Discrete-time Disease Model with Population Motion under the Kolmogorov Equation View and Application

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We introduce the Susceptible-Infected-Removed (SIR) model and the Susceptible-Exposed-Infected-Removed (SEIR) model coupled with a social mobility model (SMM). We discretize them by a Forward Euler Method, which can be viewed through a mean-field approximation from a discrete version. We calculate basic reproduction number R_0 using the next generation matrix method. Then we obtain hyperbolic forward Kolmogorov equations (high-dimensional PDEs) and show that its projected characteristics corresponding to these models coincide with population motivation. Finally, we use the Deep Galerkin Method (DGM) to solve the high order nonlinear PDEs. In this project, we can improve the global prediction of epidemics dynamics, which can provide suggestions on "how to control " epidemics. In addition, we also use these methods to solve the Cancer Immunotherapy model. We believe this Cancer Immunotherapy model can provide another way to observe the blockade of immune checkpoints in the tumor dynamics.

Keywords: Epidemic Disease Model, Social Mobility Model, Forward Euler method, Forward Kolmogorov Equations, Deep Galerkin Method