

Valuation Model for Commercial Properties in PMC

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Abstract—Knowing the involvement of capital in property market, there is a requirement of accurate valuation of a property which can be achieved by using artificial intelligence technique. From this project we can study about valuation of commercial properties in Pune, India. The main goal of this study is to develop a model using neural networks for rate prediction of commercial properties. The final results show 99% correlation coefficient for selected combination of cases with a high percentage rate of prediction. This study would help the property investors to buy or sell their properties at exact rate.

Keywords-Artificial Intelligence, Commercial property, Neural Networks, Rate, Valuation.

I. INTRODUCTION

From the basic needs of human housing is the one. Day by day property prices get rise as population increases. So calculating exact valuation of any property is becoming need. [1]. Several studies have indicated that property price usually comprises of physical and economical characteristics, location, environment and branding etc. [2]. Traditionally, methods like sales comparison method, Impact approach method, and summation or cost method, residual method have been used to predict the property value. Market study shows that the analysis of property data over time has always faced complications [3]. An exact prediction of real property price is important to respective owners, developers, investors, appraisers, tax assessors and other real estate market stakeholders. It is thus required to prepare a prediction model which would find factors affecting for property valuation. Many 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 gives chance to develop the various price models and also finding critical factors which are mostly get affected for any property valuation [1].

Commercial properties include office buildings, industrial property, medical centres, hotels, malls, retail stores, farm land. Commercial Real Estate (CRE) is simply defined as any property owned to produce income. From investment point of view, commercial real estate encompasses any kind of property, which produce income. From a business point of view, commercial real estate is any giving office on a rent, leased industrial sheds, medical, hospitality and other commercial space that can be leased go the use of the business. This study mainly focuses on commercial property value prediction.

II. IDENTIFICATION OF CRITICAL FACTORS

There are many factors which affect the valuation of commercial property. A few of these factors are location, weather, accessibility, future growth, availability of water, ambience, R sector, connectivity with main central location of the city, security, environment, buyer's comfort, budget, economic weather etc. [2]. Factors which we are going to considered for the present study are locality, availability of local transport, distance from city Centre, nearness to IT/ MIDC, location, parking availability which are explained as follows:

A. Location

To raise any business your location of property plays important role. For profit business, such as shops, showrooms, office complexes, shopping malls, service stations and restaurants. There are different zones to bifurcate commercial area and residential area. For any commercial property, for business prospect, location of the property plays a vital role as it generates income also reflects standard of that business group.

B. Availability of local transport

For making new India local transport plays vital role. It introduce strong connectivity between people also rises business growth. New transport infrastructure may increase commercial property values due to improved accessibility. Classic urban location theory states that lower transport costs will result in higher land property values. Transport's four factors like, the availability of transport, the costs, transport time and convenience of transport modes mainly affects the property valuation.

C. Distance from city center

Distance from city center is nothing but the distance of property from main railway station. Due to shift in the globalization, as well as recent technological and economic development, city centers have begun to act as central business districts (CBDs) by offering a community growth, wealth of business, retail, leisure, finance, accommodation, education, culture, recreation, health facilities. Values of commercial properties go increasing as goes far near to center of city also Vis versa decreased as goes far away from it.

D. Locality

Standard of living decides class or locality of an area. Locality mainly classify as high class, higher middle class, middle class, lower middle class, low class. It is a critical factor because locality decides the type and standard of business. Like in Pune Peth area is the one of the oldest area so obviously huge business hub is formed. Basically this area is famous for textile market and large shopping centers are situated over here. It is a middle class and developing area with all primary businesses situated over there. On the other hand, bhandarkar road, prabhat road, bhamburda, shivaji nagar are high profile areas, hence mainly famous for residential premises and not for commercial use. Also there are some newly developing industrial areas like Hadapsar industrial area, Katraj industrial area, Parvati industrial group etc. where locality is developing one.

E. Nearness to IT Park or MIDC

All the top IT companies have their presence in Pune, making it the second biggest software hub in the country. Pune is the Asia- Pacific region. The ‘ Mercer 2015 Quality of living ranking’s evaluated local living conditions in more than 440 cities around the world where Pune ranked 145, second in India after Hyderabad (138) [17]. It also highlights Pune among evolving business centers and emerging 9 cities around the world with citation “Hosts IT and automotive companies.” Pune has also emerged as a new startup hub in India with tech startups like PubMatic, Firstcerry.com, Stopick.com, TastyKhana.com and Swipe setting up base in Pune. Pune has set up green field for automotive companies such as Tata Motors, Mahendra and Mahendra, Mercedes Benz, Force Motors, Kinetic Motors, Land Rover, Jaguar and Fiat which makes the independent to city Pune as India’s “Motor City”. The Hinjewadi IT park is mainly known for the Rajiv Gandhi Infotech Park houses hundreds of companies of different sizes. A project being started by MIDC to house IT sector in Pune. With rising population and basics demands, commercialization is a must and has affected the value of commercial properties near these IT hubs and automobile hubs in and around Pune city [6]. New upcoming IT hubs in Pune are as Nanaded City IT Park, Chakan IT Park etc.

III. NEURAL NETWORKS USE

Neural Network is a concept basically drawn from simplified biological nervous system. It designs to computing performed by a human brain. It is defined as a data processing system which is formed by large number of highly interconnected processing elements/artificial neurons in architecture to mimic structure of the brain (Rajasekaran et al., 2003). NN is based on a collection of connected units called artificial neurons. Each connection between neurons can transmit a signal to another neuron. Neurons may have state, generally represented by real numbers, typically between 0 and 1. Once appropriately trained, the network can be put to effective use in solving unknown or untrained instances of the problem. Determining an appropriate architecture of a neural network for a particular problem is an important issue, since the network topology directly affects its computational complexity and its generalization capability [7]. NN have been used on variety of tasks, including computer vision, speech recognition, machine translation, social network filtering, video games, medical diagnosis and in many other domains.

A. Use of NN in general applications

NN have been used on variety of tasks, including computer vision, speech recognition, machine translation, social network filtering, video games, medical diagnosis and in many other domains. Applicability of NN has been experimented in various areas of civil engineering by number of experts. [11] Proposed NN model for predicting the failure loads of laterally loaded masonry wall panels based on their corresponding cracking patterns derived from laboratory experiments. [12] Studied the prediction capability of NN for pile capacity, settlement of foundation, soil properties and behaviour, liquefaction, slope stability etc. Application of NN in tide level forecasting, problems such as earthquake induced liquefaction and wave induced seabed instability was studied [13]. [14] Proposed the use of NN in early cost estimation of road tunnel construction work. [15] Implemented NN to predict groundwater levels of shallow aquifers and found NN to be a viable option as compared with traditional methods. [16] Developed NN model to predict the ferrite fraction of micro alloyed steels during continuous cooling and observed NN to give fairly accurate results [7].

B. Use of NN in property valuation

The study investigated an absolute error of 3.9% for ANN model and 7.5% for the MRA model. Do A. and Grudnitski G. [9] from this we can see that both these methods used for residential property valuation wherein the ANN model was more closer to accuracy than MRA. Tay D. and Ho D. [8] used the back propagation ANN model in reckoning sale prices of apartments. Then he compared ANN with the traditional MRA model for residential apartment properties in Singapore. Evans A., et al [10] used neural networks for perfection in valuation

for estimating residential property prices in England and Wales. From this overall study it was observed that range for absolute error ranging was between 5% to 7% for neural network models. From these overall literature observations, neural networks have been finalized for present study to predict value of commercial property in Pune city.

IV. METHODOLOGY ADOPTED FOR WORK

A methodology is a sequence the tasks that leads to a final deliverable and work on them in order. The power of methodology is that every step is preplanned and laid out in the proper sequence. Here we are going to discuss the methodology used for this project. Figure no 1 shows Methodology chart is follow as below.

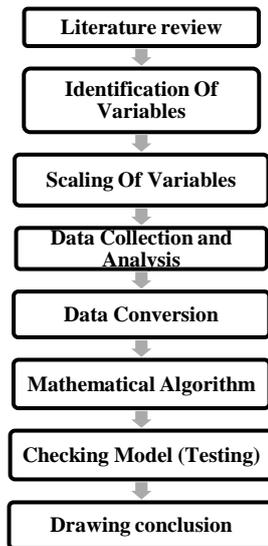


Fig 1: Methodology of Study

A. Sacking of variables

Scaling is the process of varying levels of achievement in a course. Scaling can be assigned as a range. In this research, scaling is done by using 5 point method. All variables are scaled by using the 5 point scale since many experiments have indicated that 5- point scale was more effective to predict any judgments. Specification of scaling is as follows

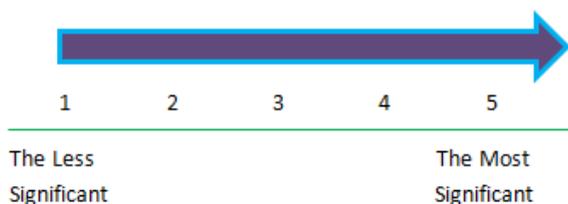


Fig 2: Scaling of variables

B. Data Collection and analysis

Data has been personally collected after doing personal technical visits. Total 150 commercial property cases have been studied. In which commercial shops, offices, showrooms

are involved [5]. For each case we have found latest rate, project location, locality, distance from city Centre, nearness to IT park terms of distance etc. We divide Pune in 6 sector namely central city as sector 1, southern area as sector 2, south western as sector 3, north western as sector 4, north eastern as sector 5 and lastly eastern as sector 6 [6]. After collecting this data we scale it using 5 point scale, as discuss previously.

C. Processing using Neuro- Solutions

Neuro Solutions is a neural network development environment developed by Neuro Dimensions. It combines a modular, icon based network design interface with an implementation of advanced learning processes, through time. Four basic functions namely training, Cross Validation (CV), testing and production are performing during model formation [7]. Training the network is a process where training cases are presented to the network, one by one (Arditi *et al.*, 1998). Being a supervised learning process, case inputs and its corresponding outputs are studied and analysed by the network to learn the pattern of resolution. To check network's overtraining, some cases out of training cases are given for cross validation. When Mean Square Error (MSE) for CV increases, the network automatically stops training. Effectiveness of the training process can be assessed by testing the cases for desired output and software generated output. If there is a large discrepancy in these two outputs, the contributing parameters to the network can be varied in the successive runs to minimize this difference and arrive at optimum solution [7].

Total 150 cases are identified initially as data. These are applied to the network for finalizing the parameters such as learning rule, activation function, number of epochs, number of hidden layers, number of processing elements in hidden layers, number of runs, type of network etc. A three layer NN is chosen for the present study, which comprises of input layer with 8 neurons, hidden layer with 4 numbers of processing elements and the output layer with one node [7]

V. MODEL FORMATION

All collected data and after conversion of it, are applied in the model development. Model should design such that it can predict commercial property's valuation. For this number of trails are to be taken also wanted to form number of combinations. One hundred and fifty cases are given for network development in various combinations of training, testing and Cross Validation (CV) sets.

Table number 1 gives idea about combinations taken in to consideration during model formation. We put total 10 CV cases for combination 1. Similarly for combinations 2, 3, 4, 5 we have to put values for CV as 13, 15, 17 and 20. Similarly testing cases for each combination vary from 30, 25, 20, 15, 10 and 4 respectively. After deciding CV and testing values software directly takes training value automatically. After the

text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper.

TABLE 1 CASES COMBINATIONS

Sr. No	Combination	Training	CV	Testing	r Value
1	1 a	60	10	30	0.4930
2	1 b	65	10	25	0.4475
3	1 c	70	10	20	0.5972
4	1 d	75	10	15	0.6887
5	1 e	80	10	10	0.8721
6	1 f	86	10	4	0.9817
7	2 a	57	13	30	0.5113
8	2 b	62	13	25	0.5517
9	2 c	67	13	20	0.5769
10	2 d	72	13	15	0.6471
11	2 e	77	13	10	0.8673
12	2 f	83	13	4	0.9908
13	3 a	55	15	30	0.5319
14	3 b	60	15	25	0.5635
15	3 c	65	15	20	0.5793
16	3 d	70	15	15	0.5999
17	3 e	75	15	10	0.8673
18	3 f	81	15	4	0.9908
19	4 a	53	17	30	0.5225
20	4 b	58	17	25	0.5761
21	4 c	63	17	20	0.5823
22	4 d	68	17	15	0.6131
23	4 e	73	17	10	0.8113
24	4 f	79	17	4	0.9908
25	5 a	50	20	30	0.4342
26	5 b	55	20	25	0.5836
27	5 c	60	20	20	0.5925
28	5 d	65	20	15	0.6166
29	5 e	70	20	10	0.8111
30	5 f	76	20	4	0.9908

Graph plotted for desired and actual network outputs generated by testing of the cases shown by figure number 3. It shows the relation between actual value which we provide and predicted output generated by the network combination. It is observed that all the six cases have nearly same values of actual and desired outputs. These combinations are 1f, 2f, 3f, 4f, 5f. But Mean Square Error value for combination 5f is coming smallest rather than for any other combinations.

TABLE 2 PERFORMANCE PARAMETRS OF SELECTED COMBINATION

Performance	RATE
RMSE	1136.25117
NRMSE	0.039181075
MAE	1083.135933
NMAE	0.037349515
Min Abs Error	500.0049664
Max Abs Error	1500.011893
R	0.990895588
Score	96.66483336

TABLE 2 TRAINING AND CV MSEVALUES

Minimum Training MSE	Minimum Cross Validation MSE
0.00114324	0.00619393

Table 2 and table 3 gives the performances statistics for the 30th case i.e. 5f with 0.990895588 R value as seen in table 1.

VI. OBSERVATIONS

Following are the observations obtained from Neuro-solutions software, it is observed that: Total 30 combinations were tried to obtained perfect prediction model.5f is the most satisfactory combination observed. For this combination out of the hundred and fifty cases, 76 cases are given for training, 20 for cross validation and 4 for testing. This combination is closer to the optimum results in terms of rate of production and correlation coefficient. Compared with other combinations, Table 2 gives idea about correlation coefficient for combination 5f is 0.990895588. Most accurate result we get it for 5f combination. Table 2 also gives values of Root Mean Square Error (RMSE) which is acceptable. Table 3 shows values of training Mean Square Error (MSE) and CV MSE which is well below zero which is expected.

VII. CONCLUSION

A. Neuro Solutions provides excel add in, data feeding becomes easier also it is user friendly software.

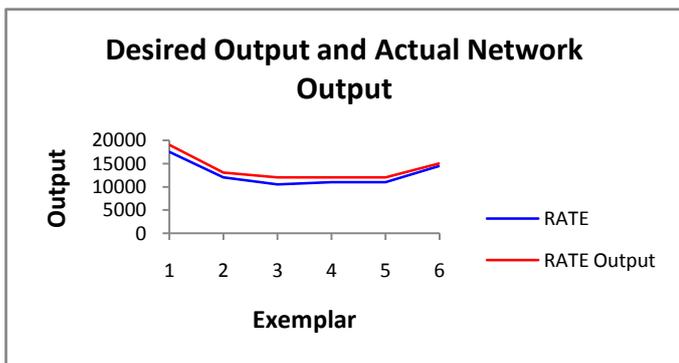


Fig 3. Comparison of desired and actual network outputs

- B. For final model we include 5 input processing elements, 3 processing elements in hidden layer and one output parameter.
- C. Number of epochs considered as 1000. Training is terminated at CV MSE.
- D. For combination 5f we get optimum solution.
- E. The sequence of cases when kept as testing, cross validation and then training, the network gives higher prediction rate and hence it is identified as optimum sequence.
- F. From table no 1 we can observed that 5f combination shows desired output with higher correlation coefficient of corresponding testing cases.
- G. In 5f combination first 76 cases given for testing, next 20 for cross validation and last 4 for training.
- H. This model should be used in predicting the value of commercial properties in Pune city. This model is basically designed for commercial properties in Pune.
- I. Maximum rate of prediction is 97% for 5f combination.
- J. Neural networks is an effective tool for any prediction problem and hence should be explored more to figure out its applicability in various fields.
- K. This model can be used to effectively predict value of commercial property in Pune. Similar model can be developed for other cities as per their globalization.

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