Trading Strategies for the Dollar, Gold and Bitcoin

Yihong Sheng

School of Southwest University of Political Science and Law, Chongqing, China

Abstract

Quant trading can create strategies by selecting from a vast pool of historical data a variety of "high probability" events that produce outsized returns. Dollar, gold and bitcoin are all financial products that often attract people's attention. Based on the transaction price data of gold and bitcoin in the last five years, gray analysis, time series analysis and decision tree model are used to find the optimal investment strategy and maximize the total return. Trading strategy is constructed by price forecasting model and asset trading model. Based on the gray prediction model, through the real transaction price data of the first T-1 day, several days' data can be constructed to obtain the data set of t-day. According to this data set, we can predict the price of gold and bitcoin on the t-day. Forecasts are made on a 30-day cycle, revolving from the past to predict asset prices each day into the future. At the same time, the asset trading model is obtained based on decision tree and "37 investment law". Invest $300 in gold and $300 in Bitcoin at the start, and don't make any trades for 30 days to ensure the strategy is accurate. Taking the maximization of total return as the objective function and the minimization of risk as the constraint condition, the planning model is established. It is concluded that the model can obtain a very rich investment return when the risk is moderate, and a good level of return when the risk is low or high. Determine the sensitivity of strategy to transaction cost and the impact of cost on strategy and conclusion. Sensitivity is measured by changes in position. Introduce different transaction costs into the trading strategy to test the impact on the strategy and results. Finding higher trading costs will lead to fewer trades and longer positions. As the cost of trading becomes higher, the returns will be relatively lower. Lower transaction costs will result in more frequent transactions and higher investment returns. Transaction cost and income are inversely related.

Keywords

Grey Prediction; Trading Strategy; Decision Tree; Risk and Return.

1. Introduction

Bitcoin (BTC) is a virtual cryptographic in the form of PEER-to-peer (P2P), based on a specific algorithm, generated by a large number of calculations. Investors like it because it is completely decentralized, limited in quantity and free from regulation. Gold, as a unique investment product, can preserve and hedge, reduce portfolio risk. In addition, with the evolution of the credit system, the degree of financial credit in the international financial market is deepening, and the derivatives of gold investment are becoming more and more popular, and the risk investment value of gold investment is becoming more and more obvious.

Mathematical model of quantitative trading refers to advanced alternative human subjective judgment, using computer technology from huge historical data in the audition can bring excess profits of big probability events to develop strategy, greatly reduce the effect of investor sentiment volatility, avoid under the condition of the market mania or pessimistic to make irrational investment decisions.

The price of various assets in the financial market is constantly changing. Diversified investment trading strategies can help us effectively reduce risks and improve returns. So when market traders buy volatile assets, they build portfolios to maximize total returns. Based on the historical transaction price information of assets, a model can be established to predict the future changes of asset prices, judge whether assets should be traded and the scale of assets to be traded, and formulate the corresponding transaction strategy to achieve the maximum income.

2. Price Forecasting Model

2.1. Prediction Method

Through the real transaction price data of the first T-1 day, several days' data can be constructed to obtain the data set of T days. According to this data set, we can predict the price of gold and bitcoin on the T day. Here, we take a 30-day period for prediction, that is, each data set contains 30 sub-data. Then you can use the trading data of the first 30 days to forecast the asset price of 31 days, and then loop through the past to predict the asset price of each day in the future. The following takes gold as an example to establish GM (1,1) grey prediction model, and the specific steps are as follows:
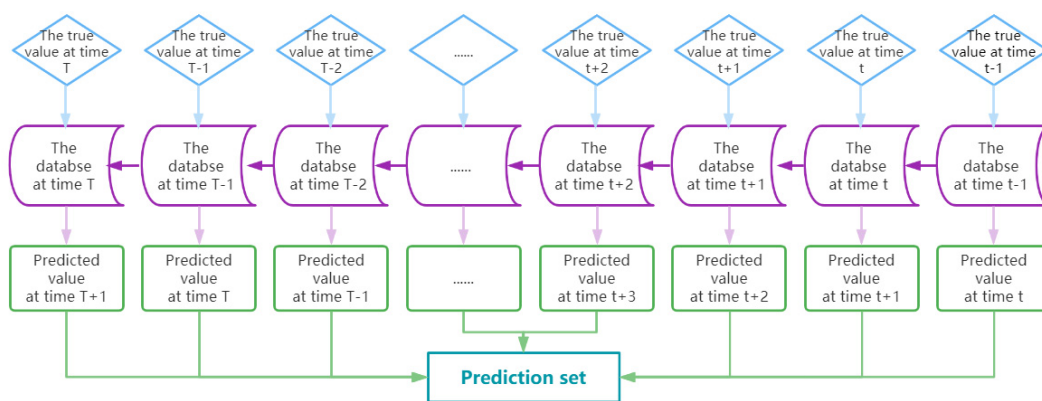

Figure 1. Schematic diagram of cyclic prediction

2.2. Data Inspection and Processing

In order to ensure the feasibility of GM (1,1) modeling method, it is necessary to check and process the known data.

Set the raw data column

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

The level ratio test is the prerequisite for grey prediction GM (1,1). Grey prediction GM (1,1) can only be used after passing the level ratio test, so we carry out the level ratio test fifirst. Calculate the level ratio of a sequence

$$\lambda(k) = \frac{x^{(0)}(k-1)}{x^{(0)}(k)}, k = 2,3,\cdots,n$$

The tolerable coverage range of the stage ratio is

$$X = \left(e^{\frac{-2}{n+1}}, e^{\frac{2}{n+1}} \right)$$

If the level ratios of all sub-data in the data set fall within the tolerable coverage range, GM (1,1) model can be established for the data column and gray prediction can be performed. A prediction cycle of 30 days is carried out, that is, when k=30, the allowable coverage interval of stage ratio is calculated as X= (0.9375, 1.0666).At the same time, k=2, 3, 4... 29 and 30, the level ratio of all sub-data is shown in Table 1:

Table 1. The level ratio of each sub-data when k=30

$\lambda(2)$=1.000717712	$\lambda(12)$=1.010173323	$\lambda(22)$=1.004826678
$\lambda(3)$=1.001437488	$\lambda(13)$=1.003402647	$\lambda(23)$=0.997572622
$\lambda(4)$=1.008353677	$\lambda(14)$=1.003338138	$\lambda(24)$=0.996391896
$\lambda(5)$=1.001872588	$\lambda(15)$=0.996672968	$\lambda(25)$=1.007429599
$\lambda(6)$=0.99505647	$\lambda(16)$=1.007005254	$\lambda(26)$=0.997569334
$\lambda(7)$=1.000799208	$\lambda(17)$=1.023377231	$\lambda(27)$=0.997297727
$\lambda(8)$=0.990724681	$\lambda(18)$=1.010950055	$\lambda(28)$=0.991450297
$\lambda(9)$=0.990291987	$\lambda(19)$=1.011877242	$\lambda(29)$=0.997955412
$\lambda(10)$=1.00033616	$\lambda(20)$=0.996623635	$\lambda(30)$=1.004423206
$\lambda(11)$=0.998619918	$\lambda(21)$=0.999404526	

By analyzing the value of the level ratio of each sub-data in the table, it is concluded that the level ratio of all sub-data is within the tolerable coverage range. Therefore, GM (1,1) model can be established and gray prediction can be made through the level ratio test.

2.3. Establish GM (1,1) Model

Defimine the grey derivative of x (1) as

$$d(k) = x^{(0)}(k) = x^{(1)}(k) - x^{(1)}(k-1).$$

Let z (1)be the adjacent value of the sequence x (1), i.e

$$z^{(1)}(k) = \alpha x^{(1)}(k) + (1-\alpha)x^{(1)}(k-1)$$

Thus, the grey differential equation model of GM (1,1) is defimined as

$$x^{(0)}(k) + az^{(1)}(k) = b$$

The estimation values of A and B are obtained by regression analysis, so the corresponding bleaching model is

$$\frac{dx^{(1)}(t)}{dt} + ax^{(1)}(t) = b$$

Calculate the

$$x^{(1)}(t) = (x^{(0)}(1) - \frac{b}{a})e^{-a(t-1)} + \frac{b}{a}$$

So get the predicted value

$$\hat{x}^{(1)}(k+1) = (x^{(0)}(1) - \frac{b}{a})e^{-ak} + \frac{b}{a}, k = 1,2,\cdots,n-1$$

And get the corresponding predicted value

$$\hat{x}^{(0)}(k+1) = \hat{x}^{(1)}(k+1) - \hat{x}^{(1)}(k), k = 1,2,\cdots,n-1$$

Set k=1, 2, 3... n is put into the grey differential equation model of GM (1, 1) successively, from which the data of z (1) (2) to z (1) (n) can be obtained.

$$x^{(0)}(2) + az^{(1)}(2) = b$$
$$x^{(0)}(3) + az^{(1)}(3) = b$$
$$\cdots\cdots\cdots\cdots$$
$$x^{(0)}(30) + az^{(1)}(30) = b$$

Introducing matrix vector notation $u = \begin{bmatrix} a \\ b \end{bmatrix}$

Using unary linear regression, the least square method, the estimate is $\hat{u} = \begin{bmatrix} \hat{a} \\ \hat{b} \end{bmatrix}$
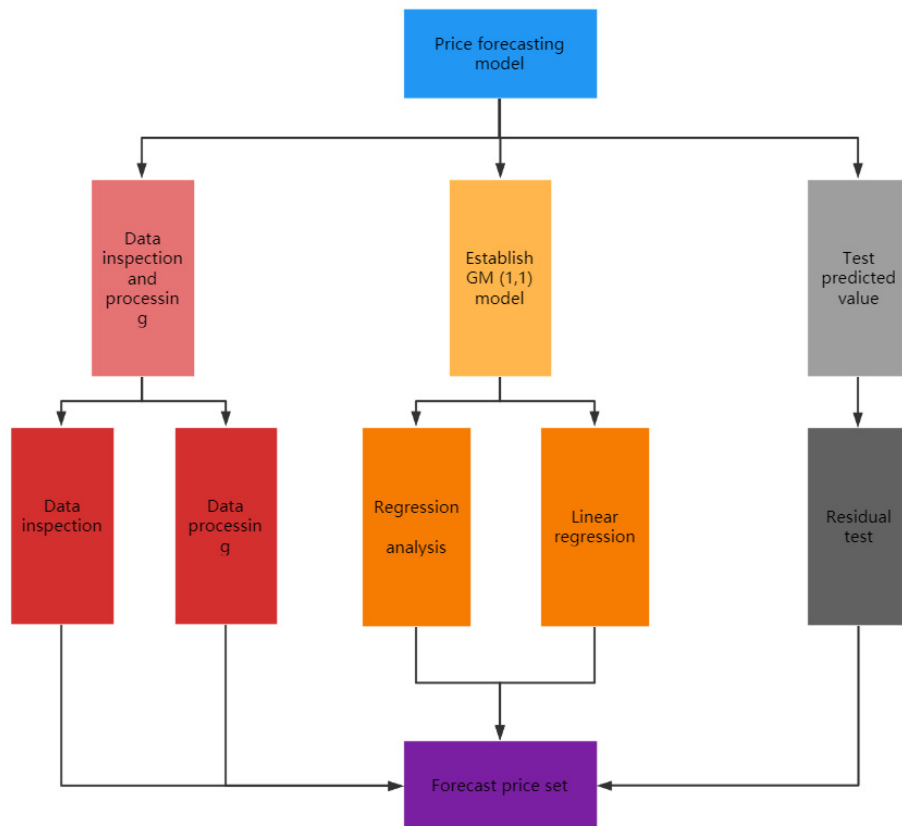

Figure 2. Price forecasting model flow chart

Since the trading cycle is set at 30 days, Set k=1, 2, 3... 29,30 is put into the grey differential equation model of GM (1, 1) successively, from which the data of z (1) (2) to z (1) (n) can be obtained.The matrix vector notation is introduced and the least square method is used to fifind their estimates.The predicted price on the 31st day is 119.06 dollars , which is close to the actual transaction price.

2.4.   Check the Predicted Value

There are many kinds of test methods for grey system model, such as posterior error test, correlation test and residual test. The residual test is a more objective test method, so this method is used to test.Residual test: calculate the relative residual

$$\varepsilon(k) = \frac{x^{(0)}(k) - \hat{x}^{(0)}(k)}{x^{(0)}(k)}, k = 1,2,\cdots,n$$

If all $\varepsilon(k)$ values are less than 0.1, it is considered that the grey system model meets the higher requirement and the prediction effect of the model is better. If all $\varepsilon(k)$ values are less than 0.2, the grey system model is considered to meet the general requirements and the prediction effect of the model is also average.

The absolute value of all relative residuals calculated from the closing price data and forecast data of gold in the previous 30 days is less than 0.1, so we can think that the model has good prediction effect.

Because the data is standardised to eliminate dimensionality, both assets can be predicted using this model, even though gold can only be traded on trading days and Bitcoin can be traded anytime. Using the model to cycle through the above operations, the predicted price of gold and bitcoin for all subsequent trading days can be calculated.

3. Asset Trading Model

3.1.   A Modifified "Rule of 37 Investing"

"The rule of 37" is a popular investment strategy that, for the most part, gives investors good returns on their money."37 investment law" refers to an investment strategy in which the total amount of initial investment will not exceed 0.3 of their total assets, and they will not invest more than 0.7 of their total assets even if they are quite optimistic about the current and future investment situation.
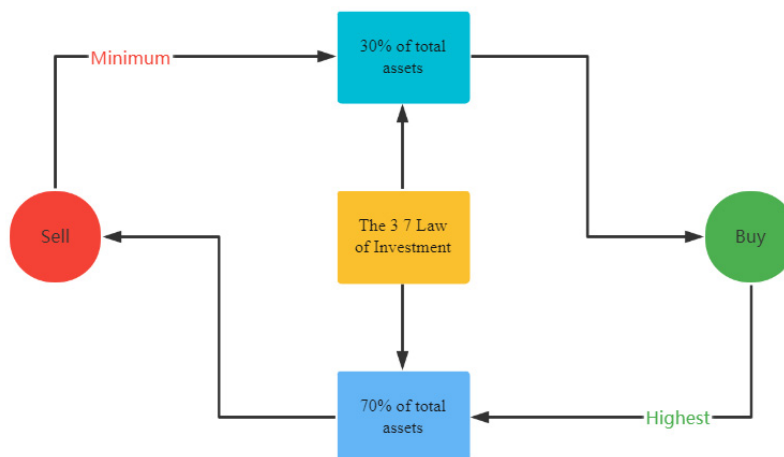

Figure 3. 37 Law of Investment

Gold and bitcoin are both high-quality assets, and it can be seen from the above prediction and analysis that these two assets have broad market prospects, and longterm holding can bring large profifits. Therefore, we decided to adopt the improved "37 investment rule" : when investors invest, the total amount of initial investment in a single asset will not exceed 0.3 of their total assets, and even if they have excellent expectations for an asset, they will not hold the value of the asset more than 0.7 of their total assets.

3.2. The Initial Investment

So, on September 11, 2016, we would buy bitcoin at the closing price of that day for 300 dollars to build a position, and after deducting transaction fees, we would actually get 294 dollars worth of Bitcoin. On September 12, 2016, he spent 300 dollars to buy gold at that day's closing price and, after deducting trading expenses, actually gained 297 dollars worth of gold. According to the grey prediction model established above, no trading will be conducted within 30 trading days to ensure the accuracy of the model prediction and the effectiveness of the trading strategy, so as to achieve the maximum total return.
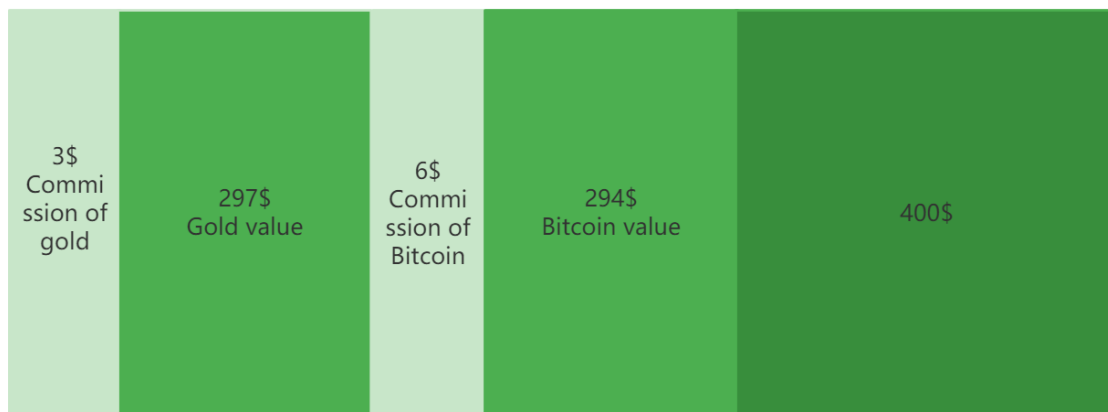
Figure 4. The distribution of assets at the time of initial investment

3.2.1. Remain the Same

The maximum position in a single asset is 0.7 , the other 0.3 is in other assets , gold and bitcoin have a minimum holding ratio of 0.1 . Unless oversold signal to sell the asset, adjust the asset position to the lowest position(Minimum space is 0.1).Keep gold and bitcoin positions no lower than regular positions(Conventional position is 0.3). Oversold signal: after rising for a certain number of times, there is more than 0.8 probability of falling tomorrow, and the cumulative increase of 0.95 percentile of all increases.
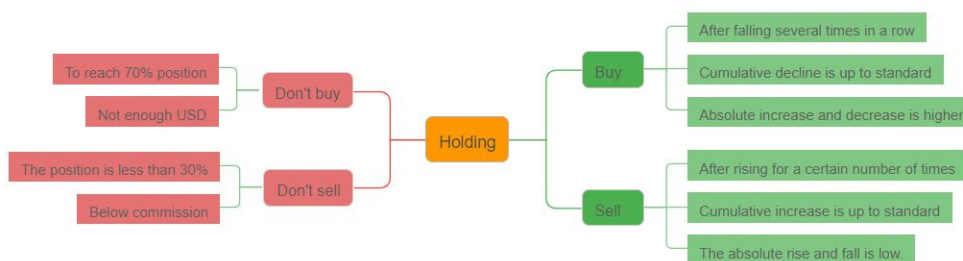
Figure 5. Trade decision graph tree

3.2.2. Buy

If it goes down a certain number of times in a row, there's a 0.9 chance it's going up tomorrow ,or,after a certain number of consecutive declines, there is a 0.5 or more chance of a rise and a cumulative decline of 0.1 of all declines . When one of these scenarios occurs and the

forecast absolute gains or losses are at least 0.7 quartile of all absolute gains or losses, we consider buying.
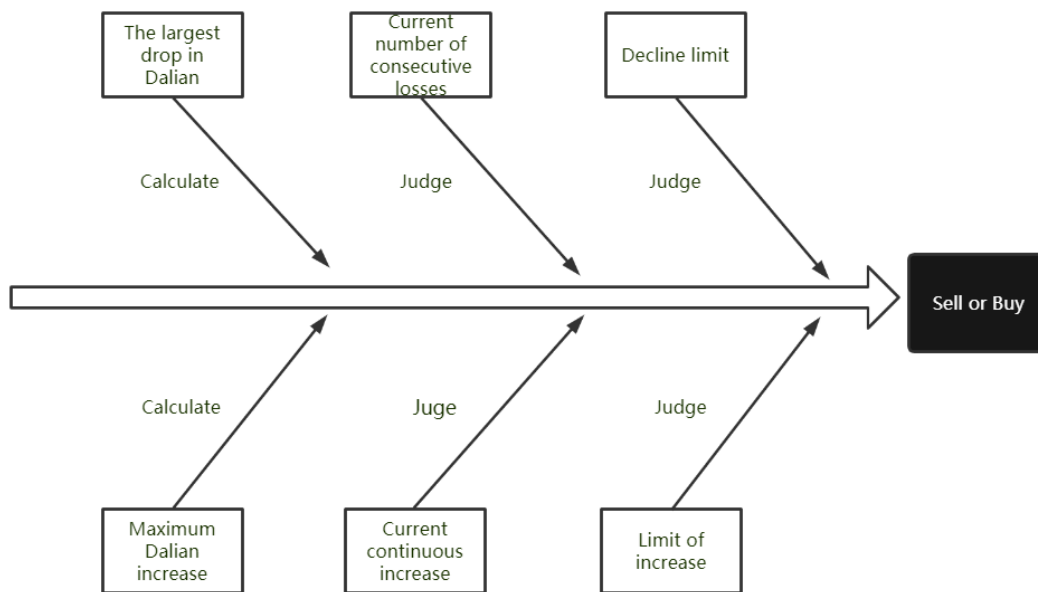

Figure 6. Transaction decision chart

After deciding that a buy decision should be made, there are two buying situations:

Situation 1: There is only one buy signal that day. Only one asset, gold and bitcoin, was bought that day. If the holding level of this asset is lower than the regular position, it needs to fifill the regular position and then buy.

$$\eta_1 = \gamma \times \frac{1}{N-n}$$

The total amount added after the NTH addition

$$\varepsilon = \frac{\gamma}{(N-n-1)} - \frac{\gamma}{(N-n)^{t-1} \times (N-n-1)}$$

If the amount needed to buy is greater than all the dollars currently held, use all the dollars to buy.

Situation two: There are two buy signals that day. Buy gold and bitcoin at the same time.

Respectively in accordance with the amount of two assets to buy. If the sum of the two assets is greater than the amount held, the allocation shall be based on the proportion of the amount added.

3.2.3. Sell

After going up a certain number of times in a row, there's a 0.9 chance it's going to go down tomorrow ,or, after a certain number of consecutive increases, there is more than a 0.5 chance of a decline and a cumulative increase of 0.9 percentile of all increases . When one of these scenarios occurs and predicted absolute gains and losses are no more than 0.3 quartiles of all absolute gains and losses , we consider selling.

$$\omega = \mu - 0.3\vartheta$$

If there is an overshoot signal in the market, then directly adjust the position to the minimum position of 10%, and then wait for the buy signal. If there is a sell signal or two on the day, sell if and only if the profit of the total added position is greater than or equal to the commission fee. When calculating the fees, consider the fees paid for all the additional purchases up to this point and the fees paid for the reduced sales.

Using price forecasting models and asset trading strategies, the initial $1,000 investment is worth $14,359.75 on October 9, 2021.

4. Models that Provide the Best Strategy

When measuring the quality of an investment strategy, it usually considers the yield and risk of the strategy from these two dimensions. An investment model is a good one if it leads to a higher return on the portfolio and a lower risk. However, risk and return often exist in opposition to each other. High return is generally accompanied by high risk, and high return is hidden in high risk. Previous models always search for low-risk but high-yield investments based on information related to market failure and resource misallocation. Such opportunities are often difficult to search and the probability of occurrence is very low.
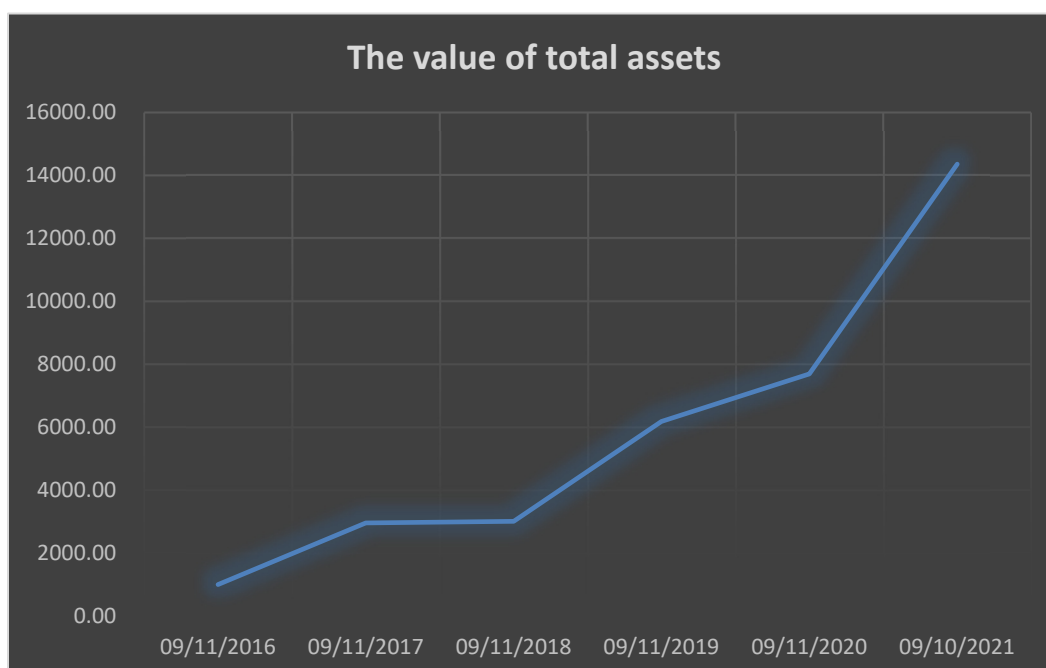

Figure 7. Total asset appreciation

Therefore, we built a model that is slightly different from the conventional investment model, and can make a good profit when the risk is moderate. Using this model and strategy, we can calculate the growth of total assets during the five years of investment, as shown in the figure above.

If you look at the chart above, you can make a good return in the first year of investing with this strategy. The second year of the total revenue curve smooth, total revenue rise smaller, is likely to be further positions. From the third year, the total assets rose rapidly, indicating a very good investment effect.
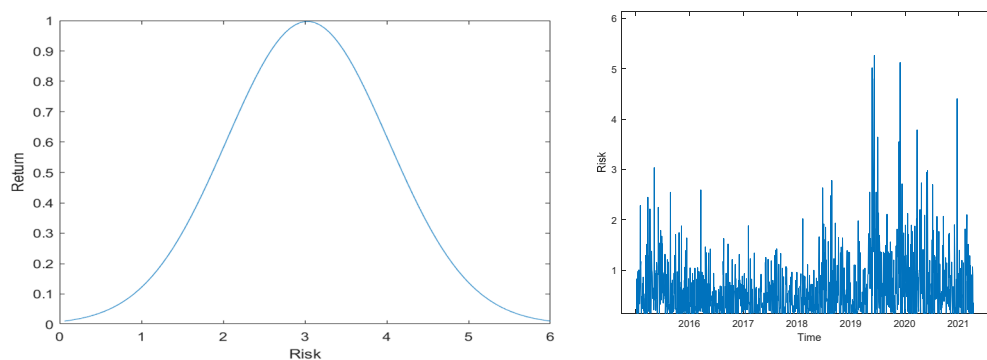
(a) The relationship between time and risk   (b) The relationship between risk and return

Figure 8. Risk scenarios

In addition, the risk situation of the model is analyzed and the above two figures are obtained. There is a normal distribution relationship between risk and return. When the risk is moderate, the return that can be obtained is the highest, and the probability of the return is also the largest. When the risk degree is moderate, the growth of total assets is also the largest.

5. The Sensitivity of a Policy to Transaction Costs

According to the cost-benefit model, cost is a very important factor affecting income. When trading, the first problem investors face when making decisions is cost, and the consideration of cost is especially important.

Generally speaking, investors will consider whether to invest when and only when expected return minus cost is greater than or equal to zero, that is to say, profit is positive, which is the prerequisite and necessary condition for investment. However, due to the uncertainty of the future, the expected revenue is often not so reliable, so it is biased to measure only the expected revenue minus the cost, which is not very accurate.
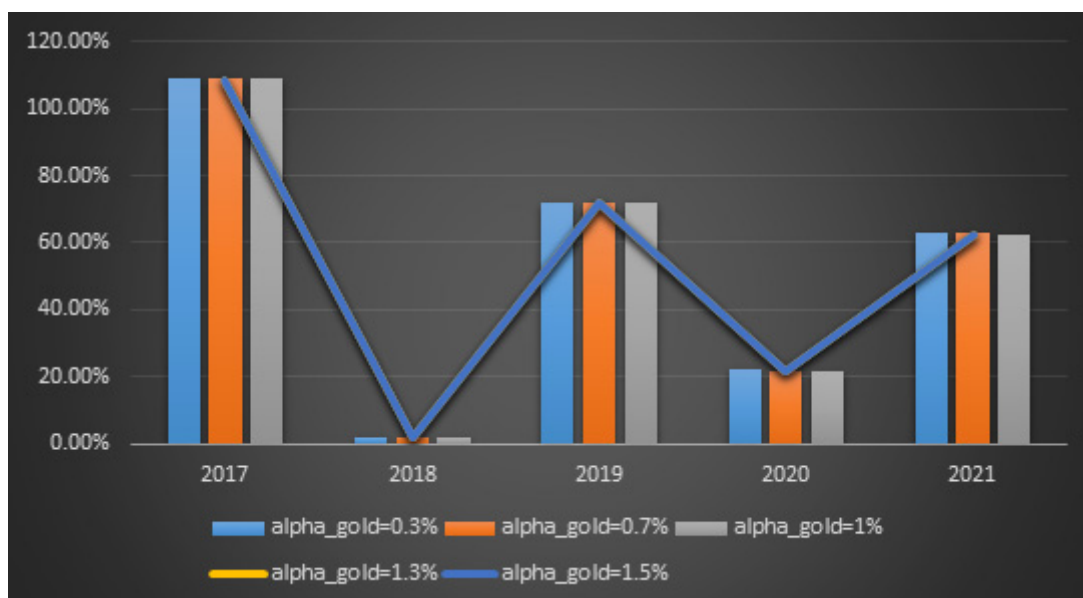

Figure 9. The impact of changes in gold transaction costs

Therefore, we conduct sensitivity analysis on the cost in the model, that is, the commission per transaction, and judge the impact of cost on revenue in this model.When exploring the

sensitivity of strategies to transaction costs, we should start from two directions: the transaction costs of gold do not change, and the impact of flfluctuation of bitcoin transaction costs on investment strategies; The transaction cost of bitcoin does not change, while the flfluctuation of the transaction cost of gold affects the investment strategy.

Due to the influence of the market, especially the increasingly fierce competition in the current financial market, the commission generally does not have a big increase, but often has a discount, so we control the gold commission between 0.3% and 1.5% fluctuation, bitcoin commission between 0.6% and 3% fluctuation. According to different commissions, we can get the following income chang.
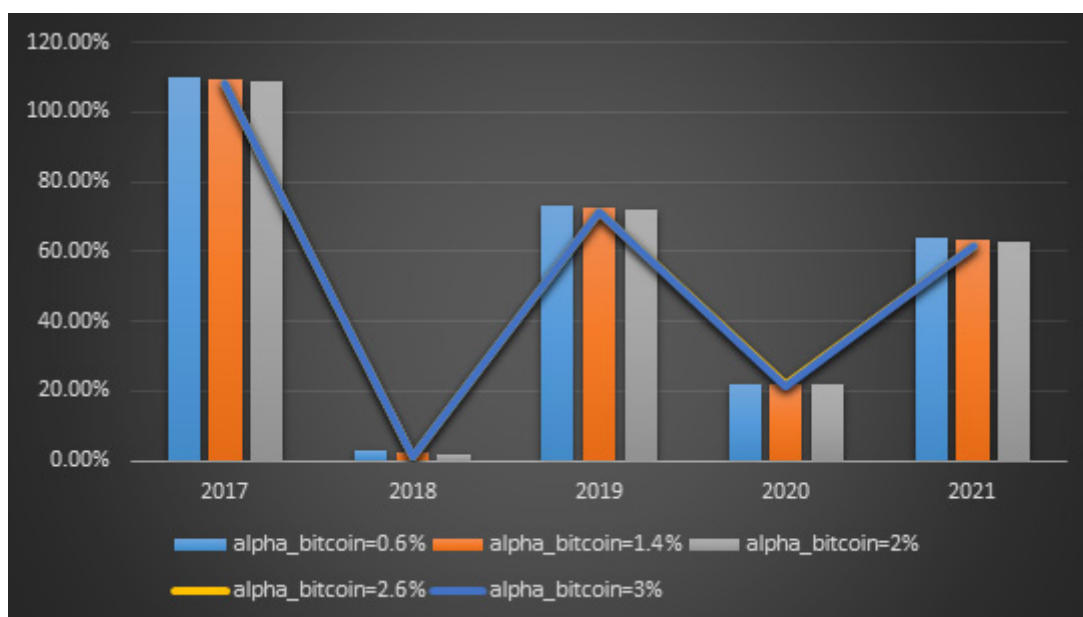

Figure 10. The impact of changes in bitcoin transaction costs

It can be seen that in this model, the change of commission has little impact on returns, investors' returns are not greatly affected by costs, and the sensitivity of commission to investors' annualized returns is low. From this we can conclude that the model is an excellent model.

6. Strengths and Weaknesses

6.1. Strengths

Our models and solutions stand out on the following points:

• The model can achieve high returns with moderate risks, and can also achieve good returns with low or high risks.

• The model is established for gold and bitcoin. The simulation of gold and bitcoin transactions is highly reliable, and the research results are of great reference value.

• The establishment of the model is based on the grey prediction model, whichcombines the time series prediction model, discriminant analysis and decision tree and other methods to construct the trading strategy, which is an innovation to a great extent.

• The model measures risks with probability, based on the fact that history will repeat itself, and deduces the possibility of future occurrence according to the law of history, with high accuracy.The predicted asset prices are very accurate under certain conditions and very close to the actual asset prices.

6.2.   Weaknesses

Due to the limitation in time and data, there are unavoidably some weaknesses in our models that we would like to improve and modify afterwards:

• The strategy is suitable for medium - and long-term investment, and is stable in the good assets, other types of assets with this strategy may not achieve such effect.

• The model does not take into account the correlation between gold and bitcoin. If there is a certain correlation between the two, it will have a certain impact on trading strategy.

• Since the closing prices of trading days are used for buying and selling transactions, the inflfluence of intraday price changes is not taken into account, which may change the stability of the model.

7. Conclusion

The Dollar , gold and bitcoin are all popular investments that people want to make a lot of money from. But the rapid changes in the financial markets have left many investors happy and unhappy, which also worries us. To this end, we propose a model to help people make investment decisions so that people can achieve the maximum return within their risk tolerance.

When we consider whether a financial product is worthy of investment, we tend to consider three factors: liquidity of financial product, safety of financial product and profitability of financial product. Therefore, we take these three factors into consideration when constructing the trading strategy, and finally get this trading strategy. This strategy is determined by two models: the price forecasting model and the asset trading model.

The first is the price forecasting model.Through the real transaction price data of the first T-1 day, several days' data can be constructed to obtain the data set of T days. According to this data set, we can predict the price of gold and bitcoin on the T day. Here, we take a 30-day period for prediction, that is, each data set contains 30 sub-data. Then you can use the trading data of the first 30 days to forecast the asset price of 31 days, and then loop through the past to predict the asset price of each day in the future.

Then there is the asset trading model. When investors invest, the total amount of initial investment in a single asset will not exceed 30% of their total assets, and even if they have excellent expectations for an asset, they will not hold the value of the asset more than 70% of their total assets. Keep the assets unchanged. The maximum position in a single asset is 70% , the other 30% is in other assets , gold and bitcoin have a minimum holding ratio of 10% . Unless oversold signal to sell the asset, adjust the asset position to the lowest position(Minimum space is 10%).Otherwise, keep gold and bitcoin positions no lower than regular positions (Conventional position is 30%).

Buying assets.If it goes down a certain number of times in a row, there's a 90% chance it's going up tomorrow ,or, after a certain number of consecutive declines, there is a 50% or more chance of a rise and a cumulative decline of 0.1 of all declines. When one of these scenarios occurs and the forecast absolute gains or losses are at least 0.7 quartile of all absolute gains or losses, we consider buying. After deciding that a buy decision should be made, there are two buying situations:

Situation 1: There is only one buy signal that day. Only one asset, gold and bitcoin, was bought that day. If the holding level of this asset is lower than the regular position, it needs to fill the regular position and then buy. Situation two: There are two buy signals that day. Buy gold and bitcoin at the same time.Respectively in accordance with the amount of two assets to buy. If the sum of the two assets is greater than the amount held, the allocation shall be based on the proportion of the amount added.

Sell assets. After going up a certain number of times in a row, there's a 90% chance it's going to go down tomorrow ,or, after a certain number of consecutive increases, there is more than a 50% chance of a decline and a cumulative increase of 0.9 percentile of all increases . When one of these scenarios occurs and predicted absolute gains and losses are no more than 0.3 quartiles of all absolute gains and losses , we consider selling.

If there is an overshoot signal in the market, then directly adjust the position to the minimum position of 10%, and then wait for the buy signal. If there is a sell signal or two on the day, sell if and only if the profit of the total added position is greater than or equal to the commission fee. When calculating the fees, consider the fees paid for all the additional purchases up to this point and the fees paid for the reduced sales.

In the long run, a transaction based on this trading strategy will not only ensure the security and liquidity of the transaction, but also ensure the profitability of the transaction. In this way, the corresponding increase and decrease of positions will be the final result of a reliable and safe higher investment income.

References

[1] Deng Xue, Lin Yingxian. Research on complex Reality-constrained portfolio Based on Improved Particle Swarm Optimization [J]. Operations Research and Management Research, 201,30(04):142-147.

[2] Xie Naiming, LIU Sifeng. Modeling mechanism of discrete GM(1,1) model and grey prediction model [J]. Systems engineering-theory & practice,2005(01):93-99.

[3] Yao Haixiang, Li Junwei, Xia Shenghao, Chen Shumin. Fuzzy Transaction Decision Based on Apriori Algorithm and Neural Network [J]. Journal of Systems Science and Mathematics, 201,41(10):2868-2891.

[4] Liu Lijun, LIANG Guopeng, Wang Haitao. Research on quantitative Trading Strategy System Model [J]. Shanghai Commerce,2021(09):158-159.

[5] He X. Virtual currency portfolio strategy design based on PLSTM-ATT [D]. Shanghai normal university, 2021. DOI: 10.27312 /, dc nki. Gshsu. 2021.001619.

[6] Tan Y. Research on CNN-BilSTM stock price prediction model and quantitative trading strategy based on Attention mechanism [D]. Harbin Institute of Technology,2021.

[7] Chen Ningjuan. Quantitative timing trading strategy based on neural network research [D]. Shandong university, 2021. The DOI: 10.27272 /, dc nki. Gshdu. 2021.003765.

[8] Peng Yong, Chen Yuqiang. An improved gray prediction model [J]. Computer & digital engineering, 2012, 40 (01):40-41+62.