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# SEMS Research Highlights



## A Network Model for Statistical Analysis of Disease Spread in Host Population

Christophe Groendyke

Director — Actuarial Science, Mathematics Department

This newsletter presents the research conducted within the School of Engineering, Mathematics and Science (SEMS) at Robert Morris University (RMU). It covers various relevant topics including: interdisciplinary efforts, successful research grants, student research, posters and papers, journal publications, presentations at national and international conferences, contribution to professional societies, STEM educational research, industrial consulting collaborations and applied research.

Networks provide an excellent, flexible model of the contact structure in a host population through which a disease spreads. Figure (1) shows an example of a network describing the contact relationships within a population; Figure (2) shows the spread of an epidemic through the population across this network.

Yet statistical inference for plausible network models is difficult. Here, we demonstrate that the parameters of a class of network models that include age-, sex-, household-, classroom- and spatial-effects can be estimated from epidemiological data taken from a single outbreak. This is done via a case study of a well-documented measles out-

break in Hagelloch, Germany in 1861. Using a Bayesian model choice procedure, we find those properties of the population that play the greatest role in propagating the outbreak and select the best-fitting model. It is shown that an advantage of using a network model is that it allows one to clearly separate the social contact process in which potentially infectious contacts are made between hosts from the transmission process describing who actually infected whom in the outbreak. The threshold parameter for this outbreak that summarizes the speed at which the disease spreads is then estimated. Analytical methods and custom software are

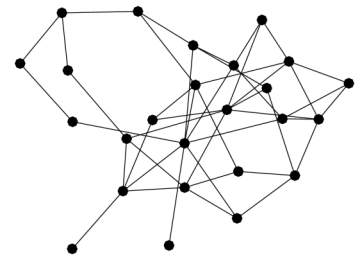


Figure 1. Network showing contact relationships.

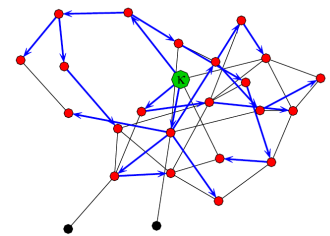


Figure 2. Epidemic spread through host population.

scalable to larger data sets which helps to bring network epidemiology into a rigorous statistical framework.

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Dr. Priyadarshan Manohar,

Co-Director, SEMS-ROC, Research and Grants, E-mail: [manohar@rmu.edu](mailto:manohar@rmu.edu), Tel.: 412 397 4027

