Exploring the interaction between models and data

Jonathan Dushoff, McMaster University
http://lalashan.mcmaster.ca/DushoffLab

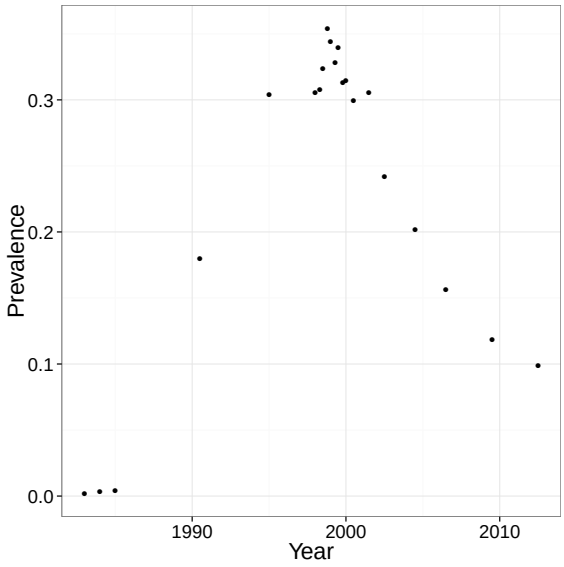
Goals

- Explore some ideas of using a model to explore disease data
- Use estimates of HIV prevalence from Zimbabwe as an example

Bridging

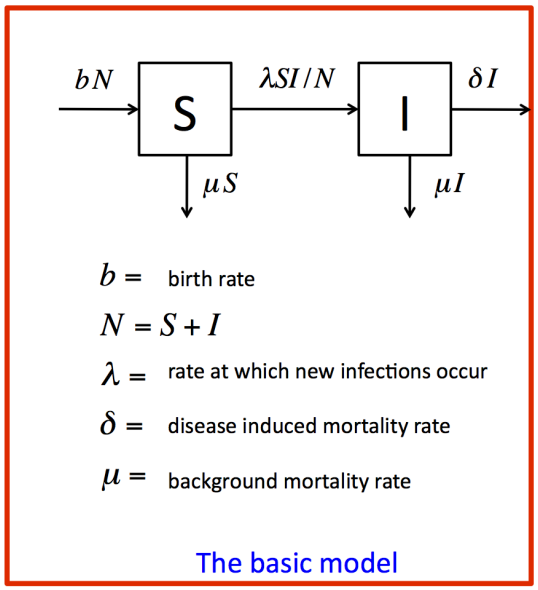
- Models are the tool we use to bridge between data and mechanisms
- In both directions

Estimated HIV prevalence in Zimbabwe



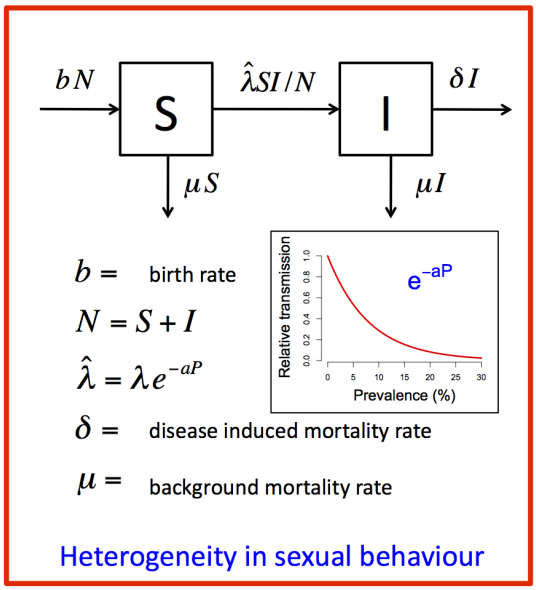
Experimental fitting

- We will fit by eye, for learning purpose only
- Later, we will talk about statistical frameworks
- Code online: https://github.com/dushoff/SIR_simulations

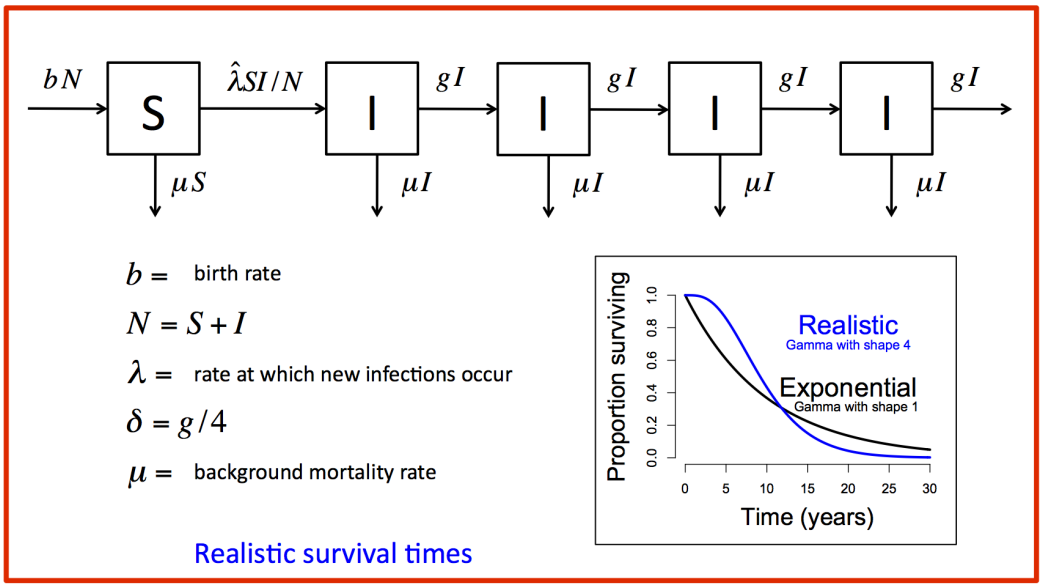


Phenomenological heterogeneity

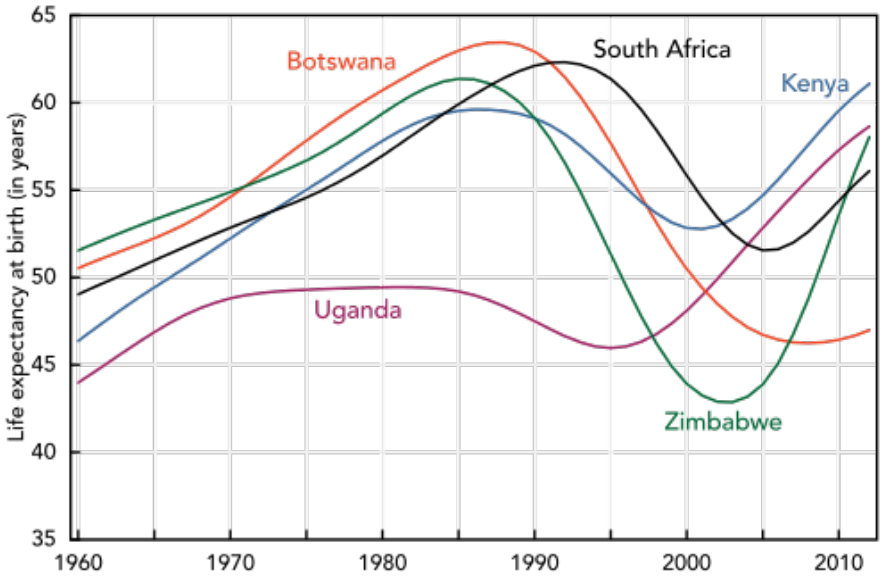
- Just *assume* that you can approximate this complicated phenomenon with a simple functional form, $\beta = f(P)$
  - Original study used $\beta = \beta_0 \exp(-\alpha P)$
  - We will use $\beta = \beta_0(1-P)^\kappa$
- Both forms start with $\beta = \beta_0$ and decline smoothly with prevalence

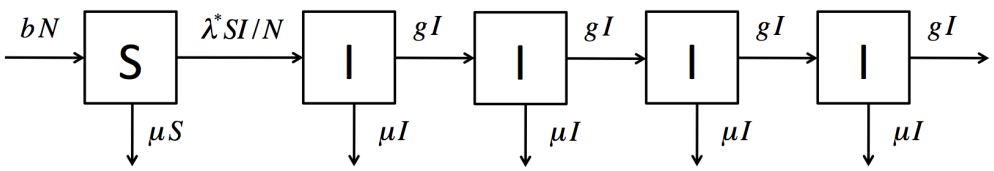


Realistic time distributions



Are people *responding* to the epidemic?





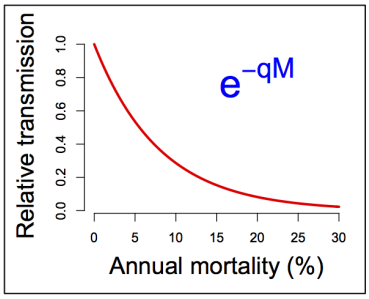
$b =$ birth rate

$N = S + I$

$\lambda^* = \hat{\lambda} e^{-qM}$

$\delta = g/4$

$\mu =$ background mortality rate



Mortality leads to behaviour change