

Hardy-Weinberg Practice Problems

1. A population of rabbits may be brown (the dominant phenotype) or white (the recessive phenotype). Brown rabbits have the genotype BB or Bb. White rabbits have the genotype bb. The frequency of the BB genotype is .35.
 - What is the frequency of heterozygous rabbits?
 - What is the frequency of the B allele?
 - What is the frequency of the b allele?
2. A hypothetical population of 10,000 humans has 6840 individuals with the blood type AA, 2860 individuals with blood type AB and 300 individuals with the blood type BB.
 - What is the frequency of each genotype in this population?
 - What is the frequency of the A allele?
 - What is the frequency of the B allele?
 - If the next generation contained 25,000 individuals, how many individuals would have blood type BB, assuming the population is in Hardy-Weinberg equilibrium?
3. A population of birds contains 16 animals with red tail feathers and 34 animals with blue tail feathers. Blue tail feathers are the dominant trait.
 - What is the frequency of the red allele?
 - What is the frequency of the blue allele?
 - What is the frequency of heterozygotes?
 - What is the frequency of birds homozygous for the blue allele? Brown hair (B) is dominant to blond hair (b). If there are 168 brown haired people in a population of 200:
 - What is the predicted frequency of heterozygotes?
 - What is the predicted frequency of homozygous dominant?
 - What is the predicted frequency of homozygous recessive?
4. If 98 out of 200 individuals in a population express the recessive phenotype, what percent of the population are heterozygotes?
5. Mourant et al. (1976) cite data on 400 Basques from Spain, of which 230 were Rh+ and 170 were Rh-.
 - Calculate the allele frequencies of D and d (DD individuals have the Rh+ phenotype. dd individuals have the Rh- phenotype. The phenotype of Dd is Rh+).
 - How many of the Rh+ individuals would be expected to be heterozygous?
6. The I^A "allele" for the ABO blood groups actually consists of two subtypes, I^{A1} and I^{A2} , either being considered " I^A ". In Caucasians, about 3/4 of the I^A alleles are I^{A1} and 1/4 are I^{A2} (Cavalli-Sforza and Edwards, 1967). What would be the expected proportions of $I^{A1}I^{A1}$, $I^{A1}I^{A2}$, and $I^{A2}I^{A2}$ among $I^A I^A$ individuals?

7. 1 in 1700 US Caucasian newborns have cystic fibrosis. C is the normal allele, dominant over the recessive c. Individuals must be homozygous for the recessive allele to have the disease.
 What percent of the above population have cystic fibrosis (cc or q^2)? **0.059%**
 Assuming a Hardy-Weinberg Equilibrium, how many newborns would have cystic fibrosis in a population of 10,000 people? **5.9**
8. The ability to taste PTC is due to a single dominant allele "T". You sampled 215 individuals in a biology class, and determined that 150 could detect the bitter taste of PTC and 65 could not.
 What is the predicted frequency of the recessive allele (t)? **0.55**
 What is the predicted frequency of dominant allele (T)? **0.45**
 In a population of 10,000 people, how many would be heterozygous (assuming Hardy-Weinberg equilibrium)? Homozygous dominant? Homozygous recessive?
 Calculate all of the potential frequencies. **TT = .203 / Tt = .495 / tt = .302**
9. Sickle-cell anemia is an interesting genetic disease. Normal homozygous individuals (SS) have normal blood cells that are easily infected with the malarial parasite. Thus, many of these individuals become very ill from the parasite and many die. Individuals homozygous for the sickle-cell trait (ss) have red blood cells that readily collapse when deoxygenated. Although malaria cannot grow in these red blood cells, individuals often die because of the genetic defect. However, individuals with the heterozygous condition (Ss) have some sickling of red blood cells, but generally not enough to cause mortality. In addition, malaria cannot survive well within these "partially defective" red blood cells. Thus, heterozygotes tend to survive better than either of the homozygous conditions. If 9% of an African population is born with a severe form of sickle-cell anemia (ss), what percentage of the population will be more resistant to malaria because they are heterozygous (Ss) for the sickle-cell gene? **42%**
10. The trait for 'male-pattern baldness' is a recessive trait encoded for by "b". Non-balding is encoded for by a dominant allele encoded for by the letter "B". A street survey conducted by Hair Club for Men found that out of 1000 men, 360 had male pattern baldness, the other 480 who did not and were heterozygous, and 160 who did not and were homozygous for a full head of hair.
 What are the phenotype ratios? **Baldness : Hair = 360 : 640**
 Using this information find the allele frequencies for B and b. **B = 0.4 / b = 0.6**
 What are the expected genotype frequencies? **BB = 0.16 / Bb = 0.48 / bb = 0.36**