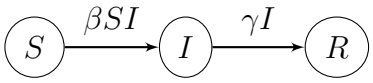
AARMS 2023 Summer School
20–30 August 2023
Stochastic models problem set

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



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

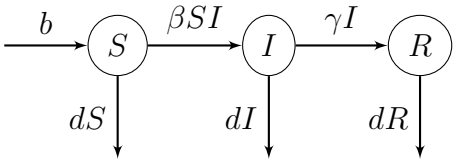
(a) List the state transition and their weights.

(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.

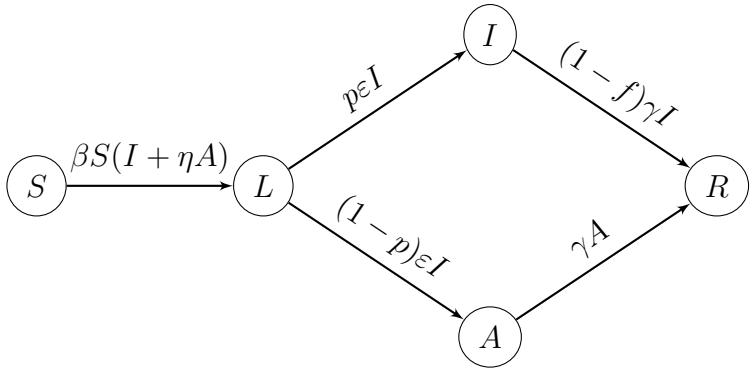
(a) List the state transition and their weights.

(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.)