

House Price Prediction at West Bengal using Fuzzy Inference System

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Abstract House and Flat are very big investment and once in lifetime for everyone particularly middle class family. House or flat at different locations and prices have different stamp duty, resale value, returns on investment. So, it is vital to predict right house and flat before buying. Prediction of house price not only helps the buyers but also help bankers, investors. House or flat price depends on various factors. In this paper, authors built an expert system to predict house price at West Bengal using Fuzzy Inferences system based on five inputs such as Area types, Facilities, Number of floors, Road Width, Industries. Also, discusses about the variation of flat prices based on different inputs or factors.

Keywords —House, Bankers, Expert System, Predict House Price, Fuzzy Inferences System

I. INTRODUCTION

Land and House are most valuable and important investment for every person. House is one of the basic needs as it is used as a place for rest and gathers with family [1]. So, predicting house or land price is very crucial for potential buyers or investors as it can be a wrong investment. House price prediction also important for banker as it help in loan approval [2]. House or land price depends on various factors like locality, rental return, urban or rural, registration charge, property tax, big industries, pollution level, condition of the house, number of floors, age of the house, basic facilities available or not such as public health services, big institutions, transportation and other facilities. House price also dependent on availability of lift, kitchen, garage, quality of material used. Some factors that effect the selling price or sell rate of house or flat which are inflation, monetary policy, availability of loan from banks, emergency situation like recession, war etc.

Real estate sector contribute 6-7% of Indian Gross Domestic Product (GDP) and it is expected it will contribute 13% by end of 2025[11]. In 2017, Indian real estate market standing at \$120 million and it is expected that it will touch \$1 trillion on 2030[12]. Sell and resale of a flat and House depend on various factors like increase in population in metro areas, migration from one place to another etc. Sometimes number of flat sell increase rapidly also sometimes it decreases. At 2008 (US homes crisis), we see decreases in flat unit sells [13]. In 2016-2017 number of flats sells decreases rapidly due to demonetization, GST and RERA, act against benami property. It is expect to increase flat sell as government decreases stamp duty, rate of interest in Home loan or work from home culture increases day by day due to revolution in telecom sector. It is expected that flat for low income groups will be sold more than other group as government already take initiative to house for all by 2022. It is also predicted that flat sell will increase in tier II or tier III cities than tier I. Price of flat increases rapidly from 2011 but now it increases very slowly. Different professional and industries associate with real estate like engineers, builders, architects, material suppliers, laborer, carpenters, brokers, real estate agents etc. Real estate also contributes to generate a big job sector for unorganized labour [4]. There are more than 250 industries depends on real estate industries.

There are few issues which faced both Builder and Consumers. Consumers facing delay to get the flat due to various reasons like finance instability of the builders, delay in getting approval from various departments, different disaster like Amphan or tsunami, court cases for various issues. It leads to consumers into huge financial loss as consumers have to pay both rent and EMI. Sometimes builders promoted their project fraudulently which leads to consumer unsatisfied as there are no standard guidelines and regulations. In default cases consumers have to pay 16%-18% where a builder pays only 2%-3%. Builder also faced many difficulties to built the project like approval from various departments, land conversion from various types and divisions, lack of finance as banks various restriction due to bad loan, cost of material also increase hugely compare to flat price.



II. LITERATURE REVIEW

Muhammad Fahmi Mukhlishinet. al. try to predict house and land price in Indonesia, where input variables are Sales Value of Taxable Object Building, House Age, House Condition, Sales Value of Taxable Object Land, Strategic Value of Land Location Variable and Output variables are Predicted house and land price[1]. Ruth Ema Febrita et. al. predict the house price as cheap, medium, expensive and very expensive where input variable are boundaries, distance to the center of the city, hospital, pharmacy, school, campus, traditional market or mall, hotel, restaurant, recreational park, public transportation and worship places [2].

Ayush Varma et al. predicted house price at Mumbai using Machine Learning, Linear Regression and Neural Networks [5]. They used various parameters like lift availability, parking availability, number of bedrooms, types of flooring, sq. ft. area, furnishing condition also consider local amenities like schools, temples, hospitals, parks, supermarkets, major stations etc. They used Google API to compare neighbor property and search localities.

There are some limitation also as it predict house price only in Mumbai. So, this model would not work outside Mumbai.

Lipo Wang et al. predicted house price at Singapore using Delayed Neural Networks with nine independent economic and demographic variables [3]. They consider six factors to predict flat price which are floors, number of rooms, duration of elapsed lease, Area of floor space, distance from nearest station and distance to the nearest school.

People lend loan from bank for buy a house. Sometimes lenders are not able to pay their EMI. So, bank authorities should verify whether the property can be resale to get the due money. In [8], author estimate whether a property can be sale based on G value using six features which are distance from city, price per sq. ft., near metro station, furnished with gas, proper document and well maintenance. If G score greater than or equal to 0.39 then high chance of property to be resale otherwise low chance to resale.

RN Shen et al. predicted house price in Shanghai using Support Vector Machine [9]. They used PCA to reduce dimension and perform better in accuracy. It perform better with experiments as this CNN model used different feature like per capita income of china, real estate development investment, GDP and many other important features.

Sifei Lu et al. predicted house price using different machine learning and classification algorithm like Logistic Regression, Decision Tree, Naive Bayes and Random forest and used AdaBoost for boosting up the weak learner to strong learner [7].

The Danh Phan predict house price at different location of Melbourne City, Australia using machine learning [6]. Gradient Boosting Model XG Boost used to predict the house prices. They used machine learning on 38961 records which is available publicly and train model with 80% of record. Twenty features are used in this model.

III. PROPOSED MODEL

In this paper, an expert system is built to predict house price per square ft. at West Bengal using fuzzy inference system. There are five inputs which are considered for predicting house price per square ft. These Five inputs are Area Types, Facilities, Number of Floors, Road Width, Industries and one output is Rate per sq. ft.

A. Input and Output with Membership Function

House price prediction per square ft. implemented using MATLAB software [10] with input output and membership function as in Table-1.

Here facilities include lift, car parking, swimming pool, gym, play ground, indoor play ground, auditorium etc. and industries includes IT hub, school, college, university, nearby stations, big industries etc.

IV. RESULTS AND DISCUSSION

We have predicted the rate per square feet and also calculated the approximate market value of a flat in West Bengal, India on different input parameters and facilities in Table-4.

One can by flat on the basis of the rate and cost calculated in Table-4 and the buyer would not be deceived. Input $[0\ 0\ 0\ 0]$ means area types is rural or very low urban with minimum road width and Number of floors. There are no facilities and no industries. This expert system predicts Rs.2205/- per square feet. A flat around 900 square feet would cost Rs 19, 84,500/-.

Input [10 10 10 10 10] means area types is very high urban with maximum road width and number of floors. There are huge facilities with big industries. This expert system predicts Rs.10032/- per square feet. A flat around 900 square feet will cost Rs 90,28,800/-. Rest inputs are varying from area types to facilities, road width, number of floor etc. So cost also predict differently based on given input.

So as per expert our system a 900 square feet flat will cost between Rs- 19,84,500/- to Rs. 90,28,800/- based on different input in West Bengal, India.

Table-1:Input with	Membership Function
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Input	Membership Function				
Area Tupes	MF1='Rural_or_Low_Urban', [-4 0 3]				
Alea Types	MF2='Semi_Urban', [3 5 7]				
	MF3='Urban', [6 10 14]				
Facilities	MF1='Low', [-4 0 4]				



	MF2='Medium', [3 5 7]			
	MF3='High', [6 10 14]			
Number of Floors	MF1='4-5', [-4 0 2]			
	MF2='6-9', [1 3 5]			
	MF3='10-15', [4 6 8]			
	MF4='16-50', [7 9 12]			
Road width in ft.	MF1='12-16', [-4 0 2]			
	MF2='16-20', [1 3 5]			
	MF3='20-35', [4 6 8]			
	MF4='35-50', [7 9 12]			
Industries	MF1='Low', [-4 0 3]			
	MF2='Medium', [2 4 6]			
	MF3='High', [5 10 14]			

Table-2: Output with Membership Function

Output	Membership Function				
Rate per square ft.	MF1='Very_Low', [2000 2200 2400]				
	MF2='Low', [2390 2650 2810]				
	MF3='Medium', [2800 3200 3510]				
	MF4='High', [3500 4300 5010]				
	MF5='Very_High', [5000 6000 7010]				
	MF6='Expensive', [7000 8000 9010]				
	^{.esearch} ir MF7='Very_Expensive', [9000 10000 11100]				

Table-3: Rule for Predicting House Price per Square ft

~ ~ ~				-		-
S.No	Area	Facilities	Number of	Road	Industries	Rate
	Type		Floor	Width		
	Type		11001			
1	RLU	L	44685	42705	L	VL
	-					
2	RLU	М	44685	42705	L	VL.
-	1120				-	• 22
3	RIII	I	44685	42705	М	VI
5	REC	L	44005	42705	141	12
4	DIII	м	11695	42705	м	T
4	KLU	IVI	44065	42703	IVI	L
E	DLU	TT	11695	42705	м	т
3	KLU	н	44085	42705	IVI	L
6	CLI	Ŧ	11605	10705	T	X / X
6	SU	L	44685	42705	L	٧L
_					_	_
7	SU	М	44685	42705	L	L
8	SU	L	44685	42705	М	L
9	SU	М	44685	42705	М	L

10	SU	Н	44685	42705	L	L
11	SU	Н	44685	42705	М	М
12	SU	М	44810	16-20	L	М
13	SU	М	44810	16-20	М	Н
14	SU	М	44810	16-20	Н	VH
15	SU	Н	44810	16-20	Н	VH
16	SU	М	44810	20-35	L	М
17	SU	М	44810	20-35	М	VH
18	SU	Н	44810	20-35	М	VH
19	SU	Н	44810	20-35	Н	VH
20	SU	М	44810	35-50	М	VH
21	SU	Н	44810	35-50	М	VH
22	SU	Н	44810	35-50	Н	VH
23	SU	М	42278	20-35	М	VH
24	SU	Н	42278	20-35	М	VH
25	SU	Н	42278	20-35	Н	VH
26	SU	Н	42278	35-50	М	VH
27	SU	Н	42278	35-50	Н	Е
28	SU	М	16-50	35-50	М	Е
29	SU	Н	16-50	35-50	М	Е
30	SU	Н	16-50	35-50	Н	Е
31	U	L	44685	42705	L	М
32	U	L	44685	42705	М	Н
33	U	М	44685	42705	М	Н
34	U	Ht	44685	42705	М	Н
35	U	е н	44685	42705	Н	VH
36	U	M	44685	16-20	М	VH
37	U	M	44685	16-20	Н	VH
38	U	H	44685	16-20	Н	VH
39	U	М	44685	20-35	М	VH
ineerin	U	Н	44685	20-35	М	VH
41	U	М	44685	20-35	Н	VH
42	U	Н	44685	20-35	Н	VH
43	U	М	44685	35-50	Μ	VH
44	U	Н	44685	35-50	Μ	VH
45	U	Н	44685	35-50	Н	Е
46	U	М	44810	16-20	М	VH
47	U	Н	44810	16-20	М	VH
48	U	М	44810	16-20	Н	E
49	U	Н	44810	16-20	Н	Е
50	U	М	44810	20-35	М	VH
51	U	Н	44810	20-35	М	VH
52	U	М	44810	20-35	Н	Е
53	U	Н	44810	20-35	Н	Е
54	U	М	44810	35-50	М	VH
55	U	Н	44810	35-50	М	Е
56	U	Н	44810	35-50	Н	VE
57	U	М	42278	20-35	М	VH



58	U	Н	42278	20-35	М	Е
59	U	М	42278	20-35	Н	Е
60	U	Н	42278	20-35	Н	VE
61	U	М	42278	35-50	М	Е
62	U	Н	42278	35-50	М	Е
63	U	М	42278	35-50	Н	Е
64	U	Н	42278	35-50	Н	VE
65	U	М	16-50	35-50	М	Е
66	U	Н	16-50	35-50	М	VE
67	U	М	16-50	35-50	Н	VE
68	U	Н	16-50	35-50	Н	VE

V. CONCLUSION

Houses and flats are most important place to spend one's spare time and one can invest once in a life time. So without the prior knowledge of the facilities and costs, the investment might be very risky. In this paper the flat rates per square feet all over West Bengal have been calculated based on different factors also compared a same size flat rate based on different input. So, the buyer can have a look the rates and costs predicted before buying flat in the state. But there is some limitation as in this paper only consider flat rate but not home. Investment on flat will consider not only factor which is discuss in this paper but it may add other factors. This model may not predict the proper rate and cost after 2 or 3 years due to the change of input parameters.

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