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Evaluation mechanism of hospital performance activities based on fuzzy neural network

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ABSTRACT

With the development of society and economy, our health care level has been greatly improved, while the size of the hospital is continually expanding. Reasonable, intelligent hospital performance evaluation mechanism plays an important role in the current hospital management. It not only can effectively help hospitals determine the future direction of development, but also help the hospital with the application of scientific methods for hospital staff assessment and evaluation to achieve a fair and impartial manner. In this study, the fuzzy neural network is introduced into the hospital performance evaluation, principles to maximize the performance of hospital performance indicators and create, and building hospital performance evaluation mechanism system. The basic framework of this system includes: operational capability, potential for development, the contribution of the staff for hospital and so on. Meanwhile, we take the attendance and medical safety as factors of evaluation hospital staff's performance. Because the staff and the judge is more often related to interest, reputation, etc, the application of performance evaluation mechanism based on fuzzy neural network can reduce the influence of subjective factors on the final results of the evaluation mechanism so as to be a fair and intelligent evaluation mechanism.

KEYWORDS

Hospital performance; Fuzzy neural network; Evaluation mechanism.

INTRODUCTION

Now, medical services gradually cared by countries and people, people want to get good treatment and the scale of the medical profession expanding by the control of the country, medical standards continue to improve. With the growth of the size of the hospital, the hospital management has become more important. Only good management system can make all aspects of the hospital work carried out smoothly, can determine a better future direction of the goal of the hospital and each stage. In order to strengthen the effective management of hospital health services, improving services, and hospitals insist on hard work getting more and contribution of prominent people to give some incentives and other policies, so it greatly inspired the hard work of every doctor, to create a better medical environment for the people.

Performance evaluation mechanism is a very effective enterprise management system, having more than 100 years of theoretical study of history in Western countries, and gradually formed a very comprehensive theory system and rich practical results[1]. With the development of the market economy, the hospital's medical standards constantly improve; hospital performance evaluation mechanism has also been a very good development. Our level of medical is advancing and hospitals can not only help to save injured, but also a profitable business, so it is natural to pursue maximum benefits. But the present hospital performance evaluation method certain defects, so this research will integrate fuzzy neural network approach to performance evaluation mechanism of the hospital, building a more comprehensive evaluation system based on fuzzy neural network. The evaluation system can first determine the set of evaluation factors and evaluation grade, decide fuzzy relationship matrix and draw the final evaluation results.

FUZZY NEURAL NETWORK THEORY INTRODUCING

The concept of fuzzy neural network is a local approaching network combining intellectual structure of fuzzy logic inference and self-learning ability of neural networks[2]. Its main approach is to use neural network to achieve the purpose of fuzzy reasoning, so that the weights of the neural network has the physical meaning of fuzzy logic inference parameters. Vagueness simply means that they cannot tell each other the line together; vagueness has its own representation. In 1965, Professor Zadeh also provides a new method of quantitative description of fuzziness.

Fuzzy logic is mainly composed by the fuzzy generator, fuzzy rule base, fuzzy inference engine and fuzzifier, but the fuzzy logic also includes systematic having great relationship with fuzzy concept[3], shown in Figure 1:

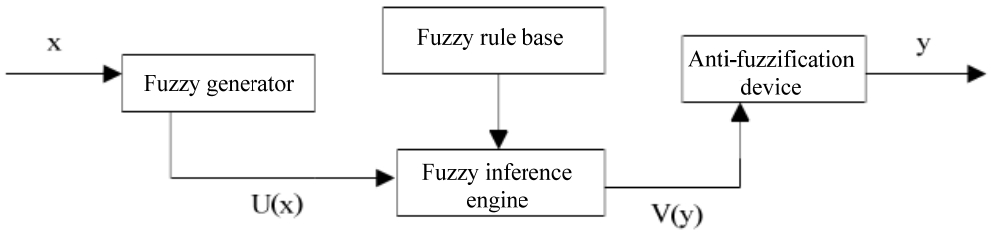

Figure 1 : Diagram of fuzzy logic system

Of course, fuzzy logic system has a lot of very important advantage;

(1) The system has a real variable input and output ports, so it is very easy to apply to a variety of engineering applications;

(2) It has a simple mode of "if-then" rules of description of fuzzy expert knowledge;

(3) It can be achieved by learning the best way to fuzzy logic system, address some more specific problems, well use of data and other information.

Artificial neural network is similar to the human brain structure, the mathematical model of information processing, mainly composed of many neurons interconnected together. A typical neuron model shown in Figure 2:

To a certain extent, artificial neural networks can change some defects of limitation neural networks handling the digital computer by a linear approach. Advantages of artificial neural network are as follows:

(1) Neural network has a more powerful parallel structure and operational ability, so the error correction capability and overall handling capacity is better.

(2) The characteristics of neural network itself is non-linear, to a certain extent, provides a good solution to solve the nonlinear problem.

(3) Like the human brain having a self-learning ability, neural networks can summarize data, has great advantages in solving mathematical models and describe a more intractable problem.

(4) Artificial neural networks have good adaptive capability, integration capabilities. Therefore, it is possible to input a lot of information at the same time, allows a good solution to the problem of data redundancy between the input information.

Currently, the neural network is divided into feed forward, feedback[4]. Feed forward network is relatively common, as shown in Figure 3, the information is received prior to each stage of neurons as the input level value, followed by the results obtained in the next stage as an input value, and has no feedback in the entire network.

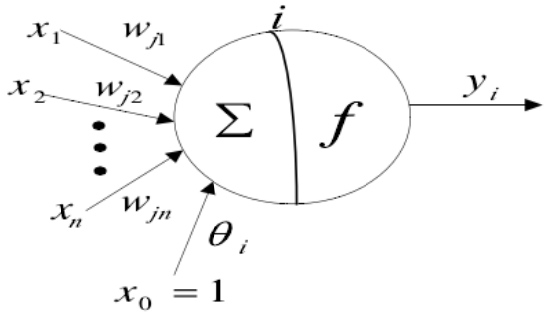

Figure 2 : Diagram of neuronal structure model

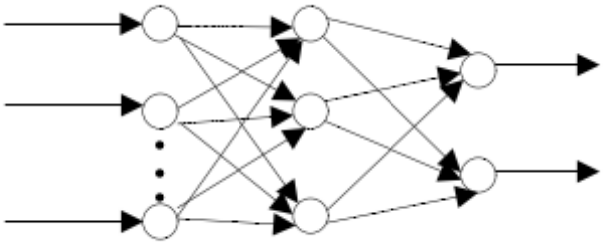

Figure 3 : Diagram of feed forward model network

Initial state of feedback neural network is determined by the signal input, after several transfer of the state, the system will gradually balance. The final equilibrium state of the entire network is analyzed after a series of the calculated output value. Feedback network model shown in Figure 4:

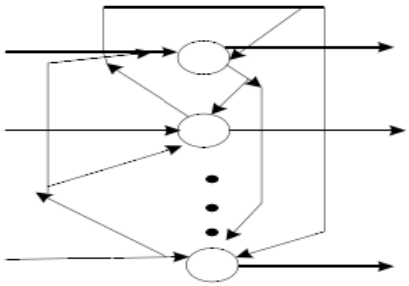

Figure 4 : Feedback neural network model diagram

Fuzzy neural network is a more complete system structure with effective combination of fuzzy logic system and artificial neural network. In this network, it can make full use of the advantages of neural network to achieve the anti-fuzzy networks, to form fuzzy inference, to the final network in the form of anti-blur. It neither changes the characteristics of the fuzzy system itself; also well keep its own characteristic of neural network.

CONSTRUCTION OF HOSPITAL PERFORMANCE EVALUATION MECHANISM BASED ON FUZZY NEURAL NETWORK THEORY

Reated index of hospital performance evaluation system activity

Hospital performance evaluation mechanism is a scientific, standardized evaluation method, application of certain evaluation system, and reference to a uniform evaluation criteria and evaluation process, through quantitative and qualitative

analysis of the hospital's operational efficiency, performance and hospital work achievements staff, make more objective, fair, comprehensive and accurate evaluation.

Evaluation system of hospital performance activity is composed of many interconnected, interdependent indicators, which can make a comprehensive evaluation of the overall development direction of the hospital, work efficiency, policy development, incentives and disincentives[5]. According to the results of the evaluation of performance activities, it can well help hospital leaders and managers to fast, accurately and comprehensive find the problems that exit at the current operational status, and draw the results and research situation of the main health workers and make better predictions decisions for the future formulation development direction, the implementation of the new program, the implementation of incentive programs of medical staff to determine the direction and other aspects of medical research. Hospital performance evaluation activities are shown in TABLE 1:

TABLE 1 : Key evaluation indicators of hospital performance activities

Quantitative evaluation	Return on equity	Net profit / average total assets
	Cost efficiency	Total profit / total cost
	main business profit margins	main business profit / hospital income
	Total asset turnover	Sales / Total Assets averages
	Working capital turnover rate	Sales revenue / current assets averages
	Non-performing assets ratio	Year-end total assets do not practice / total year-end assets
Qualitative evaluation	Staff attendance	
	Medical staff skill levels	
	Medical research	
	Patient satisfaction	
	Social Contribution situation	
	development of innovative hospital situation	

In addition, the hospital operator can base on the contrast of their own and other hospital operating efficiency situation to find their own strengths and weaknesses, which can provide a better basis for the next step to specify competing solutions. So, for the performance evaluation of the hospital's activities, we should first have to create a science-based evaluation system.

The principles of creating hospital performance evaluation system

The so-called evaluation system is needed to make objective, scientific, fair and accurate assessment by the actual performance of the evaluation object, so the final evaluation result is able to reflect the evaluating object's good or bad. In the establishment of an evaluation system, we should follow certain principles, which can ensure such evaluation mechanism created was more specification:

(1) Science and comprehensiveness combining principle

Correctly understanding the meaning of the correctness of performance evaluation mechanism, ensuring the integrity of the index system design, proving the logical rigorof mathematical treatment, etc., these must follow a few basic points of scientific principles. When establishing the evaluation mechanism indicator system of hospital performance activity, it must include the various elements and important part of normal operations of hospital. According to the principles of integrity, the index system should fully show the contact and interaction of every element and every link.

(2) Quantitative and qualitative combining principle

Quantitative evaluation method adopted with certain disadvantages, depending on a situation as shown in the hospital as an index of financial analysis, only can make the evaluation for the performance of only the last stage. But it also has a useful side, this indicator is the result of the analysis and the comparison is very intuitive, which can compare the size. However, many factors play decisive role in real life have no way to quantify, and sometimes they rely solely on the results of the quantitative evaluation of the information is not very accurate. Therefore, on the basis of quantitative analysis of qualitative evaluation, considering from the viewpoint of dynamic, open, the comprehensive point, expanding index included in the information. This enables quantitative analysis of flaws in the evaluation, to correct the shortcomings. Combination of the two can better adapt to the current hospital performance evaluation mechanism and meet the needs of hospital management.

(3) Dynamic and static combining principle

Performance evaluation system activities in hospitals as well as the composition of the index number of the whole system is relatively stable, but the direction of the hospital, research programs, personnel work are likely to change at any time, which will lead to the changes of hospital's business strategy. So the index system of evaluation mechanisms should be changed, which requires the entire evaluation mechanism has dynamic variability. Only the effective combination of dynamic and static system can make the correct and useful change timely.

The establishment of hospital performance activities evaluation mechanism model based on fuzzy neural network

Because fuzzy function with fuzzy neural network increases exponentially index level of growth trends, it will extend the structural complexity and learning time of fuzzy neural network, reduce the overall performance of the network and the generalization ability to a certain extent, then reduce the efficiency of the evaluation mechanism[6]. This study firstly use the BP neural network model to create a hospital financial indicators, and then use the fuzzy neural network model to create a non-quantitative index system, fully simplify the structure of the network, to improve the learning speed and accuracy of the network.

Building step of the hospital performance of activities evaluation mechanism based on the fuzzy neural network as follow:

(1) According to Table 1 of the main activities of hospital performance evaluation, combine with hospital management system criteria, select indicators which can be fully and accurately reflect the hospital performance, select N samples, each sample also contains P indexes data.

(2) The nature of the sample pre-treatment, screen sample data and sample data to standard. Screening sample data is incomplete and filter out data items which do not meet the requirements, for participants to have a evaluation of accuracy and informative data.

(3) Select the combination of the model structure and learning algorithm which is simple and easy to operate, the data samples pretreated for model learning and training. Among them, learn hospital's quantitative indicators with BP neural network, learn qualitative indicators by using fuzzy neural network, use membership functions and adjust the parameters; eventually establish hospital performance evaluation mechanism based on fuzzy neural network activity[7].

(4) The combined model structure of hospital performance activities evaluation mechanism based on the fuzzy neural network was shown in Figure 5:

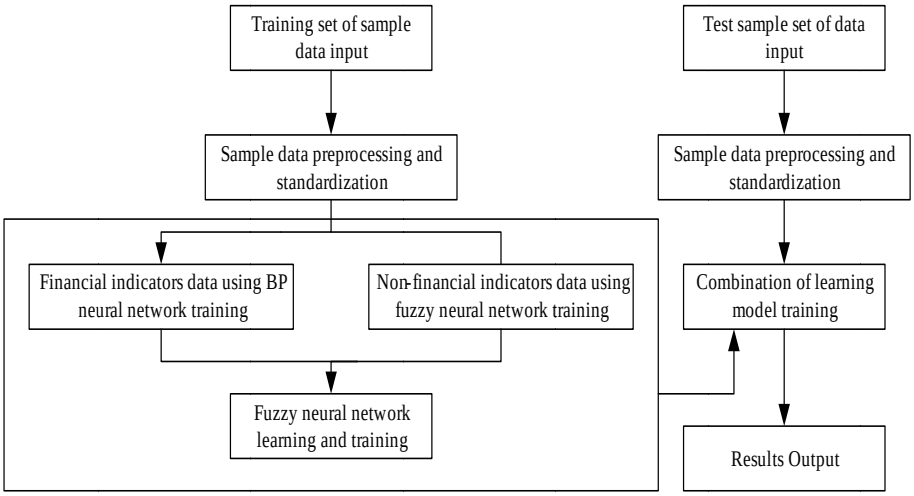

Figure 5 : Diagram of evaluation mechanisms combined model

First is the use of BP neural network to establish quantitative indicators. Because BP neural network is a hidden layer having a multilayer feed-forward neural network, so it has a wide range of applications. But BP neural network input values require accurate data, the error for fuzzy data processing results is relatively large, the financial and other quantitative data indicator data processing is to create three-tier network architecture, the structure shown in Figure 6:

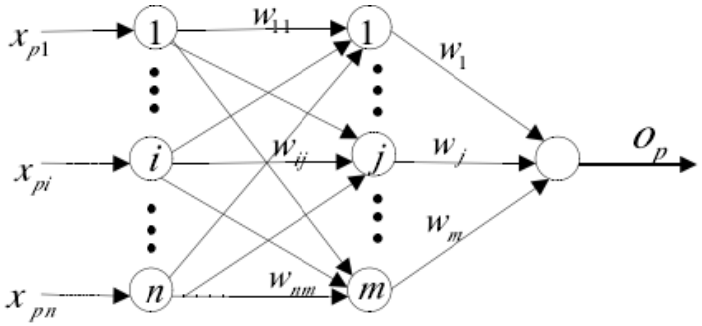

Figure 6 : Quantitative indicators BP neural network structure

BP neural network learning is performed based on gradient descent, the ability to minimize the error function, and the error value output normalized network right for the wrong network connection, and then layer back through the error value from the output layer unit transmission error decreases, minimize the error value of the final output.

Fuzzy neural network input value is generally a linear combination of variables, using the network division of space, using BP algorithm: alternating least squares method and learning[8], qualitative evaluation model based on fuzzy neural network as shown in Figure 7:

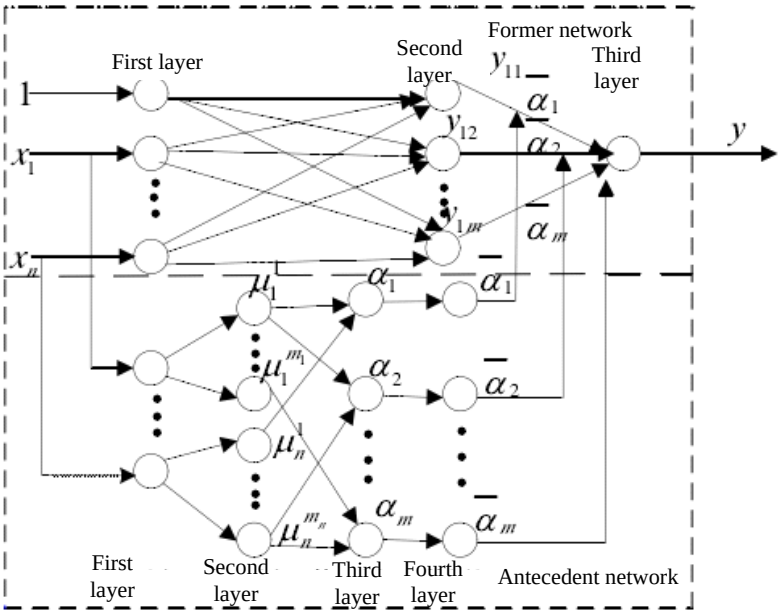

Figure 7 : The structure of qualitative indicators to evaluate fuzzy neural network

TABLE 2 : Part of the data sample performance evaluation rating

serial number	Network output rating scale	Network evaluation model output value	Network output rating scale
1	Excellent	0.9504	Excellent
2	Good	0.6978	Average
3	Average	0.6507	Average
4	Bad	0.6096	Bad
5	Bad	0.7116	Average
6	Excellent	0.8876	Good
7	Average	0.5911	Average
8	Good	0.8355	Good
9	Good	0.8244	Average
10	Average	0.6897	Average
11	Excellent	0.5024	Good
12	Bad	0.4312	Bad
13	Good	0.6533	Average
14	Average	0.7898	Average
15	Good	0.7553	Excellent
16	Good	0.9115	Excellent
17	Bad	0.5247	Bad
18	Bad	0.8812	Excellent
19	Excellent	0.8613	Excellent
20	Excellent	0.4127	Bad
21	Average	0.7992	Average
22	Good	0.3847	Bad
23	Bad	0.424	Bad
24	Excellent	0.943	Excellent

Fuzzy neural network mainly consist by the former network and the phase-lag network, in the overall function, this model is equivalent to a fuzzy system structure. However, in the analysis of the topology, the network node is mainly composed of a neural network and weights. So, Fig.7 fuzzy neural network structure has the advantage of having fuzzy systems and neural networks, and the strong ability to adapt to relatively.

For good or bad evaluation of a system, not only to build the system itself is reasonable, the selecting of the sample data will determine whether the entire system is useful. The selection of the sample data, including data object selection and sample size selection[9]. The quality of the sample data determines whether the network model has good general and computing capabilities. The number of the sample directly determines the quality and the model generalization ability, if the sample data is too big, local accuracy will reduce, the learning time is relatively long, but to promote the ability of the network model will become even better.

Using fuzzy neural network building hospital performance evaluation mechanism model, through fuzzy neural network training and learning, the data sample import trained neural network model, and then evaluate hospital performance activities, the resulting output is divided into: excellent, good, average, bad. After the sample data to test the hospital's performance rating as shown in TABLE 2:

CONCLUSIONS AND OUTLOOK

Hospital performance evaluation mechanism has an important role in the present assessment of the hospital and gets the attention and cited by various medical institutions. In the trend of rapid economic development, if the hospital wants to maintain the correct direction of development and urged hospital workers to maintain a positive working condition to ensure the hospital's medical technology can keep up with the times. It must take a more accurate assessment of the status performance of itself as a reference. At the same time, it should have more fair and accurate assessment results of hospital staffs, and implement rewards and penalties based on the results.

In this study, combined with traditional hospital examination system, we put the fuzzy neural network into the hospital's performance appraisal system. Make full use of self-learning ability of fuzzy theory and neural networks to reduce the subjective factors which are not the hospital's financial data and related indicators rights to the maximum extent. To solve the problem that fuzzy neural network number of rules will change follow the evaluation index varies, we create a hospital performance evaluation mechanism based on fuzzy neural network.

However, due to limited working time and effort, this study is just a simple theoretical research, and lack of the practical application to support and verify, theoretical research also needs further improvement. The following aspects need to improve:

(1) Hospital performance evaluation mechanism needs further improvement. The hospital intangible assets play a decisive role in the future development direction of the hospital with the rapid development, so intangible factors should add to evaluation mechanism as a reference[10].

(2) If you want to get the final analysis results more convincing, you should further expand the scope of the analysis of samples collected data. As the analysis date, it should include all aspects of the hospital: medical equipment, medical research, drug procurement, medical staff, patients, sanitary condition, and transportation and so on.

(3) Further study the influence of the membership function of the fuzzy neural network, but with respect to a variety of evaluation, the Gaussian function is not the best[11]. Therefore, we should study other types of membership functions and ultimately determine the optimal function.

(4) Because the ambiguity function will become exponential growth with the increase of the value of the network, which can cause big mistake. Therefore, further research may consider using rough set theory to screen the samples first[12]. It can ultimately achieve the purpose of reducing the number of fuzzy rules, further simplify the complexity of the network and increase the learning speed of the network.

(5) Because this research is confined to theoretical research evaluation mechanisms, there are no practical applications as the detection, so that will be the next major work.

All in all, the evaluation mechanism of hospital performance activities based on fuzzy neural network has a high value and future prospects, but it still needs more in-depth study of research and analysis.

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