

Trading Strategies for All Stock Programs

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ABSTRACT

Market traders buy and sell volatile assets frequently, with a goal to maximize their total return. There is usually a commission for each purchase and sale. Two such assets are gold and bitcoin. In order to solve the existing issues of purchases between gold and bitcoin, given that we have 1,000 USD, what strategies should we take to maximize our profits? In this article, the authors established seven models to predict the value of gold and bitcoins and how you should buy them, as the trends of value fluctuate, our models must be accurate enough to avoid being influenced. Targeted at that, the content is divided into three parts. For part 1: The authors selected several indicators that feature how the stock runs. For instance, price of gold and profit of gold to build first two models, which are the risk of investment model and the judgment on bull-or-bear market model. Then we use these models to evaluate whether it is safe to invest. The models are as follows: bear-bull market judgment model, risk of investment evaluation model, prediction model, trade model. For part 2: Based on the data concerned, the authors established the time series model to predict the way the market fluctuates. Meanwhile, the result of this model can be applied in correcting the results of former two models so as to make it more accurate. For part 3: The authors combined models above to give the best trading strategy. In addition, we improved the models by adding more indicators to make it more precise. We hope that by applying our models and strategies, you can successfully maximize your profit.

1. Introduction

1.1 Background

In order to indicate the origin of the trading strategies problems, the following background is worth mentioning.

Since the price of bitcoin and gold varies as time passes by, it is hard to maximize the profit directly, especially when the fluctuation of value is beyond any pattern, mak-

ing it essential for us to build relevant models to predict its trend and make the right choice.

1.2 Restatement on the Problem

Currently, our team has been commissioned by the ICM Institute to build a model to make trading strategies that maximize the profit of buyer, and the problems that we need to solve are:

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1) Establish a model that gives the best daily trading strategy according to the data due to present day. And give the final value of the investment of 1,000 USD.

2) Mention the proof that our model gives the best strategy.

3) Confirm the sensitivity of the strategy when trading cost varies.

2. Assumptions

To simplify the problem, we made the following basic assumptions, each of which is properly justified^[1].

Assumption 1: Indicators of the fluctuations are ascending rate and expected ascending rate and they are the main indicators.

Assumption 2: The threshold value of relevant models which is the average value is reasonable.

3. Models

3.1 Symbols and Definitions

To make our models more apprehensive, we give each indicator corresponding weight symbol:

3.2 Prediction Model

3.2.1 Selection of Parameters

After reviewing the relevant articles^[6] and considering the feasibility (quantification of the difficulty and integrity of the data), we decided to select gold BIAS, risk of purchase, etc. as assessment factors.

3.2.2 Data Process

Since the data given lacks gold price when trade is not available, to make the calculation easier, we defined the gold price of a non-trading day as that of former one trading day, and mark whether the current day is a gold trading day^[2]. To test whether it is available for time series model, we have to examine the stability of the data by applying DM (different methods), and here is what we've got:

3.2.3 Foundation of Model

Since the price varies drastically, we processed the data by applying different equations. Moreover, we raised a presumption that the data are not stable enough to apply

Table 1. Indicators and symbols

Symbol	Indicator	Definition
B_b	BIAS (bitcoin)	Percentage of distance between bitcoin's closing price of the day and its 5-day moving average price
B_g	BIAS (gold)	Percentage of the distance between the closing price of gold on that day and the 15 day moving average price
w_g	Bear-bull market judgment value (gold)	Bitcoin bear bull market judgment value weighed by increase and deviation rate of gold
W_{gt}	Bear-bull market judgment threshold value (gold)	Threshold defined by bitcoin bear bull market judgment
W_b	Bear-bull market judgment value (bitcoin)	Bitcoin bear bull market judgment value weighed by bitcoin increase and deviation rate
W_{bt}	Bear-bull market judgment threshold value (bitcoin)	The threshold set for the judgment of gold bear and bull market
A_g	Amount increase of (gold)	The rise of gold price on that day compared with yesterday's price
A_b	Amount of Increase (bitcoin)	The rise of bitcoin price on that day compared with yesterday's price
A_{ge}	Expected amount of increase (gold)	The rise of the predicted price of gold on the next day in percentage
A_{be}	Expected amount of increase (bitcoin)	The rise of the predicted price of bitcoin the next day in percentage
R_g	Risk of gold investment score	Quantitative value of gold risk description
R_b	Risk of bitcoin investment score	Quantitative value of bitcoin risk description
B_{sg}	Buy score (gold)	The value of gold purchased
B_{sb}	Buy score (bitcoin)	The value of bitcoin purchased

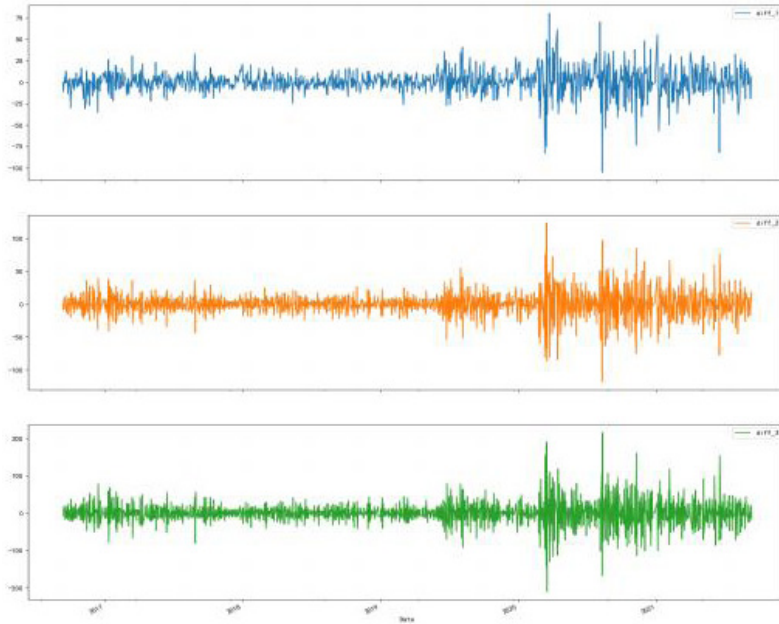


Figure 1. Different times different figure

time series model, thus reduction to absurdity is available. Meanwhile, we applied ADFuller test to examine the stability of the data, conclusion indicates that the presumption is rejected, making it possible for us to apply time series model to predict. What's more, ARIMA model is applied quite well when it comes to the prediction.

Here is the predicted gold amount of increase data visualized with python:

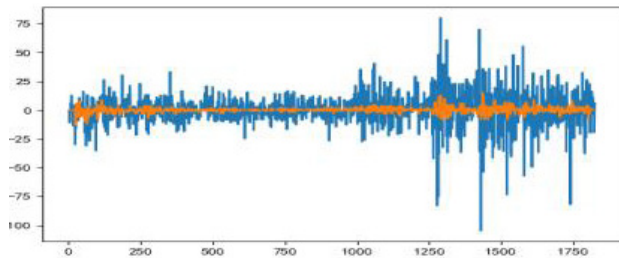


Figure 2. Gold amount of increase

And this is bitcoin amount of increase figure:

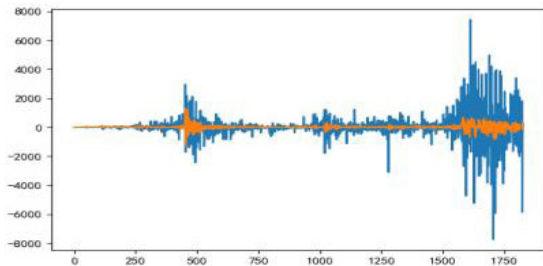


Figure 3. Bitcoin amount of increase

3.3 Bear-Bull Market Judgment Model

3.3.1 Data Process

After we converted the time to the date data type, we calculated the amount of increase of gold and bitcoins.

Then, for the better deployment of data when building bull-bear market, we use the equation below to normalize them:

$$\text{Normalization} = \frac{(\text{Current Value} - \text{Min.})}{(\text{Maximum} - \text{Min.})}$$

3.3.2 Model Building

Bull market refers to stock market in which price is on an upward trend during a long period. The trend of ascending of gold can be reflected by amount of increase in price, upward trend of average line within 15 days, expected amount of increase in price and so on, which means when the indicators above rose by certain ratio, we can regard the market as bull market. Therefore we're applying AHP to calculate the weight of four indicators in deciding whether it is bull or bear market, and multiply the value of indicator with corresponding weight, then add them all up to get a decisive value, which is Wx , Next we will randomly get several value averaged to have threshold value, when the decisive value is above the threshold value, the market will be defined as bull market, opposite the otherwise. Bitcoin model-building method and gold model-building method are similar, but considering the

gold price is stable and that of bitcoin is the opposite. Therefore, bitcoin is more suitable for short-term trading, and gold is more suitable for long-term trading, so we take the 5-day moving average rise as the bitcoin bull market judgment index, and the 15-day moving average rise as the gold bull market judgment index.

First, we will establish gold bull-bear market judgment model^[3].

To be specific, we selected the average 45-day BIAS, the average 45-day amount of increase as indicators and applied AHP to have their weight.

Then add them up to have the decisive value to determine whether it is bull market or bear market:

$$Decisive\ value = Bg45 * 0.379 + Ag45 * 0.621$$

And that of bitcoin is established with same method, the only difference is that the evaluation of bitcoin market should be carried out per month.

To make the scores of evaluation more standard, we take the same method which is normalization to unitize them so as to make it more convenient for latter AHP calculation.

3.4 Risk of Investment Evaluation Model

The way we establish this model^[4] is quite the same. What comes first is the selection of indicators. From our literature review, we got several indicators.

With the same type formula, we have its decisive value, to make it more apprehensive, we visualized them and found it quite reasonable.

3.5 Trade Model

Data Process

According to the results of former four models, we got several predicted value from ARIMA, for instance, the expected amount of increase. To make data more precise, we processed the residual difference which is mainly from non-trading days, to be specific, we applied the residual difference from last trading day to compensate this vacancy, then we normalized the expected amount of increase and residual error.

Model Building

Applying the data processed above, we established an assessment model, it gives a buy-score that composed of indicators with its weight multiplied^[5]. Whether the score exceeds a certain threshold determines whether to buy or not, the amount of the score determines how much to buy so as to achieve the mathematical quantification of

the problem. We combined the bear bull market judgment (Wx), investment risk (Rx), and the expected increase (Axe), residual difference calculated from the forecast model, By the way these indicators affect investment buying in economics, give them the corresponding weights^[7]. Buy-scores were obtained based on the formula(df is the abbreviation of difference):

$$Df[Bsx] = df_{gold\ residual\ difference} + [dfAex(normalized)] * 9 + [dfWxt] * 4 + 2 / [dfRx]$$

By the formula we have the distribution figure of the final buy-score, then we compare the distribution figure to the price expectation figure to demonstrate the reasonableness of the score, Because the price changes relatively much over a certain period of time, high score is thus lead to. We normalized the score, The final score distribution is obtained, we then set up a trading system, which is:

1) If the gold score is greater than 0.58, you are suggested to buy. If less than 0.3, you are suggested to sell. If the Bitcoin score is higher than 0.71, you are suggested to buy, if less than 0.56, you are suggested to sell. What's more, because trading both gold and bitcoin is bound to appear both are judged to buy, we established the judgment which indicates: if gold score - buy standard (0.58) > (bitcoin score - buy standard (0.71)) * 2 (because the gold score standard is smaller than Bitcoin, has a higher rise space), only buy gold, otherwise buy Bitcoin.

2) The purchase and sale amount shall be calculated by the formula: purchases = (Cash/gold price) * 0.99 * Bsx

3) We used the system editing code to calculate the total assets of each time, and map the total assets change.

To make it more comprehensible, we visualized some data, here is the gold buy-score, orange color points mean that you are suggested to sell and blue color the opposite:

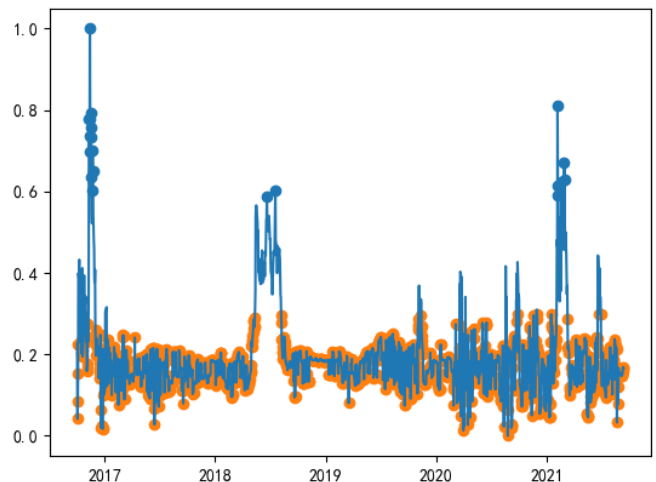


Figure 4. gold buy-score distribution

4. Sensitivity Analysis

In our model, the proportion of transaction volume is also a very important indicator. Here, it is specified as a fixed value, so it is incorporated into the model as a constant value. But we should also consider the impact of its changes on our model. Therefore, we take the gold commission from 0.01 to 0.11, take a value every 0.01, and the bitcoin commission from 0.01 to 0.21, take a value every 0.01, then calculate the final transaction result, the following figure was thus generated.

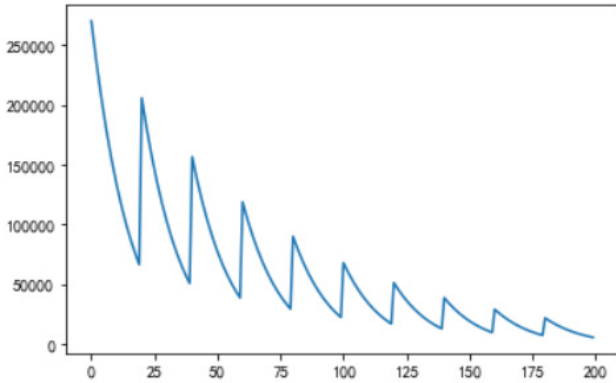


Figure 5. sensitivity analysis figure

This table can be divided into 10 intervals with a horizontal width of 20. Within the interval, it represents the curve of bitcoin Commission increasing from 0.01 to 0.21, while from the first interval to the tenth interval, it represents the increase of gold commission from 0.01 to 0.11.

Here, we can see that bitcoin transactions are less sensitive to commissions and change little. The change rate of total assets is basically unchanged from 0.01 to 0.21. For every 0.01 Commission increase, the total assets will decrease by 3.84%. The sensitivity of gold is high, but it obviously decreases with the increase of commission. When the Commission increased from 0.1 to 0.06, the total assets decreased by 73.5%, with an average decrease of 14.7% per 0.01, about five times that of bitcoin. When it increased from 0.06 to 0.11, the total assets decreased by only 47.9%, and the sensitivity was 34.8% lower than that when it increased from 0.01 to 0.06. It is foreseeable that as the Commission continues to rise, the total assets will be more sensitive to commission, but still higher than bitcoin.

5. Improved Model

5.1 Foundation of Improved Model

We optimize the model of bull market and bear market. In our initial calculation model, we obtained such a bear bull market distribution map. (bitcoin on the left and gold on the right)

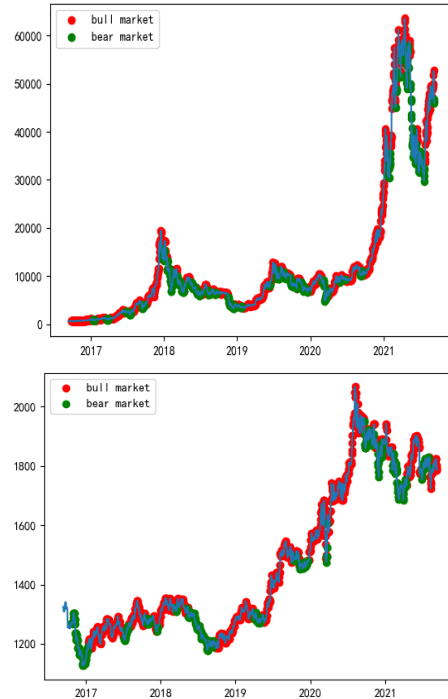


Figure 6. bitcoin&gold bear bull market distribution

However, we believe that such a model deviates from our common sense understanding of the bull and bear market. For example, the sharp decline of bitcoin after reaching its peak in early 2018 is an obvious bear market, but it is judged as a bull market at the inflection point, which will mislead our choice. In other words, its judgment is not sensitive enough.

Therefore, we used a voting method to determine the optimization model of bull and bear market. For example, according to the indicators, today is a bull market for gold, so it is a bull market a quarter ago. However, if it is calculated as a bear market yesterday and tomorrow is also calculated as a bear market, the error of today's calculation result may be large. In order to solve this error, the initial value at all times is 0. If it is currently calculated as a bull market, the value of the previous quarter will increase by 1, and if it is a bear market, it will decrease by 1. If the final result is greater than 0, it is a bull market and less than 0 is a bear market.

Under this optimization model, we get two optimized distribution maps of bear and bull market. Many inaccurate bull and bear market judgments have been corrected.

5.2 Evidence that Proved Our Best Strategy

The data that we use is definitely reasonable. Buy at a low price and sell at a high price, then we calculate the maximum yield rate under this method, then, with the model of our establishment, we calculate the maximum

yield under our strategy. Comparing the two maximum yields, the maximum yield generated by conducting exchanges with our strategy is greater, to prove that our strategy is the best strategy. We calculated the yields only by trading from the bear-bull market, that is, using a single technical means to get the yield. Compared with the yield obtained by our strategy, trade with our strategy yields greater profits, providing further evidence for our strategy being the optimal strategy.

6. Conclusions

6.1 Conclusions of the Problem

- Sensitivity of our final trade model is quite good.
- Our strategy works almost the most perfect.
- Our final property is \$220,000 (due to Sep 9th 2021).

6.2 Methods Used in Our Models

- Voting method;
- Difference method;
- Normalization of data.

6.3 Applications of Our Models

- Prediction of the bitcoin and gold market;
- Offering suggestions of purchasing.

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