ANSC 446 / IB 416 Population Genetics
Exam 2, October 23, 2009

Name _____

(5 pages) Please underline or indicate your answer. If rounding, use 3 significant digits. Show your work or describe your logic to earn partial credit for incomplete answers.

(5) 1. Assume that the initial and final allele frequencies before and after selection are 0.01 and 0.001. How many generations did it take for this amount of change to occur if the allele is a recessive lethal?

(5) 2. Give an example (from nature or from human medicine) of heterozygote advantage.

(20) 3. The relative fitnesses found for alleles at a locus are 1.2, 1, and 1.3 for alleles A_1A_1, A_1A_2, and A_2A_2, respectively.

(4) a. What are the values of the selection coefficients s_1 and s_2?

(4) b. What is the name given to this type of fitness array?

(4) c. What is the equilibrium frequency for A_2?

(4) d. Would the equilibrium frequency be stable? Why or why not?

(4) e. Four isolated populations have initial allele frequencies for A_2 of 0.0, 0.45, 0.50 and 1.0. At what frequency will allele A_2 stabilize in each of these four populations?

(14) 4. Give the best definition for the following terms:

(2) a. Gametophytic self incompatibility:

(2) b. Odds ratio (or risk ratio):

(2) c. Underdominance:

(2) d. Inclusive fitness:

(2) e. Antagonistic pleiotropy:

(2) f. Sexually antagonistic genes:

(2) g. Fisher's fundamental theorem of natural selection:

(4) 5. Explain why the greatest expected change in allele frequency per generation for a recessive allele occurs around a frequency of 2/3. Explain why the greatest expected change in allele frequency for a dominant allele occurs around a frequency of 1/3?

(10) 6. Determine the frequencies at generation t+1 for the following:

(5) a. At a biallelic autosomal locus, an additive deleterious allele with a selection coefficient of 0.3 is found at a frequency of 0.2. Assuming random mating, what will be the frequency of the allele in the next generation?

(5) b. For the situation described in (a), and assuming the Basic Selection Model, what was the frequency of the three genotypes among only those progeny that were inviable?

(10) 7. A population of 300 cattle is surveyed at a locus with two codominant alleles. The genotype A_1A_1 is found to be present in 100 cattle, A_1A_2 is present in 40 cattle, and A_2A_2 is present in 160 cattle.

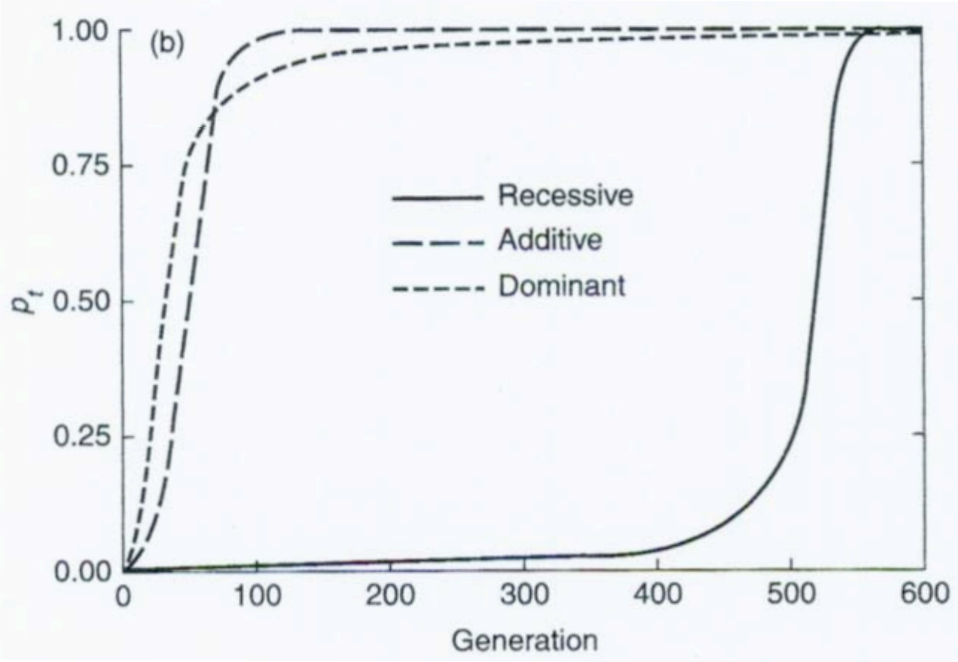
(5) a. What are the allele frequencies?

(5) b. Estimate the level of inbreeding (inbreeding coefficient) in the population.

(5) 8. Five alleles (A_1, A_2, A_3, A_4, A_5) at a single locus (A) have been identified on a plant that prevents self-fertilization by self-incompatibility. If the A locus is at equilibrium, what is the expected allele frequency of allele A_3?

(4) 9. For diploid plants that are self-fertilizing, heterozygosity in one generation is equal to half that of the previous generation. For mice undergoing generations of full-sibling crosses, heterozygosity will be equal to half that of the parental generation, plus a quarter that of the grandparental generation. Why is it necessary to add a quarter of the heterozygosity present in the grandparents' generation for the mice but not for the plants?

(5) 10. The following Figure from Hedrick's text shows the rise in frequency for an allele at an initially low frequency ($p_0 = 0.01$) undergoing positive Darwinian selection ($s = 0.1$), in cases where the allele is recessive, dominant, or additive:



Given that the fitness value for an additive allele is exactly half way between the fitness of a dominant allele and the fitness of a recessive allele, why doesn't the curve showing increase in an additive allele fall exactly intermediate between the curve for a dominant and the curve for a recessive allele?

(9) 11. A rare recessive disease has an allelic frequency of 0.02.

(3) a. Population 1 is in Hardy Weinberg equilibrium. What is the frequency of diseased homozygotes in this population?

(3) b. Population 2 also has an allelic frequency of 0.02 but is inbred so that ***f*** = 0.1. What is the frequency of diseased homozygotes in population 2?

(3) c. The allelic frequencies are the same between the two populations, but what is the ratio of the frequencies of diseased individuals between population 2 and population 1?

(9) 12. In the pedigree on the right, CA1 and CA2 are outbred.

(3) a. What is the inbreeding coefficient for individual X?

(3) b. What is the inbreeding coefficient for individual Z?

(3) c. Genotypes are shown for the A locus for individuals included in the pedigree. What are the possible genotypes for individual Z to have at the A locus? Which of these would be identical by descent, and which have identity in state?