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A stochastic SIS epidemic with demography: initial stages and time to extinction

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Abstract

We study an open population stochastic epidemic model from the time of introduction of the disease, through a possible outbreak and to extinction. The model describes an SIS (susceptible-infective-susceptible) epidemic where all individuals, including infectious ones, reproduce at a given rate. An approximate expression for the outbreak probability is derived using a coupling argument. Further, we analyse the behaviour of the model close to quasi-stationarity, and the time to disease extinction, with the aid of a diffusion approximation. In this situation the number of susceptibles and infectives behaves as an Ornstein-Uhlenbeck process, centred around the stationary point, for an exponentially distributed time before going extinct.

Key words: stochastic epidemic model, quasi stationarity, sis model, coupling, Ornstein-Uhlenbeck, diffusion approximation, outbreak probability

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