MATH 448 — Homework 9

In Exercises 9.1 and 9.2, D (tall) is dominant to d (dwarf) and W (round) is dominant to w (wrinkled), and the two genes assort independently. Critical values: $c_{1,.05} = 3.841$, $c_{3,.05} = 7.815$, $c_{3,.01} = 11.345$.

Exercise 9.1. A tall round plant is testcrossed with a dwarf wrinkled plant $ddww$. For each of the following outcomes, find all genotypes of the tall round plant that can produce it: (a) every offspring is tall and round; (b) the four phenotypes occur with equal probabilities; (c) every offspring is tall, and half are round.

Exercise 9.2. Two plants of genotype $DdWw$ are crossed. (a) Find the probability that an offspring is tall and wrinkled. (b) An offspring is tall and round. Find the probability that its genotype is $DdWw$.

Exercise 9.3. Two carriers of a recessive allele a have five children. Let X be the number of children with genotype aa. (a) Find $P(X = 0)$ and $P(X \geq 2)$. (b) Find $E(X)$, $\mathrm{Var}(X)$, and the standard deviation of X.

Exercise 9.4. In a cross $Dd \times Dd$ with 200 offspring, 162 are tall and 38 are dwarf. (a) Find the expected counts under the model $\frac{3}{4}$ tall, $\frac{1}{4}$ dwarf. (b) Find χ^2 and test the model at level .05. (c) Let X be the number of tall offspring. Find $(X - np)/\sqrt{npq}$ for the observed value of X and compare its square with χ^2.

Exercise 9.5. A testcross $DdWw \times ddww$ gives 400 offspring. The model of independent assortment gives each of the four phenotypes probability $\frac{1}{4}$. (a) Find the expected counts and the degrees of freedom. (b) The counts are 105, 95, 88, 112. Find χ^2 and test the model at level .05. (c) A second experiment gives counts 140, 60, 55, 145. Find χ^2 and test the model at level .01.

Exercise 9.6. A population of 500 has 120 individuals of genotype AA, 240 of genotype Aa, and 140 of genotype aa. (a) Find the frequencies p of A and q of a. (b) Find the genotype frequencies after one generation of random mating. (c) Find the expected genotype counts under Hardy–Weinberg and test the model at level .05. State the degrees of freedom.

Exercise 9.7. The allele a has frequency .02 in a population in Hardy–Weinberg equilibrium, and individuals of genotype aa are affected. (a) Find the frequency of affected individuals and the frequency of carriers. (b) An unaffected individual is chosen at random. Find the probability that the individual is a carrier. (c) Two unaffected individuals are chosen at random and have a child. Find the probability that the child is affected.