ANSC 446 Formula sheet for Exam 2

Verify answers using unit square

Hardy Weinberg principle: for two alleles A_1 with frequency p, and A_2 with frequency q, genotypes A_1A_1, A_1A_2, A_2A_2 have frequencies p^2, 2pq, q^2 respectively, or P, H, Q, respectively.
$P + H + Q = 1$
$p^2 + 2pq + q^2 = 1$
$p + q = 1$

FITNESS AND SELECTION:

Fitness values may be standardized with ω_{12} set equal to 1.0

Mean fitness:
$\omega\text{-bar} = p^2\omega_{11} + 2pq\omega_{12} + q^2\omega_{22}$

DIRECTIONAL PURIFYING SELECTION:

Allele frequency change, where s is selection coefficient and h is level of dominance (h is zero for a recessive allele; 0.5 for an additive allele; 1 for a dominant allele)

$$q_1 = \frac{q_0[1-s(hp_0+q_0)]}{1-2hsp_0q_0-sq_0^2}$$

$$\Delta q = q_1 - q_0 = -\frac{spq[h-((2h-1)q)]}{1-2hspq-sq^2}$$

Lethal recessive:
$q_1 = q_0 / 1+ q_0$
$q_t = q_0 / 1+ tq_0$

Generations, n, for a change to occur in the frequency of a lethal recessive allele:
$n = (1/q_n) - (1/q_0)$

HETEROZYGOTE ADVANTAGE OR DISADVANTAGE:

Equilibrium frequency $q_e = s_1 / (s_1 + s_2)$

Genetic load at equilibrium: $[s_1s_2 / (s_1 + s_2)]$

INBREEDING:

With self incompatibility, $q_e = 1/n$
where n is number of alleles

For an inbred population, where f is the inbreeding coefficient, $Q = q^2 + fpq$ and $P = p^2 + fpq$ and $H = 2pq - 2fpq$

Estimate of inbreeding coefficient:
$f = 1 - (H/2pq)$

Self-fertilization equilibrium heterozygosity:
$H_e = (4pq(1-S)) / (2-S)$ where S is proportion self-fertilizing, T is proportion out-crossing, and S+T =1

Self fertilization: at equilibrium, $Q = q - (H_e/2)$

Self fertilization: $f_e = S / (2-S)$

Self fertilization $H_{t+1} = 0.5 \text{ X } H_t$

Full-sib mating: $H_{t+2} = (0.5 \text{ X } H_{t+1}) + (0.25 \text{ X } H_t)$

Chain counting technique for estimation of inbreeding: $f = (0.5)^N$ where N excludes the actual inbred individual of interest. If more than one common ancestor: $f = \Sigma (0.5)^N$

$r = 2f$, where r is coefficient of relationship (or "relatedness") between two individuals and f is the inbreeding coefficient of their offspring

Kinship coefficient is half the relatedness

The frequency of an altruistic allele increases when $r > c/b$, where r is coefficient of relatedness (0.5 for full sibs or parent-child); c, cost in fitness to the altruist; b, benefit in fitness to the recipient

TABLE 3.5 The fitness values for the different fitness relationships examined.

	Genotype		
	A_1A_1	A_1A_2	A_2A_2
General fitnesses	w_{11}	w_{12}	w_{22}
(a) **Recessive lethal**	1	1	0
(b) **Detrimental alleles**			
(1) Recessive	1	1	$1-s$
(2) Additive	1	$1-s/2$	$1-s$
(3) Dominant	1	$1-s$	$1-s$
(c) **General dominance**			
(1) Purifying selection	1	$1-hs$	$1-s$
(2) Adaptive Darwinian selection	$1+s$	$1+hs$	1
(d) **Heterozygote advantage**	$1-s_1$	1	$1-s_2$
(e) **Heterozygote disadvantage**	$1+s_1$	1	$1+s_2$