

- 1) In a population genetic survey of variation in acorn barnacles, 7 loci were screened. Of these loci, 2 have seven alleles, 2 have five alleles, and 3 have two alleles. How many genotypes are possible at each locus individually? How many different multi locus genotypes (i.e., considering all loci) are possible? Please show your work. Assuming even allele frequencies at all loci (i.e., at each locus the frequency of each allele is  $1.0 \div$  number of alleles) what percentage of these multi locus genotypes will be heterozygous at all loci?
- 2) The Florida Gaming Commission has devised a new type of horse race involving only three horses. The three horses run three races and you are only allowed to bet on a single horse. Each horse has a certain fixed probability of finishing the race in first, second, or third place. Since there are only three horses, all horses **MUST** finish either first, second, or third (not finishing the race is defined as finishing third). To win your bet, you must correctly guess the number of times and position that your horse places over all three races. The name of your favorite horse is Motoo. The racing form gives Motoo 17% chance of placing first, 49% chance of placing second, and a 34% change of placing third in any of the three races (this does not change from race to race). Using what you know or can figure out about binominal expansions, what are the following probabilities?
- Motoo places first three times?
  - Motoo places first once and second twice?
  - Motoo places second twice and third once?
  - Motoo places first once, second once and third once?
  - What is the best bet to make and how likely are you to win?

2) The table below is the result of a RFLP survey of a 1,200 bp anonymous nuclear DNA sequence in green sea turtles from Costa Rica. Only 4 base pair cutting restriction endonucleases were used and they identified 9 different haplotypes. A total of 45 restriction sites were identified of which 32 were polymorphic. Using this information and the table of variable sites below, estimate  $\theta$ ,  $\rho$ , and their variances.

Polymorphic Site

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	Frequency				
<b>A</b>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	0.10	
<b>B</b>	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.27
<b>C</b>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07
<b>D</b>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04
<b>E</b>	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.35
<b>F</b>	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12
<b>G</b>	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03
<b>H</b>	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
<b>I</b>	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01

3) A 500 bp locus in oysters was sequenced and identified 5 haplotypes in 20 individuals. Using the data set below, a) what proportion of the nucleotide sites are polymorphic, b) calculate  $\theta$  and  $\rho$ , and c) calculate the variance of  $\theta$  and  $\rho$ .

Allele	Variable Position																Frequency
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
<b>A</b>	T	C	T	A	C	C	T	C	C	T	C	G	G	T	T	A	10
<b>B</b>	T	C	C	T	A	C	C	T	C	C	T	G	G	T	T	T	5
<b>C</b>	C	T	C	C	C	C	C	T	C	T	T	T	G	C	T	A	2
<b>D</b>	C	T	C	C	C	C	C	T	T	C	T	G	A	C	T	T	2
<b>E</b>	C	T	C	C	C	T	C	T	T	T	T	G	G	C	C	A	1