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Detecting abrupt changes in thermal electricity production data in Sri Lanka

P. L. N. S. Sumathipala[1*], A. P. Hewaarachchi[2] and D. M. P. V. Dissanayaka[2]

[1]Faculty of Graduate Studies, University of Kelaniya, Sri Lanka
[2]Faculty of Science, University of Kelaniya, Sri Lanka
sandamaliplns@gmail.com*

A changepoint or an abrupt change is a distributional change in a time series data structure. Over the past years, many studies have been conducted to search these changepoints and many researchers proposed several multiple changepoint detection methods. One such search method is the Pruned Exact Linear Time (PELT) method, which is exact and under mild conditions, has a computational cost which is linear in the number of data points. This method is a more accurate and faster method to detect multiple changepoints. The objectives of this study are to detect abrupt changes in thermal electricity data in Sri Lanka and predict thermal electricity production accurately. Since undetected changepoints may cause incorrect modelling or prediction, the accurate analysis of electricity data is vital. In this study, electricity production (Hydro, Thermal oil and coal, and wind) by Ceylon Electricity Board (CEB) in Sri Lanka for the period 2000 to 2019 was used to find abrupt changes. The PELT method is used to detect these changepoints and their location in the variance of electricity data. First, the total electricity production of oil and thermal data were used and a changepoint was found in April 2011. This is a documented changepoint since, according to CEB Annual Report 2011, 1487 GWh of thermal (oil) power was added to the system during 2011, which was a significant change. Moreover, two models, for the periods 2000 to 2019 and 2011 to 2019 (after the detected changepoint) were fitted for forecasting the production. Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) were calculated to compare the forecasting accuracy of these models. The first model (ARIMA (2,1,3)), which does not consider the changepoint structure, results in RMSE and MAPE values of 0.911 and 6.009, respectively, for the period 2000 to 2018 for the thermal electricity data. For the second model (ARIMA (1,0,3)), RMSE and MAPE were 0.244 and 3.267, respectively, for the period 2011 to 2018. It can be seen that the models fitted by considering changepoints give more accurate results for forecasting electricity production.

Keywords: Changepoints, Electricity data, Forecasting, Modelling, PELT method