Hardy-Weinberg Equilibrium Problems

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.

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

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

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.

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.

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

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.

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, 160 out of 200 individuals are *Rh*+. **Calculate** the frequency of both alleles.

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.

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

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. **Calculate** the number of individuals in a town having a population of 14,000 can be expected to carry this allele?

Questions 9 & 10

Two Siamese and three Persian cats survive a shipwreck and are carried on driftwood to a previously uninhabited tropical island. All five cats have normal ears, but one carries the recessive allele *f* or folded ears (his genotype is *Ff*).

9. **Calculate** the frequencies of alleles *F* and *f* in the cat population of this island.

10. If you assume Hardy-Weinberg equilibrium for these alleles (admittedly very improbable), **calculate** the number of cats you would expect to have folded ears when the island population reaches 20,000?

11. In a certain African population, 4 % of the population is born with sickle cell anemia (*aa*). **Calculate** the percentage of individuals who enjoy the selective advantage of the sickle-cell gene (increased resistance to malaria)?

12. In the United States, approximately one child in 10,000 is born with PKU (phenylketonuria), a syndrome that affects individuals homozygous for the recessive allele (*aa*).

    (a) **Calculate** the frequency of this allele in the population.

    (b) **Calculate** the frequency of the normal allele.

    (c) **Calculate** the percentage of carriers of the trait within the population.

13. In Caucasian humans, hair straightness or curliness is thought to be governed by a single pair of alleles showing partial dominance. Individuals with straight hair are homozygous for the *Is* allele, while those with curly hair are homozygous for the *Ic* allele. Individuals with wavy hair are heterozygous (*IsIc*). In a population of 1,000 individuals, 245 were found to have straight hair, 393 had curly hair, and 362 had wavy hair.

    (a) **Calculate** the allelic frequencies of the *Is* and *Ic* alleles.

    (b) **Explain** whether or not this population is in Hardy-Weinberg equilibrium? Justify your answer. Your explanation should include a chi-square goodness of fit test.