BIOL 3295 Fall 2019

Assignment 3 due Friday Nov 15, 1pm

Stage structure

1. Consider a population with a projection matrix:

$$\begin{bmatrix} 0 & 4 \\ 0.9 & 0.2 \end{bmatrix}$$

Calculate the eigenvalues. Will a population with this projection matrix increase over time?

2. The computer output gives the following:

```
> A = matrix(c(0,4,0.9,.2), 2,2, byrow=TRUE)
> eigen(A)
eigen() decomposition
$values
[1]  2.0 -1.8

$vectors
           [,1]       [,2]
[1,] -0.8944272 -0.9119215
[2,] -0.4472136  0.4103647
```

What is the eigenvector associated with the dominant eigenvalue? What will be the fraction of individuals in each stage, after a sufficiently long time?

3. What are the meanings of `0` and and `0.9` in the projection matrix above? i.e., biologically, what do these numbers correspond to?

4. Describe two common errors made when parameterizing matrix population models as described by [Kendall et al., 2019].

Age at first reproduction

5. Consider two genotypes:

Genotype 1

x	1	2	3	4
l_x	0.5	0.4	0.3	0.2
m_x	0	1	1	1

Genotype 2

x	1	2	3	4
l_x	0.6	0.5	0.4	0.3
m_x	0	0	1	1

Calculate R_0 for each genotype.

6. When comparing genotypes 1 and 2, what type of trade-off is seen?

7. Give one reason why R_0 may be a poor measure of fitness.

8. Consult the notes `Nov_1_Measuring_Fitness.pdf`. It is claimed that $m_1 = 1$ individuals per day is the maturation rate that is an evolutionarily stable strategy (ESS). Select values of m_1 and m_2 to provide further evidence that $m = 1$ is the ESS (different from the example values given in the notes). Do the calculations to determine whether m_2 can invade.

9. If $m_1 = 1$ is an ESS, describe what must be true of m_1 and m_2 values and the calculations to determine if m_2 can invade.

References

[Kendall et al., 2019] Kendall, B. et al. 2019. Persistent problems in the construction of matrix population models. Ecological Modelling 406: 33-43 `https://www-sciencedirect-com.qe2a-proxy.mun.ca/science/article/pii/S0304380019301085`