WEEK 9 PROBLEMS

Problems From Chapter 15

15.1 Two highly inbred strains of mice are crossed, and the FI generation has a mean tail length of 5 cm and a standard deviation of 1.5 cm. The F2 generation has a mean tail length of 5 cm and a standard deviation of 4 cm. What are the environmental variance, the genetic variance, and the broad-sense heritability of tail length in this population?

15.2 For the difference between the domestic tomato, *Lycopersicon esculentum,* and its wild South American relative, *Lycopersicon chmielewskii,* the environmental variance accounts for 13 percent of the total phenotypic variance of fruit weight, for 9 percent of soluble-solid content, and for 11 percent of acidity. What are the broadsense heritabilities of these traits?

15.3 Two homozygous genotypes of *Drosophila* differ in the number of abdominal bristles. In genotype *AA,* the mean bristle number is 20 with a standard deviation of 2. In genotype *aa,* the mean bristle number is 23 with a standard deviation of 3. Both distributions conform to the normal curve, in which the proportions of the population with a phenotype within an interval defined by the mean ± 1, ± 1.5, ±2, and ±3 standard deviations are 68,87,95, and 99.7 percent, respectively.

(a) In genotype *AA,* what is the proportion of flies with a bristle number between 20 and 23?
(b) In genotype *aa,* what is the proportion of flies with a bristle number between 20 and 23?
(c) What proportion of *AA* flies have a bristle number greater than the mean of *aa* flies?
(d) What proportion of *aa* flies have a bristle number greater than the mean of *AA* flies?

15.4 Consider a complex trait in which the phenotypic values in a large population are distributed approximately according to a normal distribution with mean 100 and standard deviation 15. What proportion of the population has a phenotypic value above 130? Below 85? Above 85?

15.5 Estimate the minimum number of genes affecting fruit weight in a population of the domestic tomato produced by crossing two inbred strains. Measured as the logarithm of fruit weight in grams, the inbred lines have average fruit weights of 0.137 and 1.689. The FI generation has a variance of 0.0144, and the F2 generation has a variance of 0.0570.

15.6 In human beings, the narrow-sense heritability of the total fingerprint ridge

count is 86 percent. On the basis of this value, what is the estimated correlation coefficient between first cousins in the total fingerprint ridge count?

15.7 A mouse population has an average weight gain between ages 3 and 6 weeks of 12 g, and the narrow-sense heritability of the weight gain between 3 and 6 weeks is 20 percent.

(a) What average weight gain would be expected among the offspring of parents whose average weight gain was 16 g?
(b) What average weight gain would be expected among the offspring of parents whose average weight gain was 8 g?

15.8 To estimate the heritability of maze-learning ability in rats, a selection experiment was carried out. From a population in which the average number of trials necessary to learn the maze was 10.8, with a variance of 4.0, animals were selected that managed to learn the maze in an average of 5.8 trials. Their offspring required an average of 8.8 trials to learn the maze. What is the estimated narrow-sense heritability of maze-learning ability in this population?