An Epidemic on a Weighted Network

Kristoffer Spricer[1,2] and Tom Britton[1]

[1]Department of Mathematics, Stockholm University, 106 91 Stockholm, Sweden
[2]Corresponding author, email: spricer@math.su.se

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Abstract

We introduce a weighted configuration model graph, where *edge weights* correspond to the probability of infection in an epidemic on the graph, focusing on two different weights. We study the *basic reproduction number R_0*, the *probability of a large outbreak* and the *relative final size of a large outbreak*, using discrete time and Markovian continuous time settings. Results are compared with those for a calibrated unweighted graph. The degree distributions are based both on empirical network data and on theoretical constructs. Using copulas to model the dependence between the degrees of the different edge types allows for modeling the correlation over a wide range. The weighted model produces much richer results than the unweighted model. Also, while R_0 always increases with increasing correlation between the two degrees, this is not necessarily true for the probability of an epidemic nor for the relative final size of it. The copula model can produce results that are similar to those of the empirical degree distributions, indicating that it is a viable alternative to using the full empirical data.

Keywords - epidemics, basic reproduction number, weighted graph, configuration model, final size, large outbreak, copula.