

Study on the Science and Engineering Course Contribution of Employment based on FNN

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Abstract

With the accelerate pace of the reform of higher education, Chinese higher education has been from the "elite education" to "popular education", which brought a series of changes to the object of education, the way of education, educational purpose. While employment of students as an important measure of the effect of our country's higher education, there are more and more domestic universities have taken it to be the ultimate test goal. In this process, how to set up the course system to keep pace with the times has become a hot issue in educational research. In this paper, take salary as an important index to measure the students' employment ability, and through the method of fuzzy neural network for machine learning to construct the model of school courses, professional courses and elective courses contribution degree to employment to study the role of science and engineering courses in the science and engineering graduates employment, hoping to be able to promote the universities curriculum reform, and improve students' learning initiative.

Keywords: science and engineering course, contribution, FNN, machine learning

1. Introduction

In recent years, our country university enrolment rate was maintained a steady growth, higher education has been changed from "elite education" to "popular education". "College students are God's favored one" era has gone, banding in a series of problems of student employment and the employment adaptability inferior.

In 2012, 10% of the students are unemployed. Even the employment population also includes a large number of academic staff; it is a stark contrast to the developed countries higher penetration rate and lowers the unemployment rate. Even in the employment of university graduates, there are 14% in the low employment status, that is to say they are engaged in not professional work, and 25% of the lowest income groups, which caused a great waste of social resources, and that about 89.6% of graduates for the professional related job cannot find and involuntary low employment [1]. Conversely, by around the talent market is also not difficult to find, as the main part of China's current employment, small enterprises have "recruitment difficult" problems.

Comparing the current situation of higher education in the developed countries, the above data is not difficult to see, the social demand for talents is far from being met, and the higher education of our country still have development space, but the difficult of employment of college students has become a big problem in our society. The fundamental reason for this problem is not the increased number of university graduates, but the students' employment quality difference. The university curriculum system as the main means of cultivating

students, it is inseparable in students' employment quality. The curriculum system has been a hot topic discussed in the educational circles at home and abroad.

In recent years, abroad researches on curriculum have their own traditions and characteristics. The American university has personalized education characteristic, the student's learning course is free elective course system, student management is the implementation of the complete credit system; focus on the foundation, expanding knowledge, elective freedom, teaching plan elastic, students can learn interdisciplinary major program, allowing students to change the professional and so on.

In the Japanese government education reform, the importance of personality principle has to hither to a higher height. Put forward eight teaching principles: respect for individuality; pay attention to the basic; cultivation of creative thinking ability and expression ability; expanding educational choice; improve the relationship between man and man in educational environment; transition to a system of life-long education; internationalization of education; education information. The higher education institutions in Europe is the European Credit Transfer System, as the promotion method of good students widely flow. At present, this system is being adopted for most universities all over Europe, and it has a constantly expanding trend [2-6].

In the construction of the curriculum system, aimed at professional, developed countries tend to establish national occupational education center [7].

Brinton Snow (1990), Swain (1996), Crandall Kaufman (2002), Coyle (2005) and Stroller (2006) suggested that for students to expand their knowledge. Enhance the construction of curriculum system has to be studied. Coyle, Hood and Marsh (2010) Co-authored book "CLIL: Content". At present, content based teaching mode has a special website discussion [8-11].

Domestic scholars have been trying to explore the curriculum system:

In the reform of higher education in China, Zhuojun Hu proposed "from elite education to mass education, is not a purely educational expansion linear development process, the process of popularization of higher education is full of challenges, it requests the higher education system and system change greatly, at the same time requirements of internal management of colleges and universities to make a series of adjustments, reestablished the popularization of higher education to adapt the internal management system" [12].

With the development of the monetary system transition and social economy, more and more people pay attention to higher education, and put forward a series of opinions and suggestions [13-20].

In the above study, the foreign scholars take the basic conditions of western countries to be the research starting point, it is inconsistent with our higher education stage, and it is difficult to learn comprehensively, and domestic scholars while exploring more of course system and education mode, but little empirical research, their advices also are more macroscopic, long-term measures, for the current to solve the employment of university students and the training problem cannot play the effect to get instant results.

This paper thinks that, in today's China society, although there are many disputes, but the students' employment as an important index of assessment of higher education, has been widely accepted, as the main means to train college students, the curriculum system is necessary to take cultivate students' employment as the primary goal. The curriculum system in various courses will no doubt is related to the student's employment ability. Therefore, in order to simplify the process of argumentation, for the science and engineering students course system and the employment situation closely related, take them as the research object, use the FNN method and student employment data for machine learning, and then establish the model of science and engineering course contribution, not only can make it is available

for mathematics method analysis course contribution, but also can get a more objective result than other research ways.

This paper is structured as follows:

The first section, the research in curriculum system is briefly introduced;

In section second, the neural network theory and Application

In section third, the fuzzy neural network theory and Application

The fourth section, by using fuzzy neural network to machine learning, build a science and engineering courses to students' employment contribution degree model. The research steps as Figure 1.

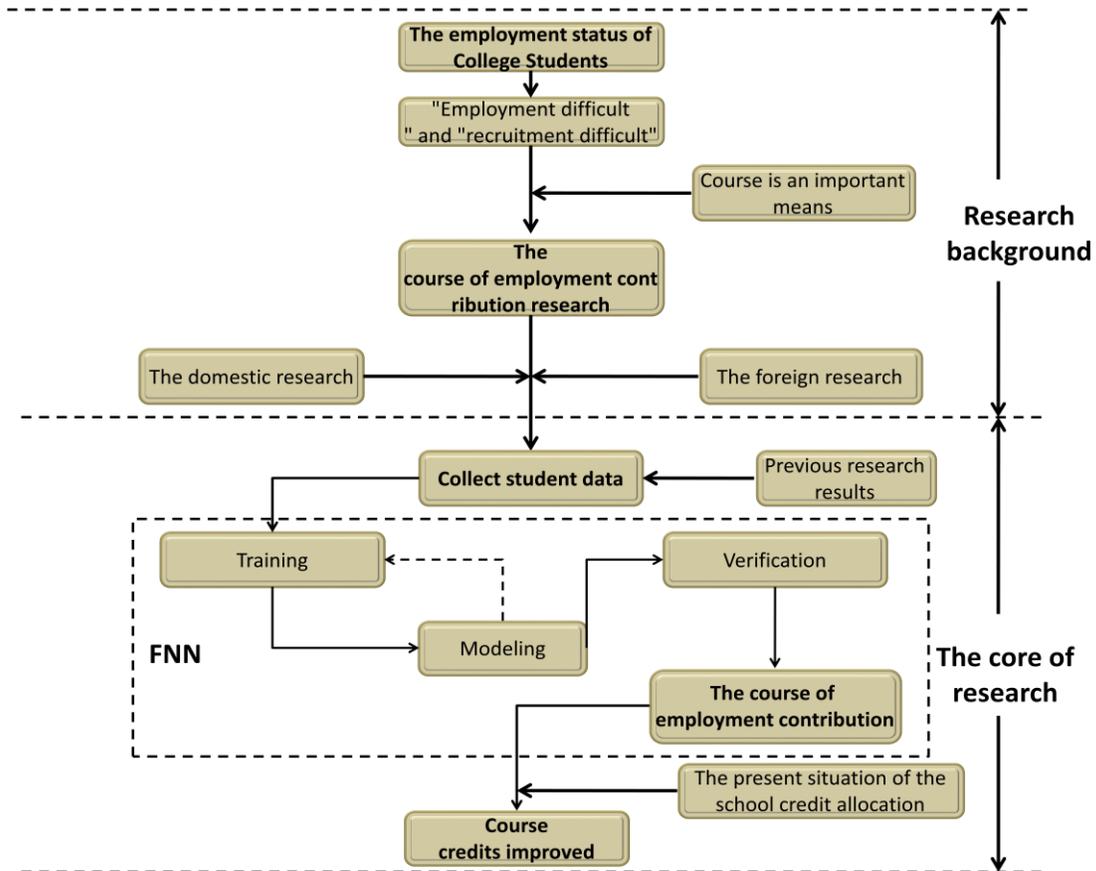


Figure 1. Research Step

2. Neural Network Algorithm

2.1. Artificial Neural Network

The human brain thinking is divided into abstract (logic) thinking, image thinking and inspiration (intuitive) three basic ways of thinking.

Artificial neural network is to simulate the second way of mortal thinking. This is a nonlinear dynamic system, which features a distributed information storage and parallel processing. Although the structure of the single neuron is extremely simple, function is limited, but a large number of neurons network systems can realize the extremely rich and colorful behavior.

The research content of the neural network is quite extensive, reflects the interdisciplinary field. The main research work is focused on the following aspects:

(1) On the biological prototype. From the physiology, psychology, brain science, anatomy, pathology, biological science research of nerve cells, neural network, and neural system structure and function mechanism of the biological prototype.

(2) Set up a theory model. Depending on the study of biological prototype, establish the theoretical model of neurons, neural network, including the concept model, knowledge model, chemical and physical model, and mathematical model.

(3) Research network model and algorithm.

(4) The application of artificial neural network system.

Artificial neural network is an adaptive nonlinear dynamic system consisting of a large number of simple basic components -- neurons to connect. Each neuron structure and function is relatively simple, but the combination of a large number of neurons generated system behavior is very complex.

Compared with the digital computer, the artificial neural network in the composing principle and functional characteristics, are closer to the human brain, it is not according to the given procedure step by step to perform arithmetic, but can adapt itself to the environment.

Artificial neural network must take certain criteria to study, then to work. The artificial neural network for handwritten "A", "B" two letter recognition as an example, the provisions when the "A" input network, the output should be "1", and when the input is "B", the output is "0".

So the network learning criteria should be: if the network to make the wrong decision, through the network learning, the network should be reduced the possibility of made same mistake. First of all, to the network connection weights to each (0, 1) random value range, the "input image mode A" corresponding to the network, the network will input mode weighted summation, compared with a threshold, then the nonlinear operation, get the output of the network. In this case, the network the probability of output "1" and "0" is 50%, which are completely random. If the output is "1" (results), the connection weights increase, so that the network again encountered "A" mode input, still can make the proper judgment.

If the output is "0" (*i.e.*, the error), the connection weights value decreases to make the network the next time to meet with "A" mode input, reduce the possibility of committing the same error. When the network turns into a handwritten letter "A", "B", through the network to a plurality of times learning according to the above study method, the network correct rate of judging will greatly enhance. This shows that the learning network of the two models has been successful; it has been the two patterns of memory in different network connection weights. When the network meets again anyone mode, can make the rapid and accurate judgment and recognition. Generally speaking, more neurons in the network, it can be memory and recognition more.

2.2. Characteristic

(1) The human brain has strong adaptive and self-organizing characteristics, learning and training can be acquired to develop some characteristic function. Such as the blind auditory and tactile very sensitive; deaf people are good at using gestures; be trained with regularity of the athletes can exhibit extraordinary skill *etc.*,

Function depends on ordinary computer program given in the knowledge and ability. Obviously, it will be very difficult for intelligence activities through summary procedure.

Artificial neural network has rudimentary adaptive and self-organizing ability. Changing synaptic weights in the learning and training process to meet the environmental requirements.

Because of different learning style and content, the same networks can have different functions. Artificial neural network is a learning system, can develop the knowledge. Usually, its training mode can be divided into two types, one is supervised or supervised learning, use the given sample standard classification or imitation; another is unsupervised learning or inaction mentors, at this time, only the provisions of learning or some rules, specific learning content with the system the environment (*i.e.*, the input signal varies), the system can automatically find environmental characteristics and laws, is more similar to the function of the human brain.

(2) The generalization ability

Generalization refers to no training samples, predictive ability and control ability is very good. Especially, when some noise samples, the network has superior prediction ability.

(3) The nonlinear mapping ability

When the system design is clear or very clear, generally using the numerical analysis of partial differential equations, mathematical tools such as the establishment of mathematical model, but when the system is complex, or the unknown system, system information quantity is very few, it is difficult to establish accurate mathematical model, the nonlinear mapping ability of neural network displays the advantage, because it does not require a thorough understanding of the system, but also can achieve the mapping relationship between input and output, which greatly simplifies the design difficulty.

(4) A high degree of parallelism

Because people can do some things at the same time, so the neural network should have strong parallelism.

For many years, people from the medical, biology, physiology, philosophy, information science, computer science, cognitive science, synergetic perspectives to understand and answer these questions. In the process of research to find the answers to the questions in these years, has gradually formed a new interdisciplinary field, known as the "neural network". Neural network research involves many subject areas, these areas with each other, mutual penetration and mutual promotion. [21-23]

3. FNN

3.1 Fuzzy Neuron

Fuzzy neuron network is capable of processing fuzzy information neural network for a class of systems of all or part of the fuzzy neuron. Fuzzy neuron has normal neuron function, also has the ability to deal with fuzzy information. Fuzzy neurons can be classified according to the functions:

(1) By the fuzzy neuron fuzzy rules "if-then" rule description. The rules are used to express expert knowledge; the first class of neurons can be described as Figure 2.

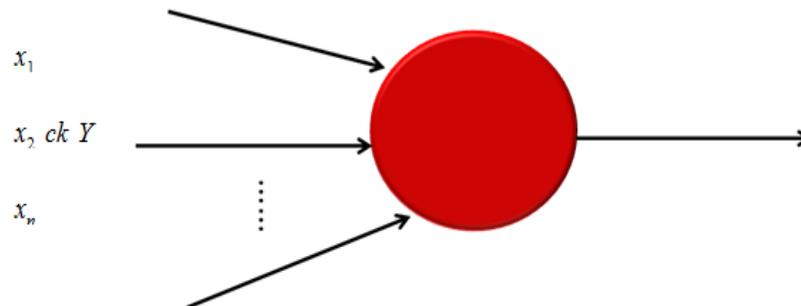


Figure 2. First Kind of Fuzzy Neuron

If x_1 and x_2 and... x_n then y

Here $x_1, x_2 \dots x_n$ is a current input, y is the output neurons. Neurons in this model experience are stored in the fuzzy relation, the output from the input current and past experience.

(2) With clear input fuzzy neuron. This kind of fuzzy neuron is as Figure 3.

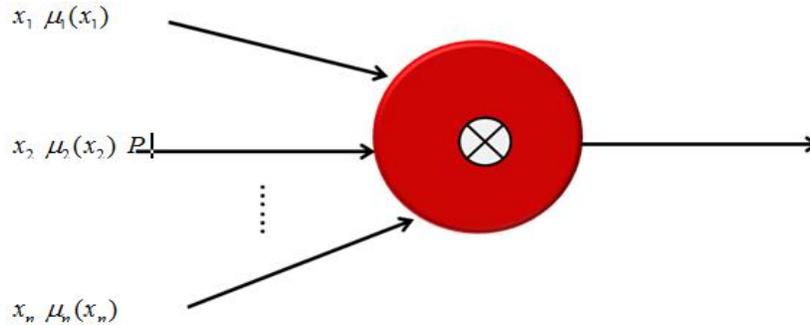


Figure 3. Second Types of Fuzzy Neurons

Neurons of N non fuzzy input, weighted operation are replaced by the membership function. Each weighted operation is the result of the fuzzy set corresponding input values, accumulation process using MIN, MAX and any other T normal form or T residual normal form.

(3) With fuzzy input fuzzy neuron. This kind of fuzzy neuron is as Figure 4.

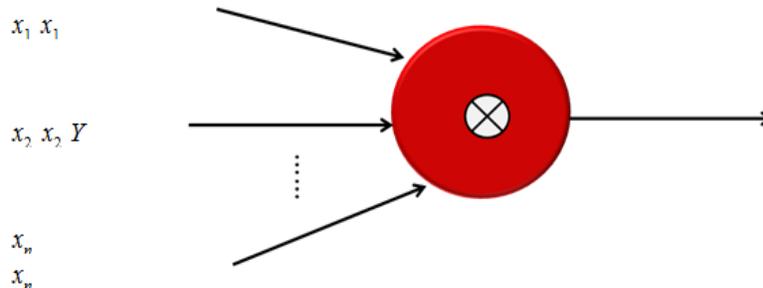


Figure 4. Third Types of Fuzzy Neurons

Different from second types of neurons, the weighted operation here is not a membership function of each fuzzy input, but is the correction operation.

3.2. The Combination of Neural Network and Fuzzy Technology

Product of fuzzy neural network is the combination of fuzzy theory and neural network, which brings together the advantages of neural network and fuzzy theory, the fuzzy system is easy to express knowledge and neural network has strong learning ability, so that the adjustment precision and fuzzy neural network controller rule learning speed can be greatly improved.

(1) Fuzzy operator neural network. Fuzzy operator neural network with fuzzy operator (T normal form or T residual normal form etc.) arithmetic operator neural operator instead of in a neural network and the neural network obtained a fuzzy neural network.

(2) Fuzzy information neural network. The main purpose of fuzzy information neural network is to use the principle of neural network to deal with fuzzy information. The neural

network is based on fuzzy set to process object. Mainly built on the extension principle, the level set computation for neural operator. The study and calculation process is complex.

(3) The fuzzy neural system, the neuron fuzzy system with a neural network framework for fuzzy systems. The general structure of the neural fuzzy system contains four layers of nodes. The calculation and study complexity is between fuzzy operator neural network and fuzzy information neural network.

Compared with the advantages of the former two systems neural fuzzy is a combination of the advantages of neural network and fuzzy system. Its essence is a fuzzy system, and the former two are the generalization of the neural network. The neuron fuzzy system is the most widely used of the three types.

It needs three steps to design fuzzy neural network: first, select the appropriate language variables, the accurate input fuzzy; fuzzy control rules that determine the fuzzy output corresponding; finally, based on a criterion of fuzzy decision, the control output defuzzification acts on the controlled object. The feed forward fuzzy inference system can be shown in Figure 5.

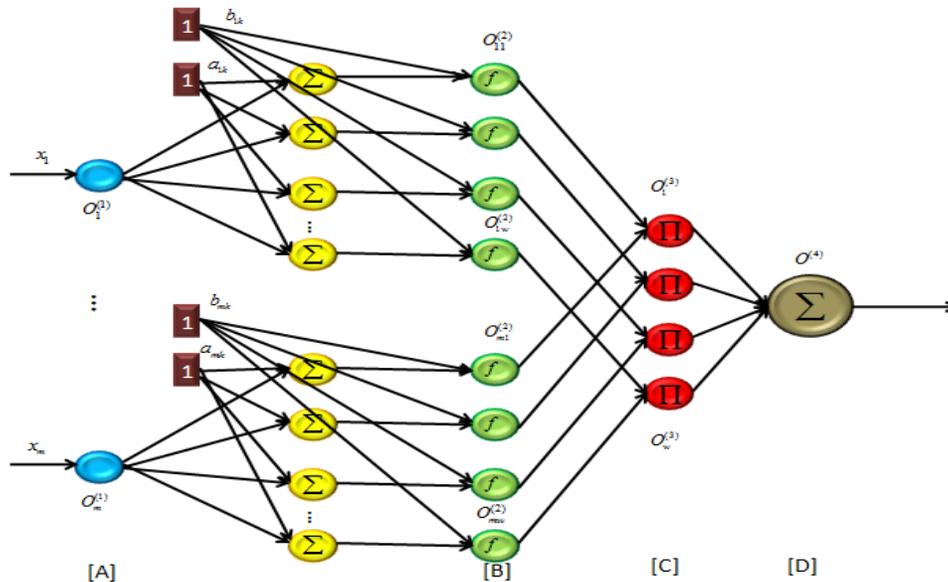


Figure 5. Fuzzy Neural Network Structure Diagrams

The first layer is the input layer, to: x_i says the nodes of input, output node

$$O_i^{(1)} = x_i, i = 1, 2, 3, \dots$$

Second layers: input node $x_i - a_{ik}$ and b_{ik} ; $i = 1, 2, 3, \dots, m$ $k = 1, 2, 3, \dots, w$. The output node

$$O_{ik}^{(2)} = \exp\left(\frac{-(-a_{ik} + x_i)^2}{b_{ik}^2}\right)$$

Third layers: input node $O_{1j}^{(2)}, O_{2j}^{(2)}, O_{3j}^{(2)}, \dots, O_{mj}^{(2)}$; $j = 1, 2, 3, \dots, w$ to the output node;

$$O_j^{(3)} = O_{1j}^{(2)} \times O_{2j}^{(2)} \times \dots \times O_{mj}^{(2)}; j = 1, 2, 3, \dots, w$$

Fourth layers: input nodes to output nodes;

$$y = O^{(4)} = \sum_{i=1}^w O_i^{(3)} \times w_i / \sum_{i=1}^w O_i^{(3)} \quad O_i^{(3)} \times w_i$$

By gradient algorithm and the error back propagation of free parameter a_i', b_i', w_i identification. For any pair of input and output data $(x_i, y_i), x \in X \subset R^n, y \in Y \subset R, x, y$ selection

$$e = \frac{1}{2}(y(x_i) - y_i)$$

Among them, $y(x_i)$ is the output of the fuzzy model; y_i is the output measurement of the actual value, and with the formula to adjust the free parameters of a_i', b_i', w_i ;

$$\begin{cases} a_i'(q+1) = a_i'(q) - \alpha \left. \frac{\partial e}{\partial a_i'} \right|_q \\ b_i'(q+1) = b_i'(q) - \alpha \left. \frac{\partial e}{\partial b_i'} \right|_q \\ w_i(q+1) = w_i(q) - \alpha \left. \frac{\partial e}{\partial w_i} \right|_q \end{cases}$$

Because of the advantage of FNN, this paper takes it as a machine learning method.

4. Study on the Science and Engineering Course Contribution of Employment Based on FNN

4.1 Construction of the Parameter Set

First of all, to simplify the computation, the university curriculum system classified set required courses for the school, required courses, elective class three kinds, and the average score of each course exam scores included students during the three courses as the standard, on the basis of student employment elements, construction of three layer evaluation the parameters collection. Because in real life, salary can measure a person's level of employment, so the three layer evaluation parameter set is as follows: the first set of evaluation parameters including student employment level; second evaluation parameter set including; student employment level, employment salary, working time, working environment; third evaluation parameter set include: employment, salary, University required course at an average, specialized required course, elective course average.

For the non-full employment or by unfair competition means to obtain employment student, this paper believes that during his employment and study the correlation is not obvious, for its random and unpredictable, this paper not to study.

According to the employment and professional high correlation and through free competition (school recruitment) to obtain employment student to construct contact model between the salaries to the level of employment, to set second evaluation parameters, said employment levels with E , shown in q_1, q_2, q_3 with employment salary, working time, working environment, the relations between several performances as follows:

$$(1) \begin{cases} E = w_{k0} + w_{k1}q_1 + w_{k2}q_2 + w_{k3}q_3 \\ \eta = \frac{w_{k1}}{w_{k1} + w_{k2} + w_{k3}} \times 100\% \end{cases}$$

According to the above process of training the fuzzy neural network model between the employment salary and employment level, employment salary can be used to describe them.

According to the method of training set and fuzzy neural network third evaluation parameters, establishes three courses of employment compensation. s Is employment salary, with Q_1, Q_2, Q_3 representing the school required courses, professional courses, elective courses?

$$8 \quad (2) \begin{cases} S = W_{k0} + W_{k1}Q_1 + W_{k2}Q_2 + W_{k3}Q_3 \\ \eta_1 = \frac{W_{k1}}{W_{k1} + W_{k2} + W_{k3}} \times 100\% \\ \eta_2 = \frac{W_{k2}}{W_{k1} + W_{k2} + W_{k3}} \times 100\% \\ \eta_3 = \frac{W_{k3}}{W_{k1} + W_{k2} + W_{k3}} \times 100\% \end{cases}$$

4.2 An empirical study:

According to the employment direction to classification 200 random samples of science and engineering graduates school performances and employment data from three engineering colleges, as showed in the Table 1 and Table 2.

Table 1. Some of the Students Learning Achievement

Na me	School courses(aver)	Professional courses(aver)	Elective courses(aver)	Employment or not
A	70	73	80	1
B	67	87	67	1
C	87	90	86	1
D	65	77	77	1
E	74	85	73	1
F	85	88	84	1
G	84	74	65	1
H	69	76	72	1
I	82	72	69	1
J	90	88	90	1
K	70	83	97	1
M	73	82	73	1
N	88	85	78	1
O	85	61	79	1
P	86	66	83	1

Q	77	76	87	1
R	69	91	91	1
S	81	65	64	1
T	82	83	88	1

Table 2. Some of the Students the Employment Situation

Na me	Employment channels	Salary level	Work environment
A	1	2350	2
B	1	3000	3
C	1	3500	3
D	1	3000	3
E	1	3100	3
F	1	2350	2
G	1	2000	2
H	1	2400	2
I	1	2000	2
J	1	3200	3
K	1	3100	3
M	1	3300	3
N	1	3400	3
O	1	1800	1
P	1	1900	1
Q	1	2500	2
R	1	4000	3
S	1	2000	2
T	1	3300	3
Na me	Major related or not	Working time	The level of Employment Evaluation
A	1	3	60
B	1	5	79
C	1	4	82
D	1	5	77
E	1	3	74
F	1	2	60
G	1	1	59
H	1	3	62
I	1	2	55
J	1	3	81
K	1	4	82
M	1	3	84
N	1	5	85

O	1	1	57
P	1	1	58
Q	1	5	64
R	1	8	90
S	1	2	59
T	1	7	81

Note:

1, the employment channels: 1 campus recruitment, 2 for the social recruitment, 3 introduction;

2, the working environment: 1 bad, 2 medium, 3 is good;

3, the level of employment for the university teacher evaluation results for students employment level

Through the above classification, 136 students were identified as the employment direction and the professional direction are highly correlated, can think it is engaged in a professional occupation. In view of the above employment and professional highly relevant students, we carry on the fuzzy neural network to train with 100 students data, and to verify the training results with 36 students' data.

Trained by Formula 1 on the data, to establish the relationship between employment and wage and employment levels obtained the concrete data as described in the Table 3.

Table 3. Second Evaluation Parameters Set Training

			The level of employment
The fuzzy parameters	Salary level	Prior to the Parameters 1	0.225922
		Prior to the Parameters 2	7.502193
	Working time	Prior to the Parameters 1	0.499841
		Prior to the Parameters 2	5.146077
	Work environment	Prior to the Parameters 1	0.309961
		Prior to the Parameters 2	3.146093
After the fuzzy parameters	After the parameters1		0.201369
	After the parameters2		0.057301
	After the parameters3		0.113742
	After the parameters4		0.003195

From the above results can be seen, employment level represents a high degree of 83.91% on the level of salary, to represent the working time and the working environment of employment levels were 28.58%, 25.76%; therefore, we basically can identify the employment salary can represent the level of employment.

Then we calculate the contribution of various professional courses.

Trained by formula 2 to the data, the results are listed in the following Table 4.

Table 4. Third Evaluation Parameters Set Training

			The level of employment
The fuzzy parameters	Salary level	Prior to the Parameters 1	0.225922
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	Working time	Prior to the Parameters 1	0.499841
		Prior to the Parameters 2	5.146077
	Work environment	Prior to the Parameters 1	0.309961
		Prior to the Parameters 2	3.146093
After the fuzzy parameters	After the parameters1		0.201369
	After the parameters2		0.057301
	After the parameters3		0.113742
	After the parameters4		0.003195
w_{k1}			0.145733
w_{k2}			0.089243
w_{k3}			0.115623
$w_{k1} + w_{k2} + w_{k3}$			0.350599
w_{k1} Contribution			25.44%
w_{k2} Contribution			61.57%
w_{k3} Contribution			12.99%

From the above results can be seen that the university required course on employment contribution as a compulsory course in 25.44%, major to employment contribution to 61.57% elective course on employment salary degree is 12.99%, these shows, professional courses has largest contribution for students' employment.

Then, the model was used to verify the remaining 36 students' data.

The verification results were shown as Figure 6.

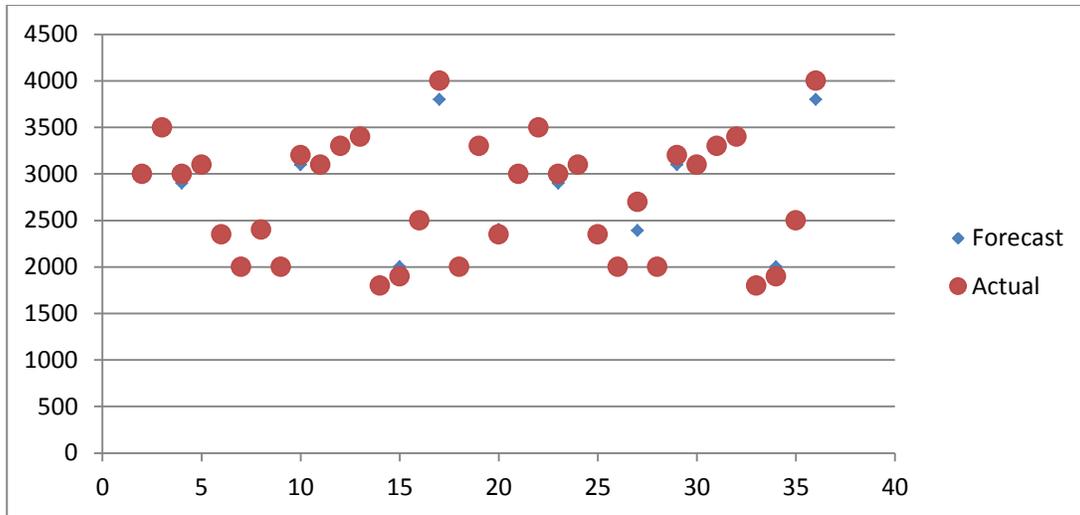


Figure 6. Verification Results

Seen from the figure, we train the model basically conforms to the reality.

7. Conclusion

As the situation in the credit allocation on the A University: school compulsory100, specialized required course, elective course of 120, 50, contrast the model the various types of course credit adjustment space are: -31, 46, -14.

Three courses in the university graduates on employment contribution degree are studied, and then through the contrast that the credit allocation in some colleges and universities still has room for improvement. Make up the blank in this kind of research.

However, this research also has shortcomings: first for the research of fuzzy neural network method, research results have a certain authority; secondly, this paper to simplify the computation purposes, the university curriculum is classified into three categories, while ignoring the difference between the same course, secondly, this paper studies in employment and professional highly related students to conduct research, and ignores the science and engineering different majors. These problems will be gradually improved in the future research.

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