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Summary: Generally speaking, $R_0$ cannot be explicitly calculated for most age-structured epidemic systems. In this paper, we discretize a linear operator produced by the infective population with a theta scheme in a finite horizon, which transforms the abstract problem into the problem of solving the positive dominant eigenvalue of the next-generation matrix. This leads to a corresponding threshold $R_{0,n}$. Using the spectral approximation theory, we obtain that $R_{0,n} \to R_0$ as $n \to +\infty$. Some numerical simulations are provided to certify the theoretical results.

MSC:
65M22 Numerical solution of discretized equations for initial value and initial-boundary value problems involving PDEs
65M70 Spectral, collocation and related methods for initial value and initial-boundary value problems involving PDEs

Keywords:
basic reproduction number; theta scheme; epidemic system