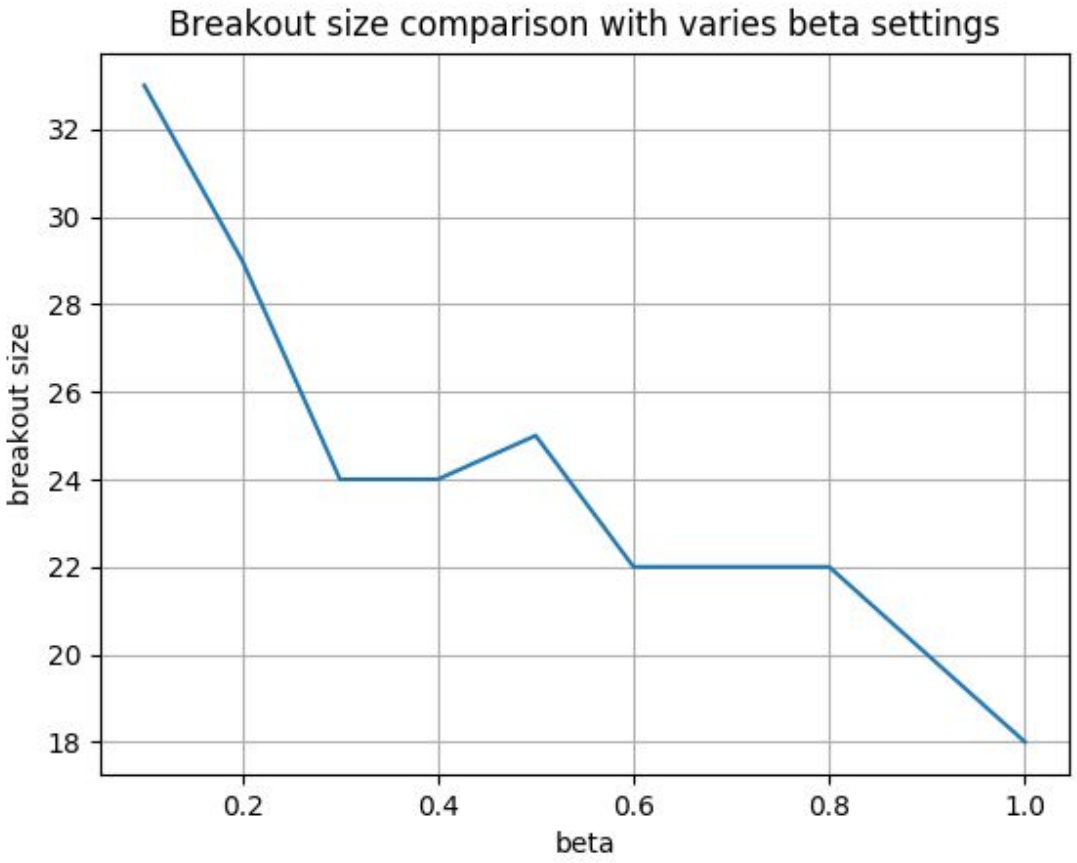
Semester 1

Outbreak size vs. Beta

N = 1000 S = 995 I = 5 R = 0

time (I -> R) = ∞ time (R -> S) = ∞

Max contact number per individual per time step = 10



Outbreak size vs. Beta

N = 1000 S = 995 I = 5 R = 0

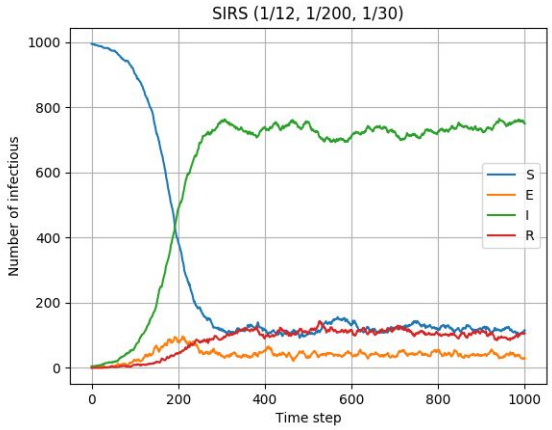
time (I -> R) = 1 time (R -> S) = 1

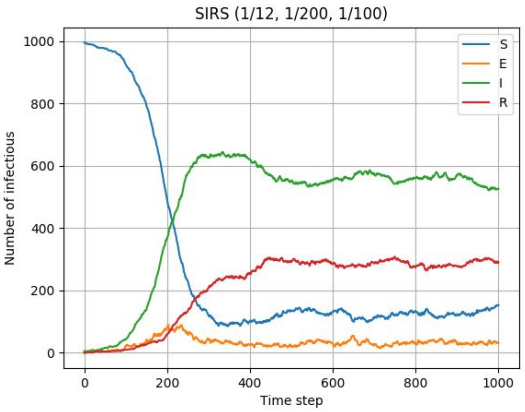
Max contact number per individual per time step = 100

The size of different groups in this SIR model is easy to reach equilibrium.

Since the the risk of infection is exponential to contact num, once the contact num is above a certain level (with contact num = 50, the probability of infectious is about 0.7-0.8). Then the model becomes stable that individuals predictably switches to next state in each time step, regardless the probability.

Compare different lambda (risk of state transfer)





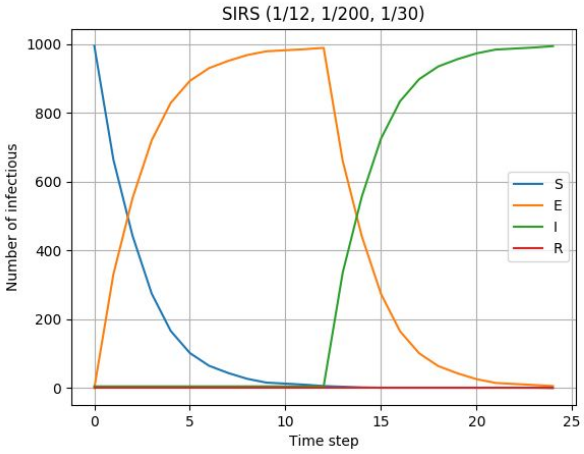
16 Sep 2019

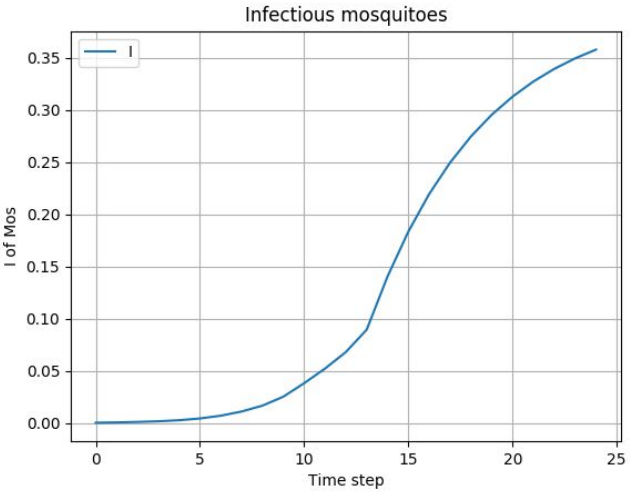
lambda_E_I = 1/12

lambda_I_R = 1/200

lambda_R_S = 1/30

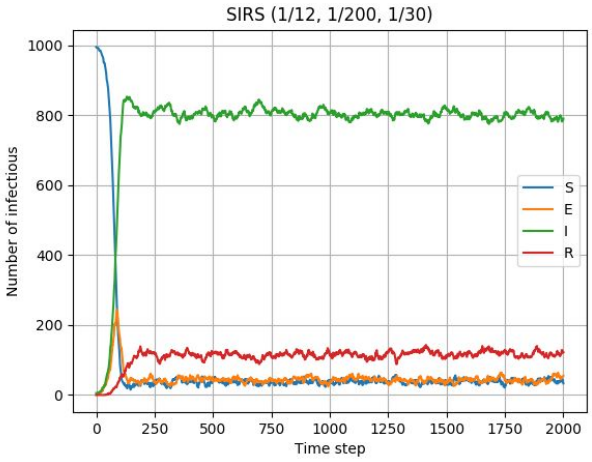
Using fixed time interval

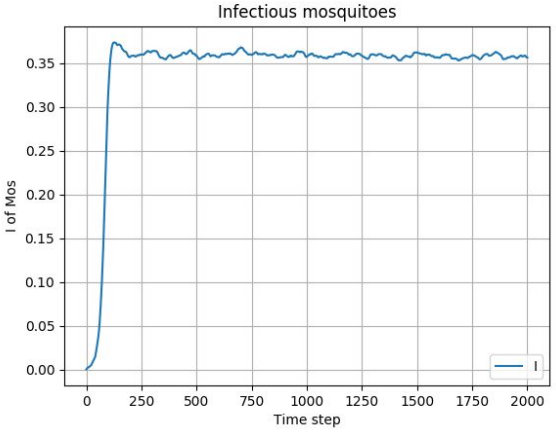




Because infectious patient getting recovery requires 200 days, in the meantime all people get will get infections.

Using uniform distribution to draw random





mean_S: 38

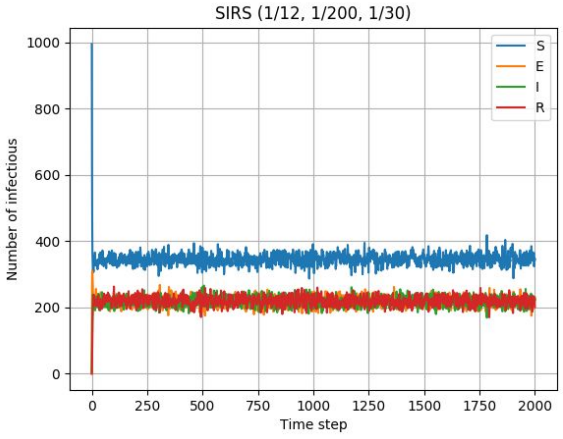
mean_E: 43

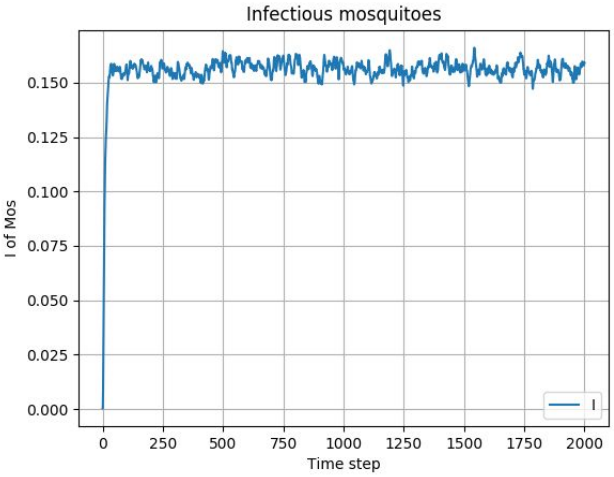
mean_I: 800

mean_R: 117

mean_Mos_I: 0.3580063

Using poisson distribution to draw random





mean_S: 346

mean_E: 217

mean_I: 217

mean_R: 219

mean_Mos_I: 0.1562033

The last poisson is wrong: (Poisson(1/p) < p). This is totally wrong way to use poisson, poisson comes up with a length of time in which the event gonna occur.

21 Oct 2019

An appropriate way to apply poisson distribution and Tau-leaping.

1. Draw from U(0, 1) as “threshold”
2. By time integral CDF: $\int_{d}^{d+1} CDF(k)\,\mathrm{d}d$,

   where

   d is duration of current state

   CDF(k) is CDF of Poisson distribution

   k is the estimated (expected) duration.
3. Once integraled value reach the threshold, the agent transfer to next state.

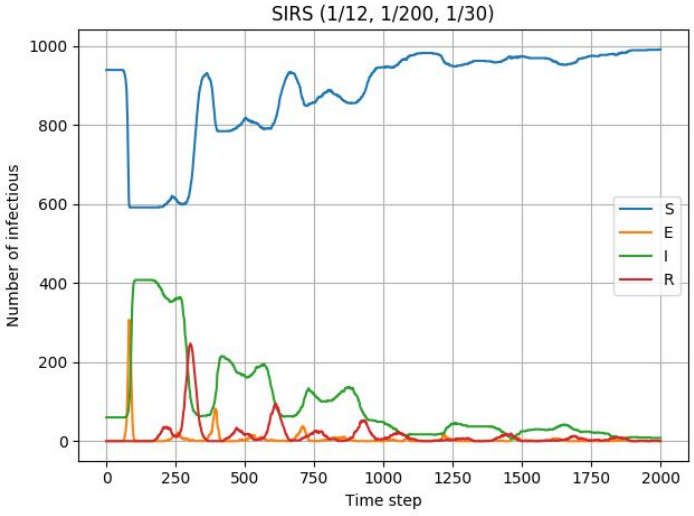
Parameter setting:

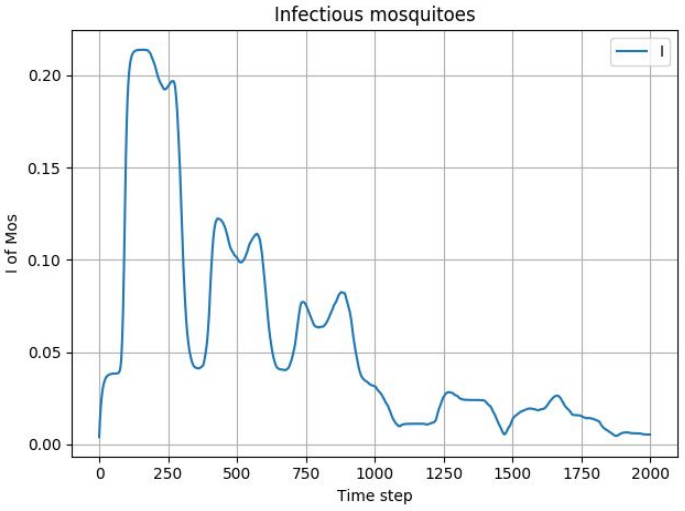
N = 1000 S = 940 E = 0 I = 60 R = 0

beta_M_H = 0.89 beta_H_M = 0.20

lambda_E_I = 1/12 lambda_I_R = 1/200 lambda_R_S = 1/30

bite_per_day = ⅓ life_expectancy = 10





Results:

mean_S: 886

mean_E: 5

mean_I: 94

mean_R: 14

mean_Mos_I: 0.0557093

It seems like the risk of recovery overweighs the risk of infections. But still, the oscillation of dynamic and the correlation between human and mosquitoes is observed.

$$y\ =\ \frac{10}{1\ +\ e^{3-0.3x}}$$

$$y\ =\ \frac{10\left(x-5\right)^{2}}{\left(x-5\right)^{2}\ +\ 5^{2}}\$$

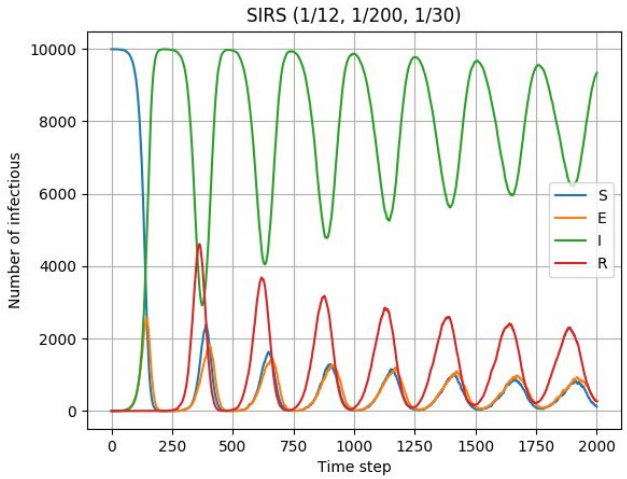
23 Oct 2019

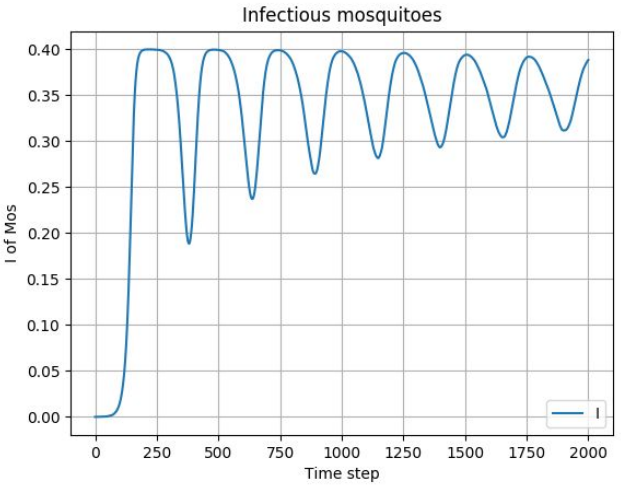
N = 10000 S = 9995 E = 1 I = 2 R = 2

beta_M_H = 0.89 beta_H_M = 0.20

lambda_E_I = 1/12 lambda_I_R = 1/200 lambda_R_S = 1/30

bite_per_day = ⅓ life_expectancy = 10





Result:

Poisson distribution leads a very smooth dynamic on a large population.

Upon a point, like t=250, all agents gets either pre-infected, infected or recovered. No more susceptible agents, no more agents can be infected, so that I_mosq stay at 0.4 without future increasing.

The reason maybe is the long time of infectious period (200 days).

N = 10000 S = 9995 E = 1 I = 2 R = 2

beta_M_H = 0.89 beta_H_M = 0.20 lambda_E_I = 1/12

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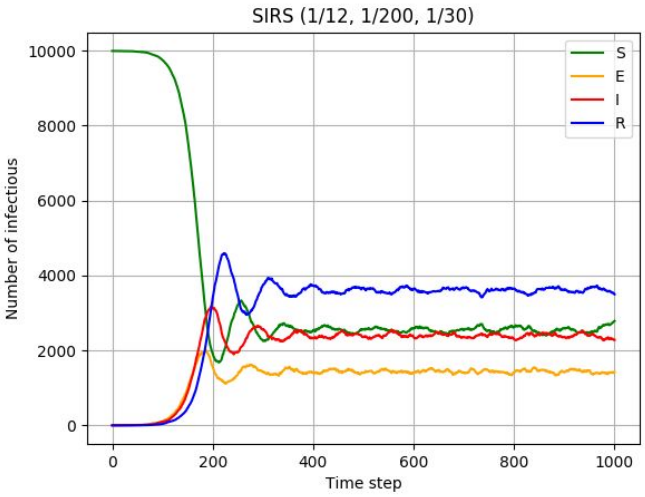

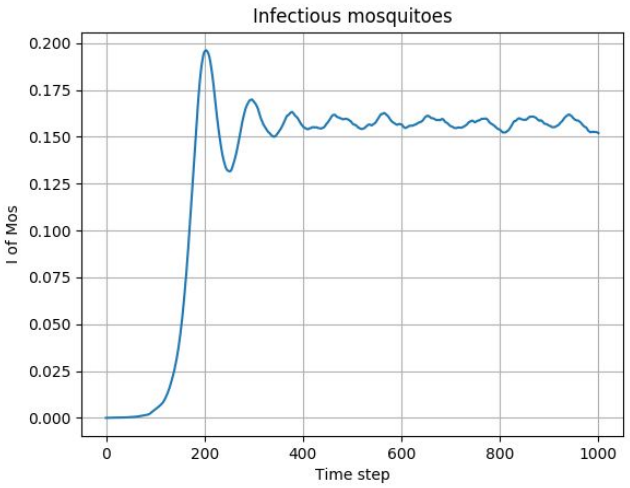

Here after change the infectious time to 20 days, the level of I dramatically gets lower.

Infectivity in Mosquito => I_m(t+1) = I_m(t)+new

G(t) -toe, put a delay in mosquito that delay parasites brining. extrinsic incubation

Symptoms is not relative to the level of gametocyte

parasitemia

symptomatic and asymptomatic are determined by exploration time.

Is is ok to combine parasitemia(including treatment and symptom) and gametocytes relationship.

A simple way is take a distribution to probability of symptomatic and symptomatic.

Can assume g(symp and asymp) are same.

u<2, u~U(0,1)