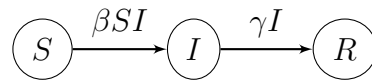

AARMS 2023 Summer School
20–30 August 2023
Stochastic models problem set

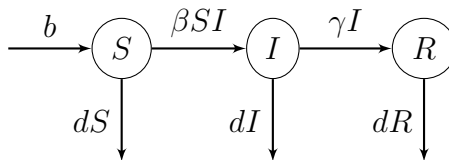
- [10] 1. Consider the Kermack-McKendrick SIR *epidemic* model



Convert the Kermack-McKendrick SIR model to a continuous-time Markov chain model.

- (a) List the state transition and their weights.
- (b) Write the Gillespie algorithm you would use to simulate the chain.
- (c) Write some code to run several simulations of the chain using `adaptivetau` or `GillespieSSA2`. Plot the solution in three different graphs.
- (d) For good measure, plot the average prevalence as well as the prevalence in the corresponding ODE. (For the former, you will probably need to interpolate solutions.)

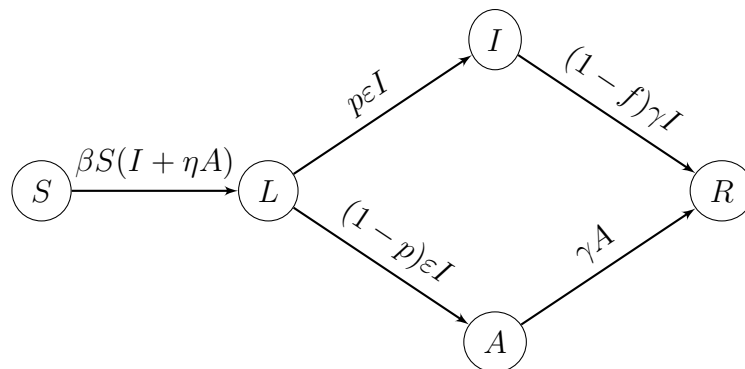
- [10] 2. Consider the *endemic* SIR model with demography



Convert the SIR endemic model with demography to a continuous-time Markov chain model.

- (a) List the state transition and their weights.
- (b) Write the Gillespie algorithm you would use to simulate the chain.
- (c) Write some code to run several simulations of the chain using `adaptivetau` or `GillespieSSA2`. Plot the solution in three different graphs.
- (d) For good measure, plot the average prevalence as well as the prevalence in the corresponding ODE. (For the former, you will probably need to interpolate solutions.)

[10] 3. Consider the *epidemic* SLIAR model



Convert the epidemic SLIAR model to a continuous-time Markov chain model.

- (a) List the state transition and their weights.
- (b) Write some code to run several simulations of the chain using `GillespieSSA2`.
- (c) For good measure, plot the average solution as well as the corresponding ODE. (For the former, you will probably need to interpolate the solutions.)
- (d) Use the `log_firings = TRUE` option of `ssa` in `GillespieSSA2` to log events and plot incidence, and decompose incidence in terms of symptomatic and asymptomatic infections.
- (e) (Bonus) Plot the quantities in (d) as epi graphs.
- (f) (Bonus) Reinterpreting I as detected infections and A as undetected infections, discuss making p , the proportion of detected infections, a function of .. something. (It could be time, prevalence, etc.)