Hardy-Weinberg Theorem
January 27, 2014
Hardy-Weinberg Theorem
January 27, 2014
Ms. Palmer

- West Morris Central High School
- Montclair State University '13
  - B.S. Aquatic and Coastal Sciences
- The College of New Jersey
  - M.A.T Secondary Biology

Contact Info

- Kpalmer@nhvweb.net
- Palmerk3@tcnj.edu
- West Morris Central High School
- Montclair State University '13
  - B.S. Aquatic and Coastal Sciences
- The College of New Jersey
- M.A.T Secondary Biology
Contact Info

- Kpalmer@nhvweb.net
- Palmerk3@tcnj.edu
Poll Everywhere
The Evolutions of Populations

• **Population**: a group of organisms of the same species that occur in the same area and interbreed or share a common gene pool.
• **Gene pool**: all of the alleles at all gene loci of all individuals in the population.
• **Populations evolve, not individuals.**

**Hardy-Weinberg Theorem**

- G.H. Hardy & W. Weinberg (1908)
- The frequency of alleles in the population will remain the same regardless of the starting frequencies.

**Genotype Frequency**:

\[ p^2 + 2pq + q^2 = 1 \]

- \( p \) = \( P \) (Dominant Allele)
- \( q \) = \( a \) (Recessive Allele)
- When determining allele frequency: \( p + q = 1 \)

Example: In a population of 100 individuals in which 40% of alleles are \( P \), \( p \) would be 0.40. What would \( q \) equal?

★ Remember: \( p + q = 1 \)
Hardy-Weinberg Theorem

- G.H Hardy & W. Weinberg (1908)
- The frequency of alleles in the population will remain the same regardless of the starting frequencies.
Genotype Frequency:

\[ p^2 + 2pq + q^2 = 1 \]

\( p = A \) (Dominant Allele)
\( q = a \) (Recessive Allele)

When determining allele frequency: \( p + q = 1 \)

Example: In a population of 100 individuals in which 40% of alleles are A, \( p \) would be 0.40. What would \( q \) equal?
When determining allele frequency

\[ p + q = 1 \]

Example: In a population of 100 individuals in which 40% of alleles are A, p would be 0.40. What would q equal?

★ Remember: \( p + q = 1 \)
**Genotype Frequency:**

\[ p^2 + 2pq + q^2 = 1 \]

\[ p = A \text{ (Dominant Allele)} \]
\[ q = a \text{ (Recessive Allele)} \]

**When determining allele frequency:**
\[ p+q=1 \]

**Example:** In a population of 100 individuals in which 40% of alleles are A, p would be 0.40. What would q equal?

⭐ **Remember:** \[ p + q = 1 \]
Example

You have a sampled population in which you know that the percentage of the homozygous recessive genotype (aa) is 36%. Using that 36%, calculate the following:

- The frequency of the "aa" genotype.
- The frequency of the "a" allele.
- The frequency of the "A" allele.
  *Remember*(p + q = 1)
- The frequency of the genotypes "AA and Aa".

\[ p^2 + 2pq + q^2 = 1 \]
Answer:

- Frequency of "aa" genotype is 36%. (Given in the problem)
- 60% The frequency of aa is 36%, which means q-squared = 0.36. If q-squared is 0.36, then q=0.6
- 40% (p + q = 1) (p + 0.6 = 1).
- Now you know:
  - p = 0.4 and q = 0.6
  - Substitute and solve the frequencies of the genotypes.

\[
p^2 + 2pq + q^2 = 1
\]

\[
(0.4)^2 + 2(0.4)(0.6) + (0.6)^2 = 1
\]

0.16 + 0.48 + 0.36 = 1
16% + 48% + 36% = 100

AA  Aa  aa

✔ Try to solve problem #2 on your own
Substitute and solve the frequencies of the genotypes.

\[ p^2 + 2pq + q^2 = 1 \]

\[
(0.4)^2 + (2)(0.4)(0.6) + (0.6)^2 = 1
\]

\[
0.16 + 0.48 + 0.36 = 1
\]

\[
16\% + 48\% + 36\% = 100
\]

\[ \text{AA} \quad \text{Aa} \quad \text{aa} \]

✓ Try to solve problem #2 on your own
The Hardy-Weinberg Theorem is only true if certain conditions are met...

What conditions do you think could influence the gene pool of a population?
The Hardy-Weinberg Theorem is true if:

- The population is very large.
- Matings are random.
- Mutation is not occurring.
- Natural selection is not occurring; all genotypes are equal in reproductive success.
- There is no migration of individuals into and out of the population.
Mechanisms of Microevolution

- Natural Selection
- Genetic Drift
- Gene Flow

Natural Selection
- A process in which individuals with certain favored traits are more likely to survive and reproduce than are individuals that do not have these traits.
- Genetic equilibrium would be disturbed on the frequency of a certain allele increased in the gene pool from one generation to the next.

Genetic Drift
- Chance events can cause allele frequencies to fluctuate unpredictably from one generation to the next.
- The frequencies of alleles will be more stable from one generation to the next when a population is large.

Gene Flow
- A population may gain or lose alleles when fertile individuals move in or out of a population or when genes (such as plant pollen) are transferred between populations.
- Gene flow tends to reduce differences between populations.
- **Natural Selection**
  - A process in which individuals with certain inherited traits are more likely to survive and reproduce than are individuals that do not have those traits.
  - Genetic equilibrium would be disturbed as the frequency of a certain allele increased in the gene pool from one generation to the next.

- **Genetic Drift**
  - Chance events can cause allele frequencies to fluctuate unpredictably from one generation to the next.
  - The frequencies of alleles will be more stable from one generation to the next when a population is large.

- **Gene Flow**
  - A population may gain or lose alleles when fertile individuals move into or out of a population or when gametes (such as plant pollen) are transferred between populations.
  - Gene flow tends to reduce differences between populations.
- Natural Selection
- Genetic Drift
- Gene Flow
Natural Selection

- A process in which individuals with certain inherited traits are more likely to survive and reproduce than are individuals that do not have those traits.
- Genetic equilibrium would be disturbed as the frequency of a certain allele increased in the gene pool from one generation to the next.
Genetic Drift

- Chance events can cause allele frequencies to fluctuate unpredictably from one generation to the next.
- The frequencies of alleles will be more stable from one generation to the next when a population is large.

Bottleneck Effect

- When an event such as an earthquake, flood, or fire kills large numbers of individuals, leaving a small population that is unlikely to have the same genetic makeup as the original population.
Bottleneck Effect

- When an event such as an earthquake, flood, or fire kills large numbers of individuals, leaving a small population that is unlikely to have the same genetic makeup as the original population.
Gene Flow

- A population may gain or lose alleles when fertile individuals move into or out of a population or when gametes (such as plant pollen) are transferred between populations.
- Gene flow tends to reduce differences between populations.