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P.O. 841: Quantitative Methods
Midterm #1 Review
10/4/2013

1.) Which probability distribution would be most appropriate for the following circumstances?
Why?
• A researcher randomly samples 1000 people and asks each if (s)he approves of Obama.
• A researcher asks a subject whether or not he feels happy at work.
• A researcher wants to know if Hillary Clinton has a shot at the presidency and wants to ask at least 1500 randomly-selected people how they feel about her on a scale of 1-50.

2.) The Hillary Clinton researcher decides instead to take a random sample of 100 people, and asks each whether (s)he has a favorable opinion of HRC. The researcher notes that, in 2008, HRC's favorability rating (the proportion of people who had a favorable view of her) was 45%.
• What is the distribution of the researcher's data?
• What is the expectation of p-hat?
• What is the variance of p-hat?
• Suppose we assume that support for HRC has actually not shifted at all since 2008. What is the probability of the researcher's finding a majority favorability rating (51% or higher)?
• Suppose the researcher thinks he should sample a few more people, and he increases the number of people he randomly surveys to 500. Generally speaking, what could he reasonably expect to happen to the variability of his p-hat? Why might this result be a good thing for his research?

3.) The following table represents the probability distribution of the number of papers published by BU professors in a given month:

k	$P_x(k)$
1	.52
2	.16
3	.13
4	.1
5	.05
6	.04

• Find E(x) and var(x)
• Suppose we collect data on publications for all professors for the next 60 months (approximately 5 years). What is the probability that a prof will publish 4 or more papers in that period of time? How about less than 2?

4.) A baseball team manager administers a drug test on all his players that will detect steroid use with 95% accuracy. The team's star player has just tested positive for steroid use, but he swears he has never used them. A reporter goes behind the scenes and discovers that while 10% of the

team's players actually do use steroids—and let's assume she knows this for a fact—the drug test that manager has administered actually has a "false positive" rate of 15% (that is, 15% of all steroid-free players test positive for steroids). What is the probability that the team's star player actually does use steroids?

5.) Assume the probability of a college senior graduating with a 4.0 GPA is .05, and assume the probability of a college senior going on to get a PhD in her major field is .07.
• What is the probability of either graduating with a 4.0 or getting a PhD if the probability that a student will do both is .03?
• What is the probability of doing both if the probability of getting a PhD given that the student already has a 4.0 GPA is .3?

6.) The GRE is a "standardized" test that follows a normal distribution for both math and verbal scores. Both sections are scored on a 200-800 scale. The mean and standard deviation for math scores for all GRE test takers are 591 and 148, respectively. The mean and standard deviation for verbal scores are 469 and 119, respectively. A new crop of 10,000 students just took the GRE last weekend.
• What do we mean, in basic terms, when we say that the standard deviation for GRE math scores is 148?
• What is the expected value of the combined score (that is, a verbal + math sections score)?
• What is the variance of a combined score? Can we find it given the information we have now? If so, why (justify in words)? If not, why not?
• Let's assume that we know that verbal and math scores have a positive linear relationship with one another, and that these scores are correlated at a factor of rho = .5 Can we find the variance now? If so, what is it?
• What is the probability of scoring a 700 or above on the verbal section?
• Bob is thrilled that he scored in the 95th percentile on the verbal section. But when people ask him what his actual, raw score was, he realizes he doesn't know. How can he figure out his raw score, and what is it?

7.) A researcher is writing a grant proposal, and she proposes that she wants to interview 75 randomly-selected people about whether or not they would vote for Hillary Clinton in 2016. The grant committee calls her in and asks why they should give her money just so she can discover the opinions of just 75 people. *Why do we care what these 75 people think?* the committee asks. What should the researcher tell them? (Yes, this is an incredibly contrived example, but it's meant to impel more conceptual thinking about stats!)

8.) You have a six-sided die. Define A as the probability that you roll a 2 and B as the probability that you roll a 6.
• What is the probability of A and B?

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- What is the probability of A or B?
- What is the probability of rolling anything but a 2 or a 6?
- Now let's say you roll the die a second time. What is the probability of rolling a 2 and then rolling a 6?