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Deterministic and stochastic stability of an SIRS epidemic model with a saturated incidence rate. (English) Zbl 1358.92093

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Summary: In this paper, we formulate an epidemic model for the spread of an infectious disease in a population of varying size. The total population is divided into three distinct epidemiological subclass of individuals (susceptible, infectious and recovered) and we study a deterministic and stochastic models with saturated incidence rate. The stochastic model is obtained by incorporating a random noise into the deterministic model. In the deterministic case, we briefly discuss the global asymptotic stability of the disease free equilibrium by using a Lyapunov function. For the stochastic version, we study the global existence and positivity of the solution. Under suitable conditions on the intensity of the white noise perturbation, we prove that there are a p-th moment exponential stability and almost sure exponential stability of the disease free equilibrium. Furthermore, sufficient conditions for the extinction of the disease are obtained and the asymptotic behavior around the endemic equilibrium is studied. Finally, we give some numerical simulations to illustrate our theoretical results.

MSC:

92D30 Epidemiology
60H10 Stochastic ordinary differential equations (aspects of stochastic analysis)

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Keywords:

stochastic epidemic model; saturated incidence rate; global stability; moment exponentialstability; Lyapunov function

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