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Research on Transaction Strategy Based on BP Neural Network

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Abstract: In this paper, in order to develop the best trading strategy, we need to predict the data first. BP neural network and sliding prediction method are adopted. The neural network is trained based on the data of the first seven days and then used to predict future prices. The expected rate of return is calculated based on the predicted value. Use the expected rate of return to calculate future returns and maximize them as the first goal. The standard deviation of past returns is used as the risk factor. Minimizing future risk is the second goal. As a constraint, the total value of assets in each transaction remains unchanged. Establish a multi-objective programming model. By introducing risk preference, the multi-objective programming problem is transformed into a single-objective programming problem. In this system, predictions and decisions are made again and again. At the same time, considering the two situations in which gold cannot be traded when the market is closed, trading is not recommended when the price of bitcoin fluctuates too much.

1. Introduction

The gold and currency trading markets are very volatile, and the returns of the two highly volatile assets vary greatly for traders. At the same time, there is a commission cost for each transaction, that is, the transaction cost incurred in each transaction. The commission costs generated by gold and Bitcoin transactions account for different proportions of transaction costs, and there is no cost to hold assets. Bitcoin can be traded every day, and gold is only traded on open days. Due to the difference between the two, they need to be considered separately when forecasting.

2. Data preprocessing

2.1 Data Cleaning

This paper collects data from the relevant gold trading market.by comparing the dates in the pricing data files, we can get the closing time of gold from9/11/2016 to 9/11/2021. At the same time, we also found that there were missing data values in the data of gold at the opening. Through searching, we found that there were only 10 missing values. In order to better predict the future gold data, minimize the error of the model and improve the accuracy, we choose cubic spline interpolation to interpolate the gold data set.

3. Data Visualization

We used the interpolated data, got figure1. The figure1 is about the daily price and date of gold and bitcoin.By comparing the two figures, it can be found that in the past five years, the fluctuation range of Bitcoin is larger than that of the gold.It can help us to build more better model.

Figure 1: God and Bitcoin

4. Best Daily Trading Strategies

4.1 BP neural network prediction model

The idea of sliding prediction is adopted [1]. Sliding prediction refers to: assuming a total of L data is collected, taking N + M data as a group, and dividing the L data into (L + 1 N - M) groups. The data division method is shown in the following figure:

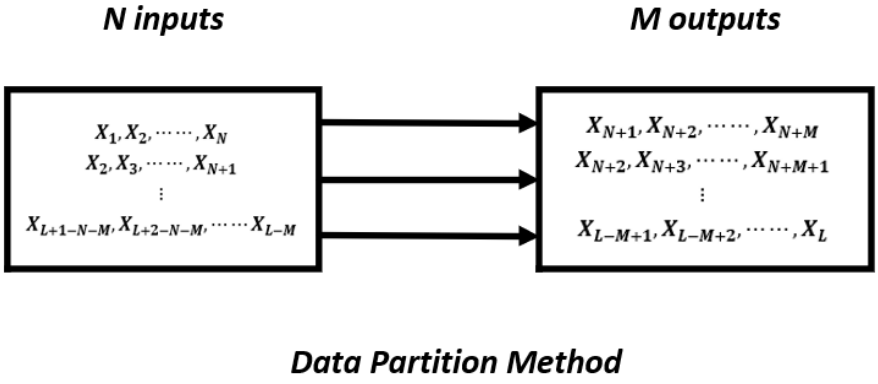


Figure 2: Data partition method

Since the price of bitcoin is known on day i, but the closing price of gold is not known, the prediction should be the price of bitcoin on day i + 1, day i + 2, and day i + 3; the closing price of gold on day i, day i+1, day i+2.

Since the price forecast for gold and the price forecast for Bitcoin are different, specific forecasting models need to be built for the two specific liquid assets. When Bitcoin does not fluctuate too much within two days, a neural network model is established to predict the price of Bitcoin in the next three days. Select the prediction results of two time periods and draw a graph to intuitively feel the prediction effect.

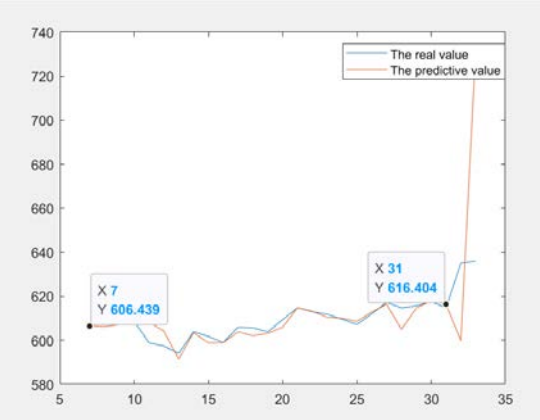


Figure 3: 9/17/16---10/11/16 data

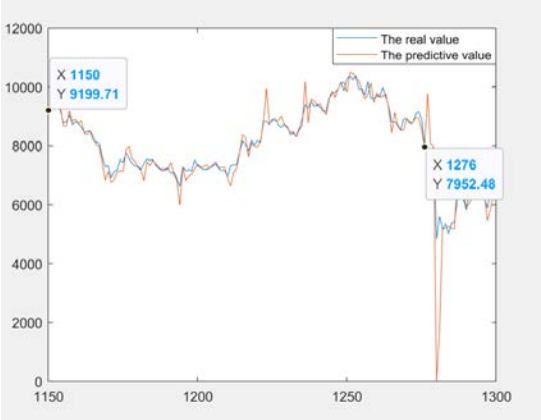


Figure 4: 11/4/19----1/19/20 data

Since there is a situation in which gold is open or not, the forecast for gold will be explained in more detail.

4.2 Gold's prediction model

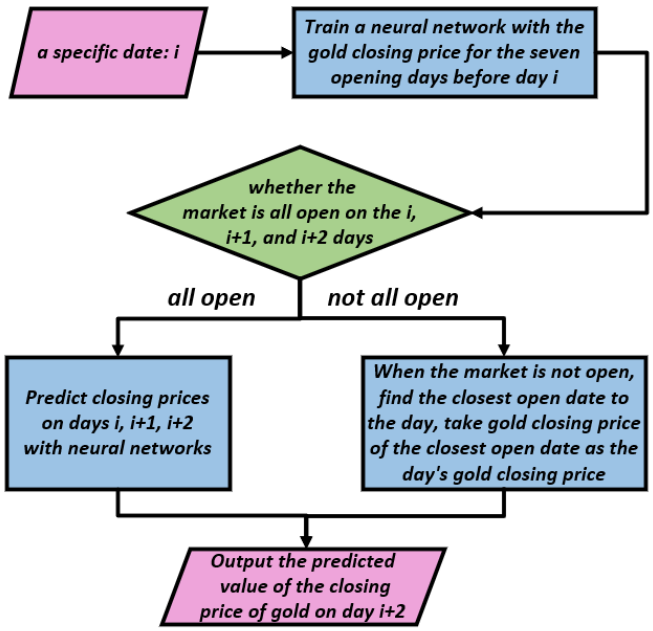


Figure 5: Gold's prediction model

Since the closing price of gold on the day is not known on day i, the predicted result is the closing price of gold on day i, day i+1, and day i+2. Since gold trading involves whether to open or not, all need to add a judgment condition. We all know that when gold is not open, its price will not change. If gold does not open on day i + 1, use the predicted value of closing price on day i as the predicted value of closing price on day i + 1. And so on.

Select the prediction results of two time periods and draw a graph to intuitively feel the prediction effect.

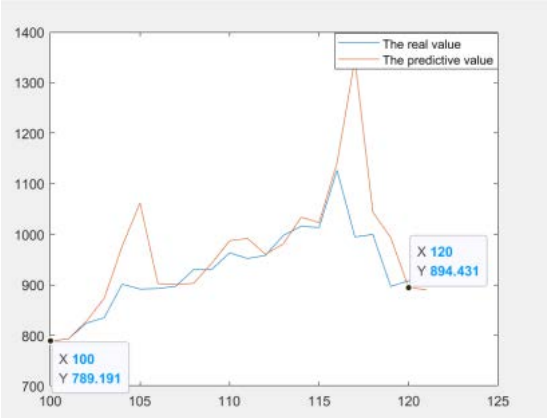


Figure 6: 12/19/16---1/8/17 data

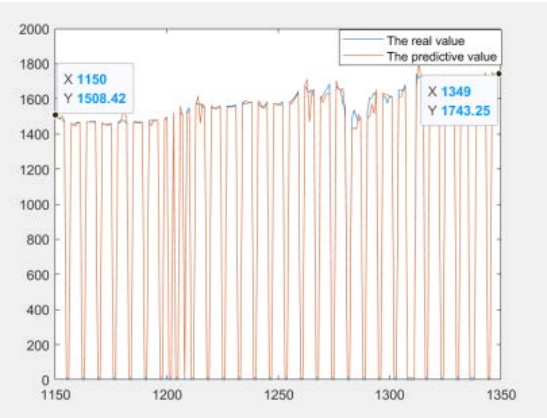
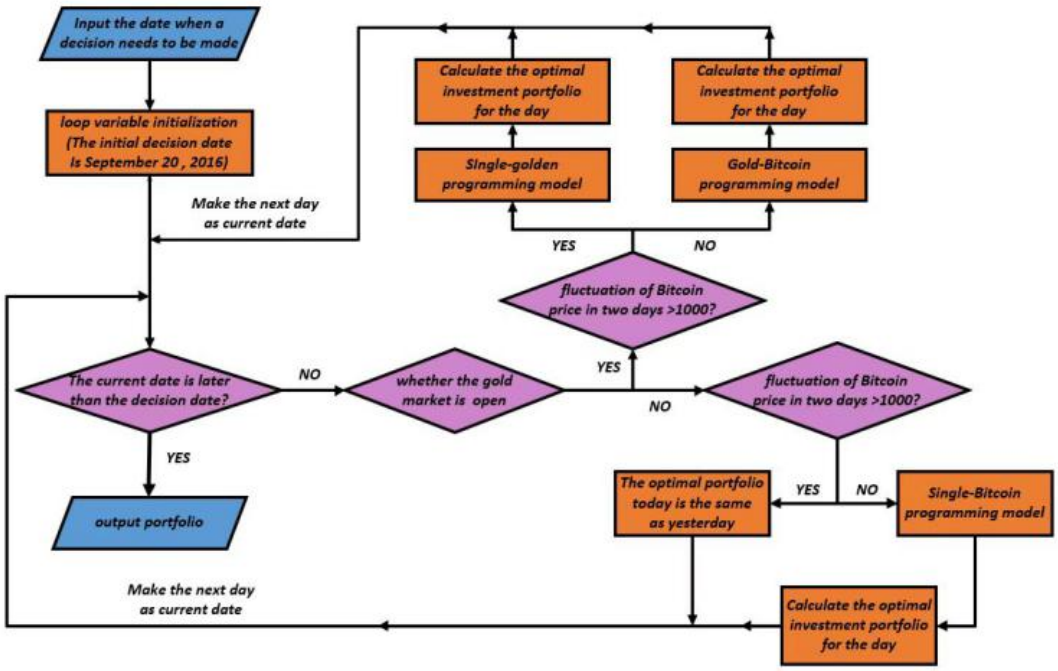


Figure 7: 11/4/19----1/19/20 data

4.3 Multi-objective programming model

Due to the excessive volatility of Bitcoin and the two effects of gold closing, the multi-objective planning model is divided into three situations. That is, Gold-Bitcoin Planning Model, Single Gold Planning Model, Single Bitcoin Planning Model. The planning process for the three models is roughly the same, with only minor differences.



The data calculation method and model construction method in the flow chart are described as follows:

(1) Calculation of expected rate of return: $fb_i = \frac{Pb_3 - b_i}{b_i}$, $fg_i = \frac{Pg_3 - g_i}{g_i}$

Formula: fb_i-The expected return on Bitcoin calculated on day i; fg_i-The expected return on Bitcoin calculated on day i; Pb_3-Bitcoin price on the third day in the future; Pg_3-The third gold closing price in the future; b_i-Bitcoin price on day i; g_i-Price when buying gold on day i

(2) Calculation of risk rate: The standard deviation of the real rate of return is used as the risk rate [2].

(3) Multi-objective programming model:

$$\max R = fg_i(G_i \times g_i) + fb_i(B_i \times b_i) - (|G_i - G_{i-1}| \times g_i \times \alpha_{gold} + |B_i - B_{i-1}| \times b_i \times \alpha_{bitcoin})$$

$$\min Q = G_i \times g_i \times \sigma g + B_i \times b_i \times \sigma b$$

s.t.

$$C_i + G_i \times g_i + B_i \times b_i = C_{i-1} + G_{i-1} \times g_i + B_{i-1} \times b_i \quad C_i, B_i, G_i \geq 0$$

R For the expected return, it is calculated as: the expected return in three days over the cost of the transaction today. Q For risk, its calculation process is: the value of gold and bitcoin held today is multiplied by the corresponding risk rate. The constraint is that during the transaction, over-trading cannot be performed. Only the portfolio can be changed, but the total value at this time remains the same. Introduce risk appetite. In this way, the multi-objective programming model is transformed into a single-objective programming model, which is convenient for subsequent solutions.

The Single Gold Planning Model and the Single Bitcoin Planning Model are similar to the Gold-Bitcoin Planning Model. Just remove the influence of another asset. I won't go into details here.

4.4 Model application

After the model is established, the algorithm is written in Matlab. Since the model uses multiple judgments and multiple cycles, the running speed is slow. First, make a decision on the 100th day (December 19, 2016) and predict the effect of the model. The optimal decision on December 19, 2016 is [1.5060*10^(-3) 0 1.6698]([cash gold bitcoin]).

Plot the return curve from the initial date to December 19, 2016:

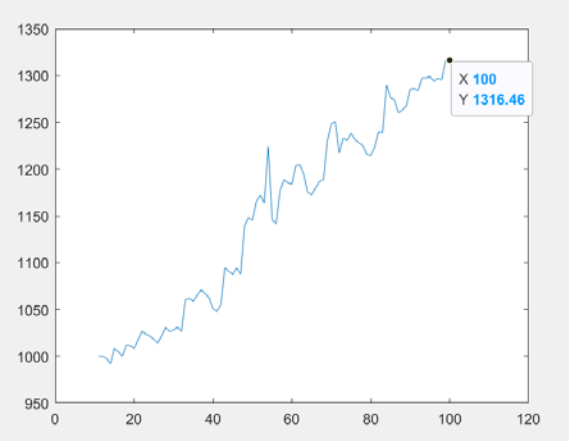


Figure 8: 2016/12/19 data

As can be seen from the image, the yield curve has a zigzag rise. Bringing in September 10, 2021, the calculated portfolio for that day is [0 0 1.3658]. The initial $1000 investment is worth $63330.7802 on September 10, 2021.

5. Conclusion

First of all, this paper predicts the data. Use BP neural network and sliding prediction method, and use the expected rate of return to calculate the future return, and maximize it as the first goal. The standard deviation of past returns is used as the risk factor. Minimizing future risk is the second goal. As a constraint, the total value of assets in each transaction remains unchanged. Establish a multi-objective programming model. By introducing risk preference, the multi-objective programming

problem is transformed into a single-objective programming problem. To determine whether the model provides the best strategy based on multi-objective programming can be considered from two aspects: the accuracy of price forecast and income. The MSE in a period of time is taken as the condition to judge the effect of price forecast. The economic index of annualized rate of return is introduced to judge the income situation.

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