Amir Alamir – Quant Project

1. Introduction

This project presents two quantitative trading strategies implemented for cryptocurrency markets: Volume Adjusted Momentum and Quant Crypto Signals. Both strategies leverage historical price and volume data to develop dynamic trading signals aimed at outperforming passive benchmarks like buy-and-hold strategies.

2. Data Collection and Preprocessing

Data was sourced from Binance using their API, encompassing multiple major cryptocurrencies such as BTC, ETH, ADA, BNB, DOT, and MATIC. The data covered the period from January 2020 to June 2024 and was sampled at different frequencies (1 hour, 1 day) to analyze both short-term and long-term trends. January 2020 – January 2023 period was used as the training set and January 2023 – June 2024 was used as the validation set. For each asset, price and volume data were collected, followed by the computation of logarithmic returns. Gaps in the time series were filled to ensure consistent analysis, and additional metrics like percentage changes and compounded returns were calculated.

3. Optimization

A grid search was conducted over various variables such as time horizons (e.g., 4h, 8h, 24h, 168h, 720h), trend windows (e.g., 1d, 10d) to identify the optimal parameters neighborhood for each strategy over different assets in the training set. The resulting Sharpe ratios for each combination were plotted on a heatmap to visualize the most effective configurations. The final portfolio signals were created by the heatmap estimates. Figure 1 is a demonstration of an optimization heatmap for the Volume Adjusted Momentum Strategy as an example.

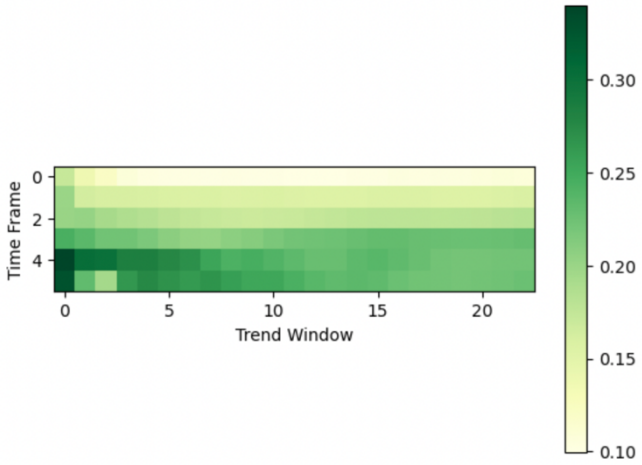


Figure 1, Optimizing trend recognition lookback window over different time frames.

4. Volume Adjusted Momentum Strategy

This strategy integrates the price momentum with volume signals. The hypothesis is that price momentum, adjusted for changes in trading volume, can signal an upward or downward trend more effectively than price momentum alone.

Signal Construction

The signal is derived by adjusting returns based on the deviation of volume from its rolling average. This deviation is used to scale the returns, leading to a momentum indicator less sensitive to price noises.

Performance

The strategy with a monthly rebalancing frequency (monthly_signal portfolio) resulted in an out-of-sample and adjusted for trading costs Sharpe Ratio of 2.67 and 1.7 with a weekly rebalancing frequency (weekly_signal portfolio) while the passive (benchmark) portfolio landed on a 0.9 Sharpe Ratio.
An alpha slightly above than 17.5% was consistently observed over both strategies when accounting for trading costs, suggesting that the active strategy effectively captured excess returns beyond the passive benchmark.

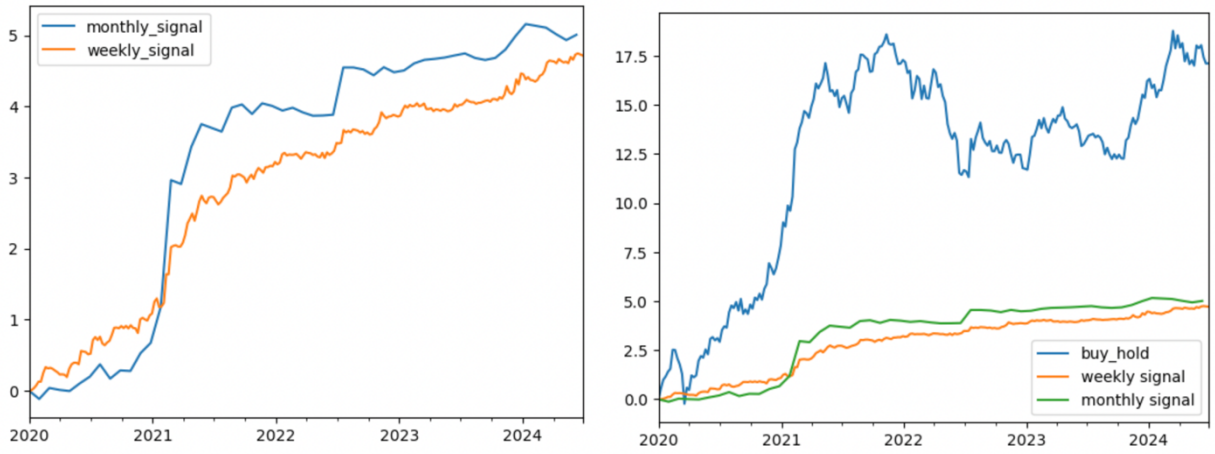


Figure 2, Different rebalancing frequencies for the Volume Adjusted Momentum Portfolio and its performance compared to the benchmark portfolio.

5. Quant Crypto Strategy

The second strategy is built on signal-based entries and exits designed to capture both long and short-term trends in the cryptocurrency markets.

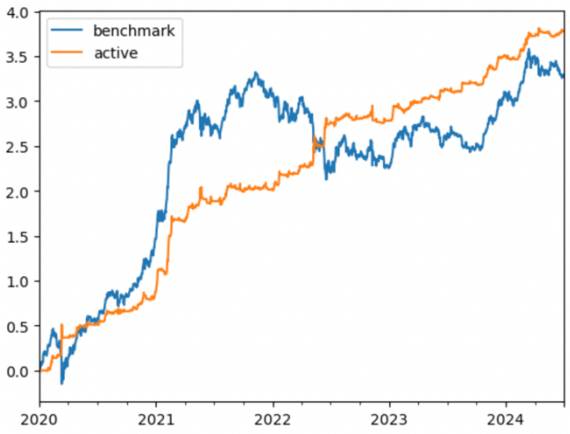
Signal Construction

Long entries and exits point are taken when prices break through recent highs, signaling the start of upward momentum. Exits are triggered when prices fall below shorter-term lows.

Similarly, short positions are taken when prices break below recent lows, signaling downward momentum, with exits triggered upon price recoveries.
The strategy evaluates returns based on these signals and adjusts portfolio weights proportional to the Sharpe ratio of each asset.

Performance

This strategy resulted in an out-of-sample Sharpe Ratio of 2.38. To further compare its performance, both active and passive portfolios were constructed for the selected cryptocurrencies. The active portfolio weighted each asset according to its Sharpe ratio contribution from the strategy signals, while the passive (benchmark) portfolio followed a diversified buy-and-hold approach.



6. Statistical Significance

To further validate the strategies, the statistical significance of the active portfolio's returns was tested using Ordinary Least Squares (OLS) regression. The active portfolio's returns were regressed against the benchmark returns to estimate the alpha and beta coefficients, thereby quantifying the strategy's ability to generate returns independent of broader market movements.

Results for Volume Adjusted Momentum Strategy (weekly_signal)

Alpha: 0.0034
Beta: -0.1468
T-statistics: Alpha 2.09, Beta -1.1
R-squared: 0.005

Regression Results for Quant Crypto Strategy

Alpha: 0.0026
Beta: -0.13
T-statistics: Alpha 5.56, Beta -9.86
R-squared:0.056

These results highlight that the strategy generates statistically significant alpha while maintaining a low correlation with the broader market.

7. Conclusion

The two strategies presented—Volume Adjusted Momentum and Quant Crypto—demonstrate a systematic and robust approach to cryptocurrency trading. By leveraging statistical techniques and machine learning-inspired optimizations, both strategies aim to capture alpha while managing risk, as reflected in their Sharpe ratios and outperformance of passive benchmarks.