Intelligent Evaluation System for Economic Level of Modern Enterprises Based on BP Neural Network Optimization Algorithm

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Abstract. Modern enterprises are more active economic organizations in the operation and development of the whole national economy, providing more employment opportunities. Establishing a perfect economic level assessment system for modern enterprises is an important task in the current economic management. This paper is to study the construction of an intelligent assessment system for the economic level of modern enterprises based on the BP neural network optimization algorithm. The basic system of enterprise economic level evaluation is proposed, the artificial neural network model is improved into PSO-BP neural network, the research of modern enterprise economic level intelligent evaluation problem is carried out, the three-layer B/S architecture is designed to implement the modern enterprise economic level intelligent evaluation system, the comparison of PSO-BP neural network and BP algorithm, PSO algorithm solves the slow convergence speed to a certain extent The results show that the PSO algorithm has solved the problem of slow convergence to a certain extent, and the PSO-BP neural network is more accurate and reliable than the BP neural network in evaluating the economic level of modern enterprises.

Keywords: BP Neural Network, Modern Enterprises, Economic Level, Intelligent Assessment

1 Introduction

With the deepening of enterprise reform, the withdrawal of modern enterprises in many business areas is accelerating. Therefore, private investors can invest in a wider range of restricted non-state industries in the future, and further expand the investment areas of the private economy. Therefore, evaluating the economic level of an enterprise is the most important and indispensable link [1-2]. The evaluation of the company's economic level clarifies the company's goals and direction in the most popular and comprehensible language [3].

The growth potential of any business depends on its economic security. Economic security must be supported by credible tools to monitor and assess the level of efficiency of its systemic mechanisms. Given all the influencing factors, economic

security is as stable as possible if a baseline is specified for the best control path for the business process. These benchmarks are used to assess the operational and economic security of the business. The index structure should include all important influencing factors [4]. Sashmita Panda conducted an analysis based on the business process execution efficiency criteria. The main common factors that should be present in the presentation of business processes and economic security assessment indicators are identified. This paper analyzes the definition of business process, determines the main characteristics of the definition, and puts forward the author's views on the nature of the concept from the perspective of future research [5]. Edmund Ofosu Benefo used four selected companies to evaluate business restructuring organizations in a global digital environment. It is assumed that under experimental conditions, R-economy-related financial relations in the field of corporate financial relations are effectively reorganized to form a complete set of statistical probability indicators, which are related to the experimental events of quantitative and qualitative measurement of independent events in the field of organizational reengineering. In terms of the influence degree of factors affecting organizational restructuring, the conditional probability of quantitative and qualitative measurement of statistical probability of related indicators is determined [6]. John Gibson established the BP neural network model for analyzing the credit risk index of listed companies, established the enterprise credit rating management learning system for predicting the future credit risk, and put forward conclusions and development suggestions [7].

The first part of this paper summarizes the research results of artificial neural networks in the fields of forecasting, economic forecasting and early warning. The second part briefly introduces the advantages and system design principles of BP neural network enterprise economic level evaluation. The third part introduces Construction scheme of enterprise economic level intelligent evaluation system. The fourth part discusses the work of each module in detail and evaluates the model according to the construction scheme.

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2.1 BP Neural Network

There are some main parts: Backpropagation is a neural network that misregulates and modifies weight and limits by backpropagation. The error here is the difference between the network result and the expected result. The first two parts of the BP neural network are repeated alternately until the system error reaches the predetermined requirements or the maximum number of neural network training [8-9].

2.2 Advantages of BP Neural Network Enterprise Economic Level Assessment

In this system, we apply BP neural network technology to the economic level evaluation of modern enterprises. Neural network model has a wide range of application prospects. Generally speaking, neural network has some incomparable advantages of other methods, which are reflected in:

(1) Adaptive capacity and self-learning, based primarily on data provided through learning and training and not merely on knowledge and experience criteria that help to reduce determinants, to identify the intrinsic links between inputs and outputs;

(2) Can handle incomplete data or noise with higher function and fault tolerance;

(3) Because the evaluation of the actual economic level is often very complicated [10-11]. Artificial neural networks allow data fusion between qualitative and quantitative signals [12]. Therefore, compared with other economic level evaluation methods, the economic level evaluation method based on neural network shows its advantages more and more.

2.3 Basic Indicators of Enterprise Economic Level Assessment

The economic benefits of an enterprise include profitability, solvency and operation capacity. Profitability is reflected by sales profit rate, return on total assets and other indicators. Solvency is reflected by the asset-liability ratio, current ratio or quick ratio and other indicators; Operating capacity is reflected by such indicators as receivables turnover and inventory turnover [13-14].

2.4 System Design Principles

According to the design standards and design specifications of the software design industry, the software design principles adhere to "simple, efficient, cost-effective" and all the content itself. The following principles were fully considered in the design of the system:

Advanced technology: Make full use of the latest achievements of software project technology.

Structural rationality: Each function module should be independent as far as possible to minimize the interference between modules and promote the independent development between system modules.

Functional integrity: A thorough understanding of all aspects of the performance evaluation process and complete logical conFig.uration of functionality.

Easy to extend and maintain: Try to inherit program code and reduce maintenance using object-oriented analysis and design techniques and data packaging techniques.

Performance requirements: The system must be responsive and not degrade significantly as the amount of data increases.

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3.1 System Architecture

The system software uses the B/S structural mode, and the operating environment and development environment are located in the WINDOWS operating system environment. The system uses a standard three-tier architecture, namely a terminal browser client, application and data logic services, and a browser/application service server model stored on the server using middleware technology. In the three-tier architecture, the first layer is the client layer, which provides the user interface function; The second layer is business logic, which provides all the database access functions and the completion of business logic; The third layer is the database layer, which provides continuous database storage capacity. The client-level operating environment is primarily the Web browser. The business logic layer consists of two main components: a Web server that provides results to the client layer over HTTP, and an application server that contains the services needed to complete the business logic. The system tools will be installed and run on the server, which is a basic corporate topology, as shown in Fig.ure 1. The technical framework of the system tool is shown in Fig.ure 2.
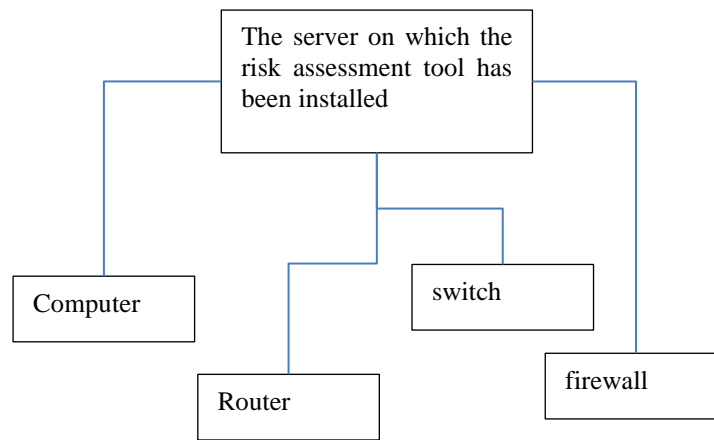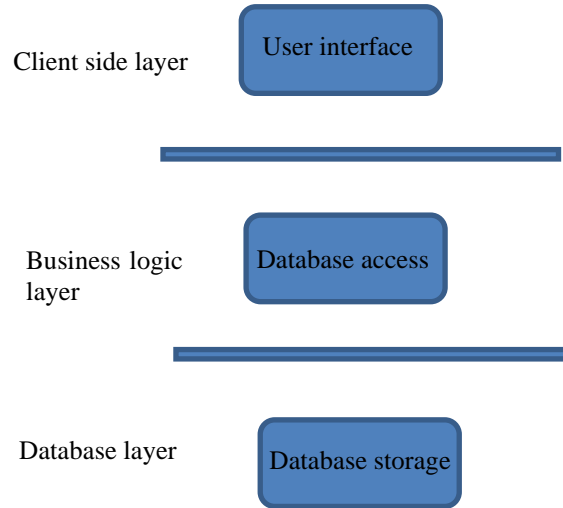

Fig. 1. Topology diagram of an enterprise user

Fig. 2. System design framework

3.2 An Intelligent Assessment Model for the Economic Level of Enterprises Based on PSO-BP Neural Networks

Before establishing the parameters and structure of PSO-BP neural network, the input network data must be standardized to speed up the network fusion. In fact, this is the key before using the BP to make predictions. The standard formula used in this document is:

$$\tilde{x} = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}, i = 1,2,...,n \qquad (1)$$

In this paper, as the input information of BP, the scores of the two components of profitability and solvency are economic level variables.

Secondly, the following formula should be considered:

$$l = \sqrt{m+n+\alpha} \qquad (2)$$

n is 1 in this paper. a ∈ [1, 10], so the value of I ranges from 3 to 12. Other parameters and structure of the network remain unchanged. The particle dimension can be calculated according to formula (2).

$$D = a*h + h*b + h + b \qquad (3)$$

In the design of BP neural network, 2, 10 and 1 have been clearly defined, so the dimension of each particle is set to 41(2×10+10×1+10+1=41).

4 Analysis and Research on The Construction of an Intelligent Evaluation System for The Economic Level of Modern Enterprises Based on BP Neural Network Optimization Algorithm

4.1 System Functional Module Division

The system is divided into the following five working modules, as shown in Fig.ure 3.

(1) Basic data management of modern enterprise economic level

The basic information about the economic level of modern enterprises includes the basic qualification, profitability, solvency, management ability and innovation of modern enterprises. This is the most basic information to evaluate the economic level of modern enterprises. Over time, the basic message of these modern businesses must be adjusted accordingly. This module enables enterprise administrators to update basic enterprise information. The main functions of this module include adding, modifying, deleting, querying and other basic business information.

(2) Evaluation model parameter Settings

This module is mainly used to generate the mathematical model needed for economic level evaluation, which is the core of this system. Including the addition of evaluation parameters, the selection and conFig.uration of evaluation parameters, through the parameter setting function formulated by the module can be based on the selected parameters and training samples to develop economic level evaluation models suitable for different modern enterprises.

(3) Economic level assessment

Using the model generated by the system to call the basic data of the modern enterprise, the basic economic level score and economic level of the modern enterprise are calculated. The module includes the function of setting the dividing standard of the economic level score section.

(4) System maintenance

System maintenance consists of user authority maintenance and information coding maintenance, to realize the standardization of information.
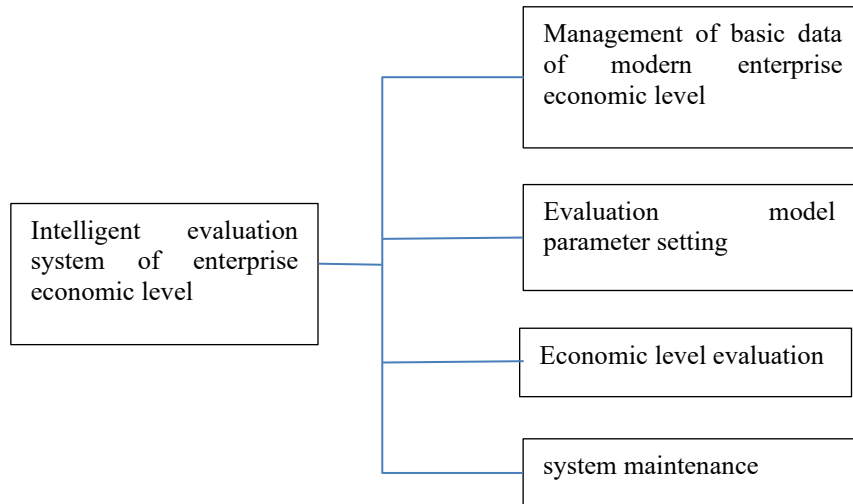
Fig. 3. System function modules

4.2 Intelligent Evaluation Performance Test

The model's assessment capability was analysed in terms of the mean squared error (MSE), mean absolute percentage error (MAPE) and running time (seconds), respectively, according to the selected evaluation criteria. It should be noted that MSE and MAPE in Table 1 refer to the MSE and MAPE of the assessment results for 2019, 2020 and 2021 for an enterprise's economic level, respectively, while the running time is the time required for the training.

Table 1. Comparison of results of two models

model	MSE	MAPE	Model training time (seconds)
back propagation	0.062	6.851%	1.854
PSO-BP neural network	0.011	5.622%	0.551
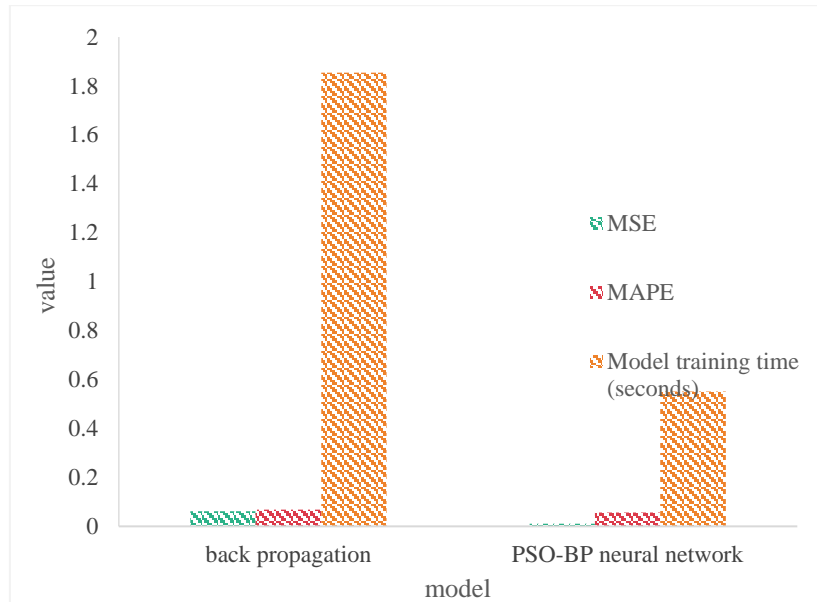
Fig. 4. Results of three evaluation indicators

The results of BP neural network and PSO-BP neural network are shown in Fig.ure 4. From the point of view of mean error (MSE), the evaluation error of BP neural network test set is 0.062, and that of PSO-BP neural network test set is 0.011, which is obviously better. From the point of view of model training time, the training time of PSO-BP neural network fusion is 0.551 seconds, which is less than one third of that of BP neural network, which means that PSO algorithm accelerates the initial particle search process and reduces the training time of neural network.

5　Conclusions

As a new subject, the research of enterprise economic level evaluation is still in the stage of discussion. In this paper, the qualitative and quantitative indicators are integrated into the intelligent economic level evaluation system, and the application of artificial neural network technology to the economic level evaluation system provides a new idea and method, but this is only an exploratory research. There is still a long way to go for the evaluation system of economic level to reach the practical level, which is a long and complicated system engineering. We believe that through the unremitting efforts of many explorers, the research in this field will continue to flourish.

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References

[1] Roberto A. Contreras-Massé, Alberto Ochoa-Zezzatti, Luis Asunción Pérez Dominguez, Karen Naudascher: Data-Driven Enterprises for Economic Recovery after Pandemic A Study Case in Consumer-Packaged Goods Industry. Int. J. Comb. Optim. Probl. Informatics 13(2): 33-39 (2022)

[2] Vladislav G. Lizunkov, Ekaterina Politsinskaya, Elena Malushko, Alexander Pavlov: Modelling as the Basis for Building a Competency Model of a Specialist Demanded by Industrial Enterprises in Priority Social and Economic Development Area (PSEDA). Int. J. Emerg. Technol. Learn. 15(13): 321-326 (2020)

[3] Dmitry A. Novikov: Complex Models of System Optimization for the Production and Economic Activity of an Enterprise. Autom. Remote. Control. 80(11): 2068-2089 (2019)

[4] Roman Sorokin, Jean-Louis Rougier: Video conference in the fog: an economical approach based on enterprise desktop grid. Ann. des Télécommunications 73(5-6): 305-316 (2018)

[5] Sashmita Panda, Ganapati Panda: Performance Evaluation of a New BP Algorithm for a Modified Artificial Neural Network. Neural Process. Lett. 51(2): 1869-1889 (2020)

[6] Edmund Ofosu Benefo, Aubrey Tingler, Madeline White, Joel Cover, Liana Torres, Christopher Broussard, Adel Shirmohammadi, Abani K. Pradhan, Debasmita Patra: Ethical, legal, social, and economic (ELSE) implications of artificial intelligence at a global level: a scientometrics approach. AI Ethics 2(4): 667-682 (2022)

[7] John Gibson, Geua Boe-Gibson: Nighttime Lights and County-Level Economic Activity in the United States: 2001 to 2019. Remote. Sens. 13(14): 2741 (2021)

[8] Natalie McGuinness, Dimitrios Vlachopoulos: Student Experiences of Using Online Material to Support Success in A-Level Economics. Int. J. Emerg. Technol. Learn. 14(3): 80-109 (2019)

[9] Santanu Paul, Zakir Hussain Rather: A New Bi-Level Planning Approach to Find Economic and Reliable Layout for Large-Scale Wind Farm. IEEE Syst. J. 13(3): 3080-3090 (2019)

[10] Onur A. Kilic, Huseyin Tunc, S. Armagan Tarim: Heuristic policies for the stochastic economic lot sizing problem with remanufacturing under service level constraints. Eur. J. Oper. Res. 267(3): 1102-1109 (2018)

[11] Karthik Subramanya Bhat, Johanna Ganglbauer, Elina Bosch: Techno-economic simulation and evaluation of scalable 'energy cells' locally generating renewable energy. Elektrotech. Informationstechnik 139(7): 612-620 (2022)

[12] Gilles Jacobs, Véronique Hoste: SENTiVENT: enabling supervised information extraction of company-specific events in economic and financial news. Lang. Resour. Evaluation 56(1): 225-257 (2022)

[13] Edy Tonnizam Mohamad, Danial Jahed Armaghani, Ehsan Momeni, Amir Hossein Yazdavar, Monireh Ebrahimi: Rock strength estimation: a PSO-based BP approach. Neural Comput. Appl. 30(5): 1635-1646 (2018)

[14] Hongmei He, Mengyuan Chen, Gang Xu, Zhilong Zhu, Zhenhuan Zhu: Learnability and robustness of shallow neural networks learned by a performance-driven BP and a variant of PSO for edge decision-making. Neural Comput. Appl. 33(20): 13809-13830 (2021)