BIOL 701 Likelihood Methods in Biology: Homework #1

Due Wednesday, February 16, 2011.

You may work with others but the work you turn in must be your own. Make an earnest effort to solve all problems on your own.

1). In a predation experiment, 5 different prey items are in arena. A predator consumes two items, one after the other. How many outcomes in

a). the sample space?
b). the event that the first prey item consumed is # 4?
c). the event that the second prey item consumed is # 4?
d). the even that the first or the second prey item is #4?
c). the event that prey item # 4 is not consumed?

2). The binoculars of four ornithologists (A, B, C, and D) get mixed up in a bag when running away from a charging rhino. After they escape, binoculars are passed out at random upon hearing a Blue-throated Barbet. Find the probability that

a). C gets her own binoculars
b). A and D get their own binoculars
c). B, C and D get their own binoculars

before they are all trampled or gored because they were only paying attention to birds.

3). Let Ω be the set of points with positive integer coordinates: $\omega = (i, j)$, and define a probability distribution by $p(\omega) = 1/2^{i+j}$.

a). Show that $\sum p(\omega) = 1$.
b). Find the probability of the event $\{(i, j) : i + j \leq 4\}$

4). One day you meet Smith, who has two children, on the street with his son. What is the probability that Smith's other child is also a boy? One line of reasoning is the following. If the sexes of the children are determined independently and with equal probability, the probability that the second child is a son is 1/2. Alternatively, one could argue that of the four possible outcomes {BB, BG, GB, GG}, GG has been eliminated because you've already met one son, which means that if each family combination is equally likely, the probability that the second son is a boy is 1/3. Which line of reasoning is correct and why? Formulate your argument with probability statements.

5). (X, Y) has the bivariate CDF $F(x, y) = \frac{1}{2}(x^2y + xy^2)$ on the unit square: $0 < x < 1$, $0 < y < 1$.

a). Show that the unit square has probability 1.
b). What is the corresponding p.d.f?
c). What is $F(x)$ for $0 < x < 1$ and $y > 1$?
d). What are the marginal distributions of X and Y?
e). What is $P(X + Y < 1)$?

6). The joint p.d.f of (X, Y) is $f(x, y) = 6(1 - x - y)$ for $0 < y < 1 - x$ and $0 < x < 1$. Find the conditional p.d.f.'s $f(x|y)$ and $f(y|x)$.