Homework no. 4
Due Wednesday, February 4

Unless I specify otherwise, you may assume random mating, an infinite population size, and no migration.

1. (12 points) Two alleles that are selectively neutral (have no difference in fitness) exist in mutation balance in a population. The rate of mutation from $B$ to $b$ is $10^{-5}$ and the rate of mutation from $b$ to $B$ is $5.0 \times 10^{-6}$.

(a) What will the equilibrium frequencies of $B$ and $b$ be?

(b) At that equilibrium which of these are correct:

(i) The fraction of copies of $B$ mutating to $b$ is equal to the fraction of copies of $b$ mutating to $B$.

(ii) The number of copies of $B$ mutating to $b$ is equal to the number of copies of $b$ mutating to $B$.

(iii) Half of the mutation events occurring at this locus are to $B$, half to $b$.

(c) If we start a new population, from individuals all of whom are $BB$, how many generations will go by before the frequency of $b$ in that population rises to half of its equilibrium value?

2. (13 points) A recessive deleterious mutant causes a syndrome S that reduces the fitness of the homozygote for the mutant by 20%. The heterozygote fitness is normal.

(a) If we observe that the frequency of the allele (note: not the frequency of the homozygote) in the population is 0.01, and assume that the allele frequency is at equilibrium under selection versus mutation, what would the rate of mutation to the deleterious allele from the normal allele have to be? Why?

(b) When in this state of equilibrium gene frequency, what fraction of copies of the allele are killed off each generation by the reduced fitness? Why?

(c) This pool of copies of the mutant allele is about how many times larger than the number of copies that arise in one generation? Does this imply that the average copy arose very recently or not? Why or why not?

(d) If we suddenly double the mutation rate, owing to some mutagen in the air or water, and it stays at that new value, by what fraction of its size will this pool of mutants increase in the next generation? Explain your reasoning.