

Research on Optimal Strategy Based on Exponential Smoothing Prediction Model

Ke Xu, Bo Lin, Shuai Ma, Hao Xu, Yuncong Wang

Guilin Institute of Information Technology, School of Information Engineering, Guilin, Lingchuan, 541004, China

Abstract: In this paper, firstly, the exponential smoothing parameter model is constructed, and after comparison, the Holt-Winters exponential smoothing model is applied. Through the analysis of variance and trend analysis, we find that the optimal model parameter γ matching gold and bitcoin is 2. Secondly, it is classified and discussed based on greedy algorithm and the final result is obtained.

Keywords: Optimal strategy; Smoothing parameter model; Greedy algorithm

1. Introduction

Market traders buy and sell volatile assets frequently, with a goal to maximize their total return. There is usually a commission for each purchase and sale. Two such assets are gold and bitcoin^[1]. In the long-term development of human society, gold has been endowed with the function of monetary value in the human's economic activities. And after a long historical evolution, it has become a quality investment project. Bitcoin, the world's first and by far the most successful blockchain application^[2], has become a hot investment product as its price has continued to rise in recent years. There is usually a commission on every transaction, so a reasonable trading strategy is very crucial to the final profit.

2. Choice of prediction model

2.1. Simple Exponential Smoothing

The first exponential smoothing method is the deformation of the simple moving average method, and the model^[3] is:

$$S_t^{(1)} = \alpha y_{t-1} + (1-\alpha)S_{t-1}^{(1)} \quad (1)$$

The predicted value of t+1 period is the weighted average of the last actual value and predicted value, and the prediction formula is:

$$S_t^{(1)} = \alpha y_t + (1-\alpha)S_{t-1}^{(1)} \quad (2)$$

In the formula, α is the smoothing factor; T is the time serial number; Y is historical data; $S_t^{(1)}$ is an exponential smoothing value.

2.2. Holt-Winters Exponential Smoothing

A triple Exponential Smoothing model^[4] is used to smooth simple Exponential Smoothing twice. It is suitable for time series models with trend and seasonality. There are two Smoothing equations and one prediction equation. The basic cubic exponential smoothing model is as follows:

$$\begin{cases} S_t^{(1)} = \alpha y_t + (1-\alpha)S_{t-1}^{(1)} \\ S_t^{(2)} = \alpha y_t + (1-\alpha)S_{t-1}^{(2)} \\ S_t^{(3)} = \alpha y_t + (1-\alpha)S_{t-1}^{(3)} \end{cases} \quad (3)$$

In the formula, α is the smoothing factor; T is the time serial number; Y is historical data; $S_t^{(1)}$ is the first exponential smoothing value; $S_t^{(2)}$ is quadratic exponential smoothing value; $S_t^{(3)}$ is a cubic

exponential smoothing value.

The prediction model ^[5] of cubic exponential smoothing is as follows:

$$y_{t+T} = a_t + b_t T + c_t T^2 \tag{4}$$

In the formula ^[6], y_{t+t} is the predicted value, t is the number of intervals between the time series requiring the predicted value and the current series, a, B and C are smoothing coefficients, and the calculation formula is as follows:

$$a_t = 3S_t^{(1)} - 3S_t^{(2)} - 3S_t^{(3)} \tag{5}$$

$$b_t = \frac{1}{2(1-\alpha)^2} [(6-5\alpha)S_t^{(2)} - 2(5-4\alpha)S_t^{(2)} + (4-3\alpha)S_t^{(3)}] \tag{6}$$

$$c_t = \frac{\alpha^2}{2(1-\alpha)^2} [S_t^{(1)} - 2S_t^{(2)} + S_t^{(3)}] \tag{7}$$

The prediction accuracy is evaluated according to Root Mean Squared Error to select the optimal smoothing factor. When MSE is the smallest, the smoothing factor is the optimal, and the formula is as follows:

$$MSE = \sqrt{\frac{1}{N} \sum_{t=1}^N (x_t - \hat{x}_t)^2} \tag{8}$$

The key of exponential smoothing method is to determine the size of smoothing coefficient α and period T. Since only the best daily trading strategy can be given according to the price data of the day, the value of smoothing coefficient α and period T in this modeling is 0.5 and 2, respectively. The prediction accuracy and RMSE are shown in the following table:

Table 1: Prediction accuracy and variance

Category	Simple exponential smoothing	Holt-Winters Exponential Smoothing	Holt-Winters RMSE
Gold	0.8272	0.9648	2.21
BTC	0.77429999	0.9066447007138935	895.88

As can be seen from the above table, the prediction accuracy of The Holt-Winters seasonal prediction model is significantly higher than that of the simple exponential smoothing model. Therefore, in this case, the Holt-Winters seasonal model is used to predict the price of bitcoin and gold and the forecast trend of the five-year trading period is obtained, as shown in Figure 1:

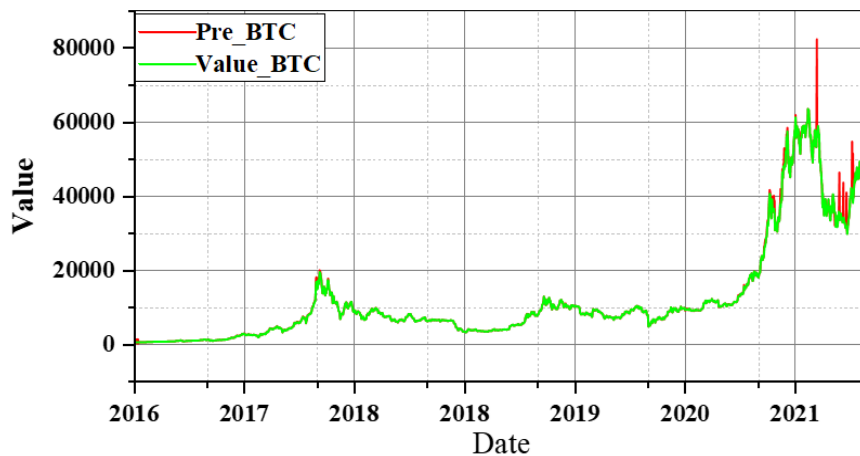


Figure 1: Bitcoin predicted value and actual value

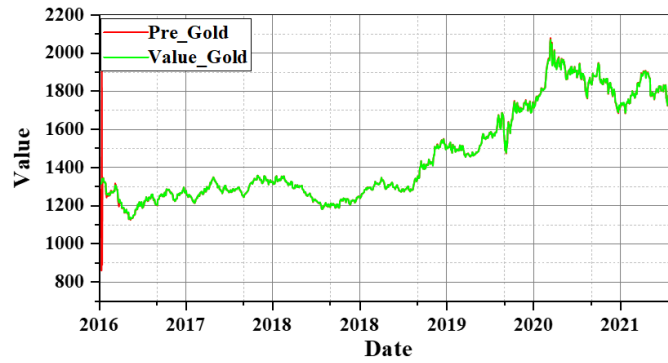


Figure 2: Gold predicted value and actual value

As can be seen from the figure above, the predicted value of gold fluctuated greatly in the previous few days, so investment can be bought after the fluctuation is stable^[7], that is, investment can be started after 1% days of the 5-year trading period. At this time, the model has a good fitting effect, so the predicted data can be used for the following modeling.

3. The optimal strategy model of daily trading

We determine that the daily trading amount is related to the assets of the previous day, and discuss by classification how to allocate the total assets of the previous day on the day. Following the greedy algorithm idea of "daily net return after trading is positive^[8]", we get the daily trading strategy by classification discussion:

Asset purchase: An asset purchase is considered when cash D is in hand and the net income forecast for tomorrow is greater than 0.

According to the above deduced buying and selling formulas, the net income formula can be obtained as follows:

$$\omega = \left(\frac{(1-a)^2 \cdot Y}{X} - 1 \right) \cdot D \tag{9}$$

Asset sale: when the number of assets held is Z and the next forecast price Y is less than the asset price X of the day, all the assets will be sold.

When both assets are bought simultaneously on a single day: buy only the assets with greater daily net returns.

According to the above predicted value and derivation analysis, the classified discussion each case can achieve maximum benefits of trading strategies, because the daily investment assets associated with the total assets of the day, so you just need to transfer with the previous state, iteration to the last day, the process cycle through the Python language found guilty of the objective function to get the daily total assets, the results shown:

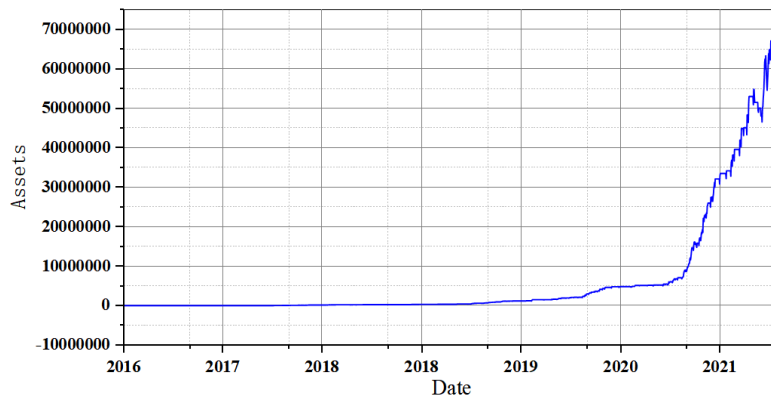


Figure 3: Daily asset change chart

4. Conclusion

In market trading, trading strategy directly determines the target rate of return, so we propose a strategy model to help market traders maximize returns. Therefore, this paper first forecasts the asset prices of the day after the trading day. We choose two exponential smoothing models and apply Holt-Winters exponential smoothing model after comparison. Through the analysis of variance and trend analysis, we find that the optimal model parameter γ matching gold and bitcoin is 2. We forecast the price of gold and bitcoin on the next trading day based on the previous data set. Secondly, the optimal strategy model of daily transaction is established: through the sale and purchase of assets in the market transaction, the predicted price trend is combined with the greedy algorithm to get different daily trading situations. and what can be done in each case is classified and discussed.

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