Homework 6
due Wednesday February 15, 2017

Do these problems, and email the results (if you can, in a PDF or else in Word .DOC or .DOCX format. PDF is best as I cannot read some .docx files. From recent versions of Microsoft Word you can save to PDF format using the Save As menu item.) Like all of the weekly homeworks this one totals 25 points and is due at the end of that day (at midnight).

1. (13 points) The country of Ruritania becomes a desirable place for residents of the country of Belgravia, and one year there is a sudden influx of immigrants from there. As a result 20% of residents of Ruritania are now those immigrants. At a locus that we are studying, the gene frequencies of three alleles are, in the two countries before the migration.

Allele	A_1	A_2	A_3
Belgravia	0.15	0.56	0.29
Ruritania	0.42	0.23	0.35

Assume that there is no natural selection at this locus, and that in each country, before the migration, genotypes are in Hardy-Weinberg proportions.

(i) Immediately after the migration, what are the gene frequencies in Ruritania, counting together both the migrants and the local Ruritanians?

(ii) At that time, before anyone has had a chance to have offspring, what are the genotype frequencies in the Ruritanian population, counting both the migrants and the local residents who were born in Ruritania?

(iii) A decade goes by and it turns out that among all marriages in the country, 10% involve a Ruritanian marrying a Belgravian immigrant. If Belgravians are just as likely to get married as Ruritanians, can you work out what fraction of marriages involve two Belgravians? Two Ruritanians? Show how and what the results are.

(v) If all these marriages have equally many children, what are the frequencies of the 6 genotypes among the whole pool of children? Is it in Hardy-Weinberg proportions? Why or why not?

(vi) Is there, among the pool of children, an excess or a deficit of heterozygotes? Is that true for all three heterozygous genotypes?

2. (12 points) Suppose that there are three neighboring populations of wombats in a line, called populations 1, 2, and 3, and in each generation 10% of the population comes from each neighboring population (both males and females migrate equally). Populations 1 and 3 receive immigrants only from population 2, while population 2 comes to consist of 20% immigrants, half from each of its two neighbors. In each generation, immediately after migration, everyone mates at random within that population.

Suppose that there is a locus with two alleles, A and a, with all populations having the gene frequency of A be 0.30. The newborns in population 3 are exposed to lower temperatures, as a result of which 20% of the aa individuals in that population die before adulthood. All other genotypes are equally fit in all populations. (There is population density regulation in each population so that the sizes of each of the populations do not change).

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(i) What is the gene frequency of the A allele in population 3 after this selection?

(ii) What are the gene frequencies of A in each population after the next round of migration?

(iii) If this selection in population 3 continues, what do you expect to happen to the gene frequencies of A in each of the three populations during the next few generations? Will we see a cline in the gene frequency during these next few generations? Explain why or why not. (I am not asking you to compute the gene frequencies).

(iv) In the longer run, what will happen to the gene frequencies in the three populations? Explain why.