Lab 4: Probability

Goals

- Get practice solving probability problems

Question #1 A bag has 3 black marbles and 4 white marbles. You reach into the bag and draw a marble, and then draw another marble without replacing the first one.

a. What is the chance that the first draw is a white marble?

b. If the first draw was a white marble, what is the chance that the second draw is a black marble?

c. What is the chance that both marbles that you have removed are the same color as each other?

Question #2 In order for an annual plant to flower, it must germinate and then survive for several weeks. A group of botanists estimate that 70% of seeds will germinate in a particular grassland. One quarter of the plants that germinate will survive until they flower.

What is the chance that a randomly selected seed from this grassland will flower?

Question #3

Due to yearly mortality, a population is biased toward younger ages such that, at the breeding season, 40% of the individuals are (almost) 1 year old, 30% are 2 years old, 20% are 3 years old, and only 10% are over 3 years. Imagine that at the breeding time, the individual fight for territories, and that experience in prior years matters for these fights. Specifically, in the first year an animal is "inexperienced", and after their first year all animals are experienced. In any fight between an inexperienced animal and an experienced one, the experienced animal will win. In all other fights, the two competitors are equally likely to win. You randomly select an individual to watch. You see it in two fights against the same opponent, and it loses both of them. What is the probability that the individual that you are observing is in its first year?

Question #4 (This is question 19 from the text): DNA is made up of A, C, G, and T. Different chromosomal regions have different frequencies of these nucleotides. Assume that one region has 20% A, 30%C, 30%G, and 20%T. In a second region, the four nucleotides are equally frequent.

a. If you choose a nucleotide randomly from each region, what is the probability that both nucleotides will be the same base?

b. Assume that nucleotides occur independently within each region and you random sample a three-nucleotide sequence from each of the 2 regions. What is the chance that the triple chosen from the first region will be identical to the triple chosen from the second region?

Question #5 (Assignment problem # 25 on page 125) A seed randomly blows around a variable habitat: If it lands on high-quality soil it has a 0.8 chance of survival. If it lands on medium-quality soil it has a 0.3 chance of survival. A low-quality soil gives it only a 0.1 chance of survival. The three soil types (high, medium, and low) are present in proportions of 30:20:50, respectively. The probability of landing in a soil type is simply the proportion of the environment that is that habitat type.

a. Draw a probability tree to determine the probabilities of survival in all circumstances.

b. What is the probability of survival of a seed (assuming that a seed lands)?

c. Assume that a seed has a 0.2 change of dying before it lands. What is the overall probability of survival?

Question 6: Territorial males of a species of fish are more obvious to females and to predators. In a particular stream, 60% of these territorial males will die before the breeding season. Another set of "cryptic" males are smaller and do not defend territories. Only one quarter of these cryptic males will die before the breeding season. Most females prefer to mate with territorial males. If a territorial male is able to survive until breeding season, there is a 70% chance that he will fertilize a clutch. Only half of the cryptic males who survive until the breeding season will fertilize a clutch of eggs. You can assume that a male cannot fertilize more than one clutch and that all males die after the breeding season ends.

(a) If you find a (live) territorial male at the beginning of the **breeding** season (after all of the seasonal mortality events have occurred), what is the probability that he will fertilize a clutch of eggs?

(b) Imagine that you are able to track a cryptic male for his entire lifetime (starting at the beginning of the year **before** any mortality events occur). What is the probability that he would fertilize a clutch of eggs?

(c) CIRCLE ONE: TRUE or FALSE: The events "the male dies before breeding season" and "the male fertilizes a clutch of eggs" are mutually exclusive.

(d) CIRCLE ONE: TRUE or FALSE: The events "the male survives until breeding season" and "the male fertilizes a clutch of eggs" are independent.