SIR epidemics on random graphs with a given degree sequence

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We study the susceptible-infective-recovered (SIR) epidemic on a random graph chosen uniformly subject to having given vertex degrees. In this model infective vertices infect each of their susceptible neighbours, and recover, at a constant rate.

Suppose that initially there are only a few infective vertices. We prove that there is a threshold for a parameter involving the rates and vertex degrees below which only a small number of infections occur. Above the threshold a large outbreak may occur. We prove that, conditional on a large outbreak, the evolutions of certain quantities of interest, such as the fraction of infective vertices, converge to deterministic functions of time. In contrast to earlier results for this model, our results only require basic regularity conditions and a uniformly bounded second moment of the degree of a random vertex.

We also study the regime just above the threshold: we determine the probability that a large epidemic occurs and the size of a large epidemic.

This is joint work with Svante Janson and Peter Windridge.