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Research on Decision Analysis of Human Resources and Financial Management Based on Artificial Intelligence Technology

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Abstract
Artificial intelligence is a new technical science, which mainly researches and develops theories, methods, technologies and application systems for simulating, extending and expanding human intelligence. In this paper, "artificial intelligence" technology is adopted, and the technical framework of human resources recruitment system based on artificial intelligence is designed. By introducing the deep learning technology of "learning machine", the scientific analysis of massive data and the objective evaluation of candidates are realized. At the same time, based on the financial management theory and enterprise early warning theory, tracking the cutting-edge theories, methods and technologies in the fields of artificial intelligence, data mining and group decision-making, and adopting the interdisciplinary comprehensive research methods of combining quantitative and qualitative, normative and empirical, machine learning and expert experience, the intelligent decision-making method system of enterprise financial crisis early warning is systematically studied.
Keywords: Artificial intelligence; Human resources; financial management

1.Introduction

Artificial intelligence technology is one of the top high-tech technologies in the world at the present stage, which is deeply concerned by different countries and vigorously studied. Some countries use artificial intelligence machines instead of domestic service, while some developed countries strive to use artificial intelligence technology to cope with wars and replace their own soldiers to reduce national casualties [1]. In this context, on the one hand, the growth of enterprises needs to fully rely on "people", which requires enterprises not only to manage human resources in the traditional sense, but also to transform into new strategic human resources management, that is, comprehensive information-based human resources management or electronic human resources management [2]. On the other hand, with the advent of the era of big data, the development of new technologies such as data mining and artificial intelligence has created a situation in which enterprises who master data first and extract useful information first can be ahead of other competitors in the industry.

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Artificial intelligence has become an extensive interdisciplinary and frontier science. As the core driving force of industrial transformation in the era of big data, artificial intelligence technology has gradually integrated into all walks of life [3-4]. At present, for the business model and management system of enterprises, the active use of artificial intelligence technology makes the additional costs of enterprises in the process of human resource management gradually reduce, thus maximizing the comprehensive strength and core competitiveness of enterprises. With the development of big data, cloud computing, intelligent robot, VR and neural network technology, "artificial intelligence" has entered the real world and played an increasingly important role [5]. Knowledge-based human resources are the driving force of social progress and development. As the main organization of society, how to use a knowledge-based intelligent system to manage knowledgeable employees in enterprises and institutions has become an important research topic.

Artificial intelligence is the information simulation of people's thinking process, which profoundly affects the traditional management mode, promotes the upgrading of financial information technology and drives the innovation of financial

management. Based on the relevant research and theory of artificial intelligence technology, this research designs and develops the corresponding modules based on the cloud computing human resources internet service platform, and finally realizes the computerized human resources and financial management decision support system.

2. Literature review

2.1 Overseas

Lopes et al. [6] think that when an enterprise goes bankrupt, defaults on preferred stock dividends, is unable to repay debts, and overdrafts bank deposits, it is a financial crisis. Altman(1968) regarded the enterprises entering the legal bankruptcy procedure as financial crisis enterprises. Boulanger et al. [7] think that there is an inevitable connection between the human resource management strategy and the business strategy of enterprises. In order to achieve the business objectives of enterprises, we must attach importance to human resource management. He pointed out that human resources should be allocated according to the development strategy of the enterprise, and the external environment and internal environment of the enterprise should be combined. Alejandro et al. [8] analyzed the human resources management status of a bank in India over the years, such as talent recruitment, training and incentives, and concluded that whether human resources are subject to science or not has an inevitable impact on the operation of the bank. The financial crisis defined by Ababneh et al. [9] includes negative net asset value, inability to repay creditors' debts, overdraft of bank deposits, inability to pay preferred stock dividends, delay in payment of goods, delay in payment of due interest and principal, etc.

2.2 Domestic

Zhao Yixuan and others [10] think that the talent problem is a major problem in the operation of city commercial banks. If city commercial banks want to seek development, it is the key to implement the talent strategy. Wang Jing [11] thinks that the development of human resources management of banks is conducive to promoting the improvement of their management level, the realization of their development goals, and ultimately the promotion of their core competitiveness and their survival and development in financial institutions. Xiao Yufang [12] believes that technical failure means that the total assets of an enterprise are greater than the total liabilities, but the enterprise cannot pay off the debts due to its unreasonable financial situation; Bankruptcy means that the total assets of an enterprise are less than the total liabilities, that is, the accounting bankruptcy that is insolvent. Zhao Shaoling [13] divides the financial crisis into two stages: financial distress and financial bankruptcy, and thinks that financial distress is a dynamic and continuous process and state. It is not a temporary state, but has the characteristics of continuity and regularity, which can neither be formed nor subsided in a day or two. It needs to be repaid by reducing production capacity, that is, enterprises need to realize long-term assets.

3.Research technique

3.1 Decision analysis of human resource management

3.1.1 Overall framework of human resource intelligent system based on WEB

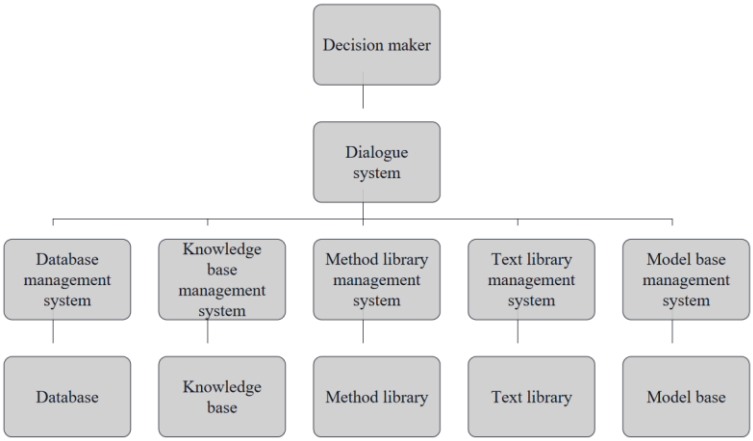

Figure 1 The frame structure of IHRMS

Group companies generally need to conduct various management activities across regions or national borders, and must use Internet/, Intranet and other resources. In order to meet the human resources management needs of group companies, IHRMS uses physical media such as Internet/ Intranet to manage human resources in different places and obtain human resources information inside and outside the organization in real time. IHRMS database intelligent management system is a six-database system consisting of six sub-databases: database and its management system, model base and its management system, dialogue system, knowledge base system, method base and text base [14-15]. The framework structure of IHRMS is shown in Figure 1.

3.1.2 Design of subsystems and functional modules

In order to fully realize the functions of the human resource planning system, we divide the system into three subsystems according to the ideas before, during and after the planning work, which correspond to the investigation preparation subsystem, the planning prediction subsystem and the planning formulation, implementation and evaluation subsystem. As shown in fig. 2.

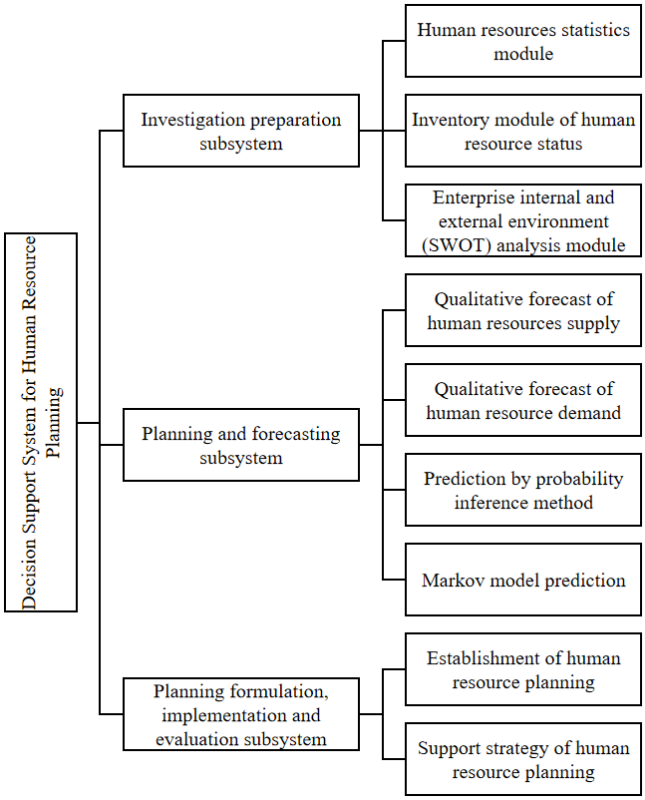

Figure 2 Human resource planning subsystem and functional module design

(1) investigation preparation subsystem. Be responsible for managing the preliminary investigation and preparation of human resources planning, including three modules: human resources statistics, human resources inventory and SWOT analysis.

(2) Planning and forecasting subsystem. This is the core part of the whole human resources planning system, which is responsible for forecasting the supply and demand of human resources, including seven modules: qualitative forecasting of human resources supply, qualitative forecasting of human resources demand, simple forecasting, probability inference forecasting, trend extrapolation forecasting, queuing theory forecasting and Markov model pre-testing.

(3) Planning formulation, implementation and evaluation subsystem. It is used for post-decision work such as formulation, implementation and evaluation of enterprise human resource planning, including two modules: formulation of human resource planning and support strategy of human resource planning.

3.1.3 Using learning machine to control "intelligent screening system" to complete resume screening

Candidates input their relevant information from the system according to the resume template, and these massive resume data are stored in the resume data pool. Because of the huge number of resumes and more personalized content, efficient screening is needed. The learning machine technology based on neural network is adopted in this system [16]. Automatic screening of resumes needs to establish a standard, which is the established post model. The learning machine commands the intelligent screening system to complete the matching between resumes and posts, and imports qualified resumes into the "qualified resume pool" according to the set threshold. The system adopts artificial neural network technology (i.e., BP).

With the help of the learning machine, the intelligent screening system can obtain qualified resumes from the resume data pool by deeply analyzing the basic conditions, basic skills and personal personality of candidates. The system adopts BP neural network and deep learning algorithm, which firstly obtains massive data from resume information resource pool, and then establishes constraint equation based on post matching model to judge whether each index is within the set threshold range, especially subjective index [17]. Combined with manual intervention, CNN is used to complete deep learning. After learning, the convolution value is fed back, and the weighting parameters, threshold weights and control parameters are adjusted by this feedback to complete the final learning process and training process, as shown in Figure 3.

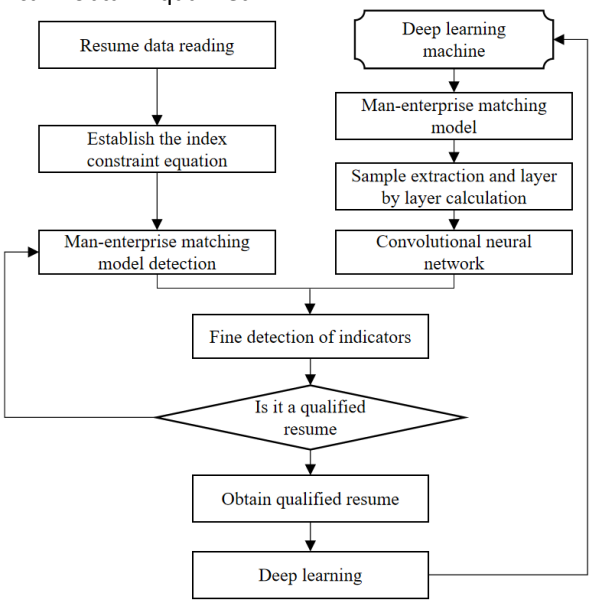

Figure 3 Technical framework of resume screening based on "deep learning".

3.1.4 Weight model of department contribution degree based on neural network

The connection within an organization is equivalent to the structure of neural network. It can be assumed that a department is a cell body, and the contribution degree of posts or subordinate departments under the department is dendrite, while the contribution degree of the department to its superior department is axon, so that a neuron model can be constructed.

Dendritic contribution weight threshold [18]:

$$W = \left(w_0, w_1, \cdots, w_n\right)^T$$
$$X = \left(x_0, x_1, \cdots, x_n\right)^T \quad (1)$$

The output contribution of contribution neurons is:

$$net = \sum_{i=1}^{n} w_i x_i \quad (2)$$

Because the current organization still follows the hierarchical structure of bureaucracy, and because of the prosperity of learning organization team and flat organization ideological trend, the organization generally tends to adopt three to four management levels, so we build a three-layer feedforward neural network model for the contribution of the organization, and each point represents a department of the organization, such as formula (3):

$$w_{ij}=(t+1)=w_{ij}(t)+\Delta w_{ij}(t) \quad (3)$$

The contribution weight of each node in each layer to all nodes in the previous layer must satisfy the following formula(4) [4]:

$$\sum_{i=1}^{n} w_{ij}(t)=1 \quad (4)$$

In this formula, i represents the node $(i=1,2,\cdots,n)$ of each layer, j represents the node $(j=1,2,\cdots,k)$ of the upper layer, and $w_{ij}(t)$ represents the contribution weight function of t in a certain period.

The algorithm of organizational contribution model based on neural network is as follows:

(1)Establish the evaluation matrix E_1 of the department's contribution to all departments at the previous level;

(2)Calculate the contribution weight $w_{ij}(t)$ of this department to all departments at the previous level;

(3)Calculate the total salary distribution share $T_m(t)$ of each department.

The model only considers the evaluation of the contribution of lower-level departments to higher-level departments, but does not consider the evaluation of the contribution of lower-level departments to higher-level departments and the evaluation of the contribution between departments at the same level. The latter two need to build a neural network model of feedback connection between the front layer and the same layer and the front layer, which is not discussed in this paper.

3.2 Financial management decision analysis

3.2.1 Architecture design of financial management decision system

This topic applies data warehouse and data mining technology, and adopts relational database to store huge business data, which enhances the expansion ability of the system for large data management [20]. The system also constructs a variety of mining models, which can automatically analyze the data, discover the internal relations among the data, and discover the models that play an important role in forecasting and decision-making, so as to establish new business models and help decision-makers to formulate targeted market strategies and make scientific decisions.

This system adopts B/S three-tier architecture, including data acquisition layer, data storage organization layer and data analysis display layer. As shown in Figure 4.

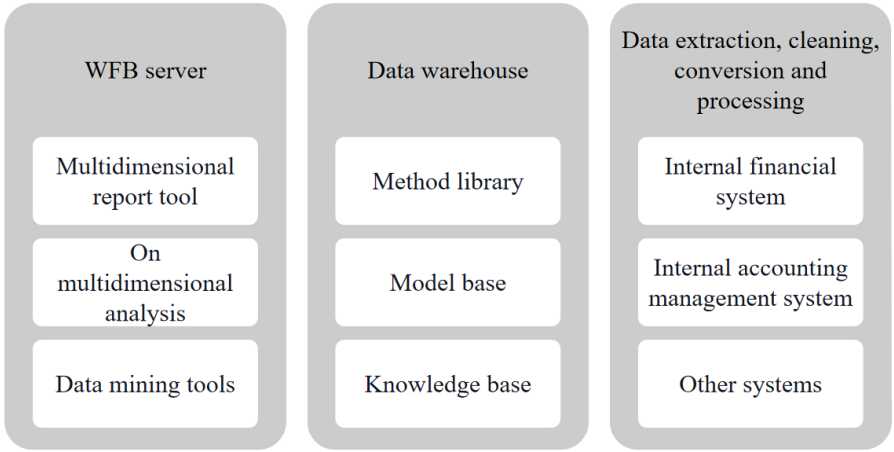

Figure 4 System structure of intelligent financial decision system

The system structure includes three subjects. One is the model base and database system, which is the foundation of decision support system and provides quantitative analysis auxiliary information for decision-making; The second is data warehouse and OLAP, which extracts information that can reflect the intrinsic nature of data from data warehouse; The third is data mining and expert system, in which the mining results are stored in the knowledge base of expert system, and knowledge reasoning is used to assist decision-making.

3.2.2 Real-time monitoring of individual financial indicators

At present, the basic consensus of the mainstream research methods of financial crisis early warning is that before the financial crisis occurs, the financial indicators of enterprises often show some signs of crisis. Through the comprehensive evaluation

of these financial indicators, the operating rules of enterprises can be deeply revealed to achieve the purpose of predicting financial crisis [21-22]. Finding the source of alarm is the starting point of the early warning process, and it is a qualitative factor analysis of the source of alarm. Analysis of warning signs is the key link in the early warning process, and it is also an analysis of the external performance in the process of police source evolving into police situation. There are two main methods of pre-alarm degree: one is to establish a common model of alarm situation, make a prediction first, and then transform it into alarm degree according to the alarm limit; The second is to establish a warning degree model, and predict the warning degree directly from the warning signs.

As a functional branch of enterprise early warning, financial crisis early warning should be guided by the theoretical framework of enterprise early warning and combined with the specific characteristics of financial crisis to construct the corresponding financial crisis early warning theoretical system. On the basis of the traditional yellow warning method, financial crisis early warning research should pay attention to the construction of modern early warning system, and take financial crisis prediction and financial crisis possibility evaluation as the core content of financial crisis early warning research.

The real-time monitoring of individual financial indicators is based on the basic premise that the enterprise information technology platform is mature and can process, process and report financial accounting information in real time. Using computer technology can realize the automatic alarm at this level, so that the management authorities can take corresponding control measures in time when the financial situation is locally abnormal.

(1) Standardized coefficient of financial indicators

Let I_i be the actual value of a financial indicator, and $\left[I_i^L, I_i^U\right]$ be the ideal interval of the financial indicator determined by a specific enterprise, and define the financial indicator standardization coefficient ρ_i as shown in Formula (5).

$$\rho_i = \begin{cases} \dfrac{I_i - I_i^U}{\left(I_i^L + I_i^U\right)/2} & I_i > I_i^U \\ 0 \quad I_i^L \le I_i \le I_i^U \\ \dfrac{I_i - I_i^L}{\left(I_i^L + I_i^U\right)/2} & I_i > I_i^L \end{cases} \tag{5}$$

When $\rho_i > 0$, it shows that the financial index is in a positive imbalance state; When $\rho_i < 0$, it shows that the financial index is in a negative imbalance state; When $\rho_i = 0$ is used, it means that the financial index is in a certain equilibrium state within the established ideal range. If only the standardized coefficient of financial indicators is 0 as the standard, real-time monitoring and alarming of individual financial indicators can send out warning messages when financial indicators deviate from the ideal interval, but enterprise decision makers will not be able to intuitively obtain relevant information on the degree of deviation of financial indicators from the ideal interval. Therefore, it is necessary to further define the concept of financial index vigilance.

(2) Vigilance of financial indicators

Let ρ_i^+ and ρ_i^- represent the upper and lower critical values of the standardized coefficient ρ_i of financial indicators, that is, the upper and lower limits of the allowable deviation of the actual value of financial indicators from the ideal interval, and define the vigilance degree Deg of financial indicators as shown in formula (6) [23]. When the standardization coefficient of financial indicators takes different values, the corresponding relationship between the values of financial indicator vigilance is shown in Table 1.

$$Deg = \begin{cases} \dfrac{|\rho_i|}{\rho_i^+} & \rho_i > 0 \\ 0 \quad \rho_i = 0 \\ \dfrac{|\rho_i|}{\rho_i^-} & \rho_i < 0 \end{cases} \tag{6}$$

Table 1 Corresponding relationship between standardization coefficient and vigilance degree of financial indicators

The value range of ρ_i	The value range of Deg
$\rho_i > \rho_i^+$	$Deg > 1$
$\rho_i = \rho_i^+$	$Deg = 1$
$0 < \rho_i < \rho_i^+$	$0 < Deg < 1$
$\rho_i = 0$	$Deg = 0$
$\rho_i^- < \rho_i < 0$	$-1 < Deg < 0$
$\rho_i = \rho_i^-$	$Deg = -1$
$\rho_i < \rho_i^-$	$Deg < -1$

(3) Monitoring chart of financial indicators

According to the different values of financial indicator alert degree, the financial indicator status interval is divided into three areas [24]: green safety line, advanced warning line, critical warning line, yellow warning area, orange warning area and red unbalanced area, as shown in Figure 5.

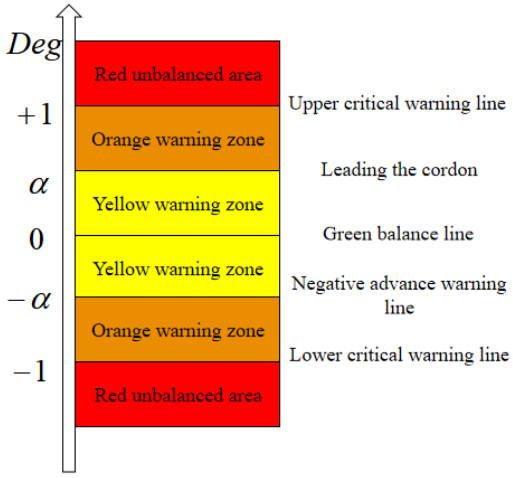

Figure 5 Monitoring chart of financial indicators

On the basis of the upper and lower critical warning lines, the reason for increasing the positive and negative advance warning lines is that if the warning degree of financial indicators is separated from the green balance line, only the upper and lower critical warning lines are used to divide the warning area and the unbalanced area, it is likely that the financial indicators will be close to the serious unbalanced state when the alarm is issued. When the alert degree of financial indicators deviates from the green balance line and has not yet reached the positive and negative advance warning line, a yellow alarm is issued; When the alert degree of financial indicators exceeds the positive and negative warning lines and has not yet reached the upper and lower critical warning lines, an orange alarm will be issued; When the alert degree of financial indicators exceeds the upper and lower critical warning lines, a red alert will be issued.

Enterprise cash forecast based on neural network technology

Cash forecast refers to the use of cash budget means, combined with the past cash flow situation of enterprises, comprehensive factors that have an impact on cash flow and their weights, to predict and measure the future cash inflow and outflow situation of enterprises. With the country's shift of enterprise policy, enterprises are increasingly facing the situa-

ion of self-financing demand and market risk. Therefore, cash management has become an important content of enterprise financial management, and the forecast of future cash demand often serves as the starting point of cash management, which is related to the financing decision taken by enterprises in the future.

The intelligent data analysis process based on neural network is divided into six stages: preprocessing of sample data, structure design of BP neural network, transfer function and function training, rule extraction and evaluation, and system application. Taking capital demand as an example, the process of realizing demand forecast by enterprise financial intelligent decision support system is as follows:

(1) Pretreatment of training sample data.

Good data foundation is a necessary condition for data mining, and correct, non-redundant and meaningful data is the working goal of data preparation. In addition to the necessary data preprocessing such as cleaning and transformation before loading the data into the data warehouse, it is also necessary to select, define, associate and represent the mined data to make it adapt to the neural network.

(2) Structure design of BP neural network.

The structure design of BP neural network mainly includes the determination of the number of nodes in input layer and output layer, the number of hidden layers and the number of nodes in each hidden layer.

Most general neural networks have predetermined network layers, while BP networks can contain different hidden layers. For multilayer BP neural network, the number of hidden layers is at least one layer or more, and the number of neurons in each hidden layer is at least one or more, otherwise it contradicts the proposition of multilayer network. According to experience, the number of nodes in hidden layer can be designed with reference to the following formula:

Where n is the number of hidden layer nodes; n_i is the number of input nodes; n_0 is the number of output nodes; a is a constant between 1 and 10. Gradually change the number of nodes, train with the same sample set, try and compare constantly, and determine the corresponding number of hidden layer nodes when the network error is the smallest.

(3) Transfer function and function training.

Sigmoid function is often used as the transfer function in BP network, and pure linear function may be used in some special cases. The transfer function of BP neural network is taken as sigmoid function, that is $f(x)=1/(1+e-x)$. After the completion of the network design, the design value should be used to repeatedly run forward for all samples and modify the weights in reverse, so as to achieve the goal of the correction function itself.

(4) Rule extraction and evaluation.

According to different design ideas, rule extraction methods can be roughly divided into two categories. One is neural network rule extraction method based on structural analysis. The other is a neural network rule extraction method based on performance analysis.

(5) System application

The trained neural network is used in the system as a data mining method. Neural network is a common method in data mining application. The advantage of this algorithm is that it can predict complex problems well, and it can bear noise data well. In the enterprise financial intelligence decision support system, this algorithm can be used to effectively solve some complicated financial forecasting problems with many related factors in groups and scientific research institutions.

Analysis and research of financial early warning

Financial performance analysis and performance evaluation are the core of financial data analysis. An important indicator of enterprise financial management is the annual financial budget of the company, which runs through the whole financial accounting activities [25]. Combined with practical problems, ID3 algorithm and its improved algorithm are tested, and C5. 0 algorithm is proposed to analyze the implementation progress of enterprise financial budget early warning, and various financial budgets are classified according to the financial budget data over the years, and data mining and early warning systems are designed to correspond to them. First of all, the design and utilization of financial budget early warning analysis system based on C5. 0 algorithm and the design of early warning analysis of enterprise financial budget execution progress are new problems, which are very innovative for the subject research.

Fig. 6 is the theoretical design framework of early warning analysis, in which the data warehouse includes basic information of each department, department name, project name, project opening

balance, temporary payment opening balance, opening balance, budget income, temporary payment loan, temporary payment repayment, net income, net expenditure, other income, project balance, temporary payment balance and project balance.

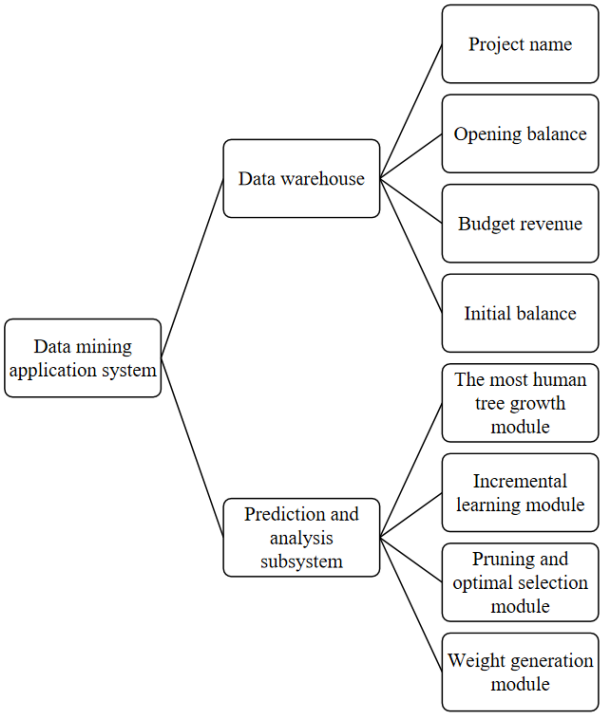

Figure 6 General architecture of early warning analysis system

The most important step and core part of data warehouse is to design the data model. The process of building data warehouse model is to complete the transformation from relational and standardized data model to multidimensional model. Fig. 7 is a three-tier model design.

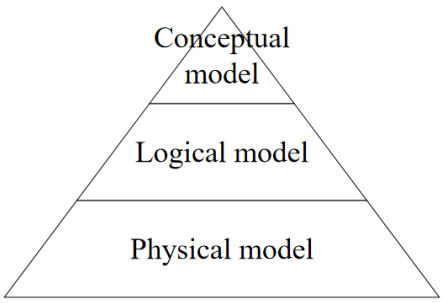

Figure 7 Three-tier model design

Data warehouse should analyze data from many aspects, such as unit, time and budget index. The main design contents of thematic analysis of financial budget implementation progress are the granularity of logical model design, the correct division of data table, the reasonable definition of relational model and the refinement of data in table. The main goal of physical model design is mainly the form of data storage and data organization in data warehouse. The relational database is the main body of the data warehouse, and the database manages the data storage. Therefore, the physical model design is a physical database process. There are data structure storage, data storage location, index strategy and data storage allocation in the construction process.

4. Analysis and discussion

The purpose of changing the input data source into a test set is to test the accuracy of the prediction result of decision tree, and to use the generated decision tree model to predict and test whether the prediction result of the model is the same as the true value. A decision tree is constructed by using some data in the data source, and then the tree is used to judge the data of the remaining 58 project budgets in the data source. The results show that the decision tree judgment results of 54 project budgets are the same as the actual results, while the decision tree judgment results of 4 project budgets are different from the actual results. Thirdly, by checking some data, it is found that this decision tree has certain

judgment function and can be applied in practical work. Table 2 Accuracy of decision tree model.

Table 2 Accuracy of decision tree model

Correct	54	93.1%
Mistake	4	6.9%
Amount to	58	

The training accuracy and corresponding mean, variance and dispersion coefficient of each single classifier and three multi-classifier combination financial crisis prediction methods on five experimental data sets are listed in Table 3.

Table 3 Experimental results of training samples combined with multiple classifiers

Data set	MDA	Logit	NNs	DT	SVM	Connect in a parallel	Series	Mix
1	88.36	83.33	87.21	89.21	87.52	91.25	90.24	88.36
2	82.01	85.82	86.93	84.15	84.39	90.33	89.39	89.21
3	89.21	88.34	83.25	86.03	88.25	93.74	89.27	90.01
4	85.63	83.69	87.21	82.63	89.61	92.01	91.24	89.27
5	87.41	87.59	88.20	85.99	84.28	91.17	90.55	91.57

The multi-classifier parallel combination financial crisis prediction method achieves the highest training accuracy on all other experimental data sets. In addition, the parallel combination method of multiple classifiers has the highest average training accuracy on five experimental data sets. SVM not only trains the first basic classifier in the series combination system of samples, but also occupies two positions, so it plays a leading role in the series combination results. In addition, although the average training accuracy of hybrid combination method is lower than that of parallel combination method, it is still higher than that of any single classifier method and series combination method.

There are two main parameters to be determined in the financial crisis prediction method of k nearest neighbor cases by similarity weighted voting: the environmental parameter b when calculating the grey correlation degree and the threshold percentage p when determining the k nearest neighbor case set. In order to determine satisfactory parameter values, grid search technology is adopted, with parameter b according to the sequence [0.1:0.03:1] and parameter p according to the sequence [0.5:0.02:1], and the accuracy corresponding to each pair of possible parameter values is circularly calculated, and the parameter value corresponding to the highest accuracy is taken as the final parameter value. Take the values of the two parameters corresponding to the highest accuracy rate for the annual data to construct the scatter chart, as shown in Figure 8 and Figure 9.

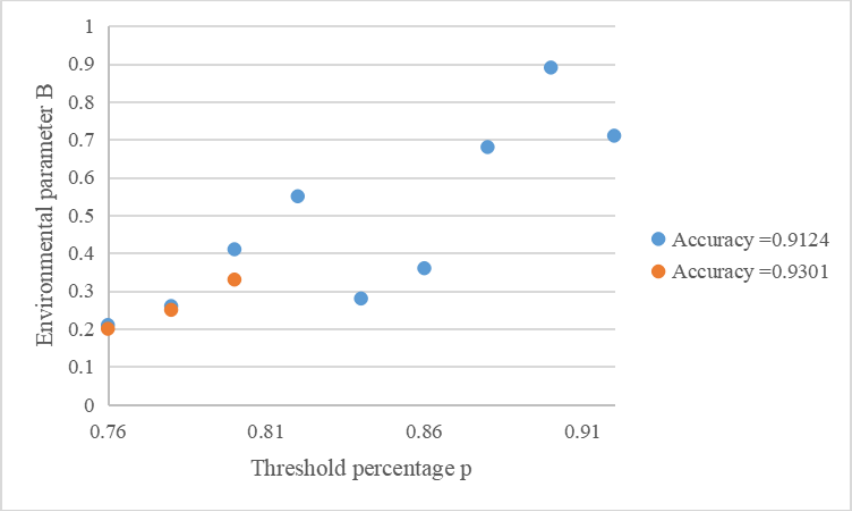

Figure 8 Scatter diagram of grid search environment parameters and similarity threshold percentage in $(t-1)$ year

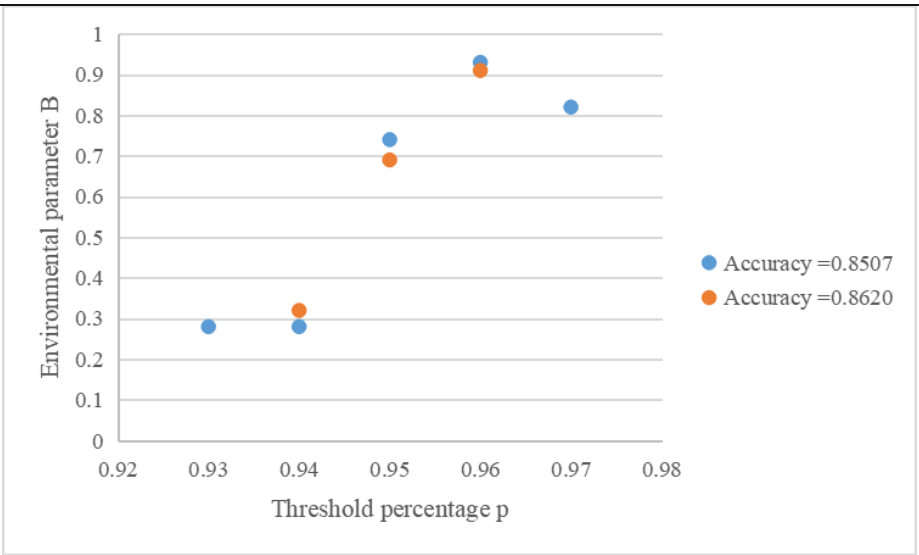

Figure 9 Scatter diagram of grid search environment parameters and similarity threshold percentage in $(t-2)$ year

As shown in figs. 8 to 9. It can be seen that the empirical range of the optimal value of b is relatively large, and it is possible between [0.2,1]; The empirical range of the optimal value of p is relatively concentrated, mainly distributed between [0.6,1]. This shows that the similarity weighted voting combination k nearest neighbor case financial crisis prediction method has a good discrimination ability for enterprises that may break out of financial crisis within two years, and its effect is obviously better than other methods; For enterprises that may break out of financial crisis in more than two years, their discrimination ability is inferior to that of traditional statistical methods and SVM. Therefore, the similarity weighted voting combination k nearest neighbor case financial crisis prediction method is more suitable for short-term prediction of enterprise financial crisis.

5. Conclusion

The development and application of artificial intelligence has changed from quantitative change to qualitative change, driving the innovation of business rules, the reform of financial management concepts and the upgrading of financial management models. With the maturity and wide application of artificial intelligence technology, great changes will take place in the financial field. China's state-owned enterprises should keep up with the pace of the times and take advantage of their own advantages to accelerate the informationization, digitalization and intelligence of financial management. In order to meet the management requirements of organizations for knowledgeable employees, this paper studies the human resource intelligent system by using the theories of neural network, artificial intelligence and decision-making technology, puts forward an architecture of knowledge-based human resource intelligent system (IHRMS), deeply analyzes the system functions, and focuses on the construction of the system model. In order to provide scientific decision-making for the high-quality development of enterprise human resources management. Ensure that the financial subject can develop well, realize the sustainable economic development goal of the enterprise, and provide the maximum benefit value for the stakeholders.

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