

PORTFOLIO MVP RESEARCH

Written by Zachary Lee – 7/10/2023

SUMMARY STATISTICS

Sharpe Ratio	Sortino Ratio	CAGR%	Max Drawdown %	Daily VaR
3.26	9.74	63.28%	-7.55%	1.74%

ABOUT THE STRATEGIES

VWAP TREND FOLLOWER (VTF): This strategy is the **core** of the portfolio MVP showcased in this packet. It is beautifully simple – follow the whales by distinguishing between newly formed, volume supported, breakouts and fake breakouts. This results in lots of trades (**926 trades** over a 2-year period per sub-strategy, over **7000 trades** for the combined strategy, which has open positions about 89% of the time). This strategy has symmetric entry rules, resulting in **46% long** positions and **54% short** positions, with a market neutral $\beta = -0.03$. While a Sharpe Ratio of **2.2** is upper-medium territory, the Sortino Ratio comes in significantly higher at **5.3**. The high trade frequency combined with a massive 25 bip mean expectancy results in a very rare type of strategy. The rest of the portfolio is designed to mitigate the weaknesses of this strategy. VWAP Trend Follower has been trading on Binance **Testnet since May 2023**. I anticipate taking it live in July/August 2023 in partnership with a prop firm or market maker.

RELATIVE VOLUME TREND FOLLOWER (RVTF): Seeks to address one weakness of **VTF** – it can struggle during consolidatory periods with high internal volatility (fakeouts), especially on the short side. When markets collapse, especially lower liquidity markets in crypto, the moves are more violent and parabolic, basically black swans, when compared to upside price action, which is typically more moderate. To take advantage of this fact, you need to be OK with entering later and holding for larger profit deltas.

However, you need to take profit based on deltas, not based on hold duration like **VTF**. To fix these

weaknesses, I created a **short-only relative volume strategy**. **RVTF** has a lower Sharpe Ratio when measured across all market conditions but maintains a very low correlation to both BTC and both **VTF** and **BBPS**, making it a very valuable addition to the portfolio MVP.

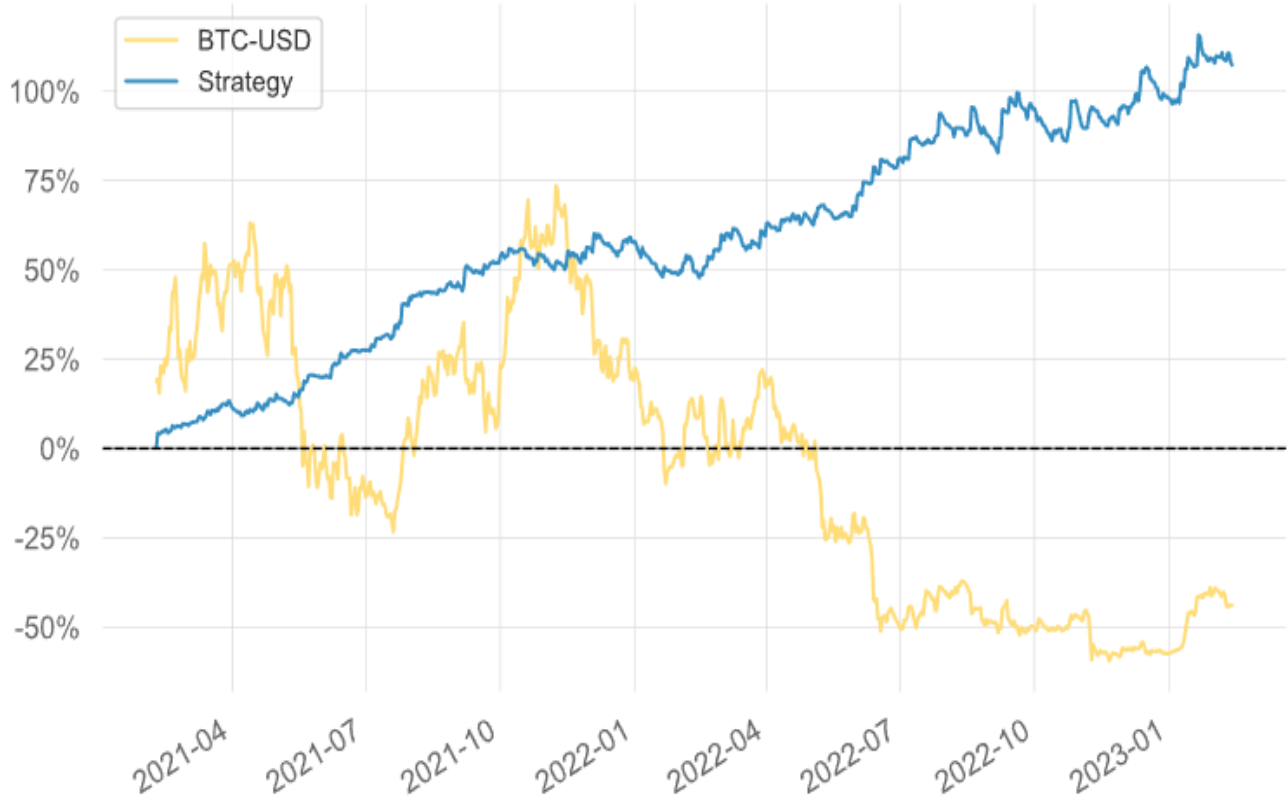
BOLLINGER BAND PULLBACK STRATEGY (BBPS): This strategy is mean reverting, using limit entry orders, generally during pullbacks after Bollinger Band breakouts occur. This results in a lower correlation to **VTF** than several other similarly profitable candidates I was considering for the portfolio MVP. Similar to VTF, symmetrical entry rules lead to a market neutral ($\beta = -0.03$) strategy (**54% long 46% short**). The weakness of this strategy is that it has a lower trade count (Bollinger band breakouts happen less often than whale market orders or VWAP breakouts.)

VWAP TREND FOLLOWER STRATEGY DATA

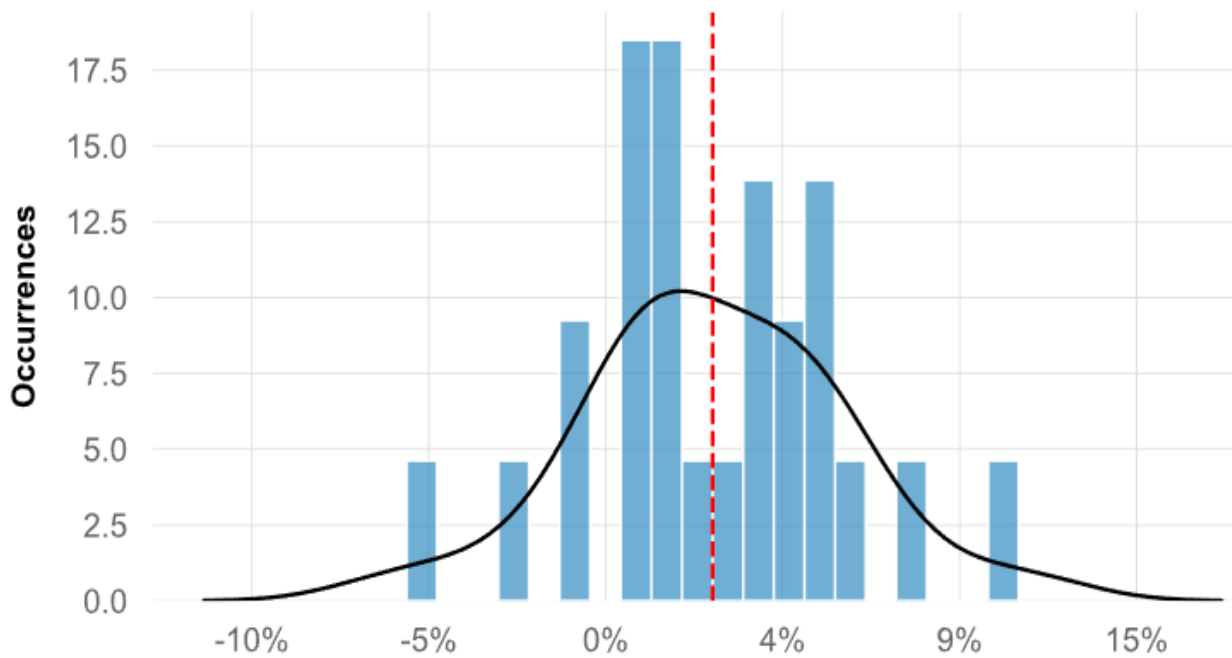
Please reference the [vwap_trend_follower_tear_sheet.html](#) file for the comprehensive tear sheet

PRO FORMA

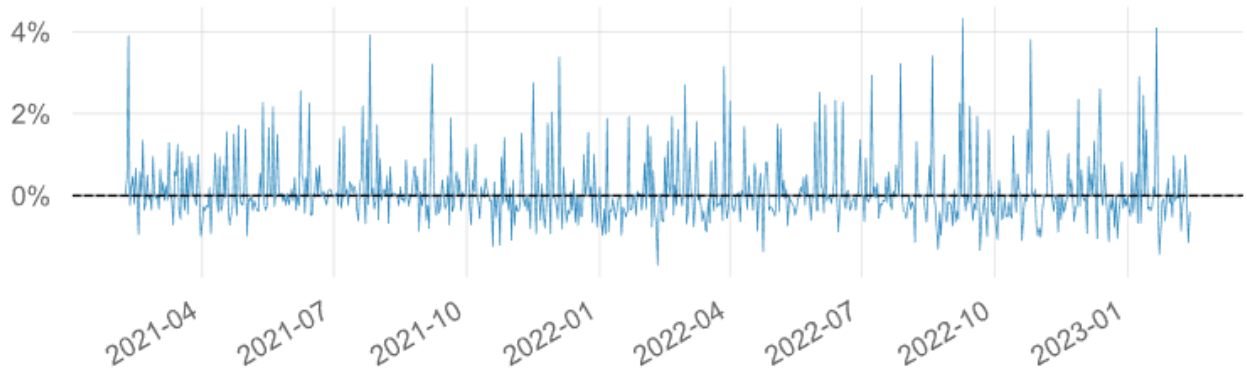
Cumulative Returns vs Benchmark



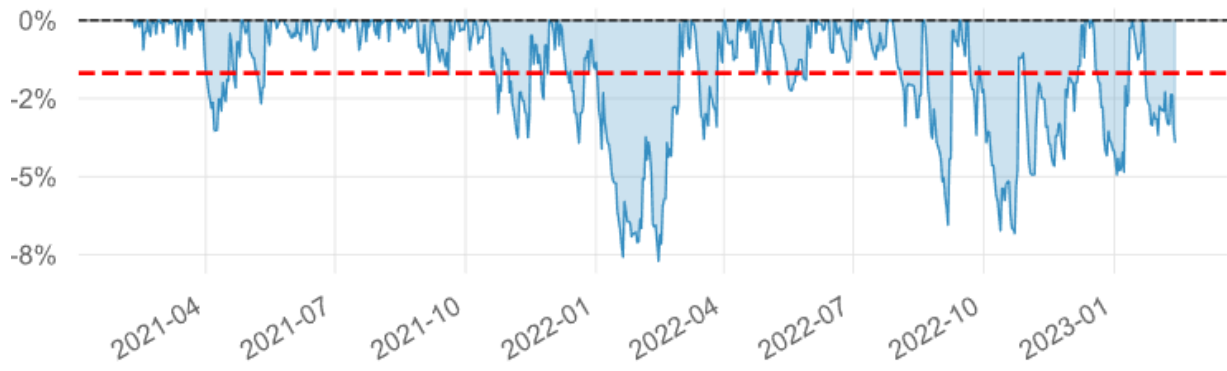
Distribution of Monthly Returns



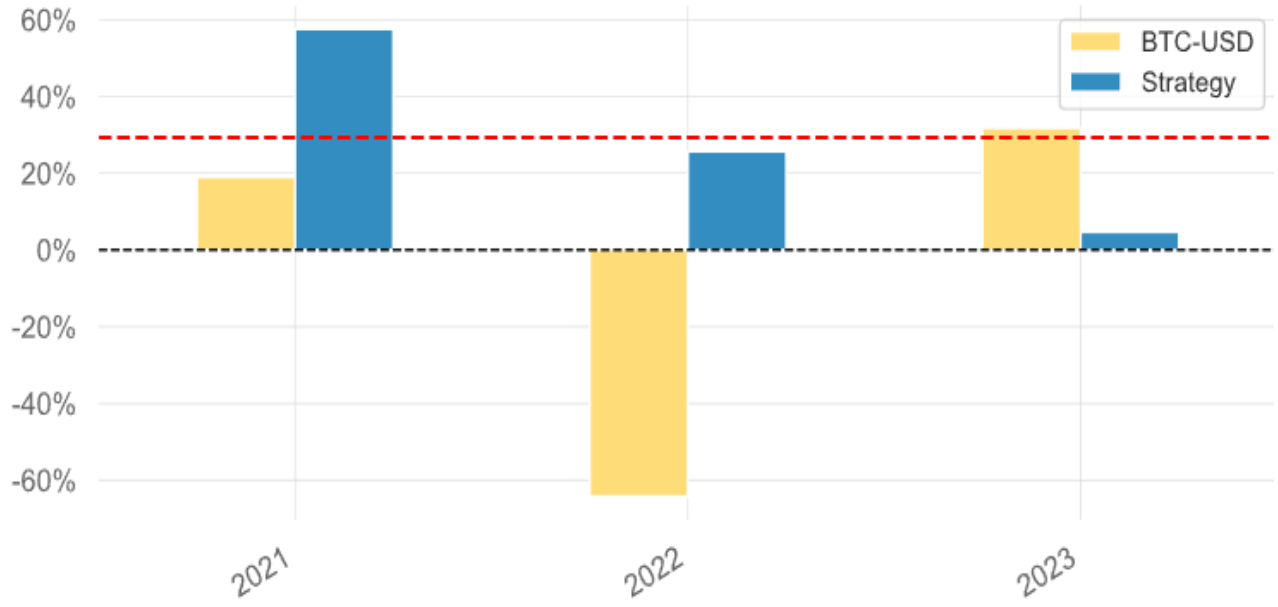
Daily Active Returns



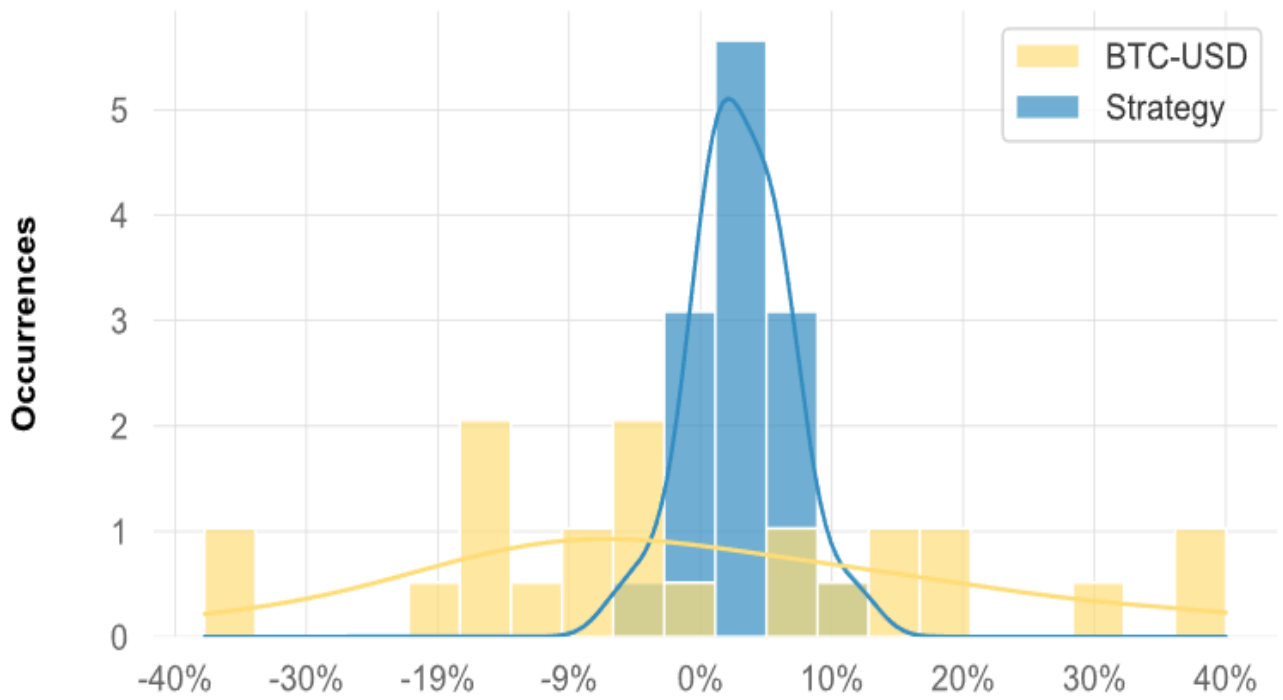
Underwater Plot



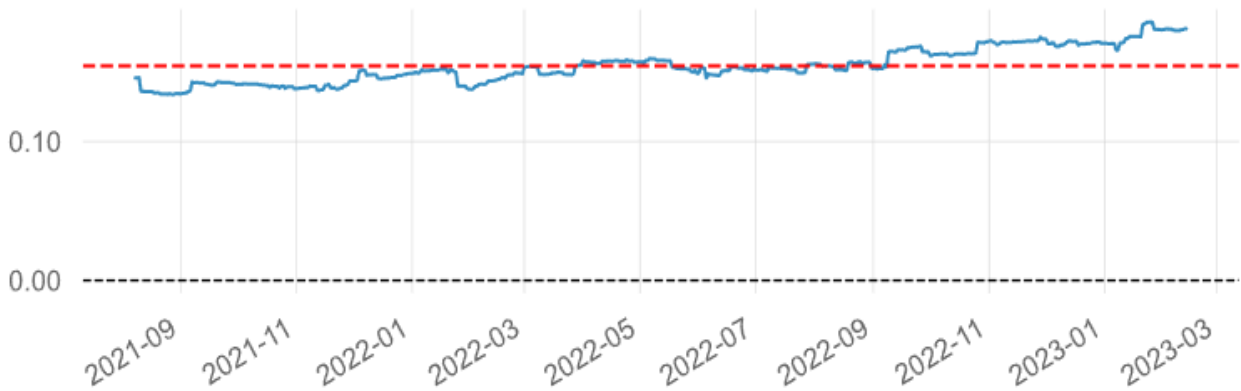
EOY Returns vs Benchmark



Distribution of Monthly Returns



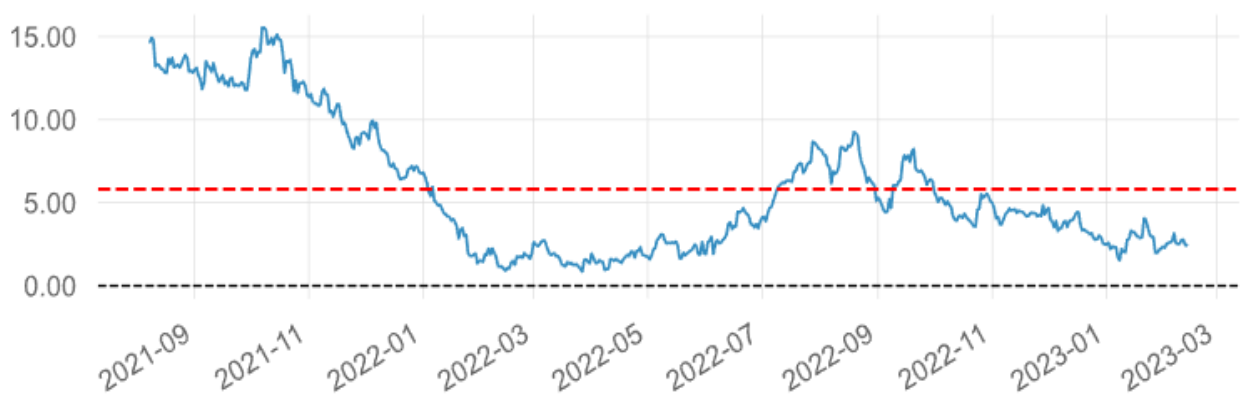
Rolling Volatility (6-Months)



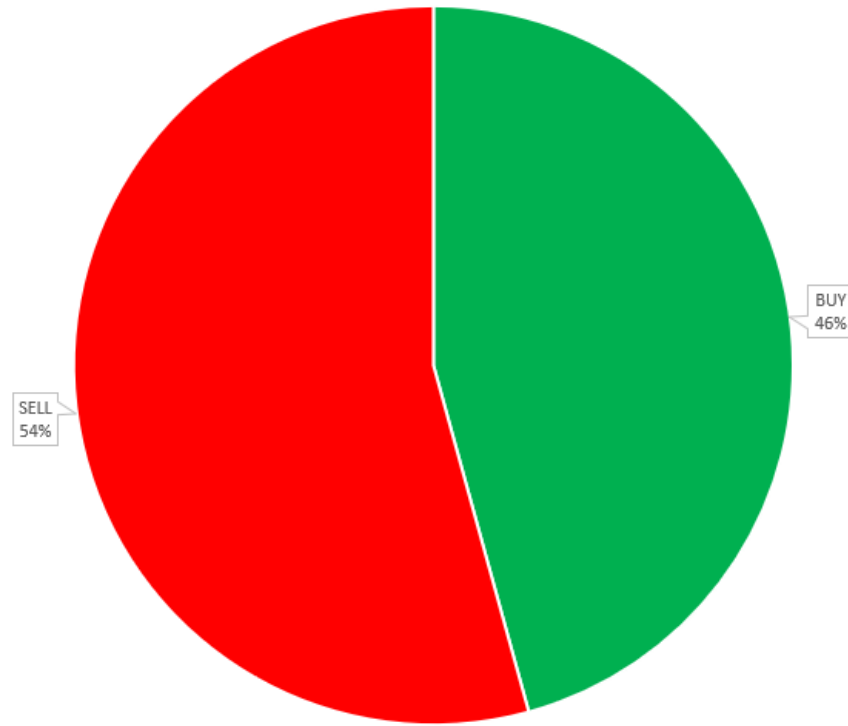
Rolling Sharpe (6-Months)



Rolling Sortino (6-Months)



Buy vs Sell Trades

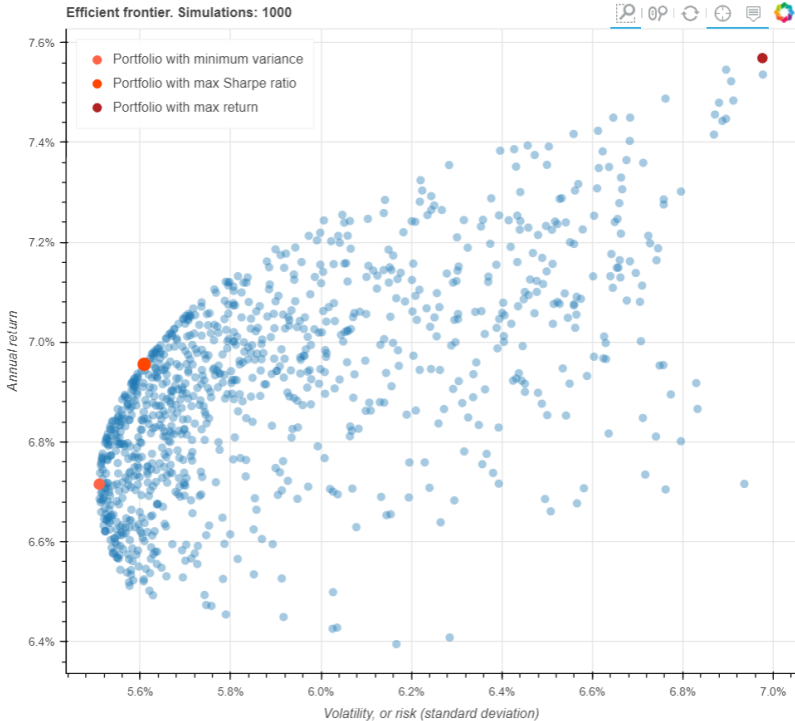


Strategy - Monthly Returns (%)

2021	0.00	6.77	4.99	1.19	5.69	6.33	11.67	1.93	4.67	1.37	1.50	0.84
2022	-5.63	4.70	2.38	3.10	1.80	8.25	6.15	-2.60	4.13	-0.47	0.95	1.12
2023	5.48	-0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

RELATIVE VOLUME TREND FOLLOWER STRATEGY DATA

SUB STRATEGY PORTFOLIO CONSTRUCTION

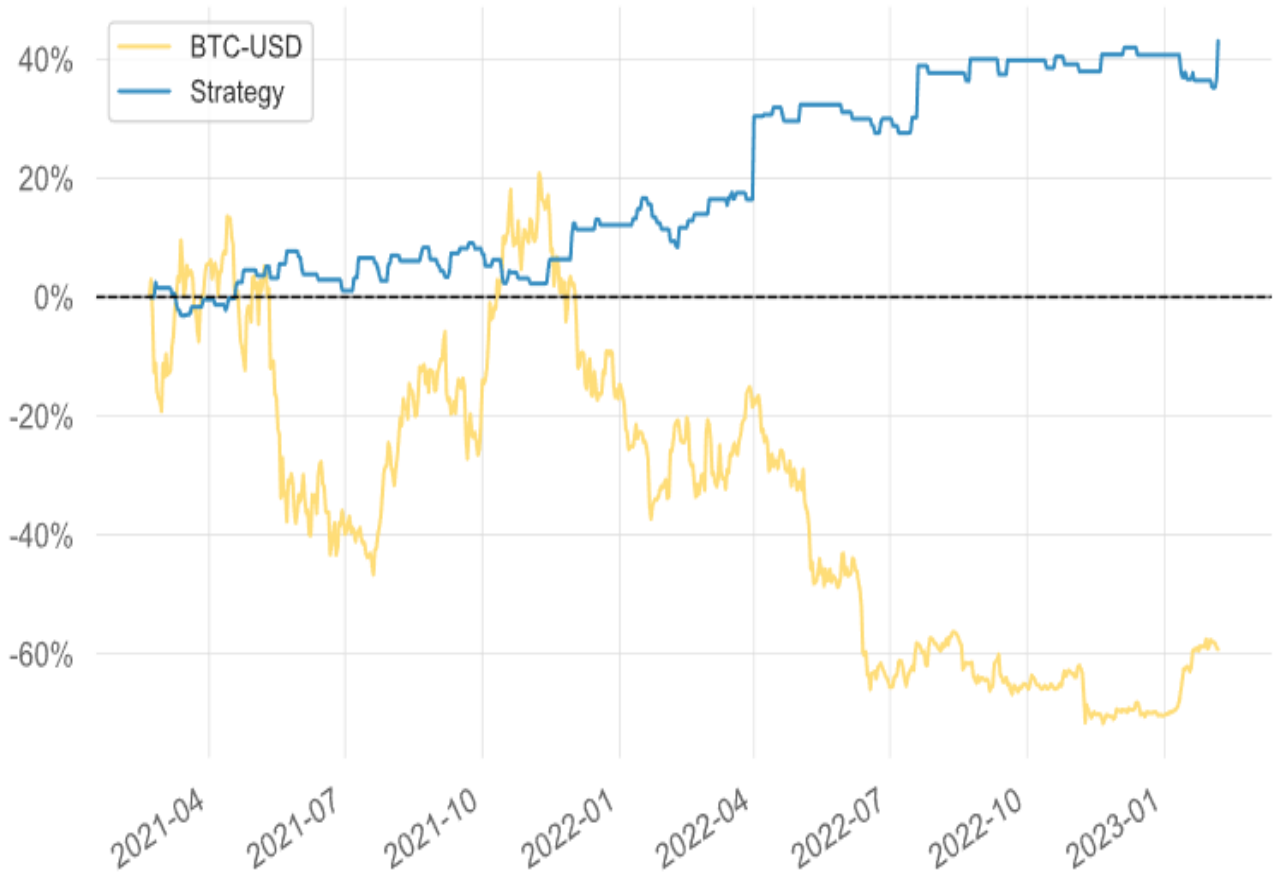


PRO FORMA

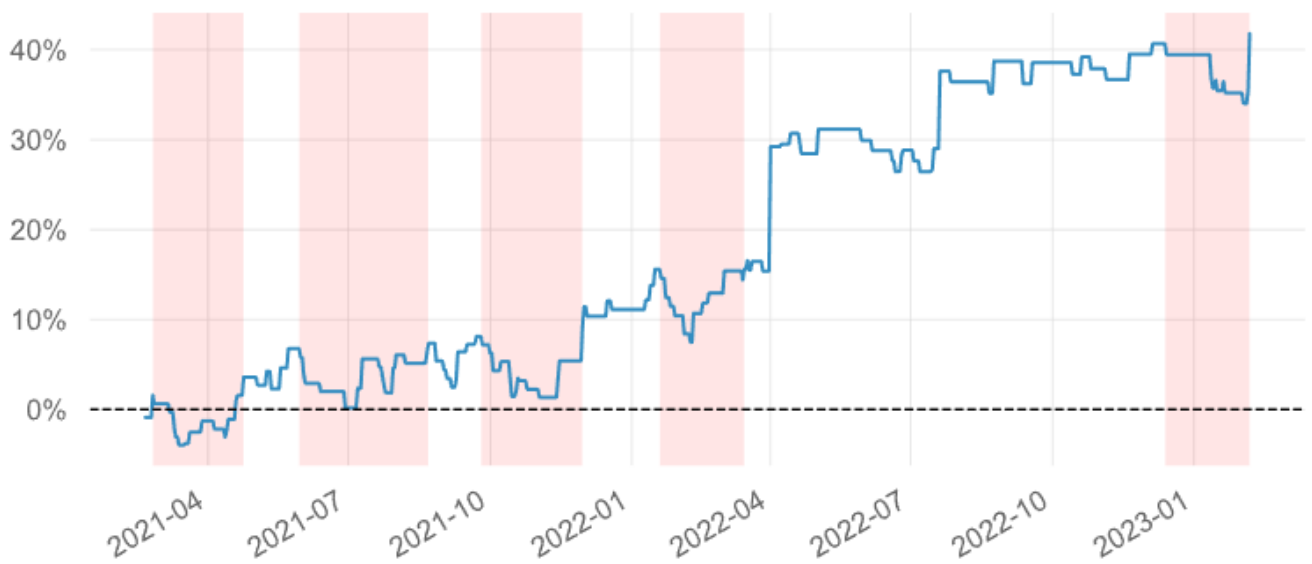
Please reference the [rv_trend_follower_tear_sheet.html](#) file for the comprehensive tear sheet



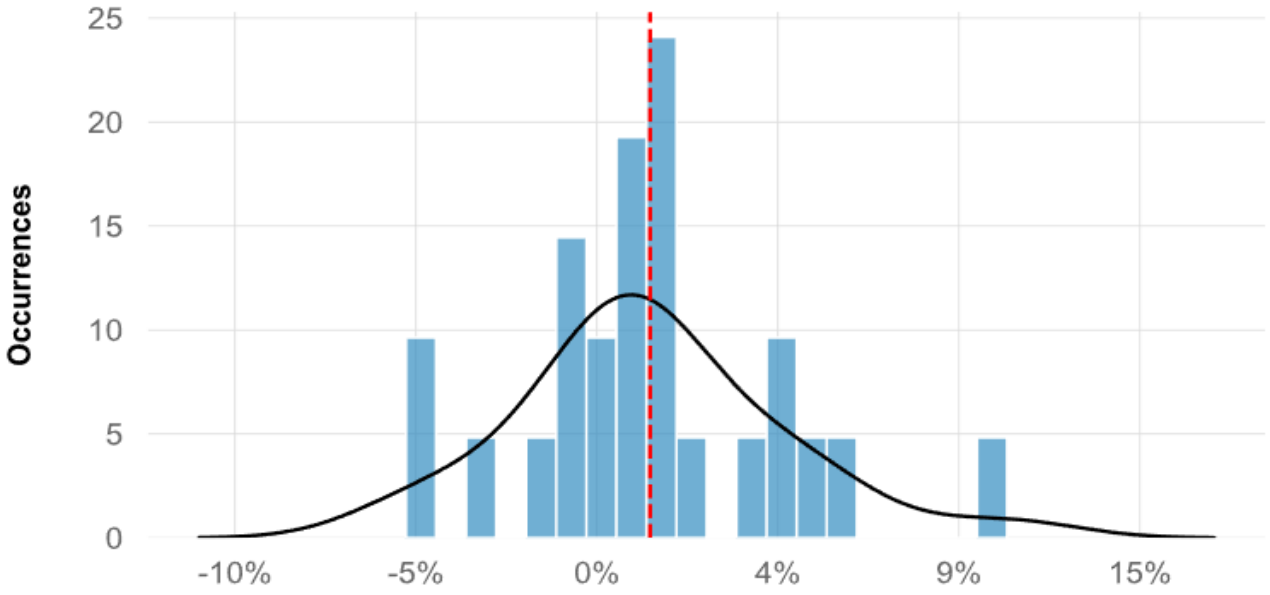
Cumulative Returns vs Benchmark



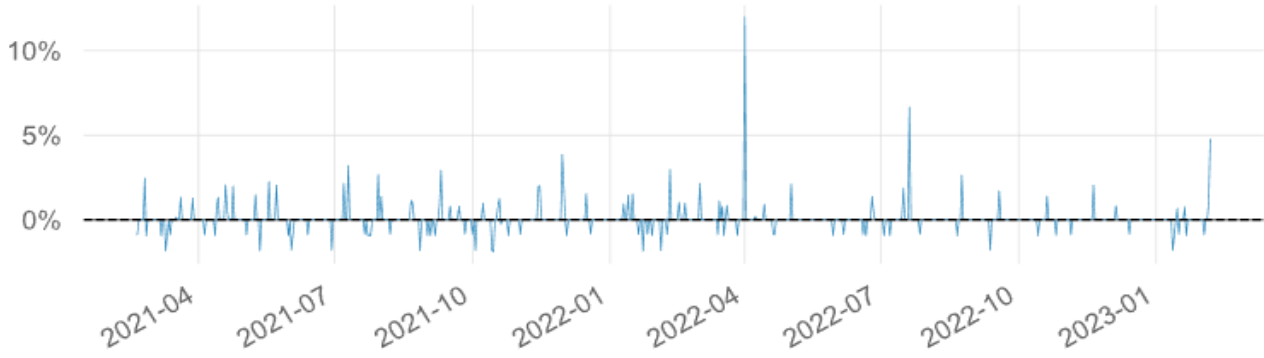
Strategy - Worst 5 Drawdown Periods



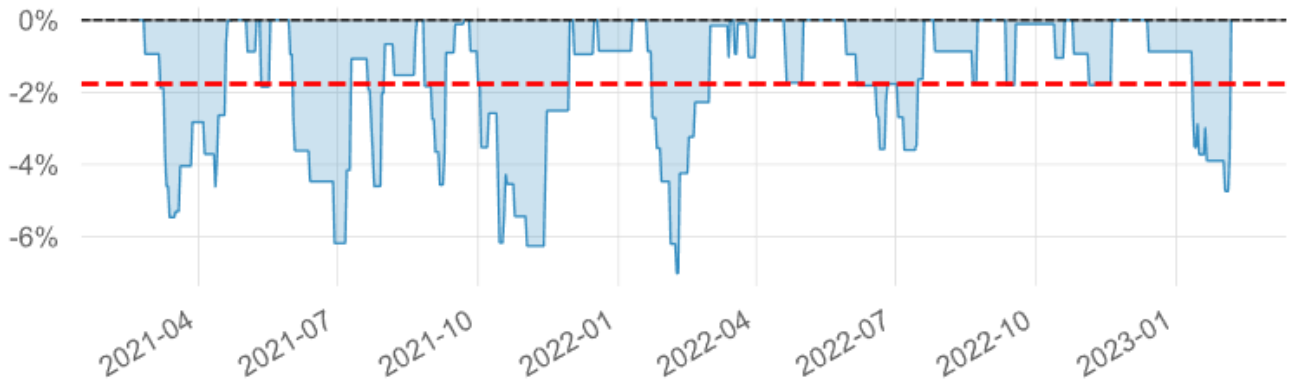
Distribution of Monthly Returns



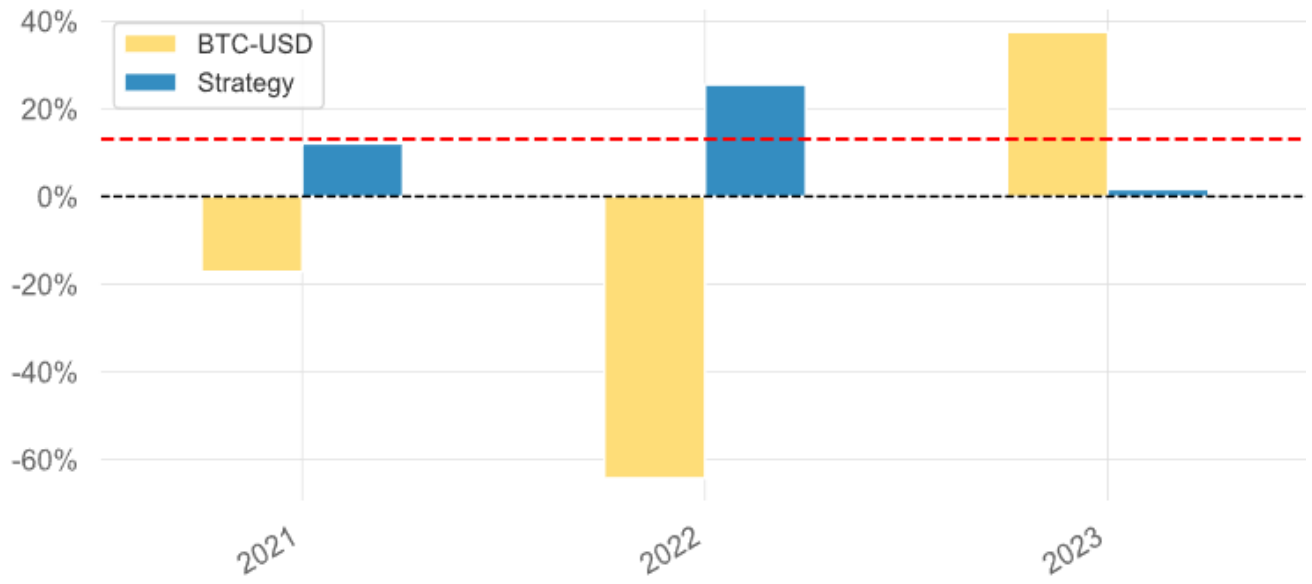
Daily Active Returns



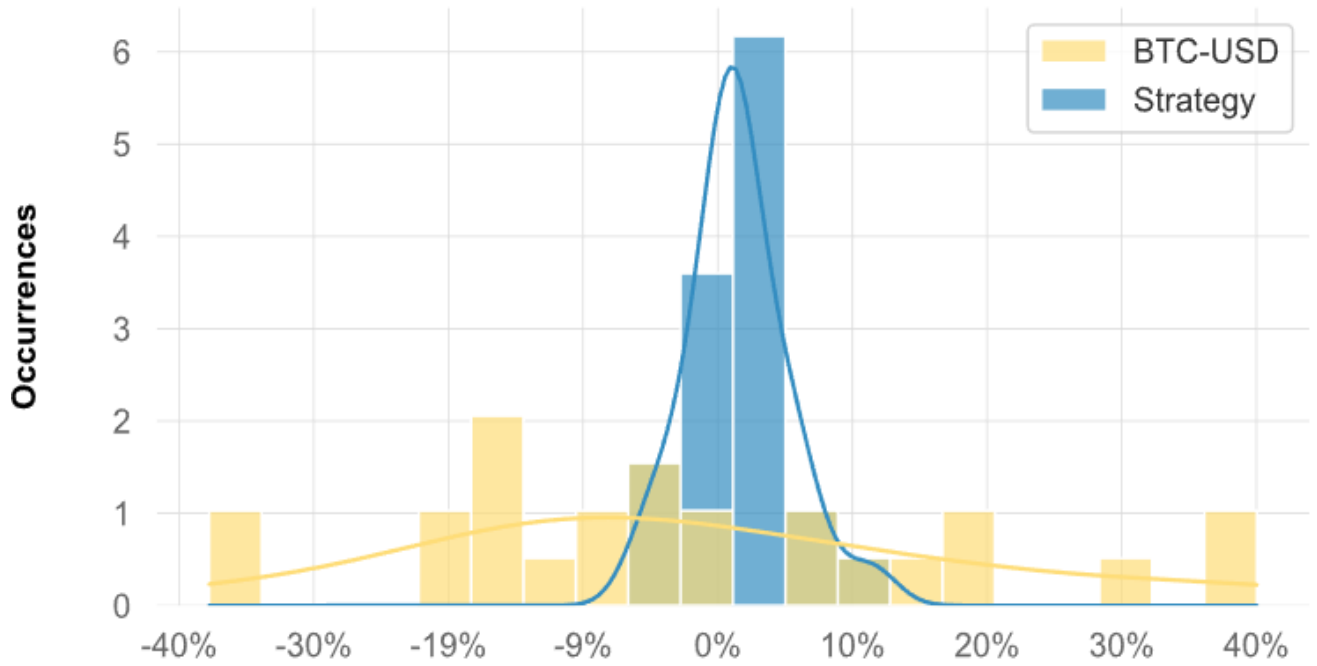
Underwater Plot



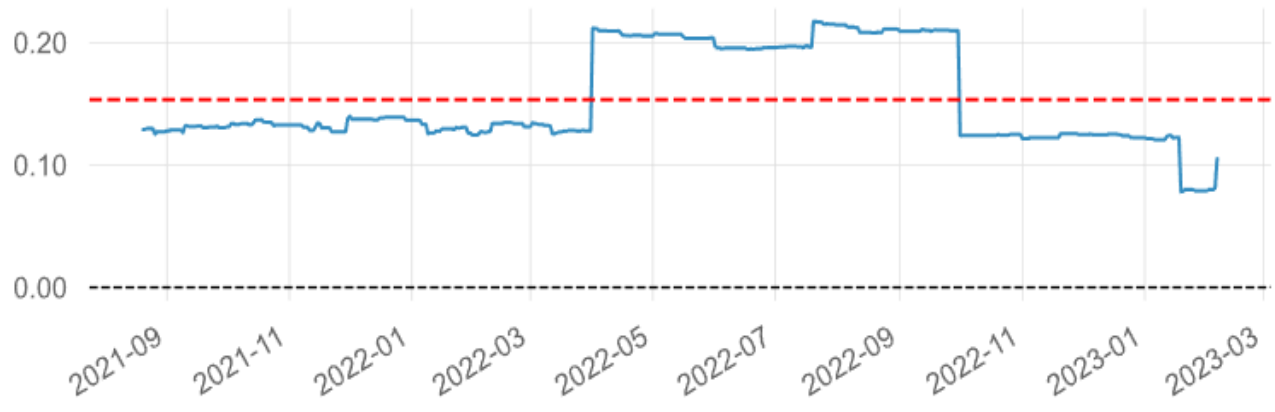
EOY Returns vs Benchmark



Distribution of Monthly Returns



Rolling Volatility (6-Months)



Rolling Sharpe (6-Months)

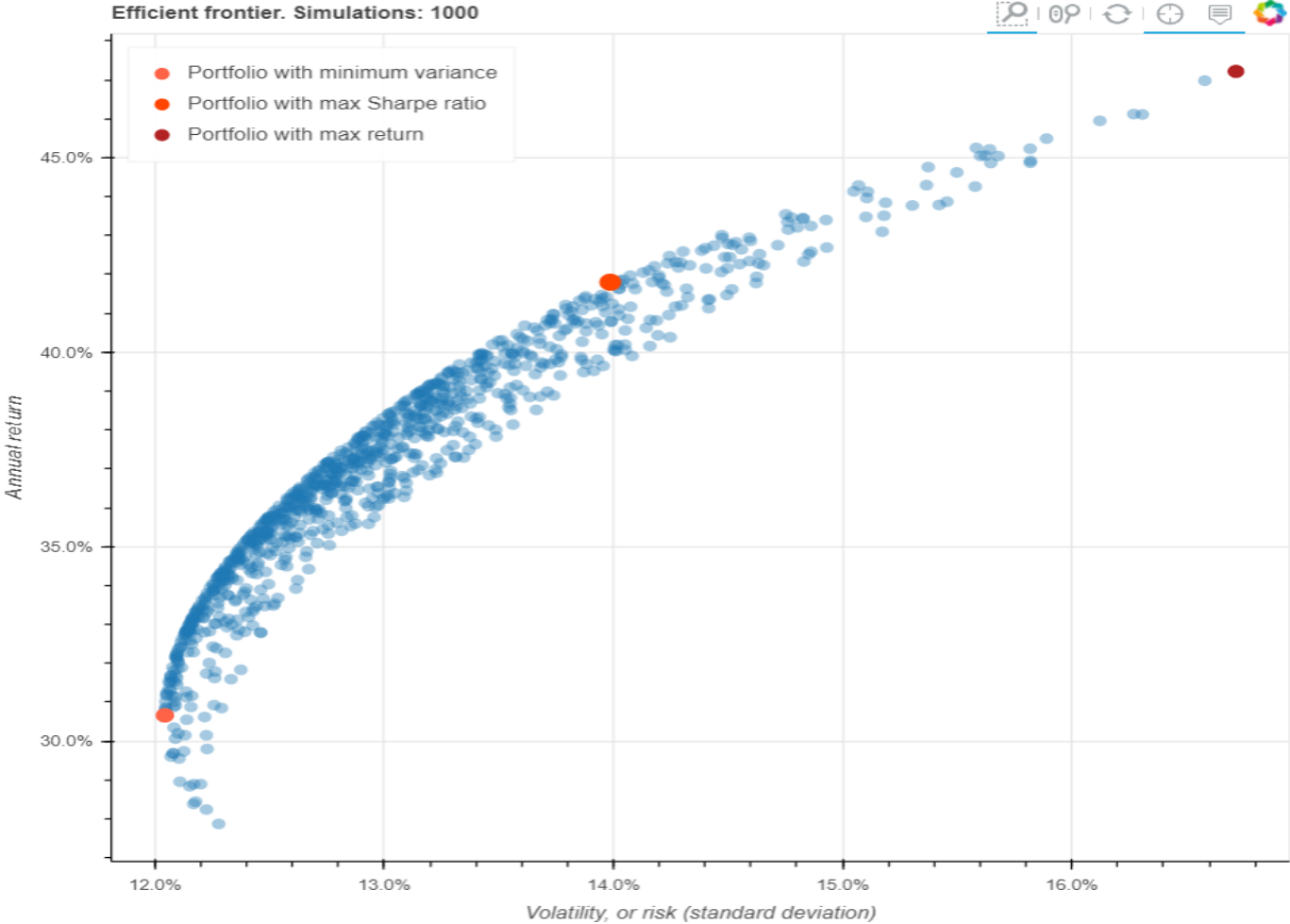


Rolling Sortino (6-Months)



BOLLINGER BAND PULLBACK STRATEGY DATA

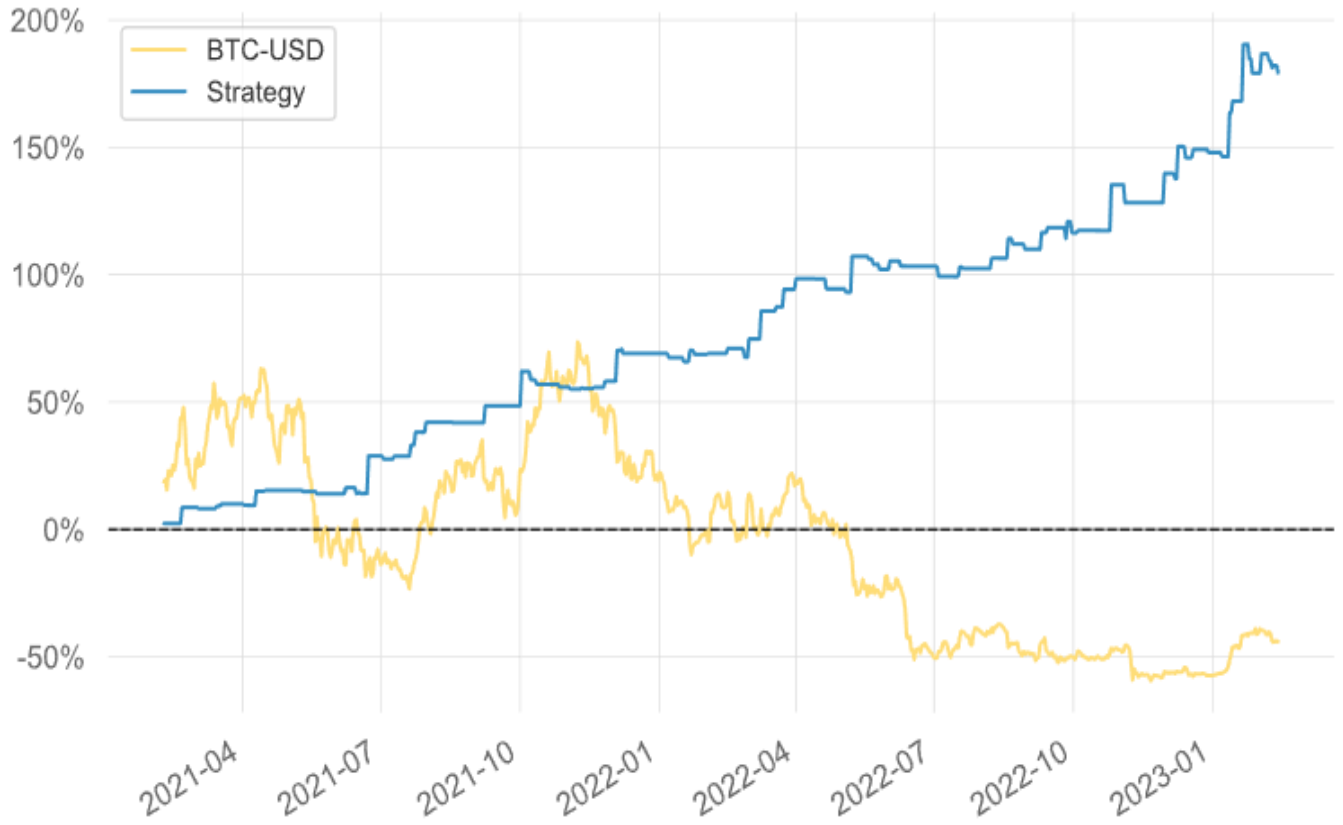
SUB STRATEGY PORTFOLIO CONSTRUCTION



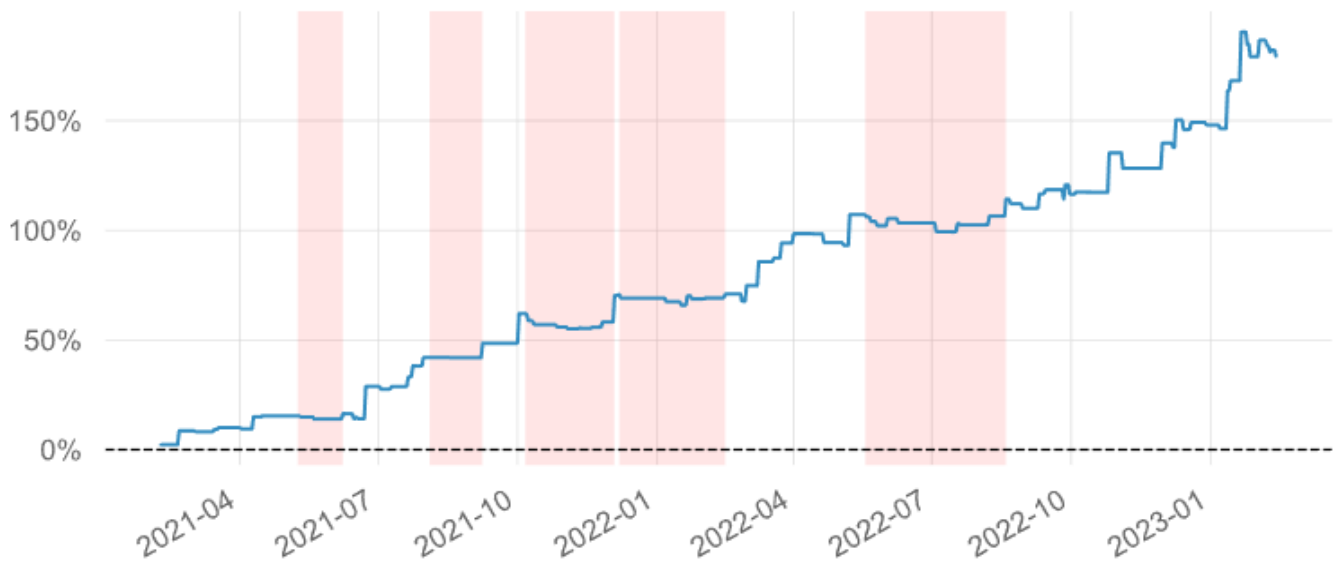
PRO FORMA

Please reference the [bb_pullback_tear_sheet.html](#) file for the comprehensive tear sheet

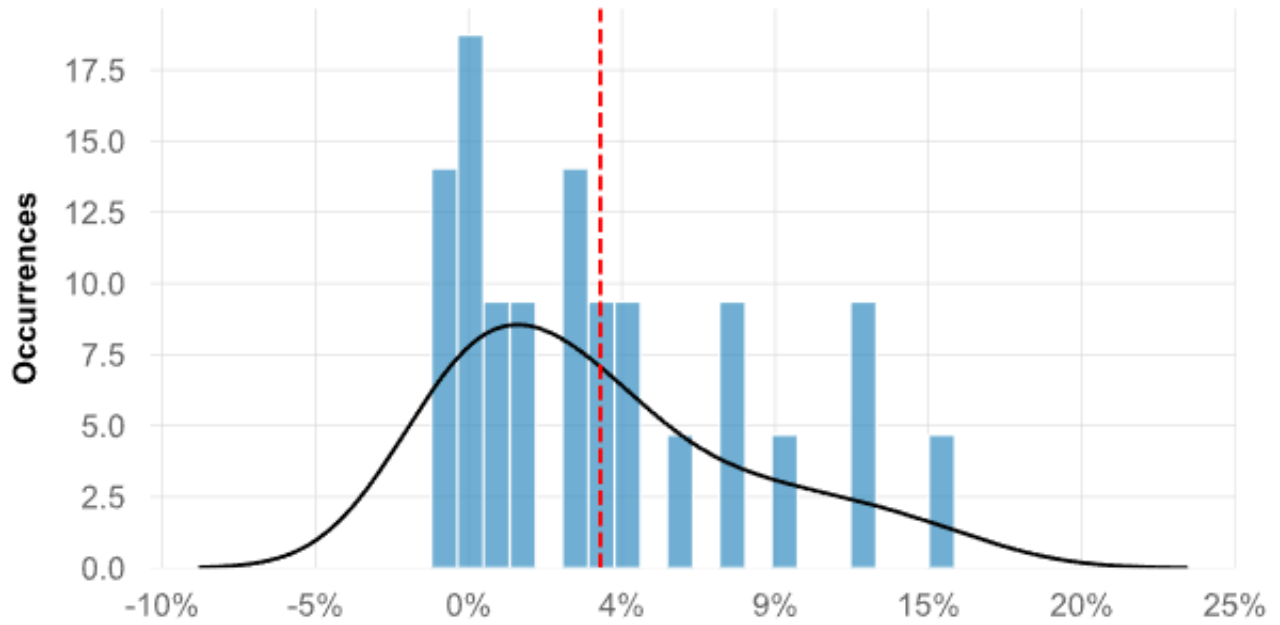
Cumulative Returns vs Benchmark



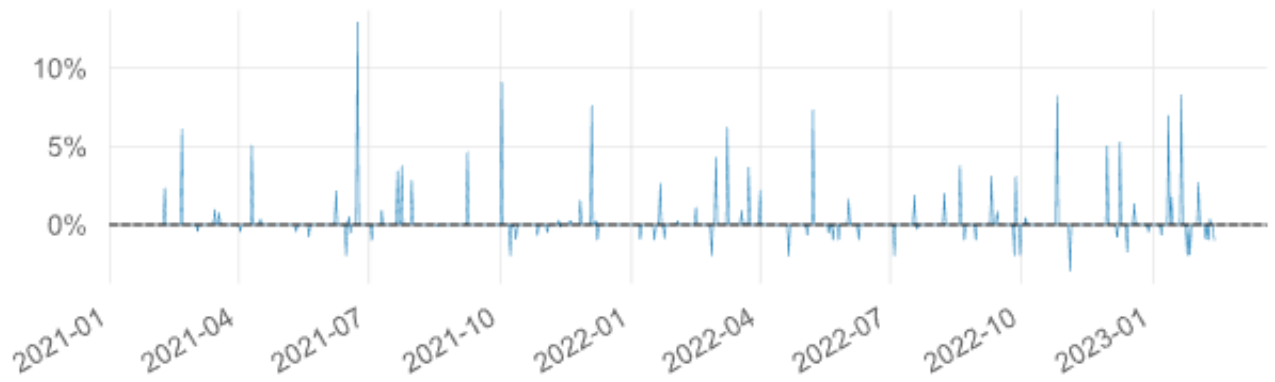
Strategy - Worst 5 Drawdown Periods



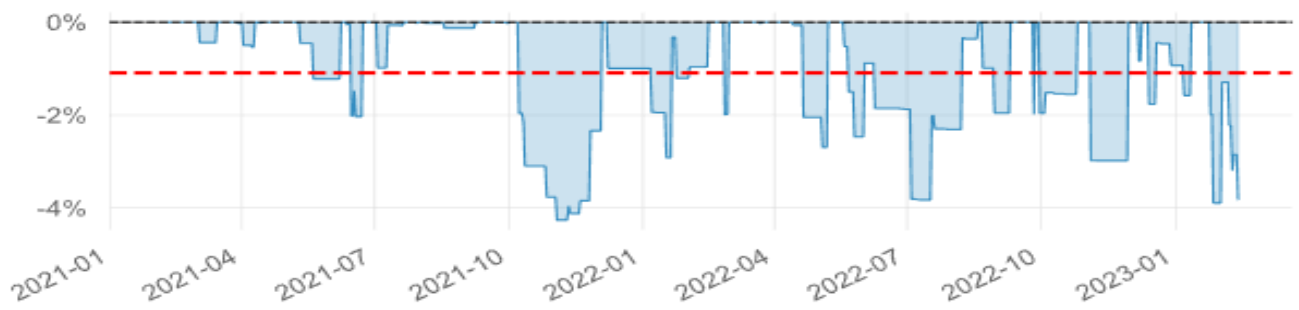
Distribution of Monthly Returns



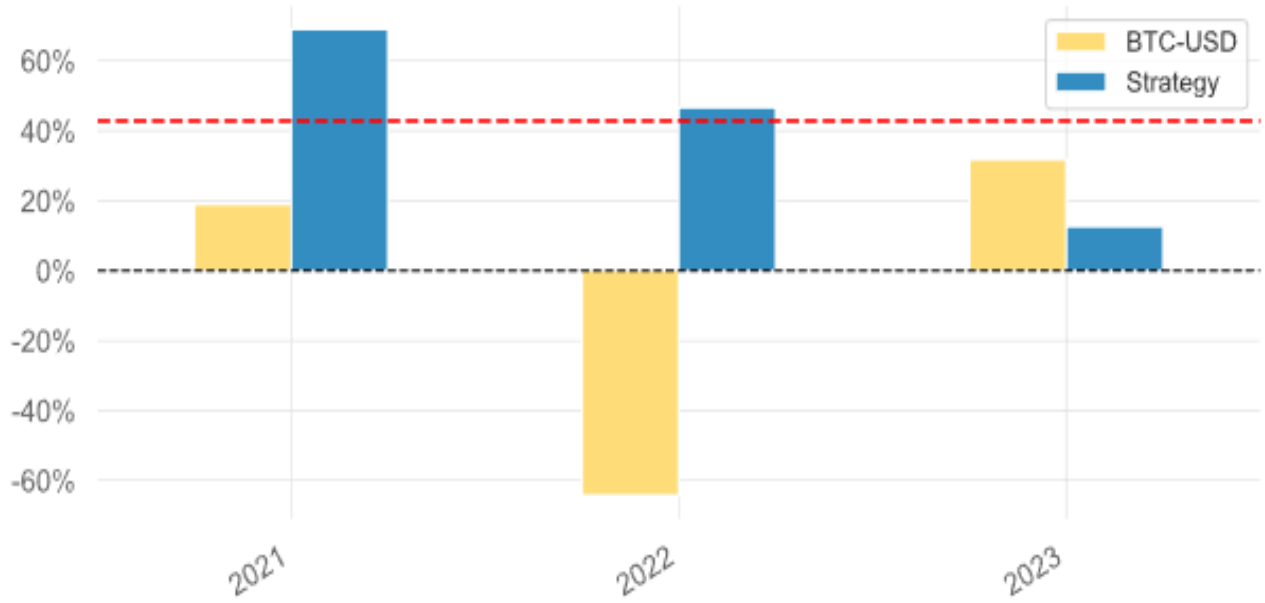
Daily Active Returns



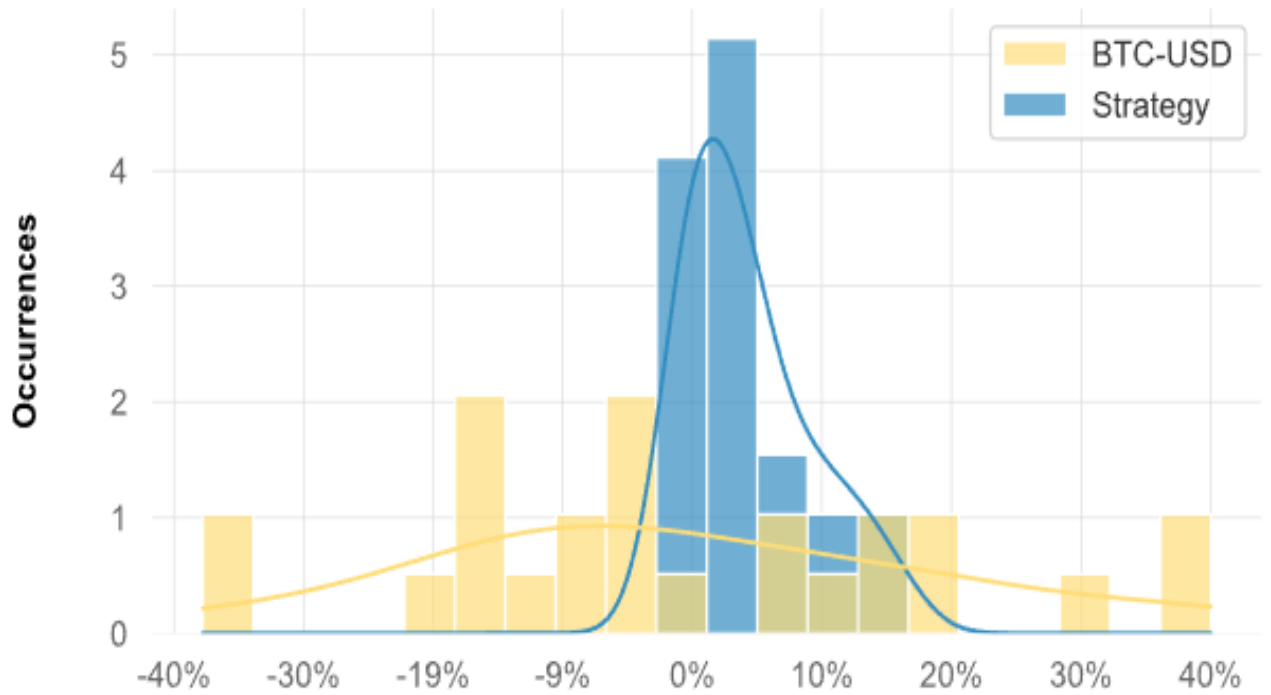
Underwater Plot



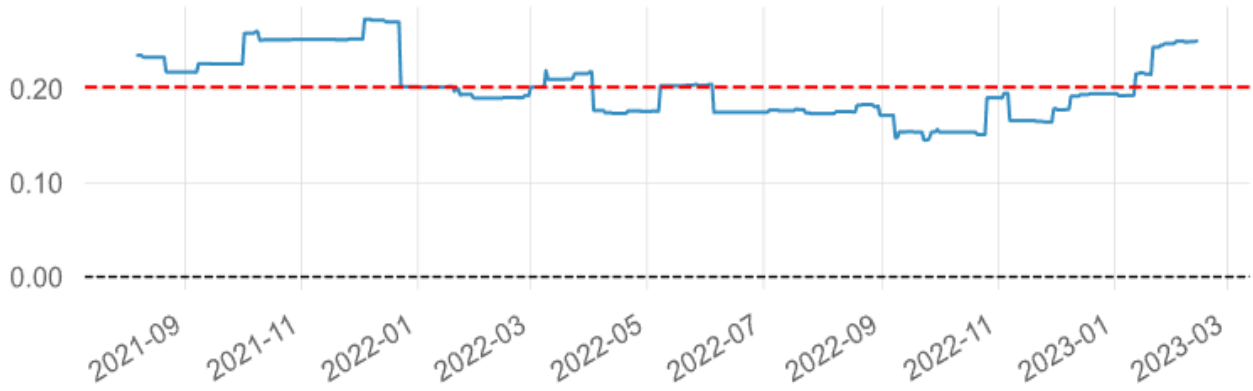
EOY Returns vs Benchmark



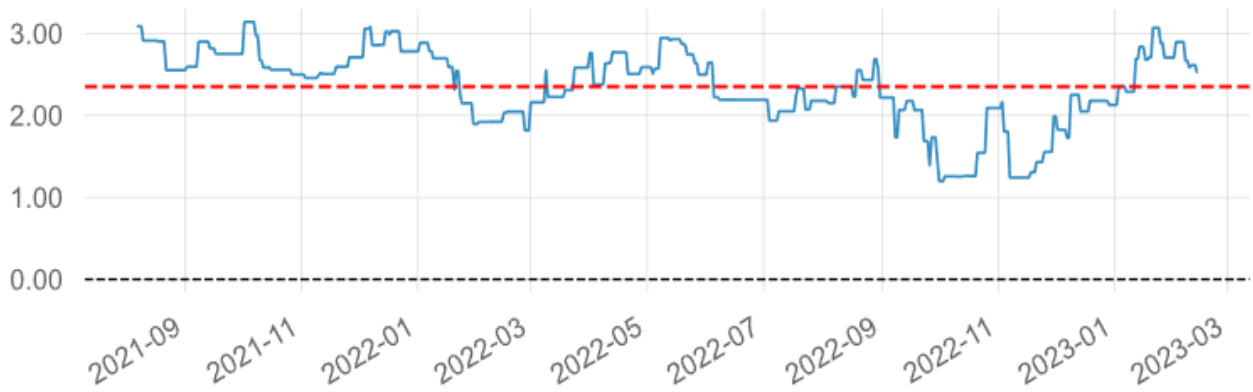
Distribution of Monthly Returns



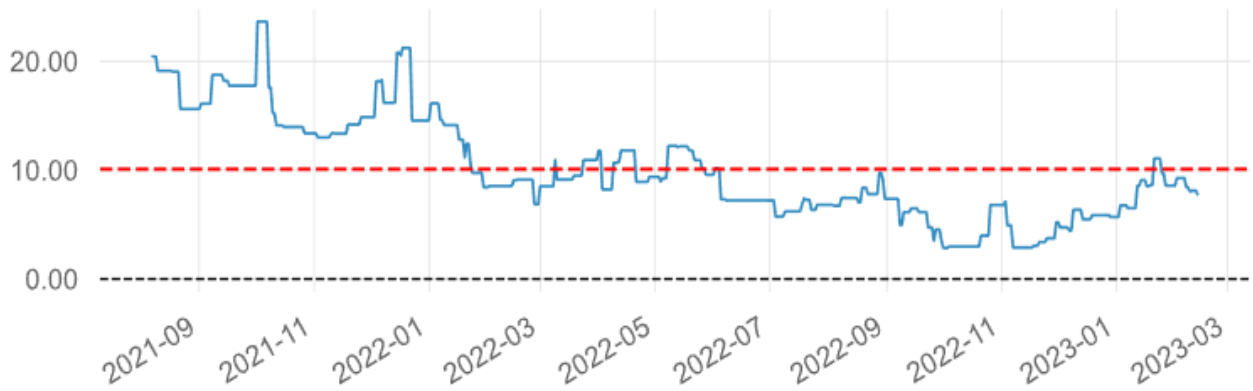
Rolling Volatility (6-Months)



Rolling Sharpe (6-Months)

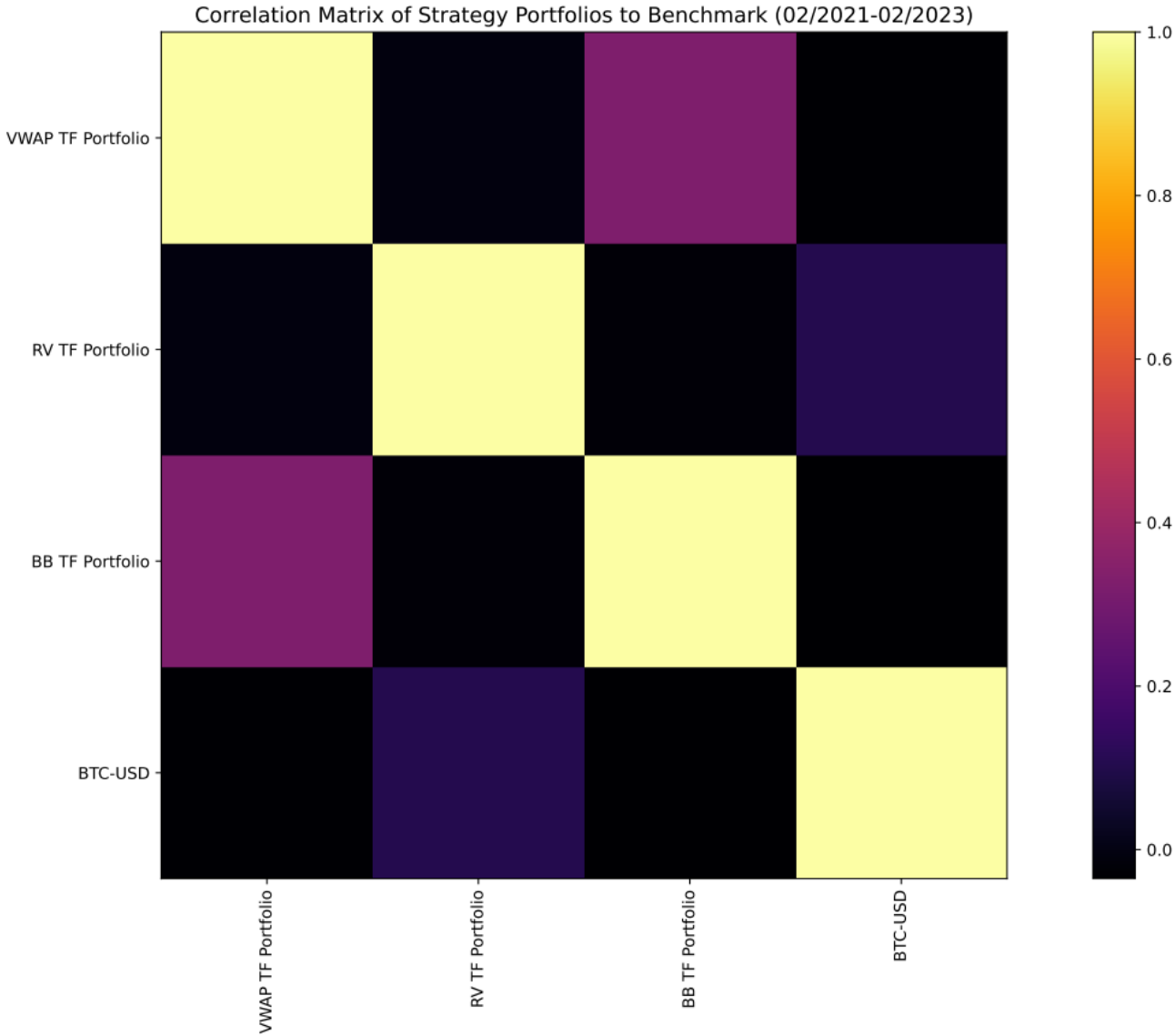


Rolling Sortino (6-Months)

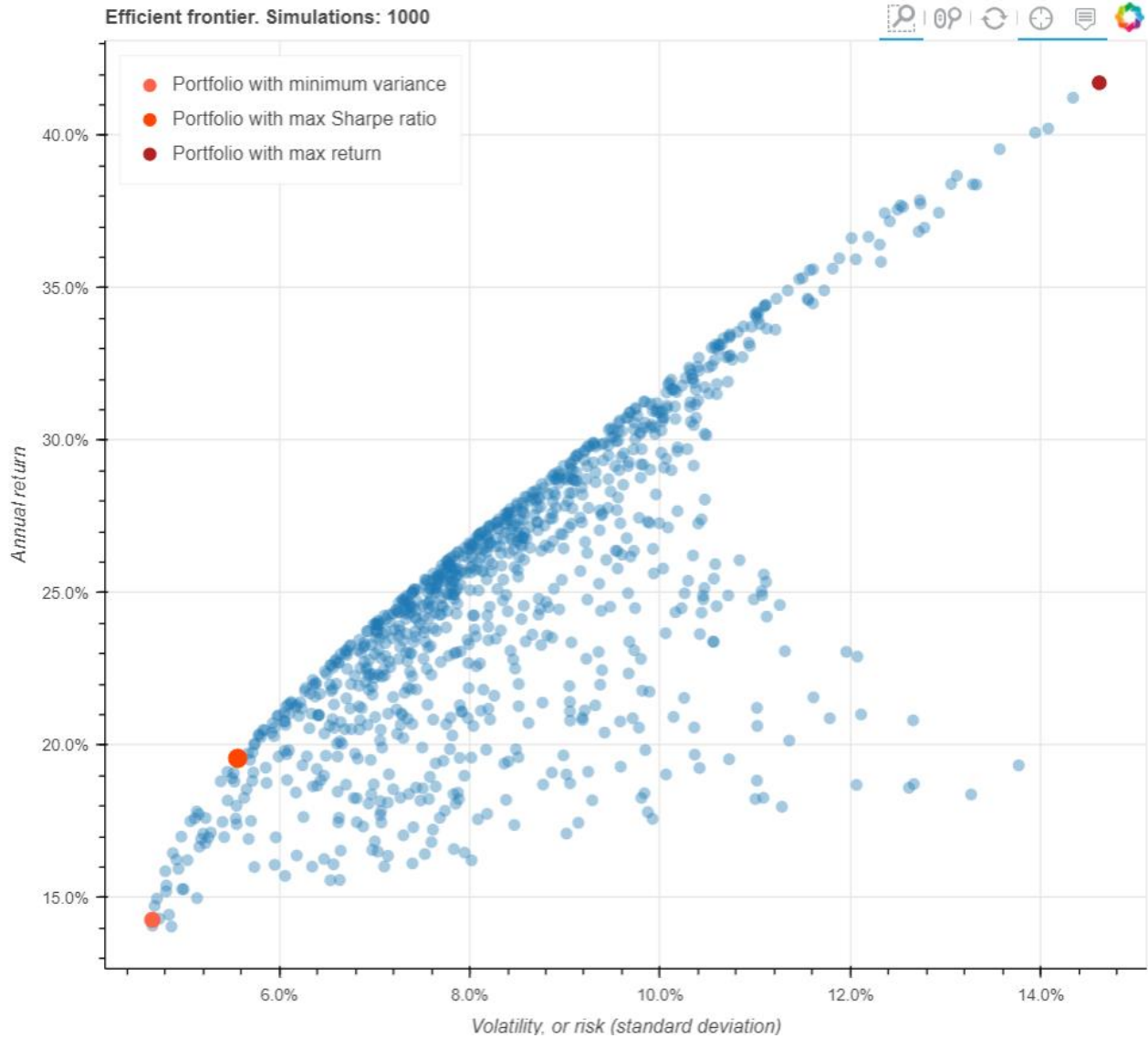


PORTFOLIO MVP DATA

STRATEGIES + BTC CORRELATION MATRIX



PORTFOLIO CONSTRUCTION



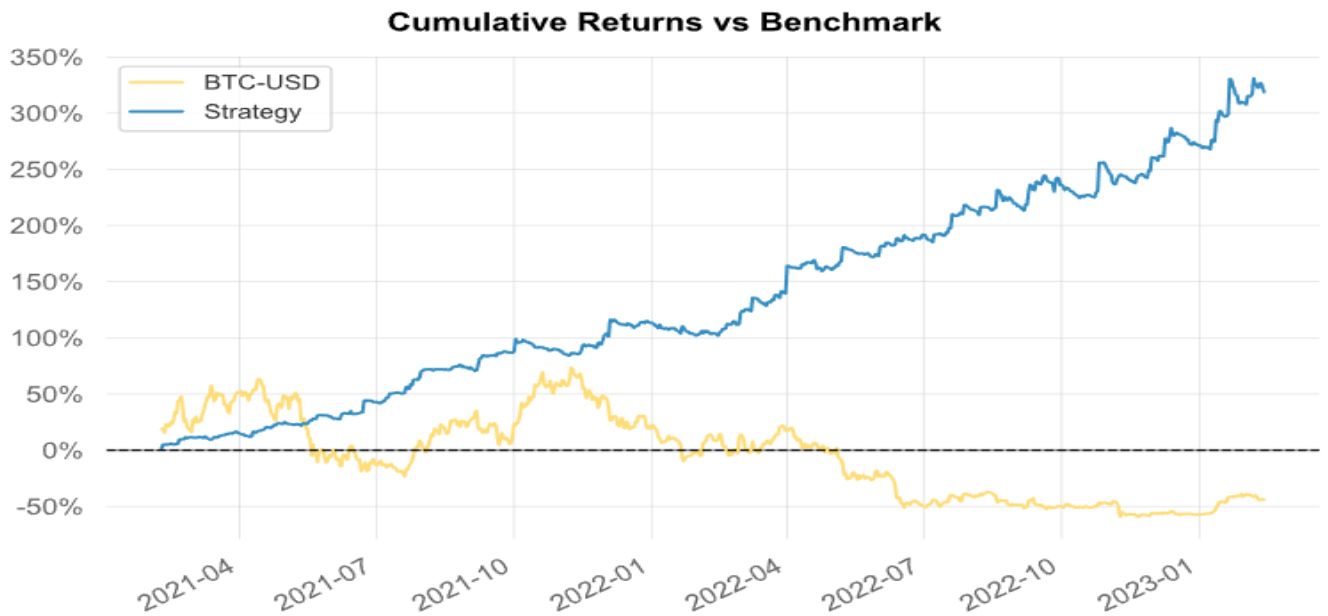
Note: The table below shows the weights for the “Max Sharpe” portfolio on the efficient frontier. Depending on client preferences, I would likely increase the weight of VWAP TF and reduce the weight of BB TF, which would result in higher return, higher volatility, slightly lower Sharpe (around 3.25 instead of 3.5), but more volume behind the higher trade frequency (more robust) strategy.

VWAP TF	RV TF	BB TF
20.4%	14.7%	64.9%

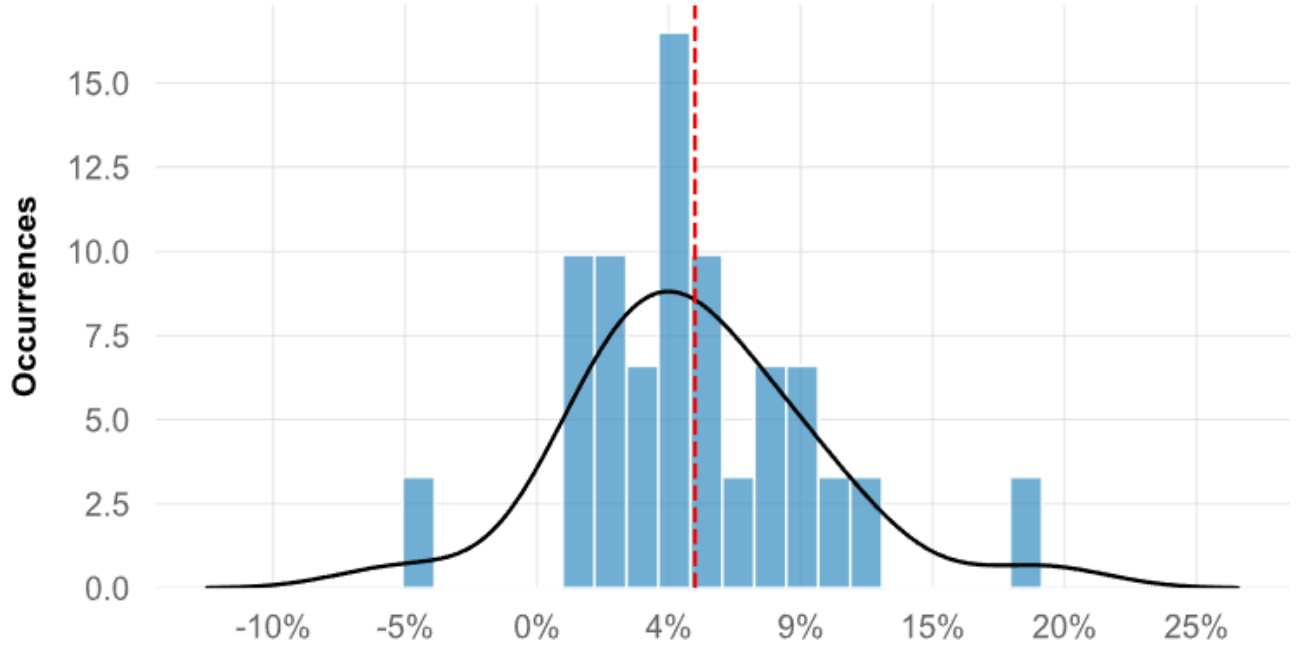
PRO FORMA

Please reference the [portfolio_mvp_tear_sheet.html](#) file for the comprehensive tear sheet

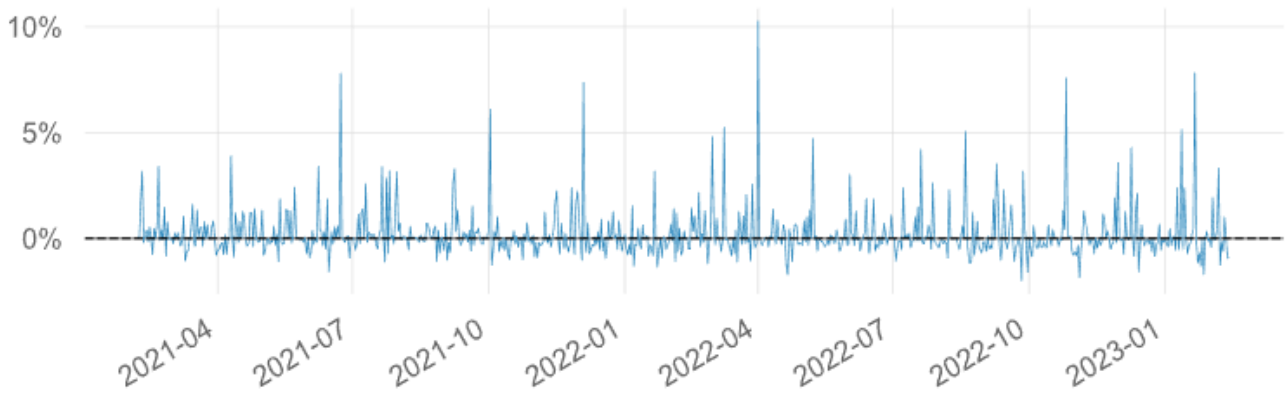
Note: The portfolio visuals below were generated with leverage of 1.3x as compared to the single strategy visuals above. This was done to keep max drawdown consistent around 7.5% (enabling apples to apples comparison of CAGR% numbers).



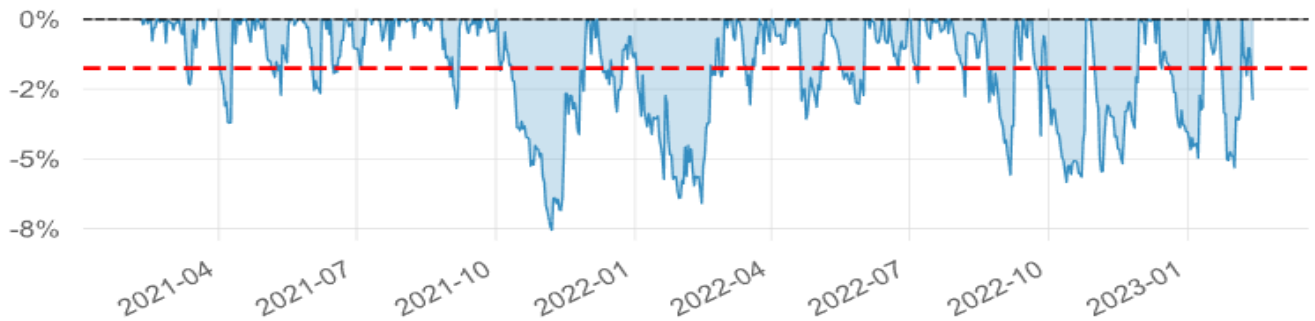
Distribution of Monthly Returns



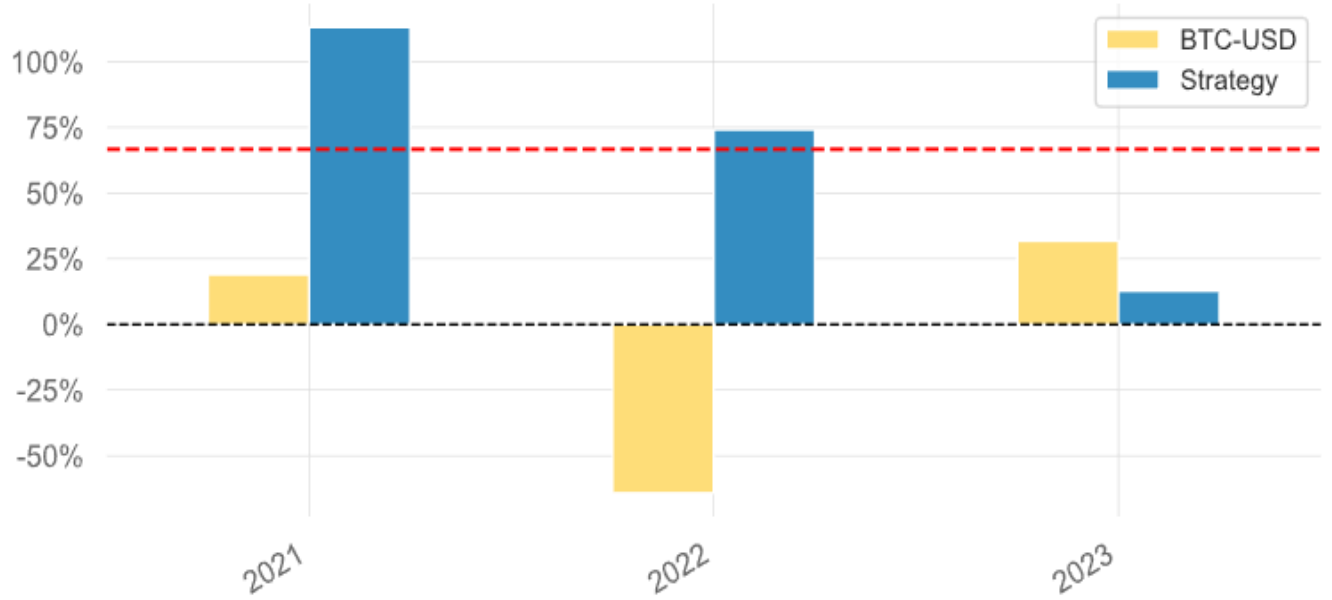
Daily Active Returns



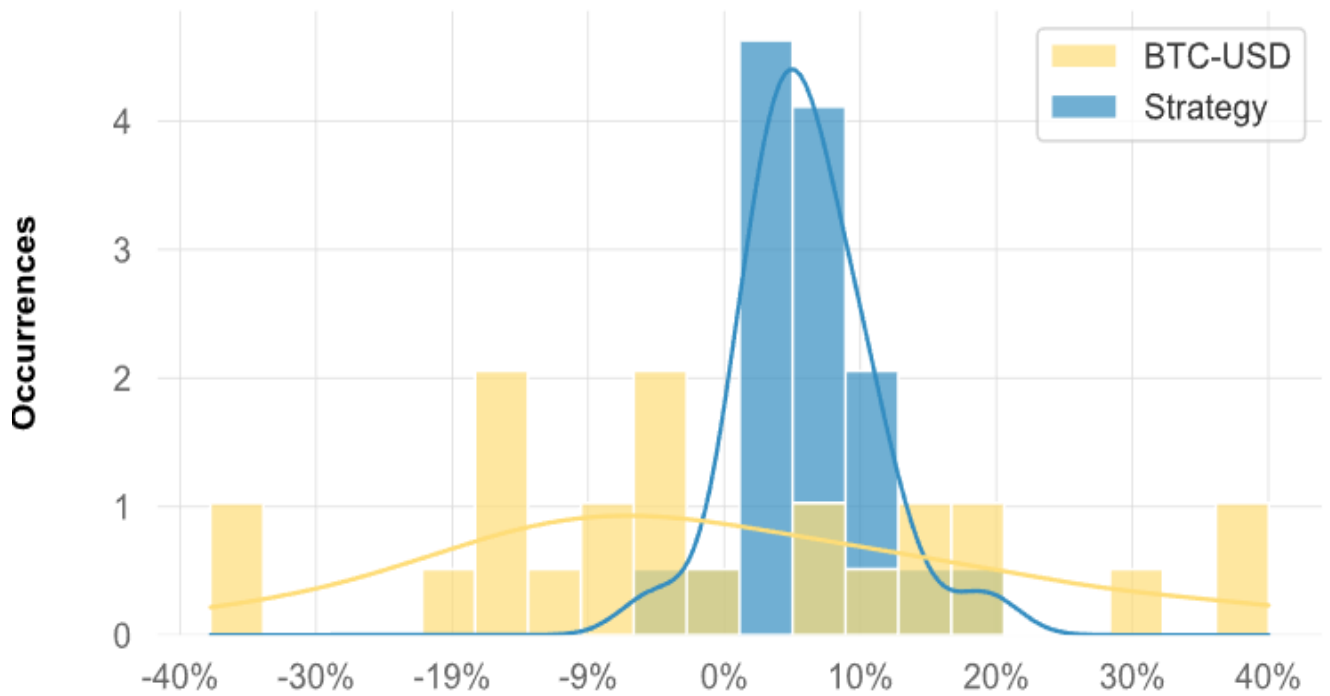
Underwater Plot



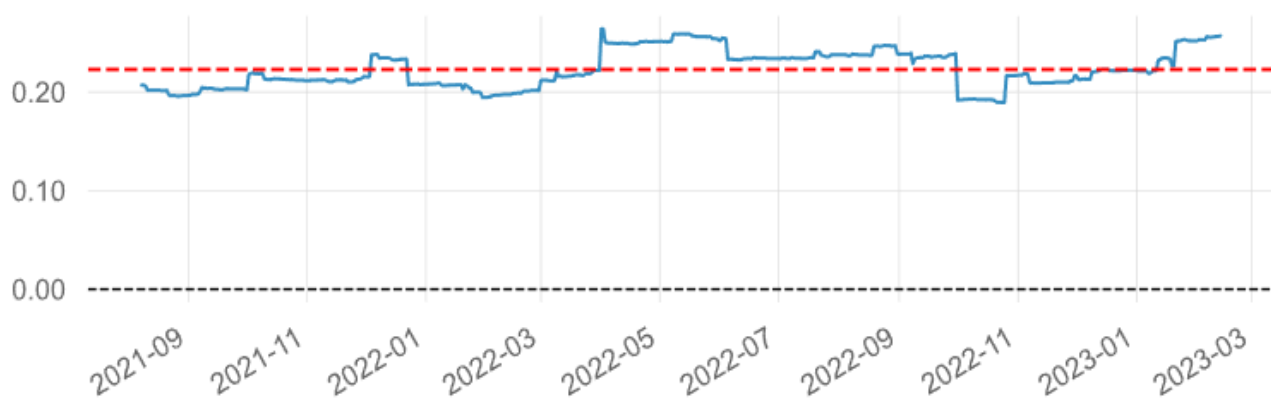
EOY Returns vs Benchmark



Distribution of Monthly Returns



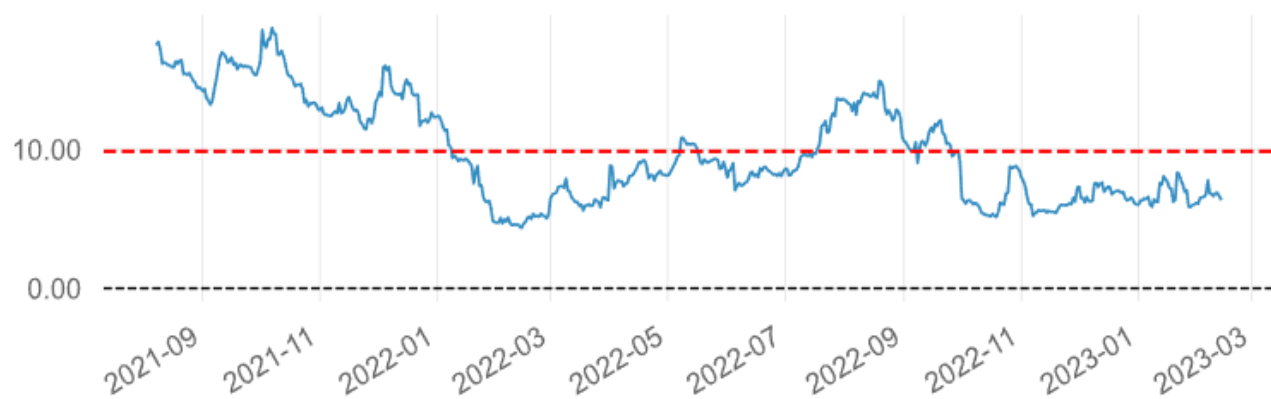
Rolling Volatility (6-Months)



Rolling Sharpe (6-Months)



Rolling Sortino (6-Months)



Strategy - Monthly Returns (%)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2021	0.00	11.41	3.71	6.94	5.15	9.90	19.15	1.97	7.81	1.43	6.35	5.71
2022	-5.09	4.86	12.86	9.20	4.66	6.57	8.38	1.04	5.22	4.49	2.67	2.99
2023	10.23	2.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ABOUT THE PROCESS:

RESEARCH

- **Everything** I do is about reducing overfitting and maximizing out of sample performance
- **My purpose** is to construct a portfolio of strategies that perfectly counterbalance each other
- **An “ideal market”** Most strategies have an “ideal market” where they will predictably kill...
- **Breaking even** ...but if they are good, they should be able to break even in almost ANY market
- Use 3 groups of alternating IS/OOS date ranges, holding out significant amount of data (2 years) for subsequent optimization + validation
 - IS1 08/2017-11/2018
 - OOS1 11/2018-06/2019
 - IS2 06/2019-06/2020
 - OOS2 06/2020-08/2020
 - IS3 08/2020-03/2021
 - OOS3 03/2021-07/2021
- Early promise I NEED to see
 - Sharpe above 1.5
 - High trade count
 - Trade count is a currency you can spend to improve other metrics
 - Mean basis point expectancy per trade (measured via underlying not simulated acct)
 - 0.3% expectancy per trade will survive live execution much better than 0.05%
 - Correlates strongly with higher capacity
- Why not require Sharpe above 2? Above 3? You will miss:
 - Strategies with very high pnl
 - Strategies with a right tail trade returns distribution (Sharpe penalizes upside vol)

- Short biased or short only strategies that are **crucial** during portfolio construction

OPTIMIZATION

Deflated Sharpe The more tests you run, the greater the gap between backtest Sharpe and live Sharpe

Recent data is the most “challenging” – that’s why it has been held out for optimization and validation

Stages I use three stages of optimization AND a final holdout set over which no optimization occurs

- Optimization 1: 02/2021-04/2021
- Optimization 2: (I am currently using 04/2021-04/2022 as it contains the most regime changes present in a 1 year period)
- Optimization 3: 02/2021-02/2023
- Validation set: 02/2023-07/2023

Advanced techniques I sometimes use:

- Genetic optimization
- Walk forward optimization
- Bayesian Search
- Strategy specific feature rule based or ML based sizing models

PORTFOLIO CONSTRUCTION

Useless strategies are those that are highly correlated to the current portfolio

Seek low meta model correlation by understanding what market conditions are responsible for max DD

Academic approach says a portfolio is a bunch of coins you optimize allocations between using MPT

- This is a very “easy” method that provides **minor** performance improvement **until** all coins crash due to an unexpected contagion event (shocker)
- The true benefits of diversification can only be unlocked with **market neutral** or even...

Performant short strategies and are worth 100x more than any variation of “buy the dip in bitcoin”

Sharpe capacity tradeoff can be mitigated by proper portfolio construction

Advanced techniques I sometimes use

- Synthetic hedging
- Kelly Criterion
- Postmodern portfolio theory

WHAT’S NEXT?

1. Tuning these models on ETH/USDT perpetual futures data.

2. Adding an 8 Sharpe arbitrage strategy to the portfolio (not part of MVP due to execution logistics, cost of development, data sourcing)
3. Adding a high capacity 5 Sharpe liquidation strategy to the portfolio
4. Custom execution algorithms to further reduce cost of trade for all strategies
5. Generally, plan to allocate majority of time to crypto specific feature sets or second order arbitrages. (My overall perspective is that indicator-based strategies have lower Sharpe ceilings, possibly lower lifespans, but may have higher capacity or applicability on larger universes within crypto. This makes them more efficient from a developer workflow perspective.)

DUE DILIGENCE Q&A

1. How many basis points of BTC/USDT does the average trade capture (including both wins and losses)
 - a. VTF: **25** basis points
 - b. RVTF: **57** basis points
 - c. BBPS: **73** basis points
2. Were commissions used in the pro forma results?
 - a. **Yes**, the following commission tiers were used taker=**0.0153%**, maker=**0.0%**, equivalent to Binance USD-M Futures VIP 9 tier values, assuming USDT Maker/Taker.
3. Was slippage modeled in the pro forma results?
 - a. **1 basis point** of slippage was included for taker orders. Note: taker orders are only used for stop loss exit order types, except for **VTF** where they are also used for entries.
4. What are your thoughts on total cost of trade and market impact?
 - a. There is no way to predict total cost of trade until the strategy is taken live. Thus, the portfolio MVP is designed such that all of the constituent strategies have average trade captures significantly higher than any realistic total cost of trade projection.
5. What data granularity was used to model fills?
 - a. TradeTick data from BTCUSDT perpetual USD-M Binance futures markets was used for fill modelling.
6. What data granularity was used to update features?
 - a. Most of the features are updated on bar close. This then results in pending order placement. The pending orders can then be triggered by TradeTicks.
7. Why were 5) and 6) selected?
 - a. That is the way the strategy will process data in the live environment. It is a good balance between computational complexity and backtest -> go-live transition.
8. What has been done to mitigate market impact?
 - a. First, strategies are split into sub-strategy portfolios, resulting in small average trade sizes. Sometimes, most of the sub-strategies will react to the same signal over a few minute period, other times they will react to different signals altogether.

- b. The sub-strategy portfolios then go into a meta portfolio. Thus, trade sizes are reduced by about 20x when compared to a single strategy.
 - c. I intend to use VWAP, TWAP, etc. execution algorithms or synthetic fills from market makers to further reduce cost of trade until I have time to build more custom ones.
 - i. This was not modeled in the pro forma to be conservative
 - d. Limit orders are sent as iceberg orders at randomized fractions of their total size to avoid detection.
 - e. Limit orders are not sent to the market until they are close to marketable
9. What is the mean hold duration of the strategies?
- a. It varies between 3 and 8 hours