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The role of infection on shifts in population cycles in a discrete-time epidemic model

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Abstract

One-dimensional discrete-time population models, such as for logistic or Ricker growth, exhibit periodic and chaotic dynamics. Adding epidemiological interactions into the system increases its dimension and the resulting complexity of its behaviors. Previous work showed that while a discrete SIR model with Ricker growth exhibits qualitatively similar total population dynamics in the presence and absence of disease, a more complicated viral infection (SIV) system does not. Instead, infection in the SIV system shifts the periodic behavior of system in a manner that distinguishes it from the corresponding disease-free system. Here, we examine a SI model with Ricker population growth and show that infection produces a distinctly different bifurcation structure than that of the underlying disease-free system. We use analytic and numerical bifurcation analysis to determine the influence of infection on the bifurcation structure of the system. In addition, we derive the basic reproductive number, R_0, and determine the influence of population growth and decay parameters on R_0. Our work shows that even in the SI model, infection dynamics can shift the location of period-doubling bifurcations as well as the onset of chaos.