

Analysis of Quantitative Economic Investment Strategy

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Abstract

In this paper, we analyze the problem of fund asset allocation strategy by establishing a price forecast model and an investment decision model, aiming to obtain the optimal portfolio strategy. Specifically, by manipulating the data, removing invalid information, and then transforming the data form into a temporal data sliding window transformation, we use extreme gradient boosting to predict the price of gold and bitcoin one day in the future with data from the past five days. In addition, using the association rule algorithm to calculate the number of subsets of 2-6 consecutive rises and falls in the historical data of gold and Bitcoin prices, a dynamic programming model is established to determine the objective function.

Keywords

Quantitative Investment, XGBoost, Investment Strategy Formation, Data-Based Measures.

1. Introduction

Quantitative investment refers to the issuance of buying and selling orders through quantitative and procedural procedures, for the purpose of obtaining stable returns [1]. Overseas development has a history of more than 30 years, its investment performance is stable, the market size and share are constantly expanding, and it has been recognized by more and more investors. Many asset management institutions rely on computer technology to make investment decisions, and the scale of funds managed by quantitative and programmed exchanges is constantly expanding. Market traders buy and sell volatile assets frequently, with a goal to maximize their total return [2]. There is usually a commission for each purchase and sale. Two such assets are gold and bitcoin.

For a long time, gold has been considered as the preferred hedge asset. Although bitcoin is a "new thing," it is controversial whether it will erode the market share of gold for various reasons. Bitcoin and gold have obvious advantages over legal currency because they cannot be diluted [3]. One possibility is that bitcoin may one day pass prohibitive legislation and not exist. Some Bitcoin derivatives have been banned, companies like Facebook trying to start encryption technology have been blocked. Therefore, although Bitcoin is a relatively new form of investment and certainly has been hyped, gold has maintained its v for centuries. gold and bitcoin have very similar aspects in the portfolio [4].

In this paper, by establishing a price prediction model and an investment decision model, we first predict the price of financial products on the next trading day according to the price of historical financial products, and then formulate the optimal trading strategy according to the predicted price of financial products to find the most optimal trading strategy. Finally, we analyze the sensitivity of transaction costs.

2. The Investment Model

2.1. The Principle of Transaction Model

The first purchase amount is:

$$P_1 = \frac{P_{\text{总}}}{U_1} \times 0.5 \tag{1}$$

The second purchase amount is P_2 , which can be expressed as:

$$T_1 = P_2 \times 0.99 \times M_{0.5} + P_1 \times 0.99 \times \frac{M_{0.1}}{U_1} \times M_{0.5} = 0 \tag{2}$$

The third purchase amount is P_3 , which can be expressed as:

$$P_3 \times 0.99 \times M_{0.5} + P_2 \times 0.99 \times \frac{M_{0.1}}{U_1} \times M_{0.5} + P_1 \times (0.99 \times \frac{M_{0.1}}{U_1})^2 \times M_{0.5} = 0 \tag{3}$$

The N times purchase amount is P_n , which can be expressed as:

$$P_n \times 0.99 \times M_{0.5} + P_{n-1} \times 0.99 \times \frac{M_{0.1}}{U_1} \times M_{0.5} + \dots + P_1 \times 0.99 \times (\frac{M_{0.1}}{U_1})^{N-1} \times M_{0.5} = 0 \tag{4}$$

2.2. The bitcoin Principle of Transaction Model

The first purchase amount is:

$$P_1 = \frac{P_{\text{总}}}{U_1} \times 0.5 \tag{5}$$

The second purchase amount is P_2 , which can be expressed as:

$$T_1 = P_2 \times 0.98 \times M_{0.5} + P_1 \times 0.98 \times \frac{M_{0.1}}{U_1} \times M_{0.5} = 0 \tag{6}$$

The third purchase amount is P_3 , which can be expressed as:

$$P_3 \times 0.98 \times M_{0.5} + P_2 \times 0.98 \times \frac{M_{0.1}}{U_1} \times M_{0.5} + P_1 \times (0.98 \times \frac{M_{0.1}}{U_1})^2 \times M_{0.5} = 0 \tag{7}$$

The N times purchase amount is P_n , which can be expressed as:

$$P_N \times 0.98 \times M_{0.5} + P_{N-1} \times 0.98 \times \frac{M_{0.1}}{U_1} \times M_{0.5} + \dots + P_1 \times (0.98 \times \frac{M_{0.1}}{U_1})^{N-1} \times M_{0.5} = 0 \tag{8}$$

The investment strategy is obtained by fitting the index to achieve the maximum return.

2.3. The Model of Quantitative Economic

The number of consecutive rise and fall is more than ninety percent recorded as :U1

By introducing the association rule algorithm, the number of subsets that rise and fall twice, three times, four times, five times four consecutive times, five consecutive times and six consecutive times is counted respectively, which is denoted as : $m_2, m_3, m_4, m_5, m_6, n_1, n_2, n_3, n_4, n_5$

Statistics of every rise and fall in historical data M0.9 With all the declines M0.1

In the investment model construction, the number of continuous rise and fall is x , The continuous rise in the price of financial products is recorded as , Continuous decline is recorded as U1, The maximum cumulative increase is M0.9, The maximum drop is M0.1 .

In an ideal state, if the magnitude of each rise and fall is the same. When the decline u times,It just dropped M0.1 . Buy the product every time it goes down, if it goes up M0.5 for the first time, which can be obtained [5]. The data results are as follows:

Table 1 Gold bunkering

| buy in | P_1 | P_2 | P_3 | P_4 |
|---------------------|-------|--------|---------|---------|
| The purchase amount | 125 | 0.3875 | -0.0301 | 0.00024 |

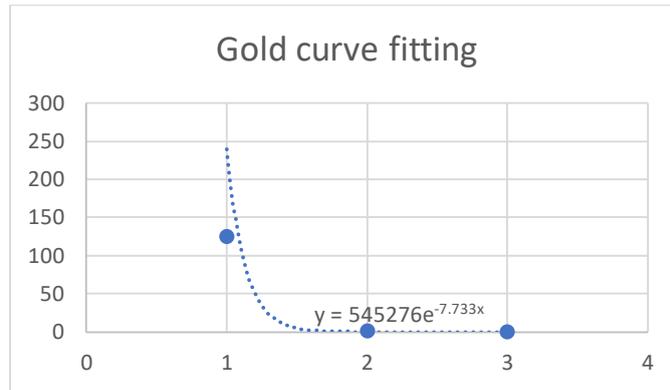


Figure 1 gold curve fitting

Table 2 Bitcoin bunkering

| buy in | P_1 | P_2 | P_3 | P_4 |
|---------------------|-------|-------|-------|----------|
| The purchase amount | 500 | 9.65 | -0.02 | 0.000068 |

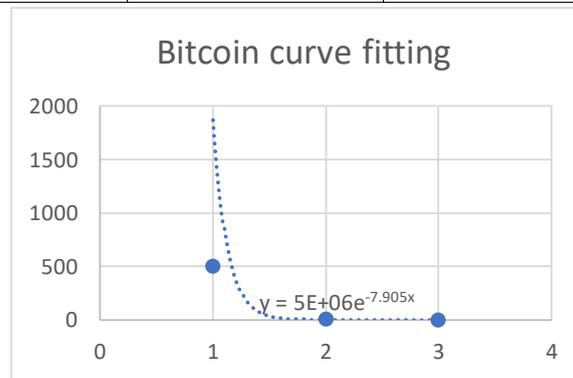


Figure 2 Bitcoin curve fitting

By introducing the linear regression model to fit it, we can get:

$$y = ae^t \tag{9}$$

In this case we must tightening up the management. If the continuous rise and decline are x times, the cumulative decline is w , where

$$y_{加} = ae^{\left(\frac{w}{M_{0.1}} \times U_1\right)}, \quad y_{减} = ae^{\left(\frac{w}{M_{0.9}} \times U_1\right)} \tag{10}$$

3. Algorithm design

3.1. Data Retest

In the prediction of the price of the next trading day based on time series, we adopt the same price for gold and bitcoin. We use spsspro software to eliminate the invalid data in the data, and then we use the method of time series conversion to process the data. Let the price of the first five days as the basis for the prediction of the next day [6]. Then we use xgboost in spsspro to predict the data, and let x after the conversion of the time series variable as the independent variable, and let y after the time series variable as the dependent variable. Then we use the heuristic algorithm in spsspro to find the optimal v of learning rate and regularization parameter in xgboost. Through this step we get the following data.

Table 3 Valid data analysis

| MSE | RMSE | MAE | MAPE | R ² | |
|---------------|--------|-------|-------|----------------|-------|
| training sets | 20.21 | 4.496 | 3.21 | 0.244 | 0.998 |
| testing set | 19.247 | 4.387 | 2.999 | 0.17 | 0.998 |

What we can know from the data in the table 3 is valid data analysis. And get the curve of the real v and predicted v, which is shown in Fig.3.



Figure 3 The most suitable V value

3.2. Parametric Computation

According to the above content, we can predict the price of the next working day , The actual price of the next working day is , We can get . The

above vs are indicated as the relative error between the predicted price and the actual price.

In order to make the prediction results more convincing, according to the above prediction strategies, we can know that for the prediction of the price of financial products, in fact, we predict it according to the price change law of historical financial products. The statistics of the price change law of financial products are greatly related to the methods we use. In order to make the above prediction vs more convincing, we adopt the prediction model of cycle [7].

From the above prediction model we can get the prediction v of financial products for each trading day in the future, and the predicted price of financial products can only reflect the future direction of the transaction, and can not determine our specific transaction model. In order to make a more reasonable transaction strategy, it is necessary to analyze the price trend of specific financial products and related laws through historical data.

According to the historical investment data of the financial market and the means of transactions, we need to know that when the v of financial products falls, we need to buy properly. When the v of financial products in the market rises, we need to sell, so as to obtain

the maximum profit. In order to clarify the amount of specific transactions, we need to study the laws of gold and bitcoin, so as to formulate relevant strategies [8].

We use the statistical function of Excel software. The statistical data about gold is shown in table 5-10.

Table 5

| Calculation of median gold fall and rise | |
|--|--------------------|
| median of decline | median of increase |
| -0.0043882 | 0.0041907 |

Table 6

| The falling quantile of gold | |
|---|---------|
| Gold fell by 90 quantiles for five consecutive days | -0.0024 |
| Gold fell by 10 quantiles for five consecutive days | -0.0341 |
| Gold rose by 90 quantiles for five consecutive days | 0.0303 |
| Gold rose by 10 quantiles for five consecutive days | 0.0021 |

Table 7

| Statistics of continuous fluctuation of gold | |
|---|-----|
| The probability of continuous increase of 5 days exceeds 95 % | 695 |
| More than 95 % probability of falling for 5 days% | 611 |

Table 8

| Calculation of Bitcoin ' s Drop and Rise Median | |
|---|--------------------|
| median of decline | median of increase |
| -0.01519524 | 0.01551669 |

Table 9

| Bitcoin fluctuation quantiles | |
|--|---------|
| Bitcoin continued to fall 5 days 90 deciles | -0.0059 |
| Bitcoin continued to fall 5 days 10 deciles | -0.1677 |
| Bitcoin rose by 90 quantiles for five consecutive days | 0.1446 |
| Bitcoin rose by 10 quantiles for five consecutive days | 0.009 |

Table 10

| Statistics on the Continuous Fluctuation of Bitcoin | |
|---|------|
| The probability of continuous increase of 5 days exceeds 95 % | 1045 |
| More than 95 % probability of falling for 5 days% | 617 |

Based on the above investment model, we can get a more reasonable investment plan. We first normalize the score of Bitcoin purchase and obtain, which is shown in Fig.4.

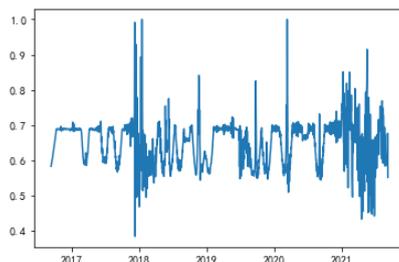


Figure 4 Bitcoin and gold buying score chart

We formulate corresponding rules for the buying or selling of bitcoin, blue for buying, orange for selling, which is shown in Fig.5.

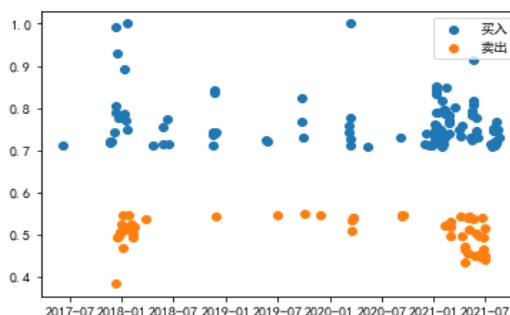


Figure 5 Bitcoin score comparison chart

We set the a score greater than 0.58 to buy, less than 0.3 to sell, bitcoin greater than 0.7 to buy, less than 0.56 to sell. Under certain restrictions of trading rules:

We can get :Purchase amount=Current cash amount*Purchase score* (1-service charge) /present price

Sale amount=Shareholding* (1-score+Sale standard)

The relevant data is shown in Fig. 6.

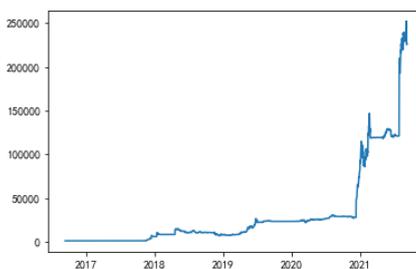


Figure 6 Total assets map

The trend diagram of three asset holdings are shown in Fig.7-Fig.9.

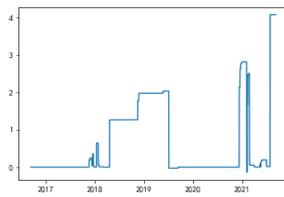


Figure 7 bitcoin

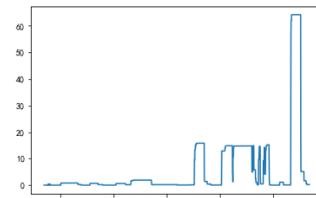


Figure 8 a

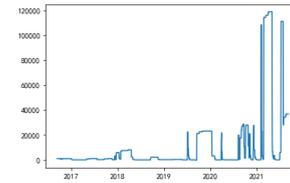


Figure 9 cash

4. Sensitivity Analysis

Through Excel visualization, we can get the trend chart of the maximum total assets of different fees, which is shown in Fig.10. We can know that as fees increase, total assets are decreasing

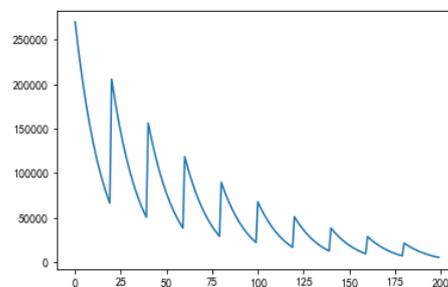


Figure 10 The total assets trend chart of different fees

5. Conclusion

In this paper, we first transform the re-predict data by using a time series method, and then we analyze the prediction data with xgboost, in which the learning rate of the heuristic optimization and the regular v xgboost are greatly improved. In addition, we use association rules algorithm to process related data. Finally, we used a linear fitting method to predict the results to find the best quantitative trading results. We analyzed the sensitivity of the model.

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