. The idea of the model is defined as follows the trader should take a long position (buy and hold the financial instrument) where the short-term moving average MA(S) is greater than the long-term moving average MA(L) and the trader goes short position when the opposite condition holds true. This is because the MA(S) follows closely the price movement of the financial instrument as opposed to the MA(L).

In general, this simple strategy has several disadvantages when compared to other variations of the moving average. It lacks quick reaction capability, particularly in highly volatile financial markets, where its weaknesses become apparent. For instance, when a certain condition is meet such as, MA(S) > MA(L) in this case, the the algorithm takes immediate action as expected. However, due to the high volatility in the financial market, the position, therefore, might rapidly change again which leads to undermine the effectiveness of the strategy.

First of all, the algorithm calculates various combinations of lengths to determine the effective lengths for our MAs. Furthermore, it calculates both asset returns (log returns) and strategy returns for each length combinations. The algorithm then arranges the list of length combinations in descending order based on the edge strategy which represents the difference between strategy returns and log returns. Finally, it selects the optimal combination from the sorted list and proceeds with further analysis using those specific length combinations.

MA(S)	MA(L)	Log returns	Strategy Returns	Edge
45	65	0.989339	1.036441	0.047102
40	60	0.990744	1.032279	0.041534
195	215	0.989726	1.029549	0.039823
50	70	0.990453	1.028699	0.038246

Table 1: Performance and Optimisation

Looking at the table which indicates the performance and optimisation of the strategy, it is clear that the combination of $MA(45)$ and $MA(65)$ outperforms the simple buy-and-hold strategy. It is important to acknowledge that the optimal combinations may vary for each financial instrument. This is because, different markets may require different sets of parameters to achieve the best performance.

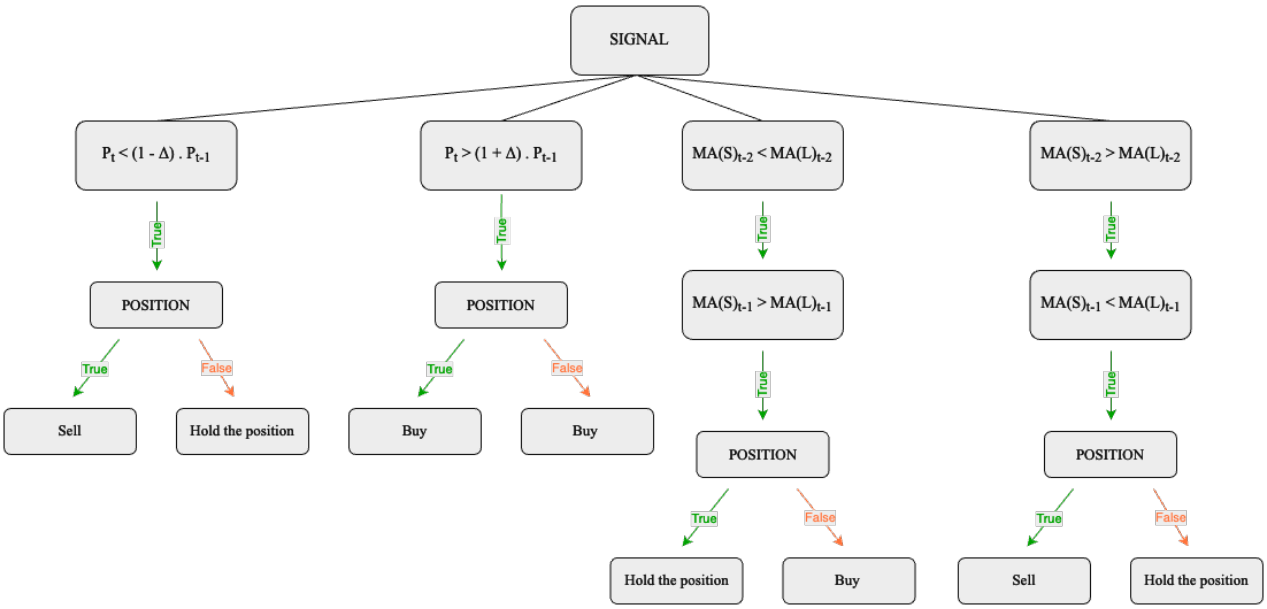

Chart 1: Signal

To strengthen the weaknesses of the MA strategy, the model is designed to actively identify crossovers between MA(S) and MA(L). It achieves this by evaluating several conditions. For example, if MA$(S)_{t-2} <$ MA$(L)_{t-2}$ and MA$(S)_{t-1} >$ MA$(L)_{t-1}$ then the model effectively capture the crossover, thereby enhancing its overall performance.

The model also introduces additional conditions while generating the trading signal (Chart 1). For instance, if a long position is held, the trader can set a threshold to close the position if the stock price begins to decline, even if the short-term moving average has not yet crossed the long-term moving average (Kakushadze & Serur, 2018). When the condition $P_t < (1 - \Delta) \times P_{t-1}$ is satisfied, it then triggers the liquidation the long position to protect profits. Similarly, when the condition $P_t > (1 + \Delta) \times P_{t-1}$ is met, the trader can establish the long position. The model introduces here Δ is predefined percentage, the current stock price P_t and the previous stock price P_{t-1} in our model Δ is set at $\Delta = 1.7\,\%$. These stop-loss mechanisms not only plays a significant role in determining various thresholds and conditions within our strategy but also helps reducing the risk of volatility.

Backtesting and Performance Evaluation

The trading strategy was backtested on historical data from July 9, 2023 to July 15, 2023. Looking at the second chart, it is evidence that 69 trading orders were executed by using $MA(45)$ and $MA(65)$ along with the additional conditions specified previous sections.

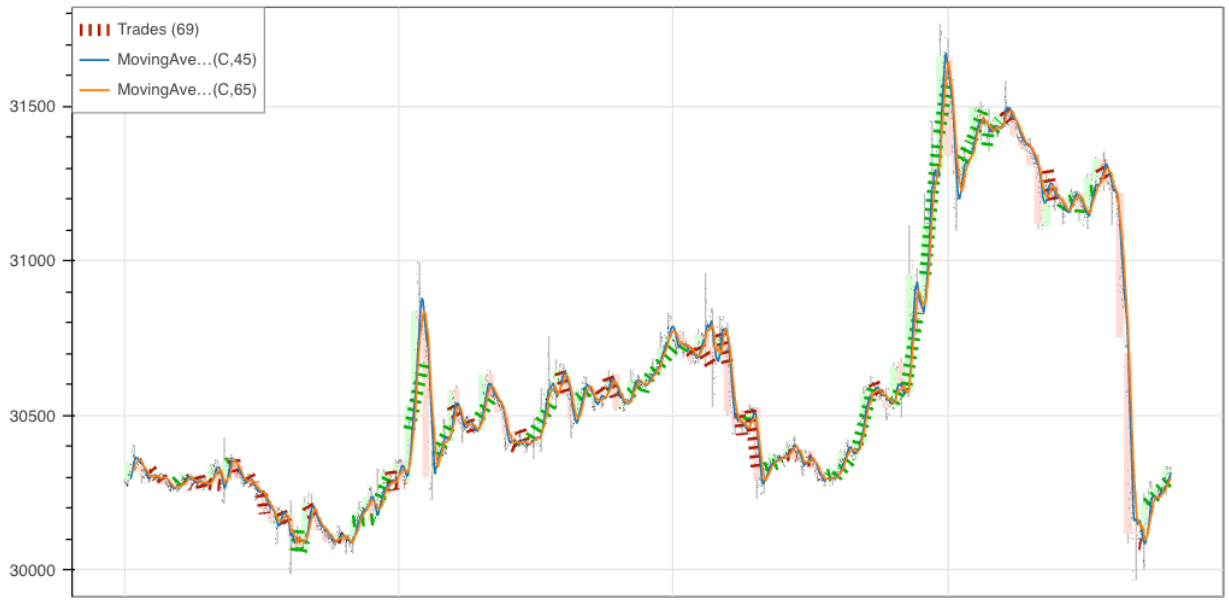

Chart 2: Backtesting result

The several parameters are also generated by the trading strategy during the backtesting period that play a significant role in indicating the overall performance of the strategy. The calculated return, for instance, was 3.46%, in contrast to the buy-and-hold strategy's return of 0.01%. The model observed a Sharpe Ratio of 2.79, which indicates a favourable risk-adjusted performance. Furthermore, the observed volatility during the one-week backtesting period was calculated as ~129%.

Conclusion

In conclusion, the moving average-based trading strategy offers a systematic approach to identify and effectively capture trends in financial markets. However, it the volatility in the financial market should be taken into account when using MA model. Compared to EMA and WMA strategies, MA is generally considered less susceptible to rapid market fluctuations due to its smoothing effect. Nevertheless, the preliminary objective of the model was to enhance MA approach. The preliminary backtesting results indicated promising outcomes and demonstrated the effectiveness of the modified MA strategy in capturing profitable trends in the financial markets. When it comes to the live trading, the model has been running 6 hours and 15 minutes, the strategy took into account several risk scenarios that effectively influence its implementation. However, it appears to be vulnerable in the unpredictable financial markets, particularly cryptocurrency market. It is crucial to acknowledge that the strategy is not particularly strong in short-term trading as opposed to other strategies. Nevertheless, the model aims to address these weaknesses and is of course expected to be effective in long-term trading.

LITERATURE

Hayes, A. (2022). Simple Moving Average (SMA). Accessed by https://www.investopedia.com/terms/s/sma.asp#:~:text=A%20simple%20moving%20average%20(SMA)%20is%20an%20arithmetic%20moving%20average,periods%20in%20the%20calculation%20average. July 15, 2023.

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