Homework for Lecture 15 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, Oct. 27, 2025.

Subject: hw13

with an attachment hw13FirstLast.pdf

1. Read and understand, and be able to reproduce without peeking (e.g. in examination conditions) the derivatin of the Hardy-Weinberg rule.

$$(u,v) \to \left(u^2 + vu + \frac{1}{4}v^2, -2vu - 2u^2 + 2u - \frac{1}{2}v^2 + v\right)$$

2. If right now, 20 percent of the polpulation have genotupe AA, 30 percent of the polpulation have genotype Aa, what is the percentage of aa genotypes (i) Right now? (ii) In the next generation? (iii) In ten generations? i) $w = 1-u-v$ $= 1-.2-.3$ $= .5 \Rightarrow 50\%$ ii) $p = u + \frac{1}{2}v$ $= .2 + .15 = .35$ $q = .65$ $w' = q^2 = .65^2$ $= .4225$ $\Rightarrow 42.25\%$ iii) Stays at HW proportions so 42.25%

3. If right now the 50 percents of the polpulation are of aA genotypes, and 30 percents of the polpulation are of aa genotypes, what is the percentage of AA genotypes (i) Right now? (ii) In the next generation? (iii) In ten generations? i) $v = .5$ $w = .3$ $u = 1-v-w = .2$ 20% ii) $p = u + \frac{1}{2}v$ $= .2 + .25$ $= .45 \Rightarrow p^2 = .45^2$ $.2025 \to 20.25\%$ iii) HW Proportions say 20.25%

4. Read and understand Linda Allen's article:

`http://sites.math.rutgers.edu/~zeilberg/Bio25/AllenSIR.pdf`

Experiment with procedure `AllenSIR(a,b,c,x,y)` for various values of a, b, c and find the ultimate behavior using `ORB`

in our Maple package:

$R_0 = .8 < 1$ orbit converged to $(0,1)$ (disease-free)
$R_0 = 4 < 1$ converged to $\sim(.4509, .3237)$ which matched the solution of the equilibrium equation.
$R_0 = 2.4 > 1$ converged to $\sim(.222, .445)$ which agree with R_0 threshold / endemic-equilibrium characterization.

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