Spreading of disease in heterogeneous population

Jaewook Joo
Rutgers University

Heterogeneities in population are important in the dynamics and persistence of the spreading of infectious diseases. Two kinds of heterogeneities are considered: social heterogeneity and spatial heterogeneity (spatial correlation).

For social heterogeneity the structure of social interactions in a population is represented by weighted scale-free (WSF) networks with power law connectivity distributions: $P(k) \sim k^{-\gamma}$. Considering cases where the transmission of infection between nodes depends on their connectivity, we introduce a weight that reduces the rate of infection transmission across an edge going from a node with high connectivity. A mean field approximation of susceptible-infected-susceptible (SIS) model then leads to a finite threshold for WSF graphs with $2<\gamma \leq 3$. An indirect cause of spatial heterogeneity is the interaction between individuals leading to spatial correlations. One of simplest ways to model the spatial correlation is the pair approximation that approximates higher moments in terms of second moments. We investigated the phase diagram of the stochastic Susceptible-Infected-Recovered-Susceptible (SIRS) model via computer simulations on lattice and compared the results with those obtained from the mean-field approximation and pair approximation.