

Problem set on selection. Reference: Michod (1999) Darwinian Dynamics.

1. Review the covariance calculations in Equation 1-6, making sure you understand them. Using the last form of Equation 1-6 and the average properties of the unselected (Equation 1-3) and selected (Equation 1-4) populations, the change in the average property of the population is given by Equation 1-7.
2. Thought question. What is the special relationship among the variables that makes the basic Price equation 1-7 work?
3. Show that the change in gene frequency for a single locus is given by Equation 4-1.
4. Verify that by subtracting the new gene frequency from the old (and using the definition of covariance) you get Equation 4-10.
5. Verify that for a single locus with two alleles Equation 4-12 equals Equation 4-1.
6. Show that the dynamics of population size,  $N$ , associated with gene frequency change (Equation 4-1) is given by Equation 4-3 (see, for example Chapter 3 of Roughgarden 1979).
7. Relate the covariance approach to selection at a single diploid locus considered at the beginning of Chapter 4.
8. Using the construction given in table 4-2, show that the genetic variance in fitness assuming the additive model,  $\text{Var}[W_i^+]$ , is simply the middle expression in Equation 4-15  $\mathbf{a}^2 \text{Var}[q_i]$ .
9. In the case of full-sib family groups and weak selection (so that  $F(q)$  in Equation 4-7 is a function of  $q$  alone), show that Wright's fitness function defined in Equation 4-7 equals the average inclusive fitness effect in Equation 4-19, where  $f_i$  is defined in Table 4-1.