International Journal of Innovative Research in Engineering & Management (IJIREM)
ISSN: 2350-0557, Volume-3, Special Issue-1, April-2015
Fifth National Conference on Innovative Practice in Construction Waste Management (IPCWM'15) On 8th & 9th April, 2015
Organized by Department of CIVIL Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, India

An Assessment on the Building Demand Forecasting by Linear Regression Analysis

Raghavan T.R
Assistant Professor
Sri Ramakrishna Institute of Technology
Coimbatore.

SindhuVaardini U
Assistant Professor
Sri Ramakrishna Institute of Technology
Coimbatore.

ABSTRACT
An accurate forecasting of prospective building demand in a developing city with high growing population is always a useful task for the socio-economic improvements all along the city. It also involves in the welfare and improvement of the people of all categories. Despite that, a realistic forecasting of all types of buildings (incl. residential, commercial, and governmental) is never an easy task, as it governed by a number of social and economic factors. In this project a leading indicator model is developed especially for the demand forecasting of all type of buildings in Erode city, District headquarters of Erode District, Tamilnadu. This study comprises factors and statistics required for the Linear regression analysis.

Keywords
Forecasting, Building Demand, Regression models, LRA.

1.INTRODUCTION
The effects of population growth are varied and vast. While population growth, of any species, may be beneficial to a certain extent, there may come a time when the number in the population exceeds the natural resources available to sustain it. This is referred to as overpopulation. The consequences of such an event are severe and major.

As the population grows the opportunities for quality, available housing may become an issue. More people crowded into less space is not a good combination in any locality. As space is taken up, it becomes more valuable. Eventually, it begins to affect to poorest in the area. In the long run the effect of population growth may be substandard housing or homelessness.

Cost of living is Higher- when land is limited in a country and population grows rapidly the cost of housing becomes expensive. Sometimes it is very difficult for people earning upper middle income to buy a decent home.

2.URBANISATION
According to the 2001 Census, Tamil Nadu has the highest level of urbanisation (43.86%) in India, which accounts for 6% of India's total population and 9.6% of the urban population. It has 10 corporations, namely Chennai, Madurai, Coimbatore, Trichy, Salem, Tirunelveli, Erode, Tirupur, Vellore and Thoothukudi.

Due to the development of the globalization, peoples are eager and wish to settle in cities. So most of the people after been graduated, moves into the cities and settled down.

3.OBJECTIVE OF THE STUDY
Regression Analysis (LRA) model. The search through past history expresses that LRA model provides that most accurate forecasting for a long time horizon. In providing a random of possible forecasts, the LRA model also paves way for an opportunity of selecting mere possible and accurate forecasting for the decision-makers. This study provides exhaustic empirical research and detailed study (both macro and micro level) of past statistics and current statistics by combining with the future prediction of building growth in the city. This will give an alarming indication to the government authorities about the rapid demand in all type of building in the city.

A Study on the building demand forecasting for a Satellite Town through Artificial Neural Network (ANN) by developing a Linear Regression Analysis (LRA) model in it.

4.NEED FOR THE STUDY
- According to the 2011 land survey, 83.25% of the ERODE municipal area has been developed along the road side in all major road .
- According to the 2011 census, ERODE city population is increasing by 11% annually and it seems mear impossible to provide a shelter for both the residents and commercial peoples of the city.
- This building demand forecasting will overview and predict the year, in which population of the city exceeds beyond the building capacity.

5.STUDY AREA DESCRIPTION
Erode District lies on the extreme north of Tamil Nadu. It is bounded mostly by Karnataka State and also River Palar covers pretty long distance. To the East lies Namakkal and Karur Districts. Dindigal District is its immediate neighbour to the South and on the West, it has Coimbatore and Nilgiri Districts, as its boundaries. Thus Erode District is essentially a land-locked area having no sea-cost of its own. Erode District situated at between 10 36" and 11 58" North Latitude and between 76 49" and 77 58" East Longitude.

Erode district had a population of 22,59,608 as of 2011. It is 46.25% urbanized as per census 2001. The district has a literacy rate of 72.96% and is on the rise. Erode is the largest city in the district followed by Gopichettipalayam which is another major center.

Table 1. Population As Per Census 2011

Erode City	Total	Male	Female
Population	156,953	78,094	78,859
Literates	126,638	66,307	60,331
Children (0-6)	13,675	6,935	6,740
Average Literacy (%)	88.39	93.18	83.65
Sex ratio	1010		
Child S Sex ratio	972		

Table 2. Population of the District Decennial Growth

PERIOD (subject to the period of availability)	REGION	POPULATION	PERCENTAGE VARIATION SINCE PREVIOUS CENSUS
1991-2001	Total	2016582	11 %
	Rural	1028983	-21 %
	Urban	987599	108 %

6. AREA OF THE ERODE DISTRICT

Area - 2198sq.miles (5692 sq.kms) (whole district)

6.1 Area of the Erode City

Rural Area - 287sq.miles ($MILES^2$) (743 sq.kms)

Urban Area - 3.22sq.miles ($MILES^2$ (8.34 sq.kms)

7. FACTORS IDENTIFICATION

There is a close relationship between the increase in population and building demand of a particular region. The building demand forecasting of a particular region will be based on may criteria and data, which includes the past history and statistics about the building demand relation with population. The increase in population paves way for the construction and emerging of Residential, Industrial, Commercial and Public Offices.

Some of the factors considered as necessary data for finding the building demand forecasting are as follows:

- ✓ Free space available inside the city (private & public)
- ✓ Population of the city
- ✓ Percentage of population of the city Increased/Decreased yearly
- ✓ Population of the whole city
- ✓ Percentage of Area of the city Increased/Decreased yearly
- ✓ Number of Residential buildings in the city
- ✓ Number of Governmental buildings in the city
- ✓ Number of commercial buildings in the city
- ✓ Capacity of the buildings as per the codal provision & raw data

8. METHODOLOGY :

- Literature collection
- Review of literature
- Selection of parameters
- Data collection
- Data analysis using spss
- Developing lra model
- Results and discussions

9. DATA COLLECTION AND ANALYSIS

9.1 Population of the Erode City

- 2011 - 5,21,776 peoples
- Male - 2,61,470 peoples (82.2%)
- Female - 2,60,306 peoples (72.42%)
- Ratio - 996 Females **:** 1000 Males

Table 3. Buildings Constructed under Public Sector

YEAR	MODE	ROOM SIZE	TOTAL
2006-2007	Panchayat Union	1-4 units (OR) more	668
	Municipalities	1-4 units (OR) more	15
	Government Offices	1-4 units (OR) more	169
	TOTAL		**852**

Table 4. Buildings Constructed under Private Sector

YEAR	NAME OF THE SECTOR	TOTAL NUMBERS	NO.OF RESIDENTIAL BUILDINGS	NO.OF NON-RESIDENTIAL BUILDINGS	TOTAL
2007-2008	Municipalities	11	1457	114	1571
	Town Panchayats	53	2414	229	2643
	TOTAL	**64**	**3871**	**343**	**4214**

10. DEMAND FORECASTING TOOLS

10.1 Linear Regression Analysis

In statistics, **linear regression** is an approach to model the relationship between a scalar dependent variabley and one or more explanatory variables denoted X. The case of one explanatory variable is called simple linear regression. For more than one explanatory variable, it is called multiple linear regression. (This term should be distinguished from multivariate linear regression, where multiple correlated dependent variables are predicted,[citation needed] rather than a single scalar variable.)

In linear regression, data are modeled using linear predictor functions, and unknown model parameters are estimated from the data. Such models are called linear models. Most commonly, linear regression refers to a model in which the conditional mean of y given the value of X is an affine function of X. Less commonly, linear regression could refer to a model in which the median, or some other quantile of the conditional distribution of y given X is expressed as a linear function of X. Like all forms of regression analysis, linear regression focuses on the conditional probability distribution of *y* given *X*, rather than on the joint probability distribution of *y* and *X*, which is the domain of multivariate analysis.

10.2 SPSS

SPSS Statistics is a software package used for statistical analysis. Statistics included in the base software:

- ✓ Descriptive statistics: Cross tabulation, Frequencies, Descriptives, Explore, Descriptive Ratio Statistics
- ✓ Bivariate statistics: Means, t-test, ANOVA, Correlation (bivariate, partial, distances), Nonparametric tests
- ✓ Prediction for numerical outcomes: Linear regression
- ✓ Prediction for identifying groups: Factor analysis, cluster analysis (two-step, K-means, hierarchical), Discriminant

SPSS Statistics places constraints on internal file structure, data types, data processing, and matching files, which together considerably simplify programming. SPSS datasets have a two-dimensional table structure, where the rows typically represent cases (such as individuals or households) and the columns represent measurements (such as age, sex, or household income). Only two data types are defined: numeric and text (or "string"). All data processing occurs sequentially case-by-case through the file. Files can be matched one-to-one and one-to-many, but not many-to-many.

TABLE 10.2.1 CORELATION MATRIX

FOR RESIDENTIALBUILDING

		Buildings Constructed	Total number of population	Percentage (%) of population Increased	Percentage (%) of area decreased
Buildings Constructed	**Pearson Correlation**	1	.011	.774	.797
	Sig. (2-tailed)		.986	.125	.107
	N	5	5	5	5
Total number of population	**Pearson Correlation**	.011	1	.571	.517
	Sig. (2-tailed)	.986		.314	.372
	N	5	5	5	5
Percentage (%) of population Increased	**Pearson Correlation**	.774	.571	1	.871
	Sig. (2-tailed)	.125	.314		.054
	N	5	5	5	5
Percentage (%) of area decreased	**Pearson Correlation**	.797	.517	.871	1
	Sig. (2-tailed)	.107	.372	.054	
	N	5	5	5	5

The following equations for all the three types of buildings have been formed from the collected data.

SIMULTANEOUS LINEAR EQUATION FORMAT

$Y = a_0 + a_1x_1 + a_2x_2 + a_3x_3$

$£y = a_0 + a_1£x_1 + a_2£x_2 + a_3£x_3$

$£x_1y = a_0£x1 + a_1£x_1^2 + a_2£x_2x_1 + a_3£x_1x_3$

$£x_2y = a_0£x_2 + a_1£x_1x_2 + a_2£x_2^2 + a_3£x_2x_3$

$£x_3y = a_0£x_3 + a_1£x_1x_3 + a_2£x_2x_3 + a_3£x_3^2$

RESIDENTIAL BUILDING EQUATION :

$1502=5a_0+21.24335a_1+51a_2+11a_3$

$6387.3744=21.24335a_0+92.33095841a_1+217.0854a_2+47.20627a_3$

$15457.5=51a_0+217.0854a_1+520.44a_2+112.47a_3$

$3486.6=11a_0+47.20627a_1+112.47a_2+24.6a_3$

NON-RESIDENTIAL BUILDING EQUATION :

$244=5a_0+21.24335a_1+51a_2+11a_3$

$1107.8304=21.24335a_0+92.33095841a_1+217.0854a_2+47.20627a_3$

$2510=51a_0+217.0854a_1+520.44a_2+112.47a_3$

$578=11a_0+47.20627a_1+112.47a_2+24.6a_3$

GOVERNMENT BUILDING EQUATION :

$673=5a_0+21.24335a_1+51a_2+11a_3$

$2934.5038=21.24335a_0+92.33095841a_1+217.0854a_2+47.20627a_3$

$6885.8=51a_0+217.0854a_1+520.44a_2+112.47a_3$

$1502.7=11a_0+47.20627a_1+112.47a_2+24.6a_3$

11. RESULTS AND DISCUSSIONS :

The Total Equation Obtained from Lra Model

BUILDINGS	REGRESSION EQUATION
RESIDENTIAL	$\mathbf{Y = -4679.14 - 164.58X_1 + 487.71X_2 + 320.05X_3}$
NON-RESIDENTIAL	$\mathbf{Y = 1080.72 + 23.25X_1 – 148.83X_2 + 176.09X_3}$
GOVERNMENT	$\mathbf{Y = -614.21 + 28.58X_1 + 66.53X_2 – 23.30X_3}$

Thus. Total equation for each area is developed using SPSS software.

Here,

Y is the dependent variable that represents buildings in demand

$\mathbf{X_1}$ = Population in that area

$\mathbf{X_2}$ = Percentage (%) of Population increased/decreased

than previous year

$\mathbf{X_3}$ = Percentage (%) of Area increased/decreased

than previous year

Methods of linear regression model have been developed for evaluating subsets of independent variables wholly (“best subset” regression), by adding variable one at a time (“forward” selection), deleting one at a time (“backward” elimination) or a combination of these latter two (“stepwise” regression). The stepwise regression was selected. The Linear Regression analysis method is easier to operate and the amount of time required to build a model is shorter.

Thus the results have been obtained by using linear regression analysis. From this analysis we can easily predict the future building demands of Erode city for the year 2013-2018.

12. CONCLUSIONS

Building demand of the erode city increasing rapidly day by day due to the overpopulation (or) increase in population. The increase in floating population are also one of the main reason for the increase in building demand. Thus, the above results (Linear Regression Equation) which shows the building demand forecasting of the city will be very handy in predicting the demand of the city and take the necessary steps to meet the demand.

REFERENCES

1. Refense, A.N.; Zapranis, A. and Francis, G. (1994): “Stock Performance Modelling using Neural Networks: a comparitive study with regression models.” Neural Networks, 7, No.2, PP. 375-388

2. Zheng, D.X.M., NG, S.T. and Kumaraswamy, M.M. (2004) Applying a GA-based multiobjective approach for time-cost optimization. Journal of Construction Engineering and Management, ASCE, 130(2), 168-176.

[3]. Zhang, G. and Hu, M. Y.(1998): “Neural Network forecasting of the British/US dollar exchange rate.” Omega, Vol.26, No. 44, PP. 495-506.

[4]. Tse, R.Y.C., Ho, C.W. and Ganesan, S.(1999) Matching housing supply and demand: an emprical study of Hong Kong’s market, Construction Management and Economics, 17(5), 625-634.

[5]. S. Saravanan, S. Kannan and C. Thangaraj Department of Electrical and Electronics Engineering, Kalasalingam University, India , India’s Electricity Demand Forecast Using Regression Analysis and Artificial Neural Networks based on Principal Components, ICTACT Journal on Soft Computing, july 2012, Volume: 02, ISSUE: 04

[6]. Jan Franklin Adamwoski, Peak Daily water demand fprecast modelling using Artificial Neural Networks, Journal

of Water Resources Planning and Management © ASCE / March/April 2008

[7]. Guoqiang Zhang, B. Eddy Patuwo, Michael Y. Hu*, Forecasting with artificial neural networks:The state of the art, Graduate School of Management, Kent State University, Kent, Ohio 44242-0001, USA Accepted 31 July 1997

[8]. Bassam M. AbuAl-Foul , Economics Department - American University of Sharjah., Forecasting Energy Demand in Jordan Using Artificial Neural Networks

[9]. Noor Yasmin Zainun ,, Ismail Abdul Rahman and MahrooEftekhari , Faculty of Civil and Environmental Engineering, UniversitiTun Hussein Onn Malaysia,. Forecasting low-cost housing demand in Pahang, Malaysia using Artificial Neural Networks

[10]. Ng, S.Thomas and Skitmore, Martin and Wong, Keung Fai (2008), "Linear Regression Analysis", Building and Environment, 43(6), 1171-1184.