PA026 - Trading strategies for cryptocurrency markets

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1 Introduction

There are many cryptocurrency trading bots, but most of them are not free and they don't take complete portfolio management into account. They only operate with cryptocurrencies, but it is crucial to take fiat (EUR / dollar) into account, because in case of bad market conditions this serves as a safenet for our profits and a way to accumulate more of the undervalued cryptocurrencies.

The only open source cryptocurrency trading bot is Gekko [1] and it has many downsides. It only uses up to one month of past data for testing, because it fetches it in real time from exchange APIs and they restrict past data beyond some point. It doesn't take fiat (EUR / dollar) into account and has no strategies associated with it.

There aren't any papers on cryptocurrency trading. I based my research on strategies from the traditional financial markets. The most promising strategies are trend following strategies, however even these aren't completely approved by the research community. Based on [2], [3], [4], [5], [6] I incorporated different moving averages and dependencies between each of them in automated cryptocurrency trading bot.

First I gathered data for 293 trading pairs since 21th October. I started running the parser at the end of February, which means I could only get the data since January. With some parsing maneuvering and trial API keys I managed to get the data since 21th October.

I tested individual strategies and their performance on this data set. My basic strategies were the following:

- simple moving average with parametrized time window and minimum difference between actual value and moving average value

- exponential moving average with parametrized time window and minimum difference between actual value and moving average value

- short and long moving average crossover with parametrized time window sizes

- short and long moving average exponential crossover with parametrized time window sizes

- relative strength index

No library was used for the strategy implementations, because they were tested for many different parameters and they needed to be fast. I combined these strategies and implemented portfolio management algorithm. The basic idea is to have a part of portfolio in fiat, part of bitcoin as market leader and market in altcoins. Assets are dynamically relocated based on current market stage.

2 Installation

Project requires Python3.6 with numpy, matplotlib and MySQLdb driver. You can fetch database from the following link: `https://www.dropbox.com/s/e355wf23oijx9kr/dump.sql?dl=0`. After database is initialized, you can run *main.py* to test different portfolio strategies. Script contains multiple parameters and initially the best parameters found so far are selected. You can determine shortterm and longterm moving average window, number of trading markets, trading fees and initial portfolio values.

3 Functionality

Strategies were run on all market pairs on different parts of the data set (to avoid overfitting). Data set with a size of less than a month gave very inconsistent results, because on average cryptocurrency market cycles last at least a few months. I had half year of data and because one complete cycle lasted the first three months, I used that as a training set for my strategy parameters.

Individual strategy parameters were selected based on the highest and most reasonable flat area in 3D chart of two input parameters and profit plus number of trades. The idea is not to find a single value for which the profit is great, but to find an array of neighbour values with decent profits. This way it is more likely that this scenario will occur in the future and that we didn't overfit the

parameters to our data set.

I found the safest and most profitable values to be 20 for short time window and 200 for long time window with minimum difference until the change is selected as 0.5%. The most optimal values for relative strength index band were 60 for high limit and 35 for low limit. These tests can be repeated with script *individual_model_efficiency.py*.

These parameters were plugged to portfolio management algorithm. I used relative strength index to indicate wether to buy or sell bitcoin and consequently increase or decrease portfolio position in fiat value. I added additional exponent weight to relative strength index to make selling or buying more aggressive. If relative strength index was above 75, the exponent was 2 and if relative strength index was below 45, the exponent was 0.5. This resulted in selling more assets when they were overbought and buying more when it was oversold.

On the other hand I used moving average crossover to indicate wether to buy or sell specific alternative cryptocurrency. The amount of bought and sold cryptocurrency was also based on relative strength index, because it indicates how much an asset is overbought and oversold. This helps weight the actions and make total portfolio more linear and without sudden changes through the time.
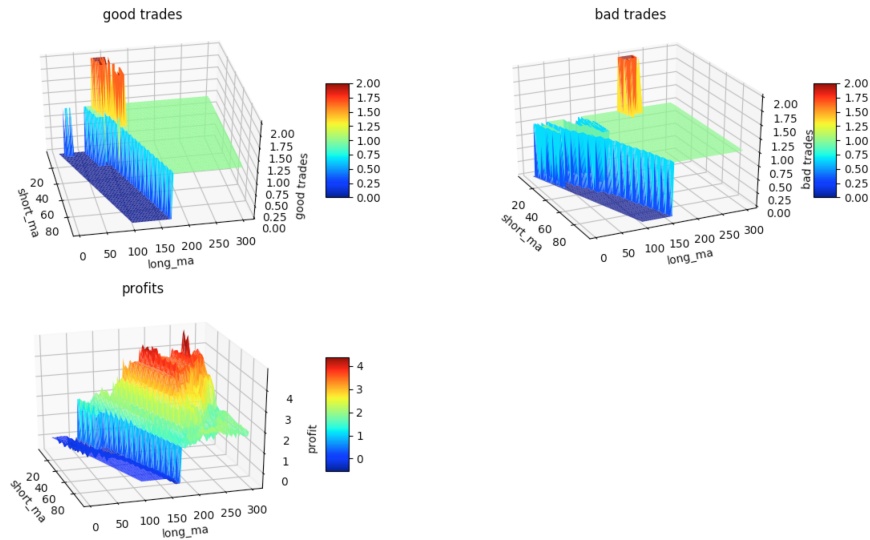
As we can see on the image above, the most promising values are 200+ for long term moving average and around 20 for short term moving average. This was the most common result for most of the cryptocurrency trading pairs. There were some outliers with slightly worse performance with these values, but they still made profit.

4 Results

Portfolio algorithm was tested with previously selected parameters and the following initial values: 5000$, 0.5 Bitcoin, 0 alternative coins. The initial value in dollars was 7920$. Total value of the portfolio in dollars at the end of the data set was 18197$. The results are statistically significant, because the parameters were chosen on the smaller time period and they were not isolated, i.e. slightly different parameters also gave similar results.

Portfolio algorithm was also tested with different models, i.e. RSI was replaced with the following models, but all of them had lower profit.

- moving average with total value of 9563$

- exponential moving average with total value of 9433$

- moving average crossover with total value of 11222$

The size of the portfolio should not matter until another magnitude increase, because that is when the liquidity starts to get problematic. Current portfolio algorithm doesn't take this into account.

So far I found it to be too risky to expand number of alternative coins to more than five. I sorted them by market capitulation and gradually expanded them during the testing and the general trend was decrease in the total profits. There were some outliers that got 1000%+ gains and when they were included they significantly increased the profits, but once more of the failed ones were added, the profits diminished.

References

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