Report for Cryptocurrency Trading Strategy

1. Executive Summary

Asset: Bitcoin

Exchange: Binance

Strategy: long buy bitcoin when exchange balance is at low level, vice versa.

Compute ***40-day*** simple moving average (*SMA*) and standard deviation (*std*) of Binance exchange balance of Bitcoin.

Set up middle band (*SMA*), lower band (*SMA* – ***1.2*** * *std*) and upper band (*SMA* + ***1.2*** * *std*).

a. LONG BUY Bitcoin when exchange balance in Binance crosses the lower band.

b. SHORT SELL Bitcoin when exchange balance in Binance crosses the upper band.

c. Exit the market when the exchange balance crosses the middle band.

d. Otherwise, no trade.

The above strategy can potentially generate $110233.68 revenue in 6.5 years with initial capital about $10000 (note that the price of bitcoin has grown from $10000 to $60000 during this period). Throughout 172 transactions (long 87:85 short), Sharpe ratio is 1.8935 while maximum drawdown is -109.12853214393448% of the accumulated return incurred.

2. Background

The exchange balance, which refers to the total amount of cryptocurrencies held on cryptocurrency exchanges, can provide insights into investors' activity and sentiment.

Increased inflows of cryptocurrencies to exchanges suggest that investors are potentially preparing to sell or trade their holdings.

Increased outflows from exchanges may indicate that investors are withdrawing their cryptocurrencies for long-term holding or for use in other applications.

Graph 1: Binance BTC Exchange Balance v.s. BTC Price since 2018:

The exchange balance is a valuable metric that can be leveraged to inform profitable trading strategies. The key consideration is the methodology.

In this report, Bollinger band (Z score) will be demonstrated.

3. Back Test

3.1 Data Preparation

Data is fetched from Glassnode API.

Period: 01/01/2018 – 14/06/2024 (338010 data points)

Frequency: 10 minutes

Sample size: 338010 * 2/3 = 225340

Test size: 338010 * 1/3 = 112670

Table 1: Preprocessed data (part)

timestamp	price	binance
05/06/2024 06:10	70877.40817	651443.2717
05/06/2024 06:20	70960.21767	651329.5797
05/06/2024 06:30	70960.41383	651618.998
05/06/2024 06:40	71099.05907	651618.998
05/06/2024 06:50	71077.16779	651734.5873

3.2 Strategy

Bollinger Bands consist of three lines: a simple moving average (the middle band) and *n* standard deviation bands above and below the moving average (the upper and lower bands). Bollinger Bands adjust their width based on market volatility, with wider bands indicating higher volatility and narrower bands indicating lower volatility.

Strategy:

a. LONG BUY cryptocurrency when exchange balance in Binance crosses the lower band.
b. SHORT SELL cryptocurrency when exchange balance in Binance crosses the upper band.
c. Exit the market when the exchange balance crosses the middle band.
d. Otherwise, no trade.

Parameters:

a. *n*, the number of standard deviations above and below the moving average for the construction of the upper and lower bands.
b. *d*, the number of days involved in computing moving average and moving standard deviation

Variations:

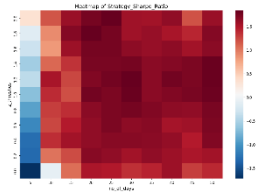
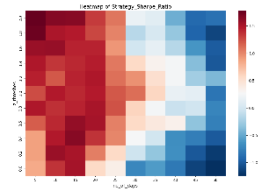
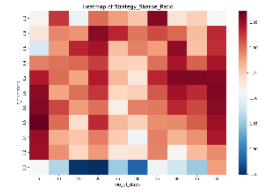
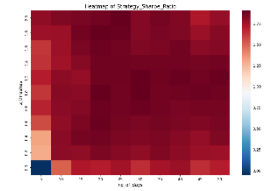
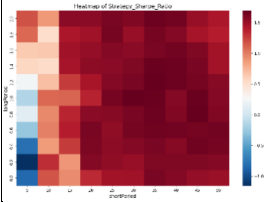
a. Exit conditions (crosses the middle band or outer bands?)
b. Simple moving average v.s. Exponential moving average
c. Split bet
d. Multiple coins trading

3.3 Simulation

This part is for parameter tuning and strategy adjustments. The main visualization tool is heatmap. The vertical axis is the z-score threshold. The horizontal axis is the number of days for computing moving average and standard deviation.

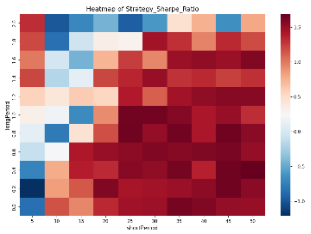
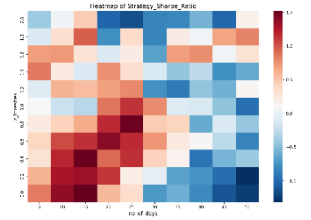
3.3.1 Exit when exchange balance crosses middle band

Heatmap for Sharpe Ratio with respect to n and d.

NO DELAY, Exit when exchange balance crosses middle band	
Test_set 1 z-score threshold: 1.2 number of days for computing moving average and std: 30 sharpe_ratio: 1.83989650296294 accumulated return: 17926.231670927664 number of transaction: 80 long-short ratio: 39:41 max_drawdown: -51.478545666531794%	
Test_set 2 z-score threshold: 1.8 number of days for computing moving average and std: 5 sharpe_ratio: 1.7517021545782194 accumulated return: 48241.426405537204 number of transaction: 382 long-short ratio: 192:190 max_drawdown: -53.68989345142513%	
Test_set 3 z-score threshold: 0.6 number of days for computing moving average and std: 5 sharpe_ratio: 1.8727553641196604 accumulated return: 57524.92900688368 number of transaction: 416 long-short ratio: 206:210 max_drawdown: -36.57448297174779%	
Whole set **z-score threshold: 1.0** **number of days for computing moving average and std: 20** **sharpe_ratio: 1.9065811895774252** **accumulated return: 111599.44654441833** **number of transaction: 382** **long-short ratio: 192:190** **max_drawdown: -75.2117197502773%**	
DELAY (20-minute), Exit when exchange balance crosses middle band	
Test_set 1 z-score threshold: 1.0 number of days for computing moving average and std: 30 sharpe_ratio: 1.6971475822685398 accumulated return: 53662.0135945 number of transaction: 25 long-short ratio: 12:13 max_drawdown: -50.18544972423782%	

Time delay does not cause significant impact on strategy performance.

3.3.2 Exit when crosses outer band

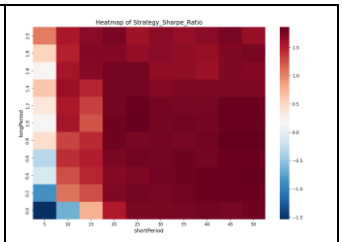
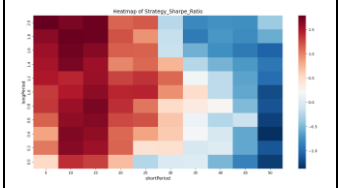
Test_set 1 z-score threshold: 0.4 number of days for computing moving average and std: 50 sharpe_ratio: 1.6917065384799292 accumulated return: 53198.69527120998 number of transaction: 69 long-short ratio: 34:35 max_drawdown: -53.58275175288318%	
Test_set 2 z-score threshold: 0 number of days for computing moving average and std: 15 sharpe_ratio: 1.5222478897399792 accumulated return: 31463.61070424312 number of transaction: 590 long-short ratio: 295:295 max_drawdown: -75.2468883577433%	

By comparing the test set 0 results between two exit conditions, **exit when exchange balance crosses middle band** give a better and more reliable performance based on the graph pattern.

Basic enter and exit conditions are confirmed:

3.3.3 SMA v.s. EMA

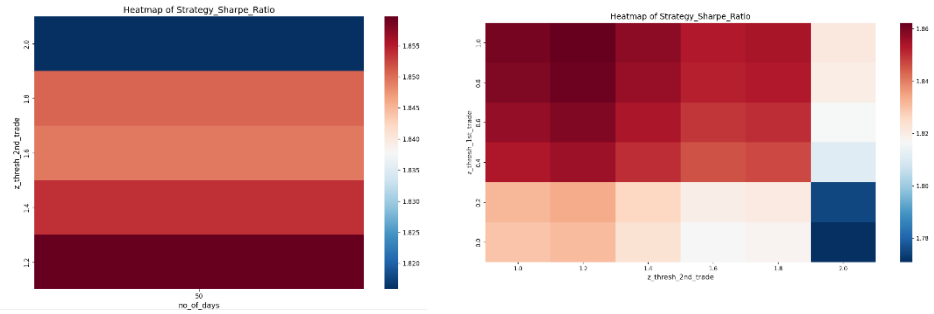
The back tests above use SMA. Now, use EMA instead.

Test Set 1 z-score threshold: 1.0 number of days for computing moving average and std: 25 sharpe_ratio: 1.8603647277663744 accumulated return: 21167.88971091537 number of transaction: 100 long-short ratio: 49:51 max_drawdown: -52.82792267204155%	
Test Set 2 z-score threshold: 2.0 number of days for computing moving average and std: 5 sharpe_ratio: 1.7936827158857624 accumulated return: 52935.18145892034 number of transaction: 340 long-short ratio: 172:168 max_drawdown: -41.90856576975425%	

The results are similar. Switching from SMA to EMA does not significantly improve the performance of the strategy.

3.3.4 Split bet

Use the result in 3.3.1 test set 3 (no delay). z-score threshold = 1.2, number of days = 50 Test z-score threshold for second trade: [1.2, 1.4, 1.6, 1.8, 2.0]



Splitting bet does not show significant improvement on strategy performance.

Parameters confirmed: Exchange balance z-score threshold: 1.2 Number of days for computing moving average and standard deviation: 40

3.3.5 Testing the strategy on other coins

Ethereum

Data since 06/07/2023.

z-score threshold: 1.2
number of days for computing moving average and std: 40
sharpe_ratio: 1.8076166708631356
accumulated return: 2980.036422571801
number of transaction: 23
long-short ratio: 11:12
max_drawdown: -36.68190530776789%
****
Data from 04/08/2022 to 05/07/2023.
z-score threshold: 1.2
number of days for computing moving average and std: 40
sharpe_ratio: 1.3696092400173554
accumulated return: 553.8936758722003
number of transaction: 15
long-short ratio: 8:7
max_drawdown: -41.1271731579846%
****
Data from 03/09/2021 to 03/08/2022
z-score threshold: 1.2
number of days for computing moving average and std: 40
sharpe_ratio: -1.5682827616792456
accumulated return: -1770.257236751196
number of transaction: 21
long-short ratio: 10:11
max_drawdown: -111.42685209287673%
****
Data from 02/10/2021 to 02/09/2021
z-score threshold: 1.2
number of days for computing moving average and std: 40
sharpe_ratio: -1.5653402574404953

accumulated return: -1939.0357067676955
number of transaction: 16
long-short ratio: 8:8
max_drawdown: -184.91642458250078%

The strategy has worked for ETH only during the past two years. It is hard to conclude whether the strategy works also for other coins.

4. Conclusion

Asset: Bitcoin

Exchange: Binance

Strategy:

Compute ***40-day*** simple moving average (*SMA*) and standard deviation (*std*) of Binance exchange balance of Bitcoin.

Set up middle band (*SMA*), lower band (*SMA* – ***1.2*** * *std*) and upper band (*SMA* + ***1.2*** * *std*).

e. LONG BUY Bitcoin when exchange balance in Binance crosses the lower band.

f. SHORT SELL Bitcoin when exchange balance in Binance crosses the upper band.

g. Exit the market when the exchange balance crosses the middle band.

h. Otherwise, no trade.

Strategy back test result for the whole dataset:

sharpe_ratio: 1.8935

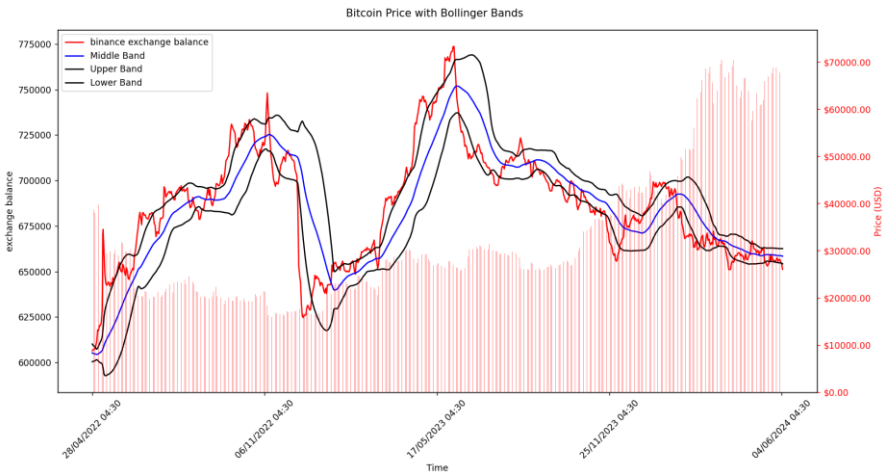
accumulated return: 110233.68

number of transactions: 172

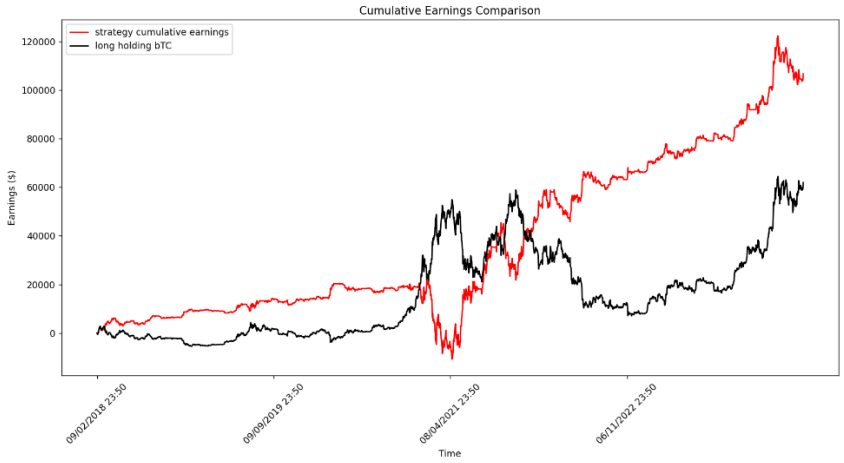
long-short ratio: 87:85

maximum drawdown: -109.12853214393448% (accumulated return approach)

Bollinger Band Demonstration



Cumulative Earnings



5. Workplace

https://github.com/cheungkimhang/cryptocurrency-machine-learning.git