

The best choice between gold and bitcoin

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Abstract. In this paper, we use Analytic Hierarchy Process (AHP) to determine the appropriate weights and establish a bull market and bear market judgment indicator and investment risk models. Secondly, the Autoregressive Integrated Moving Average model (ARIMA) is constructed to make the expected trend for the next five years, and the optimal asset portfolio of gold assets and bitcoin assets is constructed through quadratic programming, and the Dynamic Programming (DP) model is used to compare strategies between two trades. Finally, the rationality of the model calculation is verified by the test of Long-Short-Term Memory (LSTM).

Keywords: Autoregressive Integrated Moving Average model (ARIMA), risk assessment, Dynamic Programming(DP), Analytic Hierarchy Process (AHP), Long Short-Term Memory (LSTM).

1. Introduction

In the past ten years, quantitative investment has developed rapidly abroad. The increase of quantitative investment funds has also gradually outnumbered the traditional investment fund. With thirty or forty years of history of development in overseas, more and more investors have recognized it for its stable performance in investment and continuous growth of scale and share in the market. However, the quantitative investment in China is still in its initial development stage. Quantitative investment counts less than 5% in financial investment. Quantitative investment gradually shows its development potential in the domestic market in April 2010. The major brokers and institutional investors have launched in-depth studies of quantitative trading. Quantitative investment funds became hot again in these two years. The performance of some of the quantitative funds even takes the leading position. They bring more options for domestic investors.

In this paper, traders need to pay commissions for each transaction, and the assets traded are gold and bitcoin. Because our goal is to maximize the total return on investment, we need to use the known data from 2009 to 2016 to determine the estimated future five years, that is, from 2016.11.9 to 2021.9.9 for each trading day Portfolio [C, G, B], They are dollars, troy ounces, and bitcoins. Daily traders buy, sell or hold assets based on the results of mathematical models. The initial asset allocation is [1000,0,0]. The commission for each transaction (purchase or sale) is $\alpha\%$ of the transaction amount. Suppose $\alpha_{\text{gold}} = 1\%$ and $\alpha_{\text{bitcoin}} = 2\%$. At the same time, we note that Bitcoin can be traded on a daily basis, but gold is only traded on days when the market is open

2. Analysis Process

Process the data line, convert the time into date type data, then merge the two tables, and complete the value of gold on non-trading days according to the last gold trading day. According to the calculation, the increase of gold and Bitcoin can be obtained, which increased, and draw a curve as shown in the Fig.1.

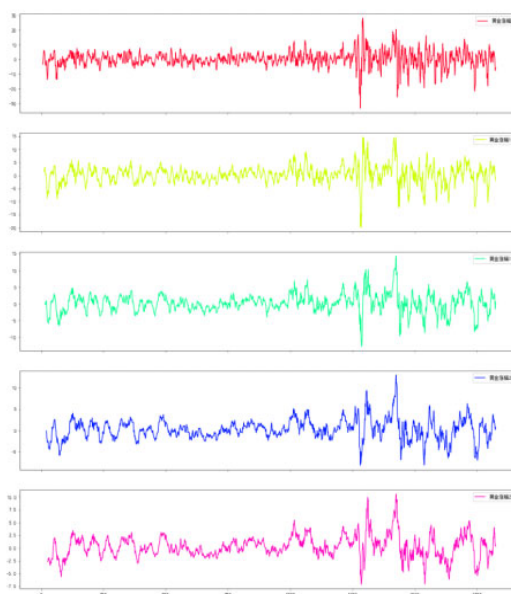


Figure 1 Gold rising in different time average comparison chart

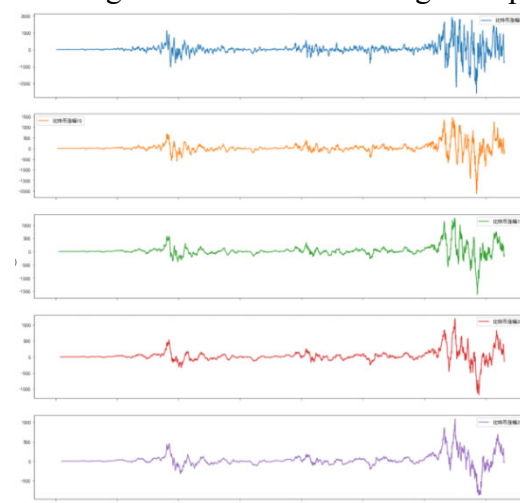


Figure 2 Bitcoin rising in different time average comparison chart

As shown in Fig.2, Bitcoin chooses short-term trading due to its large fluctuations, while gold fluctuates less, and long-term trading can be selected. Therefore, the 5-day moving average is chosen as the important trading indicator F1 of Bitcoin, and the 15-day moving average is selected as the gold important trading indicator F2. Gold Gain Indicators P and Q.

At this time, it is necessary to add the indicators Bitcoin's 5-day deviation rate M and gold's 15-day deviation rate N.

$$\text{Deviation rate} = (\text{Current price} - \text{Average price}) / \text{Average price} \quad (1)$$

If the price is far from the 5-day moving average, if it is too much higher than the 5-day moving average, it can be regarded as a large five-day deviation rate, and it is a short-term appearance opportunity. Generally, the price is 7%~15% higher than the 5th line, which is high and suitable for selling. Below 7%~15%, it is suitable for short-term entry to buy.

Increase the indicator O of whether gold is tradable. If it is a non-trading day of gold, the value of O is 0, and if it is currently a gold trading day, the value of O is 1.

After converting all assets into cash, the proportion of total assets is A. Among them, the current proportion of gold investment is A1, and the proportion of bitcoin investment is A2.

Then add the indicator N for judging whether a bear market or a bull market. Here, a model needs to be established to judge according to the current year's situation. If it is less than half a year, it will

not be judged and marked as NULL. For more than one year, bear markets are marked with 0, and bull markets are marked with 1.

2.1 Bull or bear market judgment model

Gold investment risk R1, Bitcoin investment risk R2, it is necessary to establish a suitable mathematical model here and use the results obtained by the bear and bull market judgment model to evaluate. For gold, we define Bull Market Evaluation Indicator as μ :

$$\mu = p \times 0.666 + n \times 0.333 \quad (2)$$

The corresponding results are compared from Fig. 3 to Fig. 6.

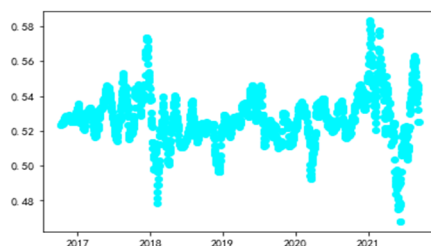


Figure 3 Bitcoin bull market indicator chart

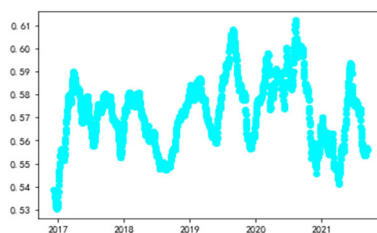


Figure 4 Gold bull market indicator chart

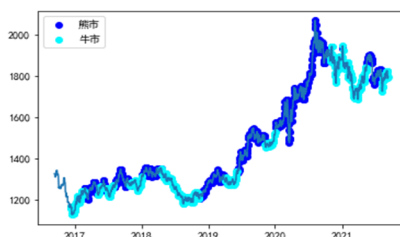


Figure 5 Bull market distribution graph of gold

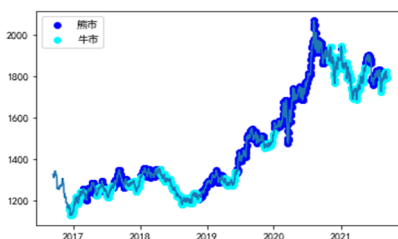


Figure 6 Bull market distribution graph of bitcoin

2.2 Risk Evaluating Model

We defined the buying risk as N, and we got the following graphics.

$$N = p \times 50\% + n \times 50\% \quad (3)$$

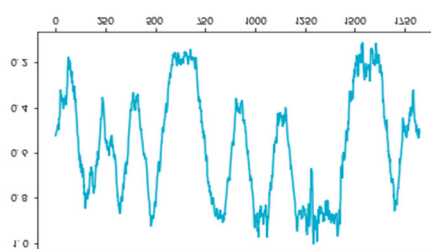


Figure 7 Buying risk chart of gold chart

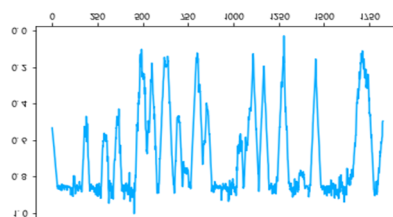


Figure 8 Buying risk chart of bitcoin chart

Therefore, Bitcoin holds share C, gold holds share G, and cash holds share B. And add profit L, an important indicator for judging whether to sell. The profit here refers to the profit after buying, and the profit needs to be cleared when the intermediate transaction is sold. The current gold profit is L1, and the current Bitcoin profit is L2.

2.3 ARIMA Model

At the same time, the time series model is used to compare the forecast of Bitcoin after five days and gold after 15 days, and increase the indicators: the expected share of Bitcoin after five days is Cf, the expected share of gold after 15 days is Gf; the expected increase of gold is Pf, and the expected rise of Bitcoin is Qf, Bf, estimated total assets Tf, estimated rate of change in total assets Cf. Then the code adds each indicator and normalizes it.

Use the above indicators to start time series forecasting, and use the ARIMA model to get the following image.

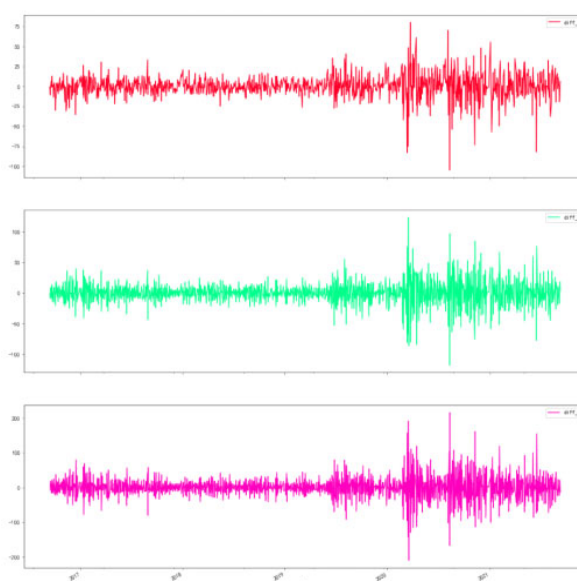


Figure 9 Data normalization

From Fig. 9, 1%, 5%, and 10% reject the null hypothesis to varying degrees compared with the ADF Test result. If the ADF Test result is less than 1%, 5%, and 10% simultaneously, it means that the hypothesis is rejected very well.

At the same time, the p-value is required to be less than the given significance level, and the p-value should be less than 0.05, and equal to 0 is the best. The null hypothesis of the ADF test is that there is a unit root. As long as the statistic is less than the number at the 1% level, the null hypothesis can be rejected very significantly, and the data is considered stable. So we proceed to time series analysis next.

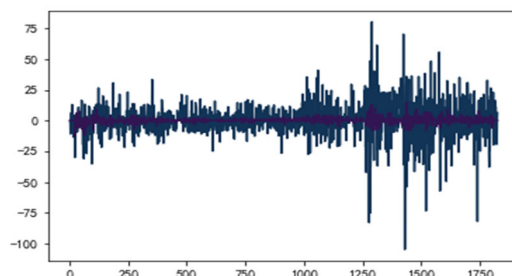


Figure 10 Gold rising chart

Then calculate the buying score, selling the asset when the buying score is low and buying the asset when the buying score is high

$$\text{buying score} = Pf * 10 + N * 4 - R1 * 5 \quad (4)$$

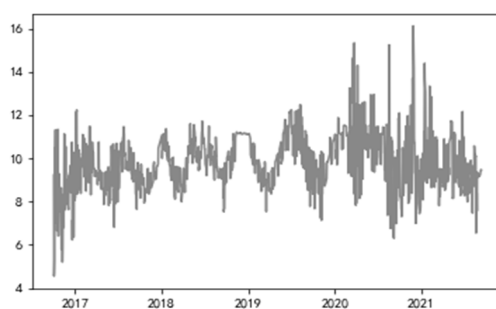


Figure 11 Buying score of gold chart

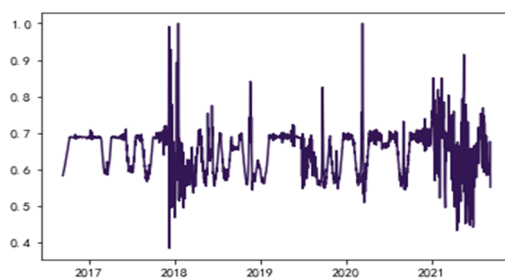


Figure 12 Buying score of bitcoin chart

2.4 The trading model

If the score is greater than 0.5, buy gold; If the score is less than 0.3, sell it. If the score is greater than 0.7, buy bitcoin; If the score is less than 0.5, sell it. Then we run the program and get the total asset info chart, and in the end, we work out that the total asset is approximately equal to \$269878, as shown in

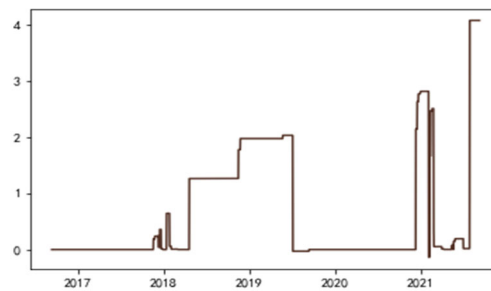


Figure 13 Bitcoin asset info chart

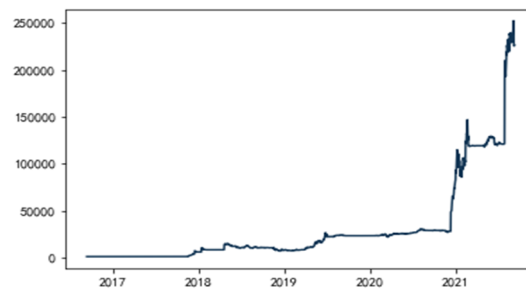


Figure 14 Gold asset info chart

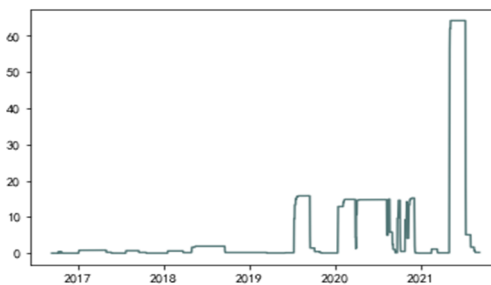


Figure 15 Total asset info chart

In this part, we select the indicators, the first two models use the analytic hierarchy process to set weights for each indicator. The floating-point data range obtained by the investment risk model ranges from 0 to 1, and the data obtained by the bull and bear market judgment model is 0 or 1. Finally, according to the original indicators and the indicators obtained from the model, use the AHP method to set weights for each indicator, and then add them together to determine whether it is greater than a certain value.

However, except for the trading model, we can sell all gold or Bitcoin. We use the dynamic programming algorithm. If you only buy bitcoin and gold, using the dynamic programming algorithm, you can get the theoretical maximum profit: the maximum profit of bitcoin is 358499.290083, and the theoretical value of gold is 7357.45, which is 350,000 dollars and 7,000 dollars, respectively

3. Comparison Process

We will answer this question by dividing the time into two parts: 2016-2020, 2020-2021. Fig.16 is the gold profit trend chart from 2016-2021. From Fig. 16, we can learn that the gold profit trend during 2016-2020 is smoother than 2020-2021.

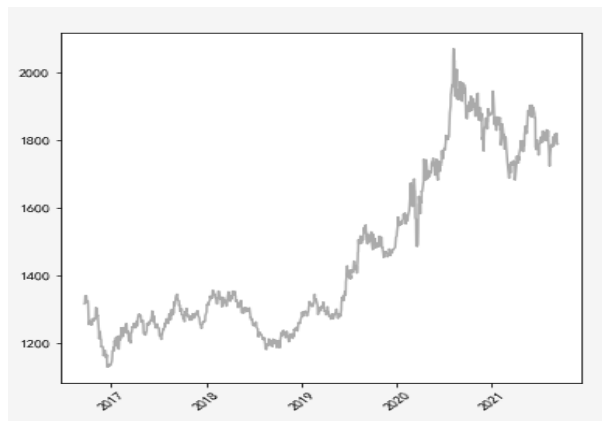


Figure 16 Gold profit trend chart

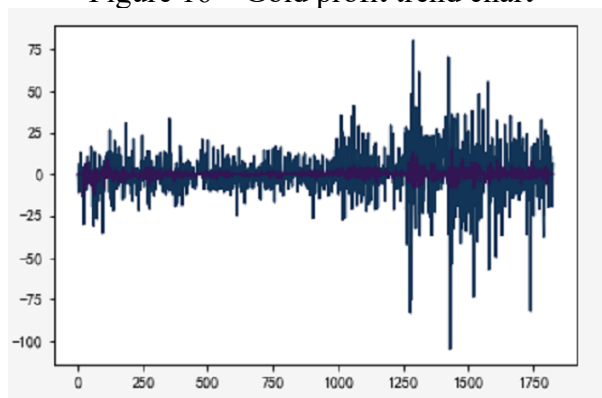


Figure 17 First-order difference of gold chart

Fig.17 is the first-order difference of gold from 2016 to 2021. We only use the chart of the first-order difference of gold because the first-order difference is precise enough.

From Fig.16 and Fig.17, we know that the difference during 2020-2021 has a larger fluctuation, which means the gold price during 2020-2021 is the same. So from this, we make the final strategy. The bitcoin's trading strategy is similar to gold.

As for the model, we have three models: bull or bear market estimating model, risk assessment model, and the time sequence model. With all of these three models integrated we can get the trading model and use this model to make the final trading strategy.

Last, for the risk of our model, here are two systematic errors which we reckon are hard to avoid. First, because of the large span of our data collecting, our database is unavoidable has some missing data, which may add inaccuracy in the result prediction. In addition, gold trading is only allowed on the market opening day, which may cause some issues.

4. Conclusion

In this work, we superimpose two trend indicators to construct a comprehensive judgment and risk indicators of the bear market and bull market, and use code test results to display and select representative indicators for analysis. Through various nonlinear processes, neural networks can solve the multi-dimensional optimization problems. Under these conditions, we should find the representative factors affecting Bitcoin price factors. Finally, based on the model results, design RSI trading strategies and noise trading strategies for empirical analysis. From the results, the trading strategy with the prediction results of the improved recurrent neural network performed well, the fixed-period stop-loss effect is the best.

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