

ANSC 446 / IB 416
Population Genetics
Exam 1, Sept. 19, 2008

Name _____

(5 pages) Please show decimals rounded to 4 significant digits. Show your work or describe your logic to earn partial credit for incomplete answers.

- (9) 1. A survey in one state finds that the proportion of newborn infants who have the recessive autosomal disease cystic fibrosis is 1 in 2000.
- (3) a) What is the estimated frequency of this disease allele?
- (3) b) What proportion of individuals would be carriers of the disease?
- (3) c) Assuming a random-mating population, what proportion of matings would be between two carriers?
- (15) 2. Assume that the following mtDNA sequences were found in four different individuals sampled from a population.
- AATCGAGACTTTAGT
ATTCCAGATTTAAGC
ATTCCAGATTTAAGC
AATTGAGACTTTAGT
- (3) a) How many sites are segregating?
- (3) b) What proportion of nucleotide sites differ between the first and second sequences?
- (3) c) How many transitions are present between the first and second sequences?
- (6) d) Estimate the population nucleotide diversity from this sample.

- (6) 3. A population of caracals was sampled to determine the weight of adult males. A normal distribution was present in which the arithmetic mean weight of the sampled caracals was 20 kg, with standard deviation of 5 kg.
- (3) a) What proportion of adult male caracals would be expected to weigh 29.8 kg or more?
- (3) b) Among 200 adult male caracals, how many individuals would be expected to weigh between 15 and 25 kg?
- (16) 4. Red-green color blindness in humans is an X-linked recessive trait present in 7% of males in the United States. Assuming Hardy Weinberg Equilibrium:
- (3) a) What would be the expected frequency of the trait in females?
- (3) b) What would be the expected frequency of carriers among females?
- (3) c) Alice is a daughter born to a father with normal vision and a mother who is a carrier. Using just this information, what is the probability that Alice is also a carrier?
- (7) d) As an adult, Alice has four sons who all have normal vision. Using information regarding her ancestors and descendants, what is the (posterior or Bayesian) probability that Alice is a carrier?

- (3) 5. Four babies were born in a hospital on the same night, and their blood groups were later found to be O, A, B and AB. The four pairs of biological parents were:

O and O
 AB and A
 A and A
 B and O

Assign the four babies to their correct parents.

- (2) 6. What is the difference between a Punnett square and a unit square?

- (9) 7. Coat color in horses is determined by multiple alleles. A complete Black horse (C1 black horse with black mane and tail) is dominant to a Bay horse (C2 brown horse with black legs, mane and tail) and a Mahogany Bay. A Bay is dominant to a Mahogany Bay (C3 brown horse with black roots, legs, mane, and tail). Your sample has 1000 horses (Black, Bay, and Mahogany Bay).

<u>Color</u>	<u>Observed Number</u>
Black	360
Bay	150
Mahogany Bay	490

Estimate the allele frequencies for C1, C2, and C3.

- (5) 8. An AFLP marker in xantusid lizards was found to be heterozygous in 80 lizards and homozygous in 10 lizards.

Estimate the effective number of alleles at this marker.

- (16) 9. A survey of MN blood type frequencies was conducted using samples from 400 Navaho in New Mexico. The phenotypic results were:

336 M
48 MN
16 N

- (3) a. What is the frequency of the M allele?
- (3) b. What is the frequency of the N allele?
- (6) c. What are the expected genotypic frequencies under Hardy-Weinberg equilibrium?
- (4) d. Using a chi-square (χ^2) test, are the observed genotypes in the sampling consistent with Hardy-Weinberg equilibrium?

Potentially useful chi square critical values.

Degrees of freedom	P value = .05
1	3.84
2	5.99
3	7.81
4	9.49

(4) 10. Give the best definition for the following terms:

(2) a) Synonymous mutation

(2) b) Transversion (mutation)

(15) 11. Two populations of cattle were sampled and found to have the following allele frequencies for two SNP sites:

	<u>Site 1</u>		<u>Site 2</u>	
	G	C	G	A
Ten Asian cattle	.20	.80	.30	.70
Forty African cattle	.60	.40	.35	.65

(3) a) Estimate the mean allele frequency of G at Site 1.

(8) b) Calculate genetic identity and its three components for Site 1.

(4) c) Estimate Nei's standard genetic distance between the two cattle populations at Site 1.