A Prediction Model for Taiwan Tourism Industry Stock Index

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ABSTRACT

Investors and scholars pay continuous attention to the stock market, as each day, many investors attempt to use different methods to predict stock price trends. However, as stock price is affected by economy, politics, domestic and foreign situations, emergency, human factor, and other unknown factors, it is difficult to establish an accurate prediction model. This study used a back-propagation neural network (BPN) as the research approach, and input 29 variables, such as international exchange rate, indices of international stock markets, Taiwan stock market analysis indicators, and overall economic indicators, to predict Taiwan's monthly tourism industry stock index. The empirical findings show that the BPN prediction model has better predictive accuracy, Absolute Relative Error is 0.090058, and correlation coefficient is 0.944263. The model has low error and high correlation, and can serve as reference for investors and relevant industries.

KEYWORDS

Artificial Neural Network, Stock Market Analysis, Prediction Model

1. INTRODUCTION

Investors aim to reduce risk and obtain high returns in stock investment; however, there are many factors affecting stock market changes. Prediction of stock market change is difficult and complicated; the previous studies have conducted fundamental analysis [1,2] and technical analysis [3,4] to predict stock change. Nowadays, with advancements of technologies, and improvement of computer algorithm performance, Artificial Neural Network (ANN) is derived to deal with complicated and mass stock prediction problems. The relevant research findings have demonstrated that ANN has good accuracy and reliability in stock market prediction.

ANN is a type of artificial intelligence. Due to better fault tolerance, it is able to accurately predict results even if some noise occurs. Thus, many researches use ANN to predict changes of stock indices. This study uses BPN to establish a model for prediction of Taiwan's monthly tourism industry stock indices. The international exchange rate, international stock indices, Taiwan stock analysis indicator, and overall economic index, are input variables to improve the accuracy of the prediction model [5-8].

2. RESEARCH METHOD

ANN is an information processing system that simulates brain and neural networks, and can store, learn, and recall external input signals. ANN is a computing system involving software and hardware, which uses a mass of interconnected artificial nerve cells to simulate neural networks. It obtains and calculates information from external environments or other nerve cells, and sends the results to external environments or other nerve cells [5-8].

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In this study, the proposed ANN is divided into three parts: process element, layers, and network, as shown in Figure 1 [9-14].

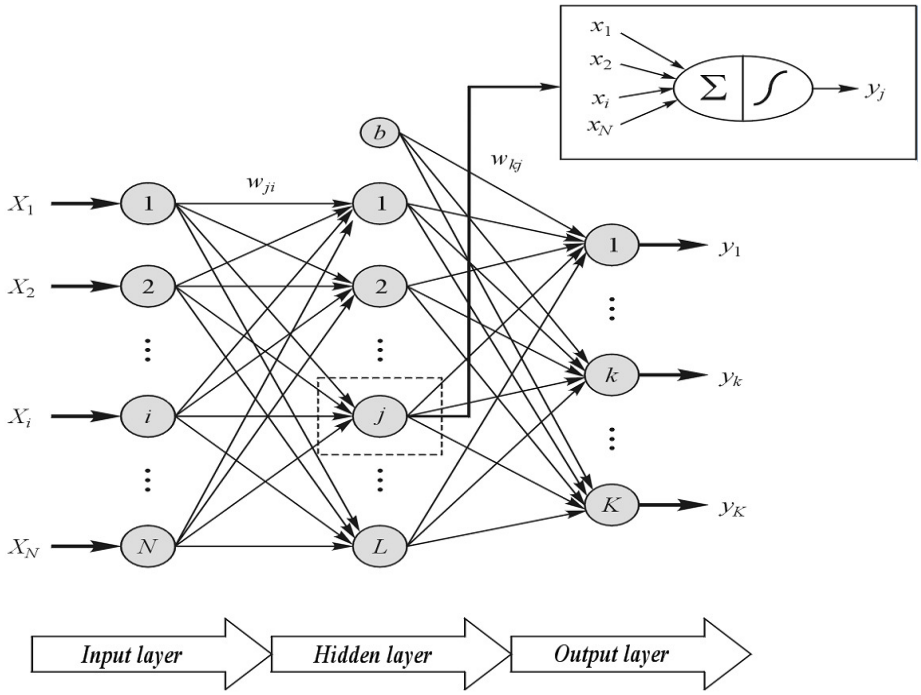

Figure 1. Three-layer network model architecture [11-14]

(1) Process element: artificial neurons are called nerve cells, artificial nerve cells, or process element. Each type of nerve cells are sent in the shape of a fan, and become the input of other types of nerve cells. The relationship between input and output values of each element can be expressed by the weighted product of input value and function.
(2) Layer: the part consisting of several process elements with the same functions is called a layer. The artificial neural network contains three layers: input layer, hidden layer, and output layer.
(3) Network: the architecture consisting of different layers is network connection. Layers are bonded through neurons to form the entire network connection. It has two functions of learning and recall.

2.1. ANN operation steps

Step 1: Analyze-International exchange rate, international stock markets (Dow Jones index, Nasdaq index, ICIW 225 and Shanghai composite index), technical analysis of Taiwan stock market (MA5, MA10, MA20, K9, D9, BIAS5, BIAS10, BIAS20, RSI5, RSI14, MACD, and OSC), and overall economy (consumer price index, Taiwan's GDP, cyclical indicators, industrial production index, expected rate of inflation, score of business cycle indicators), are used as input variables to predict Taiwan's monthly tourism industry indices: the data between November 2003 and May 2013 were selected, for a total of 127 data; where 70% of data are used for model training, 15% for model verification, and 15% for model testing.

Step 2: Preprocess-The image range of input variables is set to intervals [-1,+1], and [0,1], and variable data are normalized.

Step 3: Network architecture design: automatic search function is used to select the optimal network architecture. The optimal network architecture is 29-71-1 (Figure 2); the Input layer has 29 neurons, the hidden layer has one layer with 71 neurons, and the output layer has one neuron.

Step 4: Network training and verification: quick propagation is used. The quick propagation coefficient is set to 10, and the learning rate is set to 0.2. The limit for number of iterations is set to 2000 times for network training (Figure 3).

ID	Architecture	# of Weights	Fitness	Test error	Akaike's criterion	R-Squared	Correlation	Train Error	Stop Reason
12	**[29-71-1]**	**2202**	**0.13211**	**7.569426**	**0.000241**	**0.975494**	**0.987728**	**3.845507**	**All iterations done**
8	[29-70-1]	2171	0.128666	7.772035	0.000243	0.968631	0.98445	4.696317	All iterations done
3	[29-62-1]	1923	0.113331	8.823708	0.000275	0.95008	0.974998	5.811271	All iterations done
4	[29-38-1]	1179	0.109964	9.093884	0.000464	0.937209	0.968158	6.612603	All iterations done
2	[29-100-1]	3101	0.101315	9.870212	0.000167	0.943399	0.972534	6.221454	All iterations done
5	[29-85-1]	2636	0.100433	9.956928	0.000197	0.900267	0.949229	8.303599	All iterations done
11	[29-68-1]	2109	0.099995	10.000518	0.000248	0.902206	0.950218	8.088917	All iterations done
6	[29-52-1]	1613	0.098669	10.134945	0.000329	0.901969	0.949901	8.32012	All iterations done
13	[29-72-1]	2233	0.092059	10.862589	0.000233	0.8956	0.949397	8.433126	All iterations done
7	[29-76-1]	2357	0.091894	10.882113	0.000221	0.900349	0.951902	8.427195	All iterations done
9	[29-66-1]	2047	0.090738	11.020759	0.000265	0.995299	0.997691	1.525125	All iterations done
10	[29-73-1]	2264	0.087939	11.371469	0.00023	0.883723	0.940947	8.824916	All iterations done
1	[29-1-1]	32	0.058021	17.234997	-0.013964	0.67355	0.882362	15.183782	All iterations done

Figure 2. The result of optimal network architecture

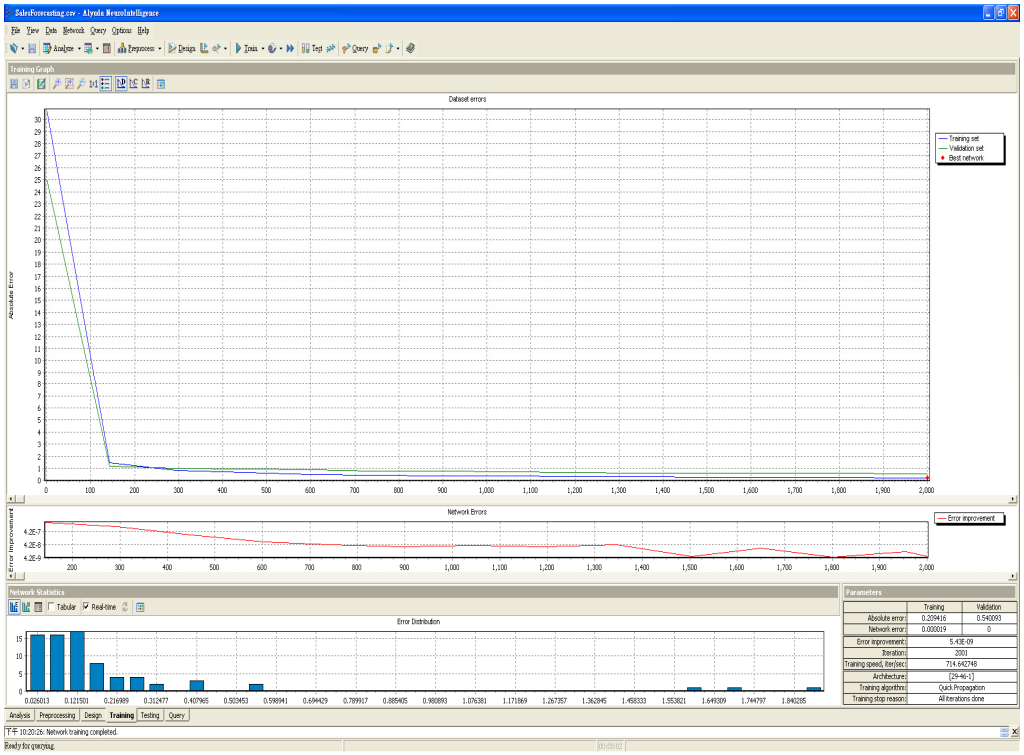

Figure 3. Absolute error of iterative convergence

2.2. Evaluation criterion

In this study, three indices are used to evaluate the accuracy of the proposed model:

- AE (absolute error) is the difference between the measured value and true value.
- ARE (absolute relative error) is expressed as a percentage ratio of absolute error to true value, and can reflect the confidence level of data. The smaller the value, the higher the confidence level.
- r(correlation coefficient), when r is close to 1, the actual value is highly related to the predicted value, and when r is close to 0, the actual value is less related to the predicted value.

3. RESULTS OF EMPIRICAL ANALYSIS

In this study, the 29 input variables, including international exchange rate, indices of international stock markets, indicators of Taiwan stock market analysis, and overall economic indicator, are used to predict the monthly tourism industry stock index. The results of model training are as shown in Table 1. The output value and actual value of the model are ARE=1.8611% and r= 0.996878, indicating the trained model has low error and high correlation. Figures 4 and 5 are the trend chart and scatter diagram of the model input value and actual value. It can be found that the input value can reflect the fluctuation of actual value, and has high correlation.

Table 1. Results from model training

	Target	Output	AE	ARE
Mean	106.299136	106.22766	1.758696	0.018611
Std Dev	32.807466	32.486709	1.915795	0.020894
Correlation: 0.996878				

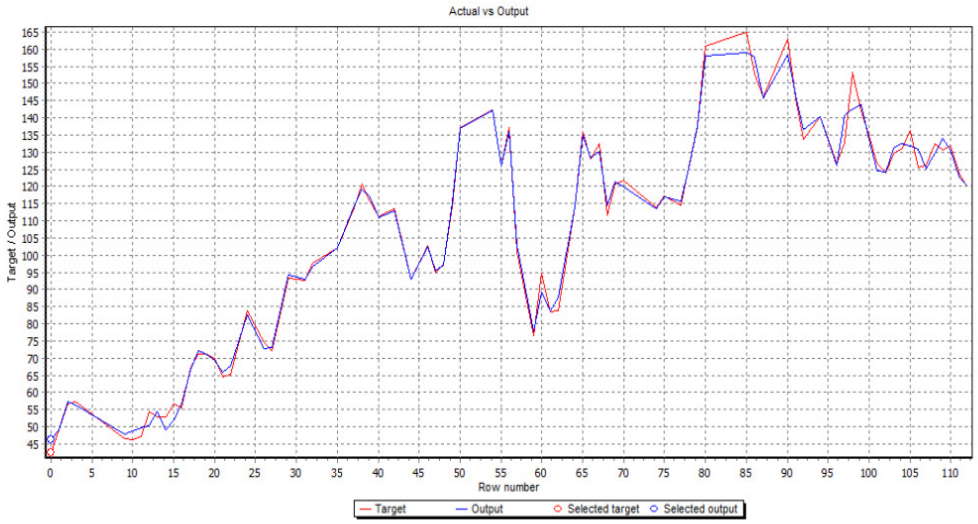

Figure 4. Trend chart of model training

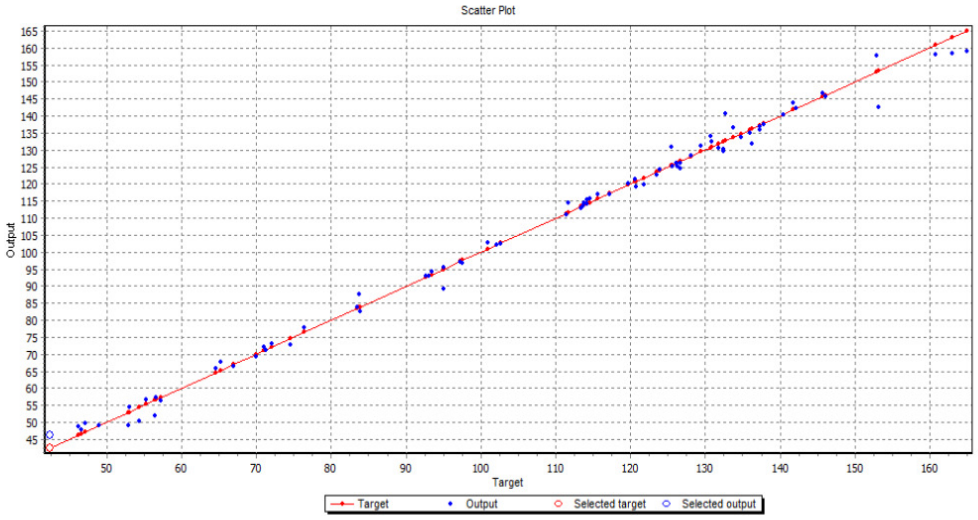

Figure 5. Scatter diagram of model training

The results of model verification are as shown in Table 2. The output value and actual value of the model are ARE= 6.8242% and r= 0.996878, indicating the model has low error and high correlation. Figures 6 and 7 are the trend chart and scatter diagram of the model input value and actual value. It can be found that the input value can reflect the fluctuation of actual value, and has high correlation.

Table 2. Results from model verification

	Target	Output	AE	ARE
Mean	108.472353	104.653816	7.626058	0.068242
Std Dev	40.76889	33.526889	8.36618	0.053997
Correlation: 0.977641				

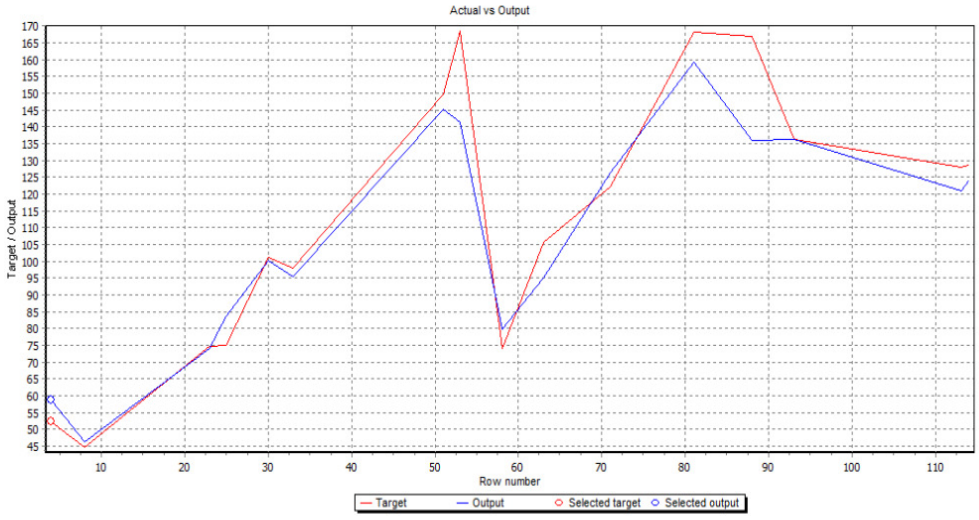

Figure 6. Trend chart of model verification

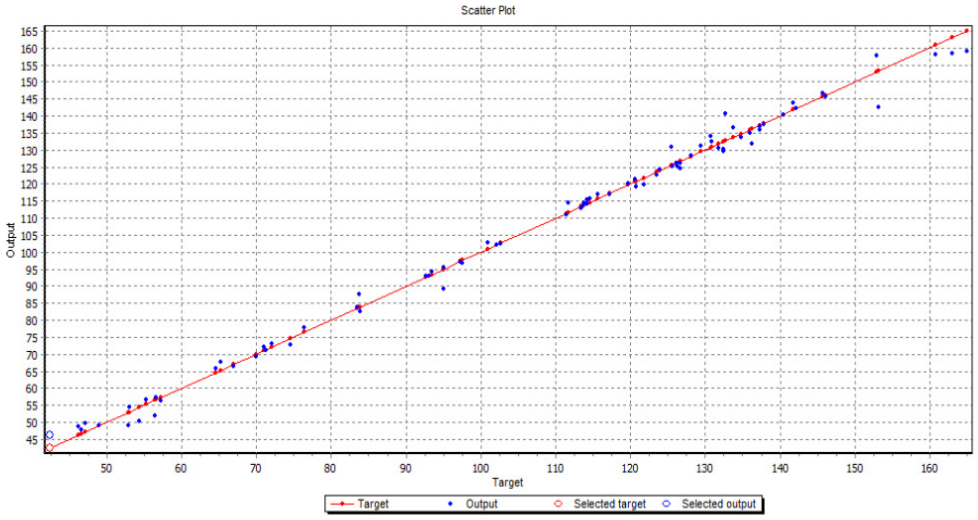

Figure 7. Scatter diagram of model verification

The results of model testing are as shown in Table 3. The output value and actual value of the model are ARE= 9.0058% and r= 0.996878, indicating the model has low error and high correlation. Figures 8 and 9 are the trend chart and scatter diagram of the model input value and actual value. It can be found that input value can reflect the fluctuation of actual value, and has high correlation.

Table 3. Results from model testing

	Target	Output	AE	ARE
Mean	119.123529	117.29254	9.87264	0.090058
Std Dev	36.33083	35.617172	7.116143	0.070703
Correlation: 0.944263				

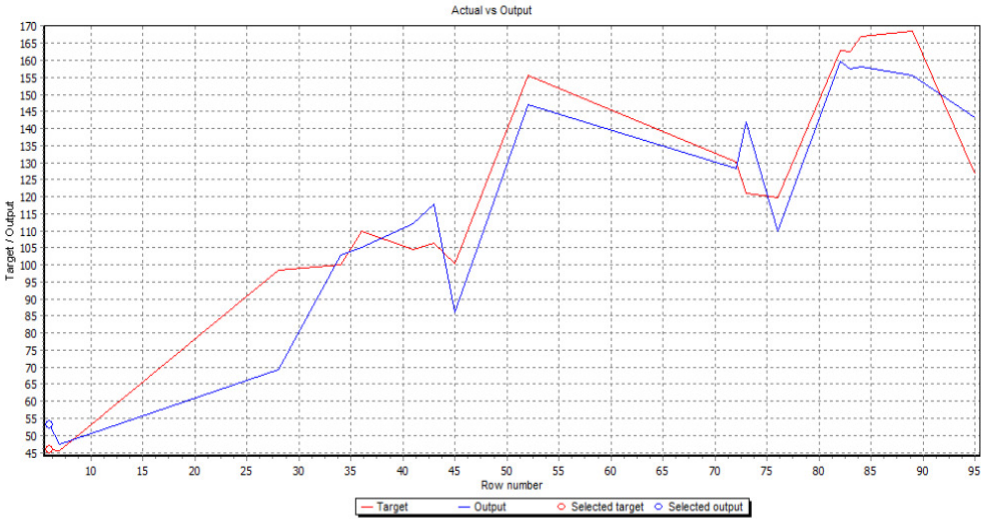

Figure 8. Trend chart of model testing

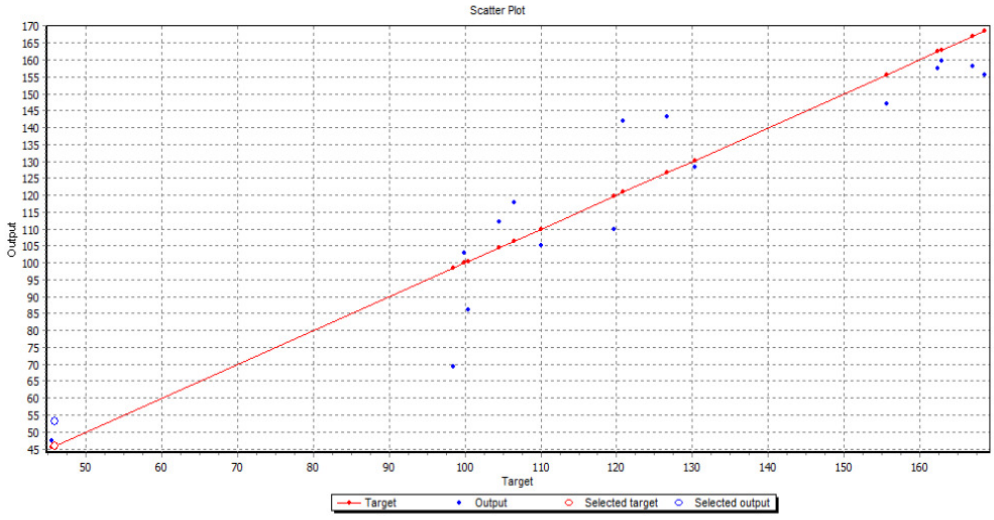

Figure 9. Scatter diagram of model testing

4. CONCLUSIONS

This study used BPN to establish a model for predicting the monthly tourism industry stock index. Moreover, the 29 input variables, such as international exchange rate, indices of international stock markets, indicators of Taiwan stock market technical analysis, and overall economic indicator, are used to predict Taiwan's monthly tourism industry stock index. The BPN has better prediction accuracy, ARE is 9.8058%, and correlation is 0.944263, which indicates the model has low error and high correlation. The model can accurately predicate trends and index changes. The findings can serve as reference for future study or investors.

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