Midterm exam, Part B

Population Genetics, Spring 2020

This part of the midterm is due at **5:00 pm on Friday, March 13** (tomorrow). You can bring it to my office or email me a PDF. You are free to use your notes and calculator, but no internet. You cannot communicate about the exam with anyone else. **For questions 1 and 2, show your calculations, and be sure to put a box around your answer for each question.**

1. The relative fitnesses at locus *A* are:

*W*11 *W*12 *W*22

1 1.1 1.21

If allele *A*1 is currently at a frequency of *p*1 = 0.4, what will be its frequency in 10 generations? (Two significant digits is fine.) Assume that selection is the only force at work. [12 points]

2. Consider a mutation under multiplicative selection that has a fitness effect (selection coefficient) of *s*. What the ratio of fixation probabilities in two populations, one of which has size *n* and the other has size 4*n*? In which population is the mutation more likely to fix? Why does population size have that effect on the fixation probability? [12 points]

3. What affects genetic diversity (π) in a region of a genome? Name at least three factors, explain how and why they affect π. [25 points]

4. Assume there are two populations, pop1 and pop2, adapting to different environments. Pop2 is much smaller than pop1 and split from pop1 a long time ago. Migration rate is ~0.1 migrants/generation. Draw profiles of π, Tajima’s *D*, and LD around a site that is under divergent selection between pops 1 and 2 (i.e., selected in both pops, but for different haplotypes), for three data situations:

a) Sample of *N* individuals from pop1

b) Sample of *N* individual from pop2

c) Situation where we sampled *N*/2 individuals from each of the two populations (perhaps not being aware of their subdivision).

Please match the scales of y-axes in the three plots. [25 points]

5. You have performed GWAS and found that nearly half of the genome appears to be significantly associated with your trait of interest. What is going on? Think of multiple possible explanations, indicate under which conditions they would be likely, and how we can test them. [25 points]