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I didn't work with other students.

ECO 602 - Week 5 Reading Questions

Reading:

- Bolker ch. 1: Intro and Background
  - Read section 1.6: Outline of the Modeling Process
- McGarigal 5: Probability Distributions
- Jorge Luis Borges: La Biblioteca de Babel (The Library of Babel)
  - Don't worry, you can read the English translation!
- ***Optional*** Bolker chapter 4: Probability and Stochastic Distributions for Ecological Modeling
  - This is a *much* more in-depth and technical overview than we will be covering in class.
  - This reading is totally optional, I've provided it as a reference only in case you're interested.

Warm-up questions:

- **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 = likelihood**
  - **b = dependent event**
- **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.

  - **Since we care about order, there 8 total possible outcomes.**
    penny first - (H_pH_Q)(H_pT_Q)(T_PH_Q) (T_PT_Q)
    quarter first – (H_QH_p) (H_QT_P) (T_QH_p) (T_QT_P)

- **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.

  - **Since order doesn't matter, the sample space is 3.** (T,T)(T,H)(H,H). It could also be (H,T) but that is equivalent because there is no difference between the two coins, so (T,H)=(H,T) in this case.

- **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 3 flips with 2 options (H/T) for each flip. So there are 2^3 possible combinations = 8 possible events in the sample space.**

- **Q5 (1 pt.):** Are these *combinations*, or *permutations*?
  - **Since we care about order, these are permutations.**
- **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?
  - **The options are:** none, 1 head, 2 heads, 3 heads. **So there are 4 possible events in the sample space.**
- **Q7 (1 pt.):** Are these *combinations*, or *permutations*?
  - **Since we don't care about order, these are combinations.**

Simultaneous acorns:

- **Q8 (2 pts.):** What is the size of the sample space?
  - **Order doesn't matter because we are selecting 2 acorns at the same time. The sample space is six.** (B, R) (B, W) (R, W) (B, B) (W, W) (R, R)
- **Q9 (2 pts.):** Given the scenario description, how many ways are there to collect two acorns of the *same species*?
  - **There are 3 ways to collect 2 acorns of the same species because there are 3 different species present.** (B, B) (W, W) (R, R)
- **Q10 (2 pts.):** Given the scenario description, how many ways can you collect two acorns of *different species*?
  - **Since we are picking them up at the same time and order doesn't matter, there are 3 ways to collect 2 acorns of different species. (B, R) (R, W) (W, B)**

Sequential acorns:

- **Q11 (1 pt.):** What is the probability that the acorn in your *left pocket* is *Q. alba*?
  - **Pr(Q.alba)** = 1/3 = 0.33
- **Q12 (1 pt.):** What is the probability that the acorn in your *right pocket* is *Q. macrocarpa*?
  - **Pr(Q.macrocarpa)** = 1/3 = 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*?
  - **Pr(Q.alba | Q.alba)** = 1/3 = 0.33. Since these are independent events and you walk a short distance before picking up the second acorn, I expect the probability of picking up Q. alba to be the same whether you already have Q. alba in your left pocket or not.
- **Q14 (2 pts.):** What is the probability that **both** acorns are *Q rubra*?
  - $\mathbf{Pr}(\mathbf{A} \cap \boldsymbol{B}) = \mathbf{Pr}(\boldsymbol{A}) \times \mathbf{Pr}(\boldsymbol{B})$ -> Pr(Q.rubra) x Pr(Q.rubra) = 0.33 x 0.33 = 0.11
- **Q15 (2 pts.):** What is the probability that you collected exactly one each of *Q. alba* and *Q. rubra*?
  - This is where it gets more complicated to calculate because we want the probability that we selected the species only once, so it has to include the probability of selecting the species once and the probability of NOT selecting that species for the other draw.
  - **Pr(Q.** alba) = 0.33
  - **PrNOT(Q.**alba) = 1 – 0.33 = 0.67
  - **PrNOT(Q.**rubra) = 1-0.33 = 0.67
  - **Pr(Q.** rubra) = 0.33

- **Probability of collecting exactly 1 each = 0.33 x 0.67 x 0.67 x 0.33 = 0.049**
- **(Note – this doesn't seem quite right to me but I'm not sure how else to do this)**

- **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?
  - $\mathbf{Pr}(\mathbf{A}\cap\boldsymbol{B})=\mathbf{Pr}(\boldsymbol{A}) \times \mathbf{Pr}(\boldsymbol{B})$ -> Pr(Q.alba) x Pr(Q.rubra) = 0.33 x 0.33 = 0.11

Binomial and Poisson

- **Q17 (1 pt.):** Which of the following is the size of the sample space of this Poisson distribution?
  - 10
  - 11
  - 0
  - 2
  - 6
  - ∞ - the sample space is {0,1,2,3,4…., ∞}.
- **Q18 (2 pts.):** Which of the following is the size of the sample space of this Binomial distribution?
  - 10
  - 11 – the sample space for a binomial distribution = n+1, so 10+1=11
  - 0
  - 2
  - 6
  - ∞
- **Q19 (2 pts.):** Describe a characteristic that is common to both the Binomial and Poisson distributions that makes them good models for counts.
  - **They are both discrete distributions because the events have to be integers.**
- **Q20 (2 pts.):** Hypothesize a scenario in which a Binomial distribution may be a better count model than a Poisson distribution.
  - **The Binomial distribution might be better if the number of trials is small and the probability of success is high.** The proportion of ticks that successfully find a host on which to feed in a 1 acre plot of land where many hikers pass through daily and there is a large population of mice and deer.