Analysis and Dynamically Consistent Numerical Schemes for the SIS Model and Related Reaction Diffusion Equation

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Abstract

The classical SIS epidemiological model is extended in two directions: (a) The number of adequate contacts per infective in unit time is assumed to be a function of the total population in such a way that this number grows less rapidly as the total population increases; (b) A diffusion term is added to the SIS model and this leads to a reaction diffusion equation, which governs the spatial spread of the disease. With the parameter R0R0 representing the basic reproduction number, it is shown that R0 = 1R0 = 1 is a forward bifurcation for the model (a), with the disease-free equilibrium being globally asymptotic stable when R0R0 is less than 1. In the case when R0R0 is greater than 1, traveling wave solutions are found for the model (b). Nonstandard finite difference (NSFD) schemes that replicate the dynamics of the continuous models are presented. In particular, for the model (a), a nonstandard version of the Runge-Kutta method having high order of convergence is investigated. Numerical experiments that support the theory are provided.