



# IJEAST

INTERNATIONAL JOURNAL  
OF ENGINEERING APPLIED SCIENCE  
AND TECHNOLOGY



**VOLUME : 1    ISSUE : 8    Print / Issue Publication Date: 09-Oct-2016**



**ISSN : 2455-2143**



Indexed In



[WWW.IJEAST.COM](http://WWW.IJEAST.COM)

[editor@ijeast.com](mailto:editor@ijeast.com)



# LONG TERM LOAD FORECASTING BASED ON INTELLIGENT TECHNIQUE

Meena Kumari  
Student  
BRCM-CET Bahal

Neha Khurana  
Electrical Engineer  
MDU Rohtak

Naveen Yadav  
Assistant Professor  
BRCM-CET Bahal

**Abstract**— Long term load forecasting has a vital role in generation, transmission and distribution network Planning. One of the primary tasks of load forecasting is to accurately predict the load demand requirements at all times. The purpose of this paper is to develop an advanced model for load forecasting by two approaches based on Regression method and Artificial Neural Network (ANN). Long term forecasting is affected by several economic factors such as GDP, no. of households, temperature, consumer price index, electricity price, population, GNP, index of industrial production (IIP) etc. Economic factors are more influential than weather conditions. Weather conditions are omitted in our study, to prevent noise. 6 economic factors are considered as input of forecasting model in regression analysis and neural network. The result obtained from these methods is compared. It is found that performance of ANN is better than regression method.

**Keywords**— long term load forecasting, Neural Network, Regression method, Economic factors

## I. INTRODUCTION

The accuracy of long term load forecast has significant effect on developing future generation and distribution planning. It plays a dominant part in the economic optimization and secure operation of electric power system. The time horizon for long term load forecasting ranges between a few weeks and several years. The time horizon may be up to 5, 10 and 15 years for planning and construction of new generating capacity and purchasing of generating units [1].

It is difficult to forecast load demand accurately over a planning period of this length because there are large numbers of factors affecting load characterized by direct or indirect effect on the underlying forecasting process [2]. In general load forecasting problems can be broadly divided into three main categories (i) Short term forecast (few minutes, hours or days to few weeks ahead) (ii) Mid-term forecast (a few months to years ahead) (iii) long-term forecasts (up to twenty years ahead). All models applied to forecast short, medium and long-term load are greatly influenced by the characteristics of the past load observation. So a fair comparison of an old one and new one method would have to be based on response error when applied to the same year as data selected [3]. In order to predict long term load forecasting two Artificial Neural Network (ANN), a Recurrent Neural Network (RNN) and three layers feed forward Back Propagation (BP) applied and

prediction were done for twenty one years (1975 to 1995) in Japan [4]. The first step to make a proper load forecast is to identify factors that would affect load pattern and relation among corresponding factors [5]. There are some economic factors like population, no. of households, GDP, Consumer price index (CPI), Electricity consumption, IIP, Temperature and Electricity price are selected as input of forecasting model [6]. Many approaches are applied to predict the load forecast [7]. It has been a challenging problem due to its spatial diversity and sensitivity to land usage and customer habit [8]. One major AI technique used for LTLF is based on ANN. Hence ANN is a flexible and accurate method for non-linear system. To get better performance a new forecasting method by combining ANN and grey prediction is applied and is more superior to any method alone [9]. We apply the regression and ANN method as two possibilities. Regression is a classical method and applied only for linear data. It is not accurate in forecast. Thus for getting more accurate results ANN method is applied [10]. It gives better accuracy and also can handle nonlinear system. ANN can yield satisfactory results with limited information.

## II. LOAD FORECASTING

Prediction of future events and conditions is called forecasts, and the act of making such predictions is called forecasting. Load forecasting means estimating active load at various load buses ahead of actual load occurrence. Load forecasting helps an electric utility to make important decisions including decisions on purchasing and generating electric power, load switching, and infrastructure development. As we see, a large variety of mathematical methods and ideas have been used for load forecasting. The development and improvements of appropriate mathematical tools will lead to the development of more accurate load forecasting techniques.

### 2.1 Regression Methods

Linear regression is a technique which examines the dependent variable to specified independent variables. The future value of the dependent variable can be estimated. Essentially, regression analysis attempts to measure the degree of correlation between the dependent and independent variables. Regression is one of the most widely used statistical techniques. For electric load forecasting, regression methods are usually used to model the relationship of load consumption



and other factors such as weather, day type, and customer class. Regression is used for forecasting by establishing a mathematical relationship between two or more variables. The simplest form of regression is linear regression.

**Linear Regression** is a mathematical technique that relates one variable, called an independent variable, to another, the dependent variable, in the form of an equation for a straight line. A linear equation has the following general form:

$$y = \alpha + \beta x$$

where

$y$  = the dependent variable

$\alpha$  = the intercept

$\beta$  = the slope of the line

$x$  = the independent variable

Because we want to use linear regression as a forecasting model for demand, the dependent variable,  $y$ , represents demand, and  $x$  is an independent variable that causes demand to behave in a linear manner.

**2.2 Artificial Neural Network**

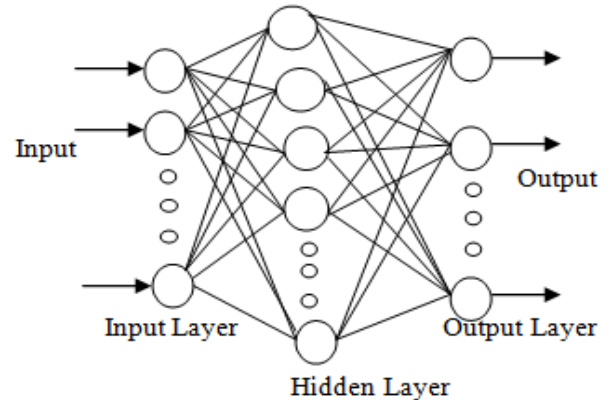
Artificial Neural Network (ANN) is a machine learning approach inspired by the way in which the brain performs a particular learning task. ANN is modeled on human brain and consists of a number of artificial neurons. Each neuron in ANN receives a number of inputs. A function called activation function is applied to these inputs which result in activation level of neuron. The ANN is designed by using the Multilayer Perceptron (MLP) and Back Propagation (BP) learning technique. The three layers connect to feed forward back propagation, there includes one input layer, one hidden layer and one output layer. Designing an ANN model for loading has always been a challenge because the problems mainly consist of selecting the input variable, model structure and training data. The data used in ANN learning algorithm are separated in two parts: the first part is to perform the training called training data set; and other part is to measure the network performance called the testing set. The multiple layer feed forward, trained in a supervised and back propagation, are used as the training method.

The procedures setting up the input for ANN are:

1. Select input and define output variable
2. Determine the no. of layers and the neurons in hidden layers
3. Train the network from historical data. At this step, the network learned by adjusting the weight to input in order to minimize the less error based.
4. After the training is complete, the network is tested by using the testing data which contains historical data that the network has never learned.

**Multi-Layer Perceptron**

Multi-Layer Perceptron network is a class of neural networks which consists of a set of sensory units that constitute the input layer and one or more hidden layer of computation nodes and output layer of computation nodes. In general MLPs are trained with the back propagation algorithm to develop successful classification and regression system.



**Fig.2: Multilayer feed forward network**

A Back Propagation network consists of at least three layers of units:

1. An input layer,
2. At least one intermediate hidden layer, and
3. An output layer.

Typically, units are connected in a feed-forward fashion with input units fully connected to units in the hidden layer and hidden units fully connected to units in the output layer. When a back-propagation network is cycled, an input pattern is propagated forward the output units through the intervening input-to-hidden and hidden-to-output weights. The output of back-propagation is interpreted as a classification decision. With Back-propagation network, learning occurs during a training phase.

**III. METHODOLOGY**

The data can be preprocessed to improve the quality of data and thereby improve the prediction result. To solve the forecasting problem various and nonlinear model were analyzed and applied to a real case with information from Haryana state. A flow chart is drawn in fig.3.1

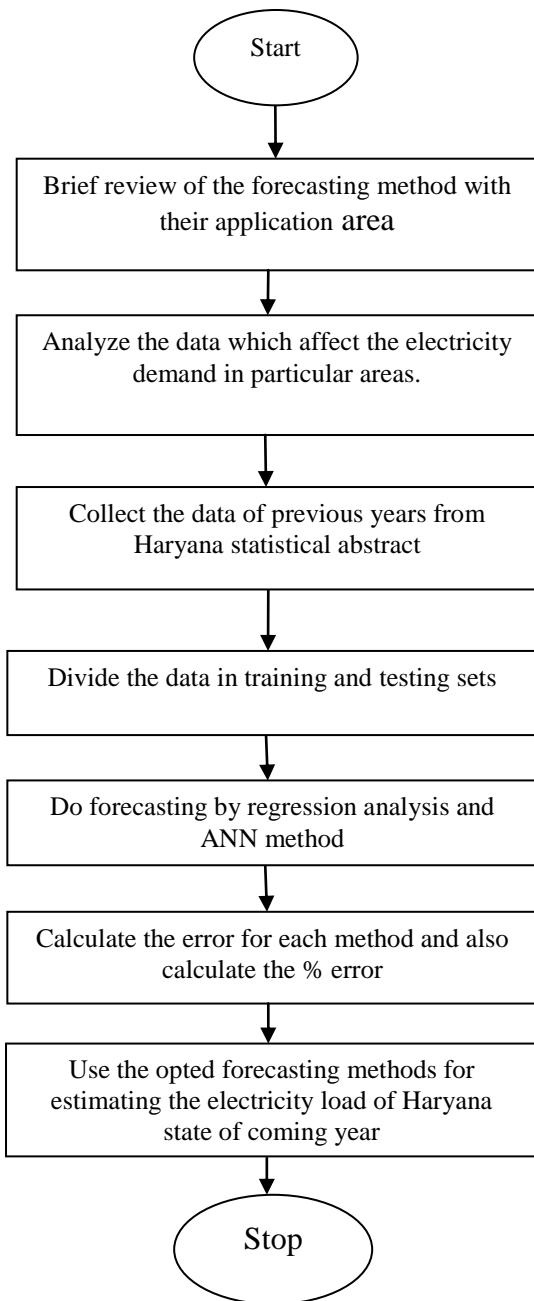


Fig 3. A general flow chart representing the steps involving in developed model

This represents the steps involved in the forecasting model. Firstly various methods are studied with their application area. Many factors which affect to the load forecasting are taken as an input to do forecasting. These data are collected from

statistical abstract from Haryana. Whole data are divided in training and testing sets. Training set is used to build the model and testing set is used to evaluate the model and create the forecasting model using Regression and ANN method. Both method does not give the accurate result thus errors are obtained from these two method are calculated. By comparing the result of methods it is concludes that ANN is better than regression method.

#### IV. CASE ANALYSIS

Electric load is predicted using both regression and neural network. The error in both the models is presented below

Table 1: comparison of Regression and ANN

Model	MSE	MAPE (%)	MAX APE (%)
Regression	5.58	4.36	11.36
Neural Network	3.56	1.72	8.31

From this table it can be observed that NN gives a better performance than Regression analysis.

Fig 4.1 and fig 4.2 show the performance of both models

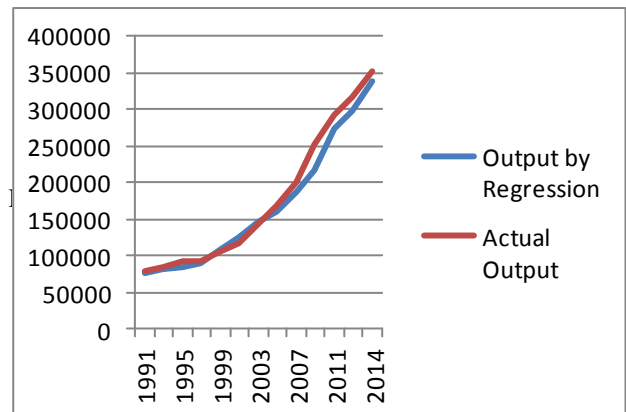


Fig 4.1: Actual output and output by Regression analysis

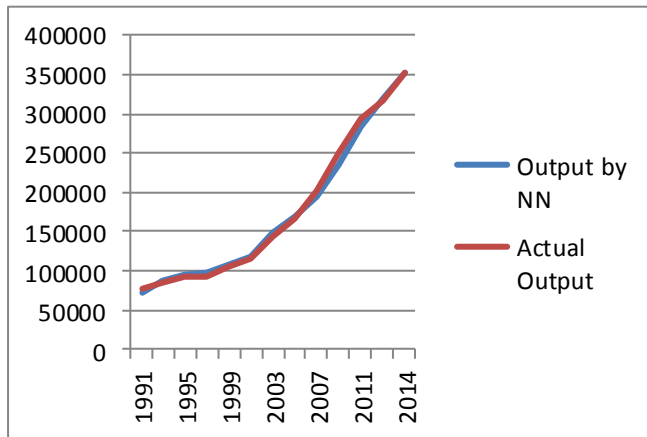


Fig 4.2 Actual output and output by NN model

#### V. CONCLUSION

In order to provide a high quality and reliable service to the customers, it is essential for electric power distribution companies to carry out projections regarding anticipated Electric Peak load demand in the future. In this paper two models were proposed for LTLF. The first one is based on Regression and In order to provide a high quality and reliable service to the customers, it is essential for electric power second one is based on ANN method. The regression wasn't successful in accurate forecast. Results showed that ANN had a better performance in LTLF because of its flexibility in handling nonlinear system, and ability to learn from historical data and generalize the solution based on input data. This result indicated that the proposed model has more efficiency to forecast future load for next several years.

#### VI. REFERENCES

- [1] Zhiheng Zhang and Shijie Ye, "Long term load forecasting and Recommendations for China based on Support Vector Regression" International Conference on Information Management, Innovation Management and Industrial Engineering, 2011, pp. 597-602.
- [2] Ghods and M.Kalatar, "Different Method of Long-Term Electric Load Demand Forecasting; A Comprehensive Review" Vol. 7, No. 4, pp.249-258, Dec. 2011
- [3] Christ. Petros, Bikas Pandelis, Paz. Michail and Vogl. Manthos, "Long-term peak load forecast in the Greek power system" International Conference on Energy and Environment System, Chalkida, Greece, May 8-10, 2006 pp243-248
- [4] Kermanshahi, B. and Iwamiya, H., "Up to year 2020 load forecasting using neural nets", Electrical power and energy system, vol.24(2002) pp.789-797.
- [5] H.Dhaneshi, M.Shahidehpour, A.L. Choobbari, " Long-term load forecasting in Electricity Market" Electro/Information Technology, IEEE, 2008 pp. 395-400

- [6] M.M.Dalvand, Zahir Azami and Hadi Tarimoradi, "Long-Term load forecasting of Iranian Power Grid using Fuzzy and Artificial Neural Networks" Universities Power Engineering conference (UPEC) IEEE, 2008, pp 1-4

- [7] Feinberg A. Eugene and Genethliouss Dora, " Load Forecasting applied Mathematics for Power System" pp. 269-285

- [8] Smt.K.Padamakumari, Dr.K.P.Mohandas, Dr.S.Thiruvengadam, " Application of fuzzy system theory in land use based long term distribution load forecasting" Dept. of Electrical Engineering, 1998, pp. 311-315.

- [9] Dahai Zhang , Zhiwu Ren , Yanbing Bi, Dazhou Zhou, Yanqiu Bi, " Power Load Forecasting Based On Grey Neural Network" Industrial Electronics, 2008. IEEE International Symposium on, pp. 1885-1889, July 2008

- [10] Y. Aslan, S.Yavasca, C. Yasar, " Long term electric peak load forecasting of Kutahya using different approaches" June 2011, issue 7, vol. 3, no. 2, pp. 87-91.

# IJEAST

INTERNATIONAL JOURNAL  
OF ENGINEERING APPLIED SCIENCE  
AND TECHNOLOGY

## ABOUT IJEAST

International Journal of Engineering Applied Science and Technology (IJEAST) is a peer-reviewed, open access journal that publishes high-quality research papers in the field of Engineering, Applied Science and Technology.

IJEAST aims to provide a platform for researchers, academicians, and professionals to share their innovative ideas, research findings, and practical experiences with the global scientific community.

## FOCUS AREAS

- Engineering
- Applied Science
- Technology
- Innovation & Development
- Interdisciplinary Studies



### PEER REVIEWED

All submissions are rigorously peer reviewed to ensure quality.



### OPEN ACCESS

Free and unrestricted access to research for all.



### GLOBAL REACH

Connecting researchers and professionals worldwide.



### TIMELY PUBLICATION

We ensure a swift and efficient publication process.



For more information, visit our website

[www.ijeast.com](http://www.ijeast.com)



INTERNATIONAL JOURNAL  
OF ENGINEERING APPLIED SCIENCE  
AND TECHNOLOGY

✉ [editor@ijeast.com](mailto:editor@ijeast.com)

🌐 [www.ijeast.com](http://www.ijeast.com)

📍 India



2455-2143