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# International investment risk prediction based on BP fuzzy neural network

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## ABSTRACT

China's venture investment promotes development of new and high technology industrialization from the start. So far, there are many problems in theory has already formed the common understanding in the risk investment, such as the concept and function and external environment and conditions and the operation mechanism, but there are also many controversial issues. Part of the research from the Angle of new and high technology industrialization spread, which is easy to cause the microcosmic ignore economic interests, make the risk investment company operation deviates from the rational decision orbit, especially at present most of the risk investment institutions by the state under the condition of capital are more likely to have management idea mistake. This paper first introduces the artificial neural network model and theoretical basis. It introduced the theory and policy of risk investment and risk assessment. Characteristics and risk evaluation mainly includes the risk investment operation. Risk analysis and management of venture capital market in china. As well as the risk investment fund of China's investment in high-tech enterprise development strategy etc. BP neural network is applied to project investment risk evaluation. Contents of project investment risk evaluation index system, neural network method etc.. Application of simulation and test result and examples is use of MATLAB6.5 software programming.

## KEYWORDS

International risk investment; Fuzzy; BP neural network; Adaptive predictive control.



## INTRODUCTION

Risk investment has more and more influence in the world today. Especially in the new and high technology industrialization process, risk investment played an important role. It can promote the development of high-tech industries and promote technology innovation. In general speaking, China's venture capital industry both in terms of scale and development speed, or from the quality and the developed countries have a considerable gap. The venture capital industry market mechanism is yet to be established. It is the external environment of development is not perfect. Also on the practice of risk investment caused a huge obstacle. Even so, the venture capital industry outstanding results can still attracts more and more high-tech technology enterprise. But the many high technology enterprise select growth potential is high, moderate risk of enterprise investment.

The development of venture investment has ten years history. Venture capital industry in order to promote the development of the industry has played an important role. However, in the practice of risk investment, our country also met with setbacks and lessons. Because many venture capital organizations are the operation is not standard problem. Risk investment institutions in their money to the capriciousness are very strong. Risk investment institutions into management are dilemma. The company's collapse is a typical case. In general speaking, China's venture capital industry both in terms of scale and development speed, or from the quality and the developed countries have a considerable gap. The venture capital industry market mechanism is yet to be established. Development of the external environment is not perfect. Also on the practice of risk investment caused a huge obstacle.

Risk investment projects has the characteristics of high risk, high income. Scientific and accurate evaluation method to project investment is very important. The traditional evaluation method is too subjective factors. And artificial neural network model to overcome the traditional project evaluation depends on the disadvantages of expert experience. For project investment risk evaluation opens a new way. At present the most widely application of project investment risk evaluation method is the Delphi method, principal component analysis, analytic hierarchy process and grey system evaluation method, and fuzzy comprehensive evaluation method, etc. But because of these methods in the evaluation of random factors more. Evaluation result is susceptible to the influence of subjective evaluation personnel and experience, knowledge limitations. So it will gradually be replaced. This paper is different from the above method of BP neural network.

## INTERNATIONAL INVESTMENT RISK STATUS

The new and high technology project evaluation research in the early 1960 s has aroused people's interest. Its starting point is Myers and Marquis of large-scale empirical research. In recent years the research still emerges in endlessly. To find out the influence of the basic factors of high-tech investment is success or failure. For instance, Mortarly and Kosnik think risk is divided into two categories: market risk and technical risk; Souder and Bcthay think should be divided into three types of business, market and technology risk. And Belev will high-tech risk is divided into 6 types: technology, capital, the design, the support system, cost and schedule and external factors. In addition, due to the high-tech investment will inevitably involve one or more new technology. So the present study general began to emphasize the significance of the technical risk. Glasser think technology is the concept of risk high-tech market risk?

### China's high-tech project investment risk evaluation problems

High and new technology project quite a number of indicators systems much copied the foreign evaluation system. They not fully aware of China's high-tech project investment risk of industry development status and foreign gap. Foreign high-tech projects investment risk operation reliable and specification. Especially in the investment behavior and risk assessment, has a lot of case study and empirical analysis. On China's high-tech projects investment risk evaluation system has important reference and reference. But at present in China, the high technology and new technology project investment risk industry is still at an early stage. Many ways it is not perfect, and are quite different. In addition, the domestic corresponding laws and regulations, cultural background and so on also and abroad have a big difference.

Our country is a developing country. China is in short economy. Is one of the most important characters of the supply shortage of economy? From the present situation of short supply, almost the

majority of investment projects are needed. Through the evaluation often show that they are all has certain economic benefits. Assessment of risk may come out in affordable range. But, only from the project their factors, based on simple benefit standard to measure the investment is feasible. The condition is not very full. The project is expected to benefit is good, can only that the project is feasible, and the investment is not feasible. Because the investment eventually will always carry out to a certain area of a certain industry can enterprise. Investment project evaluation inaccurate or invested enterprise quality is low.

Lack of high and new technology project investment environment risk is assessment. The investment environment to provide to the investors and investment activities of the various conditions, it affects the investor's investment activities. The superior investment environment is investment smoothly and development guarantee. Conducive to the realization of the project economic efficiency, bad investment environment will hinder the smooth progress of investment activities. Impact on project economic benefit, and increase the risk of a high and new technology investment.

From the above analysis, we can conclude that the paper tries to build suitable for the characteristics of high and new technology project investment risk assessment theory to ensure the high and new technology investment project success is very important. It can help investors from the professional Angle, the investment environment, management experience, new and high technology project technology, market and so on comprehensive risk assessment. And the new and high technology project investment risk having a clear understanding of, this to make the right investment decisions have very important significance.

Of course, for new and high technology project investment, people really care about is the project risk is behind the investment income. So, for new and high technology project investment risk assessment is the basic starting point in care project risk income at the same time the need to face the risk of making the right risk assessment. So in treating high-tech investment projects need to avoid two kind of tendency. One is only pay attention to high and new technology project investment income and ignore it has great risk. The second is only pay attention to the project risk and didn't see project investment income.

**The connotation of international investment**

International investment activity is the capital of multinational business shipping activity. It is with the international trade phase difference, and with the simple international credit activities phase difference. International trade is mainly goods international circulation and exchange, realize the value of the goods. International credit mainly is the currency of the credit and recovery, although its purpose is in order to realize the value of capital appreciation. But in the capital of the specific operation process, the capital of all the people there is no control. And international investment activity, it is the combination of all kinds of capital operation. It is in the operation of the realization of the value of the capital.

**Economic risk**

According to the long-term nature of the exchange rate change, multinational companies can take adjust business strategy and marketing strategy. By changing the product market structure and other ways is to maintain its competitive power. The exchange rate change on the influence of the market share is through the influence of the implementation of the cost and price. In the international market it has the subsidiary of devaluation. It can make the subsidiary products in the international market price relative decline. Make subsidiary in pricing strategies have great agility and in export market has a strong competitive strength.

The global business diversification strategy is:

<1> The diversity of regional management in international business to avoid make enterprise overseas business activities of too much focus on a country or region. That the business activities to keep the other countries or areas, make overseas production point of production and marketing activities such as localization as far as possible.

<2> The diversity of product structure can take the diversification of product structure. To avoid because of the production and operation of enterprises depend on some or some kind of products. Reduce as the product market competition intensifying suddenly or market suddenly atrophy of the bad influence of the.

<3> The diversification of investment and financing structure including actively carry out international securities keep the origin of capital and invest in currency, term on mutual matching and form a reasonable structure, etc.

## BP FUZZY NEURAL NETWORKS

Since the 1980 s fuzzy theory system has been improved step by step. Fuzzy technology in industrial control applications made great success, especially neural network research upsurge again rise up. Many people naturally look to fuzzy logic system and neural network combined with the important direction. In the 1980 s to 90 s, the fuzzy logic system and neural network fusion started to really attention from the academia. This two kinds of methods is fusion, has become in recent years intelligent control method.

### Artificial neural network

According to the operation process of the information flow can be divided into forward network and feedback type network two kinds big. Prior to the network through the many has a simple processing capacity of neurons of mutual combination makes the whole network has complicated nonlinear approximation ability. Feedback type network through the change of network state of neurons is ultimate stability in equilibrium state. Get associative memory or the result of optimization calculation. P erceptron, adaptive linear element and BP network, belongs to the forward network, and Hopfield network. the computer belong to feedback type network. According to the learning methods and neural network can be divided into supervised learning and unsupervised learning and reinforcement learning three categories. Supervised learning needs to contain known input and output sample training set. Learning system according to the known output and the actual output the difference between the values to adjust the system parameters?

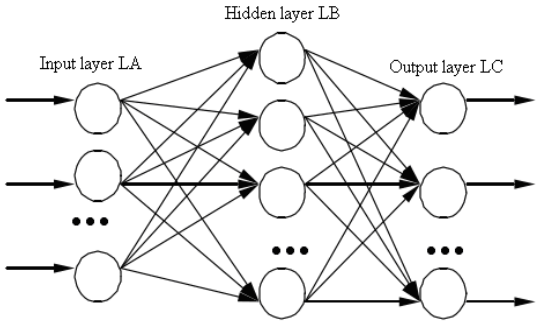


**Figure 1 : Artificial neural network work theory**

For the fuzzy information processing of the neural network is called it a fuzzy neural network. They are usually is a kind of fuzzy or not by fuzzy neurons connected into a network system. FNN in addition to general neural network with the nature and characteristic also has some special properties. For instance it takes the use of fuzzy mathematics calculation method. Make some processing unit calculation becomes more convenient. So that the information processing speed can also as a result of the fuzzification operation mechanism. This makes the tolerance of the system was improved. But the fuzzy neural network to expand the scope of the system process information. The system can also deal with deterministic information and uncertain information. At the same time, it also greatly improves the system process information means.

### Adaptive neural fuzzy inference system

Artificial neural network has strong self learning and adaptive ability. But it is similar to a black box, the lack of transparency. It can't be very good to express the brain function of reasoning. And fuzzy system itself has no adaptive ability and limits its application.

Adaptive neural Fuzzy Inference System (Adaptive Neuro - Fuzzy Inference System), also known as Network based on Adaptive Fuzzy Inference System (Adaptive Network - based Fuzzy Inference System), ANFIS. 1993 by scholars put forward Jang Roger. It combines the neural network learning mechanism and fuzzy system language reasoning ability etc. Make up respective deficiency; belong to a kind of neural fuzzy system. Compared with other neural fuzzy system, ANFIS has convenient and efficient characteristics. So has been income the MATLAB fuzzy logic toolbox. It has set up a file in the fields to get the successful application.

The typical ANFIS structure as the chart shows,

In order to realize the t-s fuzzy model of learning process, generally transformed into an adaptive network, namely, adaptive fuzzy neural reasoning system, as shown in Figure.

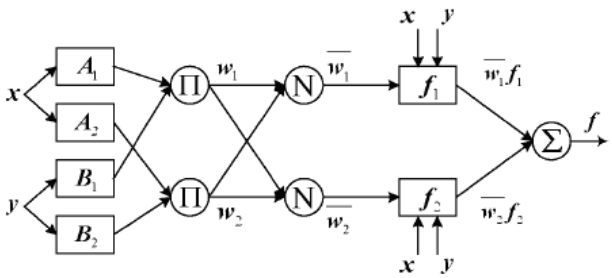


**Figure 2 : corresponding adaptive neural fuzzy inference system structures**

The adaptive network is a multilayer feed forward network, one of the square node need to study the parameters.

The first layer: input variable membership function layer.

$$O_i^1 = \mu_{A_i}(x) \quad i = 1,2 \text{ or } O_i^1 = \mu_{B_i}(y) \quad i = 1,2 \tag{1}$$

Where *x*, *y* is the node of i layer input. $A_i$ and $B_i$ is fuzzy set. That $O_i^1$ is the membership function value of $A_i$ and $B_i$ . It says *x*, *y* belongs to the degree of $A_i$ and $B_i$ . Membership function $\mu_{A_i}$ and $\mu_{B_i}$ shape and completely by some parameters, these parameters are called antecedent parameters.

The second: the strength of the rules of the release layer.

$$O_i^2 = \omega_i = \mu_{A_i}(x) \times \mu_{B_i}(y) \quad i = 1,2 \tag{2}$$

The output of each node is on behalf of the credibility of the rules.

The third layer for all the rules of the normalized intensity.

$$O_i^3 = \overline{\omega_i} = \omega_i / (\omega_1 + \omega_2) \quad i = 1,2 \tag{3}$$

The fourth floor calculating the output of the fuzzy rules, a layer of each node I for adaptive node, its output is:

$$O_i^4 = \overline{\omega_i} f_i = \overline{\omega_i}(p_i x + q_i y + r_i) \quad i = 1,2 \tag{4}$$

Here the $\overline{\omega_i}$ is output of third layer, $\{p_i, q_i, r_i\}$ as the parameters of the node set, called the consequent parameters.

The fifth layer for fixed nodes, calculation of all input signals of total output:

$$O_i^5 = \sum \overline{\omega_i} f_i = \sum \omega_i f_i / \sum \omega_i \quad i = 1,2 \tag{5}$$

In the network prior to the learning process, using *n* training data set input values. Parameter $p_i, q_i, r_i$ value and the output value $O_i^5$ , *n* value $O_i^5$ according to the least square method and principle of calculating value and the training data of the original expectation error. And this error reverses back, the premise parameters correction according to the maximum gradient method. After learning network for the same sample concentration of the training is samples. It can still give right input - output relation ability called the generalization ability of the system.

**The design of the neural network identifier**

When the system identification for multilayer feed forward neural network based on BP algorithm, single input, single output system (SISO) nonlinear dynamic model (NARMA) as shown in (6). Among them, $u(k)$, $y(k)$ respectively as input, output in the $k$ system, $f\{.\}$is a nonlinear function. $m$,$n$ and m respectively before the input and output of $n$.

$$y(k+1) = f[y(k), y(k-1), \cdots, y(k-n+1)] + \sum_{i=0}^{m-1} b_i u(k-i) \quad \textbf{(6)}$$

In order to ensure the stability of the structure identification and the output of your model fully approximation to the actual object output, generally USES the series-parallel identification model.

$$\hat{y}(k+1) = f_{NN}[y(k), y(k-1), \cdots, y(k-n+1)] + \sum_{i=0}^{m-1} b_i u(k-i) \quad \textbf{(7)}$$

Offline learning teacher signal collection

$$TS = \{X(k) \to y(k+1) \mid u(k) = A \cdot Rand(1), k = 1, ..., N\} \quad \textbf{(8)}$$

That is $X(k) = \{y(k), y(k-1), \cdots, y(k-n+1), u(k), u(k-1), \cdots, u(k-m+1)\}$. $u(k)$as the excitation signal. $A$ is the amplitude of the signal. $Rand(1)$ for the [-1,1] between the uniform distribution random number. $m$、 $n$ and the actual object order on. $N$ is the number of training sample set.

Because it contains a hidden layer BP network can approach arbitrary bounded continuous nonlinear. So for nonlinear system identification using contains a hidden layer three layer forward network. Each layer neuron number can accord the selection principle.

(1)The number of input layer neurons for $n_I > n + m + 1$。

(2)The number of hidden layer neurons $n_H > n_I$。

(3)The number of neurons $n_o$ in the output layer number output to identify system. For the single input, single output system $n_o = 1$. Based on the off-line identification system BP network can use correction rules and dynamic $\delta$ of training. The input layer of the network for:

$$Q_i^1 = \begin{cases} y(t-i), & 0 \le i \le n-1 \\ u(t-i+n), & n \le i \le m_1 - 1 \end{cases} \quad \textbf{(9)}$$

Among them $m_1 = n + m$, that is the number of nodes in the input layer. Make the node of hidden layer number $m_2$, the hidden layer can be expressed as:

$$net_j(t) = \sum_{i=1}^{m1} W_{ij}^2 Q_i^1(t), \quad j = 1, 2, \cdots m_2 \quad \textbf{(10)}$$

$$Q_j^2(t) = g[net_j(t)], \quad j = 1, 2, \cdots m_2 \quad \textbf{(11)}$$

The output layer:

$$\hat{y}(t+1) = \sum_{j=1}^{m_2} W_j^3 Q_j^2(t) \quad \textbf{(12)}$$

The $W_{ij}^2$ is connection weights between input layer and the hidden layers. The $W_j^3$ is connection weights between hidden layer and output layer.

Incentive function takes as follows:

$$g(x)=\frac{2}{1+e^{-x}}-1 \quad \textbf{(13)}$$

The definition of objective function for training for NNI:

$$E=\frac{1}{2}[y(t+1)-\hat{y}(t+1)]^2 \quad \textbf{(14)}$$

According to the BP algorithm with dynamic items, get NNI weight correction formula is as follows:

$$W_{ij}^2(t+1)=W_{ij}^2(t)-\gamma_1\frac{\partial E}{\partial W_{ij}^2}+\beta_1[W_{ij}^2(t)-W_{ij}^2(t-1)] \quad \textbf{(15)}$$

$$W_j^3(t+1)=W_j^3(t)-\gamma_2\frac{\partial E}{\partial W_j^3}+\beta_2[W_j^3(t)-W_j^3(t-1)] \quad \textbf{(16)}$$

When the actual system input is not fixed, a fuzzy controller is the system of unknown nonlinear part identification. And then the method is out of control. From the simulation results it can be seen that the output of the system in the steady state still have small amplitude of vibration.

RLS training algorithm is as follows：

$$\hat{W}_{it}(k)=\hat{W}_{it}(k-1)+M_{t-1}(k)\delta_{it}(k) \quad \textbf{(17)}$$

$$\delta_{iL}(k)=r_{iL}(k)-net_{iL}(k) \quad \textbf{(18)}$$

Equation (17)~(18) is back propagation of RLS estimation algorithm of the general formula. When the neural network layer of t take L (this paper for 3 layer), which is output layer：

$$\delta_{iL}(k)=r_{iL}(k)-net_{iL}(k) \quad \textbf{(19)}$$

Take other value, which is hidden or input layer：

$$\delta_{iL-1}(k)=\delta_{iL}(k)W_{iL}\,f'[net_{iL-1}(k)] \quad \textbf{(20)}$$

By using the algorithm of neural network weights of the adjusted, until the performance index requirements so far.

## CASE SIMULATIONS

International investment risk is refers to the investment in a specific environment and the specific period of time. Due to it have various uncertain factors. Which lead to international investment project real income and the gap between the expected value or international investment economic loss?

The international herald BBS newspaper website on May 1st reported that the investors chasing the growth of China's economy and ignore the risk.

Last Friday, renren will be 30% of the price of the stock prediction interval up to 12 to 14 dollars a share. Investors to the company stock needs be clear at a glance. Headquarters is located in Beijing's Wallace borui consulting company general manager mark, NAT jin said: "now, China investment enthusiasm is very high, some investors even willing to ignore some in other markets will not ignore the risks." The company mainly for China's Internet and telecommunication field of investors to provide advisory services.

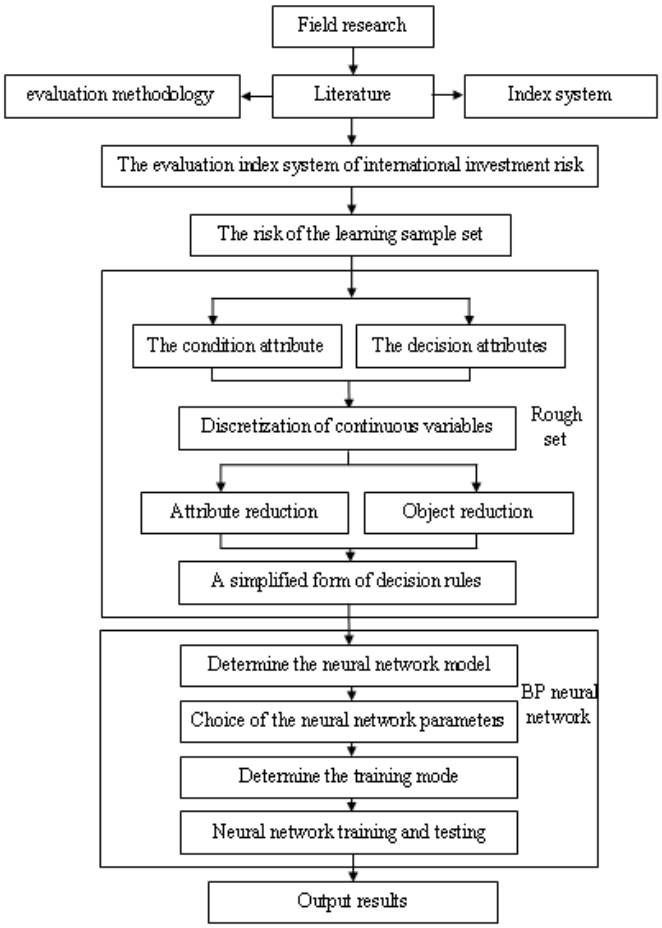


**Figure 3 : The algorithm flow**

Mercedes is German brand cars, with its speed quickly, the price is expensive, insurance premium high in the United States is considered a symbol of the identity and status. 1981 than DE hughes as Benz us sales headquarters President, Mercedes Benz sales center of gravity from European transfer to the United States. And through various efforts, the company has established in the United States marketing network. In the United States will Benz car sales from 1980 in 10000 to improve car in 1985 to 35000 cars, a growth nearly 3 times. But 1987 years later, the Benz car sales in the United States gradually decreases. By 1993, sales in the United States dropped to 3000 vehicles. In the United States was forced to shut down the spare parts wholesale storage and transportation center. Than DE hughes also forced to quit the presidency and leave Benz company.

## SUMMARIES

Fuzzy neural system input variable number, each input variable the membership function of the number, the number of training and the training accuracy with fuzzy neural system of the relationship between the generalization ability. Not fuzzy neural system training error is smaller that ability to learn more, its generalization ability is better. Conversely, when fuzzy neural system input variable number too much, each input variable the membership function of the number of too much, too much training number, the number of rules and parameters number too much. Although can improve the accuracy of training. The analysis of the high and new technology based on the characteristics of the project risk. Combined with China's reality, put forward a set of suitable for China's national conditions of high and new technology investment project risk assessment indicators and established based on rough set, the BP neural network risk assessment model. Rough set is powerful numerical analysis ability. And the BP neural network has accurate approximation convergence ability, so rough set and serial combined with BP neural network. Establish a rough set based on a BP neural network of high-tech projects investment risk evaluation model. Eliminate

sample redundancy and reduce the BP neural network input dimension and hidden neurons weights the number of connections. In order to improve the BP neural network training speed, speed and evaluation fine.

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