

Population Genetics Homework 2: due Monday, 28 March

(1) Use the genetic drift simulation in Populus (Model → Mendelian Genetics → Genetic Drift). For all simulations, set Number of Loci = 10, Initial Frequency = 0.3, Runtime → Other: Generations = 50, and check to Permit Selfing.

Note: it is fine to work with others, but everyone should do unique simulations.

a) Do one iteration with Population Size (N) = 5.

Determine:

- at generation 50, the number of loci which have gone to fixation at $p = 1$, the number which have gone to fixation at $p = 0$, and the number which remain polymorphic.
- at generations 10, 20, 30 and 50, the variance in p (you'll need to estimate the 10 values of p and then calculate their variance); this is the genetic variability across loci.
- at generations 10, 20, 30 and 50, the average expected heterozygosity $\frac{1}{10} \sum_{i=1}^{10} 2p_i q_i$.

This is the average of the frequency of heterozygotes expected at Hardy-Weinberg equilibrium, as a function of the allele frequencies at each locus; it is a sort of average amount of within-locus genetic variability in the population)

b) Repeat (a) with $N = 10, 20$ and 30 .

c) Plot the variance of p against generation, for each population size. Do the same for 'average expected heterozygosity.'

d) Answer the following questions:

- i. How do the rates of fixation of A and of a relate to population size N ?
- ii. Over all population sizes, how does the ratio of alleles fixed for A and alleles fixed for a compare to the expected proportion?
- iii. How do the variance of p and the average expected heterozygosity change over time, for a given population size?
- iv. How do the rates of change in the variance of p and the average expected heterozygosity vary with population size N ?

(2) Read the paper by Hauser *et al.*¹ and answer the following:

- a) What is the temporal method used by Hauser *et al.* to estimate effective population size, and how does it relate to the Population simulations above?
- b) What are the main conclusions of the paper?
- c) How well do the data support those conclusions?

1. Hauser, L. *et al.* 2002. "Loss of microsatellite diversity and low effective population size in an over-exploited population of New Zealand snapper (*Pagrus auratus*)."
PNAS **99**(18): 11742—11747.