

# Make the Best Trading Strategy

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## Abstract

Making trading strategy is a difficult problem that many researches is interested in this field, because it will bring much profit directly. And with the fast development of Bitcoin, the price of it has increase dozens of times. The gold market is relative steady, and the price also rise much. We are asked to develop trading strategy model that can bring significant money. Firstly, we processed the data in SPSS, and make statistical analysis, then we need to forecast the future trend of Bitcoin and gold price. BPNN model has been employed in this paper and the accuracy of BPNN is tested by error measures R2 and MSE, and the result shows high accuracy. Therefore, the models can be applied as the reference to judge whether to buy or not. Then the predicted trend will lead us to buy, hold or sell bitcoins and gold. In financial field, Bollinger Bands strategy (reversion strategy) is a good way for investment decision. So, we combine the BPNN model and Bollinger Band strategy to decide how to operate the bitcoin and gold market. The initial \$1000 investment worth \$85264.06 on 9/10/2021 using our best trading strategy. At last, there is high relevance between the transaction cost and trading strategy and the correlation coefficient is -0.8425, that means the if the transaction cost rise then the returns from our trading strategy will decline much. And the memorandum has been done.

## Keywords

SPSS; BPNN; Bollinger Bands; Correlation Coefficient.

## 1. Introduction

### 1.1. Background

It's important to be careful when buying Bitcoin and gold, and the trend of bitcoin and gold is hard to predict. Figure 1 and Figure 2 is the data of recent 5 years.



Figure 1. Gold daily prices



**Figure 2.** Bitcoin daily prices

## 1.2. Analysis of Problems

(1) We can use only the past stream of daily prices to date to determine each day if the trader should buy, hold, or sell their assets in their portfolio. And first of all, we should build a prediction model, like BPNN, it will help us to know the trend is rising or failing, and the use the financial investment model to determine how to use money more properly.

(2) Compare different strategies to prove our strategy can bring the most investment return.

(3) Design some different transaction ratio and use Pearson correlation method to analyze the relationship between them.

(4) Write a memorandum to describe our findings.

## 2. Assumption

There is no missing data in Bitcoin and there is missing data in gold on holiday.

Assume  $\alpha_{\text{gold}} = 1\%$  and  $\alpha_{\text{bitcoin}} = 2\%$ . There is no cost to hold an asset.

## 3. Symbols

**Table 1.** Symbols

Symbols	Definition	Units
Y	The distance herring and mackerel move	km
t	The migration time	year
v	The migration speed	km/year
T	Sea surface temperature	°C
H	Chlorophyll concentration in seawater	μL/g
B	The biomass	

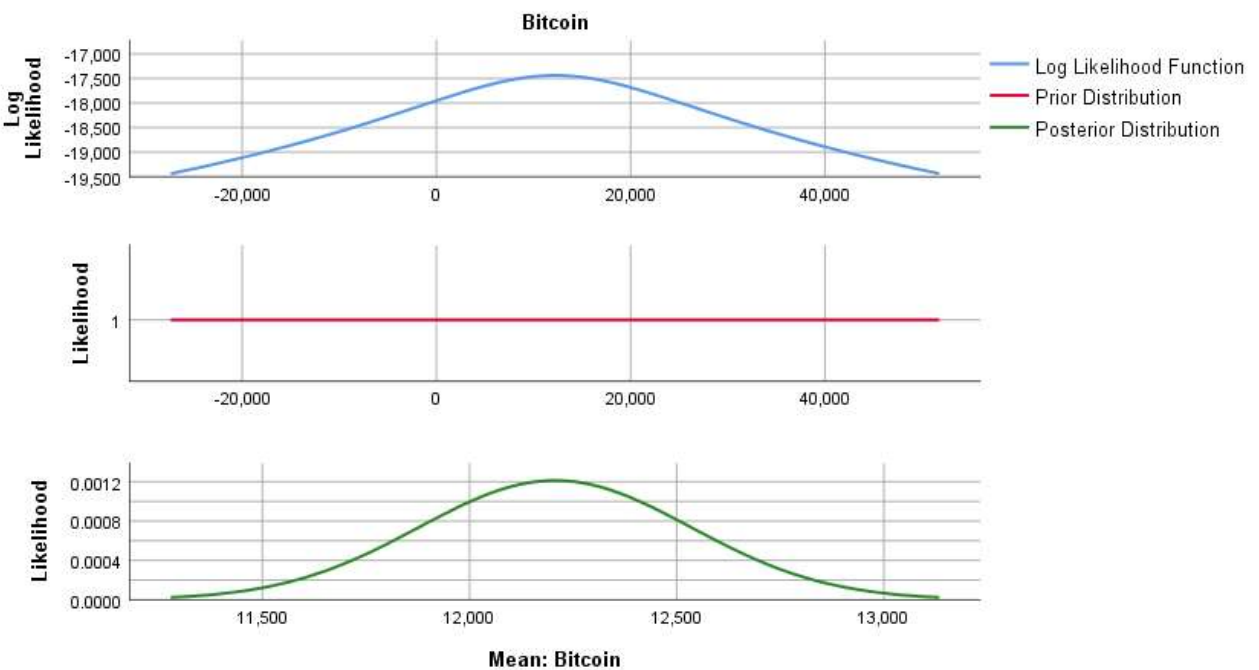
## 4. Trading Strategy Model based on BPNN Mode

### 4.1. Model Preparation

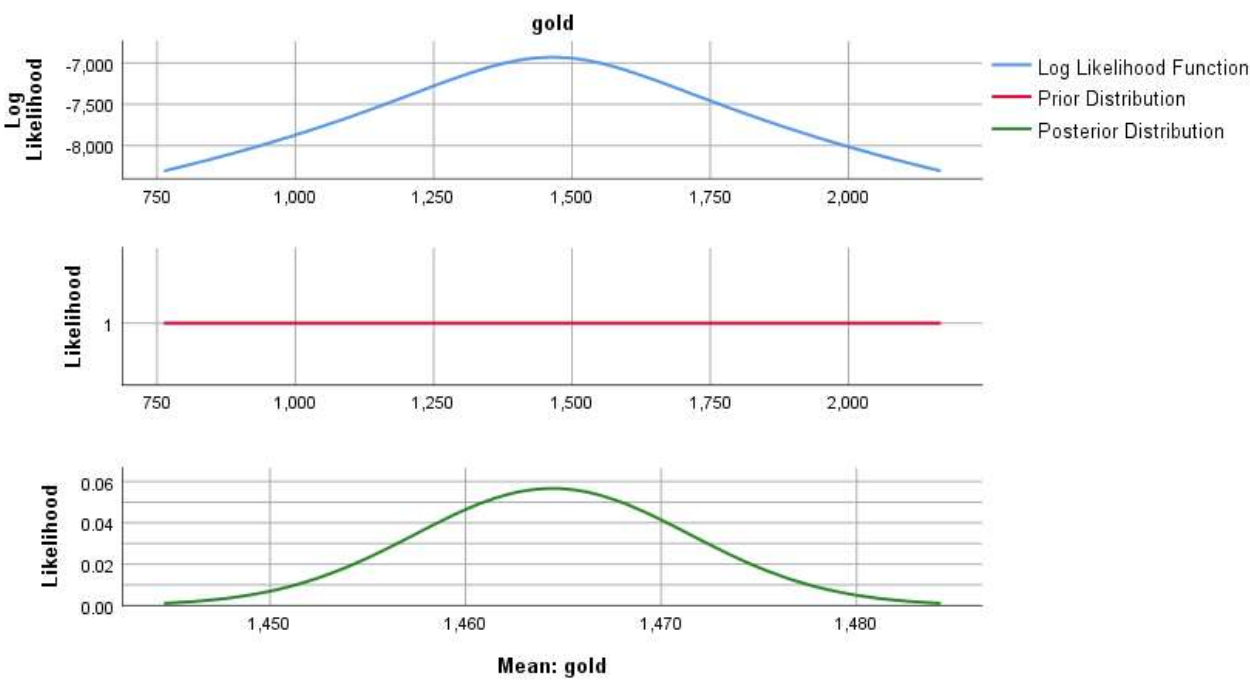
We use SPSS software to describe the data provided statistically, it can be summarized as Table 2 and Figure 3.

**Table 2.** Data information

	Number	crowd	average	variance	95% Lower bound	95% Upper bound
Bitcoin	1826	12206.0683	12206.0683	108249.797	11561.1396	12850.9970
gold	1256	1464.4380	1464.4380	49.611	1450.6307	1478.2453

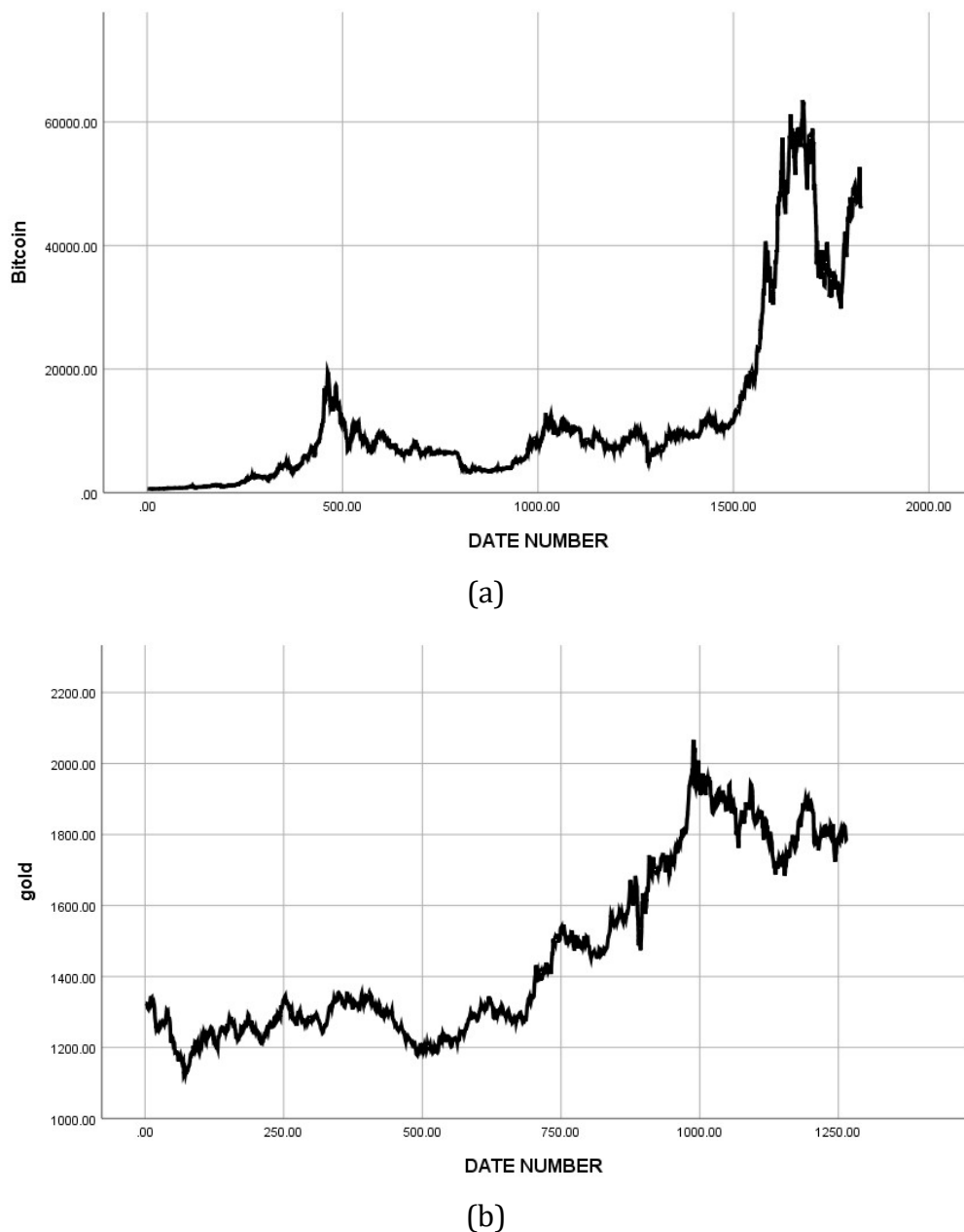


(a)



(b)

**Figure 3.** (a) bitcoin data information, (b) gold data information

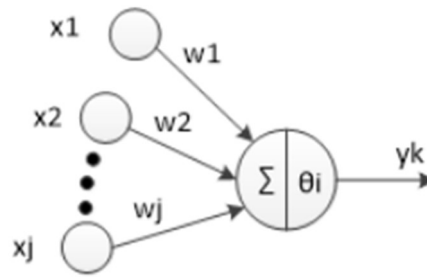


**Figure 4.** (a) bitcoin price trend, (b) gold price trend

From Figure 4, we can see that the Bitcoin has increase much in recent years and the gold also increase but the price of gold has not gone up as much as bitcoin.

#### 4.2. BP Neural Network Model Establishment

BP (Back Propagation) neural network is a multilayer feedforward neural network trained according to the error back propagation algorithm, which is a very classical type of machine learning algorithm for function prediction, pattern recognition classification and other problems. It consists of an input layer, a hidden layer and an output layer. Each layer consists of a neuron as the basic unit, which is a topological network established by biological research and the response mechanism of the brain, simulating the process of neural conflict, where the ends of multiple dendrites receive external signals and transmit them to neurons for processing and fusion, and finally transmit the nerves to other neurons or effectors through axons. The topology of neurons is shown in Figure 5.



**Figure 5.** BP neural network

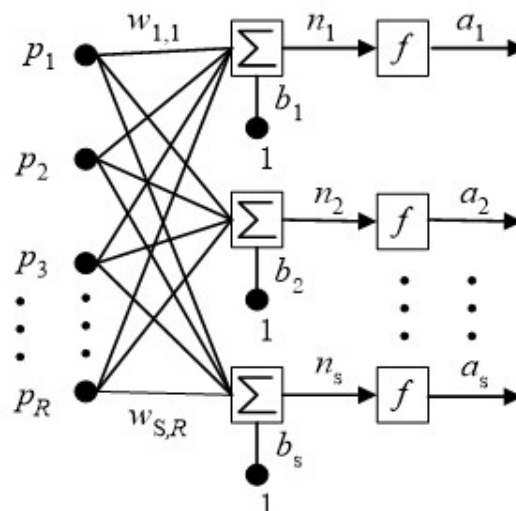
For the  $i$ th neuron,  $X_1, X_2, \dots, X_j$  are the inputs to the neuron, the inputs are often the independent variables that are critical to the system model, and  $W_1, W_2, \dots, W_j$  are the connection weights to adjust the weighting ratio of each input. There are various ways to combine the signal inputs to the neuron, and the most convenient linear weighted summation is chosen to obtain  $Net_{in}$  Net input to the neuron:

$$Net_{in} = \sum_{i=1}^n w_i * x_i$$

$\theta_i$  denotes the threshold value of the neuron, and according to the knowledge in biology, the neuron will be activated only when the received information reaches the threshold value. Therefore, we compare  $Net_{in}$  and  $\theta_i$  and then process them by the activation function to produce the output of the neuron as:

$$y_j = f\left(\sum_{i=1}^n w_i * x_i\right)$$

where  $w_0 = -1, x_0 = \theta_j$ , where  $f$  denotes the activation function, and the common types are threshold function, log Sigmoid function, tangent Sigmoid function and linear function, etc. The structure of a single-layer neural network can be represented as Figure 6.

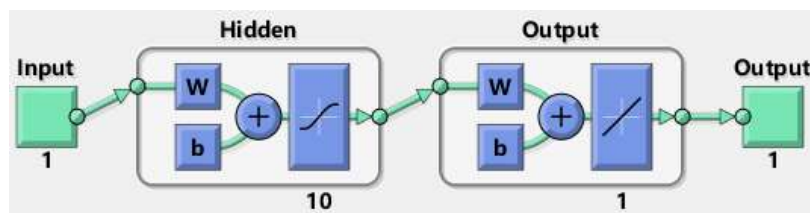


**Figure 6.** single neural network

The BP neural network will adjust the weights of each layer according to the backward transmission of the error of each training, thus continuously improving the model accuracy until it reaches the invitation, where the error function can be expressed by the least squares method as:

$$e = \frac{1}{2} \sum_{o=1}^q (d_o(k) - y_{o_o}(k))^2$$

And we apply BPNN model to predict the price of Bitcoin and gold the result. We use the five-year trading period, from 9/11/2016 to 9/10/2021 to train and test the model, and the structure are shown in Figure 7.

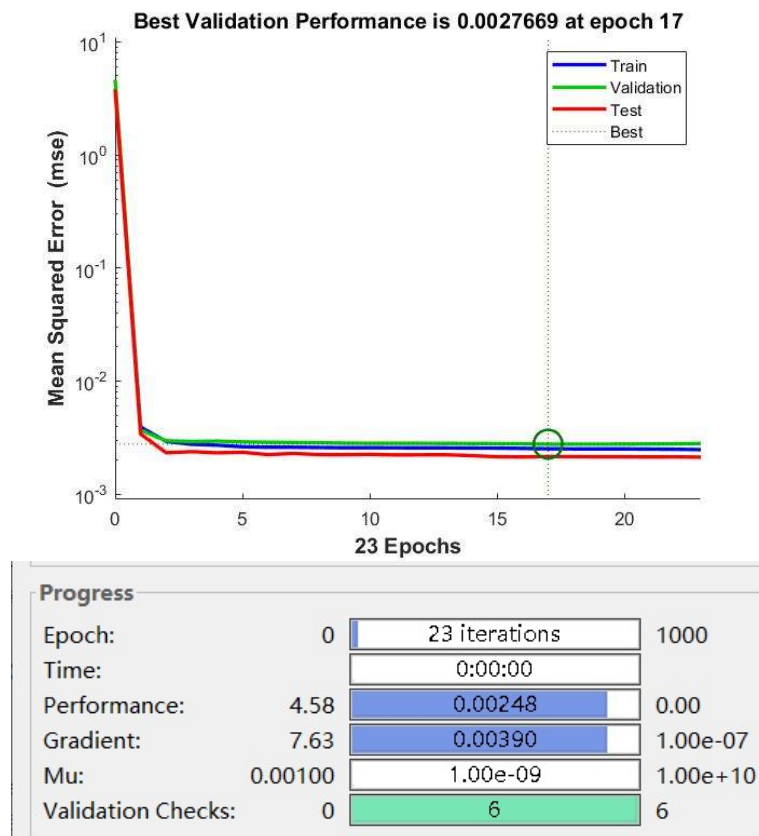


**Figure 7.** The BPNN model in this paper

The hidden layer of BPNN is 10, which can bring a good accuracy.

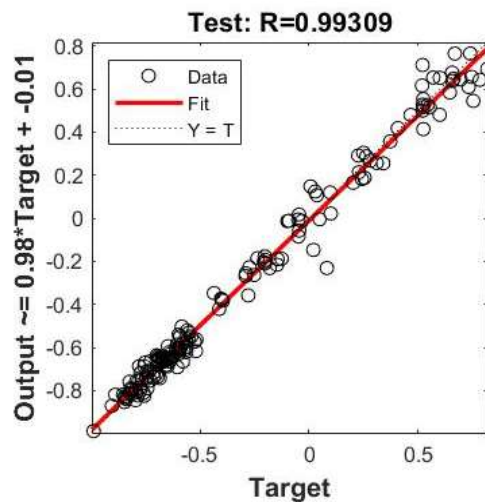
#### 4.3. Model solution and error test

The training process of model is shown as:



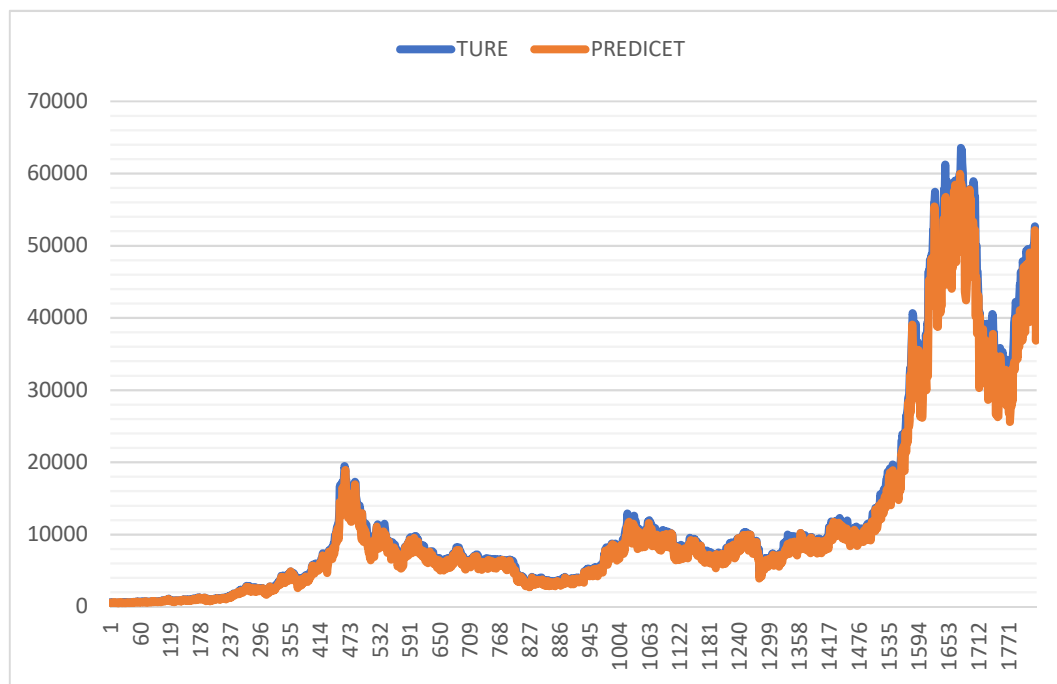
**Figure 8.** BPNN iteration process

The BPNN training stop at 23 iteration, and get a high accuracy, that is  $MSE=0.00248$ , and  $R^2 = 0.993$ .



**Figure 9.** BPNN error test of  $R^2$

And Figure 10 compares the true price and the predicted price.



**Figure 10.** true price vs predicted price

It can be found the error of predicted price is quite small, and this prediction model will be used to predict the trend of price of bitcoin and gold.

#### 4.4. Financial Model

When it comes to the Bollinger Bands mean reversion strategy, it is important to mention the concept of Bollinger bands. Bollinger bands are calculated using a combination of the mean and standard deviation in statistics and are divided into averages, upper and lower tracks. The Bollinger Bands mean reversion strategy considers that the underlying price floats within the

range enclosed by the upper and lower rails, and even if the upper and lower rails are broken in the short term, it will still return to the Bollinger bands in the long term. Therefore, once the upper and lower rails are broken, a buy and sell signal is formed. When the stock price breaks the upper boundary upward, it is a sell signal, and when the stock price breaks the lower boundary downward, it is a buy signal. The equations are show as follows:

$$\text{Mid-Track} = \text{N-Day Moving Average}$$

$$\text{Upper line} = \text{Middle line} + k \text{ standard deviation}$$

$$\text{Lower line} = \text{Middle line} - k \text{ standard deviation}$$

And another strategy is:

Step 1: Select a tracking index with a component stock that has a weight of more than 0.35% as the stock pool.

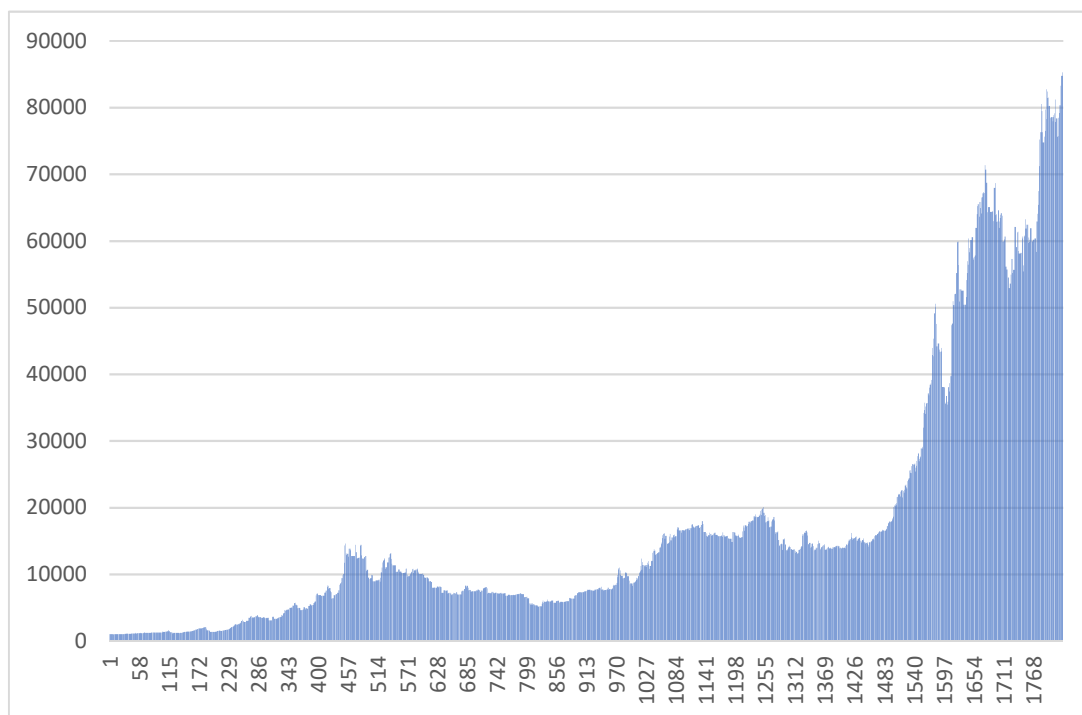
Step 2: Determine whether a stock is a quality stock based on its price momentum, i.e., if it rises for 5 consecutive days, it is a superior stock; if it falls for 5 consecutive days in between, it is an inferior stock.

Step 3: Adjust the weight of high quality stocks up by 0.2 and the weight of poor quality stocks down by 0.2.

As for application in our model, we just transfer the stock into bitcoin and gold.

#### 4.5. Result

Combine the BPNN model and financial model to determine buy, hold or sell today. And the result shows \$85264.06 can be return if start with \$1000 on 9/11/2016. And the detailed asset of every day can be shown in Figure 11.



**Figure 11.** The detailed asset of each day

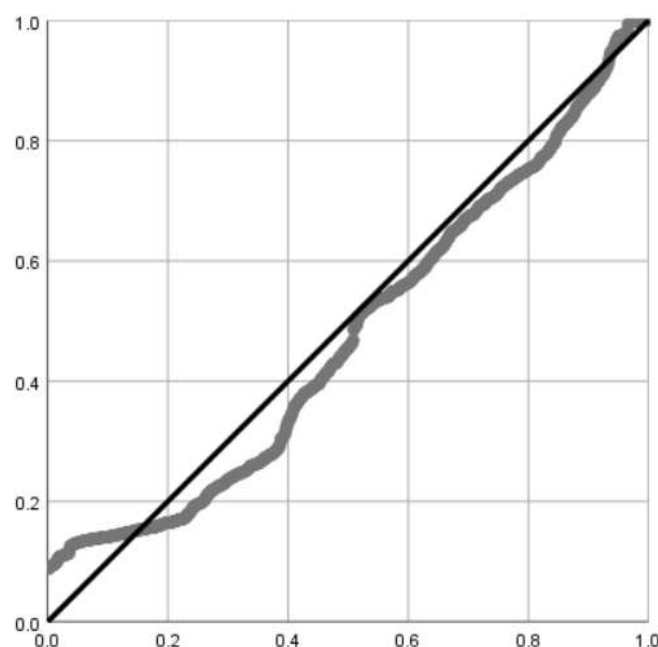


## 5. Sensitivity Model of Transaction Cost and the Strategy

### 5.1. Model Establishment

The successful application of sensitivity analysis usually requires good judgment, and it is usually neither possible to calculate sensitivity coefficients for every parameter in the model, nor is there such a special requirement. We need to select those parameters with large uncertainties for sensitivity analysis. The interpretation of the sensitivity coefficients also depends on the degree of uncertainty of the parameters. The degree of uncertainty of the data in the original problem affects the degree of confidence we have in the answer.

The covariance is used to measure the overall error of the two variables. If the two variables have the same trend, the covariance is positive, indicating that the two variables are positively correlated. If the two variables have opposite trends, the covariance is negative, indicating that the two variables are negatively correlated. If the two variables are independent of each other, then the covariance is 0, which means the two variables are not correlated. The following is the formula for calculating the covariance. And the result is show in Figure 12.



**Figure 12.** the relationship between transaction cost and trading strategy

### 5.2. Result Analysis

There is high relevance between the transaction cost and trading strategy and the correlation coefficient is -0.8425, that means the if the transaction cost rise then the returns from our trading strategy will decline much.

## 6. Strength and Weakness

### 6.1. Strength

The predicted BPNN model has high accuracy.

The financial model is reasonable and can make much profit.

### 6.2. Weakness

The accuracy can be higher.

Some theories in stock can be used herein.

## 7. Memorandum

The core idea is to define a range, and the upper and lower boundaries of the range are support and resistance lines respectively. When the price exceeds the upper boundary, if you hold a short position, close it first and then open a long position; if you do not have a position, open a long position directly. When the price falls below the lower boundary, if you hold a long position, close it first and then open a short position; if you do not have a position, open a short position directly.

The setting of the upper and lower bounds is the core part of the trading strategy. In the calculation of the upper and lower boundaries share the following four parameters: the highest price, the lowest price, the closing price, the opening price. It can be expressed as follows:

$$\text{Range} = \text{Max} (\text{HH-LC}, \text{HC-LL})$$

$$\text{Upper bound: Open} + \text{K1 Range}$$

$$\text{Lower bound: Open} + \text{K2 Range}$$

Firstly, we processed the data in SPSS, and make statistical analysis, then we need to forecast the future trend of Bitcoin and gold price. BPNN model has been employed in this paper and the accuracy of BPNN is tested by error measures R2 and MSE, and the result shows high accuracy. Therefore, the models can be applied as the reference to judge whether to buy or not. Then the predicted trend will lead us to buy, hold or sell bitcoins and gold. In financial field, Bollinger Bands strategy (reversion strategy) is a good way for investment decision. So, we combine the BPNN model and Bollinger Band strategy to decide how to operate the bitcoin and gold market. The initial \$1000 investment worth \$85264.06 on 9/10/2021 using our best trading strategy.

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