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LECTURE 15: DISCRETE PROBABILITY FUNCTIONS II

I. Hypergeometric Distributions
   a. In a binomial distribution, we discussed the assumption of each trial as independent. For example, the sample taken is less than 5% of the population or there is replacement.
   b. What happens if your sample is more than 5% and there's no replacement? If each trial affects the likelihood of success, we need to use a different discrete probability function: hypergeometric.
   c. The mean is:

$$\mu = \frac{nR}{N}$$

      i. Where *N* is the population size
      ii. *R* is the number of successes in the population
      iii. *n* is the sample size.
   d. The standard deviation is:

$$\sigma = \sqrt{\frac{nR(N-R)}{N^2}}\sqrt{\frac{N-n}{N-1}}$$

   e. The probability of success is as follows:

$$\mathrm{P}(x,n) = \frac{{}_{N-R}C_{n-x} \times {}_{R}C_{x}}{{}_{N}C_{n}}$$

      i. Where *x* is the number of successes.

II. Poisson Distribution
   a. This type of distribution describes the number of times some event occurs during a particular interval (such as time, distance, area, volume, etc). Unlike other distributions, there can be any number of occurrences (successes).
      i. Examples: number of returns in an hour; number of strawberries in a patch that don't pass quality control; number of lost golf balls per year at a mini-golf course.

b. Requirements
    i. Mean must be the same for each interval.
    ii. Intervals cannot overlap.
    iii. Occurrences in each interval must be independent.
c. If we know how often something occurs on average, we can use Poisson to figure out how often something other than the average occurs.
    i. Because the Poisson distribution begins with knowing the average number of events, there is no equation for the average number of events.
d. The standard deviation is:

$$\sigma = \sqrt{\lambda}$$

    i. Where λ is the average number of events that occur in the period in question.
e. The probability of exactly *x* events occurring is:

$$\mathrm{P}(x) = \frac{\lambda^x e^{-\lambda}}{x!} = \frac{\lambda^x}{x!\, e^{\lambda}}$$

    i. Where *e* is about 2.718
    ii. Note that the negative exponent means that part of the equation goes to the denominator.