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Risk Investment Decision Making Model Based on Grey Prediction

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Abstract: *Market traders frequently buy and sell assets with the goal of maximizing total investment returns. There is usually a commission on each sale. Develop a model with only the daily price stream to date, Use the model to determine whether traders should buy, hold or sell assets in their portfolio on a daily basis. This article a portfolio maximization model is established. In order to develop this model, the Gray Forecast Model is first used to predict the daily transaction price flow of these two assets from the perspective of the day. Then establish a market analysis model, use the form of data segmentation fitting and prediction, select the first 260 days of data from the perspective of the day of purchase to analyze the market conditions (if it is less than 260, try to use all of it), and prepare for the next risk assessment Secondly, a risk evaluation system is established, five evaluation indicators are proposed to use the AHP model to evaluate the risk of gold and bitcoin, and the weights are established and the risk indicator Var is proposed. Finally, according to the triple [C, G, B], an investment income model is established, and the idea of dynamic programming is used to maximize the income C+G+B minus the commission. Finally, the final maximum investment of [1000,0,0] on September 11, 2016 is 154220.6385$, And visualize the daily investment plan and investment curve*

Keywords: *Grey forecasting model; Analytic Hierarchy Process; Dynamic Programming; Investment decision*

1. Introduction

In the process of buying and selling volatile assets, the ultimate goal is to maximize total returns. When buying assets such as gold and bitcoin, each transaction costs a commission, so the goal is to reduce the number of buying and selling as much as possible, and provide traders with a reliable risk assessment and a trading strategy supported by sufficient data.

The purpose of the research is to guide future investment and trading behavior by making future predictions on the past trend data of gold and bitcoin. Daily prices determine whether traders should buy, hold or sell assets in their portfolios on a daily basis. It is hoped that the data obtained through this research will be helpful to traders' investment activities.

2. Grey forecasting model

A screening of the given data found that the golden data table has 10 missing values. After studying the regularity between the data, it is found that the data has a local linear correlation, so linear interpolation is used to fill the missing values in the data. Use the preprocessed data to make gray predictions, obtain the development coefficient and gray action, and then calculate the predicted values of gold and bitcoin.

2.1. Data preprocessing

(1) Given two data tables. Gold transactions can only be conducted when the market is open, while Bitcoin can be conducted every day. When the two data are merged according to the time series, the time period when the gold market is not open is regarded as zero, and Bitcoin fluctuates normally.

(2) In the process of data preprocessing, it was found that the golden data had intermittent and continuous missing values, and the local linear correlation was satisfied, so linear interpolation was decided. The data has 10 missing values. In order to ensure the integrity of the data and to predict the

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next data, the data is fitted and interpolated, and the interpolated value is automatically replaced with spaces.

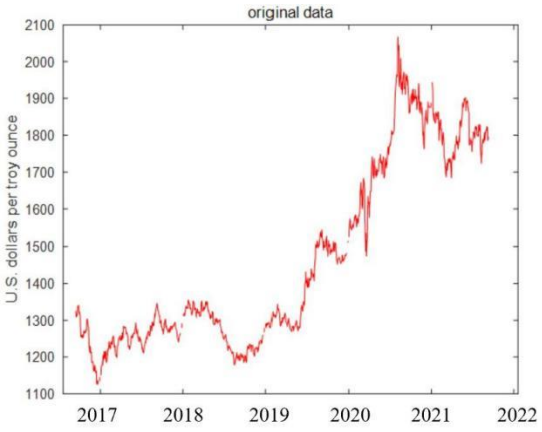

Figure 1: Before missing values are filled

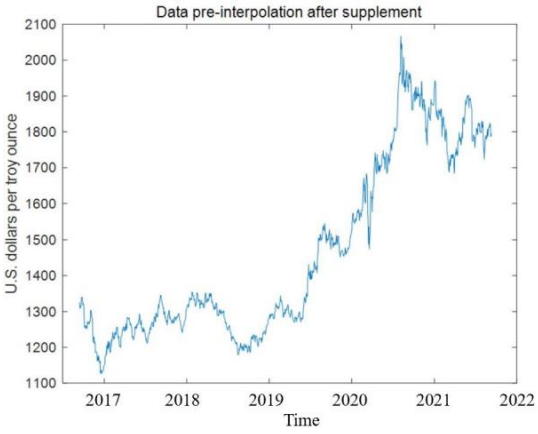

Figure 2: After filling in missing values

(3) The time series in the two tables are uniformly processed to form the same data type structure, and then the gold price table and the Bitcoin price table are merged according to the time data column.

2.2. The grey prediction method is used to calculate the predicted value

Grey prediction [1] is used to improve the prediction accuracy of the model. $GM(1,1)$ The main steps of the model are as follows:

A non-negative sequence whose initial value is known is set to $x^{(0)}$, Seek the accumulation to generate a new sequence as $x^{(1)}$, and the adjacent mean sequence is $z^{(1)}$.

Its formula is as follows: Assume $x^{(0)} = \left(x^{(0)}(1), x^{(0)}(2), \cdots, x^{(0)}(n)\right)$ is the initial non-negative data column, We accumulate it once to get a new generated data column $x^{(1)}$.

$$x^{(0)} = \left(x^{(1)}(1), x^{(2)}(2), \cdots, x^{(1)}(n)\right)$$

$$\text{In } x^{(1)}m = \sum_{i=1}^{m} x^{(0)}(i), m = 1,2,\cdots,n \tag{1}$$

(1) Let $z^{(1)}$ be the adjacent mean of the sequence $x^{(1)}$ to generate a sequence, that is

$$z^{(1)} = \left(z^{(1)}(2), \cdots, z^{(1)}(n)\right)$$

$$z^{(1)}m = \delta x^{(1)}(m) + (1-\delta)x^{(1)}(m-1)$$

$$\mathrm{m} = 2,3\cdots,\mathrm{n}$$

$$\delta = 0.5 \tag{2}$$

(2) Development Coefficient and Ash Action

$x^{(0)}(k) + az^{(1)}(k) = b$ is $GM(1,1)$ model basic form is $(k = 2,3, \cdots, n)$

Where b is the ash action amount and -a is the development coefficient.

(3) Predictive value

The original intention of gray modeling is to establish an approximate differential equation model for the series, but since the differential equation is only suitable for continuous and differentiable functions, and the time series data is not continuous and not differentiable, so the gray prediction modeling obtains an approximate differential Equations, called "grey differential equations".

$$\text{Whitening Equation: } \frac{dx^{(1)}(t)}{dt} = -\hat{a}x^{(1)}(t) + \hat{b} \tag{3}$$

If we take the initial value $\hat{x}^{(1)}(t) \mid \mathrm{t} = 1 = x^{(0)}(1)$, The corresponding solution can be obtained as:

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$$\hat{x}^{(1)}(t) = \left[x^{(0)} - \frac{\hat{b}}{\hat{a}}\right] e^{-\hat{a}(t-1)} \frac{\hat{b}}{\hat{a}} \tag{4}$$

$$\hat{x}^{(1)}(m+1) = \left[\hat{x}^{(0)}(1) - \frac{\hat{b}}{\hat{a}}\right] e^{-\hat{a}m} \frac{\hat{b}}{\hat{a}} + \frac{\hat{b}}{\hat{a}}, m = 1,2,\cdots,n-1 \tag{5}$$

due to: $\hat{x}^{(1)}(m) = \sum_{i=1}^{m} x^{(0)}(i), m = 1,2,\cdots,n-1$

$$\hat{x}^{(0)}(m+1) = \hat{x}^{(1)}(m+1) - \hat{x}^{(1)}(m) = \left(1 - e^{-\hat{a}}\right)\left[x^{(0)}(1) - \frac{\hat{b}}{\hat{a}}\right]$$
$$m = 1,2,\cdots,n-1 \tag{6}$$

2.3. Forecast result

Comparison of the actual price of gold and the predicted price:

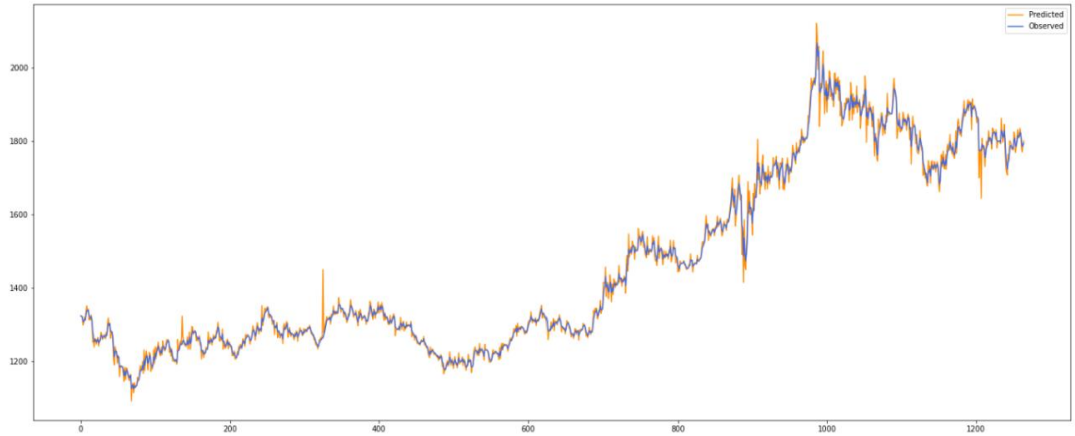

Figure 3: Gold forecast price comparison chart

Comparison chart of Bitcoin's actual price and predicted price:

Figure 4: Bitcoin forecast price comparison chart

Blue represents actual prices and yellow represents predicted prices. As shown in the figure, the trend of the predicted price curve is roughly the same as the actual price curve, and it is more accurate to predict the time point of price turning.

In order to more intuitively show the difference between the forecast and the actual, calculate and draw a trend chart of the difference between the actual and the forecast, see the figure below:

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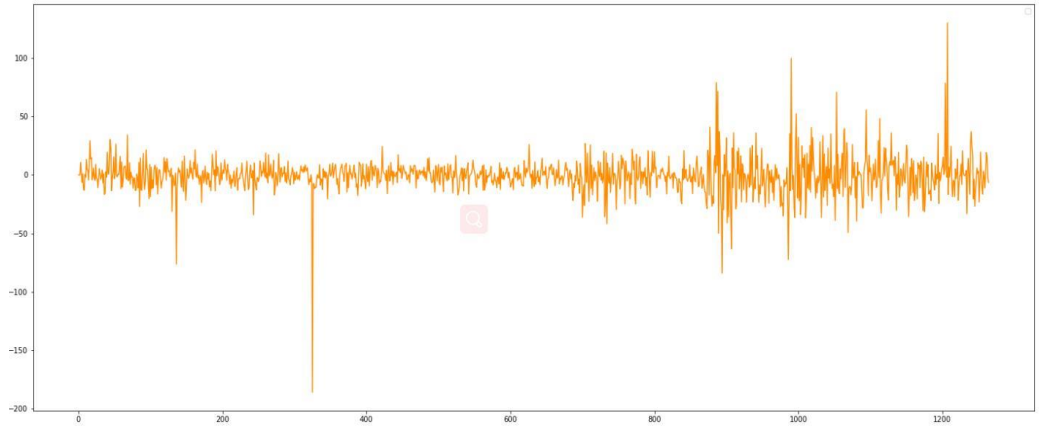

Figure 5: Gold's Actual and Forecast Difference Chart

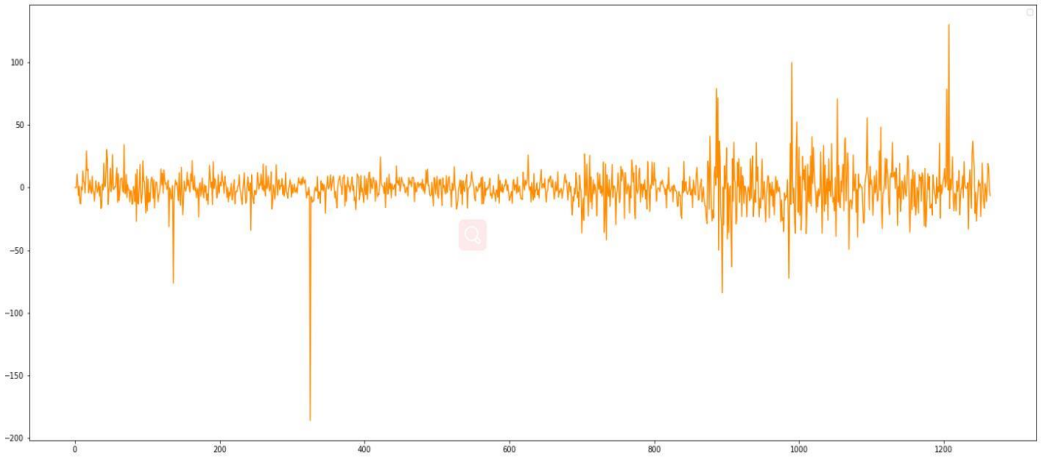

Figure 6: Bitcoin's Actual and Forecast Difference Chart

3. Investment Risk Assessment Model

3.1. Discrimination of market conditions

How to judge whether the market is rising, falling or oscillating, firstly,ivide the data into four sections, fit the four sections of data separately, and find the extreme value of the fitted curve. If it is a maximum value, it will form a sequence with the following maximum value. If it is a minimum value, it will be combined with the following maximum value. DA sequence is formed. If both sequences are increasing sequences, it is a rising period. If both sequences are decreasing sequences or only have a maximum value sequence or a minimum value sequence, it is a descending period. Otherwise, it is an oscillation period.

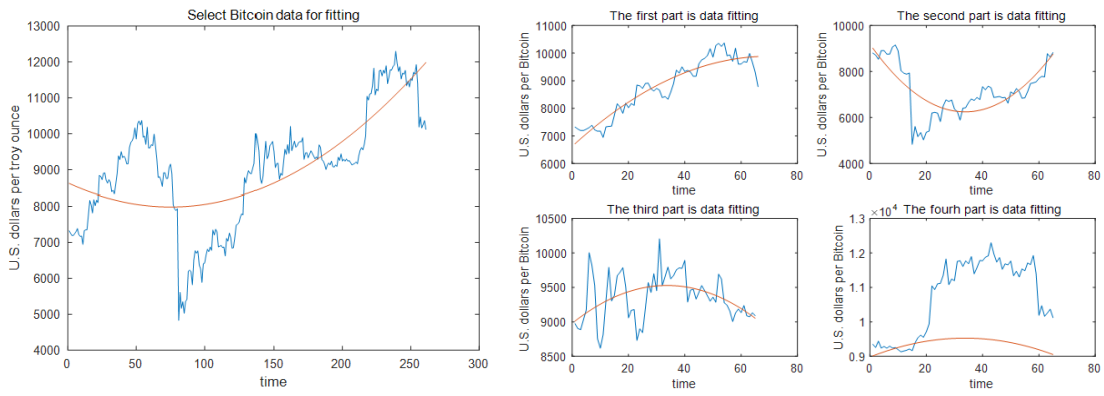

Figure 7: Prediction is an uptrend

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Use the data from the 1200th to the 1460th day of Bitcoin to judge the market price of the 1461st day. As shown in the figure, the left is the overall picture of the predicted market, and the right is the market map divided into 4 segments.

In the figure on the right, it can be seen that the openings of the four fitted quadratic equation curves have three openings facing down and one opening facing upwards. 3 maxima; the second segment a>0, there is 1 minima. The maximum value decreases first and then increases, and it can be judged that the current Bitcoin market is an oscillation period.

Table 1: Fitted extreme points

day n	first paragraph	second paragraph	third paragraph	fourth paragraph
	maximum	minimum	maximum	maximum
1461day	988.6	0624.5	0952.8	1160.4

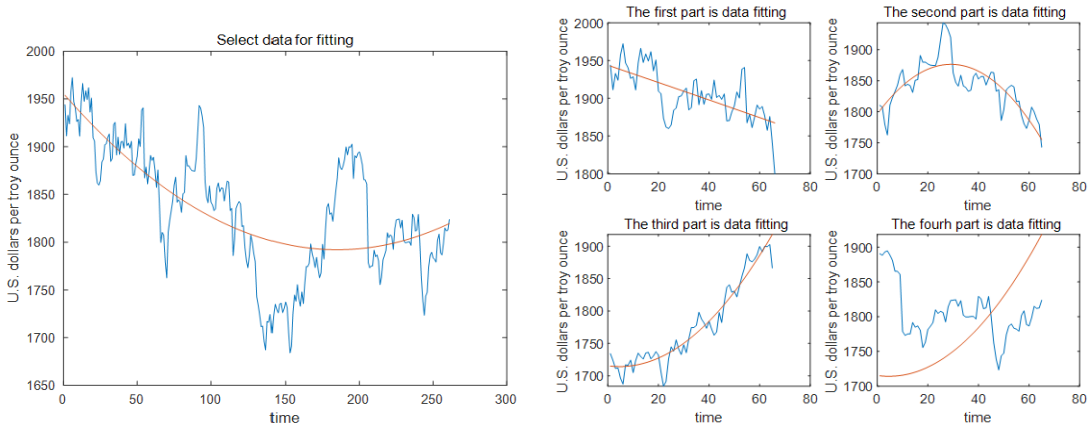

Figure 8: Prediction is an oscillation

Table 2: Fitted extreme points

day n	first paragraph	second paragraph	third paragraph	fourth paragraph
	minimum	maximum	minimum	minimum
The last day	3.0216	1.8764	1.7142	1.7837

Use the last 260 days of gold data to judge the market on the last day. As shown in the figure, the left side is the overall picture of the forecast market, and the right side is the market analysis chart divided into 4 segments.

In the figure on the right, it can be seen that the openings of the four fitted binary linear equation curves have three openings facing upwards and one opening facing downwards. It is inferred that a<0 of the second curve has a maximum value; The second segment a>0, there are 3 minimum values. The minimum value first decreases and then increases, and it can be judged that the current gold market is an oscillation period.

4. Conclusion

In this paper, two models are used in the research of gold and bitcoin, grey model and risk evaluation model based on analytic hierarchy process. Grey model has the following advantages in predicting gold and bitcoin, Firstly, there is no need for a large number of samples. In this question, due to the limited amount of data obtained, it cannot provide enough attributes for analysis, so gray prediction is more suitable for this question. secondly, the samples do not need to be distributed regularly, market laws are elusive, and there is no way to conduct quantitative law analysis. next, the computational workload is small and the computational efficiency can be improved. Finally, the grey model has high accuracy. In addition, the value at risk model based on analytic hierarchy process has the following advantages, the systematic analysis method divides the research object into a system, decomposes it, and completes the decision-making of the problem step by step. the decision-making method is easy to understand, decomposes complex systems, and simplifies multi-objective and multi-criteria problems into multi-level single-objective problems, The required data information is relatively low, starting from the evaluator's grasp of the nature of the problem, and more emphasis on qualitative analysis than general quantitative methods.

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References

[1] Zhang Jiuping. Forecast of cold chain logistics demand for agricultural products in Shandong based on grey forecasting method [J]. China Storage and Transportation, 2021(08): 98-99. DOI: 10.16301/ j.cnki.cn12-1204/f.2021.08. 042.

[2] Chen Yunsong, Yan Fei. Does Internet Public Opinion Affect the Stock Market? Boundary Analysis of ARDL Model Based on Sina Weibo Big Data [J]. Society, 2017, 37(02): 51-73. DOI: 10.15992/j. cnki.31-1123/c.2017.02.003.

[3] Deng Xue, Li Jiaming, Zeng Haojian, Chen Junyang, Zhao Junfeng. Analysis and Application of AHP Weight Calculation Method [J]. Practice and Understanding of Mathematics, 2012, 42(07): 93-100.

[4] Hu Q , Peng Z . Risk Investment Decision-making Model and Application Based on Grey Correlation Theories and Group-decision AHP[C]// 2nd International Conference on Risk Management and Engineering. 2008.

[5] Si Shoukui, edited by Sun Zhaoliang, Sun Xijing, Zhou Gang, Zhong Weijie, Kang Shugui, Mathematical Modeling Algorithms and Applications (Second Edition), Beijing: National Defense Industry Press, August 1, 2011.

[6] Liu Changan, Yan Xiaohu, Liu Chunyang, Wu Hua. Dynamic path planning method for mobile robots based on improved ant colony algorithm [J]. Journal of Electronics, 2011, 39(05): 1220-1224.

[7] Li Peng, Liu Feiyan. Regression scoring method for comprehensive evaluation of multiple indicators [C]//Proceedings of the 2nd China Aviation Science and Technology Conference in 2015., 2015:544-549.

[8] Ji Deyang, Jin Feng, Dong Lei, Zhang Shan, Yu Kunyang. Data restoration of photovoltaic power station based on Pearson correlation coefficient [J/OL]. Chinese Journal of Electrical Engineering: 1-9 [2022-02-22]. DOI: 10.13334/j.0258-8013.pcsee.211172.

[9] Zhang Qi. Functional data correlation test based on Kendall correlation coefficient [D]. Northeast Normal University, 2020. DOI: 10.27011/d.cnki.gdbsu.2020.000389.

[10] Qian Chenjian. Hypothesis test and sample size estimation for comparison of Spearmanrank correlation coefficients [D]. Southern Medical University, 2021. DOI: 10.27003/d.cnki.gojyu.2021. 000765.