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**Problem Set # 2**

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.

1a) If the genotypes A1A1, A1A2, and A2A2 have frequencies 0.5, 0.25, and 0.25 respectively, what are the frequencies of the A1 and A2 alleles? b) After a single generation of random mating, what are the expected frequency of A1A1, A1A2 and A2A2 in the offspring? c) If A2 is a recessive allele causing freckles, how many freckled offspring do you expect if there are 441 offspring in total?

2) 1000 Canadians were genotyped at two loci that code for separate glycoproteins that are expressed on the outside of red blood cells, yielding the following results:

Glycoprotein A Glycoprotein B  
A1A1: 298 individuals B1B1: 99 individuals

A1A2: 489 individuals B1B2: 418 individuals

A2A2: 213 individuals B2B2: 483

Are genotypes at the Glycoprotein A locus at Hardy-Weinberg expected frequencies? State the statistical null hypothesis of the test and show your calculations with the degrees of freedom, p value and conclusion based on the test result.

3a) Given the data in question 2 for glycoproteins A and B, what are the expected frequencies of all possible gametes assuming gametic equilibrium between these two loci?

3b) The following haplotype counts were observed in this population. Calculate the gametic disequilibrium *D* and *D’*. Explain, in one sentence, what the value of *D’* means.

haplotype A1B1 = 474

haplotype A1B2 = 611

haplotype A2B1 = 142

haplotype A2B2 = 773

4. The presence of a long-haired coat is an autosomal recessive condition in mice. In a lab study, a student uses stock mice to start a new population of 200 individuals in which 10% of the males had long haired coats (*aa*); the remaining males and all of the females were homozygous wild-type at this locus (i.e. *AA*).

a) Assuming the population has an equal sex ratio, what are the sex-specific allele frequencies in this newly created population?

b) What are the expected genotype frequencies of the first generation offspring, assuming random mating?

c) What are the allele frequencies in these first generation offspring?

d) What are the expected genotype frequencies in the second generation of offspring, again assuming random mating?

e) At what generation are HW-expected genotype frequencies achieved?

In your solution, denote *p* as the frequency of the *A* allele and *q* as the frequency of the *a* allele.

5a) Two different loci (Loc1 and Loc2) are at varying physical distances from a focal locus such that the recombination rate between Loc1 and the focal locus is 0.1 while that between Loc2 and the focal locus is 0.4. All else being equal, which locus (Loc1 or Loc2) is more likely to be in gametic phase disequilibrium with the focal locus and why?

b) Give the frequencies of the four gamete types that would be produced by an individual of genotype A1B2/A2B1 (A1 and A2 are alleles at the focal locus and B1 and B2 are alleles at Loc1).

c) If the gametic disequilibrium between two loci is 0.4 and the recombination rate is 0.1, what would you expect the disequilibrium to be in the next generation assuming the absence of any process creating or favouring disequilibrium?