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Load Forecasting using Linear Regression Analysis and Moving Average Technique in Time Series Model for RGUKT, R.K. Valley Campus HT Feeder

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Abstract:
Electric Load forecasting plays major role in satisfying equality constraints at generation side. At transmission side if load forecasting is not proper then high load current may flow through the conductors, which may lead to damage of conductors. At distribution also load forecasting is necessary because at higher load, high current will flow through the conductors and hence through the equipment. With proper load forecasting at distribution side cost can also be reduced in educational institutions by reducing unnecessary power loss. In this paper an attempt has been made to estimate load in RGUKT, R.K. Valley. For estimation of load, linear regression technique has been applied. The load data has been collected from the energy meter reading of the substation. After application of linear regression to the load data obtained, it is found that the coefficients are found to be 2.197 and 7008.44. For estimation of load, Moving average technique considering seasonality and trend has also been applied. A graph has been plotted for both forecasted and actual output with respect to time for both cases.

Index Terms: Load forecasting, Linear regression, Moving average, RGUKT, HT Feeder.

I. INTRODUCTION:

Now days the importance of electricity has been increasing drastically, without electricity world cannot be imagined. Since the electricity can't be stored in bulk. The equality constraints must be satisfied for the proper functioning of the system (i.e generation must meet the load demand and losses). Failing which leads to loss of synchronism due to voltage collapse. If the problem persists it may lead to collapse of grid, which may even causes to blackout. Speed governor system will play key role in maintaining the grid synchronism. The grid can be maintained in stable mode if the load will be estimated in advance properly. Otherwise generators may enter into unstable state. This type of load forecasting is called as Short Term Load Forecasting (STLF). STLF will be done for duration of one hour to one week. If the duration is more than one week to one year, then the forecasting is called as Medium Term Load Forecasting (MTLF). MTLF is used mostly to estimate fuel prices. If the duration of forecasting is more than one year, then the forecasting is called as Long Term Load Forecasting (LTLF). The Load depends upon various parameters such as Gross Domestic Product (GDP) of the people, climatic conditions etc. In RGUKT an educational institution funded by Andhra Pradesh Government, HT Feeder Data has been taken to estimate Load Demand. Linear regression Technique has been used for forecasting.

III. LINEAR REGRESSION:

Linear regression is a statistical technique used for finding a relation between two or more variables. If the relation is found between two variables, it is called simple linear regression. If the relation is found for more variables, it is called multi variable linear regression. After finding relation between the variables, it is assumed that the parameters are varying with same relation. Hence the same relation is applied to the forthcoming parameters. Which will give the values of dependent variable value for the corresponding forthcoming independent variable? Linear regression is quite simple method to fit the curve and find the coefficients. The model takes the form $y = mx+c$. Where m is the slope of the curve and c is the intercept. The parameter x is the independent variable. $f(x)$ is dependent variable. The task is to find the coefficients m and c with the help of available data of x and y.

Moving Average Technique: Moving average is a simple statistical technique to do forecasting. In the moving average technique there are following different types

(a) Simple moving average: In the simple moving average technique the forecasted value is found by averaging n recent discrete data in time series model.

(b) Weighted moving average: In the weighted moving average technique a weight is multiplied by the existing data and for the resultant data, simple moving average technique is applied. The weight being allocated maximum for the most recent and minimum for the most old value. The weight value will be decided by past experience.

(c) Exponential moving average: In the exponential moving average, trend and seasonality is also included. For trend consideration one constant will be there and for seasonality one more constant will be there.

Performance Evaluation: There are different measures to evaluate the performance of the fore casted result.

Least Squared Error (LSE): It is measured by adding squares of error between actual value and forecasted value.

$$LSE=\sum_{i=1}^{N}(Y_i - X_i)^2$$

Where Y_i is Actual output at i^{th} instant.
X_i is the value of forecasted variable at i^{th} instant.
N is number of independent variable instances.

III. MEAN SQUARED ERROR (MSE):

It is measured by find mean of squares of errors at each and every point.

$$MSE=\frac{\sum_{i=1}^{i=n}(Y_i - X_i)^2}{N}$$

Where Y_i is value of Actual dependent variable at i^{th} instant of independent variable.
X_i is the value of forecasted variable at i^{th} instant of .
N is number of independent variable instances.

Root Mean Squared Error (RMSE): It is measured by square root of Mean of Square of difference between fore casted variable value and actual output. https:// mail. google. com/mail/ u/0/#inbox? compose=15c1f0b9d1a17472

$$\textbf{RMSE}=\sqrt{\frac{\sum_{i=1}^{i=n}(Y_i - X_i)^2}{N}}$$

Where Y_i is value of Actual dependent variable at i^{th} instant of independent variable.
X_i is the value of forecasted variable at i^{th} instant of .
N is number of independent variable instances.

Mean Absolute Percentage Error (MAPE): It is also known as Mean Absolute Percentage Deviation (MAPD). It is one of the most accurate and most popular measures of finding the performance.

$$MAPE=\frac{100}{N}*\sum_{i=1}^{N}\left|\frac{Y_i - X_i}{Y_i}\right|$$

Where X_i is the value of fore casted variable at i^{th} instant .
Y_i is the value of Actual output at i^{th} instant
N is number of independent variable instances.

IV. TIME SERIES LINEAR REGRESSION:

In the normal linear regression there will be two variables specifically known. But in Time Series Linear Regression time is taken as one variable. That is dependent variable is taken strictly in equal intervals of time. So we have only one variable known specifically. These cases will be known as Time series linear regression.

V. RESULTS AND CONCLUSION:

The data has been collected from RGUKT R.K. Valley substation for the month of January in 2017. The data is collected in the equal intervals of 30 minutes every day. As the known dependent variable is only Load data, the technique applied is time series Linear Regression. For the data collected Time series linear regression has been applied. As the Load forecasting is heuristic in nature, for different cases different coefficients will be there. For RGUKT, R.K. Valley campus coefficients have been found as 2.197 (slope) and 7008.44(intercept). The error performances obtained are as follows.

Performance Index	Linear Regression	Moving Average
LSE	132.4821	39.1724
MSE	6.0219	1.78
RMSE	2.453	1.334
MAPE	0.029	0.016

From the Comparison, it is observed that for this case of load forecasting, Moving average technique gave more accurate result compared to Linear regression.

The graph showing Actual load and fore casted load is shown in figure-1

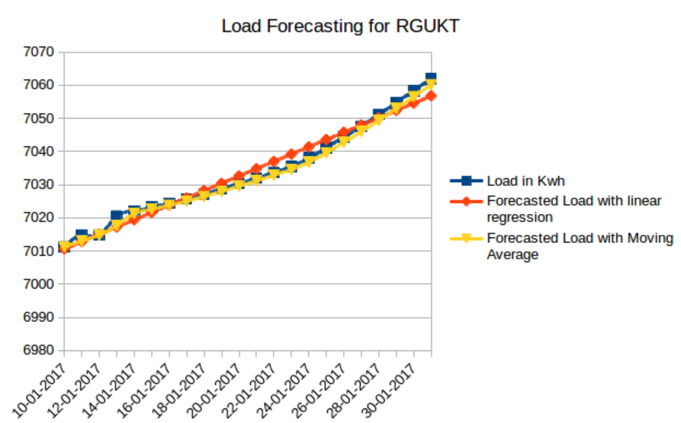

Figure.1.

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