Background and Basics

I) General Ideas

A) Definitions

1) Gene
2) Allele
3) Locus
4) Genotype

$$\#genotypes = \frac{m(m+1)}{2}$$

5) Phenotype

B) Probability

1) Multiplicative Rule
2) Additive Rule
3) Repeated Trials

$$\frac{n!}{r!(n-r)!} p^r q^{(n-r)}$$

C) Mathematical Models

1) General Ideas

$$N_t = b^t N_0$$

2) Parameters and Estimates

3) Distributions – all sampling data come from an idealized frequency distribution that may be unique to the type of data that are being collected. Three (actually two) basic types of importance for us.

a) Binomial Distribution – discrete measures (numbers of things)

i) Usually describes two things that occur at varying but fairly equal frequencies (i.e., p and q)

ii) either infinite population or sample with replacement

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iii) generally only a few occurrences.

iv) $\mu = pk$ and SD = $\sqrt{\frac{pq}{k}}$ where k is the number of occurrences and p and q are the frequencies of the events.

e.g.,, p = probability of passing Population Genetics = 0.4

q = probability of failing Population Genetics = 0.6

7 students taking the class for a grade

$$(p + q)^7 = p^7 + 7p^6q + 21p^5q^2 + 35p^4q^3 + 35p^3q^4 + 21p^2q^5 + 7pq^6 + q^7$$

$p^7 = 0.00164$ (note $p^6 = 0.004096$)

v) Properties of a Binomial Distribution

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b) Hypergeometric – essentially the same as the binomial except finite population size sampled without replacement.

e.g., Population size = 100 with 4 mutants

F(mutant) = 0.04

If one mutant is sampled then there are 3 mutants in 99 individuals and

F(mutant) = 0.0303

c) Poisson Distribution – approximates a Binomial when the frequencies are nearly equal (i.e., $p \approx q$) and the number of occurences (k) is small. A poisson distribution is observed when $p >> q$ and k is large. The mean equals the variance (i.e., $\mu = \sigma^2$)

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