Assets Trading Strategy Based on ALG Evaluation and Prediction Integrated Model

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Abstract. With the rapid development of economy and the maturity of financial markets, more and more people choose to invest in stocks to achieve property appreciation, so the study of stock investment decision-making is increasingly important. In this topic, in order to maximize the interests of investors, our team not only needs to accurately predict the future trend of gold and bitcoin, but also needs to make the most reasonable strategy according to the future trend of gold and bitcoin. Therefore, our team reads a large number of papers, refer to the current model of stock trend prediction and decision-making and combine with the data given by the topic to establish our model. According to the stock trend, this paper designs an ALG (Apriori algorithm - Attentional BiLSTM neural network - GARCH model) evaluation and prediction integrated model, and makes a time series chart of daily return rate related to gold and bitcoin, finally predicts the daily return rate. This paper compares the daily yield predicted by ALG model with that predicted by grey model, which shows that the yield predicted by ALG model is much higher than that predicted by grey prediction model.

Keywords: ALG evaluation and prediction integrated model; daily rate of return; Apriori algorithm; Attentional BiLSTM; GARCH.

1. Introduction

With the gradual improvement of the financial market and the improvement of people's income level, more and more people begin to increase their property by investing volatile asset [1-2]. However, due to the uncertainty of the volatile asset trend, many market traders have suffered a lot of losses when investing in volatile asset [3-5]. Therefore, how to establish an accurate asset trend prediction and decision-making model, so as to maximize the interests of traders is very important [6-7].

Specifically, we need to browse a large number of relevant literatures, refer to relevant asset prediction and decision models, and use the data of the past daily prices of gold and bitcoin to put forward our own model of asset prediction and decision based on that, so as to provide favorable opinions for investors and maximize their interests [8-10].

In this paper, according to the stock trend, an ALG evaluation and prediction model is designed to predict the daily return. Compared with the daily rate of return predicted by the grey prediction model, it shows that the prediction of ALG model is accurate and the benefit is high.

2. ALG evaluation and prediction integrated model

We first analyze the daily price of gold and bitcoin for five years and make a time series chart. Then, based on the previous daily price data, we use the Attentional BiLSTM neural network to predict future gold and bitcoin daily prices based on previous daily price data to make better decisions. for the best daily strategy, we use Apriori algorithm to get the strong correlation between gold's buy, hold, sell and bitcoin's buy, hold, sell. Finally, our team uses the GARCH model to calculate the daily return rate of gold and bitcoin in five years, and makes the relevant time sequence diagram of daily rate of return for our team to make better decisions on daily trading strategies. The following chart is

the flow chart of ALG evaluation and prediction integrated model designed by our team. According to Figure 1.

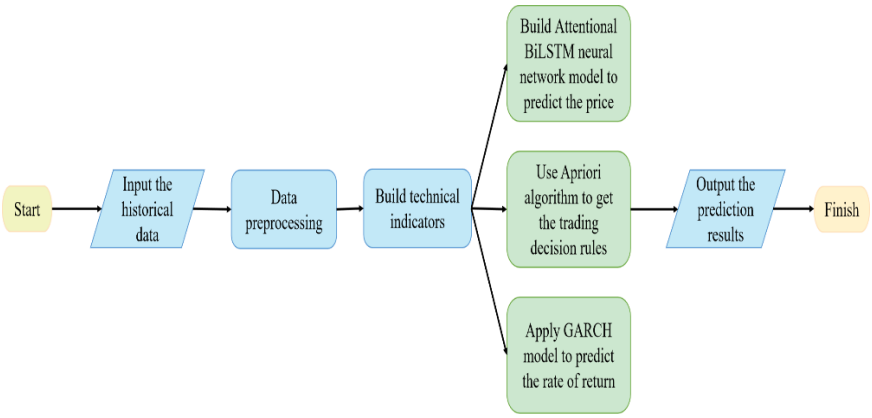

Figure 1. ALG model flow chart

2.1 Apriori algorithm

The principle of Apriori algorithm is that firstly, candidate 1- item sets are generated by scanning the data set, and the number of occurrences of each candidate data item (item set support) is calculated. Then, frequent 1- item sets L1 are generated based on the given minimum support, and candidate 2- item sets are generated based on L1 and the data in the data set, and frequent 2- item sets L2 are generated based on the given minimum support. Using the same method, until it is no longer possible to generate (n + 1) - item sets satisfying minimum support in the generated frequent n- item sets Ln. Our team uses Apriori algorithm to get the strong correlation between bitcoin and gold transactions, so as to make better transaction decisions. The formula of Apriori algorithm is:

$$support(A \Rightarrow B) = P(A \cup B) \tag{1}$$

$$confidence(A \Rightarrow B) = P(B|A) = \frac{support_count(A \cup B)}{support_count(A)} \tag{2}$$

2.2 Attentional BiLSTM neural network

The bidirectional LSTM neural network is divided into input layer, bidirectional LSTM part, fully connected layer and output layer. The bidirectional LSTM part is composed ofmultilayer bidirectional LSTM, and the fully connected layer part is composed of multilayer fully connected layers. In addition, we add multi-head attention mechanism to the bidirectional LSTM neural network, which can make the model focus on different aspects of information and integrate, so as to better predict the price of gold and bitcoin transactions. The effect is better than random forest, deep neural network (DNN) and logistic regression model. Based on previous trading data, our team uses this neural network to predict the future price of gold and bitcoin to make better scientific and accurate decisions. Figure 2 is the structure diagram of Attentional BiLSTM neural network:

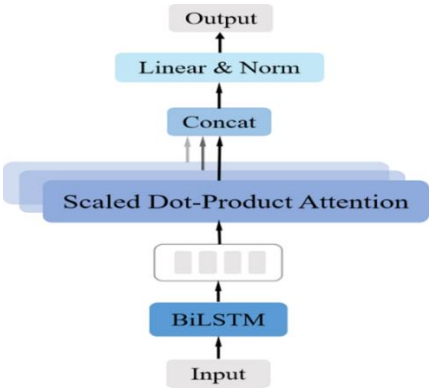

Figure 2. Structure diagram of the Attentional BiLSTM neural network

2.3 GARCH model

GARCH model is called autoregressive conditional heteroscedasticity model, which is suitable for high-frequency financial time series. The data often show the characteristics of volatility clustering, but in the long run, the data is stable, that is, the long-term variance (unconditional variance) is a constant, but in the short term, the variance is unstable. We call this heteroscedasticity conditional heteroscedasticity. Gold and Bitcoin trading is characterized by frequent volatility clustering. Our team uses this model to predict the daily return rate within five years of trading time, and combines Apriori algorithm and Attentional BiLSTM neural network to make daily trading strategy decisions. Based on this model, GARCH formula are:

$$y_t = a_0 + x_t + \varepsilon_t, in\ \varepsilon_t = v_t\sqrt{h_t}, x_t contains\ y_t\ and\ \varepsilon_t\ lag\ term \tag{3}$$

$$h_t = a_0 + \sum_{j=1}^{p} \beta_j h_{t-j} + \sum_{i=1}^{q} \partial_i\, \varepsilon_{t-j}^2 \tag{4}$$

$$\sum_{i=1}^{q} a_i + \sum_{j=1}^{p} \beta_j < 1, a_0 > 0, a_i \geq 0 (i = 1,2, \dots, q), \beta_j \geq 0 (j = 1,2, \dots, p) \tag{5}$$

$$v_t = and \varepsilon_{t-i} (i \geq 1) independence, and E(v_t) = 0, var(v_t) = 1 \tag{6}$$

3. Application of ALG model

3.1 Forecast rate of return based on deep network LSTM and GARCH model

The Attentional BiLSTM neural network is used to predict the daily price of gold and bitcoin. First, the data is preprocessed, and then the data is input to the bidirectional LSTM neurons until the LSTM neurons in the forward and backward layers learn the complete time series, and then the features are further extracted through the multi-head attention module, and finally the predicted value is output through the full connection layer. According to the predicted data, our team adopts the method of combining Apriori algorithm with GARCH model to provide scientific and accurate decision-making scheme.

The mean square error (MSE) of the model is 30.36, the mean absolute error (MAE) is 21.78, and both values are within a reasonable range, indicating that the error is not very large. The mean absolute percentage error (MAPE) is 0.0071, and the value is close to 0, indicating that the model is perfect. The selection of the model is reasonable, and the fitting coefficient (R2) is 0.9818, indicating that the model has good fitting effect.

Table.1. Gold part closing price forecast

Date	**Closing price true value**	Closing price forecast
2016-9-13	1323.65	1327.52
2016-9-14	1321.75	1328.92
2016-9-15	1310.80	1312.24
2016-9-16	1308.35	1309.10
2016-9-19	1314.85	1323.09
2016-9-20	1313.80	1313.42
2016-9-21	1326.10	1325.26
2016-9-22	1339.10	1342.21

Table.2. Bitcoin partial closing price forecast

Date	**Actual value**	Predictive value
2016-9-12	609.67	597.44
2016-9-13	610.92	609.16
2016-9-14	608.82	610.21
2016-9-15	610.38	601.19
2016-9-16	609.11	603.42
2016-9-17	607.04	606.75
2016-9-18	611.58	613.63
2016-9-19	610.19	609.94

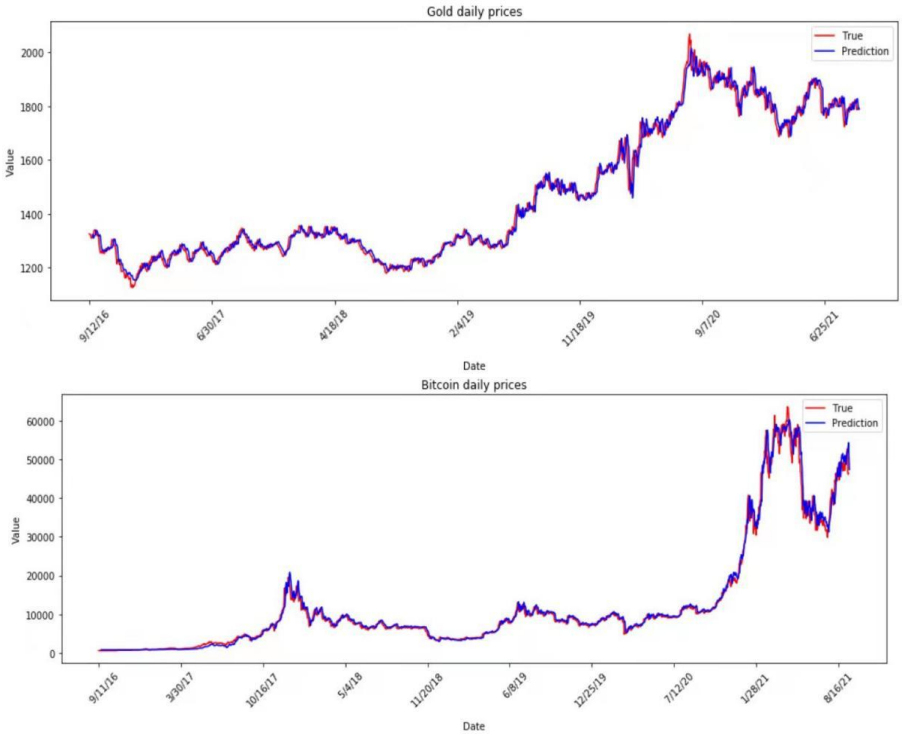

Figure 3. Real and predicted closing prices of gold and bitcoin

From Table.1 and Table.2 and Figure 3, it can be seen that the daily price of gold and bitcoin predicted by the Attentional BiLSTM neural network is very close to the real value, indicating that the prediction effect of the model is good. From the graph, it can be seen that the two lines of the real value and the predicted value of gold and bitcoin are very close, further indicating that the fitting effect of the model is good.

Then our team uses Apriori algorithm, GARCH model and combines with the prediction value of Attentional BiLSTM neural network to make decisions on gold and bitcoin's holding, selling and buying. Finally, we combine with the daily forecast yield analysis to provide the best strategy. Through the analysis of Apriori algorithm, we conclude that gold selling is likely to lead to bitcoin selling, and this confidence reach 70%, while the importance of this combination reached 25%

The unit root test p value of the GARCH model results is 0, and the original hypothesis is rejected at the 99% confidence level, so the time series is stable. The P value of the test value lag by 12 items is 0.9358, which is greater than 0.05, and the original hypothesis cannot be rejected at the level of 5% dominance. Therefore, the white noise test can be considered, that is, we believe that the residuals obtained by regression do not have obvious correlation, so the model is effective.

Through the ALG model, we predict the daily rate of return with the condition of the commission for each transaction costs for gold and bitcoin are 1% and 2% respectively. At the same time, we consider that gold is an international currency and bitcoin is a virtual currency. Therefore, for the sake of insurance, more gold is initially bought and bitcoin is less bought. Finally, we calculate that the initial $1000 values $1504 on October 9,2021.

Figure 4. Golden time series diagram

Figure 5. Bitcoin time series diagram

It can be seen from the time series diagram of gold and bitcoin that the index sequence is not stable, especially the fluctuation between 2020 and 2021. It can also be seen that the price of gold and bitcoin has risen overall in five years, and bitcoin's upward trend is greater, and better evidence of high risk and high returns. According to Figure 4 and Figure 5.

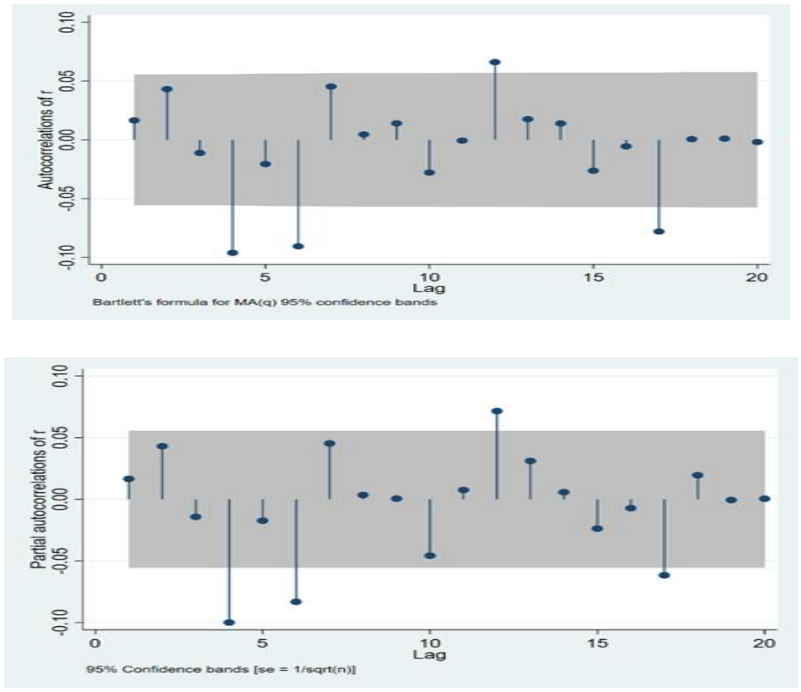

Figure 6. Gold autocorrelation and partial correlation diagram

From ACF diagram and PACF diagram, the correlation coefficients of gold grade 4 and 12 are more obvious, but the obvious difference after 12 may be due to error, so it is not considered. According to Figure 6.

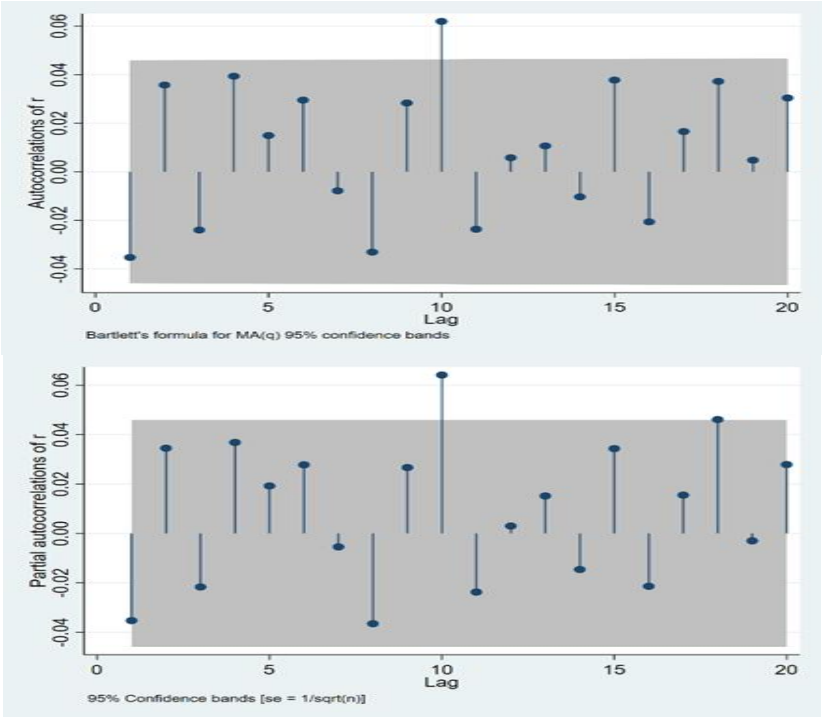

Figure 7. Bitcoin autocorrelation and partial correlation diagram

It can be seen from ACF diagram and PACF diagram that the correlation coefficients of order 8 and 10 in bitcoin are obvious, but the obvious difference after order 10 may be caused by error, so it is not considered. According to Figure 7. Therefore, in order to ensure the accuracy of model selection, we fit four models and select the optimal model. Model1: ARMA (8,8); Model2: ARMA (10,10); Model3: ARMA (8,10); Model 4: ARMA (10,8). According to Table.3.

Table.3. Model AIC and BIC values

Date	AIC	BIC
Model 1: ARMA (8,8)	10378.61	10477.78
Model 2: ARMA (10,10)	10364.07	10479.77
Model 3: ARMA (8,10)	10361.91	10472.1
Model 4: ARMA (10,8)	10357.91	10457.08

According to AIC and BIC criteria, Model4 should be selected in these four models, namely ARMA (10,8) model. The average AIC and BIC values of this model are the smallest, which can be better predicted and tested.

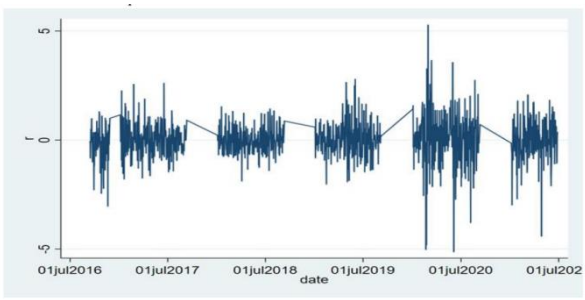

Figure 8. Time series of gold daily returns

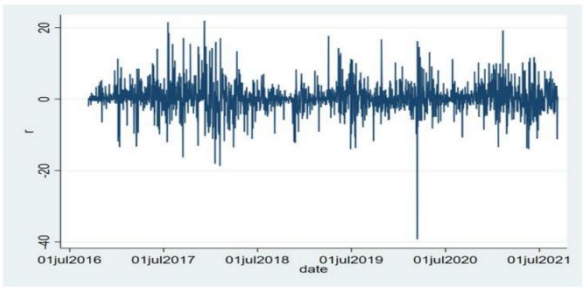

Figure 9. Time series chart of bitcoin daily returns

From the time series diagram of daily yield of gold and bitcoin, it can be seen that the fluctuation range of daily return rate of gold is relatively small, and the risk is relatively small but the return is also small. It also indirectly verifies the characteristics of gold as an international currency, and the fluctuation range of daily return rate of bitcoin is large, and the risk and return both are large. Considering the risk, we initially buy bitcoin of $300 and gold of $700. After five years of trading, the value is predicted to be $1504 after five years, with an average annual rate of about 10%, which meets the requirement that the annual rate of products is within 30%. According to Figure 8 and Figure 9.

Our team carries out residual analysis to determine whether the regression effect is good, so as to determine the effectiveness of the model. The following figure is the residual distribution.

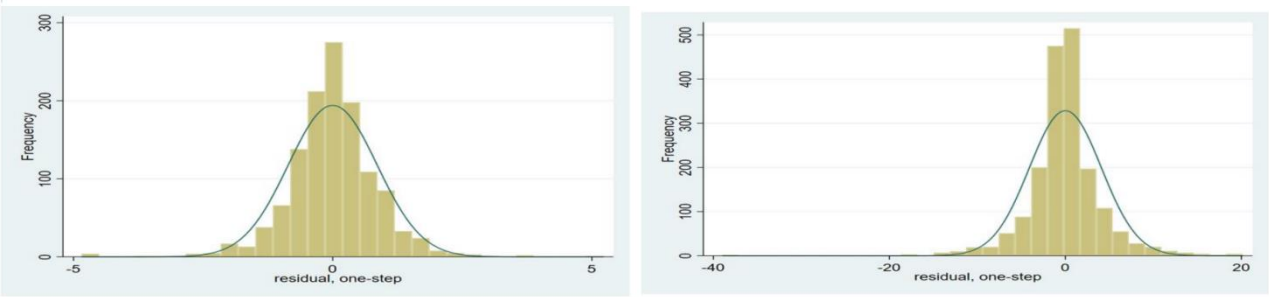

Figure 10. Histogram of distribution of golden residuals and bitcoin residual distribution

It can be seen from the residual distribution histograms of gold and bitcoin that the residual is concentrated near 0 and obey the normal distribution, which further indicates that the model has good fitting effect and good effectiveness. According to Figure 10.

3.2 The pros and cons comparison between GARCH model and gray prediction model for yield prediction

The daily return rate predicted by using the ALG model is compared with that predicted by the grey prediction model. For the daily decision-making strategy, our team uses the combination of Apriori algorithm and GRACH model to determine, and the daily return rate is an important reference

index. Therefore, our team decides to compare the yields predicted by the two models. The following figure is the relevant comparison figure. According to Figure 11.

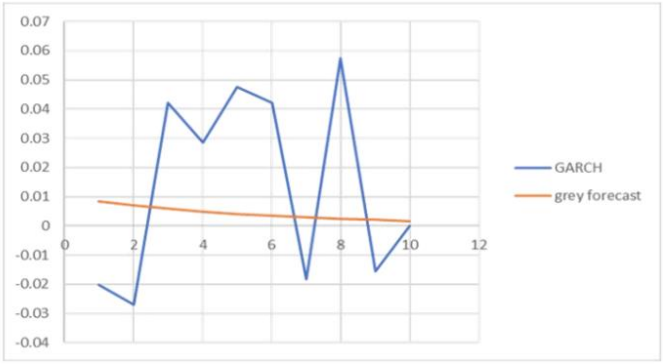

Figure 11. Comparison of GARCH and grey forecast

It can be seen that the rate of return line of grey prediction is overall below GARCH, which further explains that the income obtained by using ALG model is much higher than by using grey prediction model. It can also be seen from the figure that the volatility of the daily rate of return predicted by the GARCH model is large, which is also in line with the characteristics of the stock market. It better verifies the correctness of the ALG model and the optimality of the daily trading strategy.

4. Conclusions

Nowadays, with the continuous improvement of financial markets and the continuous improvement of people 's living standards, more and more people want to invest in volatile assets to increase the value of property. But day-to-day changes in the volatile assets market are unpredictable, resulting in a lot of people voting for negative assets. In order to maximize the interests of investors, it is crucial to accurately predict the trend of the stock market and make the most reasonable trading strategy.

So, our team designed an integrated model of ALG (Apriori algorithm- Attentional BiLSTM neural network- GARCH model) evaluation and prediction. Our team first analyzed the daily price of gold and bitcoin for five years and make a time series chart. Then, based on the previous daily price data, we use the Attentional BiLSTM neural network to predict the daily price of gold and bitcoin in the future. Then, Apriori algorithm are used to get the strong correlation between gold's buy, hold, sell and bitcoin's buy, hold, sell. GARCH model is used to calculate the daily rate of return of gold and bitcoin in five years, and the daily rate of return time sequence diagram is made.

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