Prediction and Research on Vegetable Price Based on Genetic Algorithm and Neural Network Model

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Abstract Considering the complexity of vegetables price forecast, the prediction model of vegetables price was set up by applying the neural network based on genetic algorithm and using the characteristics of genetic algorithm and neural work. Taking mushrooms as an example, the parameters of the model are analyzed through experiment. In the end, the results of genetic algorithm and BP neural network are compared. The results show that the absolute error of prediction data is in the scale of 10%; in the scope that the absolute error in the prediction data is in the scope of 20% and 15%. The accuracy of genetic algorithm based on neutral network is higher than the BP neutral network model, especially the absolute error of prediction data is within the scope of 20%. The accuracy of genetic algorithm based on neural network is obviously better than BP neural network model, which represents the favorable generalization capability of the model.

Key words Genetic algorithm, Neural network, Vegetables price, Prediction, China

The price of vegetable is unstable and changes rapidly, which have great impact on residents' daily life and become the root that causes the fluctuation of market price of agricultural products and the change of people's living and consumption indexes, so governments at each level should pay attention to the changes of vegetable price. It is hard to foreshadow the market information of vegetable, so scientifically taping the changing trend of vegetable price and timely and accurately predicting the market price trend are of great importance. As for the non-linear time series prediction, there are many kinds of prediction and control method on the basis of neural network. Among them, the application of BP algorithm is the most mature one. But the BP neural network has the defects of extremely local minimum, long training time and slow convergence speed, which affect the prediction results. Genetic algorithm is a method used for seeking optimization in high-dimensional space by using the natural section and evolution. In its essence, the method has the capability of seeking excellence in the whole, which is widely used in time series prediction[1-3]. In the paper, the genetic algorithm is used to optimize neural network to predict and analyze the vegetable price.

1 The establishment of model

The neural network model applies three-layer feed-forward network structure including input layer, output layer and hide layer. Each nerve cell connects with all nerve cells in the next layer and there is no connection among nerve cells at the same layer. Because the market price of vegetable is output in a certain period, but the price was input in the previous periods, which constitutes the output and input of neural network model. And then, the weights of neural network model can be optimized by using the genetic algorithm. In the generic algorithm, the fitness function is used to evaluate the chromosome. The larger the fitness value of a chromosome, the better the results represented by the relevant chromosome and the larger the possibility of survival. The process of applying generic algorithm to optimize the neural network model can be seen as follows:

Firstly, gene coding Through the man-made neural network model structure, the total weight of to-be-trained network can be obtained. Each weight represents a gene in the chromosome, which constitutes a chromosome.

Secondly, generating the primary chromosome groups Determining the number of chromosomes in primary groups and then constituting the primary groups by generating weights randomly in the scope of weight.

Thirdly, calculating the fitness value of individual chromosome in the groups: Training the neural network represented individual in the chromosome groups, and calculating the learning error E of each individual, the formulation is as follows:

$$E=\sum_{i=1}^{n}E_i,\ E_i=\sum_{l=1}^{m}(y_l^j-c_l^j)^2/2$$

In the equation, n is the number of training samples, m is the number of output unit; $y_l^j-c_l^j$ represents that when using the i samples, the differences of actual output and expected output. The fitness function fs is determined by the following equation,

$$fs=1/E$$

In calculation the value of fitness function, the smaller the error of fitness function, the bigger the value of fitness degree.

Fourthly, selecting Applying the roulette selection to conduct individual selection operation on chromosome groups and applying the retaining strategy of optimized individual.

Fifthly, conducting crossover operation If x_1 and x_2 are the parent individuals, y_1 and y_2 are the offspring individuals generated by the following equation:

$y_1=\alpha x_1+(1-\alpha)x_2$, $y_2=\alpha x_2+(1-\alpha)x_1$, α is a parame-

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ter, which changes with the evolving algebra.

Sixthly, conducting mutation operation. By using the Gaussian approximation variant and the improved generic algorithm to seek functions of partial area in the key seeking area. When it is mutated, the original generic value can be replaced by a random number in the normal distribution which is in accordance with average value $\overline{P}$ and variance P^2.

Seventhly, the fitness value in the chromosome groups will be re-calculated.

Eighthly, if the evidences are satisfied for stopping seeking, the iteration will stop and the optimized results will be outputted; or else returns to step 4.

By applying the above method, the model can be realized in the matlab environment after programming the software and using matlab tool box[4].

2 Analysis on the model parameter

The price of cotion very month is applied as the output of the model and the price in the previous four months is used as input, the model on the basis of neural network is established by applying the method mentioned above. Taking the data of market price of mushrooms in Beijing from 2003 to 2007 as an example to train, after training, the market price of mushroom from 2008 to 2009 can be predicted. In order to test the impact of the number of chromosome groups in genetic algorithm and the number of the middle layer neurons of neural network on the mocking and predicting results of model. 20, 30, 40, 50 and 60 chromosome groups and 4, 6, 8, 10, 12 and 16 middle layer neurons are selected to mock and predict. The results can be seen on Fig. 1 and 2.

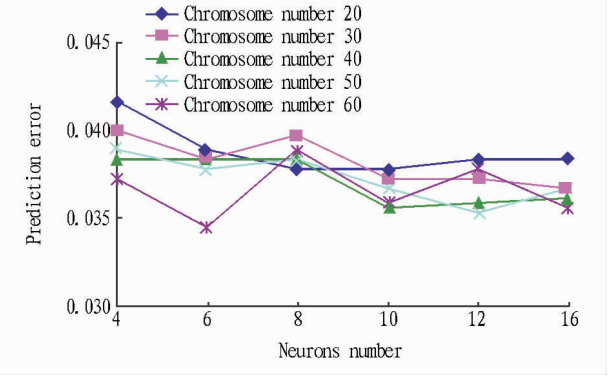

Fig. 1 Simulation errors with different neurons and chromosome numbers

Fig. 1 is the mocking results. When using the genetic algorithm to optimize the weight of neural network, it is not so sensitive to the number of middle layer of the neural network model. With the increase of number of neurons in the middle layer, the simulation results are basically in line. Model optimization is also not so sensitive to the number of chromosome groups, the number of chromosome is between 20 and 60 and the simulation results are basically in line. The results show that generic algorithm has strong stability in terms of mocking date.

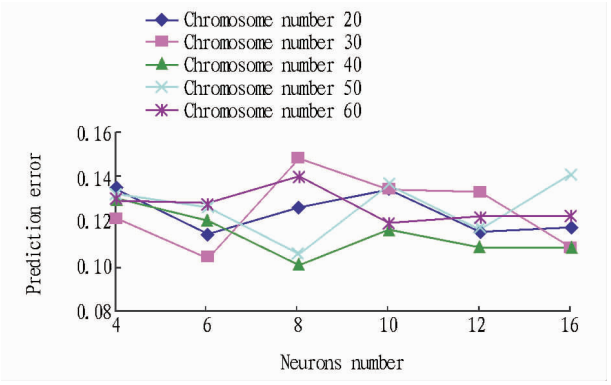

Fig. 2 Prediction errors with different neurons and chromosome numbers

Fig. 2 is the prediction results. When applying the generic algorithm to optimize the weight of neural network model, the, the number of neurons in the middle layer of neural network model and the number of chromosome groups have little effect on the results of model prediction. It indicates that the overall optimization capability of generic algorithm is strong and the stability of the actual application of algorithm is stable. By comparison, when there are 40 chromosomes and 8 middle layer neurons, the prediction results are good.

3 Application of the model

We select 40 chromosome groups, 8 middle layer neurons and the optimization aim is 0.03 and the optimized algorithm is 3 000. We use the prices of mushroom in the wholesale market in Beijing from 2003 to 2007 to train the model and use the market price of mushroom from 2008 to 2009 to predict, the results can be seen on Fig. 3 and 4.

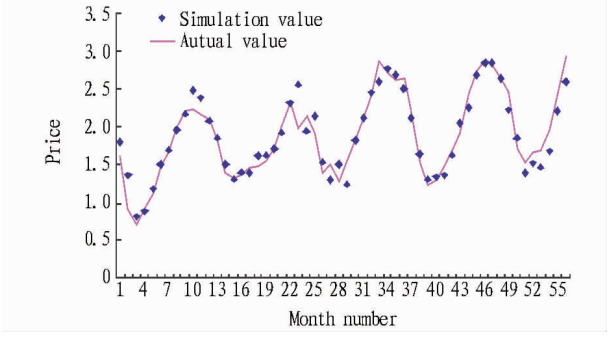

Fig. 3 The simulation results of the neural network model based on genetic algorithm

In Fig. 3 and 4, the stimulation average absolute error of generic algorithm model to mushroom is 0.075%. The average absolute error of predicting the price of mushroom has achieved 0.114%. The prediction results of model to date can fully reflect the actual application effect of model, so in order to reflect the effectiveness of model prediction, we compare the model prediction results and the prediction results of BP neural network model. The BP neural network model applies Levenberg-Marquardt algorithm optimization and the comparison of its absolute prediction error can be seen on Table 1.

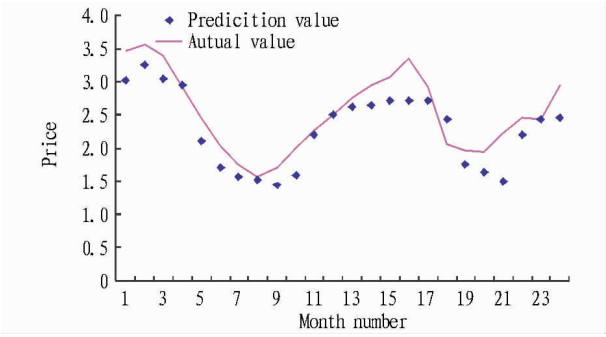

Fig. 4 The prediction result of the neural network model based on genetic algorithm

Table 1 The error distribution comparison of the two models %

Model	Absolute error		
	<20	<15	<10
BP neural network model	66.7	50.0	25
Genetic algorithm network model	91.7	58.4	25

The above results shows that when the absolute error of prediction data is within 10%, the two models have similar prediction function; when the absolute error of prediction data is within 20% and 15%, the genetic algorithm of neural network model is more accurate than BP neural network model, especially when the absolute prediction error is within 20%, the genetic algorithm of neural network is significantly more accurate than BP neural network model. The genetic algorithm of neural network shows good generalization capability.

4 Conclusion

In the paper, the neural network prediction model of vegetable market price is established by applying genetic algorithm. Taking the market price of mushroom is wholesale market of Beijing City as an example to mock and predict. The prediction results of genetic algorithm neural network model and that of traditional BP network are compared. The results show that genetic algorithm neural network has high accuracy, which indicates that the method can be one way for predicting the market price of vegetable with the non-linear time series. The research can only be used in predicting the price alone, considering other major influencing factors into consideration to improve the prediction results of vegetable needs further studying.

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