

Infectious Disease Project Proposal V1

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Background

"Superspreading" is a term referring to an event or sequence of events in which secondary infections are far above normal in the context of a specific contagion. Understanding these events, their sources, and their consequences are of critical importance to managing and forming public policy surrounding outbreaks and epidemics. At a very basic level, stochastic branching models under some assumption of random branching rates are useful in understanding outbreak behaviour such as outbreak size, duration, and frequency. These models make some key assumptions of independence of individual outbreaks and ignore information such as contact structure.

Research Questions

For this project, I propose an extension of the superspreading model onto a network infrastructure and comparing it to branching models of the same or similar type. To make this concrete, consider a scenario where some empirical data exists suggesting a contact structure, such as frequency of individuals with some number of contacts. A branching model can be used immediately substituting the contact distribution estimate. Alternatively, a Configuration model or Chung Lu network model can be generated from the data and provide an estimation of the contact network where a categorical SIR model, infection rate model, or even a Potts model, can be simulated or analysed and used to compare to estimates of the branching model. A systematic comparison and review of the models is proposed.

Learning Goals

During this review, I expect to gain insight into network and contact structure effects on inhibiting or enhancing superspreading activity to make a meaningful contribution to the discussion and understanding of such events. Further, I hope to gain further understanding of the impact of superspreading and similar effects on spreading mechanics in physical space.

Relationship to Disease Modeling

While superspreading is a relatively recent topic of discussion in the coursework, it has been particularly relevant in the recent Covid-19 pandemic to a degree that it has entered the common lexicon. Further, superspreading can play a pivotal role in understanding emergent behavior in epidemiology.