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ECO 602

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Week 5 Reading Questions

**Question 1 and questions 11-16 discussed with Kato. All other questions answered alone.*

Q1 (2 pts.): Choose the best words or phrases to fill in the blanks: A probability distribution is a map from the (a)_____ to the (b)_____.

a) events

b) likelihood

Q2 (2 pts.): How many possible outcomes are there (i.e. what is the sample space) if you flip two coins *sequentially*: a penny and a quarter? Assume that

- **the two coins each have a *head* and a *tail***
- **you care about order, but you may flip either coin first.**
- **the probability of heads or tails is about 0.5 for each coin.**

There are eight events in the sample space, because the penny and the quarter have four possible outcomes: (H, H), (H, T), (T, H), and (T, T). Since we care about order of the result, (H, T) and (T, H) are distinct events, rather than the same.

Q3 (2 pts.): How many possible outcomes are there (i.e. what is the sample space) if you flip two quarters *at the same time*? Assume that

- **the two coins are indistinguishable**
  - **i.e. you just want to know the number of heads or tails for each possible outcome.**
- **each have a *head* and a *tail***
- **the probability of heads or tails is about 0.5 for each quarter.**

There are six events in the sample space, because each quarter has three possible outcomes: (H, H), (H, T) or (T, H), and (T, T). Doing the coin flips at the same time doesn't mean anything except that we don't care about order because they are happening simultaneously. The result of one coin flip is still independent from the other, assuming that the coin is fair.

Q4 (2 pts.): How many outcomes are there if you flip a penny three times? If you care about the order of flips, how many possible events are there in the sample space?

There are four possible successes for each penny flip, (H, H), (H, T), (T, H), and (T, T). So in total, there are 12 possible outcomes.

Q5 (1 pt.): Are these *combinations*, or *permutations*?

These are permutations, because you care about the order of the penny flips.

Q6 (2 pts.): Now suppose you don't care about the order, and you simply want to know about the number of heads when you flip the penny three times. How many possible events are in the sample space?

Three events are in the sample space, because there are three possible successes in the probability of getting heads when you flip the penny three times: (H, H), (H, T) or (T, H), and (T, T), so there are 9 possible outcomes.

Q7 (1 pt.): Are these *combinations*, or *permutations*?

These are combinations, because you do not care about the order of the penny flips.

Q8 (2 pts.): What is the size of the sample space?

The sample size is ten, because there are three types of acorns, and you could get any of five outcomes for each of your two acorns: (R, R), (R, M), (R, A), (M, M), (A, A).

Q9 (2 pts.): Given the scenario description, how many ways are to there to collect two acorns of the same species?

There are three ways to collect two acorns of the same species, (R, R), (M, M), or (A, A).

Q10 (2 pts.): Given the scenario description, how many ways can you collect two acorns of different species?

There are two ways to collect two acorns of different species: (R, M) or (R, A).

Q11 (1 pt.): What is the probability that the acorn in your left pocket is Q. alba?

PA = 0.33

Q12 (1 pt.): What is the probability that the acorn in your right pocket is Q. macrocarpa?

PM = 0.33

Q13 (2 pts.): 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?

PA = 0.33

Q14 (2 pts.): What is the probability that both acorns are Q rubra?

PR = 0.33

Q15 (2 pts.): What is the probability that you collected exactly one each of Q. alba and Q. rubra?

PR*PA = (0.33)*(0.33) = 0.11

Q16 (2 pts.): 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?

PR*PA* = (0.33)*(0.33) = 0.11

Q17 (1 pt.): Which of the following is the size of the sample space of this Poisson distribution?

10, 11, 0, 2, 6, ∞

The Poisson distribution has an infinite sample space.

Q18 (2 pts.): Which of the following is the size of the sample space of this Binomial distribution?

10, 11, 0, 2, 6, ∞

The sample space of the binomial distribution is 11, because in a binomial distribution, the sample space is n +1, which, in this case, is 10 +1.

Q19 (2 pts.): Describe a characteristic that is common to both the Binomial and Poisson distributions that makes them good models for counts.

Both binomial and Poisson distributions are discrete distributions, meaning that the numbers included are only fixed, whole numbers with a specific value. This makes them both great for count data because in counts, you can only use discrete data, for example, you can't count half a bird, you can only have one bird.

Q20 (2 pts.): Hypothesize a scenario in which a Binomial distribution may be a better count model than a Poisson distribution.

The binomial distribution is used when the probability of success has an upper limit, meaning that we know the total sample size and that places a limit on the possible successes. So, in a population of peppered moths, you may have different "successes" of finding a light morph moth as opposed to a dark morph moth. Here, you might use a binomial distribution when you want to look at specific counts of a success, in this case, understanding the theoretical distribution of your light morph moths. This is better than a Poisson in this case because there's a finite upper limit on your moth population, we don't have an infinite number of light moths.