Modeling, Analysis, Maximum Likelihood Estimation and EM-Algorithm in a COVID19 Stochastic Model

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Despite continuing medical intervention and control with almost 14 billion vaccine doses distributed by September 6, 2023, the WHO recorded a wide global spread of the Coronavirus Disease 2019 (COVID-19) including over 770 million infected individuals, and over 6.9 million deaths. In this presentation, we derive and study a theoretical discrete-time Markov chain model for the disease, that approximates a Markov jump process for the disease dynamics. We numerically conduct sensitivity analysis on the model to determine the impacts of vaccination, hospitalization, and asymptomatic/ symptomatic transmissions. We investigate disease control by deriving epidemiological parameters such as the basic reproduction number and the probability of no spread. Finally, we begin statistical inferences in the model; applying the Maximum-Likelihood method; and deriving the EM-algorithm for the model.