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Research Article

Food Safety Evaluation System Construction Based on Artificial Neural Network

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Abstract: This study uses regression model and artificial neural network model to apply food safety index in food safety trend predication and makes policy advices in the construction and release of an authoritative food safety index, The results showed that the BP neural network was high-precision, fast and objective, which could be used to food safety evaluation of circulation links of production, processing and sales.

Keywords: Artificial neural network, evaluation, food safety system

INTRODUCTION

It is the foundation of life, stability and the source of wealth for People. Food safety concerns born economic development and social stability, which relate to the image of Government and nation. In recent years, food safety incidents accrued frequently. It has become an extremely prominent society Problem (Jiang, 2001). So it is significant to strengthen the research on regulation of food safety, establish the food safety regulatory system and carryout the effective response measures. The application of scientific food safety evaluation model with high performance is the key point in food safety evaluation. The supervision departments still use the traditional violation ratio evaluation which has the advantages of reliability, objectivity and simplicity, but has low identify ability. To compensate for this shortcoming, the accuracy of the food safety evaluation model directly influences the accuracy of food safety situation assessment and forecast. Based on the artificial neural network model, a food safety evaluation index system was established from the perspective of the food supply chain. In order to detect the convergence speed and fitting degree of the model's deviation, in the backward propagation neural network algorithm. Meanwhile, the sample data were trained and the test data were validated. Only the food safety model based on the principles of "substance determination", "quantity determination", "and limit determination" and "information comprehensivization", proposed by this study can have a corresponding "reliability", "objectivity", "simplicity" and "identifiability". The food safety model considering "violation ratio" and "violation degree", which are key attributes describing food safety, has higher identifiability.

MATERIALS AND METHODS

The "violation degree" evaluation and food safety model can deal with test value with the requirements of positive limit and negative limit and have high data applicability to meet the requirements of the supervision departments on evaluation information. Although current subjective valuation methods can provide comprehensive and detailed information compared to traditional violation ratio evaluation method, they have drawbacks of complicated calculation, unreliable information, non-objective evaluation and less identifiabilityion in food safety supervision showing that food safety model constructed has greater ability to identify influencing factors than that of traditional violation ratio index and has significant warning ability (Karl and Beck, 2000).

Construction of neural network model: BP (Back Propagation) neural network is developed by the BP algorithm, through the output of the output layer in the BP algorithm to advance step by step to estimate the errors of each layer. This algorithm promotes the rapid development of the artificial neural network. The neurons of BP neural network still use neuron described earlier, which are connected in fully meshed form, but in the selection of activation function, the activation function of BP neural network requires they should be derivate anytime. The BP neural network can be broadly divided into two steps, the forward propagation of the information and back propagation of errors. In

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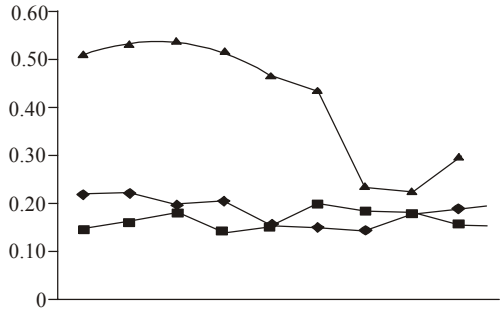

Fig. 1: Food harmony degree trends

the process of error back propagation, a comparison between the actual error and the expected error should be taken and then adjust the weights between neurons. BP algorithm (Jiang, 2001) is shown as below:

For h =1 to M do
Initialize weight $W^{(h)}$
Initialize precision control parameters ε
$E = \varepsilon + 1$
While $E>\varepsilon$ do $E = 0$
To each sample of S (X_P, Y_P)
Calculate the actual oupt O_P of X_P
Calculate E_P $E = E + E_P$
Adjust weight $W^{(m)}$
$h = M$-1
While $h \neq 0$ do Adjust weight $W^{(h)}$
$h = h$ -1
$E = E$ /2.0

According to centroid angle theory for identifying target, the target tool is constructed through using "violation ratio" and "violation degree" as transverse and longitudinal axis and using concentric zones to identify the risk level of food safety and represents the beam (OR) length from the origin. As shown in Fig. 1. Compared with one way index, it has higher and more comprehensive food safety risks distinguish ability and can support the supervision departments and improve the decision efficiency.

The first method: Neurons in the hidden layer are twice as many as the neurons in the input layer and output layer. In the actual experiment, on the basis of twice of the input or output neurons and in the simulation experiment, the best performance of BP neural network will be got by increasing or decreasing the number of neurons.

The second method: At the beginning stage of network design, we can design many enough neuron experiments in network and remove the neurons which have little impact on the network in simulation experiment, so as to achieve the best performance of the network.

The third method: We can use the formula $s = \sqrt{n+m} + \alpha$, which neurons number in each layer can satisfy, where m stands for the number of input neurons, n refers to the number of output neurons, a randomly selected numerical value.

And also neural network probability model is the core algorithm of multi-attribute inversion. To description of the relationship between multiple-attribute is the most suitable statistical relationship, the best method of multi-attribute solving the objective function is neural network and Kriging method has been widely used and spatial interpolation calculation. In this study, we combine those algorithms, which provided the core effective technology for the inversion of physical parameters of high resolution.

Firstly, according to the seismic multi-attribute and the objective function to form a multi-dimensional matrix:

$$\begin{aligned}&\{A_{11}, A_{21}, A_{31}, L_1\}\\&\{A_{12}, A_{22}, A_{32}, L_2\}\\&\cdot\\&\cdot\\&\cdot\\&\{A_{1n}, A_{2n}, A_{3n}, L_n\}\end{aligned} \tag{1}$$

where, L_i is the target curve. Given a set of training data:

$$x = \{A_{1j}, A_{2j}, A_{3j}\} \tag{2}$$

Estimate a new output curve:

$$\hat{L}(x) = \frac{\sum_{i=1}^{n} L_i \exp(-D(x, x_i))}{\sum_{i=1}^{n} \exp(-D(x, x_i))} \tag{3}$$

where,

$$D(x, x_i) = \sum_{j=1}^{3} \left(\frac{x_j - x_{ij}}{\sigma_j} \right)^2 \tag{4}$$

Calculate the checksum error:

$$\hat{L}_m(x_m) = \frac{\sum_{i \neq m} L_i \exp(-D(x_m, x_i))}{\sum_{i \neq m}^{n} \exp(-D(x_m, x_i))} \tag{5}$$

The "food safety index" with "four properties" is are liability, objectivity, simplicity and identifiability index. Based on food safety limit standards and twoun-weighted evaluation indexes "violation ratio" (C) and

"violation degree" (D) this study constructs the food safety index, $R = \hat{j} (C)^2 - h (Z))^2$. It can provide evaluation information on the frequency and size of unsafe food and response the change of violation ratio or violation degree with y/*l* times sensitivity, which is better than violation ratio index and it has advantages of simplicity, reliability, objectivity and identify ability, which also is better than other common comprehensive indexes.

RESULTS AND DISCUSSION

Food security situation is influenced by the natural environment, processing and sanitation, agriculture and the accuracy of the test values. The gap between the result of safety evaluation and expectation is bigger; the paper used the improved neural network information processing and evaluated the food security situation (Mikola and Schmid, 2005).

Food safety evaluation model is a political model that transformed the inputs into outputs. It inputs funds, talents, equipments, technologies and some other information resources that evaluation required; it is the service that food safety evaluation services outputs; while it is conversion that completed the process from the input to the output. The function of food safety evaluation model function is mainly included: first of all, through the food safety evaluation model, it can have seamless evaluation on the food chain, which can ensure the food safety from soil to each links of the table to meet the requirements of the corresponding standards, so as to safeguard public health and safety; secondly, the food safety evaluation model has the function with feedback. It can find that issues during the evaluation process, such as the effect of the policies, regulatory loopholes, the public views and suggestions, etc. When feedback goes back to the subject of evaluation, it can promote the supervision subject to modify and improve the supervision theory and operation mechanism; thirdly, the food safety evaluation model can conduct self adjustment in certain conditions and better itself, even bring about new policies. The evaluation model itself can exchange information with the external environment, with the change of the internal and external environment, it can adjust its structures, functions, means and methods to make the adjustment (Gorris, 2005). The principle of system analysis, the overall effect of food safety evaluation model must be greater than the effect of each component. That is to say, the overall efficiency of food safety evaluation model cannot depend on the function of a certain part alone (such as the evaluation theory), it should pay attention to the integrity, structure, hierarchy and the correlation of the evaluation system, so as to ensure the coordination in quantity and quality between the various parts, realizing the maximum efficiency through the overall optimization of the evaluation system.

CONCLUSION

This study constructs the food safety model with reliability, objectivity, simplicity and identifiability and application research. It uses food safety testing data to carry out multiple implementations and multiple performances verification and analysis on food safety model.

Experimental results show that the evaluation of the accuracy is feasible, it can solve the shortage that traditional evaluation model is week in relying too much on subjectivity, self-learning ability is weak also, improve the accuracy of the food safety evaluation effectively.

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