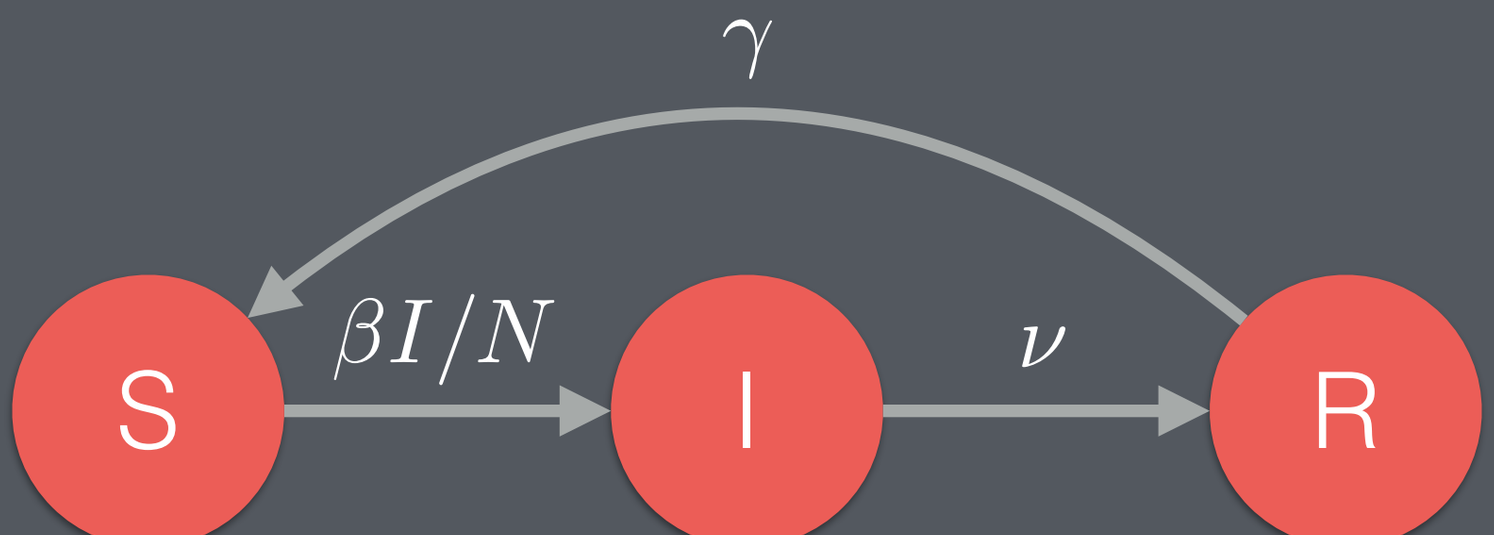
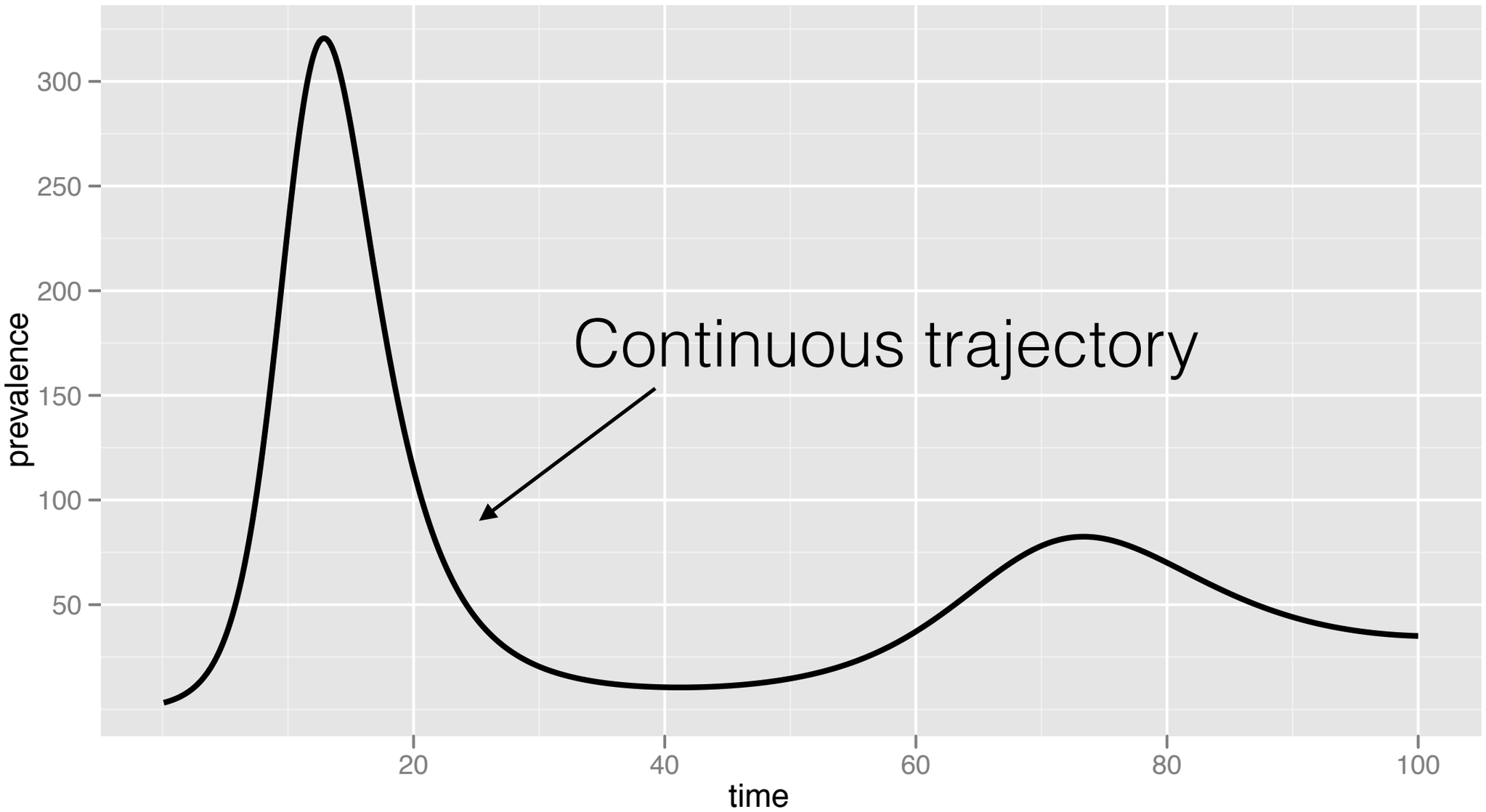
Modelling small population outbreaks

Deterministic models

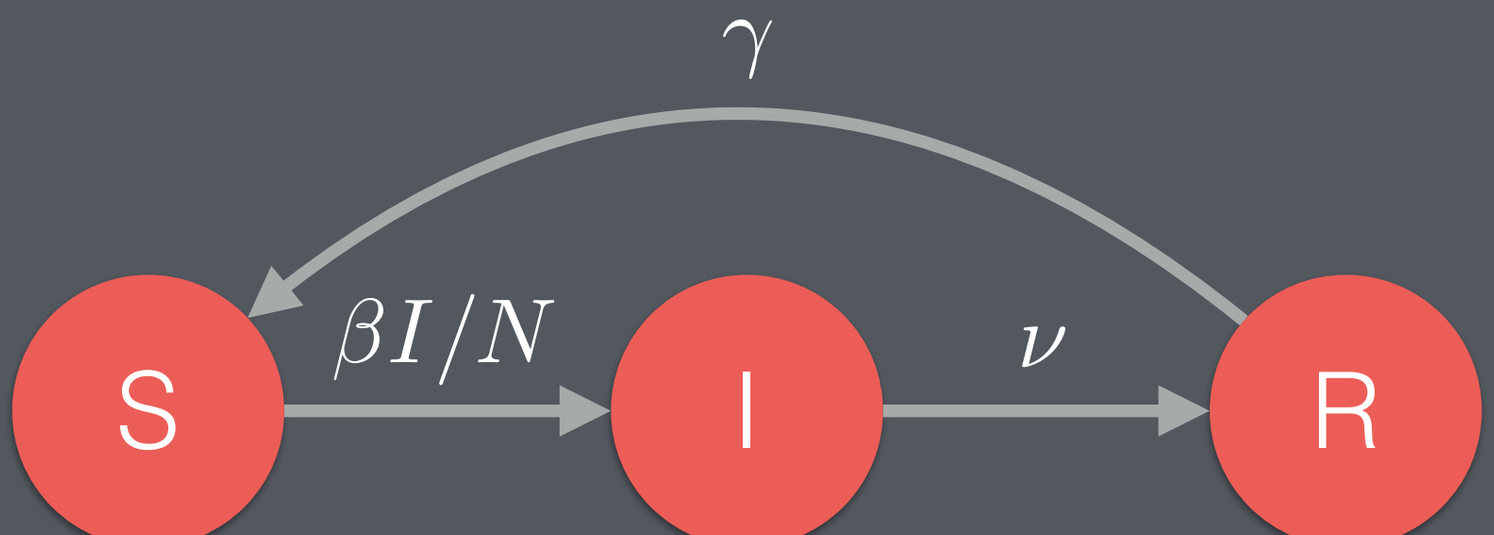


$$\frac{\mathrm{d}S}{\mathrm{d}t} = -\frac{\beta}{N}SI + \gamma(N - S - I)$$
$$\frac{\mathrm{d}I}{\mathrm{d}t} = \frac{\beta}{N}SI - \nu I$$

One θ = One trajectory

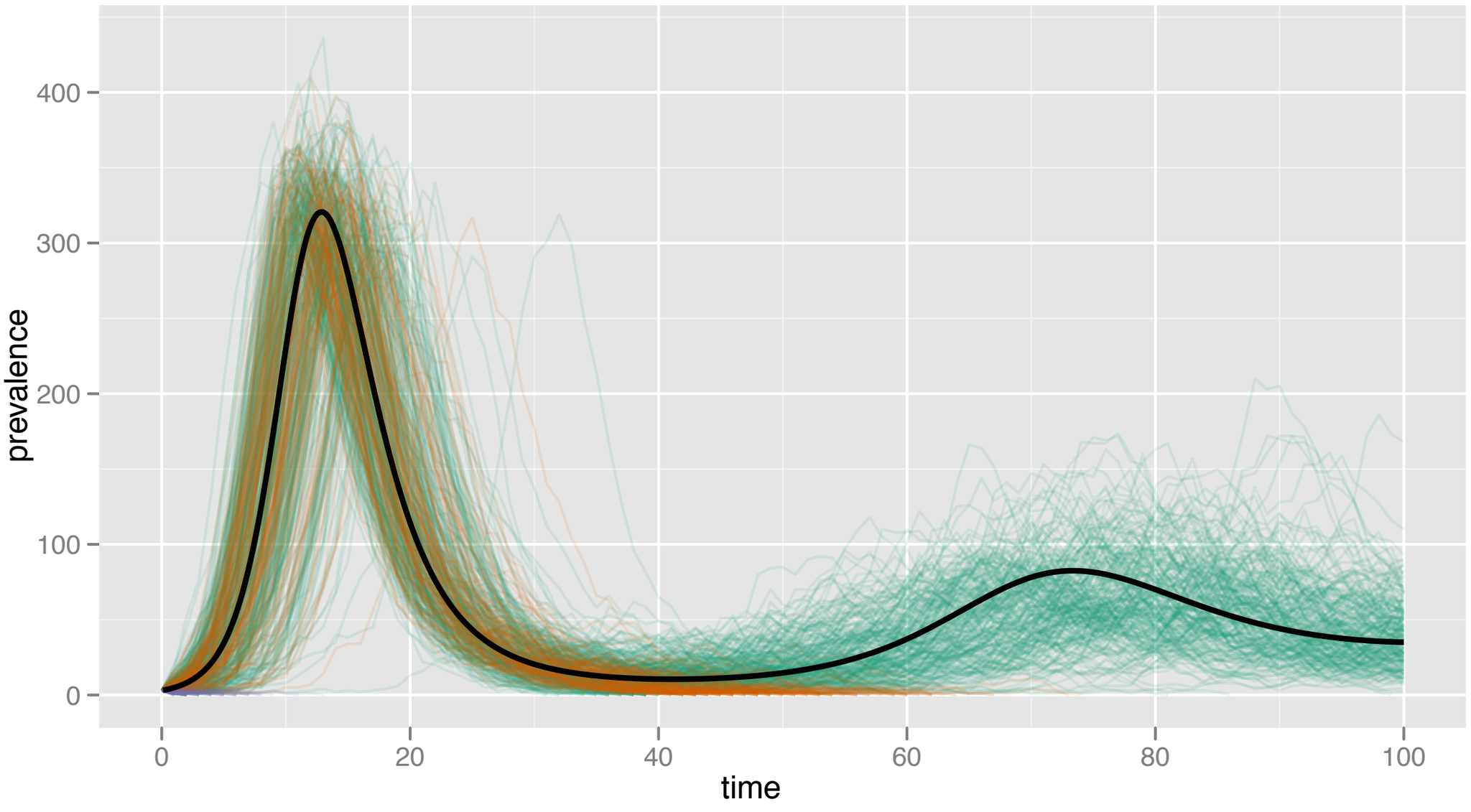


Life is discrete & stochastic

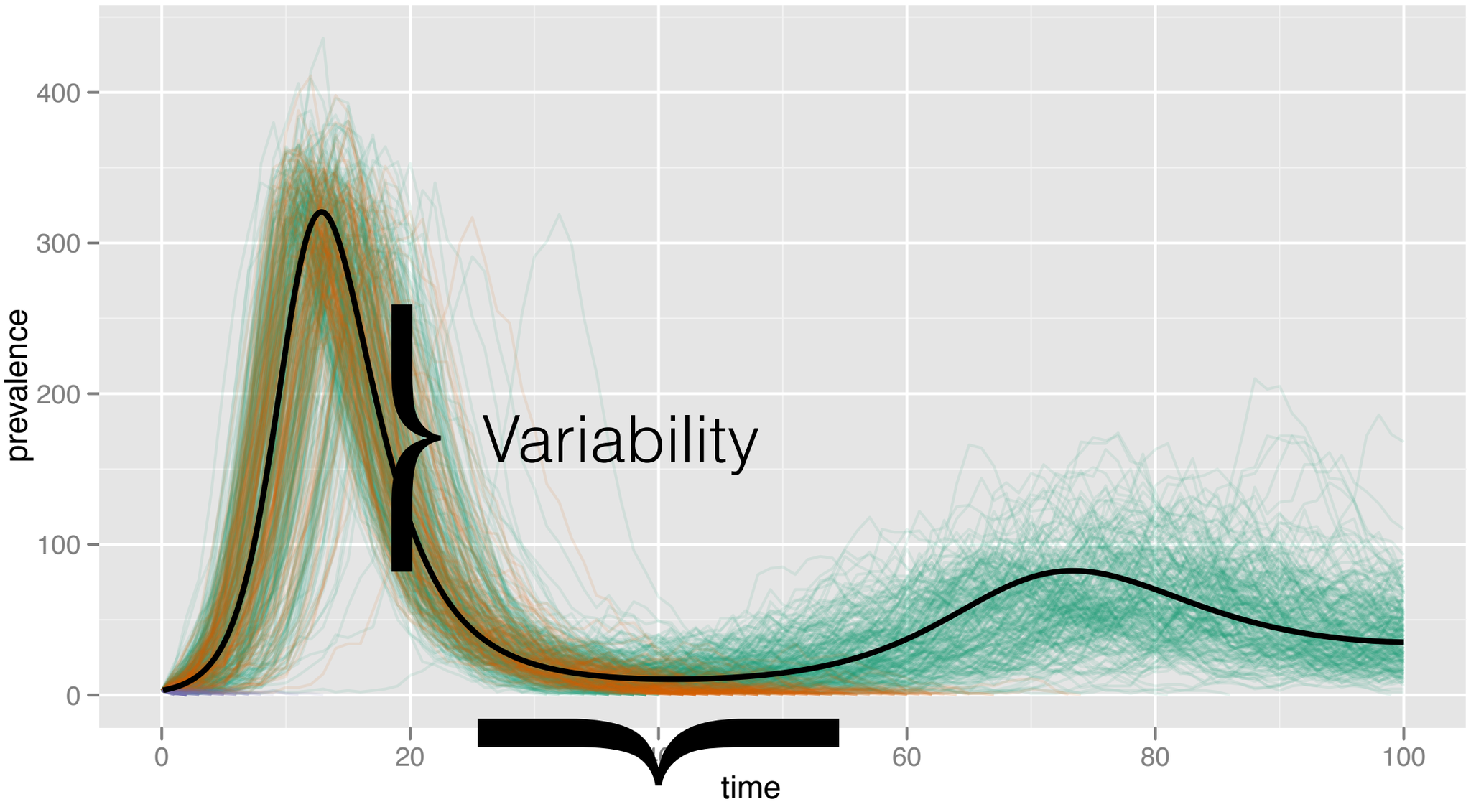


Event	Transition	Jump intensity
Infection	$(s,i) \to (s-1, i+1)$	$\beta si/N$
Recovery	$(s,i) \to (s, i-1)$	νi
Loss of immunity	$(s,i) \to (s+1, i)$	$\gamma(N-s-i)$

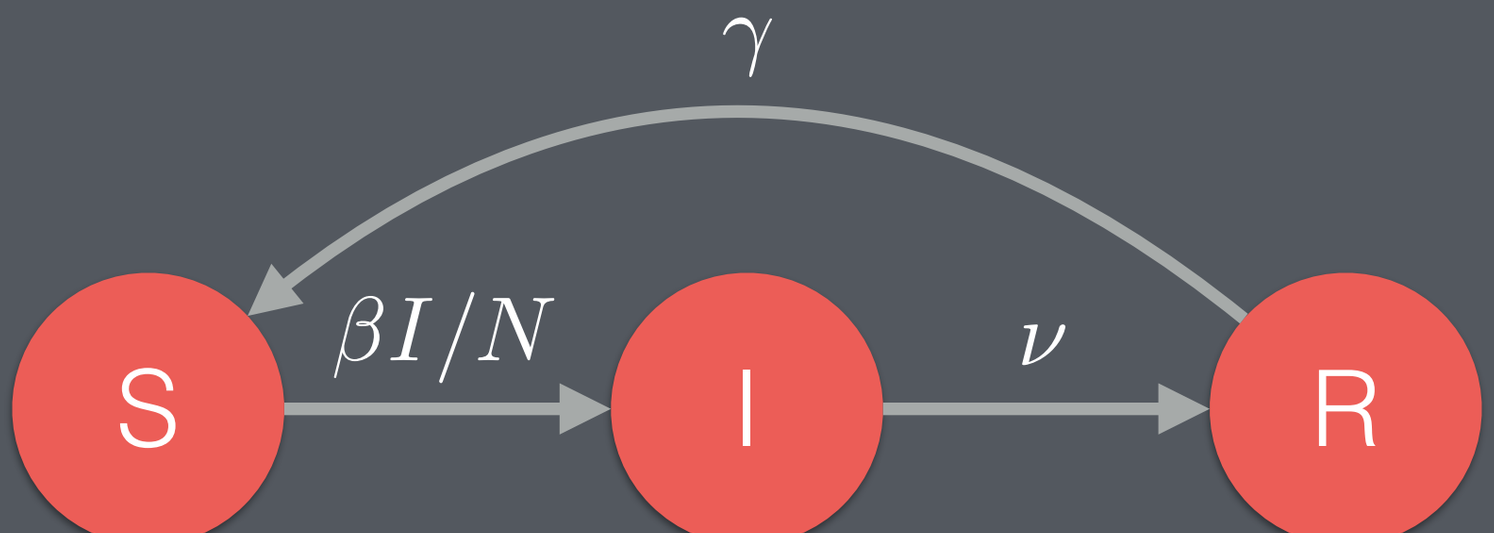
One θ = Many trajectories

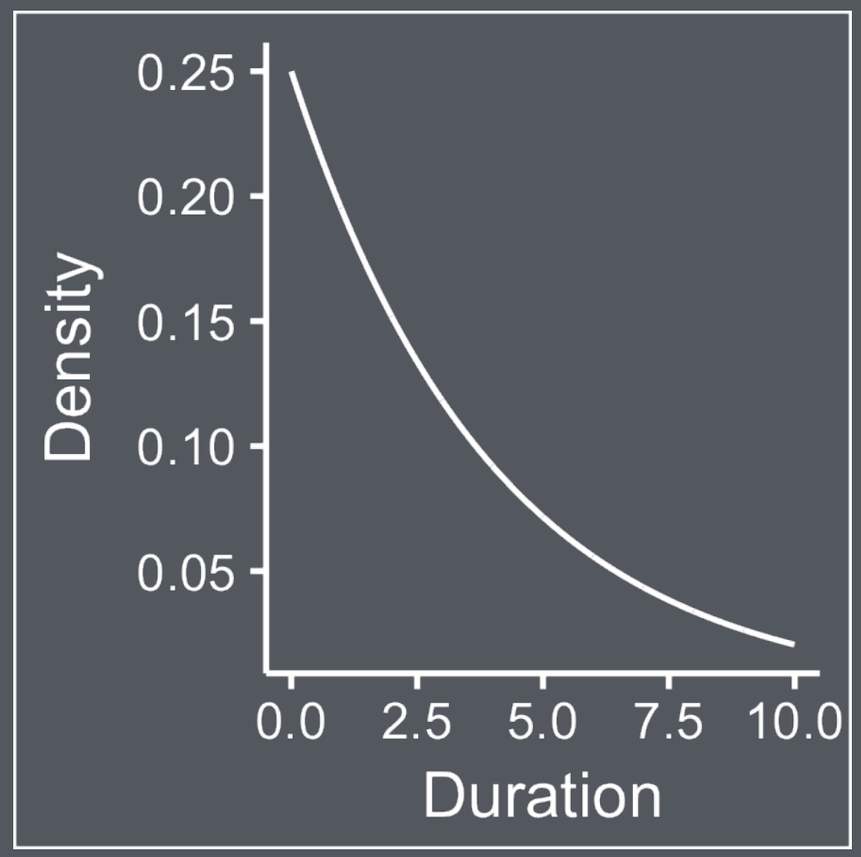


One θ = Many trajectories



Exponential distribution

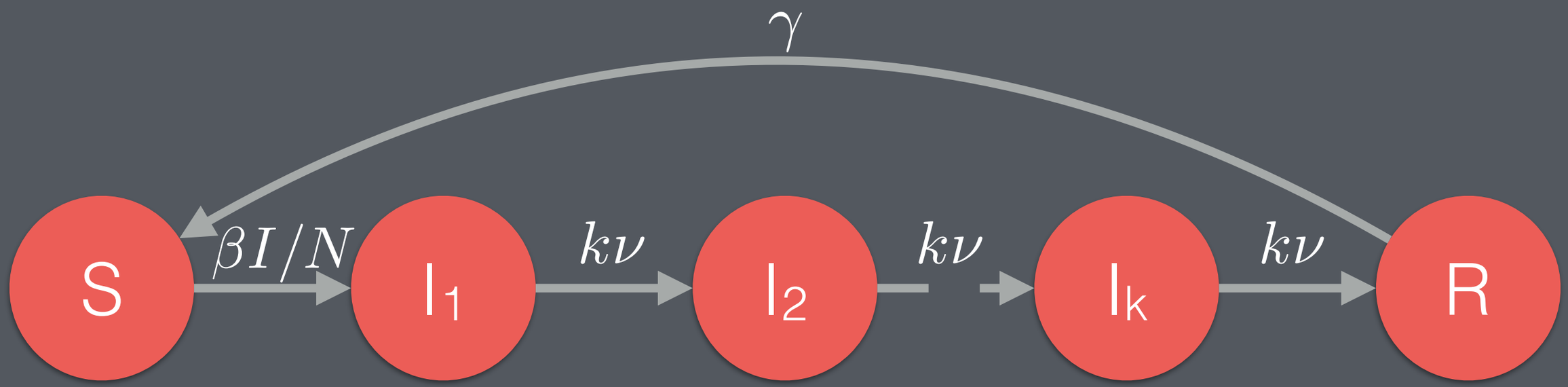


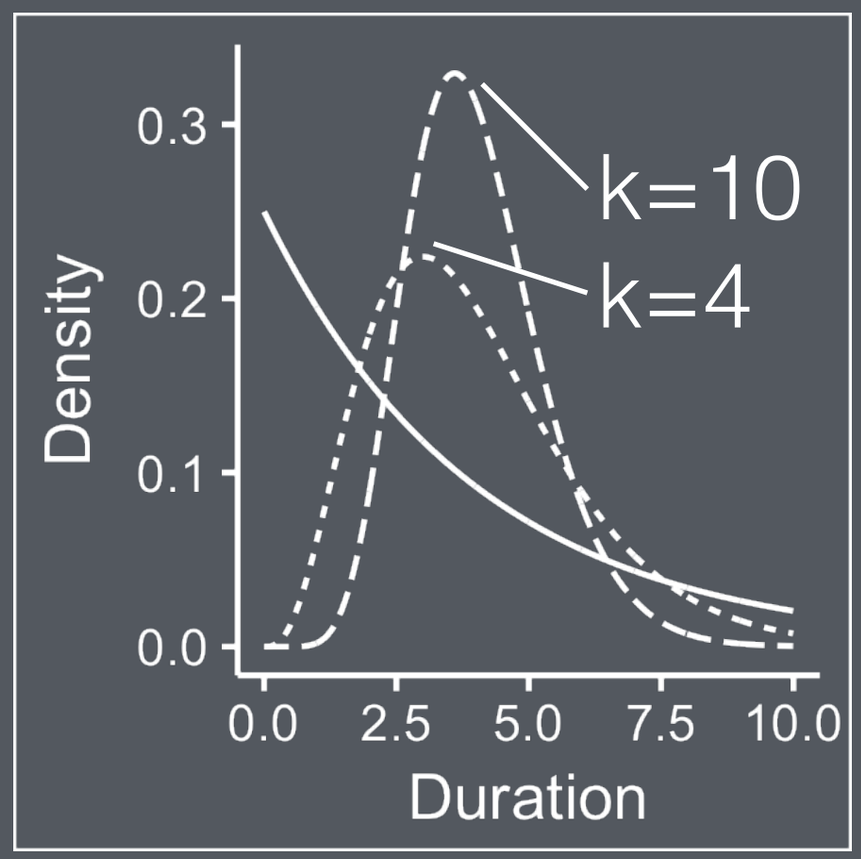


Mean = $1/\nu$
Var = Mean

Memory less

Erlang distribution

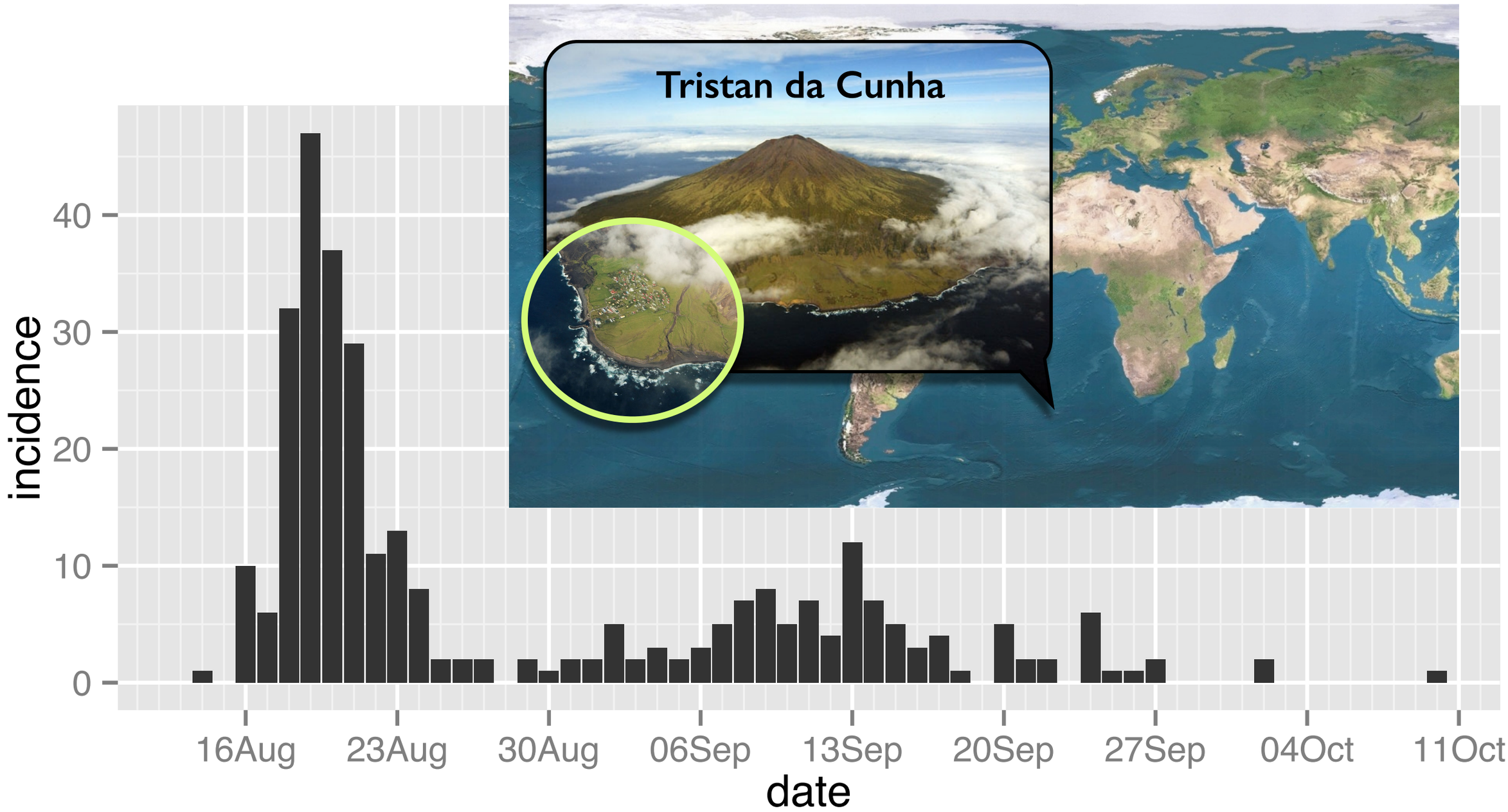




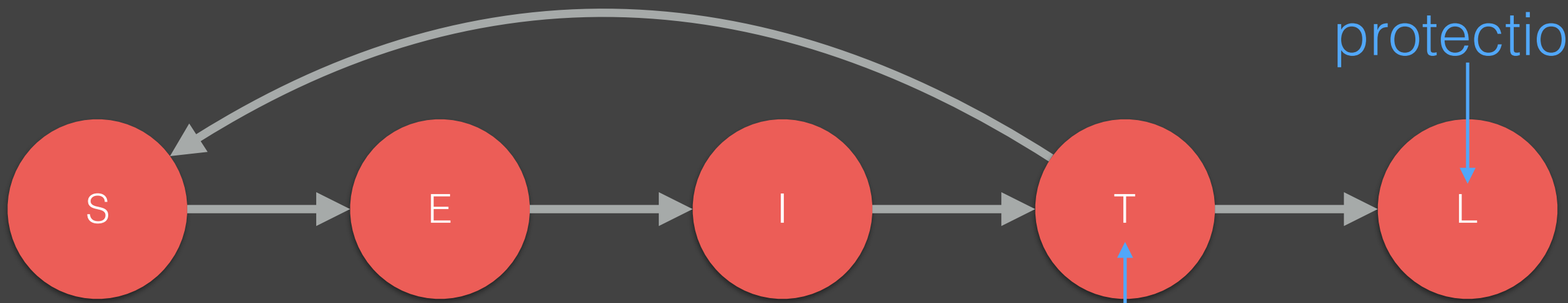
Mean = $1/\nu$
Var = Mean/k

Memory like

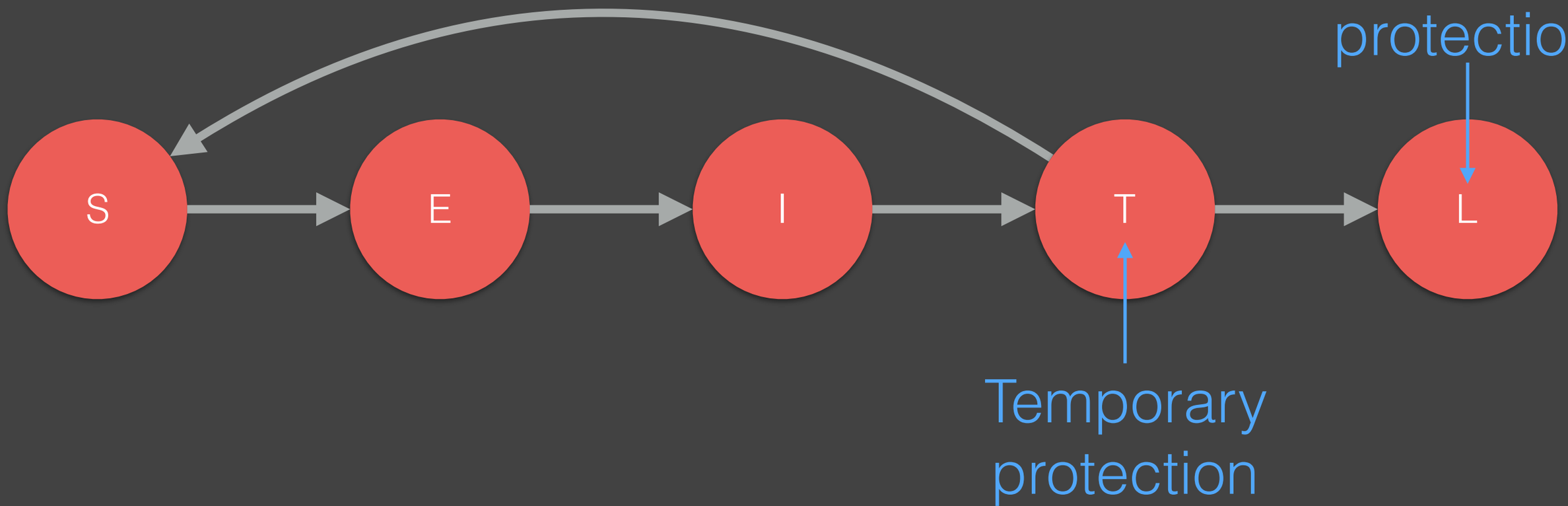
284 ind - 32% reinfected



One possible model…



One possible model…



Already implemented as a fitmodel!