Mathematics 375 – Probability and Statistics 1
Discussion 3 – Binomial and Geometric Random Variables
September 30, 2005

Background

Last time we introduced two types of discrete random variables – *binomial* and *geometric* variables. Both deal with the situation where independent trials of the same process are repeated, and the probability of success in any one trial is p.

1) The prototypical *binomial* random variable is the number of "successes". The probability mass function for a binomial Y looks like

$$p_Y(y) = \binom{n}{y} p^y q^{n-y},$$

where $q = 1 - p$ is the complemetary ("failure") probability.

2) The prototypical *geometric* random variable is the number of the trial on which the first success is observed. The probability mass function for a geometric Z looks like

$$p_Z(z) = q^{z-1}p.$$

Today, we will deal with both types of situations, and practice telling them apart.

Discussion Questions

A) An oil prospector drills a succession of wells in a given area. The probability that she is successful on a given trial is $p = .2$, and the trials are independent. She has financing to drill 10 wells in all.

1) On average, how many wells would she expect to have to drill before finding a productive well?
2) On average, how many productive wells would she expect to find among the 10?
3) What is the probability that she will find at least 2 productive wells?
4) What is the probability that she will fail to find a productive well?

B) In responding to a sensitive question such as "Have you ever used marijuana?" on a survey, many people prefer not to answer "yes" even if that is true. Suppose 80% of the population will truthfully answer "no", and of the 20% who should truthfully answer "yes", 70% will lie.

1) If 100 people are selected randomly and asked this question, what is the expected number of "yes" responses?
2) What is the expected number of people you would need to question before obtaining a "yes" response?

C) Of the volunteers donating blood at the Worcester Red Cross, 80% have the Rh (+) factor (i.e. one of the blood types $A+, B+, O+, AB+$).

1) If 5 volunteers are randomly selected, what is the probability that least one does not have the Rh factor?
2) What is the probability that 6 volunteers will be tested before we find one that does have the Rh factor?
3) Say you want to be "90% sure" that you have at least 5 donors who do have the Rh factor. What is the smallest number of volunteers you would need to select in order for the probability that at least 5 have the Rh factor to be at least .9? (Note: You can use Maple or a calculator here as you prefer. The binomial tables in our text don't cover all the cases you need.)

Assignment

Group writeups due Wednesday, October 5.