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Valuation of Residential Building by Using MATLAB

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A B S T R A C T

Due to the rising demand in the housing sector, the need for the valuation is also increasing rapidly. Valuation of any land or building is an important aspect for the buyer or seller for deciding on a particular property. The various traditional methods such as comparison method, investment method, profit method, development method, etc. are available for valuation, but when a large number of factors are involved for predicting house value then prediction by using these methods will become cumbersome. Therefore the use of various modern techniques such as artificial neural networks (ANN), genetic algorithm, hedonic pricing method, fuzzy logic, etc. is significant for such types of properties. In this paper, the valuation reports of various sectors of Kolhapur City were collected, and then the model has been developed by using fuzzy logic for predicting house selling prices.

1. Introduction

From basic human needs housing is one of the major needs. Day by day property prices rise as the population increases. So calculating the exact valuation of any property is becoming a need. Several studies have shown that property prices typically include physical and economic features, location, climate, and branding, etc. (Mokalkar, n.d.). Housing prices have been found to show variations based on various directly or indirectly related variables. The variables that influence changes in housing prices are of interest to urban planners, developers, real estate professionals, and financial executives as well as buyers and sellers (Sandbhor and Chaphalkar 2016).

Forecasting of any value is estimating an indefinite future based on 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. With the initiation of computer systems and modern information technology, came the development of automated valuation methods based on artificial intelligence. 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 (Chaphalkar and Sandbhor 2013).

2. Equations

Real property is defined as all the interests, benefits, rights, and encumbrances inherent in the ownership of the physical real estate, where real estate is the land together with all improvements that are permanently affixed to it and all appurtenances associated thereto. The valuation of real estate is therefore required to provide a quantitative measure of the benefit and liabilities accruing from the ownership of the real estate (Pagourtzi et al. 2003). There are various conventional and non-conventional methods of valuation.

Conventional methods of valuation are explained as follows (French 2004).

(1)   Comparable method- Used where there is clear proof of prior sales for most types of land.

(2)   Investment/income method - Used for the most commercial (and residential) property that is producing, or has the potential to produce, future cash flows through the letting of the property.

(3)   Accounts/profits method - Used for trading properties (other than normal shops) where evidence of rents is slight as they tend not to be held as investments. The accounts method determines an appropriate rent, which is then used in the investment method.

(4)   Development/residual method - Used for properties ripe for development or redevelopment or bare land only. Determines the value of the asset undeveloped relative to the potential sale price of the completed development.

(5)   Contractor's/cost method - Used for only those properties not bought and sold on the market and for technical purposes only.

Non-conventional models or methods try to analyze the market by directly mimicking the thought processes of the players in the market in an attempt to estimate the point of exchange. These models tend to be more quantitative (Pagourtzi et al. 2003). Artificial Neural Networks (ANN), Fuzzy logic, Genetic Algorithm, Expert System are some of the non-conventional methods which are used for prediction values in the real estate sector. Out of these methods, fuzzy logic is used for developing this method.

3. Fuzzy Logic

In 1965, by LotfiZadeh, the Fuzzy Logic tool was introduced and is a mathematical tool for dealing with uncertainty. It provides a soft computing relationship with the significant idea of word computing. Fuzzy sets provide a way of modeling vagueness-related ambiguity (Sivanandam, Sumathi, and Deepa 2007). The definition of fuzzy logic, which in many of its implementations plays a central role, is that of a fuzzy if-then rule or simply a fuzzy rule. In artificial intelligence, rule-based systems have a long history of use, but what is lacking in such systems is a framework that deals with fuzzy implications and fuzzy backgrounds. This framework is given in fuzzy logic by the calculus of fuzzy rules (G. Sarip and Hafez 2015).

The foundation of human communication is the basis of fuzzy logic. Many of the other statements about fuzzy logic underpin this observation. Since fuzzy logic is based on natural language, used every day by ordinary people, thousands of years of human experience have influenced it to be convenient and productive (Natick 1995). The nonlinear mapping that transforms data from fuzzy crisp input to non-fuzzy value output is a fuzzy logic method. It consists of four main phases: (1) fuzzifier (input), (2) rules, (3) process inference engine, and (4) defuzzifier (output), as shown in the figure below.
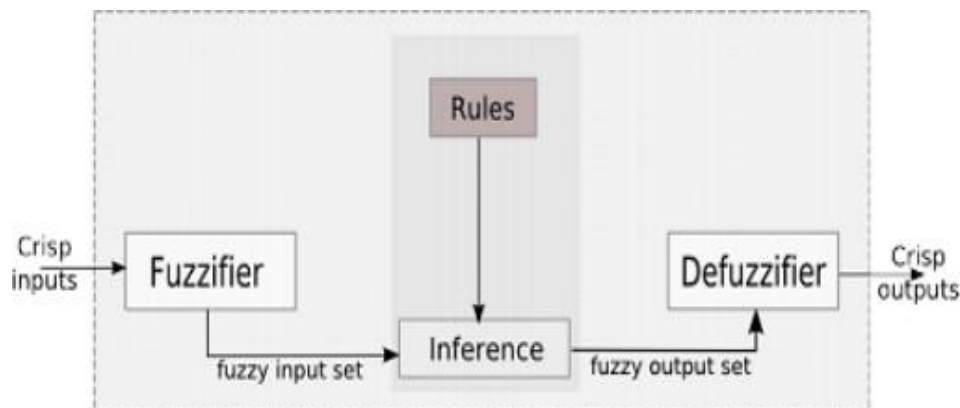

**Fig. 1 –Fuzzy Logic System (G. Sarip and Hafez 2015)**

4. Case Study

The data has been collected in terms of valuation reports from various valuers of Kolhapur. A total of 115 cases or valuation reports of residential properties were collected. For each case, different parameters such as the latest rate, location of the project, location, distance from the city center, proximity to the distance terms of the IT park, etc are taken into consideration.

For each valuation report, no. of inputs and their corresponding output are inserted as membership function in the fuzzy logic toolbox of MATLAB. Then the prediction is done for the unknown cases and the accuracy of the model was checked. The various parameters considered as the input for the model development are explained in the following table.

Sr. No.	Name of the parameters
1.	Area of the plot (in sq. m)
2.	Locality
3.	Classification
4.	Development surrounding
5.	Feasibility of the civic amenities
6.	Road facility and type of road
7.	Built-up area in sq. m
8.	Type of flooring for floor
9.	Type of opening door
10.	Window
11.	Type of plumbing
12.	Water supply
13.	Age of building

5. Equations

As 115 valuation reports were collected from different sectors of City. Out of which 101 reports were given to the software and 14 were used for prediction. Based on 101 reports software predicts some value for these 14 reports. These values are then compared with the actual value of the corresponding report. The graph between actual values and predicted values for these reports is given below.
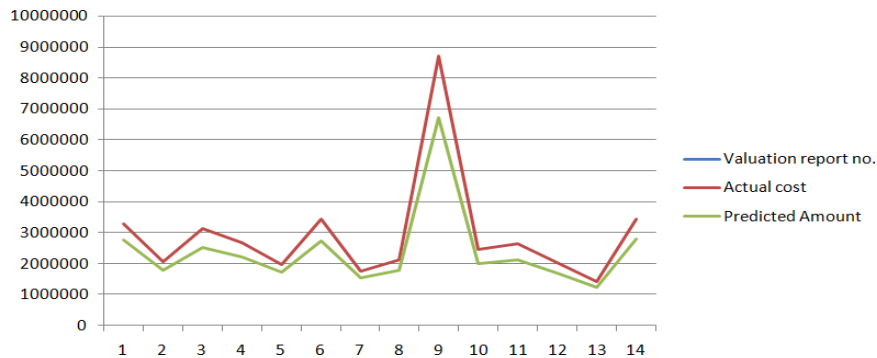
Also, MAPE (Mean Absolute Percentage Error) is calculated for this model. It is a commonly used performance index that is used to analyze the error of the model. The MAPE value for the given model is coming out as 17.32 %. It means that there is an overall 17 % error present in this developed model.

4. Conclusion

From this model, it was concluded that identifying factors affecting property value is crucial to predict the behavior of property prices in the future. This study involves the prediction of value in the real estate sector by preparing a prediction model for the Kolhapur city and corresponding factors with reference to applications in the past, data has been implemented for a more inclusive exploration of property characteristics directly affecting its present-day value. The analysis includes identifying a few factors which are mostly influencing the value of the property. These factors can be changed with a change in the locality. Therefore it is important to find out various factors for a particular locality which mainly affects the value of the property. Proper selection of parameters while model development will lead to greater accuracy of the model.

This study includes work done in Kolhapur city and explores the possibilities of applying AI techniques in the prediction of property value. The results of the fuzzy logic model were compared with the actual case studies property value. The predicted value indicated that the fuzzy logic model is capable of simulating the property value with 82.67% accuracy. The development model will act as a guide in predicting the value of the property. With advances in

technology, there is a vast scope for future development in the same valuation of real estate. It may include a market value which can produce the payable amount in case of apportionment of valuation. It is hoped that this system will be a base work for many researchers to start their work in the same field.

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