

Problem Set 3, Bio 4181: Due Sept. 29, 2009

1. A large ancestral population is subdivided into a large number of isolates, each of ideal size 20. An autosomal locus with two alleles, A and a , with p (the frequency of A) = 0.8 in the ancestral population. Assume that genetic drift is the only evolutionary force operating.

a). What is the average allele frequency of A in the overall population of isolates after 5, 10, and 100 generations?

b) What allele frequencies of A do you expect to find within the isolates at equilibrium, and what percentage of the isolates will have a specific allele frequency.

c). What is the variance in the frequency of A among the isolates after 10 generations of isolation?

d). What is the equilibrium variance of the frequency of A among the isolates.

e). What is the average pedigree inbreeding coefficient within each isolate after 10 generations of subdivision, assuming $F=0$ for all individuals before subdivision.

2. A large population has an allele a at an autosomal locus with a frequency of 0.1. The population then experiences a bottleneck and is reduced to 4 individuals.

a). What is the probability that the a allele will increase in frequency in the gene pool defined by these 4 individuals?

b). The population of 4 instantly grows into an ideal population of 189 individuals and remains at that size ever after. What is the probability of ultimate fixation of the a allele given the initial condition that $q=0.1$ in the pre-bottlenecked population.

3. A founder population is established, and the average probability of identity by descent is calculated for each subsequent generation as follows:

Generation	F
1	0.005
2	0.129375
3	0.133728125
4	0.138059484

a), What are the inbreeding effective sizes in generations 1 through 4 relative to the previous generation (generation 0 is the founder population)?

b) What is the inbreeding effective size of each generation to the founder population?

4. A set of equally sized replicate, isolated populations is established from a large population in which the frequency of the A allele at an autosomal locus is 0.4. The variances in allele frequency for each subsequent generation are as follows:

generation	variance
0	0
1	0.012
2	0.01314
3	0.035826
4	0.036336435
5	0.061794381

a), What are the variance effective sizes in generations 1 through 5 relative to the previous generation (generation 0 refers to the large population from which the replicates were drawn)?

b) What is the variance effective size of each generation relative to generation 0?

5. A population is ideal in every way except that the size of the population fluctuates from generation to generation as follows:

generation	N
0	50
1	300
2	200
3	10
4	100
5	500

What are the approximate inbreeding and variance effective sizes of this population over the time period given above using generation 0 as the reference generation?