
Human Genetics: Problem Set XI

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Abstract

This work contains the solutions to the problem set XI of Human Genetics 2015 course at New York University.

Question 1.

1. An STR locus on chromosome 6 has many alleles, each with a different number of CA repeats. In a particular population, the alleles have these frequencies:

allele	allele frequency
20	0.10
21	0.001
22	0.12
23	0.05
24	0.30
25	0.10
26	0.009
27	0.09
29	0.23

These frequencies describe the local gene pool for the STR locus. Assume that the population is at Hardy-Weinberg equilibrium.

- a. What's the expected frequency of 25/25 homozygotes?
- b. What's genotype is expected to be the most common genotype in this population?
- c. What's the expected heterozygosity at this locus? (You'll want a calculator for this one.)

Solution. (a) The expected frequency of 25/25 homozygotes is $0.1^2 = 0.01$.

(b) The most common genotype in this population will be 24/29 heterozygote with $2 \cdot 0.30 \cdot 0.23$ chance.

(c) The expected heterozygosity at this locus, can be computed by $1 - \sum_{locus} p_{locus}^2$, where p_{locus} is the allele frequency at a particular locus. Carrying out the calculations, we obtain that the expected heterozygosity is approximately 0.812

□

Question 2.

2. Which of these loci shows greatest differentiation between populations?

Locus	Frequency of allele #1 in Abu Dhabi	Frequency of allele #1 in Sydney
A	0.4	0.6
B	0.5	0.5
C	1.0	1.0
D	0.1	0.9
E	0.1	0.1

Solution. By referring to the differentiation map, we see that the (0.1, 0.9) pair of allele frequency results in the highest differentiation. Hence, the *D* locus shows the greatest differentiation between populations. ☐

Question 3.

3. A cattle breeder wants to have milk cows with higher yields. The method of artificial selection has been very effective in achieving this goal in the past, as our current industrial milk cows produce an average of 20,000 pounds of milk a year, almost triple the yield from 50 years ago. Suppose the heritability of milk yield is 0.4 and the farmer selects only cows that produce on average 21,000 pounds per year and mates them to bulls that are expected to be similarly genetically-endowed for high milk yield (this is readily determined by measuring the average milk yield of multiple daughters of a bull by different mothers). Suppose that the average milk yield of the selected class is 21,000 pounds, and the average of the whole pre-selection population is 20,000 pounds. In the next generation, after selection, what's the expected average milk yield of the breeder's cows? Show your work (2 points).

Solution.

Question 4.

4. Why is heterozygosity lower in people with Native American ancestry than in those with East African ancestry?

Solution.