Prediction of Residential Property Prices – A State of the Art

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Abstract Forecasting property price is an important module, in the decision making for buyers and investors in supporting budget allocation, finding property funding stratagems and determining suitable policies. The number of approaches to predict the property price for any particular location like hedonic pricing method, travel cost method etc. but the stakeholders that are involved in the process are unaware of the various approaches and statistical techniques available to predict the property price considering various aspects relating to surroundings, environment and other amenities etc. Hence the aim of the paper is to provide clean visual of the impact of housing sector, the approaches and statistical techniques that are used for prediction of residential property prices.

Keywords: Forecasting, Statistical techniques, Budget allocation, Stakeholders.

I. INTRODUCTION

The construction industry has always been closely related to the national economy. The significant role of the construction industry in the national economy has been highlighted by Turin (1969) and its importance further elaborated by Hillebrandt (1984). Residential construction (housing sector in India) accounts for 1.24 percent of economy, 1 percent of GDP, and 6.86 percent of employment (by the study of NCAER). Consequently, studies have shown that building and business cycles are closely related, with one having influence over the other.

Even though housing sector contribution is seen in significant but on the contrary buying a house is a nerve-racking process for the individuals involved. One must pay huge sums of money and invest many hours and even then, there is a persisting concern whether it's a good deal or not. Buyers are generally not aware of the contribution of factors that influence the house prices. Almost all the houses are described by the total area in the square foot, the neighborhood, numbers of the bedroom, etc. Sometimes houses are even priced at X rupees per square foot. This creates an illusion that house price is dependent almost solely on the above-stated factors.

Most of the houses are brought through real estate agents. People rarely buy directly from the seller, since there are a lot of legal terminologies involved and people are unaware of them. Hence real estate agents are trusted with communication between buyers and sellers as well as laying down a legal contract for transfer. This just creates a middleman and increases the cost of houses. Therefore, the houses are overpriced, and a buyer should have a better idea of the actual value of these houses.

There are various portals available to assist a person with buying houses. These portals are generally free for use but the main problem with these online portals is they are heavy on advertisement and they promote real estate agents. Estimates of actual house price will help buyers to have better negotiations with real estate agents, as the list of the house is much higher than the actual price. An accurate prediction on the house price is important to prospective homeowners, developers, investors, appraisers, tax assessors and other real estate market participants, such as, mortgage lenders and insurers (Frew and Jud, 2003). Traditional house price prediction is based on cost and sale price comparison lacking an accepted standard and a certification process. Therefore, the availability of a house price prediction model helps fill up an important information gap and improve the efficiency of the real estate market (Calhoun, 2003).

II. LITERATURE REVIEW

Monk, Tang and Whitehead (2010) examined the social and economic impact of housing in Scottish country. Investment in housing finance impacts the economy directly and indirectly. Housing finance investment impacts the employment, GDP, productivity and many other important factors. The study revealed that the housing is an important indicator for increasing the wealth of nations. It was concluded that Scottish housing policy objective is to improve the quality standard of housing as well as to increase the investment in house old sector.

Bhalla, Arora and Gill (2009) examined the performance of housing sector as well as the problems and challenges faced by this sector. The study showed that due to continuous changes in the global financial environment banks and financial institutions have brought sea changes in their strategies related to this sector so that slowly and gradually growth is shown by this sector. It was revealed that due to globalization process, India is witnessing competition among banks that has reduced the cost of finance for housing users.

Bhalla (2008) in a paper discussed the current scenario, development, performance, problems, challenges and prospects of housing finance as an industry segment. According to this study housing finance grow at the rate of 36 per cent. With the changes in strategies of banks and financial institution policies there is shift from buyer market to seller market.

Dr. Haripriya Gundimeda studied the applicability of HPM to value water resources such as Bays, lakes and reservoirs, building of a new harbour, river views, restoration of urban stream, noise, landfills, dumping sites etc. on nearby property values. In India, hedonic price method has been employed in evaluating the relation between land prices and surface and ground water access (both in quality and quantity), (Gundimeda and Kathuria, 2005) and benefits if air quality improvement in India (Murty and Gulati, 2006).

Kanojia Anita (2016) stated that the presence of Environmental Services such as parks are connected with additional environmental qualities. For example, Playground & open parks are often associated with higher air quality and lower noise levels and the presence of water can positively influence the climate of the surrounding areas. Therefore, the estimation of the capitalization of such "Services" in house prices might be biased by price effects of additional environmental qualities. It is worth noting that a park's shape and area also have a significant effect on neighbourhood residential property values. For this reason, in the future, perspective of landscape ecology, including the landscape quality, diversity, and fragmentation should also be considered. This study can provide effective information for real estate developers, government (in terms of decision-making on environmental tax), urban and landscape planners or architects, and green space conservationists and managers. Nevertheless, in future planners have to consider such Environmental Services, besides their ecological benefits, as a source of utility for the inhabitants of cities.

The travel cost model is often used to measure the benefits provided by access to public recreation sites, e.g., national parks and national forests, which have relatively minor, if any, entrance fees (Oh, et al., 2005).

Hotelling (1947) is credited with the initial development mof the travel cost model. Using the travel cost model, observed travelers' net economic benefit, or consumer's surplus, from visiting a recreation site is calculated as the value of access to the recreation site less the travel cost and necessary entrance fees (Heberling and Templeton, 2009).

The model assumes that people travel to a recreation site if the marginal value of accessing the site is at least as large as the marginal cost of traveling to the site. The estimated consumer surplus is often used as a monetary measure of consumer welfare. The aggregate net economic benefit of access to a recreation site is estimated by aggregating average individual consumer surplus per visit over all visits.

Eric Slone et.al. (2014) developed the relationships between various home characteristics and the asking price of a residential property were analysed using both a simple linear regression and a multiple linear regression using the method of ordinary least squares. Home square footage was utilized as the explanatory variable in the simple linear regression, and the multiple linear regression consisted of the addition of land parcel size, number of bedrooms, year of construction, and other explanatory variables. The results of the multiple linear regression proved the bias due to the omission of crucial factors in the simple linear regression. Home square footage was found to be the most important factor in the determination of residential property price, while garage capacity proved to be the weakest factor

Ezgi Candas et.al (2015) had found that if significance level is accepted as 0.05 all the 5 variables in the last regression model (Floor, Heating system, Earthquake Zone, Rental Value and Land Value) have a significant impact on the dependent variable Value. Land value and rental value have the highest impact on the housing price. Existing floor, heating system and earthquake zone are the following them. Although it is found that the other variable is not significant in this study, it can change according to the sample size. If sample size increases, regression model once again is recommended for further studies. The application of multiple regression analysis in a house data set explains or model's variation in house price which demonstrated good examples of strategic application of mathematical tool to aid analysis hence decision making in property investment.

There are quite a number of data analysis techniques that are being employed in the property pricing research domain and they range from econometrics (e.g., ARIMA, linear regression) to Artificial Intelligence (AI) (e.g., artificial neural network, fuzzy logic) (Pagourtzi et al., 2003; Brooks and Tsolacos, 2010). Researchers have investigated the applications of these techniques in different research fields and also in real estate.

Limsomuchai (2004) compared the predictive power of the hedonic price model with and artificial neural network mode on house price prediction. Artificial neural network models and hedonic price models are tested for their predictive power using 200 houses information in Christchurch, New Zealand. The results from hedonic price models support the previous findings. Even if the R2 of hedonic price models are high (higher than 75%) for in sample forecast, the hedonic price models do not outperform neural network models. Moreover, the hedonic price models show poorer results on out-of-sample forecast, especially when comparing with the neural network models. Thus, the empirical evidence presented in this paper supports the potential of neural network on house price prediction, although previous literatures have commented upon its black box nature and reached different conclusions. The non-linear relationship between house attributes and house, price, the lack of some environmental attributes, and inadequate number of sample size could be the cause of poor performance of the hedonic price models. However, it should be noted that cause of the optimal artificial neural network model is created by a trail-and error strategy. Without this strategy, the results may not indicate superiority of the neural network model.

Hujia Yu, Jiafu Wu (2016) lasso regression model can provide insights about chosen features, which is helpful in helping us understanding the correlations of house features and its sale prices. According to analysis, living area square feet, material of the roof, and neighbourhood have the greatest statistical significance in predicting a house's sale price. Azme Bin Khamis et.al. (2014) compared the performance between Multiple Linear Regression (MLR) model and Neural Network model on estimate house prices in New York. A sample of 1047 houses is randomly selected and retrieved from the Math10 website. The factors in prediction house prices including living area, number of bedrooms, number of bathrooms, lot size and age of house. The methods used in this study are MLR and Artificial Neural Network. It was found that, the value of R^2 in Neural Network model is higher than MLR model by 26.475%. The value of Mean Squared Error (MSE) in Neural Network model also lower compared to MLR model.

The fuzzy logic system (FLS) is one of such technique, a multi-criteria decision-making tool. The application of FLS in articles published between 1994 and 2014 was reviewed by Mardani et al. (2015). It was established that the technique is being employed in the engineering, management and business and science and technology fields of studies. However, it was found that the majority of the articles were published in 2013, the authors of the articles reviewed adopted a hybrid form of the technique and the Analytic Hierarchy Process (AHP) is the most combined technique. In addition, the results of the study show that a majority of the authors are engineers, while most of the articles originated from Taiwan (for instance, Lee et al., 2008; Lu and Wang, 2011; Chou and Cheng, 2012).

The AHP technique is another multi-criterion decision-making technique that has been in the real estate research domain for a while. The study of F.Zahedi (1986) established that AHP is applicable in different fields which include economic and planning, conflict resolution, manufacturing, portfolio selection, accounting and auditing. Others are auditing, education, politics and environment marketing, amongst others. Vaidya and Kumar (2006) examined 150 articles that adopted AHP, but eventually reviewed 27 of these articles. In addition to the exposition of the applications of the technique that is similar to that of F.Zahedi (1986), it was discovered that most of the authors adopted the technique for variable selections. The United States was identified as the country where most of the articles emanated from, while a continuous trend of application of the techniques was noticed in developing countries, especially in India. The Artificial Neural Network (ANN) is an AI technique that has gained widespread popularity in different research areas as well and has proven to be highly efficient for property pricing appraisal research (Mora-Esperanza, 2004). Widrow et al. (1994) reviewed the applications of the tool in industry, business and science disciplines. The authors presented the classification of the technique in the areas of linear applications (telecommunications, sound and vibration control), multi-element nonlinear applications (credit card fraud detection, cursive hand writing recognition, loan approval, real estate analysis and marketing analysis, amongst others) and nonlinear applications on the horizon (automotive, speech recognition and mass spectra classification, amongst others). This is like the study of Paliwal and Kumar (2009) who reviewed and classified articles that applied the ANN technique in accounting and finance, health and medicine, marketing, engineering and manufacturing and general application fields.

III. CONCLUSION

It is observed that in India there is privation of reliable economic method for price prediction of residential properties which results in inevitable way to trust the often-manipulated prices by middle person. The increasing purchasing power of subjects have led to increasing demand of property ultimately causing rise in prices of properties. However, the rate of fluctuation in prices should have a method for its traceability. Round the world, the ways such hedonic pricing method, multiple linear regression analysis, travel cost method, fuzzy logic system, AHP technique, ARIMA, ANN (Artificial Neural Network) techniques etc.

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