Forecasting Methods in Electric Power Sector

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ABSTRACT

Electric power plays a vibrant role in economic growth and development of a region. There is a strong co-relation between the human development index and per capita electricity consumption. Providing adequate energy of desired quality in various forms in a sustainable manner and at a competitive price is one of the biggest challenges. To meet the fast-growing electric power demand, on a sustained basis, meticulous power system planning is required. This planning needs electrical load forecasting as it provides the primary inputs and enables financial analysis. Accurate electric load forecasts are helpful in formulating load management strategies in view of different emerging economic scenarios, which can be dovetailed with the development plan of the region. The objective of this article is to understand various long term electrical load forecasting techniques, to assess its applicability; and usefulness for long term electrical load forecasting for an isolated remote region, under different growth scenarios considering demand side management, price and income effect.

KEYWORDS
Artificial Neural Network, Electrical Energy Consumption, Electrical Energy Requirements, Long Term Electrical Load Forecasting, Parametric

INTRODUCTION

Electric power plays a fundamental role in the process of economic growth and development. Several studies conducted in developing countries indicate significant causal relationship between electricity consumption and economic growth. These studies indicate that economic growth prospect is adversely affected due to power shortage (Ebohon, 1996; Hwang & Gum, 1992; Glasure & Lee, 1997).

To meet the fast-growing power demand, on a sustainable basis, meticulous power system planning is required. This planning needs electrical load forecasting, as it provides the primary inputs and enables financial analysis. Accurate forecasts are helpful in formulating load management strategies in view of different emerging economic scenarios, which can be dovetailed with the developmental plan of the region.

For last few decades there has been a lot of research on electrical load forecasting (Fu et al., 2003; Quilumba et al., 2015). There are mainly three types of electric load forecasting short term, medium term and long term. Short term load forecasting is the prediction of electrical load demand for a period varying from the next few minutes up to a week, medium term is for a period of next few
months to a year and long term is for a period of 2 to 15 years. A lot of other factors affect forecasting, this paper presents a list of these factors and principles. There are different methods available for different type of forecasting. Here all the methods and techniques are discussed categorically with respect to short term, mid-term and long-term forecasting.

Most of this literature relates to short term electrical load forecasting, only a few of them are related to medium term and long term electrical load forecasting (Bunn et al., 1985). Most of the long term electrical load forecasting is focused towards a large region, country or state which are well connected (Bunn, 2000). Here, an effort is made to study different types of electrical load forecasting techniques and their applicability to different geographical region. The emphasis of the study is on long term electrical load forecasting with different growth scenarios, incorporating the income, price effect on electrical load demand for an isolated remote region like Andaman & Nicobar Islands, India.

The paper is organized as follows: Next section describes what is electrical load forecasting, principles and the key factors affecting load forecasting. Then it focuses on the different methods used for short term, mid-term and long term electrical load forecasting. Recently used software are discussed in a separate section. The last section presents the conclusions and future works.

ELECTRICAL LOAD FORECASTING

Definition

Load forecasting is the predicting of electrical power required to meet the short term, medium term or long-term demand. It is a central and integral process for planning periodical operations and facility expansion in the electricity sector. Demand pattern is almost very complex due to the uncertainty of energy markets. So, to find an appropriate forecasting model for any electricity network is not an easy task.

The main function of electric power system is to provide a reliable and continuous source of electricity wherever whenever required. To provide this service each of the three main components of an electric power system – generation, transmission and distribution must perform efficiently to meet the required demand.

An electric power system is a dynamic system which is a balance of supply and demand:

- The supply of electricity consists of physical devices that must be designed, constructed & operated to generate, transmit and distribute desired quantity of quality electrical power reliably;
- The demand of electricity by the consumer, which changes as a function of time on an instantaneous basis (seconds to minutes), on a short-term basis (hours to days) and on a long term basis (months to years).

Objective

Therefore, one of the main objectives of the electric power system is to keep a continuous balance between the supply and the demand of electricity (Ebohon, 1996; Hwang & Gum, 1992; Glasure & Lee, 1997). This is possible only by an accurate assessment of requirement of electrical energy and peak load demand i.e. electrical load forecasting. The assessment of requirement of electrical energy (potential demand of electrical energy) in MU (Million Unit) is carried out by making certain assumptions of GDP, population, number of households, index of industrial production, energy consumption and electricity price, while assessment of peak load demand in MW/GW (Mega/Giga Watt) is calculated using potential electrical energy demand data multiplied with coincidence factor (occurrence of peak load of different sectors) and reciprocal of load factor (Zachariadis, 2010). The primary purpose of electric load forecasting is to address the key question of when, where, why and how much electricity would be required by a region. Electric load forecasting is a vital component
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