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SIR epidemics and vaccination on random graphs with clustering

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Abstract

In this research report we consider SIR (Susceptible → Infectious → Recovered) epidemics on random graphs with clustering. To incorporate group structure of the underlying social network, we use a generalized version of the configuration model in which each node is a member of a specified number of triangles. SIR epidemics on this type of graph have earlier been investigated under the assumption of homogeneous infectivity and also under the assumption of Poisson transmission and recovery rates.

We extend known results from literature by relaxing the assumption of homogeneous infectivity. An important special case of the epidemic model analyzed in this paper is epidemics in continuous time with arbitrary infectious period distribution. We use branching process approximations of the spread of the disease to provide expressions for the basic reproduction number R_0, the probability of a major outbreak and the expected final size. In addition, the impact of random vaccination with a perfect vaccine on the final outcome of the epidemic is investigated. We find that, for this particular model, R_0 equals the perfect vaccine-associated reproduction number.

Generalizations to groups larger than three are discussed briefly.

Keywords: SIR epidemics, Configuration model, Clustering, Branching processes, Vaccination.

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