

Analyzing and Predicting the Spread of SARS-Cov-2 Virus in Singapore Using a Time-Dependent SEIR Model

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Covid-19 is a devastating pandemic that has affected more than 200 countries. According to the World Health Organization, there are 113 million confirmed cases, 63.5 million recoveries by late February 2021. This study was carried out to model the spread of SARS-CoV-2 virus in Singapore. In addition, accurate predictions of the infected counts and recovered counts of the incidences help the authorities to evaluate, to apply and relax the interventions at the necessary time. Data were gathered from the daily situation reports published by the Ministry of Health, Singapore. In general Susceptible, Exposed, Infective, and Recovered (SEIR) modeling, parameters are assumed to be constant throughout the period. However, due to the variations in the reported patient count from 23rd January to 28th June, 2020, a time-dependent SEIR model was fitted to obtain accurate estimates for model parameters. The parameters were estimated for different sub-periods by solving a set of related Ordinary Differential Equations. Then, the variation in each model parameter with time was modeled using a cubic spline. When compared with the monthly estimated parameters, the most accurate results were obtained with weekly estimated parameters, resulting a minimum difference between the estimated and observed counts. Then, the prediction ability of the model was evaluated by computing 95% confidence intervals for the number of infected individuals and recovered individuals at the end of 5th July 2020, and they are (4008, 8709) and (39558, 45230), respectively, which capture the actual counts. Compared to short-term predictions, the proposed method will give relatively low accurate estimates for long-term predictions. Therefore, the proposed method is more suitable for short-term predictions.

Keywords: Covid-19, Cubic splines, Epidemiological modeling, Ordinary differential equations