Real Estate Price Evaluation System Based on BP Neural Network Algorithm

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Abstract. With the increasing emphasis and investment in the real estate industry, the real estate appraisal business has also become an important part of the real estate business and has developed rapidly. However, there are theoretical problems in the current real estate appraisal, ineffective appraisal work, and incorrect estimation methods, all of which are affecting the progress of the real estate appraisal business. Therefore, in-depth research on valuation theory and valuation methods has theoretical significance and value. The purpose of this paper is to study the real estate price evaluation system based on BP neural network algorithm. On the basis of analyzing the commonly used real estate evaluation methods, the BP neural network model is established, and the real estate price evaluation system based on the BP neural network model is designed and implemented. Finally, this paper takes the real estate of a certain tier city as a sample, and imports it into the neural network for training. Through calculation, it is found that the real estate value can be evaluated more accurately and quickly through BP neural network calculation.

Keywords: BP Neural Network · Real Estate Price · Price Evaluation · System Design

1 Introduction

Entering the new century, my country's real estate industry has undergone fundamental changes. The continuous introduction and implementation of reform programs such as paid land use, housing monetization, and commercialization will greatly promote the construction and development of the real estate market [1, 2]. Over time, inflation and economic overheating in the last few years have led to unusual fluctuations in real estate prices. The market demand for real estate appraisal is extremely high, real estate appraisal has attracted much attention from the society, and the increasingly mature real estate appraisal industry has become more and more popular [3, 4].

The rapid development of computer technology has forced experts and scholars to explore the automation of real estate evaluation. According to the definition of automatic evaluation, some researchers have used geographic remote sensing technology and the multi-layer perceptron module of artificial neural network to automatically collect real estate information traditionally related to housing construction to develop an evaluation system, which overcomes the traditional reception. The lack of data and methods of

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obtaining information also overcomes the problem of data noise [5, 6]. Some researchers have compared and analyzed the traditional evaluation methods of traditional market methods with automatic evaluation methods calibrated by smart computers, and the results show that they are faster and more accurate [7, 8]. Some experts have systematically expounded the importance of combining traditional market comparison methods and multiple linear regression analysis techniques to real estate evaluation, especially the tax evaluation of heavy houses [9, 10]. Some research institutions first tried to apply the random forest algorithm to the batch evaluation of residential real estate projects, and case studies have shown that random forests are relatively stable when dealing with extreme prices [11, 12]. At present, CAMA and GIS are widely applicable to taxation of houses, land, and other real estates in various countries of the world. Through China's long-term evaluation experience, in addition to the above-mentioned hedonic price method, spatial analysis method, hedonic price method, fuzzy logic method, etc., foreign theories and real estate valuation methods have been relatively complete. Therefore, the above evaluation methods can also become an important reference for China's real estate evaluation.

On the basis of referring to a large number of references and according to the common real estate evaluation methods, this paper establishes the BP neural network model, and studies the real estate value evaluation system using the BP neural network model. Finally, take a certain tier city real estate as a sample, import it into the neural network and train it to test whether the model in this paper is feasible.

2 Real Estate Price Evaluation System Based on BP Neural Network Algorithm

2.1 Commonly Used Real Estate Valuation Methods

(1) Market comparison method

The market comparison method refers to the comparison between the house to be appraised and the similar cases in the housing transaction completed in the same time period, and then based on the existing value level of the latter and with reference to its actual transaction. It is a kind of real estate appraisal that adjusts the value of the appraised real estate appropriately, and judges the real estate value level of the house to be appraised at a certain time, place, special purpose, and special property rights. Among them, similar real estate refers to the same or similar real estate in terms of use, building structure, location, price category, etc.

The market comparison method is mainly based on the principle of substitution. According to the theory of socialist market economics, the activities of various market entities in a market economy are usually subject to the principle of maximizing utility. With the interaction between the supply and demand of commodities, market prices and competition, commodities with the same or similar effects have substitution utility for each other, while commodities with substitutable prices limit each other, and finally produce a consistent price or price ratio, which is the traditional substitution principle.

(2) Cost method

The cost method is a method of calculating real estate prices based on certain interest, profits, taxes and fees in addition to estimating the usual costs required for real estate development. The theoretical basis of the cost method is the labor theory of value. In other words, the price of a product is determined by the cost and cost of producing it.

Because all real estate investments are subject to corresponding costs and costs, the cost method is also widely used, and the cost method can be used for recently developed real estate projects or redevelopment projects. The cost method is also more suitable for universities, clinics, parks, and property appraisals without related income transactions. For properties in the market that are plentiful or highly profitable, the cost method is usually not used but only cost.

(3) Income method

The income method is a method to calculate the value of the appraisal project by converting the future expected net profit of the appraisal project into the total income at the time of appraisal based on the estimation of the expected normal net income and according to a certain capital ratio.

The income method is mainly based on the principle of the expected rate of return of real estate, and the present value is expressed as follows. The real value of the house is also the objective exchange value. That is, the actual value of the home is determined based on the present value of all future earnings from the home.

2.2 Establishment of BP Neural Network Model

2.2.1 Normalization, Shuffling and Classification of Raw Data

The network input data has different dimensions, and the range of the hidden layer activation function of the neural network is limited, so the data must be normalized to enter the network. Input data normalization creates network input data of different dimensions at the same key position from the beginning of training, avoids the problem of neuron saturation due to the excessively large absolute value of network input, and adjusts the weights. Enter a flat area on the error surface. To normalize the output data, you can reduce the absolute error of the output elements. The model uses matlab's mapminmax function to normalize the data to $[-1.1]$.

2.2.2 Determine the Number of Network Layers

The determination of the number of layers of BP neural network also determines the ability of the network problem. In general, the more layers of a neural network, the more complex the structure, and therefore the better the ability to solve nonlinear problems. Therefore, increasing the number of layers in the Internet is an important way to increase the accuracy of network training. However, the higher the level of the Internet, the longer the duration of the exercise. In the Internet with few Internet layers, the structure can be so simplified that the entire network is more convergent.

Therefore, the selection of the number of network layers should not be too small or too large, but should be selected according to the specific requirements of a specific problem and the state of a specific sample. Generally speaking, a 3-layer BP neural network can already complete the mapping from m dimension to n dimension.

2.2.3 Determine the Number of Neurons in Each Layer

(1) Number of neurons in the input layer

The number of input neurons is mainly determined by the number of variables affecting the model. Typically, the number of input neurons is the same as the number of variables affecting the model. In our real estate valuation model, the number of input neurons is determined by the number of factors that affect real estate prices after testing.

(2) Number of hidden layer neurons

In a BP neural network, factors that affect the choice of the number of neurons in the hidden layer include the number of input and output nodes in the network, the difficulty of a particular problem, and the number and quality of training samples. Currently, there is no theoretical scientific method for selecting multiple hidden levels. Currently, the method of determining the optimal number of neurons in a hidden layer is a trial and error method. When using the trial and error method, several empirical formulas can be used. The number of hidden layer neurons for these types of computations is an approximation and requires a test computation. The following is an empirical formula for calculating the number of neurons in the hidden layer:

$$n_1 = \sqrt{m+n} + a \tag{1}$$

where m is the number of input neurons and n is the number of output neurons.

(3) The number of neurons in the output layer The number of output neurons is determined by the number of expected outputs in the model. Typically, the number of input neurons is the same as the number of expected outputs of the model. In the real estate valuation model in this paper, the expected result is the actual transaction value of the real estate, so the number of output neurons in the model is 1.

2.2.4 Select the Excitation Function

The excitation function is used to calculate the output value of each neuron in the neural network, and the choice of the excitation function affects the training results of the network. Typical excitation functions include threshold types, linear equations, and sigmoid functions.

Among them, the sigmoid function is often used as the function of the mapping model because it is not only discriminative, simple, and easy to express, but also has strong linear mapping properties. Since the BP neural network attribute evaluation model in this paper uses the nonlinear mapping function of the sigmoid function, the excitation

function in this paper selects the hypertangent sigmoid function:

$$\tan \operatorname{sig}(n) = \frac{1}{1 + e^{-2n}} - 1 \tag{2}$$

2.2.5 Determining Learning Parameters

(1) Determine the initial weights

The choice of initial weights affects the training results and training time of the network. Being overweight can cause training stalls, while being too light can take a long time to train. Therefore, in order to ensure the training effect of the network, the initial weight of the model is usually selected in the range of $(-1, 1)$.

(2) Determine the learning rate

The learning rate is related to the network training results and training time. If the learning rate is too high, the network tends to become unstable, and if the learning rate is too slow, it will affect the training time of the network. The network learning rate is usually 0 to 1.

In order to guarantee the stability of the network, the choice of learning rate is usually based on robustness. To avoid finding the optimal learning rate, the project employs a variable adaptive learning rate that allows the network to adjust the learning rate automatically.

3 Experiment

This paper divides the real estate price evaluation system into four parts: housing information collection, housing price evaluation, basic information of valuation and system management. The system function module diagram is shown in Fig. 1.

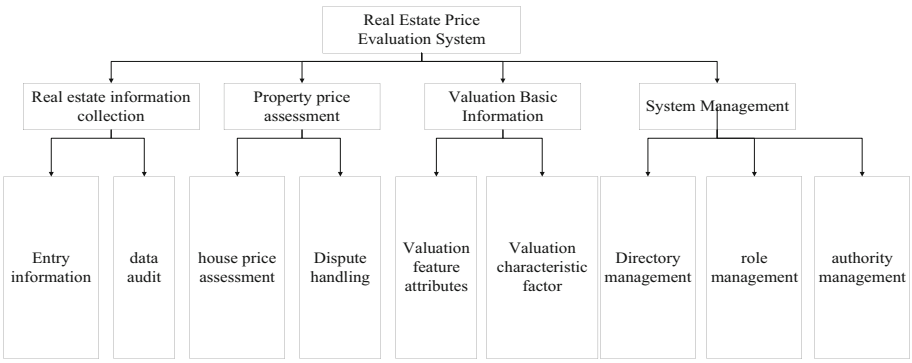

Fig. 1. System function module

3.1 System Management Module

The system management module mainly manages the rights of registered users and manages the directory. The system authentication management includes adding, canceling, and changing user registration information, and managing users' daily views and passwords. Basic system catalog maintenance, specific functions include adding, deleting, and modifying user information for system operators, assigning various permissions to registered users, and system operators can add, delete, and modify basic system catalogs, as well as various page settings and usage management. Once you have changed your password, your system administrator can reset your password.

3.2 Valuation Basic Information Module

The valuation basic information module mainly includes the characteristic attributes and characteristic coefficients of the valuation setting, and the main function of this function includes the introduction of the real estate valuation function. Floor characteristics, regional characteristics, school district characteristics, convenience of movement, convenience of living, degree of real estate, degree of ownership, distance from pollution sources, etc. Influencing factors are defined in terms of characteristics that influence the valuation of a home. These unique price patterns are determined by specific valuations from real estate services or reputable government agencies. The input data mainly includes attribute name, attribute value, attribute name and attribute coefficient. If these evaluation parameters need to be modified, the user can perform basic maintenance on the evaluation parameters and backup data processing through the system routine configuration module.

3.3 Real Estate Information Collection Module

The main functions of the housing information collection section include entering real estate information for evaluation, including information at all levels of the house, such as community name, building age, building area, floor, and placed floors. After you confirm the entered information, you will be provided with functions such as deleting, changing, and retrieving the entered information.

3.4 Housing Price Evaluation Module

The Home Appraisal module includes Real Estate Appraisal and Dispute Resolution modules. The real estate appraisal module mainly combines the market method and the BP neural network model to evaluate the real estate price after examining and approving the collected data.

The operation of the dispute resolution unit is mainly the procedure to be carried out when there is an objection to the appraisal price of the house. The applicant must provide reasonable reasons, and after the expert review and approval, through the investigation and investigation of the objection point, re-evaluate the house price. If the applicant cannot provide valid reasons, or the reasons provided are not recognized, the home price will be determined based on the system-generated appraisal price.

4 Discussion

In this paper, a BP neural network simulation application is run on the residential real estate in a certain tier city to verify the feasibility of the neural network-based property evaluation technology. The model is trained using sample data, and the predictions and expected outputs of the resulting test samples are shown in Table 1 and Fig. 2.

Table 1. Model calculation results

test sample	expected output	prediction output
1	87134	86610
2	91400	84850
3	78174	72209
4	134553	120480
5	93771	94110
6	80603	68150
7	96536	90800
8	57013	53010
9	96046	103280
10	65327	67250
11	125271	102020
12	95034	81080
13	100093	101250
14	92055	96110
15	94723	87405

The expected output is the real estate price of the tested sample, and the predicted output is the real estate price calculated by the model. The model was 92% correct, showing that the value of real estate can be assessed more accurately and quickly through neural network calculations.

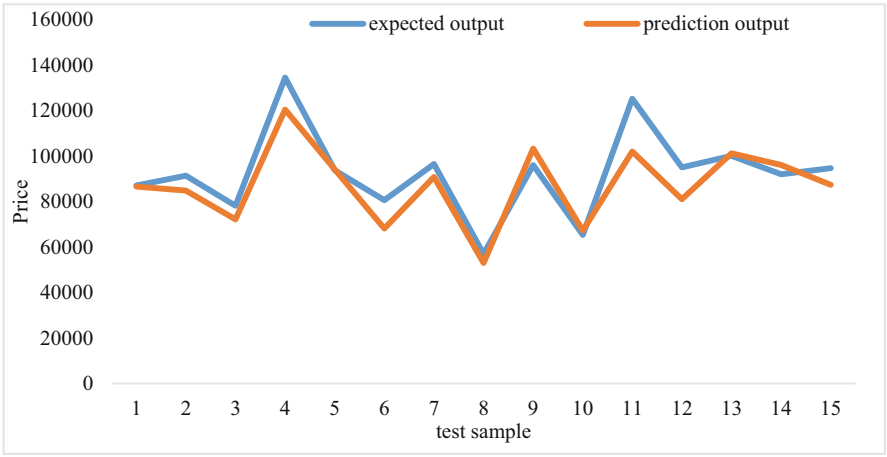

Fig. 2. Model calculation results

5 Conclusions

This paper adopts the method of evaluating housing prices based on BP neural network, which is helpful to guide the evaluation of housing prices. At the same time, with the continuous progress of modern science and the deepening of theoretical knowledge in our country, the emergence of new evaluation methods also provides a solid theoretical basis and mathematical model for better evaluation. It is believed that with more in-depth research on housing price assessment, the accuracy of the assessment will become higher and higher.

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