Math 151 – Sample Exam III Answers– Fall 2015 – Louis Gross

Note that many of the below can also be done using Venn diagrams, which are not illustrated here.

1. There are only 3 matings which can lead to aa individual offspring: Aa x Aa, Aa x aa, and aa x aa. So we find the probability of each of these and then multiply by the probability that the offspring of each is type aa given this mating:

P(aa) = P(aa | mating is Aa x Aa) P(mating is Aa x Aa) +
P(aa | mating is Aa x aa) P(mating is Aa x aa) +
P(aa | mating is aa x aa) P(mating is aa x aa)
$= .25 \times .3 \times .3 + .5 \times .3 \times .1 + 1 \times .1 \times .1 = .0225 + .015 + .01 = .0475$

2. $\binom{5}{2} = 10$

3. (a) {L1, L2, L3, N1, N2, N3, A 1, A2, A3}
(b) {AA, AB, AC, AD, BB, BC, BD, CC, CD, DD}

4. Let T = event that a patient has a tumor,
let + = event that the test is positive
then $P(+|\bar{T}) = .06$ and $P(-|T) = .14$ and P(T)= .2
so $P(+|T) = 1 - P(-|T) = 1 - .14 = .86$
(a) $P(T \cap +) = P(+|T)P(T) = .86 \times .2 = .172$
(b) $P(+) = P(+|T)P(T) + P(+|\bar{T})P(\bar{T}) = .172 + .06 \times .8 = .22$
(c) $P(T|+) = \dfrac{P(T \cap +)}{P(+)} = \dfrac{.172}{.22} = .782$

5. Probability that 3 are successful is $\binom{5}{3}(.2)^3(.8)^2 = \dfrac{160}{3125} = .0512$

Probability that 4 are successful is $\binom{5}{4}(.2)^4(.8) = \dfrac{20}{3125} = .006$

Probability that all 5 are successful is $\binom{5}{5}(.2)^5(.8)^0 = \dfrac{1}{3125} = .00032$

So P(at least 3 successful) = $\dfrac{181}{3125} = .058$

6. Let I = event that a child has an ear infection
let F = event that a child is female
(a) P(I) =100/250 = .4

(b) $P(I \mid F) = \dfrac{P(I \cap F)}{P(F)} = \dfrac{\frac{40}{250}}{\frac{140}{250}} = .286$ $P(I \mid F) = \dfrac{P(I \cap F)}{P(F)} = \dfrac{\frac{40}{250}}{\frac{140}{250}} = .286$

(c) $P(\bar{I} \mid \bar{F}) = \dfrac{P(\bar{I} \cap \bar{F})}{P(\bar{F})} = \dfrac{\frac{50}{250}}{\frac{110}{250}} = .455$

7. Let O = event that a person in the survey is obese
 let L = event that a person in the survey eats a low-fat diet
 (a) $P(O \cap \bar{L}) = P(O) - P(O \cap L) = .35 - .03 = .32$
 (b) $P(L \mid \bar{O}) = \dfrac{P(L \cap \bar{O})}{P(\bar{O})} = \dfrac{P(L) - P(L \cap O)}{P(\bar{O})} = \dfrac{.2 - .03}{.65} = .262$

8. Let E = event that Joan is Aa and note that if Joan is not Aa she must be AA
 (a) P(E) = .5
 (b) P(Alan is AA) = P(Alan is AA | E) P(E) + P(Alan is AA | $\bar{E}$)P($\bar{E}$)
 =..25 ×.5 + .5 ×.5 = .375