

Use of Artificial Intelligence in Real Property Valuation

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Abstract: Real properties possess value which is dependent on numerous factors. Investors and owners of the property are interested in the maximum returns, it would fetch. Considering the amount of money involved in real estate, there is a need of accurate prediction of returns and associated risks. This necessitates use of Artificial Intelligence (AI) prediction models. This study attempts to analyze and summarize AI techniques, which gives insight to application of various techniques for prediction related to property valuation. Comparison of various techniques shows that Artificial Neural Network (ANN) and fuzzy logic are better suited if attributes and model parameters are appropriately selected.

Keywords: Real property, value forecasting, artificial intelligence, neural network, valuation.

1.0 INTRODUCTION

Housing being one of the basic needs of humans, real property has always observed high demand in developing cities. Property prices have been major criteria for buyers in purchase decision [1]. Several studies have indicated that property price usually comprises of physical and economic characteristics, location, environment, and branding etc [2]. These and many more factors make it cumbersome to evaluate the exact value using conventional methods.

Traditionally, methods like sales comparison method, rental method, land and building method, profit method have been used to predict the property value. Market evidences from real estate transactions show that the analysis of property data over time has always faced difficulties [3]. An accurate prediction of real property price is important to prospective owners, developers, investors, appraisers, tax assessors and other real estate market stakeholders. It is thus required to prepare a prediction model which would take into consideration the effect of various changing factors on property value. To cater this need, soft computing techniques with higher data handling capabilities may be an optimum choice. These techniques have facilitated the study of complicated relationship between property price and the affecting factors.

Various researchers have implemented techniques such as multiple regression analysis (MRA), hedonic model, ANN, expert system, case based [4] and rule based reasoning [5], fuzzy logic, genetic algorithm for house price prediction. This study makes an attempt to understand the various price models developed and also summarizes the work carried out regarding value prediction of properties.

2.0 FORECASTING REAL ESTATE VALUE

Real property is defined as all the interests, benefits, rights and encumbrances inherent in the ownership of physical real estate. The valuation of real estate is required to provide a quantitative measure of the benefit and liabilities accruing from it [6]. Forecasting is estimating an indefinite future on the basis of past information which is a major issue in most aspects of real estate practice. Property development relies on forecasting of expected costs and returns. Property and investment managers use forecasts of demand and supply and respective value of property in the future.

Over the last few decades there have been significant changes to the methods of forecasting with complex methods becoming available for routine use [7]. Early endeavors at computer assisted valuation go back to the late 1980's when sufficient computing power became available [8]. The use of AI for residential value forecasting has been suggested in the literature from 1990s. With the initiation of computer systems and modern information technology, came the development of automated valuation methods based on artificial intelligence. Forecasting model using suitable AI technique takes into consideration the effect of the intrinsic as well as extrinsic factors giving a better forecast. Hence it is required to study the work done in this area and explore the possibilities of application of AI techniques in property value forecasting.

3.0 USE OF AI TECHNIQUES FOR PROPERTY VALUE PREDICTION

The field of artificial intelligence has developed very rapidly as computing power has increased. Artificial intelligence refers to the ability to perform the intelligent functions of the human brain. Various artificial intelligence techniques include ANN, fuzzy logic, neuro-fuzzy, genetic algorithm, expert system etc. AI has found applications in various fields like engineering & technology, law, medicine, biology, chemistry, social sciences. Its use is more wide spread particularly in the fields of research and forecasting. When the objective is to construct a model directly from a set of measurements of the system's behavior, data-derived AI models are preferred which give qualitative outputs [9]. Application of various techniques in value forecasting and their respective results are discussed in the study.

3.1 Use of ANN

Tay D. and Ho D. [10] used the back propagation ANN model in reckoning sale prices of apartments and compared it with the traditional MRA model for residential apartment properties in Singapore. The study revealed an absolute error of 3.9% for ANN model and 7.5% for the MRA model. Do A. and Grudnitski G. [11] also used both these techniques to predict residential housing value wherein the ANN model was more accurate than the MRA model. It was observed that neural network is reliable only if specialized training methods are used. Evans A., et al [12] tested neural networks for accuracy in valuation for estimating residential property prices in England and Wales. The study investigated the effects on the average prediction error when outliers in the data set were removed and obtained an average absolute error ranging from 5% to 7% for neural network models. Nguyen N., et al [13] compared the predictive performance of these techniques for single family residential property and found neural network's performance to be better. Xin J. Ge and Runeson G., [14] employed back propagation neural networks to produce four different housing price models by varying the contributing variables and compared their performance for Hong Kong. Varying results for these models showed the effect of relevancy of the variables on the predictability of the model. Lai Pi- Ying [15] employed recurrent artificial neural network to produce housing price models in Kaohsiung city and showed that MRA model generate more forecasting error than neural network model. On the contrary Worzala E., et al [16] found MRA superior to ANN.

3.2 Use of Fuzzy logic

Gonzalez M., et al [17] compared fuzzy logic and MRA models and revealed that fuzzy logic can handle the vagueness or imprecision present in the real estate market and give better estimates than conventional methods. The study by Guan J., et al [18] explored the use of fuzzy inference systems, ANFIS, to assess real estate property values and the use of neural networks in creating and fine-tuning the fuzzy rules used in the fuzzy inference system. It showed that ANFIS can yield results that are comparable to those obtained using the traditional regression approach and hence can be considered as a viable approach in real estate value assessment, worthy of further exploration. Krzystanek M., et al [19] implemented evolving fuzzy models giving high correlation between actual and predicted prices of properties. Lughofer E., et al [20] compared the performance of another fuzzy inference system, FLEXFIS, with traditional expert system using real world data set of prices for residential premises for a span of ten years, and observed that it was able to outperform expert based method.

3.3 Use of expert system and genetic algorithm

Rossini P. [7] examined the use of expert systems and neural network to real estate forecasting. Analyzing applicability of expert system to real estate forecast suggested it as an ideal method for dealing with qualitative forecasting and can be typically used for new products and in situations where there is no long term series that might assist in giving a forecast. There are numerous other areas within real estate practice where expert systems can be usefully employed. Wilson I.D. et al [9] showed an approach to attribute selection and dependence modeling using Gamma Test by means of genetic algorithm application to the problem of house price forecasting.

3.4 Use of other techniques

Fan G., et al [21] tested decision tree approach to assist the prediction process by finding the determinants of house price. Zurada J., et al [22] presented a comparative study where several regression and AI-based methods were applied to the assessment of real estate properties in Louisville, Kentucky, U.S.A. Four regression-based methods namely traditional MRA, and three non-traditional regression based methods such as support vector machines using sequential minimal optimization regression, additive regression, and MSP trees; and three AI-based methods such as neural network, radial basis function neural network, and memory-based reasoning have been applied and compared under various simulation scenarios. The results obtained using a very large data sample, indicate that non-traditional regression based methods perform better in all simulation scenarios, especially with homogeneous data sets whereas AI-based methods perform well with less homogeneous data sets under some simulation scenarios. More recently, hedonic pricing model (not an AI technique) has also been used to identify the real estate price. Limsombunchai, et al [23] compared the predictive power of the hedonic model with a neural network model for house price prediction and found that

the R^2 from neural network models was higher than the R^2 from hedonic price models. The results implied that the neural network model can estimate the house price more accurately than the hedonic price model in both aggregate and disaggregate models. Peterson S. and Flanagan A.B. [24] carried out study to compare appraisal performance of the two techniques and showed ANN as a better suited option to hedonic models.

4.0 OBSERVATIONS

ANN's performance is observed to be better than that of MRA as it can learn and recognize complicated patterns and it can easily be applied with little statistical knowledge of the data set. Previous literatures have commented upon neural network's black box nature and reached different conclusions. Since all studies have not reported favorable results from the use of neural networks, further comparisons are necessary. Zurada J. et al [25] compared the applicability of ANN, fuzzy logic and memory based reasoning and observed that no single AI method can be expected to consistently give better forecast than traditional MRA. This has been attributed to the size of the sample, variable selection and suitability of chosen AI technique to carry out the allotted task. The ability to capture and represent the fuzzy features of the data could lead to better assessment of property value and for that fuzzy logic seems to be a natural choice. Further, the use of genetic algorithms to help determine ANN structures and key variables would lead to superior results particularly when using large data sets.

It is observed that optimal AI models depend upon specific data sets and variables involved. Large data set augments the performance of the model. Also, selection of variables is of paramount importance in the development and use of AI models in property rate forecasting. The presence of non-linear relationship between independent variables and value of property due to inadequate number of sample size could be the root of the poor performance of any AI model. Reason for previous studies obtaining varied results may be varied parameter settings for the chosen model. Hence, the fluctuation in the AI performance can be accredited to parameter selection which plays important role in deciding the predictive power of the model. The optimal model is created by a trial and error strategy for parameter selection and by having adequate number of input variables which completely define the real scenario. The results of AI techniques, thus, depend on reliability of the data, spatial coverage of the data, variable selection and model parameters.

5.0 SUMMARY

The current era is marked by the increase in number of factors and their complex relationships for valuation of real properties. It demands the use of high end computing methods like AI tools for accurate and qualitative prediction. Further research can be done in this field to develop a model predicting variation in real estate prices considering the effect of recession. This will enable society at large to avoid disasters like Lehman brothers in future.

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