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Equipment trust and rental problem risk pre-warning model based on modular combined improved BP neural network

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ABSTRACT

Equipment paid hosting and leasing is an important service's modern service industry, Aiming at the faults occurring currently, individual equipment idle, areas of demand, leasing scheduling unreasonable. Combined paid hosting and leasing risk management sample data and fuzzy neural network, confirmed input and output vector of network according to the improve BP network and diagnosed the fault of paid hosting and leasing risk management. The diagnosis is consistent with the reality. Use MATLAB to simulate neural network fault diagnosis and the simulation results show that the diagnosis error is small, output vector and the actual fault matrix results are approximate. It have great application value for the judge paid hosting and lease management risk, analyse paid hosting and lease management risk main origin, proposed enterprise avoid paid hosting and lease management risk.

KEYWORDS

Equipment trust; Rental; Improve BP algorithm; Fault diagnosis; Neural network; Early warning model.

INTRODUCTION

The equipment collocation with payment and leasing is an important modern service business. For the requirement of the mining service, there exists many phenomena such as, leaving the equipment unused, controlling, allocation and lease dispersing in certain area, and meanwhile no returning the equipment in time, obstructing the equipment controlling and the advanced defaulting of the leasing company, which must lead to the risk of operating and producing for manufacturing technique in the coalmine production.

Up to now, so many scholars abroad and at home have studied it and obtained some research results, which has an important role in directing efficiency of the equipment leaseing with payment and improving the level of leasing regulation. But generally speaking, most of those results are based on qualitative to study the connotation, harm and protection measures of collocation and leasing regulation, not considering the risks of those from the view of quantitive. In addition, due to the influence of those facters such as the complication of management processing of the equipment collocation and leasing and outer facters, obstacaling the prediction of risks. At the same time, there exists the uncertainties and ambiguity to predict the risk of the regulation system. Thus, It has the theoty significances and pratical values to use the arithmetic of Artificial Nuerul Network and Combined Improved BP for predicting the risk of eqiupment collocation and leasing.

COMBINED FEASIBILITY IMPROVED NEURAL NETWORK TO PREDICT RISK

The combined improved BP network is introduced into the risk prediction research, comeing up with a kind of concept that In approximation, classification ability, learning speed is superior to the BP neural network of radial basis function (RBF) neural network and the concept of combination forecast. By using BP network prediction, we need to design a large number of hidden layer nodes, the hidden layer nodes and input vector to achieve required accuracy. This method can't reflect the same risk class relationship between the input vector, the falling rate of risk prediction. This method can't reflect the same risk class relationship between the input vector, the falling rate of risk prediction. Aiming at these problems, to improve the training and structure, when determining the number of hidden layer nodes and the center, for each risk types, respectively, the mean clustering method is used to training, at the same time make the terminating distance increases, such guarantee each determine the input vector of the hidden layer nodes is the same fault types of data. According to various risks in the equipment management and lease paid hosting type gathered in the feature space form, incorporating some close to the risk type first temporarily for a transitional categories, using the combination of neural network from coarse to fine, progressive elaboration of transition type. Area in our country the development of equipment management and lease paid hosting relatively short, the basic management level information incomplete, most enterprises have not yet set up scientific statistical system, continuous enterprise management, which makes originally started relatively late risk early warning research encounter obstacles, and combined improved neural network is adopted to improve the management risk early warning research provides the opportunity.

IMPROVED BP NETWORK AND ALGORITHM IMPLEMENTATION

BP neural network

Artificial neural network is to simulate biological neural network to carry out a mathematical model of information processing, characterized by a highly parallel distributed processing, nonlinear processing ability, fault tolerance, self-learning ability, and convenient for hardware implementation, etc. BP neural network, namely the multilayer feedforward back propagation neural network, is one of the artificial neural network that currently the most widely used and the success,and It can be achieved from input to output arbitrary complex nonlinear mapping relationship, and has good generalization ability.

BP nuerul network consists of input layer, output layer as well as some hidden layers,and some notes making up one layer. Each note stands for one nuerul cell. The neighbor nuerul cell connecte by weight with the most basic BP network is the three feedforward network. As expressed in picture1,the study processing of BP nuerul network is made up of forward-propagating processing and counter-propagating processing. We can obtain the stable network structure and connection weight through the iterative of BP network, after which we can predict the unknown samples.
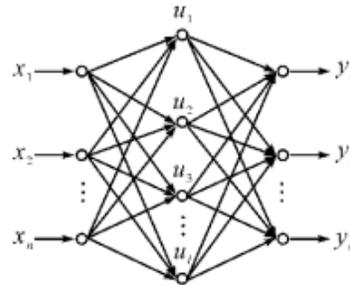

Figure 1 : Schematic diagram of neural network

Improved BP neural network algorithm

In the process of practical application, the traditional BP learning algorithm anti-interference ability is poor, learning rate is slow, the objective function and easy to fall into local minimum value problem, to solve these problems, and researchers proposed batch learning method, additional momentum method and adaptive adjustment of parameters and Levenberg - Marquardt method improved learning algorithm, etc. Compared with other improved algorithm, convergence of Levenberg-Marquardt when the number of network weights is small very quickly,and compared with the traditional BP and its improved algorithm, fewer iteration times and fast convergence speed and high accuracy. Levenberg - Marquardt algorithm basic idea is to make each iteration is no longer along the negative gradient direction of a single, but permissible error along the direction of the deterioration for the search At the same time through the steepest gradient descent method and adaptive adjustment between gauss - Newton method to optimize the weights of network, network convergence effectively, greatly improving the network convergence speed and ability.

Based on the fault diagnosis algorithm of BP nuerul network, in order to avoid suffering from the partial minimum and even the divergency, we needs to accelerate the calculating speed of the system risk evaluation and to improve the accuracy of the evaluation. The description for that as follows:

The first period,training and design of predicting sample sets

(1)accoding to the information parameter of network risk to design the sample sets.

(2)divided the sample sets into two parts: N samples consisting of the training sample sets and M samples consisting of test sample sets.

The second period, construct and train the BP nuerul network

(3)using the statistics gathered to design three layers of BP nuerul network. The input layer including n nodes and the hidden layers including I nodes, the output including m nodes. The number of the nodes in the hidden layers is determined by cut-and-trial based on the experienced formula.

(5)to set the transmission function,training function,performance function convergence error learning rate and the parameters such as the starting value and threshold value connecting the nuerul cell and weight. In this essay, the training function refers to the train function which adopts the L-M.

(6)train the BP network by using training sample sets until to obtain the net weight and expected the accuracy of error.

(7) to inspect the training results of the trained BPnerwork through the test sample sets to see if we achieve the requirement expected.

The third period,to analyze the risk of the unknown the samples

(8)put the unknown samples into the trained and advanced BPnetwork and get the risk analyzing results.

EQUIPMENT HOSTING AND RENTAL RISK EARLY WARNING INDEX SYSTEM

Equipment in the process of hosting and rental of the risk of very much, through to the rental information collection and daily risk sample analysis, equipment hosting and rental of the main risk can be divided into two classes: The One belongs to the paid hosting service risk, the main representation is hosting equipment management risk S1, logistics scheduling management risk S2, management risk, logistics scheduling management S3; Another belongs to the leasing business risk, is the main characterization of cost risk management S4, customer management risk S5, contract management risk S6. Above as an input parameter and 6 neurons in input layer; Number of output layer neurons is set by the state of risk management and they are : A is normal, B is low risk pressure, C is risk of pressure medium; D is risk of high pressure; E is risk of highest pressure. The output result : (1, 0, 0, 0, 0) is the kind of A; (0, 1, 0, 0, 0) is the kind of B; (0, 0, 1, 0, 0) is the kind of C; (0, 0, 0, 1, 0) is the kind of D; (0, 0, 0, 0, 1) is the kind of E.

TABLE 1 : Equipment paid hosting and leasing early warning system

	classification	Index		classification	Index
1	Managed device management risk	X1 Equipment dynamic security risk management; X2 Equipment installation disassembly process management risk; X3 Idle equipment risk management; X4 Managed device management risk	2	Logistics scheduling management risk	X5 Equipment scheduling management risk; X6 Transportation scheduling management risk; X7 Remove the installation professionals to manage risk
3	Money management risk	X8 Financing lease management risk; X9 Equipment purchase fund management risk;X10 Lease management risk;X11 Service charge management risk	4	Cost risk management	X12 Transportation cost risk management; X13 Professional team cost management risk;X14 Risk management cost
5	Customer management risk	X15 Lease enterprise information management risk; X16 Contract risk management; X17 Customer credit risk management	6	Contract management risk	X18 Documents management risk; X19 Cost risk management; X20 Accounts receivable risk management; X21 Settlement risk management

BASED ON THE COMBINED IMPROVED BP NETWORK RISK EARLY WARNING MODEL BUILDING

Due to hosting and rental risk prediction of characteristic parameter, caused the network structure is too big, make the network training time is long, can't even training, caused the low classification accuracy problem will affect the trust and leasing process parameters are classified, the inhomogeneity parameter respectively using improved BP network was trained and predicted results are combined in the multiple networks.

According to the analysis, the hosting and rental risk characteristic parameter space is divided into two subspaces: paid hosting services, leasing business risk, the output space has 5 kinds. Of the two sub networks respectively by MATLAB software simulation, determine the structure of each network, paid hosting service risk parameters in the network, the input layer number is 3. The output layer is 5, number of hidden layer based on BP algorithm, using test and comparison method, starting from the 3 training, through to the network training, repeatedly to determine the number of hidden layer for 16 high convergence speed and precision, so the child network structure of 3 * 16 * 5. Subnet leasing business risk parameters, the input layer 3, the output layer is 5, number of hidden layer from 3 began training, get the number of hidden layer for 12 convergence speed and accuracy is best, so the child network structure of 3 * 12 * 5.

The above two children after the network training, get the output results of the two sub networks and the results of two sub networks diagnosis are combined, in an effort to simplify the calculation, the diagnosis and expert experience based on the characteristics of risk, adopts the method of undetermined coefficients determined combination formula is as follows:

$$y = \frac{23}{35} y_1 + \frac{12}{35} y_2$$

Above, y1, y2 is the output of the two sub networks; Y is the output of the entire network, in this way the complex network programming simple network, different network processing different signs

low dimensional space to get their diagnosis, improve the network training speed, solve the network is too big and cause a variety of adverse factors. Training will be 20 groups of experimental data obtained by test, each network training error curve is shown in Figure 2, 3.

TABLE 2 : Paid hosting business parameters sample data

Risk Symptoms			Types of risk										
S1	S2	S3	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	1	1	1	1	1	1	1	1
0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	1	0	1	1	1	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	1	1	0	1	0	1	0	0	0
1	1	1	0	1	0	1	0	1	0	0	1	0	1

TABLE 3 : Leasing business risk parameters sample data

Risk Symptoms			risk type										
S4	S5	S6	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	1	1	0	0	0	0	0
0	1	0	0	0	0	0	0	1	1	1	0	0
0	0	1	0	0	0	0	0	0	0	0	1	1
1	1	0	0	1	1	0	1	0	1	0	1	0
0	1	1	0	0	0	0	0	0	0	1	0	1
1	0	1	0	1	1	0	1	0	0	1	0	0
1	1	1	0	1	1	0	1	0	1	0	1	0
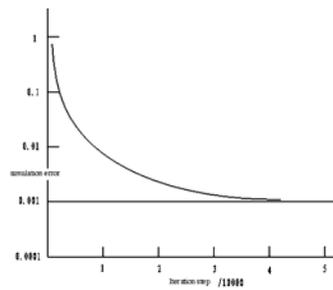
error 0.0362198; step 41502

Figure 2 : Paid hosting business risk sub-network training error curve
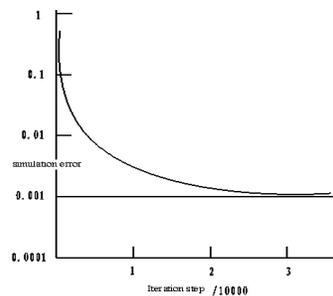
error 0.017611; step 35423

Figure 3 : Leasing business risk sub-network training error curve

INSTANCE ANALYSIS

In selecting a unit 3 set of managed compared with the test data, the lease will affect hosting and rental of the main risk factors analysis of quantitative indicators. Qualitative indicators by the risk situation of evaluation by experts, respectively for the worst, is the worst, very poor, poor, Relatively poor, Medium, Relatively good, good, very good, the best, the corresponding Figure 4 assignment criteria of evaluation.
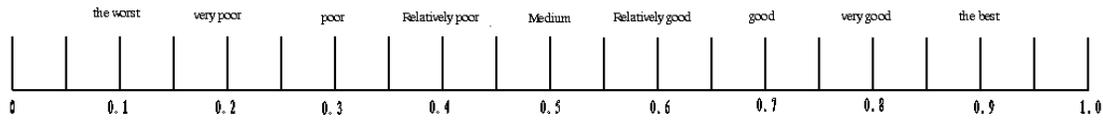
Figure 4 : The judgment of the evaluation standard

Risk evaluation of the basic steps are as follows: 1) will affect trust and leasing system is decomposed into a number of indicators of multilayer system. 2) the underlying index in the each period of the original data normalization, namely into a dimensionless value between [0, 1], get the initial fuzzy membership function value. 3) using normalization formula to quantify recursive computation. 4) get sample test data. As shown in TABLE 4, using combined improved BP network to forecast the data in the table, and early warning research carried out in accordance with the combination formula combinations, warning

TABLE 4 : Test data samples

Sample group no.	Managed device management risk	Logistics scheduling management risk	Money management risk	Costrisk management	Customer management risk	Contract management risk
1	0.71	0.667	0.929	0.968	0.706	0.68
2	0.98	0.99	0.947	0.98	0.706	0.838
3	0.47	0.52	0.99	0.824	0.99	0.99

TABLE 5 : Modular combined improve BP network diagnosis

Sample group no.	Network output					conclusion
	A	B	C	D	E	
1	0.80010	0.1480	0.0300	0.0092	0.0048	A
2	0.0001	0.0041	0.0000	0.0000	0.9994	E
3	0.0005	0.0059	0.00150	0.9953	0.0139	D

CONCLUSION

Equipment paid hosting and rental management is a very complicated problem, the service business due to the equipment use, working environment, operation state, the influence of complex factors such as transportation scheduling, its risks and management is not very clear, the relationship between risk and there are various, this can make risk prediction difficult. Using artificial neural network approximation function with arbitrary precision, by collecting equipment paid hosting and rental management common problems, determine the risk warning signs and their corresponding types, research based on combined improved neural network risk prediction method, set up equipment paid hosting with sample lease common risk, determine the input and output vectors of neural network, and the measured data are risk prediction analysis, risk prediction results in conformity with the practical application, the simulation results error is small, show that the method of risk prediction results are accurate and reliable.

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