Population Genetics Assignment
BIOL 01104 Spring 2020
Instructor: Dr. Spielman
Due Friday 3/13/20 on paper at the beginning of class (11 am), <u>stapled!</u>

Full Name:_____

FULL NAMES (this means FIRST AND LAST!) of any students you completed assignment with:

<u>Instructions</u>:
Complete each question *<u>by hand on this paper</u>* (not a different piece of scrap paper), showing all of your work.
<u>Clearly indicate your final answer by circling it</u> (including conclusions, when applicable).
If I cannot find your answer, I cannot give you credit for it!
If you do not show work for an answer you give, I cannot give you credit for it! All work MUST be shown.

1. You are studying differences in whisker length in a population of manatees in the Gulf of Mexico. This trait shows *incomplete dominance*, where **WW**=long whiskers, **Ww**=intermediate whiskers, and **ww**=short whiskers. You have found, in a population of 75 manatees, that 40 have long whiskers, 10 have intermediate whiskers, and the remaining 25 have short whiskers.
    a. What are the **genotype frequencies** in this population?

    b. What are the **allele frequencies** in this population?

    c. What is the **heterozygosity** of this population?

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d. Imagine, one generation of random mating occurs and the population will then be in Hardy-Weinberg equilibrium. What will the **genotype frequencies** be in this next generation?

e. Did heterozygosity **increase, decrease, or stay roughly the same** (e.g. 0.4 and 0.41 are roughly the same. 0.4 and 0.45 are different) when the population entered HWE?

2. You are studying a population of crocodiles with variation in their teeth characteristics. You find that genotype **SS** individuals have long but dull teeth, genotype **Ss** individuals have average-sized teeth, and genotype **ss** individuals have small but extremely pointy teeth. In a population of 120 crocodiles, 30% of individuals are SS, 60% of individuals are Ss, and 10% of individuals are ss.

    a. What are the **genotype frequencies** in this population? (Hint: don't think too hard!!!!!!! Reading instructions for this question is *very helpful*)

    b. What are the **allele frequencies** in this population?

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c. You return to the population a few generations later, and you find that of the 120 crocodiles in the population, 80 crocodiles are SS, 24 crocodiles are Ss, and 16 crocodiles are ss. Is it more likely that evolution DID or DID NOT occur at this gene since you last visited?

d. Again consider your answer to part (c) of this question: Is there evidence that the population is *randomly mating,* undergoing *assortative mating*, or is there no way to tell? (HINT: THERE IS A WAY TO TELL). Answer in 1-2 sentences (no additional math is needed beyond your part (c) math).

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3. You decide to set up an assay to compare fitnesses of the different crocodile genotypes/phenotypes from the previous question. You randomly select 20 individuals with each tooth phenotype, and you give each individual a live chicken to eat. You measure fitness by asking how much of the chicken was eaten after an hour, under the assumption that the rate of consumption is a proxy for fitness. You found these results, on average:
    - SS (long but dull teeth) consumed 70% of the chicken
    - Ss (average teeth) consumed 50% of the chicken
    - ss (small but pointy teeth) consumed 30% of the chicken

    Assuming "percent of chicken eaten" is a proxy for fitness, calculate the following quantities in the space provided:

    a. The relative fitness for each genotype.

    b. The selection coefficients for each genotype.

    c. What would be the <u>mean fitness</u> of a hypothetical population of 100 crocodiles, where 25 have long teeth, 2 have average-sized teeth, and 4 have short teeth.

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4. A species of mouse has two color phenotypes: dark fur (genotypes **PP** or **Pp**) or light fur (**pp**). You are studying a population of 250 mice that is <u>known to be in Hardy Weinberg equilibrium</u>. Of these 250, you determined that 125 have a genotype of PP.

    a. Determine the *number of mice* from population that have each of the other genotypes, Pp and pp. [Hint: The frequency of PP individuals corresponds to the p^2 quantity in Hardy Weinberg calculations. You can use this value to determine p and q, from which you can calculate the number of individuals for the other genotypes.]

    b. Assume the relative fitness of dark-colored mice kernels is 1.0, and the relative fitness of light-colored mice is 0.78. Calculate the mean fitness of this population of 250 mice.