Peak over Threshold Approach to Forecast the Probability of Covid-19 Outbreak in Sri Lanka

N.K. Boralessa

Department of Mathematical Sciences, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Kuliyapitiya 60200, Sri Lanka
nathashakb123@gmail.com

Covid-19 is a contagious disease that causes illnesses in humans extending in severity from the common cold to Severe Acute Respiratory Syndrome (SARS). This disease has spread worldwide with considerable morbidity, mortality, and an enormous burden on worldwide public health. Massive job losses, shrinking of economies, and loss of livelihood have taken place due to the high transmissibility of the Covid-19 virus. Modelling and forecasting the probability of the spread of covid-19 is essential for public health planning and managing the economy, which is an emerging topic in research. This study developed a mathematical model using Extreme Value Theory (EVT) to forecast the probability of extreme cases of covid-19 outbreak. The daily covid-19 cases reported from 1st, January 2020 to 31st, October 2020 were obtained from the epidemiology unit official website of Sri Lanka. The Peak over Threshold (POT) approach of EVT was employed to model the covid-19 cases. The Mean Residual Life (MRL) plot was used to identify the linear range because selecting the optimum threshold from the MRL plot requires substantial expertise. The Kurtosis method was used to obtain the appropriate optimum threshold. After determining the threshold, extremes were modelled, and the parameters of the Generalized Pareto Distribution (GPD) were estimated through the maximum likelihood estimator method. The bootstrap goodness of fit test was applied to validate GPD. Finally, the annual maximum daily covid-19 cases were calculated for several return periods. It was revealed that the daily covid-19 cases were positively skewed with skewness 5.1018. The graph started to become linear from 0 and continue up to approximately 70 in the MRL plot. 34 covid-19 cases exceeded the optimum threshold of 63 and these exceedances can be best described by GPD ($\xi = 0.41902$, $\sigma = 97.3077$). The annual maximum daily covid-19 cases about 1356/1639/2070/2825 are predicted to occur once in every two/three/five/ten years, respectively.

Keywords: Covid-19 outbreak, Pot approach, Threshold, Generalized pareto distribution, Maximum likelihood estimator