

Exercise Set #3

Do at least two of the following exercises

1. (a) Charlesworth & Charlesworth: Problem 4.1i, p. 192 (Calculation)
 (b) Charlesworth & Charlesworth: Problem 4.2, p. 192 (Derivation)
2. (a) Charlesworth & Charlesworth: Problem 8.1, p. 442 (Derivation)
 (b) Charlesworth & Charlesworth: Problem 8.2, p. 442 (Calculation)
3. (Computation) Write a program to iterate the general recursion for selection at two linked sites (eq. B8.8.1 on p. 419 of Charlesworth & Charlesworth) for the following set of “multiplicative fitnesses (see Table 8.3, p. 422[†]):

haplotype	A ₁ B ₁	A ₁ B ₂	A ₂ B ₁	A ₂ B ₂
A ₁ B ₁	(1-s _A) (1-s _B)	1-s _A	1-s _B	1
A ₁ B ₂	1-s _A	(1-s _A) (1-s _B)	1	1-s _B
A ₂ B ₁	1-s _B	1	(1-s _A) (1-s _B)	1-s _A
A ₂ B ₂	1	1-s _B	1-s _A	(1-s _A) (1-s _B)

Assume $s_A = 0.01$, $s_B = 0.04$ and $c = 0.1$. Try runs for two different sets of initial haplotype frequencies: (1) $x_1 = x_2 = x_3 = x_4 = 0.25$ and (2) $x_1 = x_2 = 0.2$; $x_3 = x_4 = 0.3$. For each run, have your program use the haplotype frequencies in every generation to compute the corresponding frequencies of A₁ and B₁ (p_A and p_B , respectively), the disequilibrium D , and the mean fitness \bar{w} . The formulas for these quantities are:

$$p_A = x_1 + x_2, \quad p_B = x_1 + x_3, \quad D = x_1 x_4 - x_2 x_3, \quad \text{and} \quad \bar{w} = \sum_{i=1}^4 x_i w_i, \quad \text{where} \quad w_i = \sum_{j=1}^4 x_j w_{ij}.$$

Plot and describe the evolution of p_{A_1} , p_{B_1} , D , and \bar{w} for each run. Compare the outcomes of your two runs. Discuss.

[†] Table 8.3 and Table 8.2 both contain the same typo. Can you find it?