

Hardy-Weinberg Equilibrium

Hardy-Weinberg Equilibrium, also referred to as the Hardy-Weinberg principle, is used to compare allele frequencies in a given population over a period of time. A population of alleles must meet five rules in order to be considered "in equilibrium":

- 1) No gene mutations may occur and therefore allele changes do not occur.
- 2) There must be no migration of individuals either into or out of the population.
- 3) Random mating must occur, meaning individuals mate by chance.
- 4) No genetic drift, a chance change in allele frequency, may occur.
- 5) No natural selection, a change in allele frequency due to environment, may occur.

Hardy-Weinberg Equilibrium never occurs in nature because there is always at least one rule being violated. Hardy-Weinberg Equilibrium is an ideal state that provides a baseline against which scientists measure gene evolution in a given population. The Hardy-Weinberg equations can be used for any population; the population does not need to be in equilibrium.

There are two equations necessary to solve a Hardy-Weinberg Equilibrium question:

$$\begin{aligned}p + q &= 1 \\p^2 + 2pq + q^2 &= 1\end{aligned}$$

p is the frequency of the dominant allele.

q is the frequency of the recessive allele.

p^2 is the frequency of individuals with the homozygous dominant genotype.

$2pq$ is the frequency of individuals with the heterozygous genotype.

q^2 is the frequency of individuals with the homozygous recessive genotype.

Example 1a:

A population of cats can be either black or white; the black allele (B) has complete dominance over the white allele (b). Given a population of 1,000 cats, 840 black and 160 white, determine the allele frequency, the frequency of individuals per genotype, and number of individuals per genotype.

To solve this problem, solve for all the preceding variables (p , q , p^2 , $2pq$, and q^2).

Step 1: Find the frequency of white cats, the homozygous recessive genotype, as they have only one genotype, bb. Black cats can have either the genotype Bb or the genotype BB, and therefore, the frequency cannot be directly determined.

$$\text{Frequency of Individuals} = \frac{\text{Individuals}}{\text{Total Population}}$$

Hardy Weinberg Equilibrium Study Guide

N Colangelo



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