Epidemic Conditions with Temporary Link Deactivation on a Network SIR Disease Model

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The spread of an infectious disease depends on intrinsic properties of the disease as well as the connectivity and actions of the population. This study investigates the dynamics of an SIR type model which accounts for human tendency to avoid infection while also maintaining preexisting, interpersonal relationships. Specifically, we use a network model in which individuals randomly deactivate connections to infected individuals and later reconnect to the same individuals upon recovery. To analyze this network model, a mean field approximation consisting of a system of fourteen ordinary differential equations for the number of nodes and edges is developed. This system of equations is closed using a moment closure approximation for the number of triple links. By analyzing the differential equations, it is shown that, in addition to force of infection and recovery rate, the probability of deactivating edges and the average node degree of the underlying network determine if an epidemic occurs.