Theoretical Population Genetics

Home work #6 Fall 2000

1) When considering the infinite allele model, I gave you the following equation for the probability of autozygosity at time t (equation 1.1). Using words, explain the terms in this equality and what they mean or why they are included in the equation (i.e., where do they come from?).

$$F_t = \frac{1}{2N}(1-\mu)^2 + (1-\frac{1}{2N})(1-\mu)^2 F_{t-1} \qquad (1.1)$$

2) There are 6 islands. Each island has the allele frequency shown below. The inter-island migration rate is m = 0.003. What is the equilibrium allele frequency? Using the formula for the change in allele frequency over time, plot the change in allele frequency for EACH population versus generation time. How long does it take to reach equilibrium? How does this change if the migration rate is seven times faster? If you feel up to it (i.e., you don't have to do this to complete the homework), add reversible mutation to the change in allele frequency (use $\mu = \nu$). How does this affect the outcome (please include the equation that you use). Remember, mutation is on the order of 10^{-4} to 10^{-7}.

Island	Frequency (p)
1	0.30
2	1.00
3	0.54
4	0.90
5	0.28
6	0.00

3) Using a directional selection model, plot the mean population fitness AND the change in allele frequency versus allele frequency for selection coefficients of 0.01, 0.05, and 0.2 for the following. Please describe in words the effect of the type of model and the magnitude of selection are having on the graphs.

a) the most fit allele is dominant.
b) the most fit allele is recessive.
c) the alleles are codominant and h = 0.75 or h = 0.5 (plot both).

4) Using an underdominant selection model, plot the change in mean population fitness versus allele frequency AND the change in allele frequency versus allele frequency under the following conditions. Indicate the equilibrium frequency on each curve (W_{11}'s coefficient is t and W_{22}'s is s). Please describe in words the effect the magnitude of selection is having on the graphs.

a) t = s = 0.03, 0.1, 0.25
b) t = 0.5s for the above values

5) Using an overdominant selection model, plot the change in mean population fitness versus allele frequency AND the change in allele frequency versus allele frequency under the following conditions. Indicate the value of the equilibrium frequency on each curve. Please describe in words the effect the magnitude of selection is having on the graphs.

a) t = s = 0.03, 0.1, 0.25
b) t = 0.1, s = .7; t = 0.3, s = .25; t = 0.9, s = 0.1.