Solutions to Attendance Quiz for Lecture 16 of Dr. Z.'s Dynamical Models in Biology class

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We use the Maple package of this class:

`http://sites.math.rutgers.edu/~zeilberg/Bio25/DMB.txt` .

1. In the Linda Allen SIR model if

• Individuals are born susceptible with a birth rate $b = 0.1$ and die at the same rate

• Infected individuals recover at a rate of $c = 0.1$.

What ratio of the population will be infected if the **contact rate** a is

(i) $a = 0.1$

(ii) $a = 0.3$

(iii) $a = 0.5$

(iv) $a = 0.7$

(v) $a = 1$

(vi) $a = 2$

(vii) $a = 5$

Sol. to 1: In the Linda Allen model $b = 0.1$ and $c = 0.1$ and we use `SSSgN`, so we type

`SSSgN(AllenSIR(a,0.1,0.1,x,y),[x,y]);` ,

for the various `a`

(i) `SSSgN(AllenSIR(0.1,0.1,0.1,x,y),[x,y]);`

gives (very close to) `[0, 1]` so nobody is infected.

(ii) `SSSgN(AllenSIR(0.3,0.1,0.1,x,y),[x,y]);` gives:

`[0.1586702173, 0.6826595654]` .

So %15.86 of the population is infected.

(iii) `SSSgN(AllenSIR(0.5,0.1,0.1,x,y),[x,y]);` gives:

`[0.2853911887, 0.4292176226]` .

So %28.53 of the population is infected.

(iv) `SSSgN(AllenSIR(0.7,0.1,0.1,x,y),[x,y]);` gives:

`[0.3394963354, 0.3210073294]` .

So %33.94 of the population is infected.

(v) `SSSgN(AllenSIR(1.0,0.1,0.1,x,y),[x,y]);` gives:

`[0.3798102372, 0.2403795264]` .

So %37.98 of the population is infected.

(vi) `SSSgN(AllenSIR(2.0,0.1,0.1,x,y),[x,y]);` gives:

`[0.4257286974, 0.1485426054]` .

So %42.57 of the population is infected.

(vii) `SSSgN(AllenSIR(5.0,0.1,0.1,x,y),[x,y]);` gives:

[0.4497211392, 0.1005577218] .

So %44.97 of the population is infected.

Comment: As you make a larger and larger the fraction of the infected population converges to $\frac{5}{11} = 0.454545....$ So the good news is that if with a very large contact rate about 0.55 of the population will not get infected.