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**Problem Set # 1**

This is the first of **six** problem sets. The due date for each problem set is at the class schedule at http://dambe.bio.uottawa.ca/teach/BIO3119.aspx. You may work in groups of up to three people (and are encouraged to do so). Please hand in one assignment per group with up to three names listed in a PDF file. Late assignments will be penalized 20% per day or part thereof. **Please show your work.** Incorrect answers with correct work will receive part marks; correct answers with no work will not receive full marks.

1) Consider the following general solution for a continent-island model of migration (we’ll cover this model later in the course): *pt* = *pm* + (1 – *m*)*t*(*p0* – *pm*)

If *p*m = 0.7, *p*0 = 0.2, *p*t = 0.5 and m = 0.01, solve for *t*.

2) A1 is a recessive allele causing blue eyes, meaning that an individuals needs to be homozygous for it to have blue eyes. Two heterozygous A1A2 individuals have six children. What is the probability that two of these six children will have blue eyes?

3) Consider the simple model of mutation we discussed in class in which *pt* is the frequency of allele *A* in generation *t* and *μ* is the probability that *A* mutates to *a* when producing the gametes that form the next generation. The recursion equation is therefore: *p*t+1 = *pt* - *μpt*

Assuming a non-zero mutation rate (i.e. *μ* > 0), what is the equilibrium values of *p* in this model? Is this equilibrium stable or unstable? Explain.

4) Consider the following genotype counts in a hypothetical population:

|  |  |
| --- | --- |
| Genotype | # of individuals |
| *AA* | 180 |
| *Aa* | 240 |
| *aa* | 80 |

Calculate the frequency of each genotype and then the frequency of the *A* and *a* alleles, showing how the allele frequencies can be calculated from the counts and from the genotype frequencies.

5) The mean number of mutations per replication event in the influenza A virus genome was estimated to be one. Assuming that the number of mutations follows a Poisson distribution, find the probability that across three replication events there would be 3 or 4 mutations.

6) Two different single nucleotide polymorphisms in the ataxia telangiectasia mutated (ATM) gene (rs11212617) are associated with the response to the glucose-lowering drug metformin which is used in treating type 2 diabetes. These alleles vary in frequency among ethnic populations. In a particular South Indian population, the following genotype frequencies were observed. Calculate the frequencies of the A, C1 and C2 alleles in this population.

Genotype AA AC1 C1C1 AC2 C2C2 C1C2

Frequency 0.49 0.406 0.0841 0.014 0.0001 0.0058

7) In mice, the allele for a brown dorsal coat colour (B) is dominant over that for a beige (b), meaning heterozygotes (Bb) and BB homozygotes have a brown coat while bb homozygotes have a beige coat. At another locus, the allele causing a short tail (S) is also dominant over the allele causing a longer tail (s). If a female of genotype Bbss mates with a male of genotype BbSs, what is the probability that an offspring would have brown fur and a long tail? As always, show your work.