Educational Management Data Based on Performance Appraisal Model

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Abstract. The evaluation of higher education performance appraisal has been a difficult and hot issue in the field of management research. How to evaluate the level of higher education management, how to judge the effect of higher education reform, and how to make the evaluation results more convincing are all difficult problems on the road of university informatization evaluation. This paper focuses on big data and information education, using the principle of neural network, particle swarm optimization algorithm, through the trend of the performance index data value about big data, convergence and backtracking to obtain the optimal performance index data value so as to obtain the objective performance index value. Compared with other algorithms, the predicted output value of big data is closer to the actual value; the error accuracy is 5% higher than other methods. It also proves that this study is of far-reaching strategic significance to scientifically formulate the development plan of university informatization and improve the application and service of university informatization system.

Keywords: College education · Performance appraisal · Big data processing · Neural network · PSO algorithm

1 Introduction

With the formation of comprehensive budget performance management mechanism, the situation of performance evaluation of higher education management relying on financial input has become the trend of the times. However, how to choose a suitable evaluation method for performance evaluation is the key issue that schools need to be clear about. Based on the existing theory of performance evaluation of education management, this paper analyzes the expected objectives to be evaluated and the contents of the objectives. Determine its performance indicators and the logical level of performance indicators. It uses effective tools and methods to collect index data, calculates the data results through PSO-BP neural network algorithm, which is combined with the user satisfaction data obtained from the survey, and finally forms the performance evaluation conclusion. Educational big data should continue to be collected according to actual needs, and the collection process runs through the whole educational activities. The data usually comes from all levels of management systems and functional software built in the process of campus informatization. Compared with big data in other fields, educational big data

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inherits these characteristics because educational activity itself is a complex and special social practice activity with certain innovation.

Educational management performance is actually the performance of the information system completed in the construction, which exists in any period of the information system from project establishment to construction, and runs through the whole life cycle [2]. The direct embodiment of educational management is the information system, which clearly and intuitively reflects the effectiveness and significance of the construction from the perspectives of the goal, quality, application and user satisfaction of the information system. The performance of education management can help to clarify the goal of informatization construction. On the one hand, it can improve the management level and promote the overall competitiveness; on the other hand, it can help to promote the horizontal comparison among industries. It can also find out the gap between itself and the advanced level of the industry, analyze the reasons for the gap, optimize the rational allocation of informatization construction resources, and improve the efficiency of the use of resources in all aspects [3].

Although the logical expression of educational big data in this paper is clear, the preliminary work in the evaluation process is more cumbersome, especially in data acquisition and normalization, which also urges the next work to focus on the improvement of data acquisition and normalization methods of performance indicators. This paper mainly studies the performance evaluation of higher education management, but the investment in education is not only the implementation of education management, but also more investment is to support the development of various disciplines in Colleges and universities. The evaluation method discussed in this paper can only be used in education management. For the performance evaluation of investment in other disciplines and specialties, further verification is needed. After all, the big data acquisition conditions and information system are different. Educational management itself is quite different from the development of supporting disciplines, such as the investment of chemistry, biology and other disciplines, which can not evaluate their performance in the short term, and the users of professional disciplines are relatively small, but it is hoped that more disciplinary performance evaluation methods can be derived based on the performance evaluation of educational management.

The main innovations of this paper are:

(1) The performance evaluation model is formulated from different angles according to the informatization situation.
(2) According to the characteristics of the big data model, the reasonable first-level and second-level performance indicators are formulated.
(3) The application of improved particle swarm optimization and BP neural network algorithm are used in the universities' information systems.

2 Educational Performance Assessment Management Model

The assessment objectives of higher education management are mainly reflected in two aspects. On the one hand, direct indicators, performance evaluation indicators can be quantitative indicators, cost indicators, and timeliness indicators. The quantitative indicators are mostly the number of fixed assets increased after the purchase of schools.

Table 1. Model indexes

Level 1 indicators	Level 2 indicators	Indicators show
Direct indicators	Quantitative indicator	The number of equipment purchased, the number of people served, etc.
	Cost indicator	Budget
	Timeliness indicator	Construction cycle
Indirect indicators	Improve the comprehensive ability of teaching and administrative staff	Whether there is a situation that the user learns the relevant skills and improves the ability of the personnel in the learning adaptation system time
	Improve the management system	Whether the relevant business regulations are adjusted and changed due to the system process
	Improve management level	Whether there is optimization of management process and management level

The cost indicators are the budget spent on the implementation. The timeliness indicators represent the execution efficiency or cycle. After all, the number of indicators is also affected by the execution cycle. On the other hand, there are indirect indicators, such as improving the comprehensive ability of teachers and staff, improving the management system and improving the management level [4]. The evaluation system of performance indicators of assessment objectives includes objective cost indicators and subjective potential indicators, which are important measurement factors in the process of performance evaluation. The indicator structure is shown in Table 1.

In the process design of performance evaluation, the four "views" are directly converted into the first-level indicators required for evaluation. The second-level indicators derived from the first-level indicators are set. The theoretical weights and values of the second-level performance indicators are set and assigned by relevant methods. The corresponding values of the second-level performance indicators are collected in batches during the use of subjective and objective methods and tools in the educational management. Use the algorithm to analyze the collected index data value, convert the data value of the secondary index to the theoretical data value, and obtain the score of the secondary index. Then, summarize the score of the subjective and objective secondary index, and obtain the total score and result of performance evaluation [5]. The process is shown in Fig. 1.

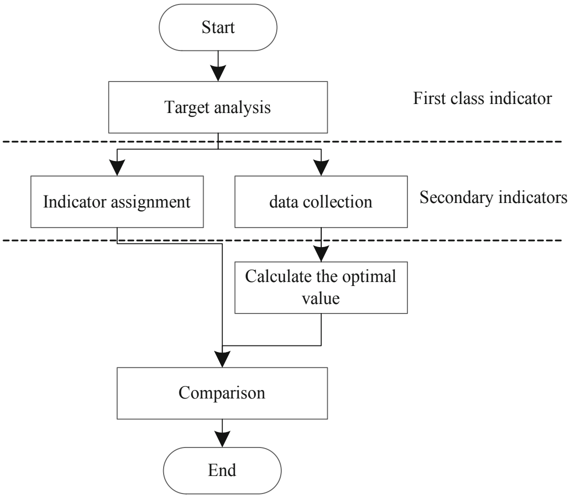

Fig. 1. Performance evaluation process

3 Particle Swarm Optimization Solution of the Model

3.1 Neural Network Model

The neural networks have the power of feedback regulation, which consumes time and space for iterative feedback to update weights and thresholds. The particle swarm optimization (PSO) algorithm is improved from two aspects of inertia weight and learning factor. The network weights and thresholds required by the BP neural network are obtained by fast convergence [6].

In Eq. 1 of the particle swarm algorithm:

$$w = w_{\min}\frac{(w_{t-w_0} - w_{0.0}) \cdot (f_{t-\pi})}{f_{t.r}f_{0.r}f_{0.r.}}, f_t \le f_{mr.} \tag{1}$$

where: w is the inertia weight. The value method affects the convergence performance of the standard PSO algorithm and falls into local optimum. The parameter $w_{\min}$ reflects the current speed of the particle itself. $w_{0.0}$ can play a balance role in the global search and local search ability. When the value of w_0 is relatively large, the global contraction ability of the particle is relatively strong; when the value of w_t is small, the local contraction ability of the particle is stronger. The appropriate value of w has an effect on improving the performance of the algorithm, the ability f to find the optimal solution, and the reduction of the number of iterations. The inertia weight adjustment strategies mainly include linear decreasing, increasing strategy, nonlinear decreasing strategy and adaptive adjustment strategy, etc. In this paper, the adaptive dynamic adjustment strategy is used to change the inertia weight, and the formula is as follows:

$$w = w_{\max}f_i > f_i \tag{2}$$

where $w_{\max}$ is the maximum value of inertia weight. $w_{\min}$ is the minimum value of the inertia weight. f_i is the fitness value of particles. The fitness value of the optimal particle is f_m. The average fitness value of the particle swarm is $f_{nx} = \frac{1}{n}\sum_{n}^{i=1} f_i$.

In the particle swarm optimization algorithm, C_1 and C_2 represent the individual learning ability of the particles in the particle swarm and the ability to learn from the collective optimal particles. When the value of C_1 is relatively large, the individual cognitive ability of the particles is relatively strong, which is easy to deviate from the best particles and enhance the self-cognitive model; when the value of C_2 is relatively large, the social cognitive ability of particles is relatively strong, and it is easy to fall into local optimum, which enhances the social cognitive model. When C_1 and C_2 are equal, it is a corresponding complete model. The value range of C_1 and C_2 in the learning factor is [0, 4], and the fixed value will generally cause premature local extremum, so it is necessary to adopt the strategy method of dynamically adjusting C_1 and C_2, and the formula is as follows:

$$C_1 = 2\sin^2\left[\frac{\pi}{2}(1 - \frac{t}{T_m})\right] \tag{3}$$

$$C_2 = 2\sin^2(\frac{\pi_t}{2T_{\max}}) \tag{4}$$

where, the iteration number is t, and $T_{\max}$ is the maximum iteration number of the particle swarm.

Algorithm pseudocode:
for each particle i
Initialization velocity V_i and position X_i for
Particle i
Evaluate particle i and $setpBest_i = X_i$.
end for
$gBest = \min\{pBest_i\}$
while not stop
for $i = 1$ to N
Update the velocity and position of particle i
Evaluate particle i
if fit $(X_i) < fit(pBest_i)$
$pBest_i = X_i$
if fit $(pBest_i) < fit(gBest)$
$gBest = pBest_i$
end for
end while

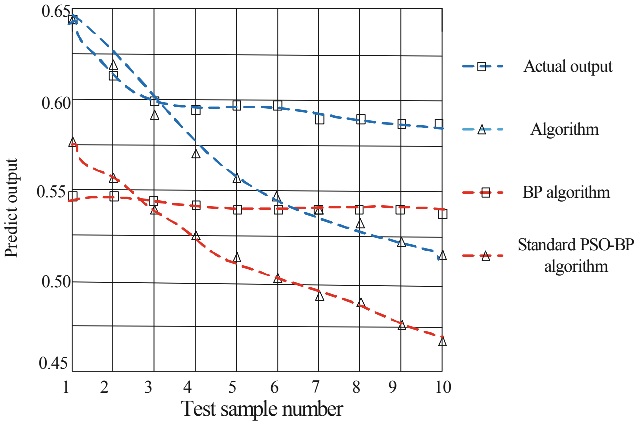

Fig. 2. Dataset Predicted Output vs. Actual

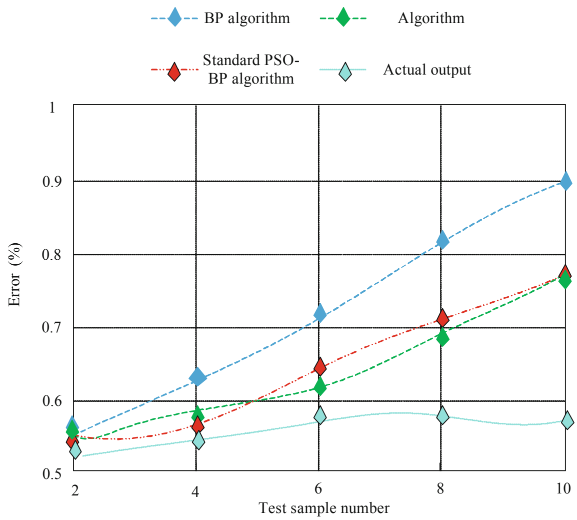

Fig. 3. The error between the predicted value and the expected value of a data set

3.2 Algorithm Parameters Setting

The parameters of the particle swarm optimization algorithm mainly include: the population size N, the value of which is 20; the inertia weight is generally 0.9; the learning factors C_1 and C_2, the value of which is 2.0; r_1 and r_2 are random numbers in two [0,1] intervals; the maximum velocity V_{max} of the particle is 20; and the termination condition is to meet the threshold, and the error accuracy is 0.001.

The structure of the Iris data set BP neural network is designed as 4 neurons in the input layer, 5 neurons in the hidden layer and 3 neurons in the output layer. Analyze the experimental results:

The algorithm in this paper is used to simulate the Iris data set, as shown in Fig. 2.

It can be seen from Fig. 2 that in the Iris data set with the same convergence target, the iteration times of the BP algorithm in the Iris data set are 69. The iteration times of the standard PSO-BP algorithm are 59, and the iterations of the algorithm in this paper are 50.

It can be seen from Fig. 3 that the comparison of the prediction output between the algorithm in this paper and the standard BP and the PSO-BP algorithm also has a good effect.

4 Conclusion

This paper takes the performance evaluation of higher education management as the research direction. Using the designed model combined with the improved algorithm to analyze the data values corresponding to the performance indicators, compare the expected performance values, judge the completion of the performance indicators, and obtain the results of performance appraisal. Main work:

(1) Analyze the index model of education management, design and formulate the performance big data index system.
(2) Design the improved swarm intelligence algorithm based on the particle swarm optimization and the BP neural network.
(3) Design the corresponding experimental methods, compare and analyze the results, and analyze the experimental effects.

The research of this paper is helpful to the reform and development of school performance. It proves that the evaluation of data indicators has become a necessary work in the management of higher education.

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