

ZeltaLabs - Crypto Trading Challenge

Team 31

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Abstract

Over the span of the report, approaches and inferences derived out of creating optimal trading strategies for the BTC/USDT cryptocurrency market are discussed in detail. .

We use two strategies — Chaikin Money Flow (CMF) and Keltner Channel—to build a performance weighted trading strategy that can outperform industry standard performance metrics over the backtest as well as future data.

Through this report we aim to explain the methodologies adopted, strategies used as well as weighting techniques used to create not only a profitable BTC USDT trading strategy but an entire framework to optimally achieve desired risk return characteristics.

1 Introduction

1.1 Data and Methodology

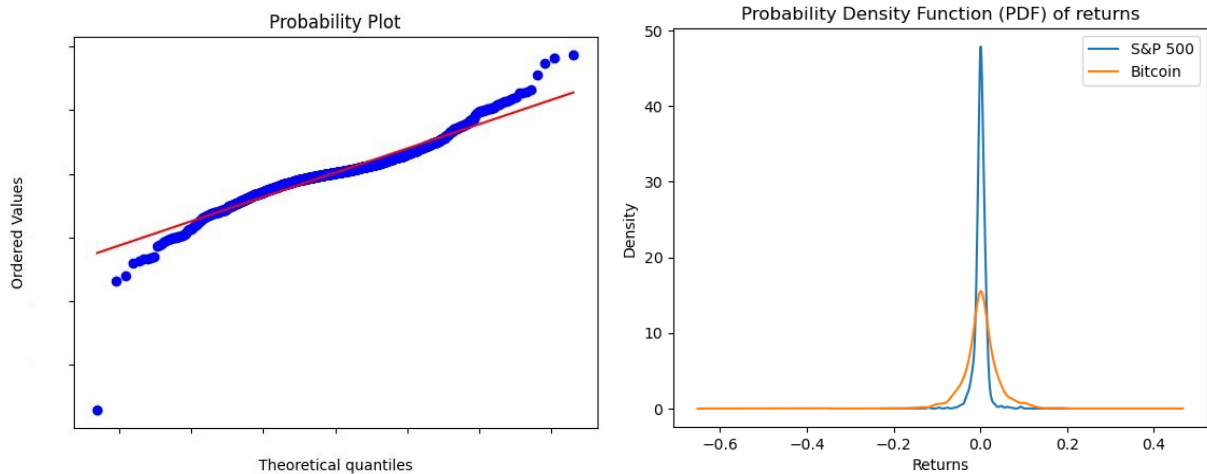
For our study, we received BTC-USDT data spanning from January 1st 2018 to January 12th 2022 available in different time frames: 3 minutes, 5 minutes, 15 minutes, 30 minutes, and 1 hour. Our main criteria for evaluating strategies were centered around maximizing profits, minimizing drawdown, and beating industry defined Sharpe and Sortino ratios.

1.2 BTC-USDT Data

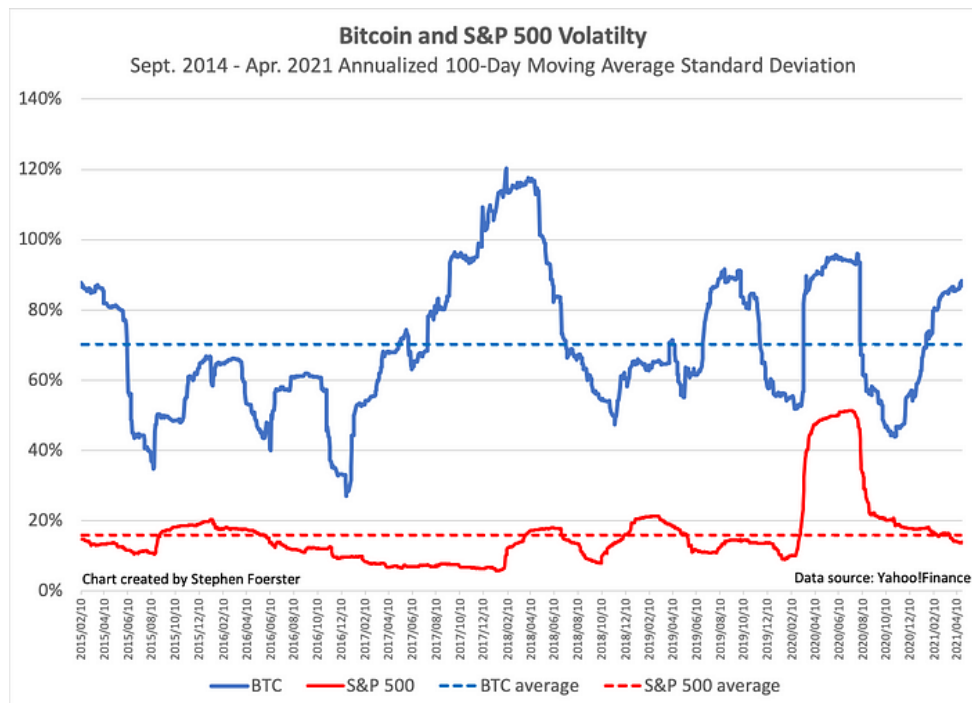
The cryptocurrency market is prone to influence from many diverse factors, with Bitcoin and Ethereum being the most sensitive to such factors. One such factor with a significant impact on crypto market trends is the trading volume. The highly volatile and unpredictable nature of Bitcoin is evident from how it compares with the other US market stocks - specifically the S&P 500 Index [7], with a 4x VAR (Value At Risk, i.e, risk of loss of investment), 3.5x standard deviation and 5x realized volatility. A review of PDF also shows the heavy tailedness for Bitcoin when compared to the S&P 500 Index, which tells us that the former has more outliers. Bitcoin is seen to have 40% more prevalence to produce high daily returns than the S&P 500 Index.

This tells us that Bitcoin has lower predictability due to unexpected news in the majorly sentiment driven market, but higher potential of high returns, which is consistent with the notion of high risk - high reward.

BTC-USDT is considered as one of the most frequently traded asset in the cryptocurrency markets but on comparing on the basis of liquidity, volatility, predictability, it fails the efficient market hypothesis to a much greater extent compared to even the "Midcap stocks" and thus profitable trading strategies are expected to start declining in performance at a much later stage in BTC-USDT compared to similarly robust strategies in stock markets.



The above plots indicate how the BTCUSDT market does not follow the normal distribution exhibited by log-returns in most of the developed markets and tends to have a significantly higher proportion of outliers.



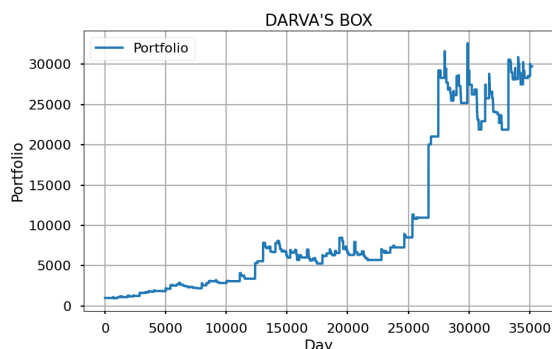
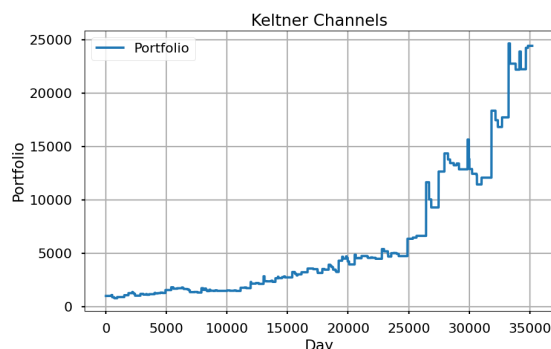
The above plot exhibits the consistently higher volatility in BTCUSDT which is considered as one of the most stable cryptocurrency when compared to the volatility of S&P 500.

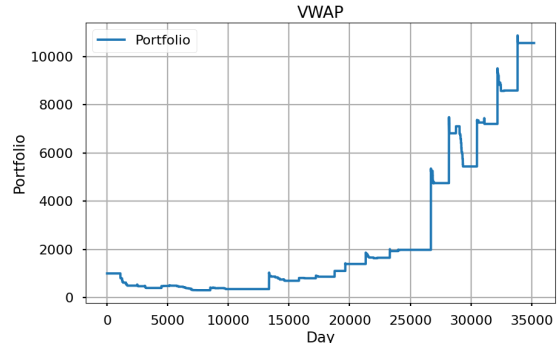
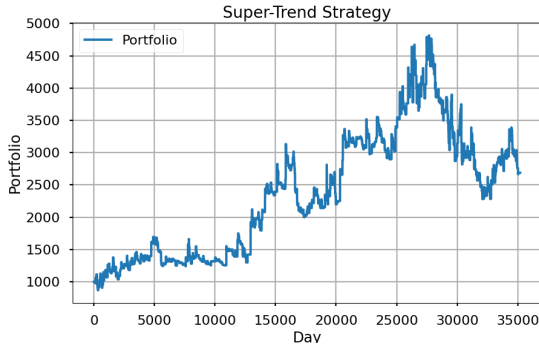
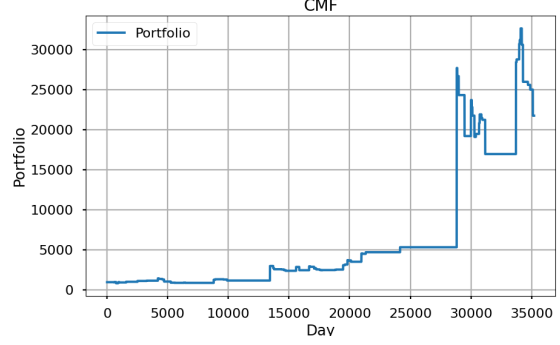
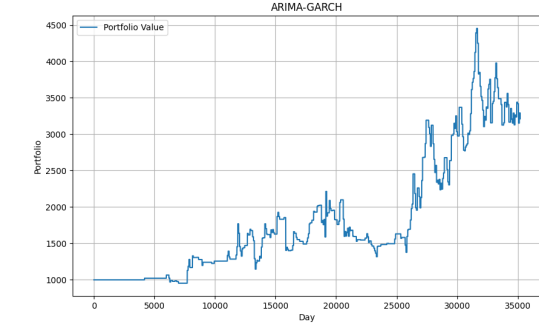
2 Exploratory Approaches

2.1 Preliminary Strategies

In our efforts to find an effective strategy, we conducted a thorough exploration, evaluating different indicators and analyzing relevant research papers. We identified the following strategies with favorable returns and minimal drawdowns, as illustrated below, showcasing their performance.

- **Keltner Channel**[4] - Keltner channels, similar to Bollinger bands and moving average envelopes are based out of volatility based bands wherein the metric used for volatility is ATR i.e Average True Range.
- **Darvas Box** [3] - A momentum strategy, identifying the asset trading within defined price ranges or 'boxes,' with buying opportunities upon breakout above the box top and exit strategies for both long and short positions based on breakout directions.
- **ARIMA - GARCH** [2] - The ARIMA(Auto Regressive Integrated Moving Average), is a time series forecasting model, which is used to determine the order of differencing and identify the Auto Regressive and Moving Average components using correlation and partial correlation functions. GARCH model works by capturing and modeling the time varying volatility in a time series, where the current conditional variance depends on past conditional variances and squared past innovations.
- **Chaikin Money Flow (CMF)** [5] - The Chaikin Money Flow Indicator quantifies buying and selling pressure in the market by assessing the relative deviation of close prices with respect to highs and lows, multiplied by volume, providing a sentiment-driven perspective, particularly valuable in the cryptocurrency market known for extreme trends and rapid reactions.
- **SuperTrend**[9] - The Supertrend indicator, incorporating the Average True Range (ATR), signals bullish reversals when crossed by the close, offering dynamic support and resistance levels with adjustable sensitivity through a multiplier, complemented by the integration of the RSI indicator for enhanced performance and risk management.
- **VWAP** [6] - The Volume weighted average price is used to get a quantified price which acts as a good substitute for the price the market perceives a financial instrument at, as it takes a weighted sum of price using volume as weights.





2.2 Weighted Combiner

Cryptocurrencies such as BTCUSDT are highly affected by market news and sentiment. Therefore, it is necessary to find ways in which strategies which are netting good performance metrics can be exploited by giving greater weightage and importance to performance in the recent past as certain trading strategies tend to outperform in specific market regimes over the others.

By using a weighted strategy [8], we try to use the performance over the previous window to get a better understanding of which strategy is best suited for the current market regime and accordingly assign weights to the strategy signals produced by them to account for the different trading signals generated by profitable and tested strategies.

Strategies are consistently adjusted in response to changing market conditions, to facilitate flexibility in sustaining profitability as common computational methods in trading lack adaptability within time series as they rely on fixed parameters which may not capture evolving market dynamics effectively.

After observing different behaviours of the tested strategies at different time periods, we came up with strategies to combine them using various combinations and metrics.

The weighted combiner observes the performance of each strategy over the previous data, and accordingly takes a trade position. This is done by giving certain weights to each strategy, and the final position taken is a combination of positions taken by each

strategy.

We tried the following combinations of strategy weights, to find the best combination.

- **Best-Till-Now** - Performance of each strategy till the current period is observed, and the weights are assigned accordingly.
- **Standard Weighting** - The performance of each strategy in only the most recent period.
- **Exponential Decay**[1] - The performance of each strategy is until the current period is observed, giving higher weights to the strategies performing well more recently. Finally, the best observed strategy is given all the weight.

2.2.1 Implementation Details

Given a set of strategies, we combine them as follows:

- Choose a metric based on which the strategies are compared. This can be PnL, drawdown, or a combination of both(e.g. PnL/drawdown).
- Obtain these metrics for each strategy in a fixed window time frame(e.g. last 500 hours).
- Assign weights to each strategy based on this metric, and normalise them such that the weights add up to 1.
- Find the weighted sum of the positions of given by each strategy.
- If the absolute value of this sum is greater than a threshold chosen by us, we take the position of the weighted sum, else we stay market neutral.

3 Final Strategy

Out of all the preliminary strategies we tried, the performance of two strategies stood out - CMF and Keltner channel.

As we already know, the Bitcoin market is prone to knee-jerk reactions, is highly volatile and trending, and overall unpredictable. Hence, we were more inclined towards momentum strategies to trade on trends, as mean reversion lets us trade only on brief price changes leading to losses due to commission.

- The **CMF indicator** is a volume accumulation/distribution strategy, that quantifies buying and selling pressure in the market by comparing the relative deviation of the close price with respect to the high and low and multiplying with the volume. This helps us determine overbought / oversold condition points in the market and yields huge profits on strong trends.

Parameters:

- Lookback period: We could observe a tradeoff between returns and risk while adjusting this parameter as a high window leads to confirmation of trends and lesser risk and lesser returns, while a low window leads to high profits but also high losses. Therefore we settled on a balance point of a lookback of 20 days.
- Threshold: A positive value of the CMF indicator tells us that the market is bullish and a negative value forecasts a bearish trend. We take threshold as 0 itself as we are implementing this strategy on a 24H timeframe which is less prone to noise.
- **Keltner channels** is a strategy based out of volatility based bands wherein the metric used for volatility is ATR i.e Average True Range. Prices being between bands are taken to be ranging regions and band breakouts are predicted as trends and accordingly traded. We have also put exit conditions when the price is continually hitting one of the bands and not the other as that could be a sign of losing momentum.

Parameters:

- Smoothing average(SMA/EWMA) window - We choose the length of the moving average as 30 days, unlike 21 days of stocks as BTCUSDT is traded 24/7.
- Length of ATR window - We choose length as 2 weeks, to show the impact of volatility in a time frame which is much more frequent than that of the smoothing window, and as the volatility of Bitcoin is dynamic.
- Multiplier - We use the multiplier as 3 instead of the stock's standard 2 or 2.5 to avoid misrepresentation bias and overfitting due to cryptocurrencies being more volatile and having more outlier movements compared to that of stocks.

CMF is a strategy that has a possibility of providing false signals during extremely high volatility and Keltner channel is a strategy that shies away from trading on significant trends and hence holds back on returns. We believed both could complement each other's strengths and limitations and bring about good results.

On finding the correlation between the positions held by different strategies, it was found that the correlation between CMF and Keltner Channel's Strategy had a correlation of only 24.92% which further consolidates the complementary nature of the times it generates returns thus giving an ideal combination of strategy.

No single strategy is a do-it-all and it is seen that different strategies perform well during different times. We have therefore used our combiner strategy to switch between strategies after an appropriate amount of time (500 hours), so we don't overfit, at the same time reap the benefits of this multi-strategy approach.

Stock markets like those of USA which are considered developed, tend to have a lower expected period of consistent profitability compared to cryptocurrencies due to the concepts of efficient market hypotheses due to which the time period window used to check P&L for assigning weights is higher than the thresholds used for stocks (benchmark number for stocks tend to be about 100 rows of data but we use windows of about 500 in order to avoid the excess noise present in cryptocurrency deviations and at the same time get a more robust metric for strategy performance).

This gave the best performance with a significantly good risk to reward ratio and more than double the returns as when the strategies were used individually.

4 Risk Management

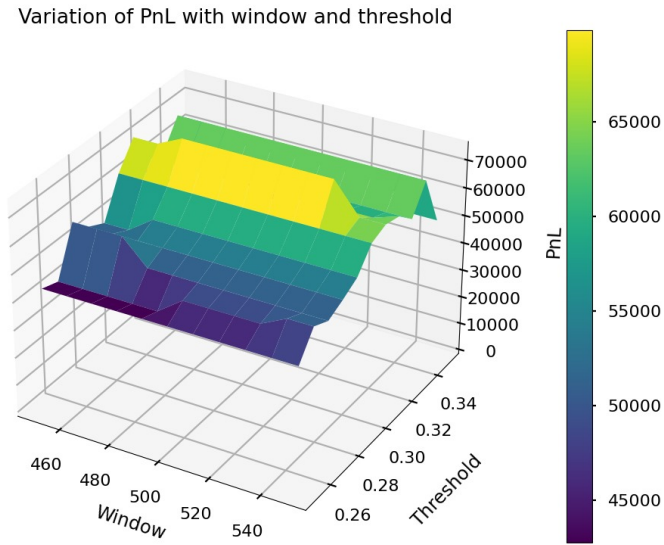
In markets which consist of much greater noise (defined as signal-trend), the effectiveness of stop losses drops multi-fold since high potential positions are at a much greater risk of being squared off due to market noise.

While sensitive stop losses work well on less noisy developed markets, risk management for cryptocurrencies (based on results of BTC, ETH, LTC, ADA on 2018-2023) is optimally done by dynamic performance based strategies and not static stop losses to make use of the current market dynamics to a greater extent and avoid loss making strategies by minimising their respective weights which accounts for the market noise factors (by using threshold weights to enter positions) which static and thus sensitive stop losses are unable to capture in noisy markets such as that of BTC-USDT.

Based on the prioritisation necessary, a weighted strategy in different settings can give the required risk return characteristic i.e. on prioritising returns and weighting strategy based on previous P&L, an approximately 6500% return was attainable at a static drawdown of 27%, while at the same time if the weight parameter is shifted to $(\text{Window P\&L})/(\text{Window Drawdown})$, returns of 3300% at a much reduced drawdown of 21% can be attained thus allowing us to achieve optimal risk return characteristics using the better performing strategies and different weighting strategies.

5 Strategy Robustness

To ensure robustness of the strategy, we ran tests across different time frames as well as on different similarly performing cryptocurrency pairs namely LTC(Litecoin)-USDT, ADA(Cardano)-USDT, ETH(Ethereum)-USDT and analysed if the returns were consistent across other currencies and also tried running our models on data from 1 January 2018 to 30 November 2023 to further check for possible overfitting.



The above plot shows that the parameters are not sensitive to cause any overfitting and the choice of parameters is hypothesis based rather than hyperparameter tuning based overfitting, which allows it to perform similarly across other time frames and other cryptocurrencies as well as shown below.

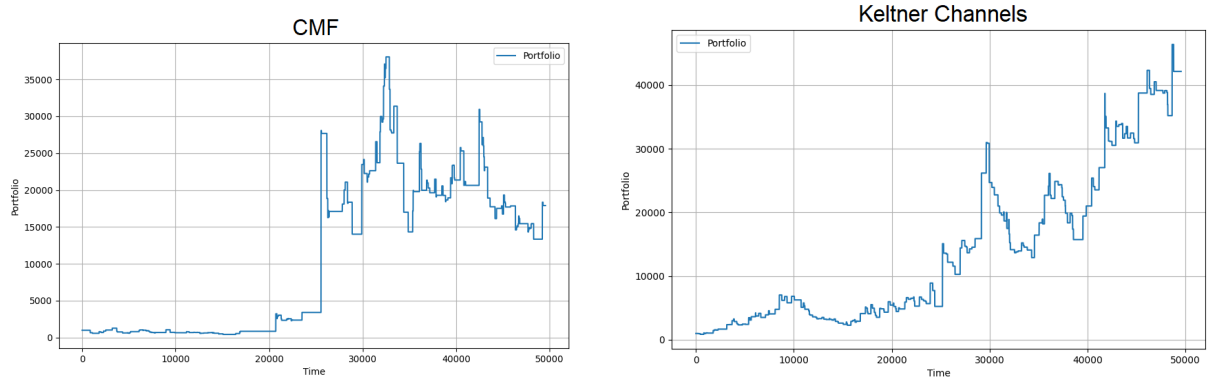


Figure 1: Returns of CMF and Keltner Channels on 2018-23 ADA-USDT data

The above are the results of the same strategy on ADA-USDT which shows consistent outperformance in terms of increased returns and reduced drawdowns showing that not only the weighted strategies but even the individual strategies are robust thus opening the possibility to extend similar strategies across different cryptocurrency pairs as well.

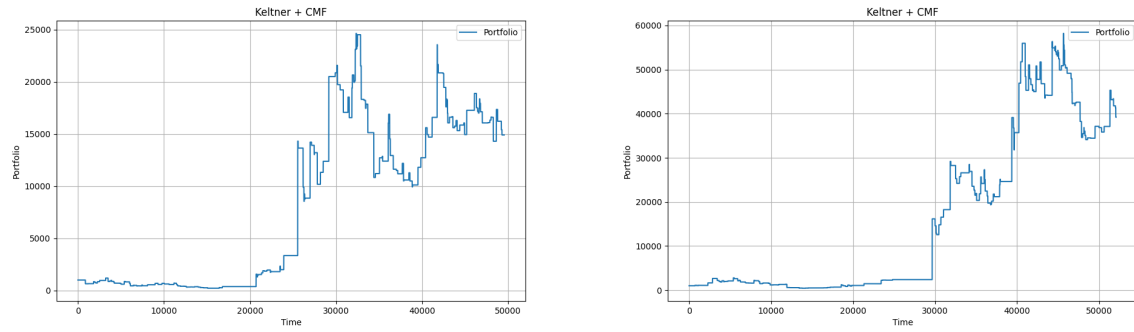
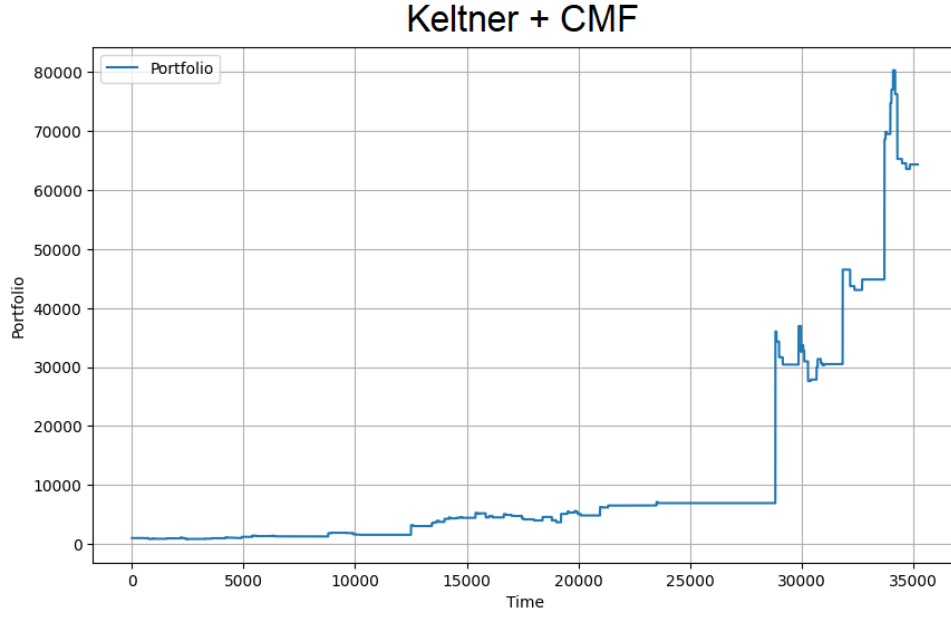


Figure 2: Returns of CMF + Keltner Strategy on 2018-23 ADA-USDT and ETH-USDT data

The above plots exhibit the consistency of strategy when used in a combined manner across different cryptocurrencies as well.

6 Results



The above graph depicts the returns of the strategy in the BTCUSDT market in the given time frame. The most notable features of the same include:

- Sharpe ratio > 3 (3.028161), industry norm = 1.5
- Sortino ratio > 25 (29.92874), industry norm = 2.0
- Peak Portfolio Balance - 80,311(approx 8000% returns)
- Maximum Drawdown - 27.633% (significantly lower than the buy and hold draw-down despite giving much greater returns)

7 Conclusion

The above generated framework can be effectively used and extended to match the risk-return preferences of individual investors based on selection of strategy as well as weighting logics.

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