

A STUDY ON COMPARATIVE ANALYSIS OF THE COMPUTATIONAL APPROACHES ANN (ARTIFICIAL NEURAL NETWORK) VIA MATLAB (MATRIX LABORATORY) AND EXTRAPOLATION VIA MS-EXCEL TO DEVELOP A SIMULINK 'PEAK/LOAD' FORECASTING MODEL

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ABSTRACT

The estimation of increment in energy consumption is very important for power sector of all governments. Forecasting of future energy consumption and forecasting of peak load demand is more important for power sector to regulate the electrical supply. A wide range of mathematical and computational approaches are available for forecasting. With the intention of forecast the peak load demand of year 2020 for India, two different computational approaches ANN via MATLAB and Extrapolation via MS-Excel are proposed in this study. ANN will provide an outcome via EBPN method resulting in a simulink model which is trained, validated and tested with reference of input data. An inbuilt function FORECAST of extrapolation is used in MS Excel to obtain the similar result. In this study, the historical data sets of peak demand of India were acquired from year 1995 to 2014 for peak load forecasting. A comparative study is obtained from the outcome of both the approaches to obtain the result with minimum errors.

INTRODUCTION TO LOAD FORECASTING

Load forecasting plays an important role in power system, it is necessary for Planning, Analysis, Operation and Control of a power system. It means prediction of future data by analysing previous data. It is classified into three types-

- (i) Short term forecasting (from few minutes to few hours)
- (ii) Medium term forecasting (from few hours to few weeks)
- (iii) Long term forecasting (from few weeks to several years).

A long term forecasting is used to find out the capacity of generation, transmission and distribution system and the type of services require in transmission extension planning, Annual hydro thermal maintenance, and scheduling etc. So the time line and accurateness of long term forecasting have significant effect on power system planning to construct new power generation plants and transmission facilities to meet the power demand in near future. Load

forecasting is very imperative for the reliable and economical operation of the power system. Modeling and forecast plays a critical role in developed and developing countries for policy makers and related organizations. The under-estimation of the demand would direct to potential outages that are devastating to life and economical areas. The over estimation would escort to unnecessary idle capacity which means wasted financial resources therefore it would be superior to model electricity demand with good accuracy in order to avoid costly mischievous. In a country like India, where load is continuously increasing over the year which can be seen in the below graph. Load forecasting is necessary to fulfil the consumer demand and to regulate the power supply effectively. Load is a unpredictable quantity, which is depends upon several factors like growth in population, growth in economical and industrial sectors, change in atmospheric condition etc. So the accurate prediction of future demand is not feasible but there are several methods used to envisage the load with minimum error, result in better accuracy like:- regression, Extrapolation, ANN, Fuzzy Logic and Rule based Expert System etc. In short and medium term forecasting high accuracy can be achieved because the factors which affects the load are almost stable, but in long term the variation in factors can't be estimated.

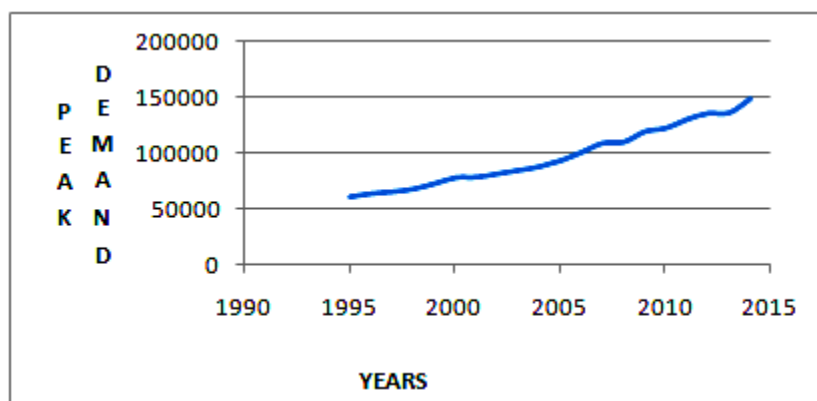


Fig. 1 Plot between Years and Peak Demand Generate

There are number of research scholars who have proposed their model for load forecasting. J. Kumaran, G. Ravi represents a simple regression analysis based model concerning population and per capita GDP for long term forecasting of India's sector wise electrical energy demand up to year 2025 using consumption during the years 1990 to 2012. Dogra Sonika et. al study about long term load forecasting between two stations taking into consideration population increment factor using Fuzzy Logic methodology. She is yet. Al developed a support vector regression model for long term load forecasting for china. SVR provides a mapping to relocate the actual time series into a multi dimensional space to depict the non linear relationship between GDP and Load. Chavez et. al used Auto regressive Integrated moving Average (ARIMA) time series analysis model based on Box- Jenkins method to formulate the forecasting model for the prediction of energy production and consumption in Austria's, Northern Spain. Asber et. al dealt with the development of a reliable and efficient Kernel regression model to forecast the load in the Hydro Quebec distribution Network. Chang et. Al

constructed a weighted evolving Fuzzy neural network for monthly electricity demand forecasting in Taiwan. The examination done by the exploration researchers expanded our interest to find out about burden guaging and urge us to attempt some exertion here. In this paper, top burden request of India of year 2020 is assessed by ANN and extrapolation through MS-Excel utilizing information of years 1995 to 2014. ANN by means of MATLAB produces a Simulink model which is prepared by variety of past information. At that point model is prepared to give a yield for any predetermined contribution by testing the information number of times and result with least blunder. "Pattern" work is utilized in MS-Excel to assess the pinnacle request by organizing the information in a table structure. A similar report is likewise given between the outcomes acquired by the two strategies for getting better arrangements. This paper further contains prologue to load estimating and writing survey in area I, depiction of approaches in segment II, displaying and advancement of ANN in segment III, brings about segment IV, end, references and list of sources in segment V, VI, VII separately.

DESCRIPTION OF METHODOLOGIES

2.1 Artificial Neural Network

An Artificial Neural Network, habitually called a neural system, is a scientific model invigorated by natural neural systems. A neural system comprises of an interrelated gathering of counterfeit neurons, and it forms data utilizing a connectionist way to deal with figuring. As a rule a neural system is a versatile framework that changes its example during a learning stage. Artificial neural system is additionally estimated as one of the cutting edge scientific computational strategies which are utilized to tackle astonishing unique issues in created conduct frameworks during a timespan By figuring out how to recognize designs from information in which other computational and measurable technique neglected to unravel them, fake neural systems can comprehend the problems. Artificial neural systems, initially created to emulate fundamental natural neural frameworks the human cerebrum especially, are made out of various interconnected simple preparing components called neurons or hubs. Every hub gets an info signal which is the aggregate "data" from different hubs or outer boosts, forms it close-by through an enactment or move capacity and produces a changed yield sign to different hubs or outside yields. Albeit every individual neuron actualizes its capacity rather gradually and defectively, all in all a system can execute an astonishing number of assignments pretty capably This data handling trademark makes ANNs an ordering computational gadget and proficient to gain from models and after that to sum up to models at no other time seen.

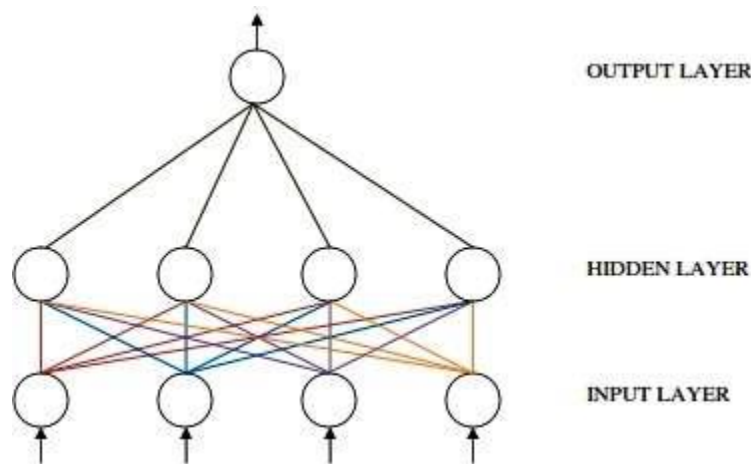


Fig 2: Neural Network

A MLP is normally made out of various layers of hubs. The first or the most reduced layer is an information layer where outer data is gotten. The last or the most astounding layer is a yield layer where the issue arrangement is accomplished. The info layer and yield layer are isolated by at least one between intercede layers called the shrouded layers. The hubs in bordering layers are normally completely associated by a cyclic curve from a lower layer to a higher layer. Back-spread, a conservation for "in reverse proliferation of blunders", is a general technique for preparing fake neural systems utilized in simultaneousness with an improvement strategy, for example, angle plummet. The strategy figures the inclination of a misfortune work regarding every one of the loads in the system. The slope is nourished to the streamlining strategy which thusly utilizes it to refresh the loads, with an end goal to limit the misfortune work. Back-engendering requires a known, wanted yield for each info esteem so as to compute the misfortune work slope. It is in this way by and large viewed as a regulated learning strategy, in spite of the fact that it is additionally utilized in some unaided systems. It is a disentanglement of the delta standard to multi-layered feed forward systems as appeared in the above figure, made conceivable by utilizing the chain guideline to iteratively register slopes for each layer. Back proliferation necessitates that the enactment capacity utilized by the fake neurons (or "hubs") be differentiable. Before an ANN can be utilized to play out any favored undertaking, it must be prepared to do as such. Essentially, Training is the way toward deciding the circular segment loads which are the key components of an ANN. The colleague learned by a system is put away in the circular segments and hubs as curve loads and hub inclinations. It is through the connecting bends that an ANN can bring out complex nonlinear mappings from its information hubs to its yield hubs. MLP preparing is an administered one in that the ideal answer of the system (target esteem) for each info design (model) is constantly accessible.

1.2 Extrapolation through MS-Excel Forecast function in MS-Excel used for computation or prophecy of a future value by using existing values. The expected value is in Y column for a given value in X column. The identified values are existing X- values and Yvalues. The new

value is forecasted by using linear regression. Someone can use this function to calculate future sales, inventory requirements or consumer trends. FORECAST(X, Known_Y's, Known_X's) X-Required information point for which somebody needs to conceive the worth. Known_Y's-Required. The needy cluster or gathering of information. Known_X's-Required. The autonomous exhibit or variety of information.

3. Modeling and Development of ANN The peak demand data of India from 1995 to 2014 along with peak demand meet, shortage in peak demand meet of each year and percentage shortage of each year as shown in table-1. Has been utilized for the preparation of ANN to predict the pinnacle request of year 2020. The proposed arrangement of ANN is appeared in beneath figure. MATLAB 2009 is utilized for ANN preparing and testing. The preparation informational collection for proposed ANN expectation contains all the four sources of info. Thus the element of the produced for preparing is 20X4, for example it contains 20 lines and 4 segments. When the neural system has been organized for a specific capacity, that system is prepared to be prepared. To begin the preparation procedure, the underlying loads are picked haphazardly. At that point the preparation or learning starts. The preparation of ANN indicator is appeared in Fig. 4. In the wake of preparing of ANN indicator, the blunder got is 2.66×10^{-23} of every 983 cycles. The preparation execution, relapse plot and preparing state speaking to slope and approval check plot are likewise spoken to in Fig. 5

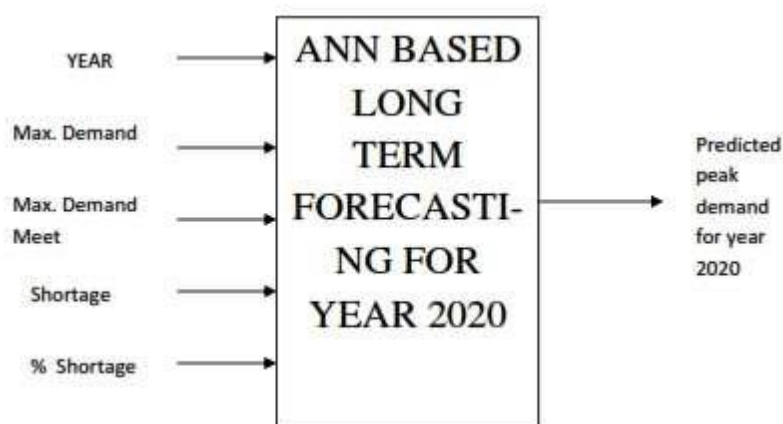


Fig 3: ANN Proposed Structure

RESULTS

Effective activity of ANN based burden anticipating requires a fitting preparing informational collection that can sufficiently covers the whole arrangement space so as to perceive and summed up the relations among the issue factors. The consequence of ANN Simulink model is speaking to in Fig.4. The peak energy demand for India calculated through ANN and Extrapolation during the year 2015 to 2020 and comparison between these results are presented

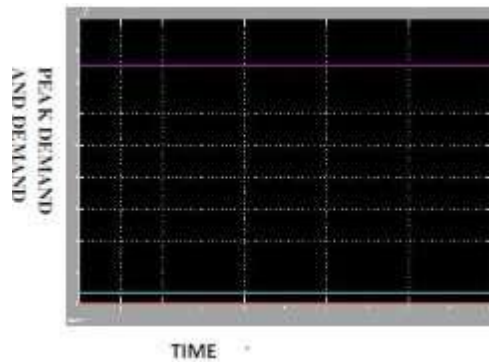


Fig 4: ANN result of Year 2020

** The maximum difference in results occur in year 2016, which is within 5% while considering any one result of that year as reference. Hence we can say the result is almost similar.

CONCLUSION

Load forecasting is an important event in efficient planning and control of electrical systems. Load serving entities use load forecasting for entire system security, load scheduling, investments in generation and transmission. The peak demand electrical energy of India has been forecasted for the future years through the previous year data by the developing ANN model and through Extrapolation. The results help the policy makers for allocating appropriate funds for constructing new generation plans and transmission system to meet the future demands and attempts to offer reliable service to the customers.