AMSE Association for the Advancement of Modelling & Simulation Techniques in Enterprises
IIETA International Information and Engineering Technology Association
Advancing the World of Information and Engineering

Advances in Modelling and Analysis A
Vol. 55, No. 4, December, 2018, pp. 190-195
Journal homepage: http://iieta.org/Journals/AMA/AMA_A

Based on Bayesian minimum risk matrix Euclidean distance and variance calculation and classification application

Gang Chen[1*], Bingcheng Qiu[1], Jinpeng Liang[2]

[1] Dept of Computer Science Guangdong Open University, Guangzhou 570091, China
[2] School of Applied Mathematics, Guangdong University, Guangzhou 510075, China

Corresponding Author Email: gdchengang168@126.com

https://doi.org/10.18280/ama_a.550402

Received: 26 February 2018
Accepted: 5 June 2018

Keywords:
probability, research and development, Euclidean distance, variance

ABSTRACT

The article mainly discussed the Euclidean distance based on Bayes minimum risk，variance calculation, on this basis probabilistic neural network model, and emphatically discusses the based on Bayes minimum risk, which based on the Euclidean distance and the calculation of variance for the probability of the advantages of neural network in classification. Combining the enterprise' poor for personnel research and development cause the shortcomings, a big electronics company in Dongguan of China research a sample training and analysis. The results show that the Euclidean distance based on Bayes minimum risk and variance calculation based on probabilistic neural network model are better than other traditional methods, and this method is effective.

1. INTRODUCTION

With the continuous development of economy and society, the enterprise economy is becoming more and more important to the social economy, and the competition among enterprises is becoming more and fiercer. Since the core of competition lies in corporate profits, and the profit of enterprises lies in innovation, the competition of enterprises is increasingly dependent on the enterprise knowledge innovation research and development. In foreign countries, large multinational enterprises have invested relatively early in R&D (research and development), so they have firmly occupied the high end in the industrial chain of products, and have absolute advantages in the high-tech field of products. Therefore, it is necessary for domestic enterprises to accelerate R&D innovation research, in order to gain a foothold in the market of high-end technology products. Then it is essential in R&D innovation talented person, what is a R&D talents, that is, the staff can work R&D, thus to build a scientific and reasonable R&D personnel competence evaluation model, and is of great significance for the development of today's domestic enterprises.

For the research of enterprise R&D talent evaluation model, it was first proposed abroad .as early as in 1973, Harvard University professor David McClelland first put forward the evaluation model of R&D personnel, and use the model to detect job performance and career success, but the model only gives the qualitative research did not give quantitative data [1]; Domestic studies in this field late, early more representative is prof Wang, that he first puts forward the competence in management psychology and studies the characteristics of our country enterprise top of managers competency structure [2]; Zhongli Feng defines the competency of enterprises [3]; Xue has made some supplementary contributions to the performance of competence [4], Xu Fang and Zhang Lan have made some extension and expansion in competency evaluation [5-6]. Due to the above studies only stay on the competence quality definition, and unable to effectively measure the competence. So that is not conducive to the effective management of enterprise innovation, and is not conducive to scientific management of modern enterprises [7, 8].Based on the above problems, this paper put forward based on Bayes minimum risk based on the Euclidean distance and variance calculation of PNN (Probabilistic Neural Network) concept, which is principle and advantage, and will be based on Bayes minimum risk based on the Euclidean distance and the calculation of variance of the probability of the Neural Network model is applied to the classification of enterprise R&D personnel, finally and is applied to the practice, and whose results show that this method is better than other traditional methods.

2. PRINCIPLE

2.1 Euclidean distance and variance

Euclidean metric (also called Euclidean distance) is a commonly used distance definition, refers to the m dimensional space in the real distance between two points, or natural vector length (the point at which the distance to the origin). The Euclidean distance between two and three dimensions is the actual distance between two points. And the n dimensional Euclidean space is a set of points, where each point X or vector $\vec{x}$ can be expressed as x_i (i=1,2,….n), which is the real number, and is called the i^{th} coordinate of x .

For the two points A_i and B_i (i=1,2,….n) the distance between (A, B) is defined as the following formula:

$$\rho(A,B) = \sqrt{\sum_{i=1}^{n}(a[i]-b[i])^2} \text{ (i=1,2,3,4…..n)} \quad (1)$$

Probability theory is used to measure the degree of deviation between random variables and their mathematical expectations (mean). The variance (sample variance) is the average of the squared difference between each sample value and the average of the sample values. In many practical problems, it is of great significance to study variance.

Variance is the measure of the difference between the source and the expected value. There are different definitions in the statistical description and probability distribution, and there are different formulas. In the statistical description, variance is used to calculate the difference between each variable (observed value) and the overall mean. In order to avoid the effect of the sum, which of the deviations from the average deviation and the sample content and the variance of the variable were described by the mean deviation of the sum of squares Calculation formula of population variance:

$$\sigma^2 = \frac{\sum(X-\mu)^2}{N} \tag{2}$$

where σ^2 is the population variance, and μ the population mean, and N is the population number.

2.2 Classification of Bayesian decision

Bias decision classification is a classical classification algorithm in data mining classification algorithm. It is a quantitative trade-off between different classification decisions and corresponding decision costs. It can be simply described as: assuming there are two types of classification patterns, for samples to be classified, they are expressed as $X = (x_1, x_2, x_3, \ldots\ldots x_N)$.

If $h_1 l_1 f_1(X) > h_2 l_2 f_3(X)$, then, the sample X belongs toα_1;

If $h_1 l_1 f_1(X) < h_2 l_2 f_3(X)$, then the sample X belongs to α_2;

In the above reasoning in h_1, h_2 respectively for α_1 classification model and α_2,h_1=(N_1/N), h_2=(N_2/N), N is a priori probability, as the total number of training samples, N_1 and N_2 respectively, α_1, α_2 classification, training samples in a specific number; l_1, l_2 α_1 and α_2 were respectively divided into training samples error to bear the punishment cost of each region or loss. $f_1$and $f_2$are the probability densities in α_1 and α_2, but in Bias classification decision, it is difficult to get more accurate probability density under normal circumstances, but in practical applications, we can only calculate their statistical value based on the existing probability density.

Based on Bayesian decision classification, Parzen window method is put forward in 1962 [9], the method is a nonparametric test method, for estimating the probability density from a random sample, and the method is as long as enough training samples, and the probability density function is obtained to close to the real value of the infinite. The formula is as follows:

$$f\ (X) = \frac{1}{(2\pi)^{P/2}} \frac{1}{m} \sum_{i=1}^{m} exp[-\frac{(X-X_{\alpha i})^T (X\text{-}X_{\alpha i})}{2\sigma^2}] \tag{3}$$

In (3), α represents the classification mode and $X_{\alpha i}$ represents the ith training feature vector in the classification mode; (1) the number of samples that m is used for training in classification mode; And $X_{\alpha i}$is the characteristic vector dimension of the classification sample, and αis the smoothing factor, and the α smoothness of different values has a great influence on the accuracy of PNN classification. At present, the value is obtained through experimental method.

2.3 Probabilistic neural network models

Probabilistic neural network was founded in 1989 by d. f. Specht Dr ,who First proposed, a kind of commonly used in pattern classification of neural network, also a kind of neural network model, and PNN is the neural network model based on statistical principle, on the classification function and optimal equivalence, The Bayes classifier developed based on Bayes minimum risk criterion of a parallel algorithm, at the same time it is not like traditional the multilayer forward network needs to reverse calculation of error propagation using BP algorithm, it is completely forward calculation process. It has short training time and is not easy to fall into local minima. The classification accuracy is higher [10]. At the same time, the learning algorithm is not required to be trained. The algorithm is completed in one time, five orders of magnitude faster than BP, and two orders of magnitude faster than RBF.

Figure 1 the input layer receives the value from the training sample, inputs it into the probabilistic neural network, and the number of its neurons is the characteristic dimension of the training sample. Sample layer, also called pattern layer, is used to calculate the characteristic vector of input layer and the training sample. The matching relation between their values reflects the similarity of the samples is as follows formula (4), and expressed as the output of the model layer.

$$f(X, W_i) = E(-\frac{(W_i-X)^T (W_i-X)}{2\sigma^2}) \tag{4}$$

(4) in the formula, the connection weight of the input layer to the mode layer is the smoothing factor, which plays an important role in the whole classification. Summation layer will be accumulate belonging to the class of probability density summation layer and only belongs to the class of the model layer that is linked together, with the cumulative value of certain probability. The output and the various based on kernel density estimation into a linear positive correlation. Competition is also called the output layer, the layer is mainly responsible for from the classification model estimates the probability of the choice of maximum probability value as the setting of the output neurons of "1", other probability, the output of the other of unknown samples shall be 0. Therefore, probabilistic neural networks are mainly applied to two valued problems, such as pattern recognition, fault diagnosis, two element classification and so on. This paper applies PNN to deal with the problem of two element classification. At the same time, the time efficiency of this method is higher than that of traditional BP and RBF in dealing with two yuan classification. In this paper, a probabilistic neural network model based on Bayes minimum risk Euclidean distance and variance calculation is applied to deal with the two element classification problem.

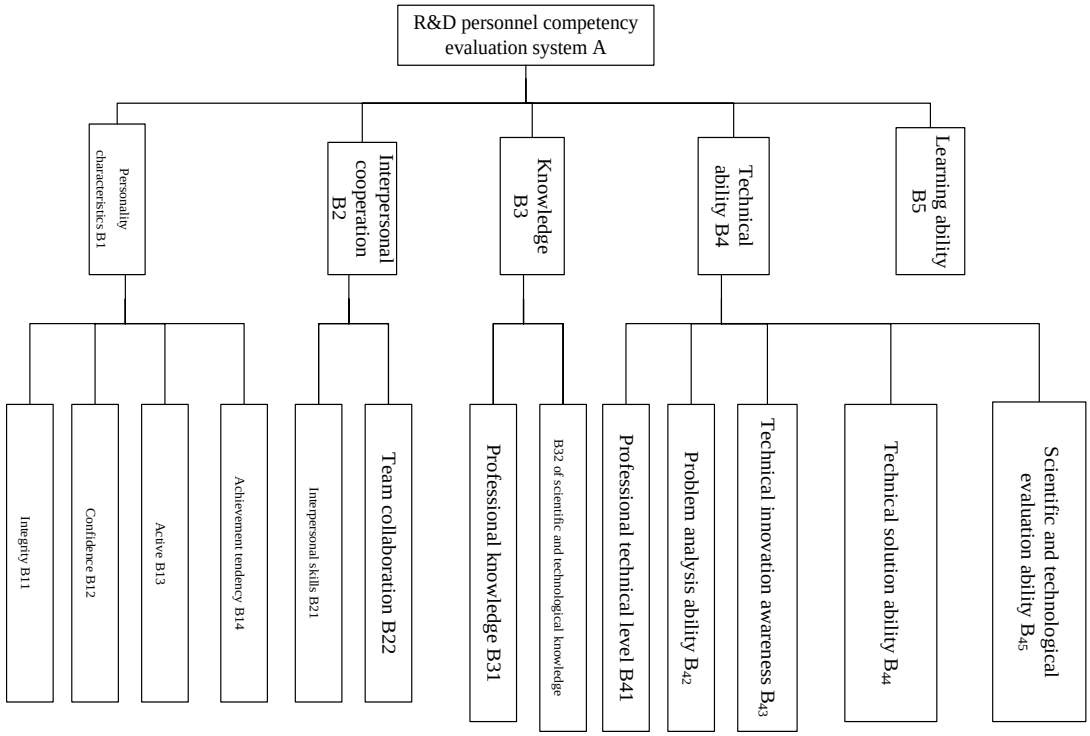

Figure 1. Enterprise R&D talent evaluation system

3. APPLICATION

R&D personnel's competence evaluation system in order to better research, this topic group get the assistance of the Dongguan electronic industries association. A electronic electronics company in Dongguan as the research object, which consist of the research team from R&D, namely: research director, managers and consulting experts. The team of R&D jobs is analyzed in detail, with the method of questionnaire survey and key behavior event interview BEI (behavioral event interview) the way of combining finally build up the R&D personnel competence evaluation system. The evaluation system mainly includes three levels: the first level is called the target layer; the secondary level is the criterion layer, which determines the various eigenvectors of the final classification. The three-level index is the index layer, which is the subdivision of the second layer, as shown in figure 1.

Can be seen from the figure 1, the enterprise R&D personnel's competence and its intelligence have no direct equivalent relation, only with the people's learning ability, technical skills, knowledge, interpersonal cooperation spirit and personality traits. Integrity, confidence, initiative and sense of achievement are the basic guarantee for the competence of R&D personnel. Integrity is the foundation of team trust. Only integrity and mutual trust between team members can facilitate the smooth development of innovative work. Self-confidence is the key to the achievement of scientific research at the same time, in the way of scientific research, the difficulties are, if the project research and development has not fully confident, research and development innovation, work was hard to hold on. High confidence of staff achievements feel strong, low confident people will reduce work difficulty and height, so high confident people are the root of project research and development work smoothly. The initiative is mainly the responsibility of the researchers, and responsible R&D personnel are able to do well in R&D projects and keep the research work of R&D projects. Interpersonal skills include interpersonal skills and teamwork. Interpersonal skills mainly include personnel communication skills, including personnel and supervisor’s personnel and team communication skills. Team cooperation mainly includes members who are good at sharing professional knowledge and skills with other members of the team, helping other members to overcome research and development difficulties. Knowledge mainly refers to the specialized knowledge and knowledge, qualified R&D. personnel must have strong professional knowledge and extensive knowledge, because R&D research involves many disciplines of knowledge, can have multiple disciplinary knowledge integration capability. Technical ability mainly refers to (1). the professional knowledge level. (2). problem analysis and solving ability and the technical innovation ability, (3). technical plan of science and technology evaluation ability. that are a qualified R&D. Meanwhile personnel must have a professional technical ability, and learning ability which can guarantee of success, especially in today's social and economic rapid development. Sustained conscious learning ability is very important to a qualified R&D personnel, every knowledge is limited to long for R&D work. So, R&D personnel must have a continuous learning ability consciously.

From the above analysis, it can be seen from the above analysis that people with integrity, confidence, initiative and achievements are the guarantee of the success of enterprise innovation and the cornerstone of R&D talents. At the same time, as the personnel of enterprise R&D, it should also have the ability to handle the interpersonal relationship and the willingness to cooperate with the team, which has provided support for the success of enterprise R&D innovation. The broad scope of knowledge and the strong professional knowledge are the personnel of the enterprise R&D personnel

to be qualified for the work. A successful enterprise's R&D projects in addition to the requirements of R&D personnel should have strong professional technical ability, but also solve the problem analysis and solving ability, innovation ability, science and technology evaluation ability and strong learning ability, these are the enterprise R&D project technical guarantee of success.

How to make the enterprise R&D executives can quickly identify the personnel that enterprises need R&D talents, can save cost, also is advantageous to the enterprise to obtain greater profits? these are the focus in the study of this article and task, enterprise R&D personnel's competence evaluation based on PNN model, which can quickly and easily to solve the above problems, the modeling process of the model are as follows:

(1) The training sample normalization processing, first of all, from the overall sample selection of m has a representative sample, and every sample vector dimensions for p (if it is used in this paper, empirical, p = 14, representing the 14 indicators), build unitary matrix as follows,

$$\begin{bmatrix} x_{11} & x_{12} & x_{13} & \dots & x_{1p} \\ x_{21} & x_{22} & x_{32} & \dots & x_{2p} \\ x_{31} & x_{32} & x_{33} & .. & x_{3p} \\ .. & .. & .. & .. & .. \\ x_{m1} & x_{m2} & x_{m3} & \dots & x_{mp} \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \dots \\ x_m \end{bmatrix} \quad (5)$$

In equation (5), normalized to (6),

$$B^T = \left[\frac{1}{\sqrt{\sum_{k=1}^{p} x_{1k}^2}} \quad \frac{1}{\sqrt{\sum_{k=1}^{p} x_{2k}^2}} \quad \dots \quad \frac{1}{\sqrt{\sum_{k=1}^{p} x_{mk}^2}} \right] \quad (6)$$

And C is the learning sample after normalization (7)

$$C_{m\times p} = B_{m\times 1}[1 \quad 1 \quad \dots \quad 1] \times X_{m\times p} \quad (7)$$

(2) The normalized m samples are fed into the network input layer, where $M_i = \sum_{k=1}^{p} x_{ik}^2$ is the jth input of the ith sample of the learning matrix

$$\begin{bmatrix} \frac{x_{11}}{\sqrt{M_1}} & \frac{x_{12}}{\sqrt{M_1}} & \dots & \frac{x_{1P}}{\sqrt{M_1}} \\ \frac{x_{21}}{\sqrt{M_2}} & \frac{x_{21}}{\sqrt{M_2}} & \dots & \frac{x_{2p}}{M_2} \\ \dots & \dots & \dots & \dots \\ \frac{x_{m1}}{\sqrt{M_m}} & \frac{x_{m2}}{\sqrt{M_m}} & \frac{x_{m3}}{\sqrt{M_m}} & \frac{x_{mp}}{\sqrt{M_m}} \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} & \dots & C_{1p} \\ C_{21} & C_{22} & \dots & C_{2p} \\ \dots & \dots & \dots & \dots \\ C_{m1} & C_{m2} & C_{m3} & C_{mp} \end{bmatrix} \quad (8)$$

(3) Calculation of mode distance.

The distance is the distance between the sample matrix and the corresponding elements in the learning matrix. Assuming that the matrix consisting of m p - dimensional vectors is called to identify the sample matrix, after normalization, the input sample matrix that needs to be identified:

$$D = \begin{bmatrix} d_{11} & d_{12} & \dots & d_{1p} \\ d_{21} & d_{22} & \dots & d_{2p} \\ \dots & \dots & \dots & \dots \\ d_{m1} & d_{m2} & \dots & d_{mp} \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ \dots \\ d_m \end{bmatrix} \quad (9)$$

It is the normalized sample vector, that needs to be identified, and Euclidean distance E of each normalized training sample Ci, is;

$$E = \begin{bmatrix} \sqrt{\sum_{k=1}^{p} |d_{1k} - c_{1k}|^2} & \sqrt{\sum_{k=1}^{p} |d_{1k} - c_{2k}|^2} & \sqrt{\sum_{k=1}^{p} |d_{1k} - c_{mk}|^2} \\ \sqrt{\sum_{k=1}^{p} |d_{2k} - c_{1k}|^2} & \sqrt{\sum_{k=1}^{p} |d_{2k} - c_{2k}|^2} & \sqrt{\sum_{k=1}^{p} |d_{2k} - c_{mk}|^2} \\ \sqrt{\sum_{k=1}^{p} |d_{pk} - c_{1k}|^2} & \sqrt{\sum_{k=1}^{p} |d_{pk} - c_{2k}|^2} & \sqrt{\sum_{k=1}^{p} |d_{pk} - c_{mk}|^2} \end{bmatrix} = \begin{bmatrix} E_{11} & E_{12} & \dots & E_{1m} \\ E_{21} & E_{22} & \dots & E_{2m} \\ E_{p1} & E_{p2} & \dots & E_{pm} \end{bmatrix} \quad (10)$$

Among them, the normalized training sample Ci, I =1,2... M; Normalized sample, represents the Euclidean distance of the ith sample (di) and the JTH training sample (Cj).

the neuron of the mode layer Gaussian

(4) is activated. After the sample is normalized, the standard deviation σ =0.1 Gaussian function is usually taken. The initial probability matrix is (11) after activation.

$$P = \begin{bmatrix} e^{-\frac{E_{11}}{2\sigma^2}} & e^{-\frac{E_{12}}{2\sigma^2}} & \dots & e^{-\frac{E_{1m}}{2\sigma^2}} \\ e^{-\frac{E_{21}}{2\sigma^2}} & e^{-\frac{E_{22}}{2\sigma^2}} & \dots & e^{-\frac{E_{2m}}{2\sigma^2}} \\ \dots & \dots & \dots & \dots \\ e^{-\frac{E_{p1}}{2\sigma^2}} & e^{-\frac{E_{p2}}{2\sigma^2}} & \dots & e^{-\frac{E_{pm}}{2\sigma^2}} \end{bmatrix} = \begin{bmatrix} P_{11} & P_{12} & \dots & P_{1m} \\ P_{21} & P_{22} & \dots & P_{2m} \\ \dots & \dots & \dots & \dots \\ P_{q1} & P_{q2} & P_{q3} & P_{qm} \end{bmatrix} \quad (11)$$

(5) Suppose that the sample has m, and the samples can be divided into C classes, and the number of all samples is the same. The number of samples is K. Then we can get the initial probability and the formula of each sample belonging to all kinds of samples in the summation level of the network (10).

$$S = \begin{bmatrix} \sum_{l=1}^{k} P_{1l} & \sum_{l=k+1}^{2k} P_{1l} & \dots & \sum_{l=m-k+1}^{m} P_{1l} \\ \sum_{l=1}^{k} P_{1l} & \sum_{l=k+1}^{2k} P_{2l} & \dots & \sum_{l=m-k+1}^{m} P_{2l} \\ \dots & \dots & \dots & \dots \\ \sum_{l=1}^{k} P_{ql} & \sum_{l=k+1}^{2k} P_{ql} & \dots & \sum_{l=m-k+1}^{m} P_{ql} \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & \dots & S_{1c} \\ S_{21} & S_{22} & \dots & S_{2c} \\ \dots & \dots & \dots & \dots \\ S_{q1} & S_{q2} & \dots & S_{qc} \end{bmatrix} \quad (12)$$

(6) Calculation probability. The probability of the ith sample belongs to the Jth class.

$$prob_{ij} = \frac{S_{ij}}{\sum_{l=1}^{c} S_{ij}} \quad (13)$$

According to the value of probe ij, the classification is determined, the maximum value is "1", and the others are "0".

4. RESULT ANALYSIS

This experiment platform adopts the Intel Pentium CPU 3.2 GHZ, memory is 2 gb, OS for WINDOWS XP, MALTLAB 7

as the simulation software A electronics company personnel engaged in R&D work in Dongguan as the research object, from the selection of the company contains selected 20 R&D staff training and testing, due to the victory of the R&D personnel evaluation index system of $B_{ij}(i=1,j=1,2,\ldots,4), B_{2,1}, B_{2,2,}, B_{3,1}, B_{3,2}$ and $B_{4,i}$ $(i=1,2,\ldots 5)$ B_5 are unstructured data, which adopt the method of AHP to data processing [11-12], the weights respectively (0.028, 0.053, 0.028, 0.028, 0.053, 0.067, 0.142, 0.048, 0.195, 0.072, 0.102, 0.027, 0.047, 0.065), the results are shown in table 1. Then $B_{1,1}, B_{1,2,}\ldots$ All the indicators of $B_{4,5}$ and B_5 are taken as PNN input P_1, P_2, and..., $P_{1,4}$ for training and testing, the output node set 1, the output value to determine the personnel for the probability of R & D personnel. The larger the value that the qualified for R & D work, the duty is less than 0.5 and indicates that the personnel is not a qualified R & D personnel. So it will be a Dongguan electronics R&D staff before 1-15 as the test sample, the sample will be 16-20 samples as test samples, training to 15 times when it has reached the required accuracy of the results as shown in table 2 and table 3.

Table 1. Competency table for R&D staff in a company in Dongguan

NO	B_{11}	B_{12}	B_{13}	B_{14}	B_{21}	B_{22}	B_{31}	B_{32}	B_{41}	B_{42}	B_{43}	B_{44}	B_{45}	B_5	value
1	8	8	9	8	8	8	9	7	8	6	9	8	9	8	8.13
2	7	6	9	8	9	3	6	7	9	8	7	8	7	6	7.18
3	8	5	8	9	7	9	8	5	9	6	3	8	9	6	7.28
4	5	9	7	9	6	5	7	8	5	5	7	5	5	4	6.24
5	9	9	9	7	5	9	9	9	8	9	8	7	9	9	8.33
6	5	9	5	9	4	5	8	7	9	6	7	6	7	8	7.44
7	5	9	5	8	9	3	8	4	8	8	5	3	5	9	6.88
8	5	3	5	5	9	7	5	7	7	5	5	4	8	5	5.76
9	8	9	9	5	9	7	5	9	9	6	3	9	6	9	6.93
10	7	6	3	3	5	5	9	6	9	3	5	7	6	9	6.48
11	7	9	8	9	3	2	9	9	8	8	8	9	9	8	7.81
12	5	9	9	8	6	9	9	8	5	5	6	7	4	5	6.72
13	5	9	8	6	8	8	9	4	6	4	7	7	5	4	6.53
14	7	2	5	9	3	3	9	3	6	7	9	7	6	4	6.32
15	8	9	8	5	3	5	4	4	6	5	3	2	4	5	4.99
16	6	7	7	9	4	3	7	6	9	4	6	8	6	6	6.73
17	4	7	3	2	4	5	5	9	9	6	4	4	5	9	5.87
18	9	5	5	5	6	9	9	4	9	8	4	8	5	7	7.04
19	7	7	7	9	9	3	7	4	6	7	8	7	6	6	6.64
20	5	7	9	8	5	5	8	7	8	7	7	6	8	9	7.38

Table 2. The training result

Sample numbe	1	2	3	4	5
Sample number	0.814	0.717	0.728	0.625	0.831
PNN training value	0.813	0.718	0.728	0.624	0.833
error	0.12%	0.13%	0.13%	0.14%	0.12%
Sample numbe	6	7	8	9	10
Sample number	0.745	0.689	0.577	0.692	0.647
PNN training value	0.744	0.688	0.576	0.693	0.648
error	0.13%	0.15%	0.16%	0.15%	0.15%
Sample numbe	11	12	13	14	15
Sample number	0.780	0.672	0.652	0.633	0.501
PNN training value	0.781	0.672	0.653	0.632	0.499
error	0.13%	0.15%	0.16%	0.16%	0.4%

Table 3. The testing result

Sample number	16	17	18	19	20
Sample number	0.671	0.585	0.701	0.666	0.741
PNN training value	0.673	0.587	0.704	0.664	0.738
error	0.29%	0.34%	0.42%	0.30%	0.4%

That can be seen from the above experiments, the R&D personnel's competence evaluation model based on PNN in almost no time to build network training, so that greatly reduce the cost of enterprise R&D personnel to identify, at the same time can be seen from table 2 and table 3, PNN was used to construct the model of the error between the output data and the expectations are less than 0.5%, and it is accuracy of 99.5% or more. At the same time, the model in the form of probability to determine whether R&D personnel qualified for R&D work, conform to the people living habits, therefore. In this paper, based on PNN enterprise R&D personnel's competence evaluation model is feasible.

With the implementation of China's science and technology rejuvenating policy and the occurrence of "Zhongxing" lack of core events, the government has increased the investment of scientific research. R&D personnel are the important cornerstone of realizing the development of science and technology, and the core talents of colleges and universities of various big enterprises. Therefore, a large number of experiments show that the probabilistic neural network model

based on Bias's minimum risk and based Euclidean distance and variance are applied to the classification of R&D personnel based on the minimum risk, and based Euclidean distance and variance calculation, which will be more efficient and convenient than the traditional artificial and other classification methods.

5. CONCLUSIONS

In today's enterprise in the identification of the high cost of R&D personnel, time is too long. In this paper, based on PNN R&D personnel's competence evaluation model of enterprise solved the model with linear learning algorithm instead of the work done by nonlinear learning algorithm. At the same time, the advantage of this algorithm is to keep the high precision characteristics of the nonlinear learning algorithm, and only needs few network build time; Finally, the model is compared with traditional AHP model, and the results show that the model is effective. But there are two caveats to this model:

(1) The experimental data of this model are obtained through the AHP method. When the index changes, the model still obtains experimental samples from the AHP method.

(2) If the experiment of the sample or the sample dimension is overmuch that will greatly increase the complexity of the PNN network. At this time should be based on the sample clustering and the application of partial least squares method for dimension reduction method of PNN network optimization, this research was conducted in this paper.

REFERENCES

[1] McClelland DC. (1973). Testing for competence rather than for intelligence. American Psychologist 28: 1-14. https://doi.org/10.1037/h0034092

[2] Wang ZM. (2000). Management psychology. Beijing: People's Education Press 51: 112.

[3] Xu J, Li XY. (2012). An empirical study on the competency of top managers in private enterprises -- Based on the evaluation of factor analysis. Journal of Chang'an University (Social Science Edition) 14: 75-70.

[4] Zhao Y. (2008). Design of knowledge based employee pressure management mechanism based on competency model. Enterprise Economy 8: 42-45.

[5] Wang MJ. (2012). The competence of human resource professionals China enterprise structure and measurement of. Chinese Soft Science 11: 168-180.

[6] Xu F. (2003). Construction of R & D team competency model and its impact on team performance. Management Exploration 53: 34-39.

[7] Fang T. (2013). Based on combined analysis of Government R & D input performance optimization model. Science and technology management research 18: 49-52.

[8] Zhang ZH. (2013). R & D investment evaluation level of output, factor analysis and cluster analysis of regional comparison of. Science and Technology Management Research Based on the 4: 71-75.

[9] Jenssen R, Principe JC, Erdogmus D, Eltoft T. (2006). The Cauchy–Schwarz divergence and Parzen windowing: Connections to graph theory and Mercer kernels. Journal of the Franklin Institute 18: 614-629. https://doi.org/10.1016/j.jfranklin.2006.03.018

[10] Jiten P, Choi SK. (2012). Classification approach for reliability-based topology optimization using probabilistic neural networks. Structural and Multidisciplinary Optimization 40: 529-543. https://doi.org/10.1007/s00158-011-0711-2

[11] Feng C, Liang J. (2014). Solve the more general travelling salesman problem. AMSE Journals, Series Avances A 51: 9-23.

[12] Feng C, Liang J. (2014). The solution of the more general traveling salesman. AMSE Journals -Series: Advances A 51: 27-40.