

## Population Genetics Problem Set 6

Please note that Exam 2 may have questions based on the following:

Hedrick chapters 3, 4 and 5 and all lectures and lecture handouts for these chapters

Chapter 3, Questions 5, 11 and 13

Last year's Exam 2, and Problem Sets 4, 5, and 6 (this one).

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1. At a diploid biallelic locus, calculate the expected heterozygosity for the first five generations, given  $H_0 = 0.5$ , for the following:
  - a. lineages where there is complete selfing
  - b. lineages where there is continuous full-sib mating
2. A rare recessive disease has an allelic frequency of 0.01.
  - a. Population 1 is in Hardy Weinberg equilibrium. What is the frequency of diseased homozygotes in this population?
  - b. Population 2 also has an allelic frequency of 0.01 but is inbred so that  $f = 0.1$ . What is the frequency of diseased homozygotes in population 2?
  - 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?
3. The relative fitnesses found for a chromosomal variant and the ancestral chromosomal type are 0.6, 0.5 and 1 for chromosomal types  $A_1A_1$ ,  $A_1A_2$ , and  $A_2A_2$ , respectively.
  - a. What are relative fitnesses when the heterozygote has a fitness of 1?
  - b. What is the name given to this type of fitness array?
  - c. What is the equilibrium frequency?
  - d. Is the equilibrium frequency stable? Why or why not?
  - e. Four isolated populations have initial allele frequencies for  $A_2$  of 0.0, 0.1, 0.4 and 1.0. At what frequency will allele  $A_2$  stabilize in each of these four populations?
4. The initial genotypic array of a population is  $.28(A_1A_1) + .64(A_1A_2) + .08(A_2A_2)$ . Compute the genotypic proportions for the next four generations if the population follows full-sib matings.

5. What is self-incompatibility in plants? What are the two basic types of self-incompatibility and how do they differ?

6. Deficiency of Uridine Monophosphate Synthase (DUMPS) is lethal as a homozygous recessive in dairy cattle. Fitness of the homozygous normal and heterozygous cattle are equal to one.

a. If the current allele frequency of the recessive ( $d$ ) was .04, how many generations would be required to halve the allele frequency of  $d$ ?

b. If the allele frequency of  $d$  was .04 in 1980, what should be expected as the allele frequency of  $d$  in 2004? (Generation interval in dairy cattle is approximately 6 years.)

7. Give the best definition for the following terms:

a. Fisher's fundamental theorem of natural selection

b. Level of dominance,  $h$

c. Antagonistic pleiotropy

d. Sexually antagonistic genes

e. Meiotic drive

f. Kin selection

g. Sexual imprinting

h. Indel

i. Sexual selection

8. In the pedigree on the right, CA1 and CA2 are outbred.

a. What is the inbreeding coefficient for individual X?

b. What is the inbreeding coefficient for individual Z?

c. Genotypes are shown for the A locus for individuals 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?

