Algorithmic Trading and High-Frequency Finance

Analysing Momentum Strategies

Report

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Code: Code Link

Security Used: Bitcoin (BTC)

Backtest period: 1st January 2014 – 31st January 2024 (10 years, 1 month)

Data Source: Yahoo Finance

Overview

In this analysis, we implement and evaluate a trading strategy based on Exponential Moving Averages (EMAs) for Bitcoin (BTC), the world's leading cryptocurrency. The strategy utilizes two EMAs: a short-term (10-day) and a long-term (100-day) to generate buy and sell signals. When the short-term EMA crosses above the long-term EMA, a buy signal is triggered, indicating an uptrend. Conversely, a sell signal is triggered when the short-term EMA crosses below the long-term EMA, signalling a potential downtrend.

Strategy Details

- **Buy Signal**: The trader enters a position when the 10-day EMA rises above the 100-day EMA.
- **Sell Signal**: The trader exits the position when the 10-day EMA falls below the 100-day EMA.
- **Stop-loss mechanism**: To mitigate risks, a stop-loss threshold is set at 20% below the purchase price. If the price drops to this level, the position is sold to prevent further losses.

Results

Sample	# of round-trip trades	Total Return %	B & H Return %	Winning Trades %	Max Drawdown %	Strategy Sharpe	B & H Sharpe
Historical	22	2178.30%	9291.69%	45.45%	-52.18%	0.90	0.87

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Number of round-trip trades: 22
Total Return: 2178.30%
Annualized Return: 39.57%
Buy & Hold Return: 9291.96%
Winning Trades: 45.45%
Strategy Sharpe Ratio: 0.90
Buy & Hold Sharpe Ratio: 0.87
Maximum Drawdown: -52.18%
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Result Explanation

- **Number of Round-Trip Trades**: The strategy executed 22 complete trades (a round-trip includes a buy and a subsequent sell).
- **Total Return**: The total return of the strategy was 2178.30%, which indicates the strategy's profitability over the test period.
- **Annualized Return**: On an annual basis, the strategy yielded a 39.57% return, accounting for compounding over the years.
- **Buy & Hold Return**: As a benchmark, the buy and hold strategy – simply buying at the start and holding until the end – would have returned 9291.96%, significantly higher than the trading strategy.
- **Winning Trades**: Out of all trades made, 45.45% were profitable, indicating less than half of the trades resulted in a gain.
- **Maximum Drawdown**: The strategy experienced a maximum drawdown of 52.18%, reflecting the largest drop from peak to trough before a new peak was achieved.

Visual Representation
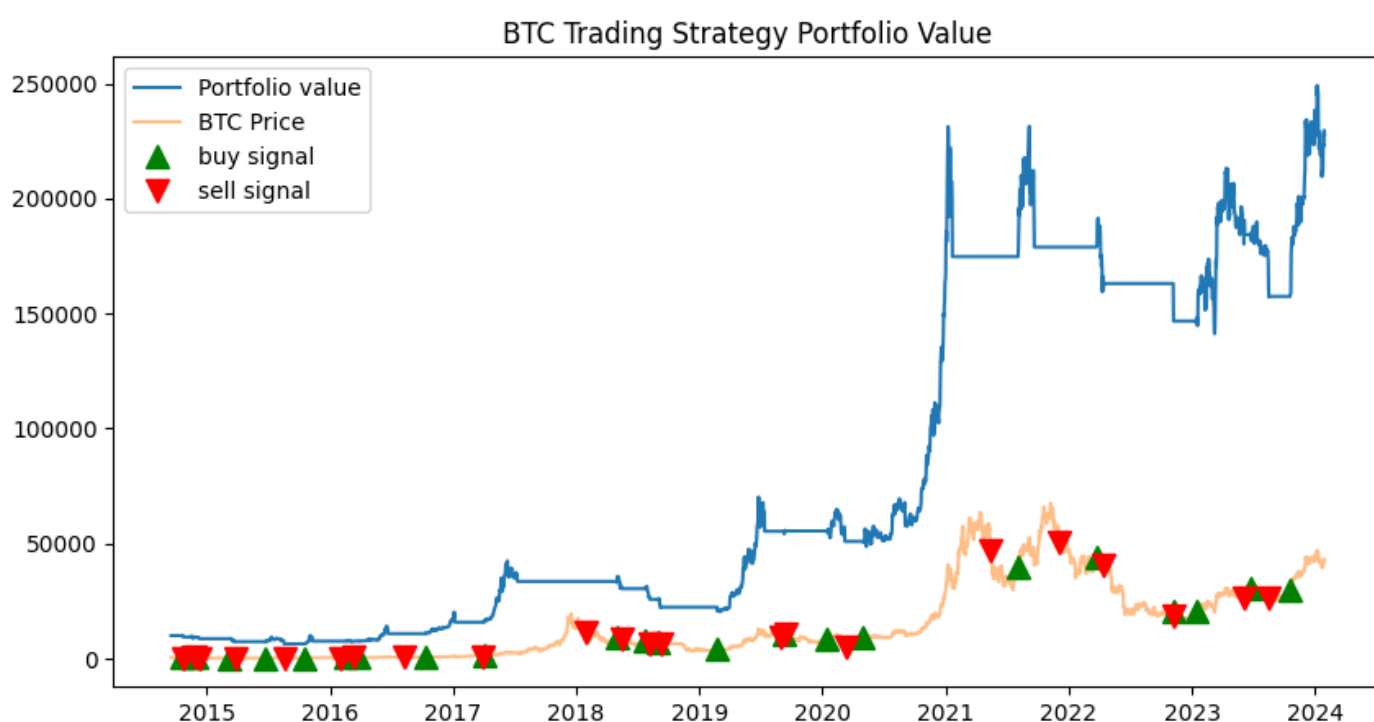
The accompanying chart illustrates the BTC price alongside the portfolio value over time, marked with buy (green triangle) and sell (red inverted triangle) signals. The portfolio value trend indicates the impact of the trading strategy in comparison to the BTC price movements.

Strategy Robustness

Bootstrapping was performed 100 times to check for the robustness of the strategy.

Average Round Trips	Median Total Return %	Median B&H Return %	Average Winning Trades %	Average MDD %	Average Sharpe	Average B&H Sharpe
22	396.60	-34.20	36.17	-93.46	0.30	0.45
SD Round Trips	SD Total Return %	SD B&H Return %	SD Winning %	SD MDD %	SD Sharpe %	SD B&H Sharpe
3	375427.17	2384.00	9.11	11.68	0.15	0.08

Portfolio Value for Bootstrap Samples
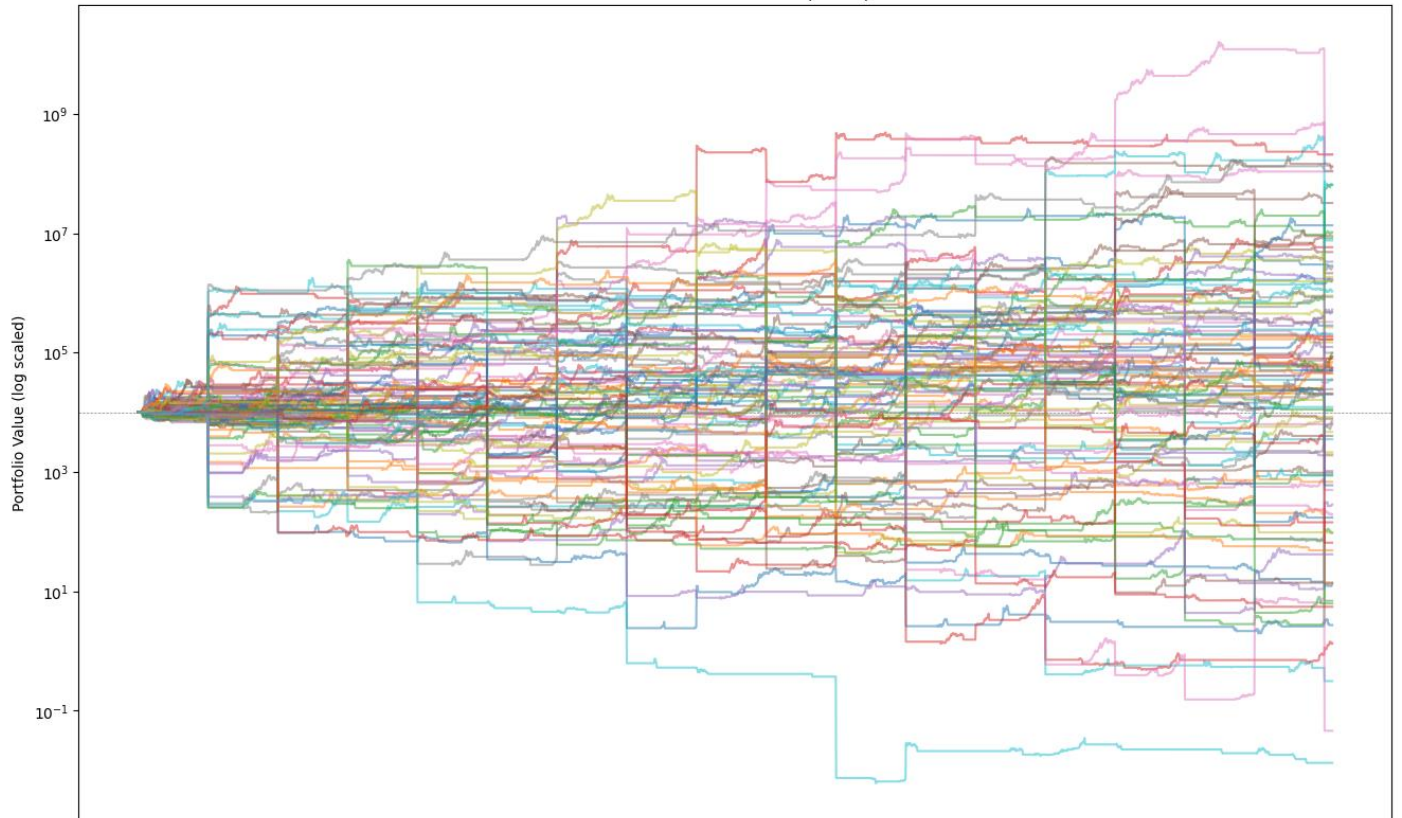
Annualized Return Distribution
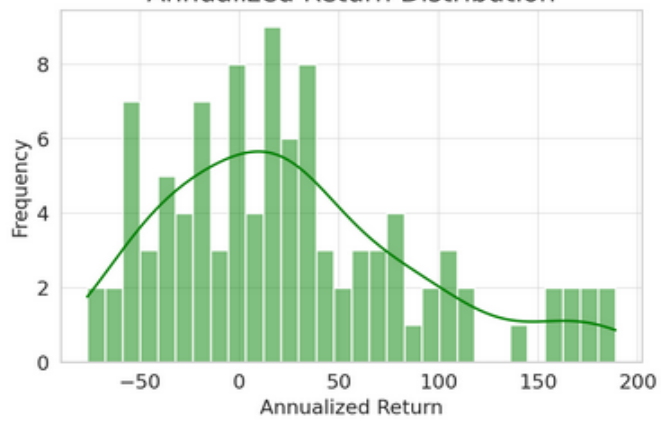
Winning Trades Distribution
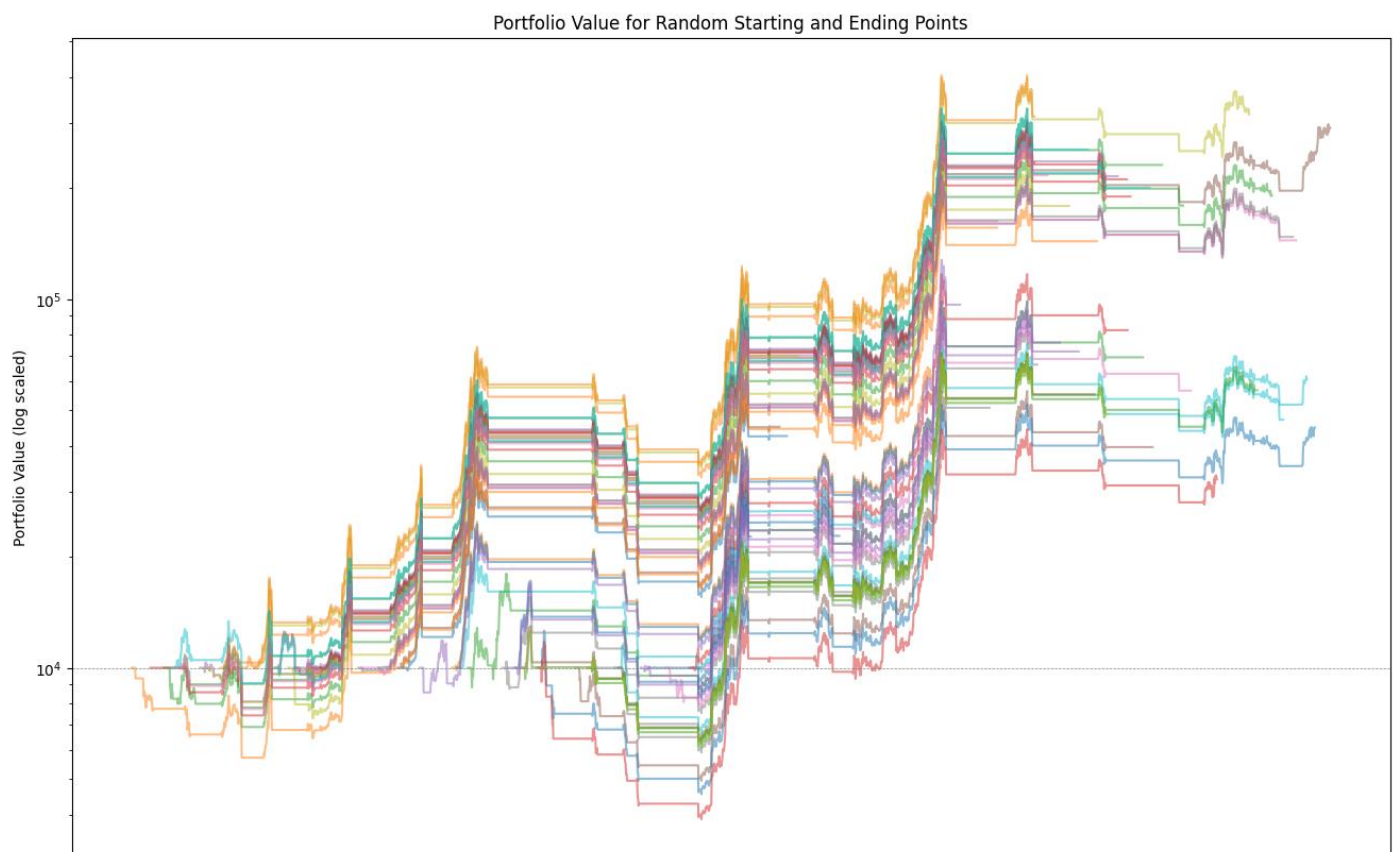
Number of Round-Trip Trades Distribution

Strategy vs. Buy & Hold Sharpe Ratio
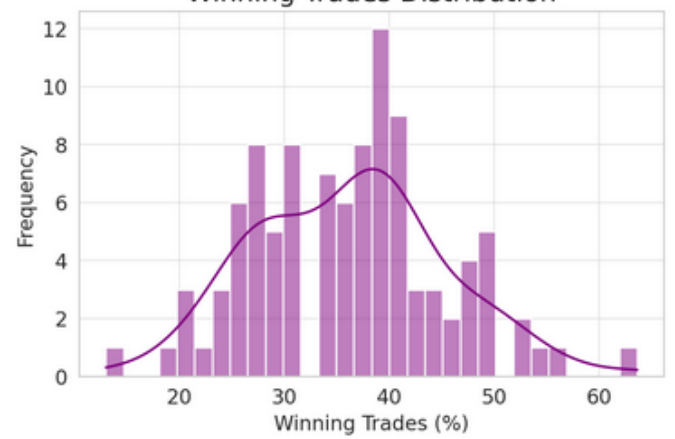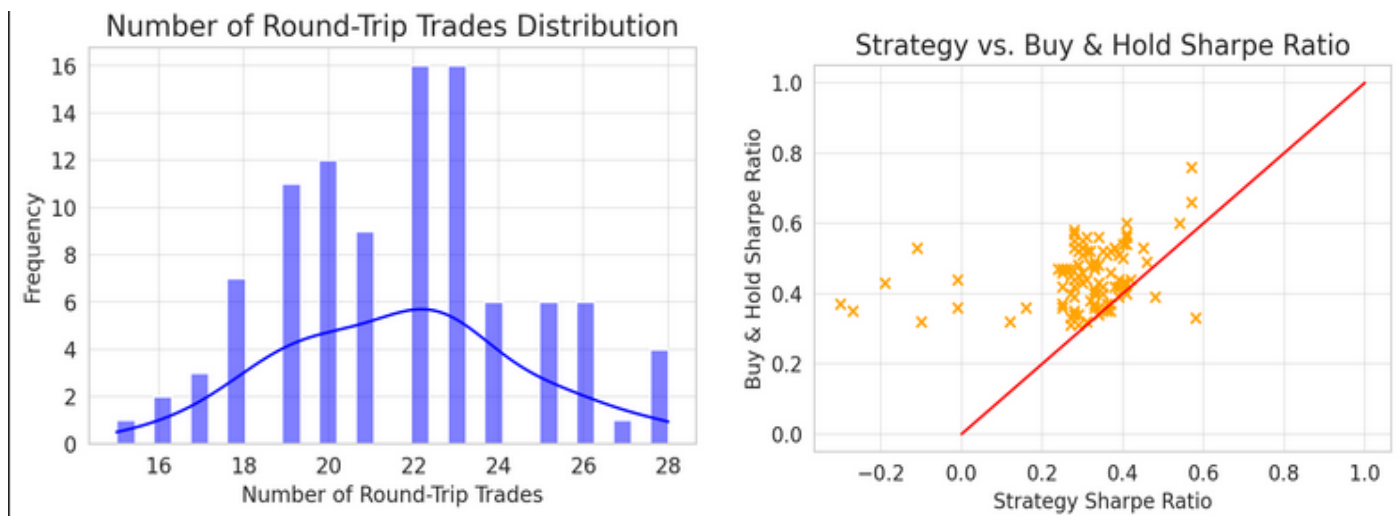
The Strategy was also tested with random periods using the actual BTC price data running the strategy 50 times with random start and end times.

Portfolio Value for Random Starting and Ending Points

Conclusion

While the EMA crossover strategy demonstrated a significant total return, it underperformed compared to a simple buy-and-hold approach for the same period. The maximum drawdown suggests that the strategy may entail substantial risk, which should be a consideration for potential traders. The less than 50% winning trade ratio also indicates that the strategy does not guarantee profit on most trades, and its success could be highly dependent on market conditions and the timely execution of trades.

The strategy is also not robust and performs poorly and unpredictably on bootstrap samples with a high variance.

Appendix

- **Link to bootstrap results**
- **Link to random period results**
- **Link to code**