Epidemic in Network

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1 Model

$$
\begin{aligned}
\frac{dS}{dt} &= -\beta_A \frac{S}{N} A - \beta_I \frac{S}{N} I \\
\frac{dL}{dt} &= \beta_A \frac{S.A}{N} + \beta_I \frac{S.I}{N} - \theta_I L - \theta_A L \\
\frac{dI}{dt} &= -\alpha_I I - \gamma_I I + \beta_I \frac{S}{N} I \\
\frac{dA}{dt} &= -\alpha_A A + \beta_A \frac{S}{N} A \\
\frac{dR}{dt} &= \alpha_I I + \alpha_A A \\
\frac{dD}{dt} &= \gamma_I I
\end{aligned}
\tag{1}
$$

where, S = Susceptible, L = Latent, I = Infected, A = Asymptomatic, R = Recovered and D = Dead. The significance of the coefficients are discussed in the report.

2 Network

2.1 Normal Condition

Categorizing interaction into different levels of physical interactions - Community Structure. The entries of the adjacency matrix is given by,

$$f(l, x) = e^{-lx}$$

"l" denotes the level of interaction and "x" takes value from an uniform random number generator. For detailed description refer to the report or netstruc.

2.2 Lockdown condition

Higher level connections get hampered strongly.

$$f(l, ld, x) = e^{-l^{(ld+1)}x}$$

3 SLIARD on Network

Adj = Adjacency matrix $\vec{S_i}$ = column matrix containing the SLIARD feature of the "i"th node. The node-node coupling is present only in the rates of S and L.

$$\frac{d\vec{S_i}}{dt} = -\beta_A \vec{S_i} \sum_j (Adj)_{ij} \vec{A_j} - \beta_I \vec{S_i} \sum_j (Adj)_{ij} \vec{I_j}$$

$$\frac{d\vec{L_i}}{dt} = \beta_A \vec{S_i} \sum_j (Adj)_{ij} \vec{A_j} + \beta_I \vec{S_i} \sum_j (Adj)_{ij} \vec{I_j} - \theta_I \vec{L_i} - \theta_A \vec{L_i}$$