

A Rapid Evaluation Method for Network Public Opinion Based on Neural Network and Analytic Hierarchy Process

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Abstract: The establishment of an effective network public opinion risk early-warning index system and evaluation method is an important basis for emergency decision-making. The automatic and rapid evaluation of network public opinion can greatly reduce manpower output. In order to establish a suitable evaluation method to measure development level of network public opinion in higher vocational colleges, an integrated algorithm for network public opinion evaluation combining BP neural network with the Analytic Hierarchy Process (AHP) is proposed. Furthermore, the possible ways for optimization are also discussed.

1. Introduction

With the advent of the Internet era, people can speak freely through various new media channels, express opinions and opinions on various public affairs, and form network public opinion. Due to the openness and virtuality of the network, network public opinion will have an immeasurable negative impact on the development and resolution of social hot spots.

Higher vocational colleges undertake the important function of spreading knowledge and training skilled talents. Because these college students pay more attention to news, political events, social emergencies, natural disasters, inequality in society will all attract their attention. Some events can lead to parades, rallies, and even violence. These bring hidden danger to the normal development of higher vocational colleges. Therefore, it is necessary to monitor network public opinion in higher vocational colleges timely in order to achieve the purpose of early intervention and diversion so that maintain the stability of colleges.

Through self-learning, adaptive ability and strong fault tolerance of neural network, the multi-index comprehensive evaluation method based on artificial neural network establishes a comprehensive evaluation model that is closer to the human thinking model. The trained neural network gives the expert's evaluation thoughts to the network in the form of connecting rights, so that the network can not only simulate the expert's quantitative evaluation, but also avoid the human error in the evaluation process. Because the weight of the model is obtained by example learning, this avoids the subjective influence and uncertainty of artificial work.

Based on the combination of Analytic Hierarchy Process (AHP) and BP Neural Network, a fusion method will applies to the development evaluation of network public opinion.

2. Evaluation Index System for Network Public Opinion

There are many factors involved in the evaluation index system of network public opinion. Based on the factors of operability and objectivity, the index system of 3 first-level indicators and 10 second-level indicators is constructed.

Among the indicators, some are qualitative and some are quantitative. The qualitative value can be quantified by grading. For quantitative values, data source mainly comes from Baidu, today's headlines, WeChat, QQ, Weibo, and vocational college campus websites, posted bars and other online exchange platforms.

A three level index system as shown in table1.

Table 1. Network Public Opinion Evaluation Index System

Aim level	First level	Second level
The Development Level of Network Public Opinion	Public Attention	Number of Visits
		Number of Retweets
		Number of Discussions
		Number of Likes
	Public Opinion Sensitivity	Political Sensitivity
		Severity of Incident
		Publisher Influence
		Platform Influence
	Public Opinion Propagation	Propagation Speed
		Time of Duration

3. Construction of Evaluation Model

AHP tries to standardize the decision-making thinking process through a certain model, so that it can be applied to the evaluation problem of combining qualitative and quantitative factors. However, how to reduce the subjective factors such as subjective arbitrariness, thinking uncertainty and cognitive ambiguity, artificial neural network method can effectively make up for the above problems.

3.1 AHP Method and Acquisition of Samples

In previous discussion we can easily see that the evaluation of network public opinion is a multi-level and multi-index comprehensive evaluation. In the comprehensive evaluation process, it is core issue how to define the weight of indicators scientifically and reasonably. In this paper AHP will be used to determine the index weight.

In this study, 30 experts are invited to join the analysis.

Since the dimensionality of each indicator unit is different, in order to compare and score each indicator, it is necessary to standardize them to [0, 1] region. Indicators are divided into positive indicators and negative indicators, which require directional consistency processing also.

Suppose the evaluation index system of network public opinion come up with m objects (k=1, 2, 3,..., m).The normalized matrix of evaluation factors in the index layer is R_{ij}^k .

The weight of each index is W_{ij} , the value of index layer is:

$$R_i^k = R_{ij}^k \times W_{ij}. \quad (1)$$

The weight of each index layer is u_i , The synthetically evaluation of this system will be:

$$B^k = \sum_{i=1}^n u_i \times R_i^k. \quad (2)$$

We can use this model to calculate the development level of network public opinion and at the same time get some samples for the next step.

3.2 The Network Structure and Algorithm of BP Neural Network

The Back Production neural network is an influential neuron model. It is a multi-level feedback network that uses "mentors" learning algorithm. The comprehensive evaluation method based on BP artificial neural network has the advantages of fast operation speed, high problem solving efficiency, strong self-learning ability, and wide adaptive surface. It better simulates the process of comprehensive evaluation by evaluation experts, and thus has broad application prospects.

The evaluation model can be constructed based on three-layer BP neural network. The advantage of this model is that it can be judged and monitored 24 hours a day and in different cycles. This approach does not rely on team of experts, it is equivalent to constructing an expert system. Samples obtained above can be used to train the network.

The number of nodes in input layer is the index numbers (here 10). The only node in output layer is the judging value. The number of nodes in hidden layer can be selected according to studying speed of network. The node input is equal to the node output in input layer. The relations between input and output of nodes in hidden layer and output layer can adopt sigmoid function.

The standardized sample value of the indicator is entered into the network and the corresponding expected output is given. Optimization principle is: let the network output approximate the ideal value. The ideal value is the value which is calculated using AHP method above.

According to the analysis above, the algorithm can be shown as follow:

- (1) Choose initial value of weight;
- (2) Forward propagation, calculating the output of each layer of nodes;
- (3) calculate the error of each layer node;
- (4) Reverse propagation, correcting weights;
- (5) Repeat above steps until the error is low enough (less than the given fit error), otherwise continue training.

Comparing the results obtained after using BP network training and testing with the use of AHP method depend on experts. If consistent, it shows that the BP network did not fall into the local minimum point of the error surface during the training process, and reached the true minimum point, and the results obtained were reliable; If it is inconsistent, it means that the BP network falls into the local minimum point of the error surface during the training process and does not reach the true minimum point. This requires taking measures such as re-selecting the initial weight, training data, increasing the number of hidden layer nerve elements, and changing to a momentum algorithm to retrain and test the network to obtain new weight values. Until it is consistent with the importance ranking obtained by using AHP method and expert investigation and qualitative analysis.

The network weight after training can be used for formal evaluation.

3.3 Algorithm Optimization

One of the fatal flaws of BP neural networks is that they are prone to local optimality during learning and training. The accuracy of the evaluation results will be affected.

Supposed Input sample evaluation index information as (x_1, x_2, \dots, x_n)

Calculate the actual output:

$$y_j = 1 / [1 + \exp(-\sum_{i=0}^n \tilde{w}_{ij} x_i)] \quad (3)$$

Where, n means the number of input nodes of node;

Above, x_i means the output value of the ith input node;

y_j Means the output of the network system;

\tilde{w}_{ij} Means the weight from input node i to j;

Compare idea outputs with calculated outputs, and modify the weights and thresholds value of k-layer nodes:

$$\tilde{w}_{ij}(k+1) = \tilde{w}_{ij}(k) + \beta \xi_j x_i + \alpha [\tilde{w}_{ij}(k) - \tilde{w}_{ij}(k-1)] \quad (0 < \alpha < 1) \quad (4)$$

Where, w_{ij} means the weight value or threshold value from node i to j;

x_i Means the output of node i;

ξ_j Means deviation modifier;

β Means learning rate;

α Means momentum coefficient.

Output node deviation modifier is:

$$\xi_j = y_j(1 - y_j)(d_j - y_j) \quad (5)$$

d_j Means the output of the sample.

Hidden node deviation modifier as follows:

$$\xi_j = y_j(1 - y_j) \sum_{i=0}^g \xi_i \tilde{w}_{ij} \quad (6)$$

In the equation above, g means the node number of the output layer link to node j.

4. Conclusion

In this paper, based on the evaluation index system of network public opinion, a new model and algorithm has constructed by combining the AHP and BP neural network. Furthermore, relevant optimization methods have been discussed. The trained network can make an immediate response to the input index matrix in the evaluation, without manual intervention, and the evaluation is objective and fast. Other methods such as AHP and Fuzzy synthetic evaluation need to interact with experts continuously and have low efficiency.

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