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Valuation of Residential Property Using Multiple Regression Analysis and Comparative Study with Traditional Methods

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ABSTRACT: Valuation is a skill that has been used to a variety of fields. When it comes to property value, however, it is rarely limited to the realm of engineers and architects. Based on the factors affecting the value of the property, the market value of a residential building in Indrali, Udipi, Karnataka State, India is projected using Multiple Regression Analysis (MRA). This value is then compared to values produced using traditional valuation methods such as the Land and Building technique, Rental Income Approach, Composite Rate method, and comprehensive estimation method. The property under valuation has a plinth area of 2069 square feet and is situated on 2177.85 square feet of freehold land. Multiple Regression Analysis (MRA) predicts a 17.21 percent difference in market value when compared to the Land and Building method, a 3.14 percent difference when compared to the Rental Income approach, a 1.37 percent difference when compared to the Composite Rate method, and an 20.86 percent difference when compared to the detailed estimate method. The benefit of employing MRA is that it employs statistical modelling, which eliminates the possibility of human bias and inaccuracy.

I. INTRODUCTION

Valuation is the skill of calculating the present value of any commodity or property based on past experience, logic, statistical data, and common sense at a specific moment. It just makes an attempt to recommend reasonable costs. Valuation is not a random procedure. It is based on particular facts, and we can only offer value or a fair price for the property after intelligent processing of such data and suggestions. The fair price can rise and fall in a very short period of time. Because time is the core of all appraisals, all valuations must clearly specify the date to which the valuation applies. It is a monetary estimation of the value of a given object. It is founded on a number of facts and considerations. Valuation of various sorts of assets is required for a variety of reasons. The individual valuing must have a clear understanding of the cost, price, value, and valuation's purpose. Valuation is critical for determining the value of a specific item throughout time or at a specific point in time. The significance of property value to stakeholders varies depending on the reason for appraisal. Traditional methods of property assessment include the Land and Building approach, the Rental Income Approach, the Composite Rate method, and thorough estimation. These methods provide a reasonable estimate of market value, but human bias and mistake are a persistent stumbling block.

II. LITERATURE REVIEW

Under various simulated settings, Zurada J et al. [1] presented a comparative evaluation of four regression-based approaches, including Multiple Regression Analysis (MRA), and three Artificial Intelligence (AI)-based methods. Non-traditional regression-based methods outperformed traditional regression-based methods in all simulated settings, especially with homogeneous data sets. With less homogeneous data sets, the performance of

AI-based approaches were excellent. Using Multiple Regression Analysis, Chaphalkar N B and Dhatunde M [2] investigated the valuation of properties (MRA). The method is helpful because it simulates the relationship between market value and property features, as well as the influence of changes in house attributes on value, and it predicts property worth with greater precision and efficiency than the traditional approach. Bunyan Unel F and Yalpir S [3] used the analytic hierarchy process (AHP) to recreate coefficients that are used to value real estate. A multiple



regression analysis (MRA) valuation model was also used to conduct comparison and performance studies. The application of Multiple Regression Analysis in real estate value for mass property tax assessment was demonstrated by Benjamin J D et al. [4]. The benefit of this method is that it eliminates appraiser bias in the selection of comparables, and the quantity and direction of the modifications are statistically determined by the programme using regression coefficients. In addition, utilising MRA eliminates the risk of human error and the issues associated with small sample numbers. Nallathiga et al. [5] addressed the varieties of stigma and their characteristics, as well as techniques to quantifying sigma, and reported on the dispersion of the stigma effect on property value degradation throughout several regions of India. The paper also examines which part of a property's value has the greatest stigma impact, namely, income yield (Y) or capital value (C). The Y-C matrix illustrates the spread of the stigma effect. The impact of sustainability on market value and the role of the valuer in absorbing the value of sustainable qualities were examined by Myers [6]. According to the author, valuers are recognising a value relationship between sustainability and market value but owing to faulty evaluations and a lack of expertise about sustainability in valuations, they are preventing future investment in sustainability. Based on comprehensive research in the field of valuation, Parmar et al. [7] presented the general field practise of real estate property value. The methodology in this study has been confirmed by a government-approved valuer and a concerned field specialist. Client pressure on property assessment, effects connected to client characteristics, and influences related to specific valuation aims, according to Achu K [8], can be a substantial cause of judgemental bias on portion of the value. E. Pagourtziet al. [9] ANN's, hedonic pricing, spatial analysis, fuzzy logic, and ARIMA model methods were compared against standard ways of valuation such as comparable, cost, income, profit, regression, and contractor's method.

III. MULTIPLE REGRESSION ANALYSIS

Multiple Regression Analysis (MRA) is becoming more prominent in property appraisal due to less human bias and error. Most practitioners and academicians recognise the MRA technique because it has been utilised for a long time. [1]. MRA is based on econometric modelling, or market value fluctuation, which uses a probabilistic framework to mimic market behaviour. [2]. To arrive at an estimate of the unknown parameters, regression analysis can be utilised. There are various factors that influence the value of real estate, each of which has a different impact. [3].

Identification of Independent Variables/Factors

There are two sorts of variables in regression modelling: dependent variables and independent variables. The dependent variable is a factor that is influenced by a number of other factors, one of which being the property's market value. The independent variables, which include both quantitative and qualitative elements, are the other type of variable. Variables such as site size, floor area, building age, number of rooms, number of storeys, and unit level are examined in quantitative attributes. Qualitative elements are variables that cannot be mathematically assessed, such as accessibility to amenities or facilities, view from property, shape, zoning, and so on.

Table 1. Independent Variables

Sl No	Variable	Type	Code
1	Built up area	Quantitative	X1
2	Number of Floors	Quantitative	X2
3	Age of Building	Quantitative	X3
4	No. of Rooms	Quantitative	X4
5	No. of Parking Spaces	Quantitative	X5
6	Plot Shape	Qualitative	X6
7	Location	Qualitative	X7
8	Access Road	Qualitative	X8
9	Nearness to amenities	Qualitative	X9

Property valuation has its own set of challenges and risks because it is a matter of subjective judgement, and opinions differ. A property's market value is determined by a number of elements that can be divided into quantitative and qualitative

categories. Each independent variable must be quantified before MRA may be used to analyse variables. The qualitative characteristics were quantified in the following way for the purposes of this study.

Plots of rectangular shape with clearly defined boundaries are allocated 1, plots of other regular shapes are assigned 2, while plots of irregular shape are assigned 3. Localities with exceptional, good, and ordinary quality of facilities are assigned 1, 2, and 3 for location attributes, correspondingly. A property with a 2-lane concrete or asphalt access road is allocated 1, a property with a single lane concrete or asphalt access road is assigned 2, and a property with an unfinished access road is assigned 3. The properties with access to facilities within a range of 0-3 km are allocated 1, the properties with access to amenities within a range of 3-6 km are assigned 2, and the properties with access to amenities within a range of 6-10 km are assigned 3. These particulars are filled in Table 2.

Application of Multiple Regression Analysis

The independent factors have an effect on the dependent variable. The impact of variables on each other is assessed using regression analysis, which employs statistical modelling. Numerous Regression Analysis (MRA) is a technique for determining the impact of multiple variables/factors on the dependent variable separately as well as the combined effect of all factors on the dependent variable. Data from 20 comparable residential properties in and around Kundapura town were obtained for this study, which are listed in Table 2 and labelled P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20. The regression analysis is carried out using the data obtained from these twenty properties with current valuations, using the 9 independent factors listed in Table 1 as the dependent variables. For the 9 independent variables chosen, the regression equation is as follows:

$$Z = A_0 + A_1X_1 + A_2X_2 + A_3X_3 + A_4X_4 + A_5X_5 + A_6X_6 + A_7X_7 + A_8X_8 + A_9X_9 + E$$

A_0 is the regression constant, which is the Y-intercept, and Z is the dependent variable, which here represents the market value. The independent variables are represented by the words X_1, X_2, X_3, X_9 in Table 1. The regression coefficients $A_1, A_2, A_3, \dots, A_9$ represent the change in the value of the dependent variable when the independent variable is changed by one unit while all other variables remain constant. The error term (E) describes the effect of all factors on the dependent variable other than the independent variables [4]. Multiple Regression Analysis (MRA) is performed using Microsoft Excel, and data is entered into the programme. Table 2 shows the regression data. Table 2.

Regression Data

Property	Market Value	Area (Sft)	No. of Floors	Age of Building (years)	No. of Rooms	Shape	No. of Parking	Location	Access road	Access to amenities
P1	18,05,001	973	1	2	2	1	1	3	2	2
P2	19,79,440	988	1	4	2	0	1	2	2	2
P3	20,10,010	1098	1	3	2	0	0	2	2	2
P4	21,28,700	1180	1	8	2	1	1	1	2	2
P5	25,61,800	1325	1	5	2	1	2	1	2	1
P6	26,98,900	1443	2	10	3	1	1	2	1	1
P7	28,63,500	1477	2	2	4	1	1	3	2	2
P8	31,67,800	1575	2	7	3	1	2	2	1	1
P9	31,99,307	1717	2	9	3	1	1	1	1	2
P10	35,11,800	1788	2	8	3	2	2	1	1	2
P11	33,02,250	1980	2	2	4	2	2	2	2	2
P12	40,03,000	2067	2	1	5	2	3	2	1	1
P13	50,52,800	2352	1	5	3	1	2	2	2	2
P14	53,80,011	2490	1	3	4	1	2	2	2	1
P15	59,63,100	2685	1	1	4	2	2	2	3	1
P16	61,44,900	2730	3	2	4	2	2	1	2	2
P17	65,80,805	2875	1	4	5	2	2	2	1	2
P18	68,73,600	2955	2	5	5	2	2	2	2	2
P19	72,96,900	3130	2	3	6	4	1	2	2	1
P20	78,72,550	3355	2	1	6	4	2	2	2	2

Table 3. Regression Statistics

Multiple R	0.991484694
R Square	0.983041899
Adjusted R Square	0.967779609
Standard Error	356054.0161
Observations	20

Table 4. ANOVA Analysis

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	9	7.34897E+13	8.16552E+12	64.4098531	1.14038E-07
Residual	10	1.26774E+12	1.26774E+11		
Total	19	7.47575E+13			

Table 3 reveals that the multiple regression value is 0.99, showing a good relationship between the dependent and independent variables. The R square coefficient of determination is 0.986, meaning that the combined effect of 9 independent factors explains 96.7 percent of market value variation. The standard error, which represents market value fluctuations, is 356054.01.

Table 4 shows the results of the ANOVA analysis. The F statistic is 64.4098, which is the ratio of Mean Square (MS) Regression to Mean Square Residual. For the test to be significant, the Significance F value must be less than the F statistic. The value of Significance F is lower than the F statistic, as shown in the ANOVA table. As a result, the test is important. Table 5 shows the final regression table.

Table 5. Final Regression Table

	<i>Coefficients</i>	<i>Standard Error</i>	<i>T Stat</i>
Intercept	2986558.152	1003984.403	2.974705725
Area(sft)	-386.3048142	510.0430871	-0.75739643
No. of floors	60683.51926	376174.1946	0.161317603
Age of building(years)	-21787.94351	30374.95802	-0.71729954
No. of rooms	796179.7163	218572.0079	3.642642641
No. of parking	-504475.8232	152391.0699	-3.31040279
Shape	599329.8252	246116.8267	2.43514364
Location	-657411.9099	235280.2785	-2.79416496
Access Road	-214243.095	276701.8551	-0.77427416
Nearness to amenities	-167304.9508	160393.0016	-1.04309383

The Regression Equation would be based on the final Regression Table 5.

$$Z = 2986558.152 - (386.304 \times X_1) + (60683.519 \times X_2) - (21787.943 \times X_3) + (796179.716 \times X_4) - (504475.823 \times X_5) + (599329.825 \times X_6) - (657411.909 \times X_7) - (214243.095 \times X_8) - (167304.950 \times X_9)$$



IV. VALUATION BY CONVENTIONAL APPROACHES AND MRA

The value of a residential building in Udupi (P0) is calculated using traditional methods such as the Land and Building method, Rental Income Approach, Composite Rate method, and thorough estimation. MRA is used to determine the value of the same property. The details of the property (P0) are shown in Table 6.

Table 6. Details of Property (P0)

LandExtent=2177.85sft	Plinthareaconstructed=2069sft
AgeofBuilding=1 year	No.offloors=2
No.ofRooms=5	No.ofparkingspaces=1
PlotShape-RegularShape	Location-Good
AccessRoad-1lanewithasphaltfinish	Nearnesstoamenities=5km

LandandBuildingMethod

In this technique, the property is valued separately in terms of land, building, and facilities, with the final assessment amount equal to the total of land, building, and amenities after depreciation of the building and amenities. In the current circumstance, the total worth of the subject property (P0) based on land and construction techniques is INR 68,02,000/-. (Rupees Sixty-eight Lakh two Thousand Only)

RentalIncomeApproach

This method involves determining the entire income that the property can provide based on current market rent and capitalising it using the rate of return. The overall value of the subject property (P0) by rental revenue technique is INR 600000/- in the current scenario (Rupees Sixty Lakh Only)

CompositeRateMethod

The valuation is done using this method by calculating the building's composite rate. This composite rate is derived in comparison to a nearby comparable building. Depreciation is also taken into consideration. By using the composite rate technique, the value of the subject property (P0) is INR 5880000/-. (Rupees Fifty-eight Lakh eighty Thousand Only)

ValuationbyDetailedEstimation

Valuation is done here by calculating the quantities of various kinds of work. For each item, a current rate analysis is performed. All work that has a value is calculated, and the entire valuation is equal to the sum of the individual work's worth. Wherever possible, depreciation is taken into account. Then there's the land value component. According to the detailed estimation approach, the property (P0) is worth INR 7010000/-. (Rupees Seventy-Lakh ten Thousand Only)

ValuationbyMultipleRegressionAnalysis(MRA)

Makinguseof theregressiononequationobtainedfromTable5,

$$Z == 2986558.152 - (386.304 * X_1) + (60683.519 * X_2) - (21787.943 * X_3) + (796179.716 * X_4) - (504475.823 * X_5) + (599329.825 * X_6) - (657411.909 * X_7) - (214243.095 * X_8) - (167304.950 * X_9)$$

$$Z = 2986558.152 - (386.304 * 2069) + (60683.519 * 2) - (21787.943 * 1) + (796179.716 * 5) - (504475.823 * 1) + (599329.825 * 1) - (657411.909 * 1) - (214243.095 * 1) - (167304.950 * 1)$$

$$Z = 57.73,665.214 \approx 5800000 \quad (\text{Rupees Fifty-eight Lakh Only})$$

The values obtained by various methods of valuation are tabulated in Table 7.



Table 7. Comparison of values obtained by different approaches

Valuation approach	Market Value (INR)	Variation w.r.t MRA (INR)	% Variation
Multiple Regression Analysis (MRA)	5800000	0	0
Land & Building Method	6802000	1002000	17.21
Rental Income Approach	600000	200000	3.44
Composite Rate method	5880000	80000	1.37
Detailed estimation	7010000	1210000	20.86

V. CONCLUSION

Table 7 shows that the market value predicted by Multiple Regression Analysis (MRA) varies by 17.21% when compared to the Land and Building method, 3.44 percent when compared to the Rental Income approach, 1.37 percent when compared to the Composite Rate method, and 20.86 percent when compared to the detailed estimate method. The property's fair market value is estimated to be around Rs 6000000/- Quantifying qualitative traits is difficult because opinions are subjective and might differ from person to person. MRA assists in determining the effect of each characteristic on the dependent variable, as well as the total effect of all attributes. The dependability factor of results obtained by Multiple Regression Analysis (MRA) can be increased by assessing more sets of data. Furthermore, the valuer's perception is extremely significant and subjective in traditional techniques. As a result, the percentage variation may change depending on the circumstances.

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