

(4) [15 points] Scientists studying pond scum at ASU have found an organism with four sexes. Suppose the parents are P1= AAAa, P2 = AAaa, P3 = AAAA, and P4 = Aaaa.

(a) What is the probability of getting an AAAA offspring?

$$= P(\text{A from P1}) * P(\text{A from P2}) * P(\text{A from P3}) * P(\text{A from P4}) \\ = (3/4) * (1/2) * (1) * (1/4) = 3/32 = 0.094$$

(b) What is the probability of getting an AAAa offspring?

Four different ways to get this a from P1 A from all others, a from P2, A from others, etc.

$$= (1/4)(1/2)(1)(1/4) + (3/4)(1/2)(1)(1/4) + (3/4)(1/2)(0)(1/4) \\ + (3/4)(1/2)(1)(3/4) = (1+3+9)/32 = 13/32 = 0.41$$

(c) Given that the offspring is AAAa, what is the chance that Parent four (P4) contributed the a allele?

$$= \Pr(\text{a from P4} \mid \text{AAAa}) = \Pr(\text{AAAa, a from P4}) / \Pr(\text{AAAa})$$

$$\Pr(\text{AAAa, a from P4}) = (3/4)(1/2)(1)(3/4) = 9/32$$

$$\Pr(\text{AAAa}) = 13/32,$$

$$\Pr(\text{a from P4} \mid \text{AAAa}) = (9/32) / (13/32) = 9/13 = 0.69$$

(5) [10 points] Consider a cross of AABBCcDD x AaBbCcDd.

(a) What is the probability of an A-B-C-D- offspring? (Loci unlinked)

$$\Pr(\text{A-}) = 1, \Pr(\text{B-}) = 1, \Pr(\text{C-}) = 3/4, \Pr(\text{D-}) = 1$$

$$\Pr(\text{A-B-C-D-}) = 3/4$$

(b) Given your answer (a), what is the probability that the first five offspring are all A-B-C-D-?

$$(3/4)^5 = 0.237$$

(c) What is the probability that none of the first five offspring are A-B-C-D-?

$$(1/4)^5 = 0.00098$$

(6) [15 points] Two loci determine the dreaded *sun-devil* phenotype: the mustard locus (with alleles M = mustard, m = normal) and the rust locus (alleles R = rust, r = normal). An M-R- individual has the *sun-devil* affliction, being scorned by all, while all other genotypes display a normal phenotype. If an MMRR sun-devil is crossed to a mmrr normal,

(a) What are the genotypes/phenotypes in the F1?

all MmRr, which are all sun-devil

(b) What is the expected percentage of sun-devils in the F2?

$$\text{Freq(M-R-)} = (3/4)(3/4) = 9/16 = 0.562$$

(c) How many F2 offspring do we need to score to have a 99.9% chance of having at least one normal?

same as finding n where Prob(all a are sun devil) \leq 0.001

$$(0.562)^n = 0.001, \text{ or } n \log(0.562) = \log(0.001)$$

$$\text{or } n > \log(0.001) / \log(0.562) = 12$$

(7) [10 points] A child has blood type O. There are two possible fathers, Joe Nosing (a mega-million dollar rock star) and Joe Sixpack (an unemployed truck driver). The mother (blood type B) claims Nosing (blood type A) is the father.

a. Based on this data, can Nosing be excluded? Why or why not?

O = ii, so i from mom and dad. Nosing could be Ai and hence cannot be excluded.

b. Joe Sixpack had an AB child from a previous marriage. Can Sixpack be excluded? Why or why not?

The AB child only says that one of Joe's alleles is either A or B. Hence, the other could still be i and hence we (based on this data) cannot exclude him.

