Population Genetics

Populations evolve
Evolution = change in allele frequency in populations over time

POPULATION =
community of potentially interbreeding individuals in a given locality
locality - geographic/cultural (social)
  Dunkers - Franklin Co
Isolate = breeding population (in-mating group)
GENE POOL = all the genes present in a population

Example

MN blood group - codominant
3 combinations possible: MM MN NN
100 people: 100 x 2 = 200 alleles

49 M (MM)  42 MN (MN)  9 N (NN)

count the alleles:
M’s = 49 MM’s x 2 = 98, plus 42 from MN’s = 140
N’s = 9 NN x 2 = 18, plus 42 from MN’s = 60
  Total 200 alleles

Frequency of M?
  140/200 = .7 = 70%

Frequency of N?
  60/200 = .3 = 30%

Frequencies must add to 1, that is 100%
HARDY–WINEBERG EQUILIBRIUM

Population unlikely to change allele frequencies:
INFINITELY LARGE, RANDOMLY MATING,
NO NATURAL SELECTION, NO MUTATION, NO ADMIXTURE
HYPOTHETICAL NON-EVOLVING POPULATION

IF population is in H–W Equilibrium:

genotypes of the offspring will conform to rules of probability!

Probability of coin flip (2 coins, like 2 alleles)

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(Pete) (Quint)

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Chance of Chance of Chance of
2 heads: heads and tails: 2 tails:

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

OR: \[ p^2 + 2pq + q^2 = 1 \] (frequencies must add to 1)

If flip 2 coins and results were:

24– 2 heads
52– one each H + T
24– 2 tails

Honest coins?

If flip 2 coins and results were:

90– 2 head
10– one each H + T
0– 2 tails

Honest coins?
back to our MN example with numbers:

Remember: frequency of M was .7 (70%)
Frequency of N was .3 (30%)

.7M .3N

.7M .49 MM .21 MN

.3N .21 NM .09 NN

Using the nicknames for the frequencies:
(p = nickname for dominant allele frequency)
(q = nickname for recessive allele frequency)

(M&N are codominant, but never mind)

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OR

p'' + 2 pq + q'' = 1 (frequencies must add to 1)

Now let’s use all this!!
We can use H-W to estimate allele frequencies.
If have dominance there is a PROBLEM: cannot count p + q
No way to distinguish homozygous dominants from heterozygotes
BUT, we can count homozygous recessives
Assumptions: q² is frequency of homozygous recessive people
(Two alleles (qq) means we are looking at people)
√q² = q = frequency of the recessive allele
We know frequencies must add to 1, so . . .
subtract q from 1 and we find p
Work a problem: what are frequencies of attached and unattached earlobe alleles? If the number of people is 200, and
150 people have unattached earlobes? Phenotypes, unattached 150, so number of people with attached earlobes must be 50.
We know their genotype: attached must be uu
(Unattached earlobes are a combination of UU and Uu)
Frequency of people with attached?
50/200 = 1/4 = .25
qq or q² = .25
q = √q² = √.25 = .5
p + q = 1, so 1 - q = p
1 - .5 = .5, so p must be .5
SUMMARY
Population geneticists
- analyze changes in gene frequencies resulting from evolutionary processes
- describe a population's genetic make-up in terms of allele frequencies and genotype frequencies
geneticists (and students) can use Hardy-Weinberg to compute allele frequencies