Continuous and Reliable Discrete Models for Simultaneous Infection

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In this talk, a continuous-time model for the transmission dynamics of two different strains/pathogens, with possibility of simultaneous transmission, for arbitrary disease(s) is formulated. The existence and stability for the disease-free equilibrium (DFE), boundary equilibrium (BE) and endemic equilibrium (EE) of the model under certain conditions are presented. Furthermore, a non-standard finite-difference (NSFD) scheme is constructed based on Mickens [1], [2] discretization framework. It is shown that the discrete model is dynamically consistent with the continuous-time model by replicating the basic features (such as positivity of solutions, the dissipativity of the system, and its inherent conservation law, equilibrium points and their stability properties) of the continuous model. Numerical simulations confirmed these properties.

References

[1] R.E. Mickens, Non-standard Finite Difference Models for Differential Equations, World Scientific, Singapore, 1994.

[2] R.E. Mickens, Applications of Nonstandard Finite Difference Schemes, World Scientific, Singapore, 2000.