

Modeling and Analysis of College Teaching Quality Based on Bp Neural Network

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Abstract: How to improve the teaching quality of higher education has become the focus of current higher education. However, in colleges and universities, classroom teaching is still the main channel to implement education, and its quality to a large extent reflects and determines the quality of education in colleges and universities. Teaching evaluation is a key measure to improve the quality of education and teaching. Therefore, it is particularly important to establish a scientific and reasonable evaluation system for college classroom teaching quality. In the evaluation system of the past, is more directly is adopted to establish the mathematical model of evaluation system, such as the weighted average method, analytic hierarchy process and fuzzy comprehensive evaluation method, etc. all of these methods in the evaluation process requirements affecting factors (namely evaluation index) has a linear relationship between, and it is difficult to rule out all sorts of randomness and subjectivity, easy to cause the evaluation results distortion and bias. As a new technology, artificial neural network (Ann) has been widely used in various evaluation problems due to its characteristics of nonlinear processing, adaptive learning and high fault tolerance. BP network is one of the many types of artificial neural network, and it is a multi-layer feed forward network with strong nonlinear mapping ability.

1. Introduction

Classroom teaching quality evaluation in colleges and universities is a complex problem, classroom teaching includes teaching conditions, the difficulty of the class, the teacher teaching and learning effect of many factors, such as their interaction, the complex relationship between teachers and students at the same time, factors affecting the quality of teaching is also more, at present, none of them has been recognized, the ideal of classroom teaching quality evaluation system, in the context of current research situation, focused on three aspects, one is the study of the evaluation main body, the second is the contents of the research on classroom teaching quality evaluation system, three is the system of each index is determined, the study of the method how to final evaluation of the quality of teaching level.

There are many ways to evaluate the quality of classroom teaching, such as: teachers' self-evaluation, peer evaluation, administrative leadership evaluation, expert evaluation and students' evaluation of teachers. Due to the different roles of evaluation subjects, their roles in the evaluation should be different. Each evaluation method and its results are only part of the evaluation of teaching quality, but not the whole of teaching quality. Because of the large number of teachers in colleges and universities and the evaluation of the number of frequent, if the organization leadership and peer expert survey evaluation method, not only time-consuming, laborious also cannot be ruled out because of the interpersonal relationship and not familiar with the teaching process and the influence of such factors as actually difficult to operate, so, take the student as the main body of teachers' teaching quality evaluation method is generally used by most colleges and universities. Since the 1980s, China's colleges and universities have gradually carried out student evaluation of teaching activities, which has played a certain role in improving the quality of classroom teaching in colleges and universities. As the direct object of classroom teaching, students have the right and ability to evaluate teachers' classroom teaching. Due to the diverse types and complicated majors in

colleges and universities across the country, students' level varies, and their requirements for classroom teaching quality evaluation are also different.

The content of classroom teaching quality evaluation is quite extensive, and there are two representative index systems abroad. One is Meeth's indicator system of teaching quality. Michel's main point is to distinguish the quality of teaching as the medium indicator of teaching process (12 items in total) and the ultimate indicator of teaching effect (9 items in total). The other is the former Soviet Union educator babansky teacher teaching evaluation index. Babansky constructed the index content from the following nine aspects: knowledge of the subject; Skills to assess the quality of knowledge, skills and techniques; Ability to develop work plans; Ability to effectively complete the project; Skills to develop an interest in a subject; The realization of interdisciplinary links; Treat students in an individual way; Develop students' general learning skills and techniques; Understanding of the principles of educational psychology of students. Babansky put forward the basic outline of the research and teaching work, and formulated the four-level scoring standard to make the evaluation index more operable.

In China, there is no strict definition of the evaluation index system, which is generally developed by the educational department of the school. Since it is difficult to compare the teaching of different subjects, different courses, different teaching links and different teaching objects, the evaluation system of teaching quality is mainly designed from the aspects of the most basic factors that can directly reflect the teaching quality and have commonness.

Traditional index weighted average method, is the school teaching management departments to make evaluation of each index, and according to the importance of every index to set the weight of each index, and then organize the student through the way of a questionnaire or online evaluation, to get the data, and then through the calculation of computer systems, to get all the scores of evaluation object, and then according to the score to determine the grade.

Scatty in the 1970s is a decision-making analysis method that combines qualitative analysis with quantitative analysis. It is a process of modelling and quantifying the decision thinking process of decision-makers on complex systems. By applying this method, the decision maker can decompose the complex problem into several levels and factors, and make simple comparison and calculation among the factors, so as to obtain the weight of different schemes and provide the basis for the selection of the best scheme. AHP is now used in many fields such as economic analysis and planning, scientific research management and enterprise management.

The basic principle of analytic hierarchy process: AHP firstly divides the problem into hierarchical levels according to the nature and overall goal of the problem, and then invites experts to make objective judgments on the factors at each level, and then gives a quantitative expression of the relative importance. Then the mathematical model is established to calculate the weight of the relative importance of all factors at each level, and the order is given. Finally, according to the ranking results, planning decisions are made and measures to solve the problems are selected.

BP neural network, with its basic characteristics of nonlinear mapping, learning classification and real-time optimization, has opened up a new approach for pattern recognition and nonlinear classification, and has been widely used in nonlinear, complex and comprehensive problem decision analysis. Its basic principle for comprehensive evaluation is: the information used to describe the characteristics of the evaluation object is taken as the input vector of the neural network, and the value representing the corresponding comprehensive evaluation is taken as the output of the neural network; Then the network is trained with enough samples so that different input vectors can get different output values. If the output value and the error between the expected value, and is beyond the scope of the provisions of error, depending on the error according to certain methods adjust the weights of neural network connection between each layer and hidden layer and output layer nodes of worshipping value, until the system error can be accepted, the weight and threshold value no longer change; In this way, the set of weights and mints held by the neural network are the correct internal representation of the network after adaptive learning. The trained neural network can be used as an effective tool for qualitative and quantitative evaluation of object systems outside the sample model.

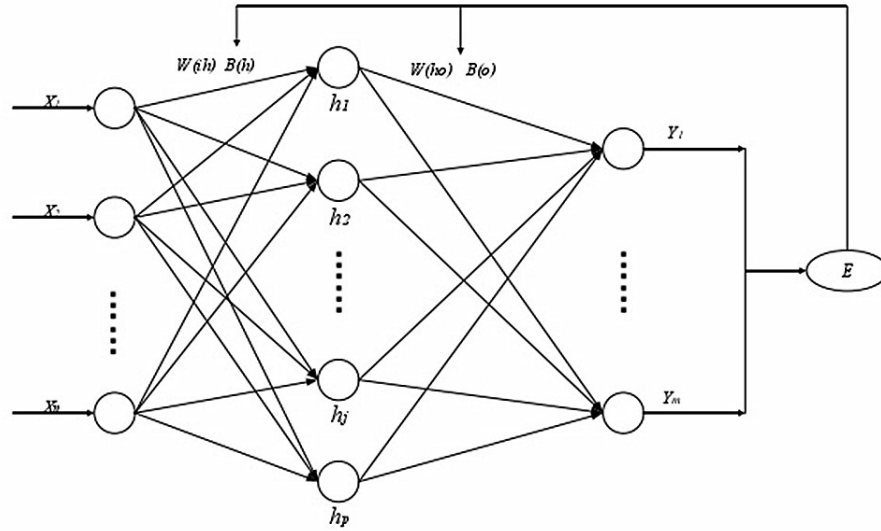


Fig.1 Three-Layer Bp Neural Network Structure

BP neural network is a classical model of multi-layer feed forward neural network. Its idea is to transmit the error between the output value of the network output layer and the target expected value along the opposite direction of the input signal transmission through the hidden layer by layer to the network input layer, and constantly correct the error of each layer. The learning process of BP neural network is divided into two processes: signal forward propagation and error backward propagation. In the case of forward propagation, the input signal is input by the input layer and processed and calculated by each hidden layer and connection weight, and the output layer outputs the final result in the whole process of forward propagation. In error back propagation stage, output the final calculated by the error function, the output layer, the error between the expected value of the actual value and the target if the error goal requirements over the learning process, otherwise the error will in some way from the output layer after all the hidden layer to the input layer of reverse transmission, forward error value and will be assigned to the whole network layers, the correction weights of each layer of neurons and worshipping value, until the final error value to achieve targets set by the network or network number of iterations required, and the whole learning process is over. Three-layer BP neural network with a hidden layer has strong nonlinear processing capability and is widely used. Its network structure is shown in figure 1.

2. Experimental Procedure

Deep neural network (DNN) is a kind of deep structure of artificial neural network (Ann). Since the 1940s, a large number of scholars and research institutions have been devoted to the study of artificial neural network models, but most of them are shallow models with only one hidden layer, such as three-layer BP neural network model, maximum state model, traditional Markova model, conditional random field, etc. The hidden layer of the model converts the original data input into the characteristic space required by a specific problem or target through the input layer. It is the key to information processing and is mainly applied to classification, regression, pattern recognition and other problems. However, because the shallow neural network model has only one hidden layer, its computing power, efficiency and modelling ability are limited in the face of high-order complex nonlinear functions. Therefore, the deep neural network containing multiple hidden layers to better obtain the feature vectors of sample data has become the research focus of researchers.

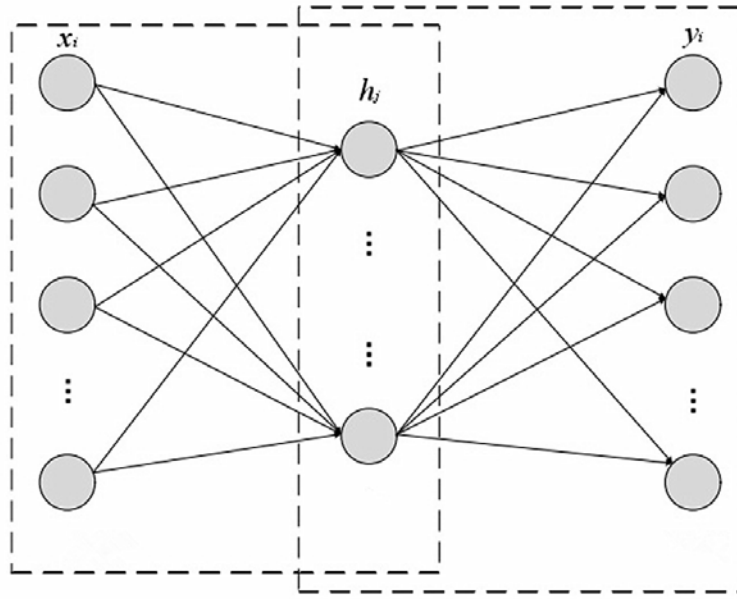


Fig.2 Automatic Encoder Model Structure

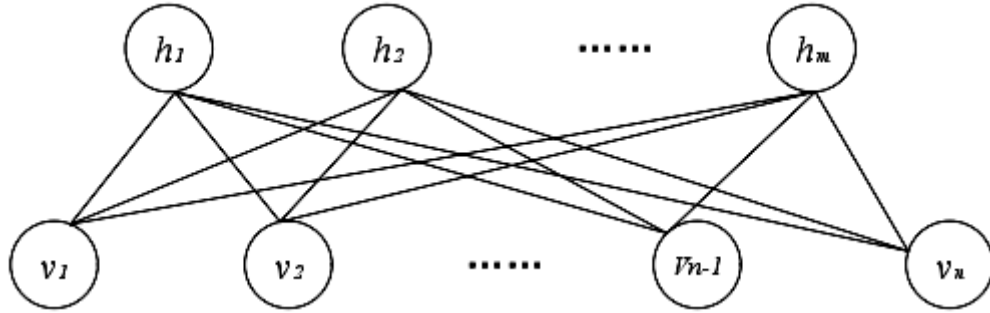


Fig.3 Restricted Boltzmann Machine Model Structure

The concept of automatic encoder was first proposed in 1986. It is an unsupervised algorithm, which is mainly used for dimensionality reduction or feature extraction of data. As a three-layer network model, the automatic encoder is composed of a coding network and a decoding network. The idea of the automatic encoder is to use the BP algorithm to back-propagate the error and constantly adjust the weight and threshold between the network layers to minimize the error between the original input data and the final output data so as to reconstruct the original input data. The processing process of the automatic encoder is firstly to transform the characteristics of the input data through the encoder network, such as converting the input data from high dimension to low dimension. Then the original input data is restored by decoding the network and the error function is used to calculate the error between the original input data and the output data. The purpose is to find an approximate identity function to minimize the error so as to realize the reconstruction of the original input data. The structure of the automatic encoder, which makes the output infinitely close to the input, is shown in figure 2.

The restricted Boltzmann machine model is an improvement of the Boltzmann machine by Hinton et al. It is a two-layer undirected graph model. The restricted Boltzmann machine model only connects the nodes between the visible layer and the hidden layer, and the connection between the Boltzmann machine units is limited to the adjacent two layers. There is no connection between the same layer unit and the cross-layer unit. The model structure is shown in figure 3:

3. Results and Discussion

Teaching quality evaluation in colleges and universities is a multi-level and multi-objective optimization problem, which is affected by many factors. So evaluation index should as far as

possible comprehensively and objectively reflect the teaching process, and as far as possible to reduce the amount of the evaluation index of “teaching” and “learning” is the two big main body in teaching activity, according to the most familiar with the characteristics of the teaching process, teaching students and teaching teams to the teacher to determine evaluation index in both groups, students as the main body of “learning” in the teaching process, and their evaluation can reflect most of the teachers teaching activities. Traditional evaluation indexes mostly evaluate the teaching situation of teachers from the teaching attitude, teaching content, teaching methods and other first-level indicators. Among them, each first-level indicator includes two to five second-level indicators, with a total of 18 indicators reflecting the teaching process of teachers, and each second-level indicator is evaluated by the percentage system. Teacher is the main part of the “teaching” in teaching activities, teachers' practical teaching situation by teaching teams to teacher's supervision and inspection, and teaching teams to teachers is made up of experienced and high level of teaching team, to the teacher's teaching attitude, teaching methods, teaching content, teaching effect, professional quality objective, comprehensive and integrated evaluation.

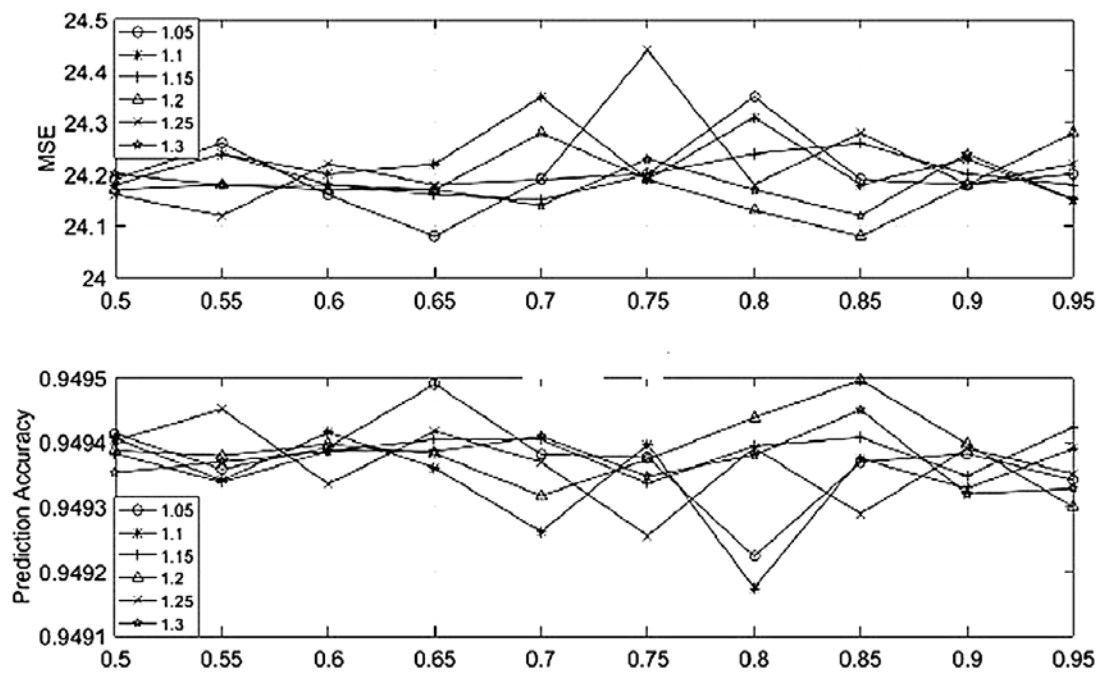


Fig.4 Combination of Growth Ratio and Decline Ratio of Different Adaptive Learning Rates

In view of the teaching quality evaluation is a multi-objective, multi-level and complicated nonlinear problem, and existing assessment methods and models of college teaching quality it is difficult to determine the weights, subjectivity and randomness is too strong, easily seen fitting, slow speed of optimization and the standard BP neural network is slow convergence speed, easily trapped in local minimum value, adaptive BP neural network model is put forward. The main idea of the model is to introduce adaptive learning rate and momentum term to improve the gradient descent method of BP neural network to improve the convergence rate and optimize the network structure to ensure the stability of the model. In addition, new evaluation indexes are added to the traditional evaluation indexes to construct the teaching quality evaluation index system of cost text to ensure the comprehensive evaluation of teaching activities of the model, and the evaluation index sample data set is normalized and used as the model input feature vector to improve the calculation efficiency of the model.

In order to ensure the convergence speed of the model in the training process, this experiment selects the combination of the growth ratio and the decline ratio of the learning rate. The number of neurons in the hidden layer of the model is 15, the training function is set as the gradient descent method of adaptive learning rate and momentum term, and the momentum term is set as 0.85. The training data set input model was trained to obtain a stable model, and the test data set input was

verified. When the model changes with the combination of growth ratio and decline ratio of different learning rates, the variation curves of MSE and prediction accuracy are shown in figure 4. It can be seen from figure 4 that, when the learning rate increases at the same rate, the MSE and prediction accuracy of the acquired model jump and change in the form of fluctuation with the increase of its declining ratio. When the decreasing ratio of learning rate is the same, the increasing ratio makes the MSE and prediction accuracy of the model increase first and then decrease. According to the data analysis and comparison in the figure, when the adaptive ratio of learning rate is 1.2 and the declining ratio is 0.85, the MSE and prediction accuracy of the model in the test data set are the best.

In order to solve the shortcomings of existing methods and models and the problems of slow convergence and easy local minimum in BP neural network, an adaptive BP neural network model is proposed in this paper. In order to improve the convergence rate of the model, the adaptive learning rate and the gradient descent method of BP neural network are introduced, and the network structure is optimized to ensure the stability of the model. In addition, new evaluation indexes are added to the input eigenvectors of the model and normalized to ensure more comprehensive evaluation of the model and improve the computational efficiency of the model. Finally, the evaluation sample data set is input into the model for training and compared with other models. The results show that the model can not only solve the problems of the existing evaluation methods and models, such as too strong subjectivity and randomness, easy overfitting, slow convergence, etc., but also predict that the evaluation results are optimal, so as to verify the effectiveness of the model in solving the problems of teaching quality evaluation in colleges and universities.

4. Conclusion

Teaching quality is an important link in the process of teaching in colleges and universities. Relevant national policies have taken teaching quality as the primary content of teacher assessment, and improved the evaluation method and content of teaching quality. Although this paper proposes an adaptive BP neural network model to evaluate teaching quality and adds new evaluation indexes, there are still many problems worth studying. In view of the future research work, the author will carry out the research from the following two aspects:

1) with data related theory and technology education gradually mature, big data and the integration of education gradually deepen education data in the teaching process has advantages in terms of data collection and data set more comprehensive education teaching is helpful to promote the reform of teaching evaluation, education pattern and so on, education big data analytics will promote the development of personalized education teaching, so education big data analysis is the focus of future research work.

2) The development of deep neural network will promote the new reform of social production mode. In the future research work, in-depth research will be conducted on deep neural network to improve computing speed and reduce training time.

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