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Worked with Madison

Suppose it is a beautiful fall day and you are sitting underneath three oak trees: Bur oak (Quercus. macrocarpa), Northern Red Oak (Q. rubra), and white oak (Q. alba). They've just started to drop their acorns.

Without looking, you reach down and pick up **two** acorns at the **same time**.

Describe the sample space of your collection (i.e. enumerate the set of all possible outcomes).

Question 1: What is the size of the sample space?
The size of the sample space is the set of all possible outcomes. There are 6 different possible combinations of species (where order does not matter):

macrocarpa, macrocarpa
macrocarpa, rubra
macrocarpa, alba
rubra, rubra
rubra, alba
alba,alba

Question 2: Given the scenario description, how many ways are there to collect two acorns of the same species?
There are three ways to collect two acorns of the same species, as there are only three species to collect (highlighted in yellow above).

Question 3: Given the scenario description, how many ways can you collect two acorns of different species?
There are three ways to collect two acorns of different species (highlighted in green above).

Suppose it is a beautiful fall day and you are sitting underneath three oak trees: Bur oak (Quercus. macrocarpa), Northern Red Oak (Q. rubra), and white oak (Q. alba). They've dropped most of their acorns. It was a productive year so there seem to be thousands of acorns from each species!

- There are approximately the same number of acorns from each species on the ground, and they seem to be evenly spread around.

You collect an acorn, place it in your left pocket, walk a short distance and collect a second acorn placing it in your right pocket.

Question 4: What is the probability that an acorn in your left pocket is Q. alba?
1/3 or 33%

Question 5: What is the probability that an acorn in your right pocket is Q. macrocarpa?
1/3 or 33%

Question 6: If you already know that the acorn in your left pocket is Q. alba, what is the probability that the acorn in your right pocket is also Q. alba?
1/3 or 33%. Knowing the identity of the acorn in one pocket does not affect the identity of another.

Question 7: What is the probability that both acorns are Q. rubra?
1/9 or 11%

Question 8: What is the probability that you collected exactly one each of Q. alba and Q. rubra?
2/9 or 22% because 2/9 possible outcomes contain Q. alba and Q. rubra (position matters).

Question 9: What is the probability that the acorn in your left pocket is Q. alba and you have an acorn of Q. rubra in your right pocket?
1/9 or 11%

Question 10: Which of the following is the size of the sample space of this distribution?
Infinity.

Question 11: Which of the following is the size of the sample space of this distribution?
10 (n+1)

Question 12: Which common characteristics of the Binomial and Poisson distributions make them good models for counts?
Poisson models assume counts are independent, which is good in situations where the count of one thing does not affect the probability of another. The unlimited sample size allows a count of any size. In a Binomial distribution there is a limited number of trials which is helpful in populations where you need to decide on the size of your sample space. It also has binary outcomes which is useful in counts of events with two outcomes. Both assume events occur randomly at a constant rate which is useful in counts, as well.

Question 13: Describe a scenario in which a Binomial distribution may be a better count model than a Poisson distribution.
A Binomial distribution would be a better count model for a scenario in which the number of outcomes is limited to two outcomes. One example of this would be presence/absence data of a species of tree within a specified range. The tree is either present or absent in that range, there are not unlimited possible outcomes. A binomial distribution is not a good distribution of counts with more than two categories (aka the above w/ three categories of species of acorns).