Hardy-Weinberg Equilibrium Problems

KEY

1. The frequency of two alleles in a gene pool is 0.19 (A) and 0.81(a). Assume that the population is in Hardy-Weinberg equilibrium.

p = 0.19, q = 0.81

(a) Calculate the percentage of heterozygous individuals in the population.

$2pq = 2(0.19)(0.81)$

$= 0.3078$

$= 31\%$

(b) Calculate the percentage of homozygous recessives in the population.

$q^2 = (0.81)^2 = 0.6561$

$= 66\%$

2. An allele W, for white wool, is dominant over allele w, for black wool. In a sample of 900 sheep, 891 are white and 9 are black. Calculate the allelic frequencies within this population, assuming that the population is in H-W equilibrium.

p = ?

q = ?

$\frac{9}{900} = q^2 = ww = 0.01$

$q = \sqrt{q^2} = \sqrt{0.01} = 0.1 = q$

$p = 1.0 - 0.1 = 0.9 = p$

3. In a population that is in Hardy-Weinberg equilibrium, the frequency of the recessive homozygote genotype of a certain trait is 0.09. Calculate the percentage of individuals homozygous for the dominant allele. (AA)

$q^2 = 0.09$

$q = \sqrt{q^2} = \sqrt{0.09}$

$= 0.3$

$p = 0.7$

$p^2 = (0.7)^2$

$= 0.49 = 49\%$

4. In a population that is in Hardy-Weinberg equilibrium, 38 % of the individuals are recessive homozygotes (aa) for a certain trait. In a population of 14,500, calculate the number of homozygous dominant individuals and heterozygous individuals.

$q^2 = 0.38$

$q = \sqrt{0.38}$

$= 0.6164...$

$p = 0.3835...$

$p^2 = (0.3835...)^2 = 0.1471... \times 14500 = 2133$

$2pq = 2(0.6164...)(0.3835...) = 0.4727... \times 14500 = 6855$

5. Allele T, for the ability to taste a particular chemical, is dominant over allele t, for the inability to taste the chemical. Four hundred university students were surveyed and 64 were found to be nontasters. Calculate the percentage of heterozygous students. Assume that the population is in H-W equilibrium.

$\frac{64}{400} = tt = q^2 = 0.16$

$q = 0.40$

$p = 0.60$

$2pq = 2(0.6)(0.4)$

$= 0.48 = 48\%$

6. In humans, the Rh factor genetic information is inherited from our parents, but it is inherited independently of the ABO blood type alleles. In humans, Rh+ individuals have the Rh antigen on their red blood cells, while Rh– individuals do not. There are two different alleles for the Rh factor known as Rh+ and rh. Assume that a dominant gene Rh produces the Rh+ phenotype, and that the recessive rh allele produces the Rh– phenotype. In a population that is in Hardy-Weinberg equilibrium, if 160 out of 200 individuals are Rh+, calculate the frequencies of both alleles.

$\frac{40}{200} = q^2 = 0.2$

$q = \sqrt{q^2} = \sqrt{0.2} = 0.4472... = q$

$p = 1 - 0.4472... = 0.5527... = p$

7. In corn, kernel color is governed by a dominant allele for white color (W) and by a recessive allele (w). A random sample of 100 kernels from a population that is in H-W equilibrium reveals that 9 kernels are yellow (ww) and 91 kernels are white.

(a) Calculate the frequencies of the yellow and white alleles in this population.

$\frac{9}{100} = ww = q^2 = 0.09$

$q = 0.3 \quad p = 0.7$

(b) Calculate the percentage of this population that is heterozygous.

$2pq = 2(0.3)(0.7)$

$= 0.42 = 42\%$

8. A rare disease which is due to a recessive allele (a) that is lethal when homozygous, occurs within a specific population at a frequency of one in a million. How many individuals in a town with a population of 14,000 can be expected to carry this allele?

$aa = q^2 = 0.000001 = \frac{1}{1000000}$

$q = 0.001$

$p = 0.999$

$2pq = 2(0.001)(0.999)$

$= 0.001998 \times 14000$

$= 28$