

Evolutionary Biology EEB 2245/ 2245 W  
Spring 2011  
Problem Set 1 Answer Key

1- MHC genes in CT deer

a. genotype frequencies

$$\text{Freq AA} = 25/150 = 0.167$$

$$\text{Freq Aa} = 75/150 = 0.5$$

$$\text{Freq aa} = 50/150 = 0.333$$

b. allele frequencies

$$\text{Freq A} = 0.167 + (0.5/2) = 0.417$$

$$\text{Freq a} = (0.5/2) + 0.333 = 0.583$$

c. expected genotype frequencies

$$\text{Freq AA} = (0.417)^2 = 0.174$$

$$\text{Freq Aa} = 2(0.417)(0.583) = 0.486$$

$$\text{Freq aa} = (0.583)^2 = 0.340$$

d. yes, expected and observed genotype frequencies are consistent

e. in equilibrium

f. the same as the expected genotype frequencies

2- Just because a genotype is recessive doesn't mean that it is uncommon. If there is a high "a" allele frequency, then the majority of horses would be black. If the population is in HWE then the gene frequencies and genotype ratios stay constant from generation to generation regardless of which allele is dominant or recessive.

3- Red and green carabid beetles

a. Possible genotypes and colors

RR = red

Rg = red

gg = green

b. Frequency of gg is 1- Freq of R, so the freq of R = 65% / 100 = 0.65 = red beetles so 1-0.65= 0.35 green beetles

c. formula for RR genotype frequency =  $R^2$  when  $R + g = 1$

$$\text{Freq of } g = \sqrt{0.35} = 0.592$$

$$\text{Freq of } R = 1 - 0.592 = 0.408$$

$$\text{Freq of } g = 0.592$$

$$\text{Freq of } R = 0.408$$

4- Three alleles at one loci

a. Possible genotypes: CD, CE, DE, CC, DD, EE

b. CC genotype freq =  $(\text{freq C})^2$

c. DE genotype freq =  $2(\text{freq D})(\text{freq E})$

5- tree frog coloration

$$\text{a. freq of aa} = 40\%/100 = 0.4$$

$$\text{b. freq of a} = \sqrt{0.4} = 0.623$$

- c. freq of A =  $1 - 0.623 = 0.368$
- d. freq of AA =  $(0.368)^2 = 0.135$
- e. freq of Aa =  $2(0.368)(0.623) = 0.465$
- f.  $100\% - 40\% = 60\%$  or  $0.135 + 0.465 = 0.6 \times 100 = 60$  frogs

6- lions in Kenya

- a. genotype frequencies
  - Freq DD =  $17/200 = 0.085$
  - Freq Dd =  $126/200 = 0.63$
  - Freq dd =  $57/200 = 0.285$
- b. allele frequencies
  - Freq D =  $0.085 + (0.63/2) = 0.4$
  - Freq d =  $1 - 0.4 = 0.6$  or  $0.285 + (0.63/2) = 0.6$
- c. expected genotype frequency
  - Freq DD =  $(0.4)^2 = 0.16$
  - Freq Dd =  $2(0.4)(0.6) = 0.48$
  - Freq dd =  $(0.6)^2 = 0.36$
- d. expected number of individuals with each genotype
  - DD individuals =  $0.16 \times 200 = 32$
  - Dd individuals =  $0.48 \times 200 = 96$
  - dd individuals =  $0.36 \times 200 = 72$

7- lions in Tanzania

- a. genotype frequencies
  - Freq DD =  $13/125 = 0.104$
  - Freq Dd =  $10/125 = 0.08$
  - Freq dd =  $102/125 = 0.816$
- b. allele frequencies
  - Freq D =  $0.104 + (0.08/2) = 0.144$
  - Freq d =  $0.816 + (0.08/2) = 0.856$
- c. expected genotype frequencies
  - Freq DD =  $(0.144)^2 = 0.021$
  - Freq Dd =  $2(0.144)(0.856) = 0.247$
  - Freq dd =  $(0.856)^2 = 0.733$
- d. combined data=
  - observed genotype frequencies
    - Freq DD =  $(13 + 17) / (200 + 125) = 0.092$
    - Freq Dd =  $(126 + 10) / (200 + 125) = 0.419$
    - Freq dd =  $(57 + 102) / (200 + 125) = 0.489$
  - allele frequencies
    - Freq D =  $0.302$
    - Freq d =  $0.698$
  - expected frequencies:
    - Freq DD =  $0.091$
    - Freq Dd =  $0.422$
    - Freq dd =  $0.487$

The observed genotype frequencies for the combined population match the expected genotype frequencies. However, this is not sufficient to show that a population is in Hardy-Weinberg Equilibrium. And in this case, we know that the combined population is not in Hardy-Weinberg Equilibrium because the observed genotype frequencies do not match the frequencies expected under Hardy-Weinberg Equilibrium in either the Kenyan or the Tanzanian population. .

8- The assumption being violated is the assumption that population sizes are infinite. Because the population sizes are small, there is some variation in allele frequencies from generation to generation. If this experiment was repeated, larger populations sizes would help to reduce this effect.