

## FINAL EXAM BIO 434: PREVIOUS YEAR

	Points
Q1	16
Q2	12
Q3	10
Q4	7
Q5	10
Q6	8
Q7	5
Q8	10
Q9	10
Q10	12

1. A population of Darwin's finches in the Galápagos has been studied for a very long time by Peter and Rosemary Grant from Princeton. They have marked every bird in the population (by putting small metal bands of different colors around their legs), and have recorded and marked every new fledgling bird. Thus they know which nest, and presumably which parents, belong to each new member of the population. They have estimated the heritability to be 0.82, by regression between the average of parents and their offspring.

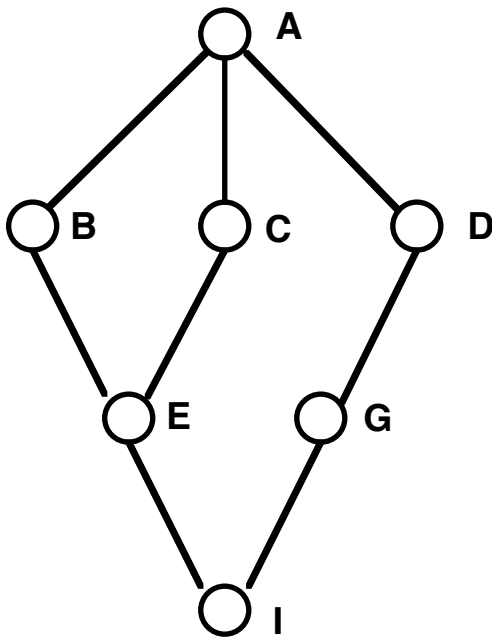
This species of finch suffered severe mortality as a result of a drought in 1977. This species eats seeds, and the seeds available during the drought were mainly large and hard ones. The surviving birds, in comparison with the population before the drought, were larger in several dimensions, particularly of the bill. The mean depth of the bill in 642 birds before the drought was 9.42 mm and in 85 birds (from the same generation) after the drought was 9.96 mm.

- What would you expect the mean bill depth to be in the next generation?
- What factors could cause the real change in beak depth to be different from this prediction?

2. A set of single pairs of individuals (one male and one female, each) are drawn at random from a large population of *Drosophila*. Each of these pairs is used to found a different population of flies which quickly grow to very large population sizes. These populations are then kept separate from each other in the same environment.

- Immediately following the generations described above, what is the inbreeding coefficient of an individual selected at random from one of these lines, relative to the base population?
- How will mean fitness change in the inbred lines relative to the outbred lines, on average?

3. Explain why and how inbreeding depression is involved in the evolution of selfing.
4. In a population of forked fungus beetles divided into several demes, the overall mean frequency of an allele for a peptidase gene is 0.61. The variance among demes in allele frequency is 0.0144. What is  $F_{ST}$  for this population?
5. What is the inbreeding coefficient of individual E in this pedigree? Individual I? Assume  $F_A=0$ .



6. Can we reliably estimate narrow-sense heritability from data on the phenotypic correlations of identical twins? Why or why not?
7. A new mutation arises in a large, randomly-mating population in which it is beneficial. Individuals which carry this allele as heterozygotes are 0.1% more fit than homozygotes without the allele, and the allele acts additively. What is the probability that this allele will fix in this population?
8. Discuss the ways in which various forms of selection may affect the amount of genetic variation in a population.

9. Suppose that two *Drosophila* stocks are maintained by putting a fixed number of unmated adults in a bottle and allowing them to mate at random. Both stocks have 10 female parents but different numbers of male parents, the numbers of males being 10 and 2 respectively. Calculate the effective population size of each stock and the inbreeding coefficient of each after 10 generations.

10. Selection in a population of cows is for higher milk production. What is the effect of the following on the response to that selection (increased or decreased, relative to a population in which this factor is not operating):

Factor	Increased or decreased response to selection?
Population bottleneck before the selection	
Stronger selection for cows with higher milk production	
Cows with high milk yield have fewer calves	
Larger total population size	