ANSC 446 Formula sheet for Exam 3 (and after)

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.
$P + H + Q = 1$
$p^2 + 2pq + q^2 = 1$
$p + q = 1$

DRIFT, EFFECTIVE POPULATION SIZE, MUTATION, NEUTRALITY:

Effective population size over t generations:
$N_e = t / (\Sigma\ (1/N_i))$ where N_i is N_e for generation i

Effective population size, effect of inbreeding:
$N_e = N / (1+f)$

Small population size, loss of heterozygosity:
$H_{t+1} = (1 – (1/(2N))H_t$

Generations until loss of heterozygosity:
$t = (-2N)\ln(x)$ where $x = H_t / H_0$

Effective population sizes for different types of markers:
Autosomal: $N_e = (4N_f N_m)/ (N_f + N_m)$
X-chromosome: $N_e = (9N_f N_m) / (2N_f + 4N_m)$
Haploid: $N_e = N_{ef}/2$ or $N_e = N_{em}/2$ as appropriate
where m is males; f is females

New neutral mutation, initial frequency: 1/(2N)

New neutral mutation, time to fixation: $4N_e$

Neutral allele A_2, probability of fixation is the current $Pr(A_2)$

Neutral allele with initial frequency of q, time to fixation: $T(q) = -[(4N)(1-q)\ln(1-q)] / q$

Equilibrium frequency of A_2: $q_e = u / (u + v)$ where u is forward mutation rate, v is back mutation rate

Time between substitutions under neutrality: $1/u$

Number of effective alleles under neutrality: $\theta + 1$ (theta plus one), where $\theta = 4N_e u$

MIGRATION, POPULATION STRUCTURE:

Nei's $G_{ST} = (H_T – H_S) / H_T$ where H_S is average subpopulation heterozygosity under Hardy-Weinberg equilibrium; and $H_T = 1 – [\Sigma\ ((\overline{p}_i)^2)]$

Allele frequency after migration, one generation:
$q_1 = (1-m)q_0 + mq_m$
where q_m is the allele frequency of the migrants

Allele frequency after migration, >1 generation:
$q_t = ((1-m)^t)q_0) + [(1 – (1 – m)^t)q_m]$
where q_m is the allele frequency of the migrants

Migration rate estimation, one generation:
m-hat $= (q_0 - q_1) / (q_0 – q_m)$

FORMULA-SHEET, (*AFTER* Exam3)

Note: Chapter questions for final:
Ch 10, Q 2 (D and D' only); Ch. 11, Q 4 and 5

LINKAGE DISEQUILIBRIUM

Linkage disequilibrium, D
= (product of coupling gametes) – (product of repulsion gametes)
$= (x_{11}x_{22}) – (x_{12}x_{21})$

$D_t = (1 – c)^t$ X D_0 where c is rate of recombination and t is number of generations

$D' = D/D_{max}$
where for $D > 0$, D_{max} is the lesser of p_1q_2 or p_2q_1
while for $D < 0$, D_{max} is the lesser of p_1q_1 or p_2q_2