Momentum Trading on Cryptocurrencies

MF796 Project

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Introduction

Objective

We can learn from Markowitz portfolio theory that constructing portfolios is necessary for investment no matter whether either hedging the risk or getting high returns.

In this project, we trade cryptocurrencies portfolios by momentum strategies in order to maximize portfolio returns as far as we can. More specifically, we first collect some price datasets from the reliable website, then construct portfolios of equally weighted cryptos selected. Next step we implement technical indicators and construct momentum strategies. Following the process above, we testify if the momentum strategies are efficient enough or not then get the results. Finally, we can make a conclusion.

Why we choose Cryptocurrencies

There are many emerging technologies from both crypto itself and its transactions. Cryptocurrency, generally, is a sort of virtual currency, which means we are able to trade directly via Internet networks.

Nowadays, cryptos have become popular assets for investors, especially for the young. Bitcoin, the first founded crypto, was born in 2009. Then it became extremely popular in 2013 since the price is dramatically rising from a very low price to above one thousand dollars. This dramatic increase attracted tons of investors to intend to make profits in the market. In other words, investors are looking for future business opportunities in the virtual currency market.

Why we choose Momentum Trading

Momentum strategy is one of the most successful and popular investing strategies in the world. People even now follow the core idea of this strategy to earn some money in the financial market. So it will be an excellent trading method to get our final goal - make a relatively high return from the asset we built. The core idea of momentum trading is to take advantage of an asset’s increasing tendency and earn the future returns, which means we need to find some good asset’s factors on rising the price. So it is important for us to choose or make reliable indicators of an asset in order to make a profit as much as possible.

Data Handling

Data Choosing

The frequency of our data, time range and data resources are important in order to analyze our strategy. So we apply hourly data between February 2019 and March 2022 from Bitfinex. The cryptos we choose are as follows.

Rank	Name	ymbol	Market Cap	Price	Circulating Supply	
1	Bitcoin	TC	$67,098,634,180.61	$3,843.52	17,457,600 BTC	$
2	XRP	RP	$14,880,496,657.82	$0.3648	40,794,121,066 XRP *	
3	Ethereum	TH	$14,665,318,369.58	$140.82	104,142,732 ETH	$
4	Bitcoin Cash	CH	$2,892,087,607.88	$164.85	17,543,263 BCH	
5	EOS	OS	$2,413,813,876.21	$2.66	906,245,118 EOS *	
6	Stellar	LM	$2,221,377,985.38	$0.1159	19,161,366,563 XLM *	
7	Litecoin	TC	$1,913,387,273.89	$31.98	59,830,877 LTC	
8	Tether	SDT	$1,892,772,546.78	$1.02	1,858,694,256 USDT *	$
9	Bitcoin SV	SV	$1,616,381,094.86	$92.14	17,542,223 BSV	
10	TRON	RX	$1,303,479,300.08	$0.01956	66,635,727,527 TRX	
11	Cardano	DA	$1,103,113,660.39	$0.04255	25,927,070,538 AI	

Rank	Name	Svmbol		Market Cap	
12	IOTA	IOTA	$1,026,158,620.95	$0.3692	2,779,530,283 MIOTA *
13	Monero	MR	$807,214,006.71	$48.37	16,689,183 XMR
14	Binance Coin	NB	$794,641,453.82	$6.08	130,799,308 BNB *
15	Dash	ASH	$692,537,856.94	$81.05	8,544,455 DASH
16	NEM	EM	$595,065,819.42	$0.06612	8,999,999,999 XEM *
17	Ethereum Cla...	TC	$560,395,113.51	$5.23	107,206,270 ETC
18	Neo	EO	$511,301,110.82	$7.87	65,000,000 NEO *
19	Maker	KR	$336,000,438.21	$461.39	728,228 MKR *
20	Zcash	EC	$333,412,877.94	$59.75	5,580,344 ZEC

Data Structure

We download all 20 large-cap cryptos datasets in which we can select their close prices accordingly to take part in our strategy.

It is normal that there is some missing data in the datasets, we choose to use the last valid value forward to fill the missing data. After that, we will check whether there is still missing data in our dataset or not.

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New shape: (22033, 9)
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volume2    0
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volume2    0
dtype: int64
```

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Original shape: (22033, 9)
New shape: (22033, 9)
Null values:date       0
unix       0
symbol     0
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high       0
low        0
close      0
volume1    0
volume2    0
dtype: int64
```

Momentum Strategies

For introducing our momentum strategies, we mainly sliced into three parts: introducing two indicators we used to construct our trading signals, explaining our specific trading algorithm and checking the existence of momentum.

Two Indicators

EWMA

EWMA, Exponentially Weighted Moving Average, is a method of calculating the cryptos' moving averages by especially weighting prices in target time range. This technical indicator is widely used in the financial markets, which does not just contain the features of investing momentum but is easy to understand and implement.

We move forward to calculating EWMA, we assume t unit hours as our target window and have factor for weighting (α) as follows,

$$\alpha = \frac{2}{1+t}$$

Finally, get the EMWA as follows.

$$EWMA(Price,\ t_0) = Price(t_0)$$

$$EWMA(Price,\ t) = (1 - \alpha)EWMA(Price,\ t - 1) - \alpha Price(t)$$

RSI

RSI, Relative Strength Index, is a threshold that measures a sense that the asset was overbought or oversold. i.e. When the asset's RSI is less than 30, it usually will be considered to be bought as the asset was considered to be oversold. When above 70, usually to be sold.

We move forward to calculating RSI. First, we assume t unit hours as our window and calculate both real upwards change (U) and real downwards change (D) of every crypto's prices during t hours as formula below.

$$U = max((Price\ Change)_t\ ,\ 0)$$

$$D = \left|min((Price\ Change)_t\ ,\ 0)\right|$$

Second, we calculate Relative Strength (RS) by following the formula.

$$RS = 100 - \frac{EWMA(U,t)}{EWMA(D,t)}$$

Finally, we can get the RSI as follows.

$$RSI = 100 - \frac{100}{1+RS}$$

Specific Algorithm

Every trading time, we select some cryptos to make mock **long-only** trades under some conditions we assume. In terms of signals for RSI, we follow the normal definition of overtrading. In terms of signals for EWMA, we compare the two to decide if the asset should be traded. We can also break trading conditions into two parts - what kinds of situations for buying and for selling.

Buying Algorithm

If selected cryptos are going to be longed, they must be under **both** two conditions:

- Every crypto's RSI is less than 30.
- Every crypto's 50-Unit of time EWMA is more than the 200-Unit of time EWMA of that.

Selling Algorithm

If selected cryptos are going to be shorted, they must be under **both** two conditions:

- Every crypto's RSI is more than 70.
- Every crypto's 50-Unit of timeEWMA is less than the 200-Unit of time EWMA of that.

Risk Control: The Triple Barrier Method

We keep monitoring our positions. And We set the upper bound, lower bound, and the holding time bound based on our entry price. Based on three Conditions, the method gives us a good control of risk and we can adjust our risk tolerance by changing the parameters.

Three Conditions:

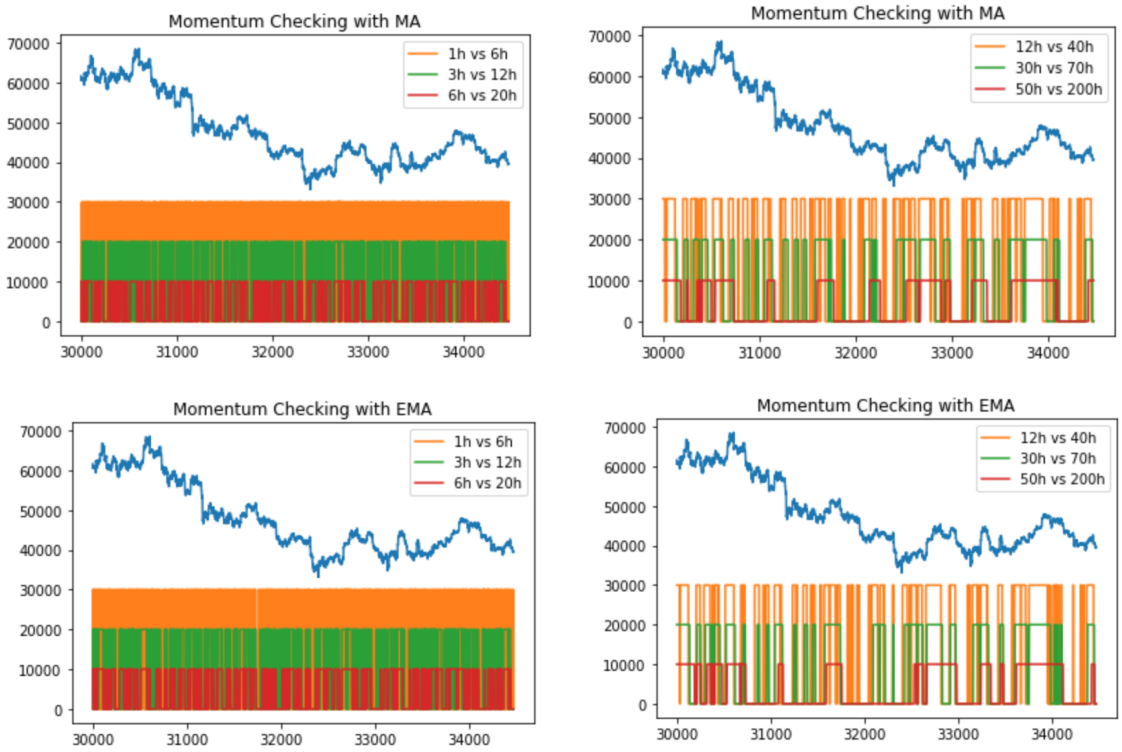
- The upper barrier is hit first. Label = "buy" or "1".
- The lower barrier is hit first. Label = "sell" or "-1".
- The vertical barrier is hit first. Max holding period reach

Existence of Momentum

We need to find out if our momentum exists. The intuition of proving the existence is crypotos have frequent and drastic rises and falls over time. We are going to check two indicators: Moving average and EWMA. So the indicator we construct to check is as follows.

$$Indicator1 = MA(t_i) - MA(t_j)$$
$$Indicator2 = EWMA(t_i) - EWMA(t_j)$$

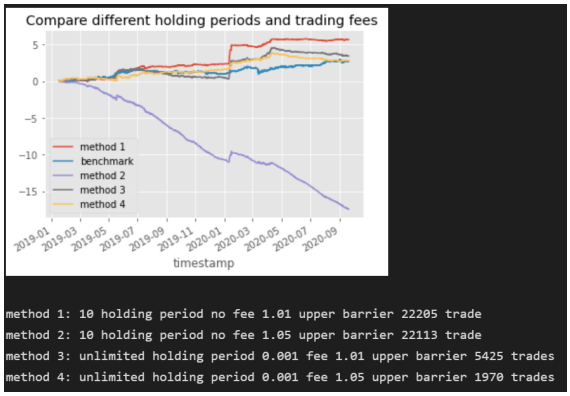
We then take some samples to explore if cryptos have the feature of checking indicators more than 0, which means to see if the momentum indicators work well. We can find the outcoming plots below.

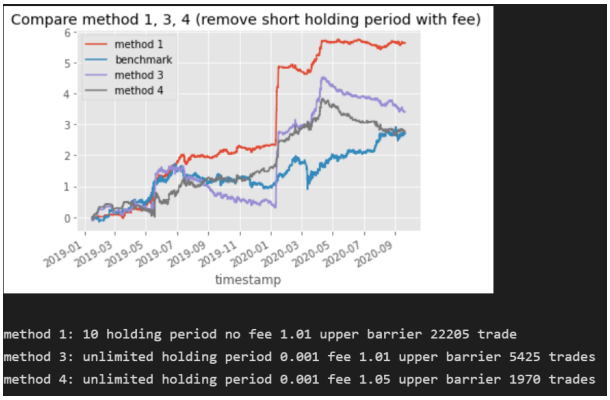


The plots show that the shorter the windows, the more sensitive checking indicators detect the patterns at the cost of more frequent trades.

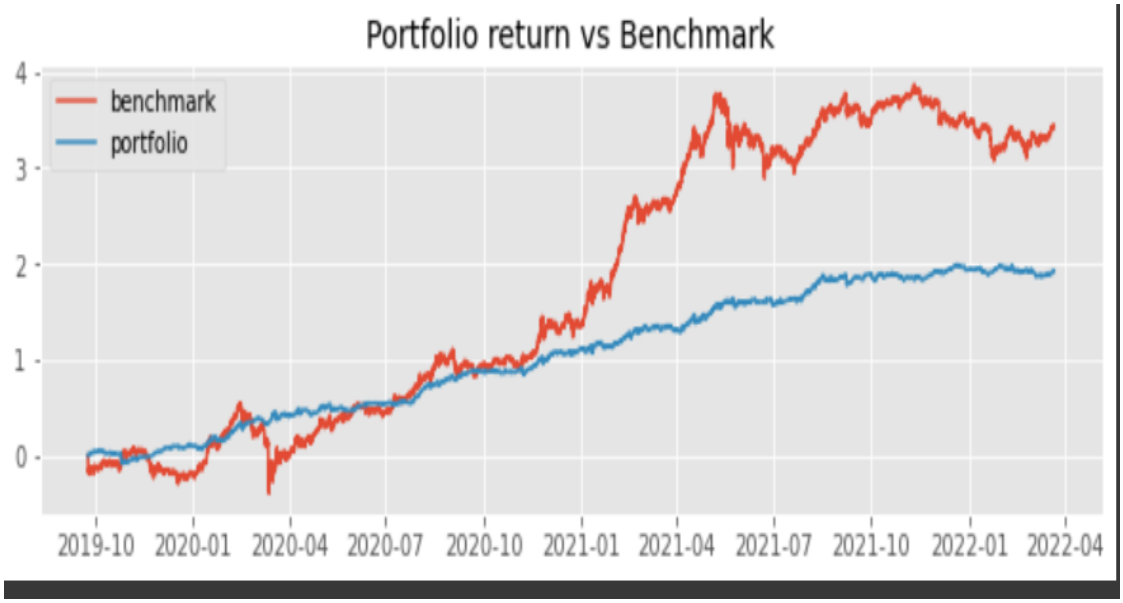
Backtesting

First, We test our trading strategy with minutely data on ETH. Method 1 and Method 2 are short holding periods without the trading fee and with the trading fee. It shows that trading fees become a great cost when trading frequency is high. Method 3 and Method 4 are unlimited holding periods with 1.01 times of upper bound and 1.05 times of upper bound. Increasing in risk gives us a method 3's return above the benchmark which is holding ETH all the time.





In order to analyze the result of our strategy, we did also construct the benchmark in which we simply hold the top-20 cryptos. In the backtesting process, we compare the returns benchmark with those of our strategy. The figure for comparison is as follows.



We compared the result of our strategy with that of the benchmark. The returns of our strategy were at first higher than that of the benchmark. After 2020, our strategy performance tended to be stable. One of the reasons could be that the margin for profit is getting small along with the investor caution increasing. Another one could be that the factors that could catch the profitable momentum are not as effective as before. And since our method is a long-short strategy compared to the benchmark which is holding, our strategy is more affected by the volatility of pricing changing. So our strategy can still be considered as a good strategy.

Conclusion

Our strategy at first could make relatively higher profits. However, it would be considered to explore more effective momentum factors into our strategy.

There is still room for improvement in the future. We could try another method. Even apply that method with good backtesting results until it doesn't work in the market.

Future Improvement

Although we are satisfied with our work, there is still room for improvement in the future.
i.e, the frequency of data - we instead apply 1min data into our strategy; Other methods, like machine learning, etc - we can construct our strategy by them then possibly get impressive results. More practically, we can access a real trading platform to work by our finance API.

Reference

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