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SIR epidemic on a configuration model network

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Abstract

In this thesis we study Susceptible-Infectious-Removed epidemics on configuration model networks. Networks are used in different kinds of studies, such as the study of the internet, social networks and biological networks, as a simplified model of the real world. We look at a closed population without births, deaths and migration. On that population we look at an SIR epidemic, which divides the population into three different states: susceptible, infectious and removed. Those who are susceptible can be infected if they are in contact with an infectious individual. Those who are infected make contacts at a fixed rate, then they recover and becomes immune or die from the disease. How a disease spreads through the population depends strongly on the connections that occur between infectious and susceptible individuals. By constucting a configuration model network it is possible to investigate when the epidemic may become large and when it will stay small with probability one and how the distribution of the infectious period affects the outbreak. We use generating functions and percolation theory to answer these questions. The early stages of an epidemic outbreak can be approximated by a branching process, we see that this approximation is possible until approximately the $\sqrt{n}$th infection in a population that consist of n individuals. We also show that an epidemic outbreak is possible when the expected number of transmission causing contacts an infectious individual has is above one.

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