MATH 764 - Assignment 2

due 22th April.

* Part I *

1. A highly isolated colony of the moth *Panaxia dominula* near Oxford, England, has been intensively studied by Ford and collaborators over the period 1928-1968 (Ford and Sheppard 1969). This species has one generation per year, and estimates of population size were carried out yearly beginning in 1941. For the years 1950 to 1961, inclusive, estimates of population size were as follows:

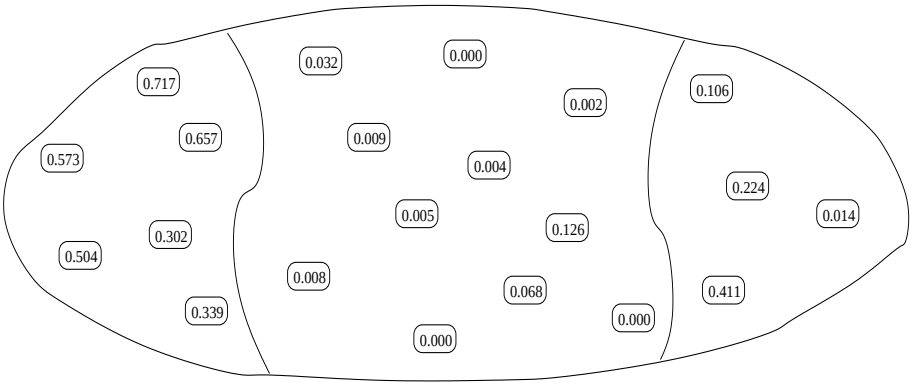
1950: 4,100	1951: 2,250	1952: 6,000	1953: 8,000
1954: 11,000	1955: 2,000	1956: 11,000	1957: 16,000
1958: 15,000	1959: 7,000	1960: 2,500	1961: 1,400

   Assuming that the actual size of the population in any year equals the effective size in that year, estimate the average effective population size over the entire 12-year period.

2. How many generations will it take for a diploid Wright-Fisher model population to lose 90% of its initial heterozygosity ?

3. James Roosevelt was one son of Eleanor Roosevelt and Franklin Delano Roosevelt, who were fifth cousins. What was his inbreeding coefficient ? (Note – fifth cousins are people who have one parent each that are fourth cousins to each other, and similarly for fourth, third and second cousins, see `http://en.wikipedia.org/wiki/Cousin`)

4. In the Mohave desert, local populations of the diminutive annual plant *Linanthus parryae* ("desert snow") are polymorphic for white versus blue flowers. Blue flowers result from homozygosity for a recessive allele. The geographical distribution of the frequency q of the recessive allele across a region of the Mohave desert is shown in the accompanying illustration.



Each allele frequency is based on an examination of approximately 4,000 plants over an area of about 30 square miles (Epling and Dobzhansky 1942). The highest frequencies of the blue-flower allele are largely concentrated at the west and east ends of the region in question. Treat each of the three regions as a single random-mating unit in HWE for the flower-color alleles. Estimate the average allele frequency in each region and in the population as a whole. From these data:

a. Estimate $\overline{H_S}$ and H_T for the flower-color gene.

b. Estimate F_{ST} for the flower-color gene.

*** Part II ***

1. Write in pseudo code a program that simulates the evolution of a locus with two alleles (A and a) under the plain Wright-Fisher model.

2. Plot the evolution of the frequency of A as a function of the number of generations when the frequency of A at the first generation is 0.5 and the population size is $N = 10$ and $N = 100$.

3. Using your program, estimate the probability of fixation of allele A after 10 and 100 generations when the frequency of A at the first generation is 0.5, for $N = 10$ and $N = 100$.