ADVS Assessment [2019-2020]
Emphasis: Bioveterinary
Skill and Career Competencies [SCC]: Learning Outcome [LO] #2
Semester/Course: Fall 2019: ADSV 4560: Principles of Animal Genetics and Breeding
Artifact: Homework #6

The Homework #6 Assignment is an assessment of SCCLO #2. The assessment measures the student's ability to Demonstrate a working knowledge of mathematics including Calculus and Statistics by having students apply statistics to the characterization of quantitative traits and genetic prediction.

2. Demonstrate Quantitative competency.

ADVS 4560: Homework #6

Problems:

15.3) Cushy Pearson has a thing for bay colored horses. He purchased a single foal. He has four mares available: one brown, one mouse colored, one black, and one chestnut. Assume the following:

- **The inheritance of coat color in horses is no more complicated than it appears in Table 15.1.**
- **Cushy has no information on the genotypes of his horses other than their phenotypes.**
- **No linkage exists among the four loci shown in Table 15.1.**
- **Frequencies of coat color alleles in the Thoroughbred population are estimated to be:**

Allele	Frequency
A	0.6
a	0.3
a^t	0.1
C	0.7
c^{cr}	0.3
D	0.2
d	0.8
E	0.3
e	0.7

a. **To which mare should Cushy mate his bay stallion in order to maximize the likelihood of producing a bay foal?**

The Brown or Black mare

b. **To which mare should Cushy be sure *not* to mate his stallion?**

The Mouse mare

c. **Prove your answers mathematically.**

Color	Genotype	Probability That a Mating will Produce the Desired One-Locus Genotype				Probability of Bay Foal
		*A_*	*CC*	*dd*	*E_*	
Brown	$a^t a^t CCddE\_$ or $a^t aCCddE\_$	0.8	1	1	0.8775	0.70
Mouse	*aaC_D_E_*	0.8	0.85	0.4	0.8775	0.24
Black	*aaCCddE_*	0.8	1	1	0.8775	0.70
Chesnut	*__CCddee*	0.92	1	1	0.65	0.60

Stallion genotype: A_CCddE_ (Bay)

Mares:

1. $a^t a^t$CcddE_ (Brown)
2. aaC_D_E_ (Mouse)
3. aaCCddE_ (Black)
4. __CCddee (Chesnut)

*Begin proving the answer mathematically by first finding the A loci for the stallion and for all the mares. To find the probability of receiving a dominant A allele we will use the equation P_c[non-A] because we are looking for the probability of getting a **non-dominant** allele from each parent (anything besides the A).

- **Start with the stallion:**
  - P_c[non-A] = ½ (*probability of giving a non-A*) + ½ (*probability of giving a non-A*)
  - P_c[non-A] = ½ (0 *because he has the large A allele*) + ½ (a + a^t) *because those are the frequencies of the non-A alleles; we do not know what the stallion has here so it could be either one*
  - P_c[non-A] = ½ (0) + ½ (0.3 + 0.1) = 0.2 *probability of giving a non-A*
- **Now do each mare:**
  - Brown: P_c[non-A] = ½ (a^t) + ½ (a^t) = ½ (1) + ½ (1) = 1 *because she is never going to give an A so she will always give a non-A allele, therefore the frequency is 100% or 1*
  - Mouse: P_c[non-A] = ½ (a^t) + ½ (a^t) = ½ (1) + ½ (1) = 1 *same as the mare above*
  - Black: P_c[non-A] = ½ (a^t) + ½ (a^t) = ½ (1) + ½ (1) = 1 *same as the mare above*
  - Chestnut: P_c[non-A] = ½ (a + a^t) + ½ (a + a^t) = ½ (0.3 + 0.1) + ½ (0.3 + 0.1) = 0.4 *because we don't know the actual alleles in this mare, we use the frequencies for the non-A alleles in* tehri *place to find her probability*

*Now we have found the probabilities for the stallion and the mares; the next step is to simulate a mating between them to find the actual probability of receiving a dominant A allele

  - The equation will now look like this P[A_] because it is the phenotype we are looking for.