A Machine Learning Feature Driven Trading System

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The Founders

Zachary Johnson, *Director of Algo Development*

- Financial Mathematics MS, UChicago ‘25, Mathematics BS, Trevecca Nazarene University ‘20
- 5 Years US Rates and Fixed Income trading Experience

Harrison Holt, *Director of Strategy*

- Financial Mathematics MS, UChicago ‘25, Finance & Analytics BS, Indiana University ‘20
- 5 Years Crypto Trading Business and Operations Experience

Jared Szajkowski, *Director of Portfolio Management*

- Financial Mathematics MS, UChicago ‘25, Engineering BS, Illinois Institute of Technology ‘07

Fund Description

- Part-Time Trading LLC is an investment firm focusing on developing machine-learning models to actively predict prices within cryptocurrency markets. Our fund’s objective is to extract predictive features from crypto market data and utilize these features to develop best in class predictive machine learning models. Currently, we are focusing our trading efforts on trading Bitcoin and Ethereum on the crypto exchange Kraken. As we continue to advance our proprietary research and models, we plan to expand into other cryptocurrencies and exchanges.

- Our trading system is designed to deliver consistent alpha by exploiting inefficiencies and opportunities in the highly volatile and liquid crypto markets. Our objective is to maximize returns while minimizing risk through data-driven decision making and robust predictive analytics.

Strategy Creation - Trading System

- Our trading system is designed to predict price movements in BTC by leveraging a combination of advanced feature engineering and XGBoost machine learning models.

- The key components of the strategy include:
  - Optimized Feature Engineering:
    - Rolling statistics
    - Technical Indicators
    - Volume and Trade metrics
    - Inter-Asset Relationships
  - Machine Learning Model:
    - XGBoost Classifier
    - Optimized hyperparameters
  - Trading Simulation:
    - Translate predictions to buy/sell decisions based on probabilistic thresholds
    - Manage capital allocation, transaction costs, stop-loss mechanisms, and freeze period after stop-loss triggers to ensure disciplined risk management

Strategy Creation - Theoretical and Practical Foundations

Theoretical Foundations

- Efficient Market Hypothesis:
    - Unlike legacy markets, crypto markets exhibit significant inefficiency
- Quantitative Financial Methods:
    - Rolling statistics and technical indicators derive from established financial methods
- Machine Learning:
    - XGBoost model

Practical Foundations

- Data Availability:
    - We utilize minute tick data on BTC and ETH to ensure robust feature creation
- Liquidity:
    - Crypto assets BTC and ETH offer deep liquidity reducing slippage and improving strategy execution
- Volatility:
    - Our model capitalizes on the price fluctuations induced by the crypto markets high volatility

Strategy Creation - Expected Market Conditions and Performance Context

Market Conditions

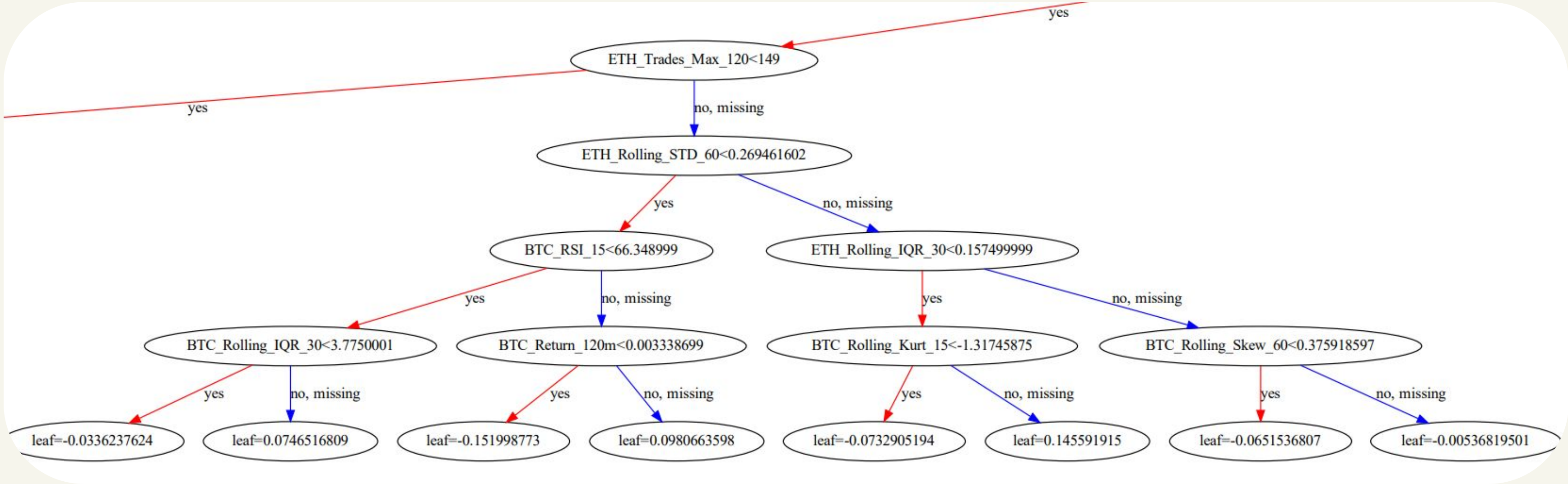
- High Volatility:
    - Strategy performs well in volatile markets where short-term price movements are pronounced and predictable
- Range-Bound Markets:
    - In sideways markets, technical indicators help capture mean-reversion opportunities
- Macro Trends:
    - Strategy adapts to macro trends by retraining model regularly

Performance Context

- Risk-Adjusted Returns:
    - Inclusion of stop-loss mechanisms and freeze periods minimize drawdowns while maximizing risk-adjusted returns
- Transaction Costs:
    - Low transaction costs assumed to to high liquidity of BTC and ETH markets and strict use of limit order type
- Scalability:
    - Strategy scalable to higher capital levels due to liquidity of BTC and ETH

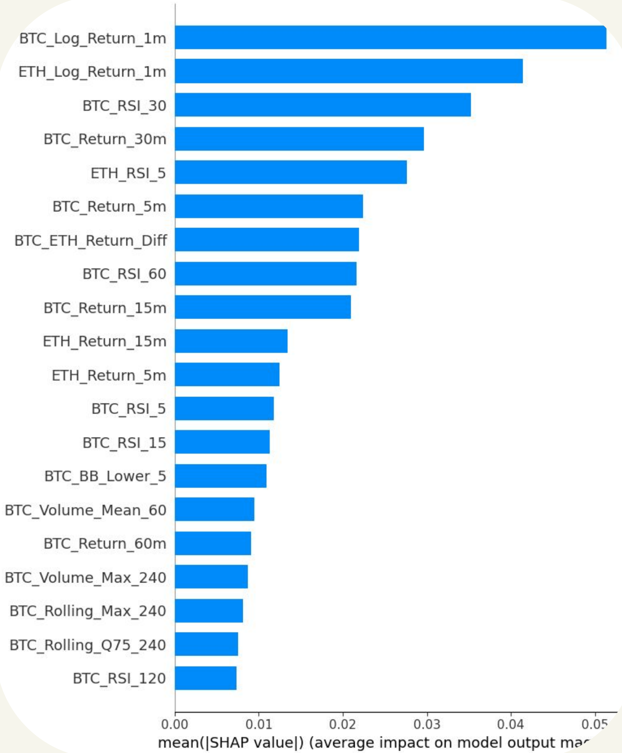
Strategy Creation - Glance Into the Graybox

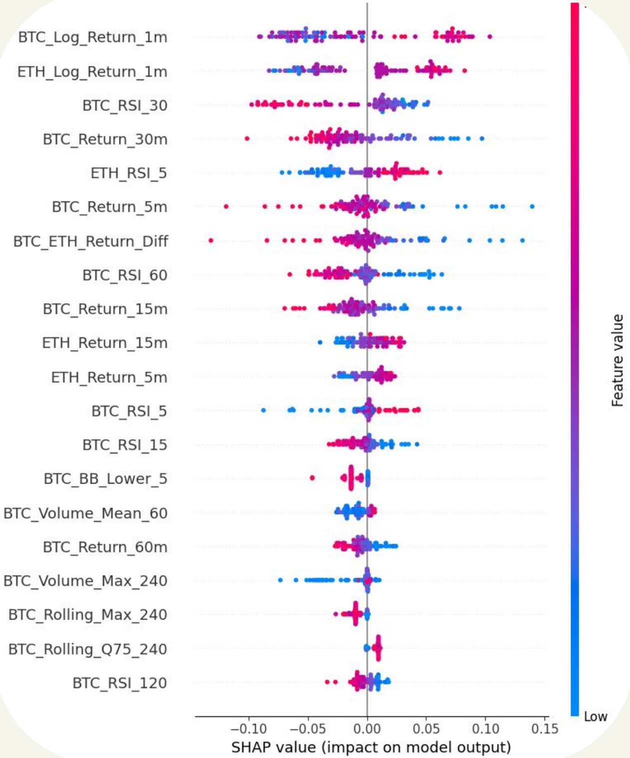
XGBoost model built 100 decision trees:



Strategy Creation - Glance Into the Graybox

Model Feature Importance

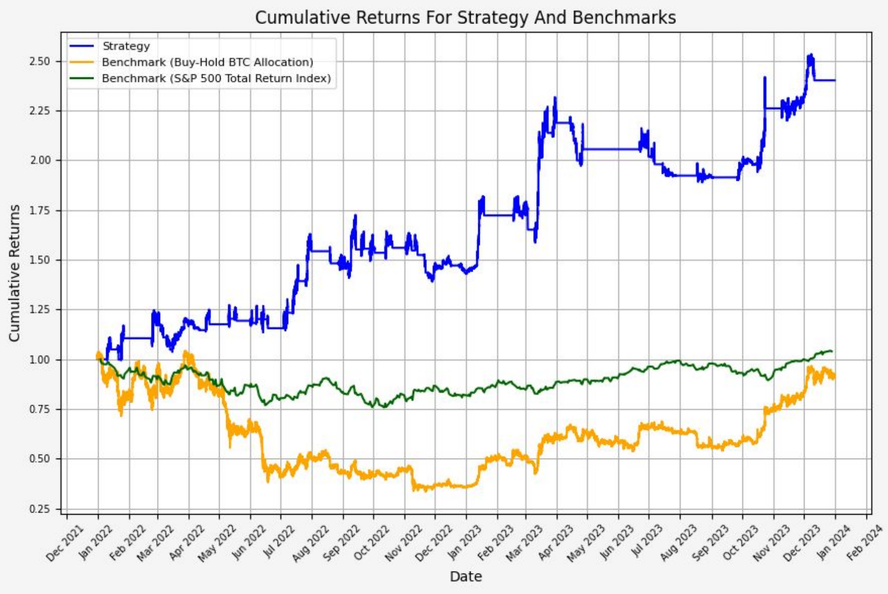




Portfolio Performance Metrics - 2022/2023 Crypto Bear Market

- Investors are often hesitant to allocate to BTC or other crypto assets due to the high volatility; our strategy provides exposure to the asset class with **significantly reduced** volatility.

- During the crypto bear market in 2022/2023, our strategy provided an **annualized return of 55%**, with a maximum drawdown of 19% and a **Sharpe ratio of 1.76**.

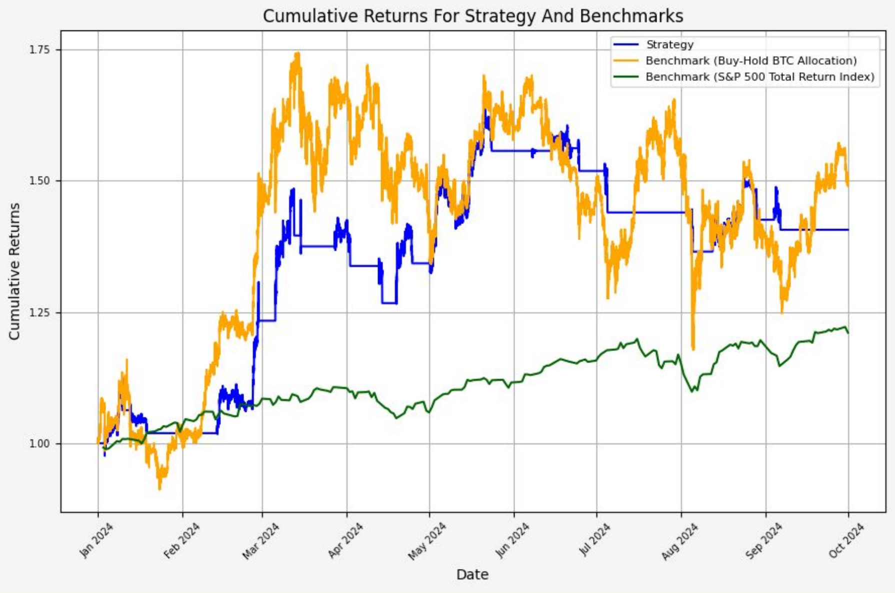


Metric	Strategy	Benchmark	S&P 500 Benchmark
Total Return	140.08%	-8.63%	3.96%
Annualized Return	54.99%	-4.41%	1.98%
Maximum Drawdown	-19.43%	-67.78%	-24.16%
Annualized Sharpe Ratio	1.76	0.18	0.19

Portfolio Performance Metrics - 2024 Crypto Bull Market

- During the ongoing crypto bull market in 2024, our strategy has delivered a year-to-date (YTD) **annualized return of 57%**, with a maximum drawdown of 18% and a **Sharpe ratio of 1.83**. These risk-adjusted returns have surpassed those of the buy-and-hold BTC benchmark.

- The strategy's resilience and performance during a bull market suggest the design is well-suited for navigating varying market environments, positioning it as a reliable choice for long-term investors.

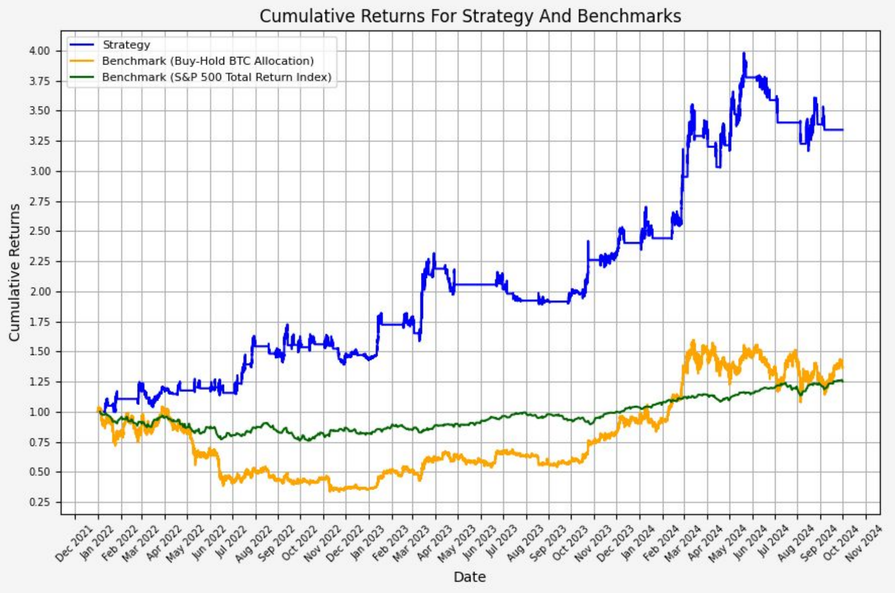


Metric	Strategy	Benchmark	S&P 500 Benchmark
Total Return	40.68%	49.58%	22.16%
Annualized Return	57.61%	71.04%	30.83%
Maximum Drawdown	-18.48%	-32.50%	-8.41%
Annualized Sharpe Ratio	1.83	1.43	2.08

Portfolio Performance Metrics - Full Data

- An **annualized return of 55%** with a **Sharpe ratio of 1.76** over the life the strategy underscores the strategy's ability to generate high returns efficiently relative to the risk taken. This efficiency sets it apart in a volatile asset class like crypto and significantly improves on a buy-and-hold approach.

- With robust performance metrics, the strategy complements traditional equity and bond investments, providing investors with an alternative that balances growth potential and risk control.



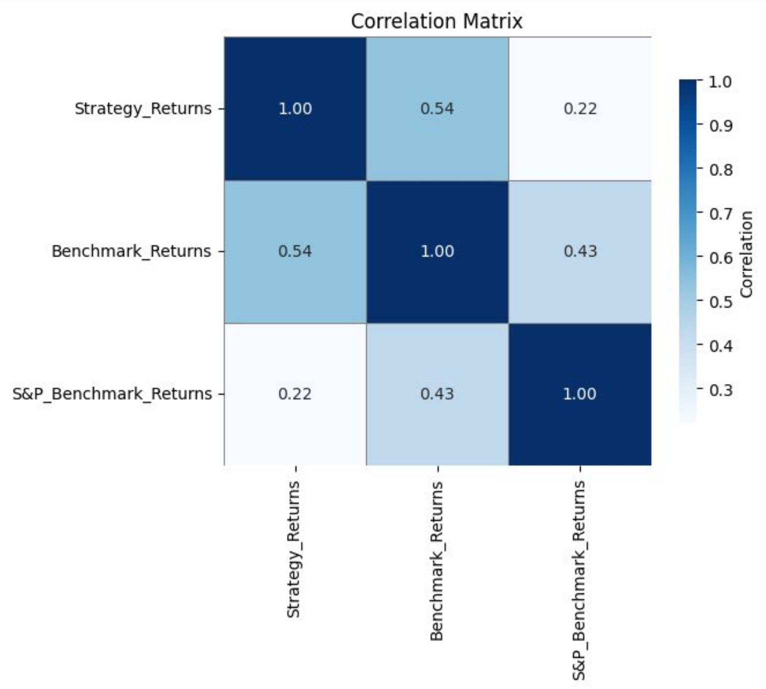
Metric	Strategy	Benchmark	S&P 500 Benchmark
Total Return	234.03%	36.73%	26.29%
Annualized Return	55.08%	12.05%	8.89%
Maximum Drawdown	-20.53%	-67.78%	-24.16%
Annualized Sharpe Ratio	1.76	0.51	0.54

Uncorrelated Returns

- Returns that are uncorrelated or have low correlation provide diversification, reduce overall portfolio volatility, and enhance the portfolio risk-adjusted returns.

- Our strategy provides returns that have low historical correlations to both the buy-hold BTC benchmark **(0.54)** and the S&P 500 Index benchmark **(0.22)**.

- The primary drivers of the uncorrelated returns include the risk-management framework used to reduce drawdowns, the selection of features used in the ML model, and the short term price prediction generated through the use of ML.



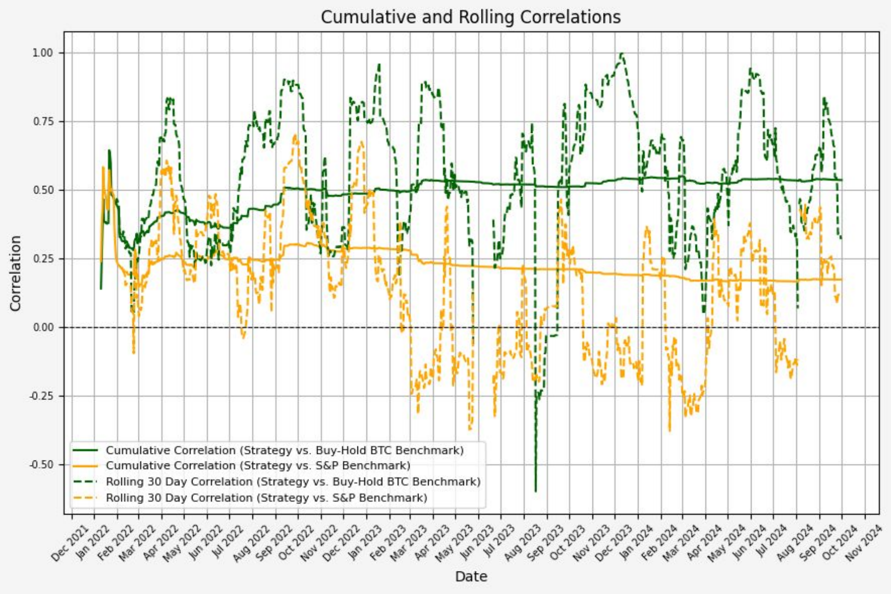
	Strategy_Returns	Benchmark_Returns	S&P_Benchmark_Returns
Strategy_Returns	1.0000	0.5353	0.2216
Benchmark_Returns	0.5353	1.0000	0.4294
S&P_Benchmark_Returns	0.2216	0.4294	1.0000

Uncorrelated Returns - Rolling and Cumulative

- Rolling 30-day returns have shown **negative** correlation with the buy-hold BTC benchmark **3%** of the time and with the S&P 500 Index benchmark **28%** of the time over the life of the strategy.

- Cumulative correlations with the S&P 500 Index have continued to **trend downward** over time. This indicates that as the strategy matures, it increasingly decouples from equity market movements, enhancing its utility as a diversification tool within portfolios exposed to traditional asset classes.

- Cumulative correlations with the buy-hold BTC benchmark have **remained consistent** over the strategy's life, signaling robustness in its behavior relative to the crypto market. This consistency allows investors to predictably allocate capital without unexpected shifts in risk characteristics.



Risk Management Framework

Strategy Risk Management Features

- Capital allocation constraints:
  - Dynamic real-time adjustment of capital allocation as a percentage of the entire fund.
- Order execution duration:
  - Pre-determine how long a limit order will remain on the book.
  - If a limit order is not filled within the specified timeframe then it is auto-cancelled to avoid an undesirable fill due to movement in the market.
- Buy/sell probability parameters:
  - Vary the thresholds for buy/sell probabilities generated from the ML model.
  - Allows the strategy to be more or less selective about trade opportunities.
- Stop loss:
  - Designed to prevent significant losses during market liquidity events.
  - Over the 33-month history of the strategy, stop-loss orders were triggered 62 times.
- Freeze window:
  - Temporarily pauses strategy post-stop-loss for analysis and market review.

Trade Execution

Trade Execution Issues

- Position sizing:
  - Dynamic position sizing to avoid impacting or moving the market during trade execution.
  - Position sizing set to $2.5m based on an initial portfolio allocation of $10m.
- Limit/market orders:
  - Use of limit orders to reduce trading costs imposed by the exchange (liquidity provider vs liquidity taker).
  - Limit orders control when crossing the market bid-ask spread for trade execution and reduce slippage.
  - Stop-loss acts as a safeguard for unfilled sell orders.
- Order execution duration:
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Risk Management Performance - 2022/2023 Crypto Bear Market

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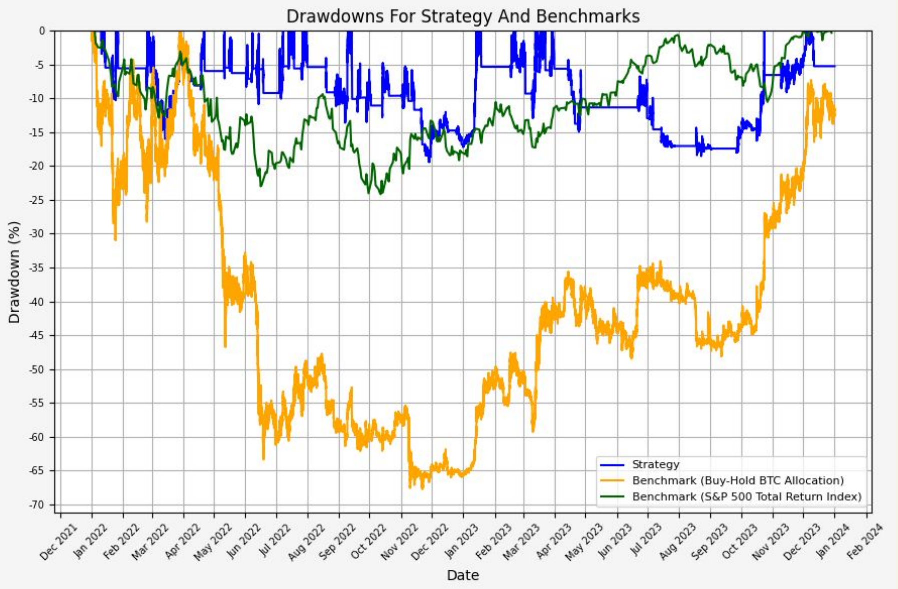

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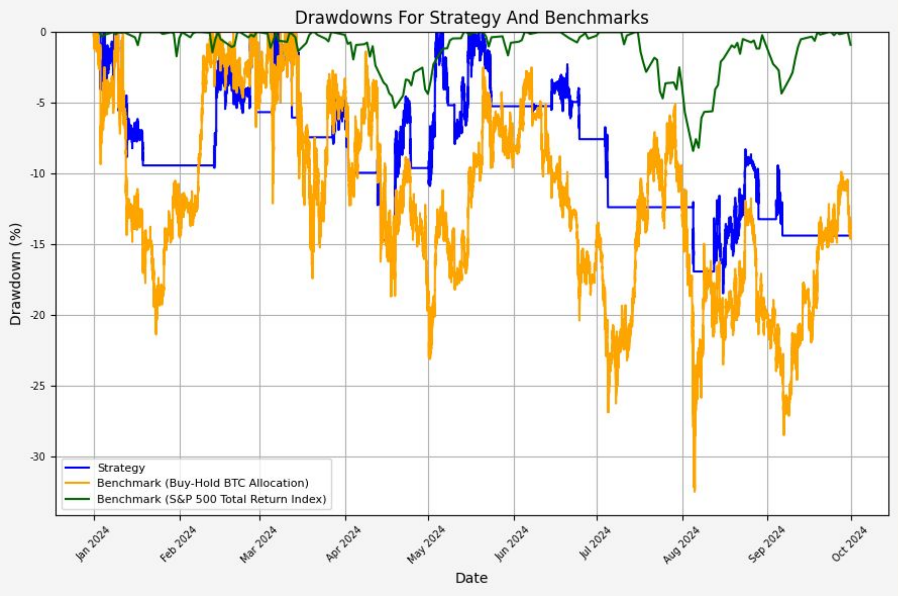

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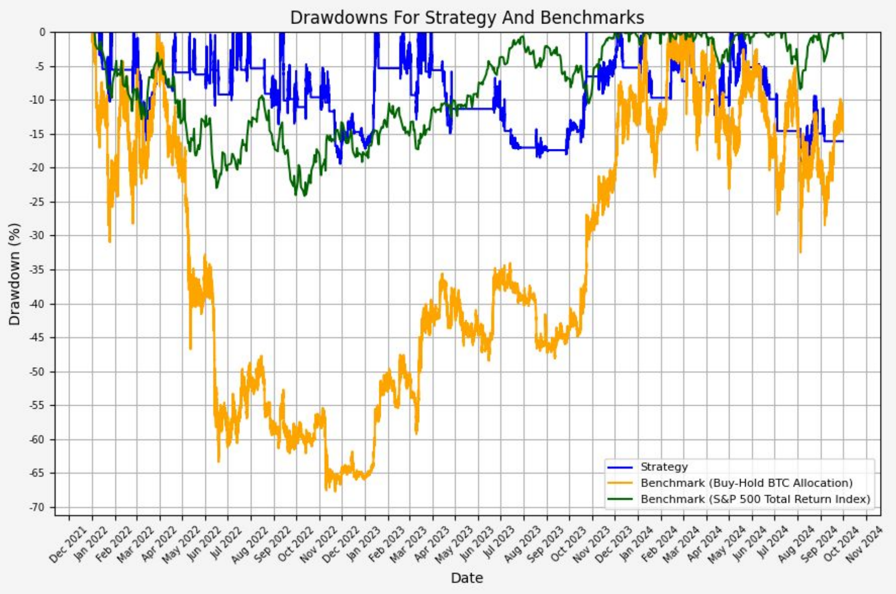

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Questions & Interactive Discussion