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Study on the evaluation model of undergraduates' ideological and political status based on BP neural network

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ABSTRACT

Given the different defects of evaluation on undergraduates' ideological and political status in terms of scientificity, objectivity and operability, fuzzy evaluation method and BP neural network were combined in this paper. Firstly, the evaluation index system and membership function were built according to the characteristics of the study object. Different variables were evaluated by means of dimensionless membership. Then undergraduates' ideological and political status was evaluated by using the sound nonlinear evaluation ability of BP neural network. Empirical analysis shows that evaluating undergraduates' ideological and political status by using BP neural network has good effect and high precision, thus providing a new way and basis for evaluating undergraduates' ideological and political status.

KEYWORDS

BP neural network; Fuzzy evaluation method; Evaluation index; Ideology and politics; Network Structure chart.



INTRODUCTION

“Strong youths lead to a strong country”, undergraduates have an important significance to the nation’s future. Evaluation on undergraduates’ ideological and political status is of great importance to learn and master undergraduates’ comprehensive psychological status. Given the problems existing in undergraduates’ ideological and political status, effective psychological counseling and controlling can be provided.

In view of the fuzziness in the evaluation contents of undergraduates’ ideological and political status as well as the uncertainties in its evaluation scope, fuzzy evaluation method and BP neural network algorithm were combined in this paper. The evaluation index system and membership function were built according to the characteristics of the study object. Different variables were evaluated by means of dimensionless membership. Then undergraduates’ ideological and political status was evaluated by using the sound nonlinear evaluation ability of BP neural network. The uncertainties and fuzziness in evaluation on undergraduates’ ideological and political status were reasonably solved.

BP NEURAL NETWORK

BP neural network was put forward by Rumelhart and McClelland in 1986. It is a network in which the errors are propagated in an inverse manner. Its structure model is as shown in Fig. 1. It is mainly composed of input layer, hidden layer and output layer.

BP artificial neural network is a multilayer forward neural network. It is a propagating multilayer forward neural network composed of input layer, hidden layer and output layer. It can be used for solving the learning problem of connection weight of hidden units in a multilayer network. Its input signal is propagated to each hidden layer through the input nodes successively before being propagated to the output node. The output at the node of each layer only affects the output of the node at the next layer. The learning process of BP artificial neural network includes forward-propagation and back-propagation. In case of forward-propagation, the input information is propagated from the input layer to the output layer before being processed by the units at the hidden layer, during which the state of the nerve cells at each layer only affects the state of the nerve cells at the next layer. If the expected output is not acquired at the output layer, then shift to back-propagation to return the error signal along the original connecting access for nerve cells. During the returning process, the connection weights of the nerve cells at each layer are gradually modified. Such process is constantly iterated, which finally enables the signal error to be in the allowed error range.

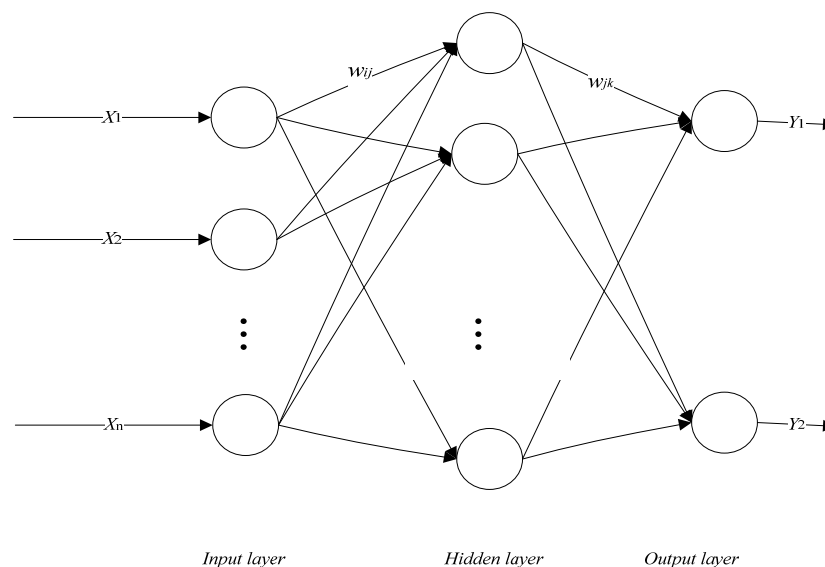


Fig.1 Structure chart of BP neural network

SELECTION OF INDEX SYSTEM

Based on relevant literatures both home and abroad as well as the actual condition of domestic evaluation on undergraduates’ ideological and political status, the index system was built by concluding existing study index system during the designing process of evaluation index system. The evaluation index system for undergraduates’ ideological and political status includes three layers of indexes: evaluation objective layer, criterion layer and sub-criterion layer. It is divided into 1 first-level index, 5 second-level indexes, 15 third-level indexes, as shown in Table 1.

Table 1 Table of evaluation indexes for undergraduates' ideological and political status

Objective layer (Layer A)	Criterion layer (Layer B)	Sub-criterion layer (Layer C)
Comprehensive evaluation indexes for undergraduates' ideological and political status U	Implementation of ideological and political education for undergraduates u_1	Organization setting for ideological and political education for undergraduates u_{11}
		Personnel allocation for ideological and political education for undergraduates u_{12}
		Development plan of ideological and political education for undergraduates u_{13}
	Subjects of ideological and political education for undergraduates u_2	Improvement level of the educatees' ideological and political awareness u_{21}
		Influence of the educatees on others' ideology u_{22}
		The educators' quality and structure u_{23}
		Improvement level of the educators' ideological and political awareness after a phase of ideological and political education u_{24}
	The process of ideological and political education for undergraduates u_3	Systematicness of ideological and political education plan u_{31}
		Scientificity of ideological and political education process u_{32}
		Creativeness of ideological and political education method u_{33}
	The information system of ideological and political education for undergraduates u_4	Information collection and management for ideological and political education for undergraduates u_{41}
		Information analysis and application for ideological and political education for undergraduates u_{42}
	The input and environment of ideological and political education for undergraduates u_5	Investment condition of ideological and political education for undergraduates u_{51}
		Internal environment of ideological and political education for undergraduates u_{52}
		External environment of ideological and political education for undergraduates u_{53}

DETERMINATION OF INDEX WEIGHT

Evaluation on undergraduates' ideological and political status is a very complicated task. To effectively carry it out, researchers should follow the following steps: Firstly, analyze to determine the evaluation index system according to the requirements such as objective and functions etc. of evaluation on undergraduates' ideological and political status, and carry out judgment analysis on the index system, thus determining the settings for each major category of indexes and individual evaluation weight. Secondly, carry out individual evaluations to acquire the extent to which the system can be realized under each evaluation index, and carry out normalization processing for the different dimensional realization values under different indexes, thus obtaining the fuzzy matrix. Thirdly, carry out comprehensive evaluation. Calculate the comprehensive evaluation values of the individual indexes successively, synthesize the overall evaluation values of the major categories of indexes and the system according to the index system. Finally, the final evaluation rating of the system can be acquired by using maximum membership principle according to the overall evaluation values of the system. In this paper, the index weight was determined by means of analytic hierarchy process, and overall evaluation was carried out on undergraduates' ideological and political status by means of fuzzy comprehensive evaluation method according to the following order.

Determining the set of index evaluation

In the model in this paper, $U = \{U_1, U_2, U_3, U_4, U_5\}$, $U_1 = \{U_{11}, U_{12}, U_{13}\}$, $U_2 = \{U_{21}, U_{22}, U_{23}, U_{24}\}$, $U_3 = \{U_{31}, U_{32}, U_{33}\}$, $U_4 = \{U_{41}, U_{42}\}$, $U_5 = \{U_{51}, U_{52}, U_{53}\}$

Determining the set of index remarks

Determining the set of ratings of remarks

$V = \{V_1, V_2, V_3, V_4, V_5\} = \text{Excellent, good, middle, general, bad}$.

Determination of weight

In this paper, the index weight is determined by means of analytical hierarchy process (AHP). Qualitative analysis and quantitative analysis can be combined by using this method. It is an analytical method which is mainly used for solving complicated systems with multiple factors, in particularly social systems which are difficult to quantitatively describe. Firstly, the problem to be analyzed is decomposed into hierarchies. According to the problem property and the general objective to be achieved, the problem is finally concluded to a problem at the lowest hierarchy about the relative important weight value or relative good/bad sequence relating to the overall objective.

The specific operations are as follows: set 5 importance grades for each index (including first-level and second-level indexes), including most important, very important, important, comparatively important, general important. The score of the most important is $K_1 = 5$, and followed by $K_2 = 4$, $K_3 = 3$, $K_4 = 2$, $K_5 = 1$. Therefore, the formula for calculating the importance of each index is:

$$M = \sum_{n=1}^5 P_n \square K_n$$

Where P_1, P_2, P_3, P_4, P_5 respectively represent the proportions of the number of persons (who select different importance grade for each index) accounting for the total number of persons.

The calculation steps are as follows:

Step1: calculate the product of the elements in each line of the judgment matrix, the formula is:

$$L_i = \prod_{j=1}^n a_{ij} \quad (i=1,2,\dots, n)$$

Step2: calculate the n th root value of L_i in each line, the formula is:

$$K_i = \sqrt[n]{L_i}$$

Step3: carry out normalization processing for vector $K = (K_1, K_2, K_3, K_4, K_5)^T$
 W is the first-level index weight.

$$W = K_i / \sum_{j=1}^n K_j$$

By parity of reasoning, the weight of the hierarchy where the index is located can be calculated. The calculation results are as shown in Table 2:

Table 2 The weights of the hierarchies where second-level indexes are located

Second-level index	w	Second-level index	w
B1	0.4	B9	0.055
B2	0.4	B10	0.328
B3	0.2	B11	0.150
B4	0.247	B12	0.068
B5	0.113	B13	0.454
B6	0.247	B14	0.447
B7	0.231	B15	0.177
B8	0.107		

EVALUATION MODEL OF IDEOLOGICAL AND POLITICAL STATUS BASED ON BP NEURAL NETWORK

Idea of the algorithm

The priority and premise for modeling by means of BP neural network are sufficient samples with good typicality and high precision. Moreover, the data collected must be divided into training sample, inspecting sample (over 10%) and testing sample in order to monitor the training (learning) process to avoid "overfitting", thus improving the performance and generalization ability of the network model. In addition, the balance between sample patterns should be taken into account as far as possible amid data grouping.

Evaluation on students' ideological status is essentially a problem of pattern recognition, i.e., compare the arrays composed of the actual monitoring results from the evaluation index system of students' ideological status and the corresponding standard evaluation values of evaluation on students' ideological status. The EQI (Ecological Quality Index) corresponding to the standard value array which is the most approximate to the monitoring value array is the recognition result of BP artificial neural network model. It is also the evaluation result of the corresponding evaluation on students' ideological status.

Flow chart of the algorithm

As mentioned above, the flow chart of evaluation on undergraduates' ideological and political status based on BP neural network is shown in Fig. 2.

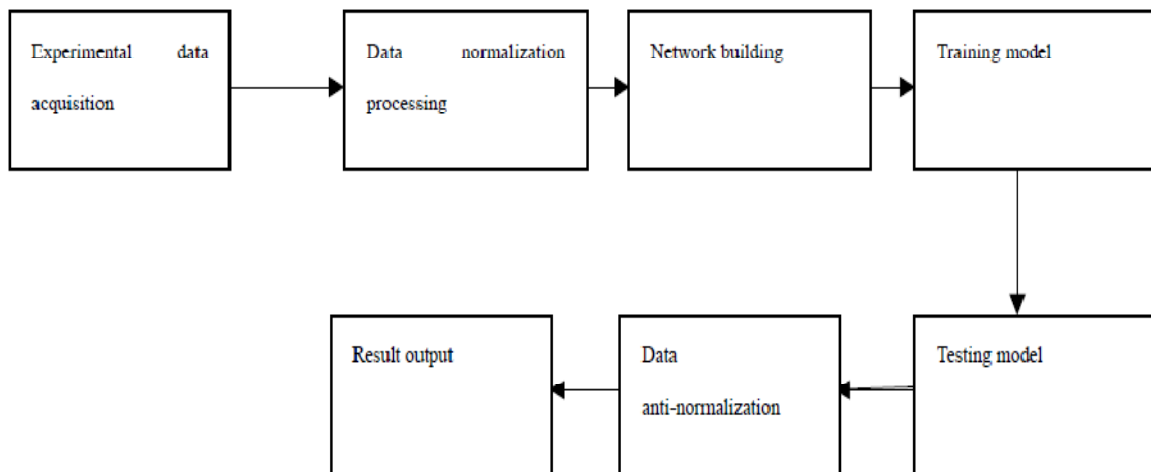


Fig. 2 Flow chart of the algorithm

Steps of the algorithm

The steps of the algorithm for evaluation on undergraduates' ideological and political status based on BP neural network are as follows:

Step 1: building training sample and data pre-processing.

Data pre-processing is mainly normalization processing, for the purpose of avoiding overlarge result deviation due to different orders of magnitude in the data. Meanwhile, it can also accelerate the convergence rate of the network.

In this paper, the normalization processing is maximin method, and the normalization formula is as follows:

$$x_k = \frac{x_k - x_{\min}}{x_{\max} - x_{\min}} \quad (1)$$

Where x_{\min} and x_{\max} indicate the minimum and maximum values in the data series respectively.

Step 2: building the model of BP neural network;

Step 3: training network; Levenberg-Marquardt method is adopted as it has fast training speed.

Step 4: testing network; using the testing sample to verify the effectiveness of the algorithm in this paper.

Step 5: output the result and save the network, for the purpose of facilitating subsequent evaluations and call of undergraduates' ideological and political status.

EMPIRICAL ANALYSIS

Model of current satisfaction

The three-layer BP network is used, with 8 nerve cells in the middle layer. The training step length is 50, and the final training precision is 0.001, the output results include satisfactory (0 1) and comparatively satisfactory (1 0).

Table 3 Evaluation index of satisfaction

Type	Index 1	Index 2	Index 3	Index 4	Index 5
Satisfactory 1	0.24	0.31	0.27	0.19	0.12
Satisfactory 2	0.23	0.28	0.19	0.21	0.11
Satisfactory 3	0.75	0.64	0.75	0.50	0.54
Comparatively satisfactory 4	0.21	0.26	0.26	0.19	0.15
Satisfactory 5	0.79	0.63	0.71	0.11	0.55
Satisfactory 6	0.71	0.57	0.72	0.54	0.63
Satisfactory 7	0.83	0.60	0.69	0.53	0.59
Comparatively satisfactory 8	0.13	0.30	0.20	0.14	0.11
Satisfactory 9	0.83	0.68	0.74	0.59	0.57
Comparatively satisfactory 10	0.21	0.28	0.19	0.17	0.18
Satisfactory 11	0.84	0.59	0.71	0.51	0.67
Comparatively satisfactory 12	0.15	0.24	0.23	0.15	0.13
Satisfactory 13	0.79	0.59	0.71	0.54	0.62
Satisfactory 14	0.73	0.62	0.72	0.52	0.59

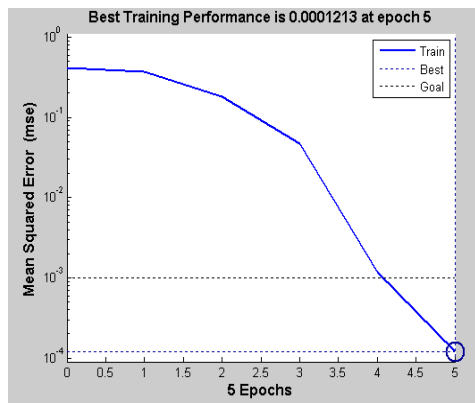


Fig. 3 Error convergence diagram

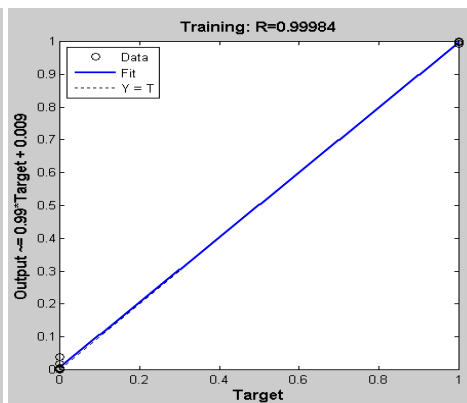


Fig. 4 Fitting diagram

Table 4 Predication results of BP neural network

Type		Network output			
Training sample	Satisfactory 1	1	0	1	-0.0000
	Satisfactory 2	1	0	1	-0.0000
	Satisfactory 3	0	1	0.0000	1
	Comparatively satisfactory 4	1	0	1	-0.0000
	Satisfactory 5	0	1	0.0000	1
	Satisfactory 6	0	1	0.0000	1
	Satisfactory 7	0	1	0.0000	1
	Comparatively satisfactory 8	1	0	1	-0.0000
	Satisfactory 9	0	1	0.0000	1
	Comparatively satisfactory 10	1	0	1	-0.0000
Testing sample	Satisfactory 11	0	1	0.0000	1
	Comparatively satisfactory 12	1	0	1	-0.0000
	Satisfactory 13	0	1	0.0000	1
	Satisfactory 14	0	1	0.0000	1

According to Table 4, after 5 trainings, the actual output of the network is consistent with that of the target output, which shows that the training process is effective. According to the results of the last 4 testing samples in Table 4, the network provides the correct judgment. This shows that evaluation on undergraduates' ideological and political status based on BP neural network is feasible and effective.

The survey data were applied to our model. The results acquired show that undergraduates are politically active, healthy and opportunistic; they are opportunistic about Chinese political situation and economic situation and pay attention to hot spots of society. However, some students' ideological activities show obviously reinforced independency, selectivity, variability and differentiation. They are affected by various political and ideological cultures to a greater extent.

Evaluation on moral concepts

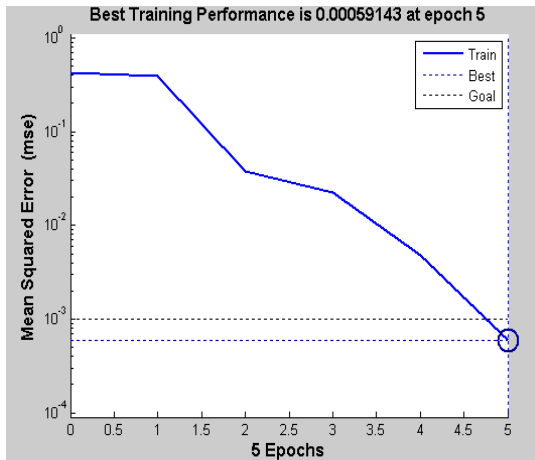


Fig. 5 Error convergence diagram

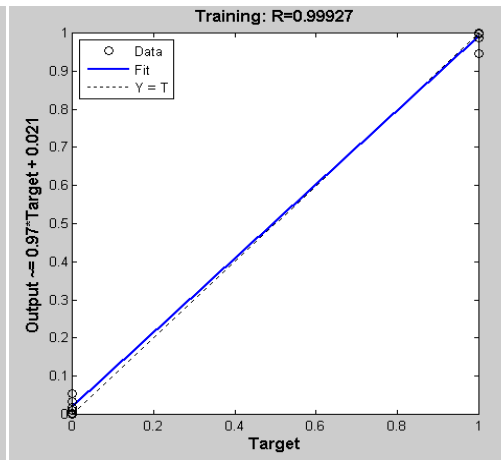


Fig. 6 Fitting diagram

The survey data were applied to our model. The results acquired show that the undergraduates generally have strong moral concepts, they love our motherland, yearn for becoming a talent, and they are enterprising. Moreover, they have their dreams, they have active thoughts and are happy to accept new things. They pay attention to self-development, and they have both pragmatic and utilitarian awareness. They also have the problems of poor moral cultivation and self-control ability, less sufficient awareness of aspiration, poor credit consciousness, lacking of social responsibility, lacking of spirit of arduous struggle, deficient teamwork and inferior psychological quality etc. to different extents.

Evaluation on life belief

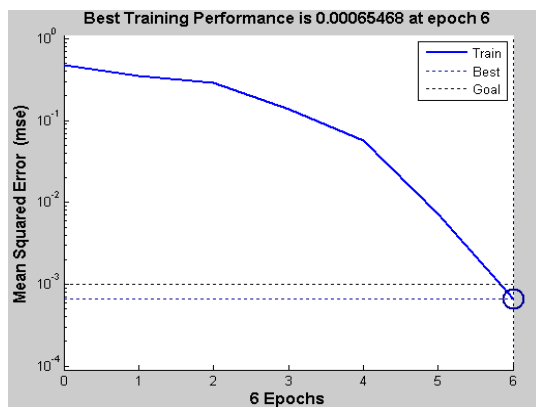


Fig. 7 Error convergence diagram

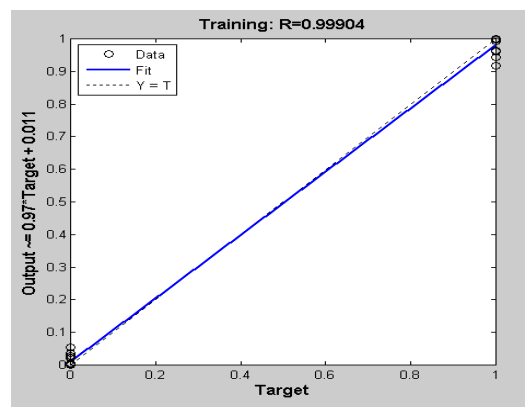


Fig. 8 Fitting diagram

The survey data were applied to our model. The results acquired show that undergraduates' life belief need to be further reinforced and guided. Contemporary undergraduates generally have a good belief in the stage of developing from low-level non-rational belief to high-level rational belief. However, it's undeniable that belief crisis exists among undergraduates to some extent, which mainly reflects in the follows: diversification, variability, non-rationalization, non-scientization and secularization.

Comprehensive evaluation

The data collected were graded by experts. 20 groups of data were acquired in order to comprehensively evaluate undergraduates' ideological and political status and realize quantitative evaluation on undergraduates' ideological and

political status, thus laying a foundation for subsequent evaluations on undergraduates' ideological and political status. The 20 groups of data were divided into two parts. The first 16 groups of data were training sample, while the remained 4 groups of data were testing sample. The simulation results are as shown in Fig. 9 and Fig. 10.

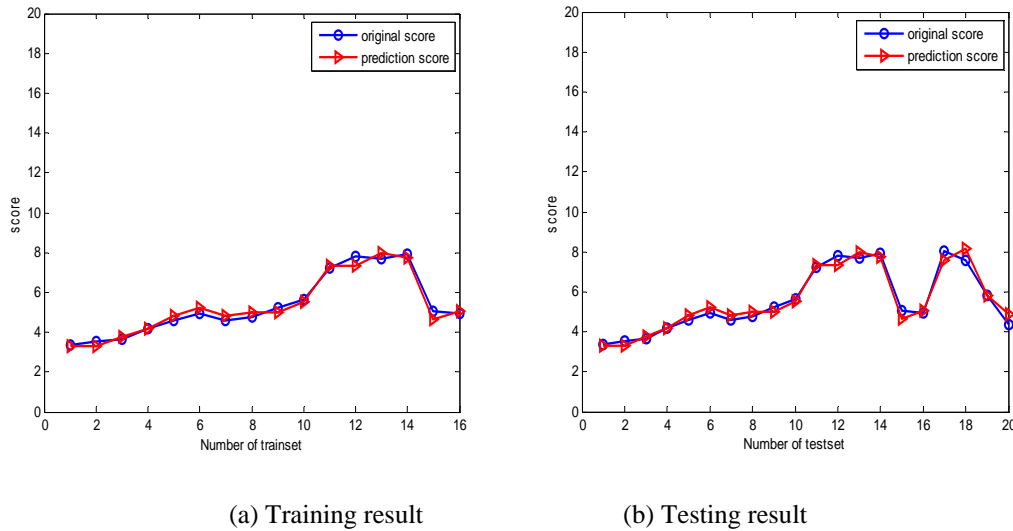


Fig. 9 Training and testing results

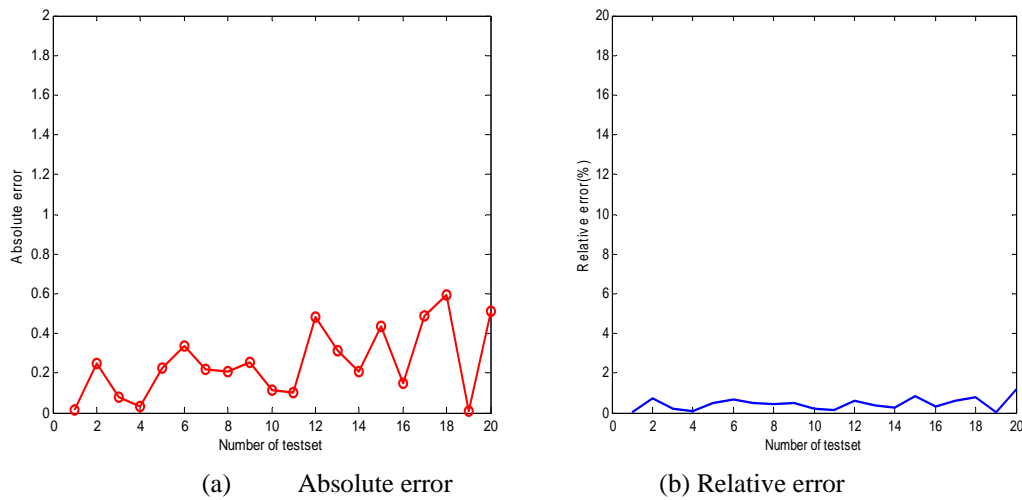


Fig. 10 Prediction errors

According to Fig. 9 and Fig. 10, evaluation on undergraduates' ideological and political status based on BP neural network has good predication effect. Its predicted relative error is less than 5% on average, which contributes to a high precision, thus providing a new method and basis for evaluation on undergraduates' ideological and political status.

CONCLUSION

Given the different defects of evaluation on undergraduates' ideological and political status in terms of scientificity, objectivity and operability, fuzzy evaluation method and BP neural network were combined in this paper. Firstly, the evaluation index and membership function were built. Then undergraduates' ideological and political status was evaluated by using the superior nonlinear evaluation ability of BP neural network. Classified evaluation on moral concepts and evaluation on life belief of undergraduates were carried out, and comprehensive evaluation was also carried out on undergraduates' ideological and political status. The evaluations show that evaluating undergraduates' ideological and political status by using BP neural network can effectively analyze and solve the ideological change of contemporary undergraduates, which provides sufficient theoretical basis for surveying students' statuses in various respects, and provides quantitative analysis and calculation method for specific problems.

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