Homework for Lecture 16 of Dr. Z.'s Dynamical Models in Biology class

Email the answers (as a .pdf file) to

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by 8:00pm Monday, Nov. 3, 2025.

Subject: hw16

with an attachment hw16FirstLast.pdf

1. For the generalized Hardy-Weinberg model given by HWg(u,v,M) where M is a 3 by 3 preferance matrix

Type

`M:=RandMat(3,30); T:=HWg(u,v,M); SSSgN(T,[u,v]);`

40 times and record in how many cases only one of the alleles AA, Aa, aa will survive (i.e. the output is closae to [0,1], [1,0], or [0,0]) and in how many of them they wull also survive.

2. for each of b=c=0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4

Using

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

for a=(b+c)/2 , a=(b+c), a=1.5*(b+c), a=2*(b+c), a=10*(b+c), a=100*(b+c)

Confirm, in each case, that in the Linda Allen model, for $a = (b + c)/2$ in the long run there are no infected individuals, but after $a = (b + c)$, they will start showing up. Also confirm that even for large a, they will not all be infected but x_n and y_n tend to some number.

Daniyal Chaudhry HW16

1. Out of 40 generalized HW trials,
   AA was the only one to survive 12 times
   Aa was the only one to survive 0 times
   aa was the only one to survive 9 times
   } 21 out of 40 trials, one genotype dominated.
   A mixture of genotypes survived 19 times

2. For values of b&c:

for different a:	0.1	0.15	0.2	0.25	0.3	0.35	0.4
(b+c)/2	essentially (0,1)	(0, 1)	(0,1)	(0, 1)	(0, 1)	(0, 1)	error in function ("not rational")
(b+c)	(0.002,0.995)	(0.002, 0.996)	(0.001, 0.998)	(0.001, 0.998)	(0.001, 0.999)	(0.001, 0.999)	maple does not like 0.4 for b&c
1.5(b+c)	(0.16, 0.68)	(0.155, 0.69)	(0.151, 0.697)	(0.148, 0.704)	(0.145, 0.71)	(0.141, 0.717)	
2(b+c)	(0.238, 0.524)	(0.232, 0.536)	(0.227, 0.55)	(0.221, 0.557)	(0.216, 0.568)	(0.211, 0.578)	
10(b+c)	(0.43, 0.15)	(0.413, 0.174)	(0.399, 0.200)	(0.387, 0.226)	(0.374, 0.25)	(0.362, 0.275)	
100(b+c)	(0.45, 0.09)	(0.435, 0.130)	(0.417, 0.167)	(0.4, 0.2)	(0.3846, 0.23)	(0.37, 0.26)	

The data above shows:

1. for all $a = \frac{b+c}{2}$ cases, in the long run, no one is infected
2. for all $a = b+c$ (and larger a), some will be infected but it will stabilize to some proportion, not everyone.
3. As a increases, the amount of infected people in the long run increases
4. As b and c increase, the amount of infected people in the long run decreases

This is all in line with expectations.