ISSN No:-2456-2165

Electrical Load Forecasting in Power System

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Abstract:- Load forecasting is normally employ to forecast and predict the rise in power demand of an area in other to prepare for electricity generation to meet the costumers demand as the population is growing. Electric load Forecasting can be used in selling, planning and buying of energy in power systems. It is very useful from generation to distribution of electrical energy. Forecasting in power system can be widely divided into three classes: Short-term electric load forecasting is generally one hour to one week, medium electric forecasting is normally from a week (7days) to a year, and while long-term electric load forecasting which are may be from a year and above. Accurate load forecasting can help in developing a plan, particularly for developing countries in which energy demand in such countries is irregular in nature as result of rapid growth rate and increase in the rate of rural–urban drift. The different methods of load forecasting were studied such as expert system, fuzzy logic, regression methods and artificial neural network (ANN).Some benefits of electric load forecasting were discussed.

Keywords:- *Regression, Forecasting, Load, Demand, Power, Electric, Generation e.t.c.*

I. INTRODUCTION

In developing the economy of a country today, there is need to engage in electric load forecasting and accurate prediction of electric future load demands will help decide and calculate approximately the amount of energy needed so as to get ready for power generation (Idowu ,2009). Demand energy forecasting is a process of calculating the electric energy necessary by a particular area by using previous records of energy usage in that location and some other relevant conditions such as temperature, weather forecast and population, etc. The issue in demand forecasting is to obtain what will be needed in future demand and by mainly extrapolating past consumption and other factors which can affect the amount of energy that is been used in an area at that specific period (Adepoju *et al* ,2007).

The verity that electric power cannot be stored to be used at the later time with the available technology and facility, this made it necessary to have the understanding of the way electric load demand behaves in the future. Electric utility planning begins with energy forecasting because of necessitate for new utility stations. Precise models for electric load forecasting are indispensable to the planning and operation of any utility. Forecasting in the countries that are just developing is extremely complex due to the large differences in the modes and the rate of energy required from one location and increase growth rate of load demand. Electric load forecasting is extremely important for energy suppliers, financial institutions, and other participants in electric energy generation, transmission and distribution (Feinberg and Dora ,2002). Electric load Forecasting is used selling, planning and buying of electric energy in power system. It is very pertinent in the power industry and it has a major economic advantage as it helps the power generating and Distribution Company to estimate the amount of power needed to be generated and supplied to a particular geographical area since electric energy cannot be efficiently stored. It is a relevant tool in taking of decision and planning by the utility. It is also used in the total planning of the system.

Accurate load forecast can help in developing development plan, energy supply policy, and especially for developing nations in which the energy demand is irregular in nature because of the increase in growth rate and rural–urban migration.

Other merits of electric load forecasting are:

- Good investment and network preparation
- enhanced and heuristic running of risk
- decrease in expenditure

Forecasting can be classified according to both the predicted quantity (peak load, integral load, hourly load) and the prediction time. Based on the prediction time, it can be categorized into three classes. They are:

- Short term load forecasting: This is generally one hour to a week. It helps to guesstimate the load flows and to make solid decisions that can avert overloading. It is employing in controlling, in power scheduling, input to load flow and also contingency analysis.
- Midterm load forecasting which is normally from a week to one year; and also
- Electric long term load forecasting is from one year and above. Long term electric load forecasting is used to verify the capacity of power system.

Some of the factors that influence forecasting include: weather data, time factor, socio-economic settings (festivities and working days) and special periods such as Christmas or Ramadan, past demand load data, and the type of location

(Ibitoye and Adenikinju, 2006). All these factors stated above will decide the amount of energy that would be need by an area at any specific period. Forecasting is a major ingredient of resolution making. Its function is to lessen the threat in decision making and lessen unforeseen expenditure. Information obtained from short-term electric load forecasting is important to power supply system as operations in conditions of short-term part maintenance service, daily, hourly and weekly load scheduling of generating station, secure operation of power systems and economic (Gangshem,2000).

➢ *Electric Load Forecasting method*

The forecast of electric load is demanding because of the different distinctiveness of the electric loads related to them. There are different methods employing in electric forecasting of load. They are widely classified into two major categories: Statistical methods and expert systems.

These various methods that can be used are explained below:

- *Simple Statistical Method*

The statistical methods normally need a mathematical model that depicts load as functions of various factors such as consumer class, weather and time. The significant categories of such models are multiplicative models and additive (George and Burton, 1979). The forecast load is a computation of a number of components and result of a many factors. The advantages of this method include its simplicity as it involves minimum number of variables. It is also the easiest to compute but has the disadvantage of not being accurate. It can be used for any of the types of forecasting.

- *Regression Methods*

Regression methods are normally employed to model the relationship of energy consumption and other factors such as type of day, consumer type and weather (Hafiz *et al* ,2002). Regression study performs linear regression using the least squares method to fit a line through a set of remarks. It is very common in short term forecasting of load.

➢ *Expert Systems*

Expert systems integrate rules and measures employed by human experts in the field of interest into software which robotically make forecasts without assistance of human beings. The program has its knowledge base extended as new information available to it, reason, perform and explain.(Amit and Satish, 2008).

➢ *Fuzzy Logic*

Fuzzy logic is a overview of the usual Boolean logic employed in digital circuit design. in fuzzy logic, inputs have connected with it assured qualitative ranges. It allows one to logically assume outputs from fuzzy inputs. It performs on the foundation of mapping input to output. Moreover, this method employed steady state component or average component. However the calculation of the load depends upon the weighted grouping of the components which varies dynamically (Amit and Satish, 2008).

➢ *Support Vector Machines*

Support vector machine (SVM) is a mew powerful tool to solve regression and classification problems. They execute non linear mapping of the data into a elevated dimensional space. Then support vector machines uses easy linear functions to form verdict boundaries in the new space. Support Vector Regression is an optimization problem. The support vector method compares favorably with the regressive method (Weichang, 2009). The predicament of choosing building is changed by the setback of choosing a fitting kernel for the support vector machine. It is employed in short term forecasting of loads

➢ *Artificial Neural Network*

This is a trouble-free model of the middle nervous system and it is part of artificial intelligence. It is an attempt to form machines that function in related way to brain of human beings by constructing these machines employing apparatus that perform like biological neurons. Neural network is interconnected neural computing basics that have the capacity to reply to input stimuli, to adapt and to learn the environment. It can be educated to solve different problems which are not easy to solve with human brain or conventional computers. After a neural network has been trained, it has the ability to make predictions.

Parameter	Definition
LW	Layer Weight
IW	Input Weight
F	Network function
P	Input
B	Network bias

Table 1:- Representation of variables of neural network equation

➢ *Training, Network Parameters and Error Correction*

Back propagation is the most universal form of learning. The weights are distorted based on their correction term and previous value. It is a means of error correction that can be employed to adjust the weights of the connections in hidden layers. The learning law is the way in which the correction condition is formulated. It is basically a steepest dive process. For the gradient dive algorithm, a step size (1.000 step size was used), that is known as learning rate in ANN writing must be indicated. The learning rate is important for back propagation in learning algorithm since it will decide the size of weight alteration, (Uduehi, 2009).

It is very known that the steepest dive endures the challenges of lack of robustness inefficiency and slow convergence. Moreover, it is sensitive to the learning rate.

Smaller learning rates tend to sluggish the learning procedure while larger learning rates may cause network oscillation in the weight space.

In back propagation, to discover the error value for a given node *h* in a hidden layer, you need to get the weighted sum of the errors of all nodes linked from node *h* i.e., of all nodes that have an incoming association from node *h*

$$\delta_h = w_1\delta_1 + w_2\delta_2 + w_3\delta_3 + \ldots + w_n\delta_n \quad (3.2)$$

Where δ_n is the error between the actual value the output from node h.
w_n is the weight of the connection to node n
δ_h is the error of the hidden layer node (Jaap,1999)

So the Weight Change = some constants × input activation x error

Output node, the error is given as:
Error = (target activation - output activation) × (1 - output activation) x output activation

The hidden node, the error is given as
Error = weighted sum of to-node errors × (1 - hidden activation) x hidden activation (Uduehi, 2009).

➢ *How to use Artificial Neural Network in Forecasting of loads*

The following steps must be taken when using artificial neural network:

- *Idea*

A better understanding of what the network is expected to give must be well cleared.

- *Information*

The information required for the predictions must be decided.

- *Data Collection*

The information required must be obtained from the available source.

- *Building a Network*

The number of input and output neurons must be specified when building a neural network.

- *Training the Network*

The actual load generated is used as input load to train the network which takes in each input and makes a guess as to the output.

- *Testing the Network*

It is important to test a network on data it has never seen.

- *Run The Network*

Entering new input into the network and gather usable result.

II. CONCLUSIONS

Electric utility planning begins with electric forecasting of load of require by the consumers the utility will be supplying. Precise models for electric power forecasting of load are fundamental to the planning and operation of any utility. Different methods discussed above have been applied to forecasting of load. The merits and demerits of these methods are discussed .All the methods discussed above can be applied in forecasting of electric loads in generation, transmission and distribution of power system.

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