Stat 50 – Worksheet #12: The Geometric and Hypergeometric Distributions

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1. Match the name of each random variable(RV) with its definition

i. Binomial RV	a) Counts the number of occurrences of an event in a unit of time or space
ii. Geometric RV	b) Counts the number of successes in a fixed number of independent and identical Bernoulli trials
iii. Poisson RV	c) Counts the number of independent and identical Bernoulli trials up to and including the first success
iv. Hypergeometric RV	d) Counts the number of successes when sampling n items without replacement from a finite population where each item falls into one of two categories

2. Find each sum:

   (a) $\sum_{x=0}^{\infty}(0.2)^x$

   (b) $\sum_{x=0}^{\infty}(0.8)(0.2)^x$

   (c) $\sum_{x=30}^{\infty}(0.8)(0.2)^x$

3. A city has 3 large businesses and 7 small businesses. The IRS randomly selects a sample of 3 businesses from this city for tax audits .

   (a) would sampling most likely be without replacement or with replacement? Explain.

   (b) Let X = the number of large businesses selected in the sample. Assume sampling is without replacement for this part through part 3e. Find $P(X = 3)$, i.e. the probability that the three sampled businesses are all large businesses

   (c) List the possible values of X. (Hint: X cannot equal 4. Why?)

   (d) Find a formula for $P(X = x)$ for the values of x listed in the last part.

   (e) Determine the mean and standard deviation of X.

   (f) For this part only, assume sampling is with replacement and calculate the probability that all 3 large businesses are selected in the sample of 3 businesses. Compare your answer to your answer in 3b. Are you more or less likely to get all 3 large businesses when sampling with replacement?

4. Suppose that there are 10 juniors and 20 seniors in a math class. 5 students are randomly selected to receive a $10 discount on the class textbook.

   (a) What is the probability that the randomly selected group consists of 3 juniors and 2 seniors?

(b) A student incorrectly calculates the probability in part (a) as shown below. What is wrong with the proposed calculation?

$$\frac{10}{30} \cdot \frac{9}{29} \cdot \frac{8}{28} \cdot \frac{20}{27} \cdot \frac{19}{26}$$