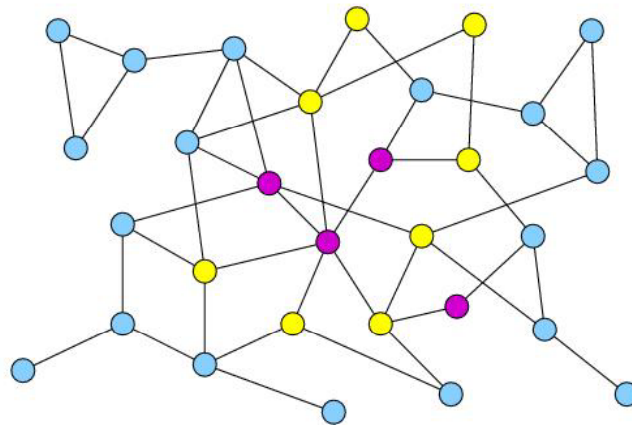


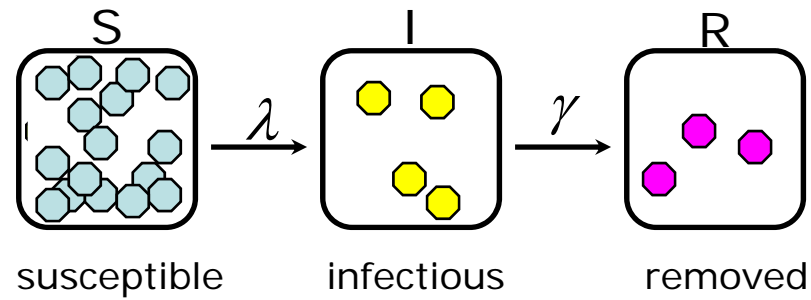
Does Individual Behavior Matter? Network and Homogenous Models



Shweta Bansal and Lauren Ancel Meyers
University of Texas, Austin

*DIMACS Meeting, Edinburgh
May 2007*

Traditional Compartmental Models



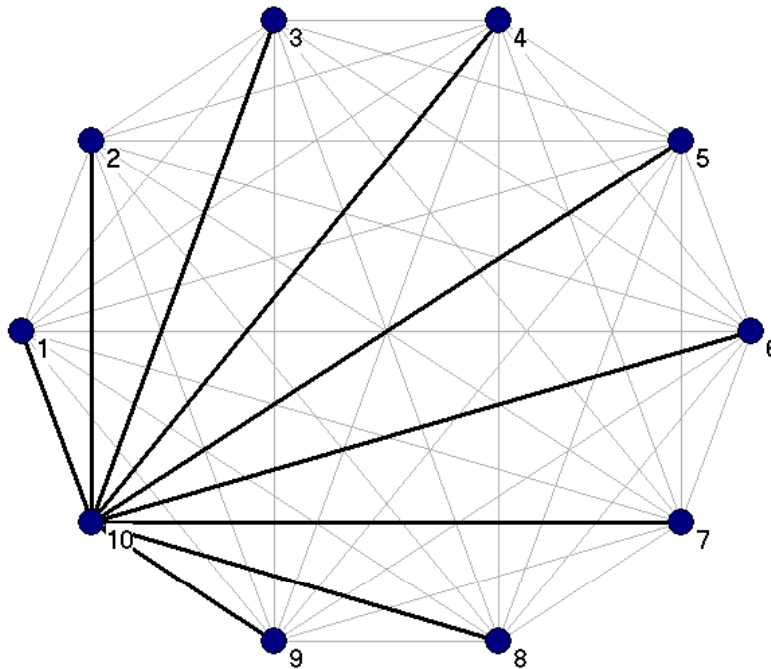
$$\frac{dS}{dt} = -\lambda S$$

$$\frac{dI}{dt} = \lambda S - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$

Network Interpretation of Compartmental Model I

Complete Graph– possible contacts

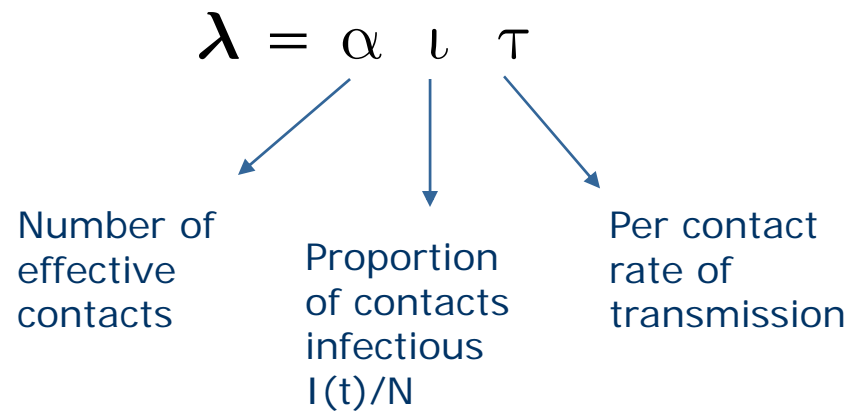


$$\frac{dS}{dt} = -\lambda S$$

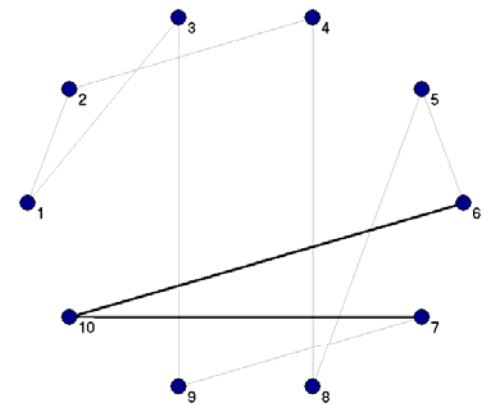
Force of infection

Network Interpretation of Compartmental Models II

Force of Infection

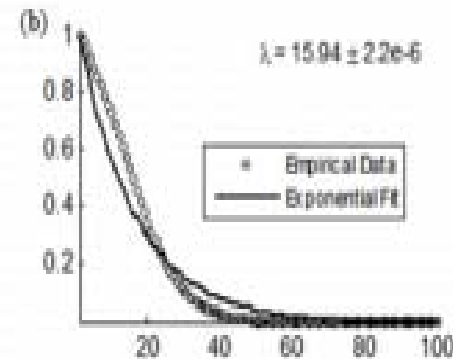
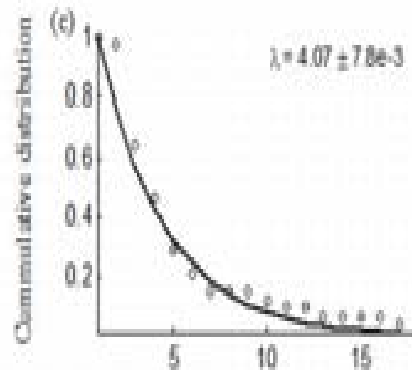


Regular Random Graph – *effective contacts*



What are the structures of real networks?

HETEROGENIETY



How to incorporate heterogeneity?

- **Network & Individual-Based Models**

- Percolation methods
(Newman et al, 2000, 2002; Meyers et al, 2003, 2005, 2006)
- Pair approximation methods
(Keeling 1999)
- Heterogeneous-mixing methods
(Moreno, Pastor-Satorras, Vespignani, 2002)
- Dynamical PGF methods
(Volz, 2007)

How to incorporate heterogeneity?

- **Modified Compartmental Models**

$$\frac{dS}{dt} = -\lambda S = -\alpha\tau(I/N)S$$

Aparicio & Pascual (2006):

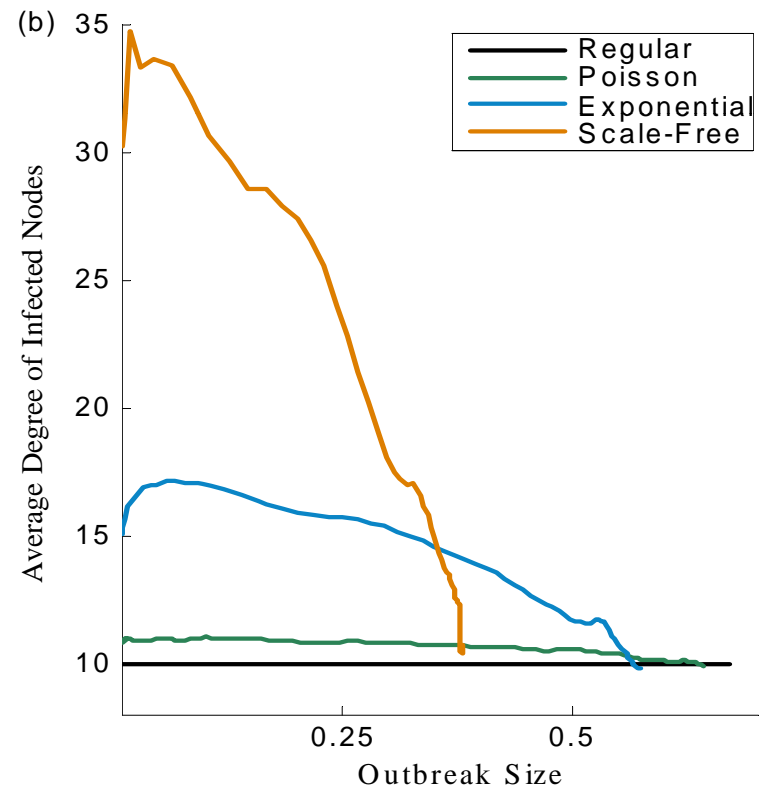
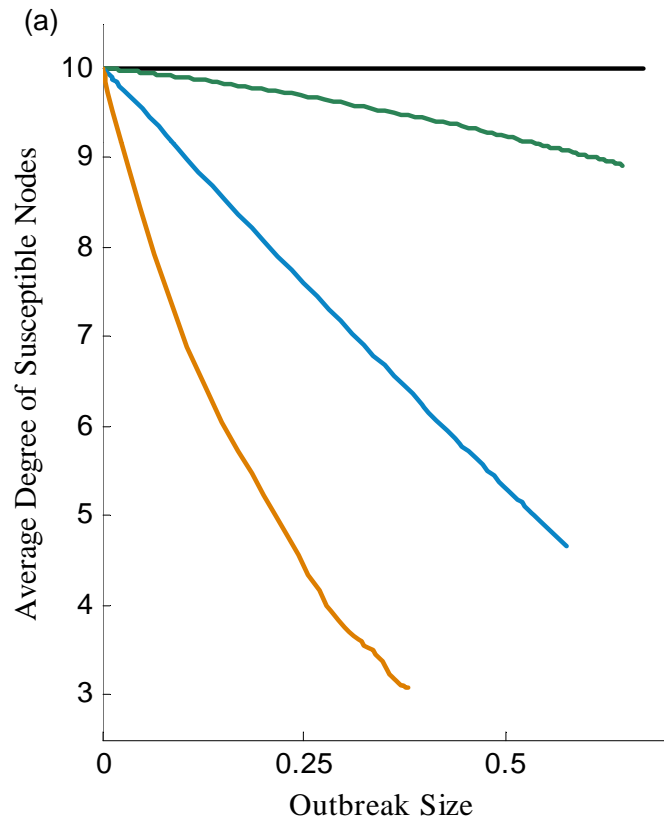
$$\frac{dS}{dt} = -\gamma R_0(I/N)S$$

Roy & Pascual (2006), Severo (1969), Hochberg (1991),
Liu et al (1987), Stroud et al (2006)

$$\frac{dS}{dt} = -\alpha\tau(I/N)^p S^q$$

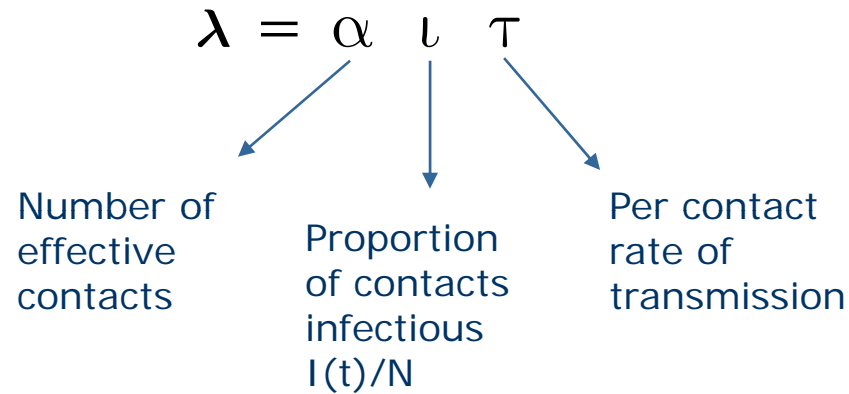
What is the correct modifier?

$$\frac{dS}{dt} = -\lambda S = -\alpha\tau(I/N)S$$

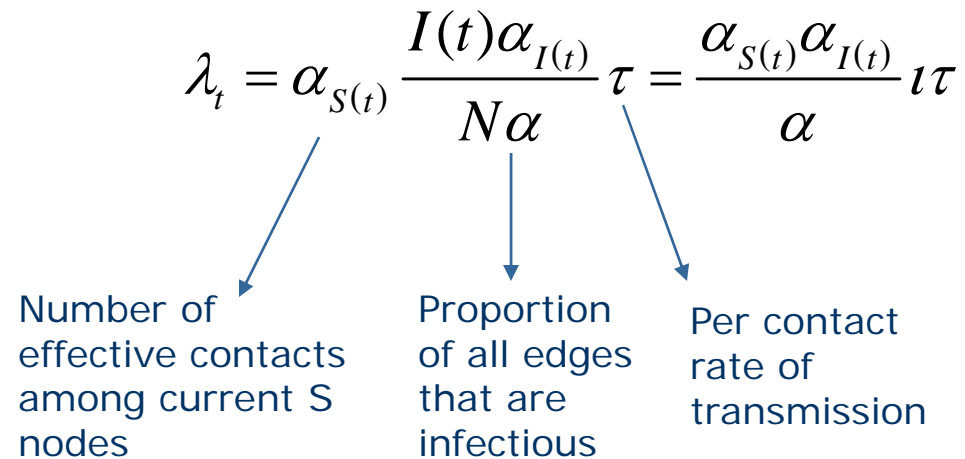


What is the correct modifier?

Force of Infection



Modified Force of Infection



Conclusions

- What have simpler models been missing, if anything?
- Which models should we use in the future?

Ref: Bansal, Grenfell, Meyers. J. R. Soc. Interface (2007)