BME 200
Lesson 16
Oct 15, 2020

By the end of the course students should be able to:
- Define probability
- Define TN, FN, FP, TP
- Define prevalence, sensitivity, specificity, PPV, NPV
- Use probability concepts to evaluate the sensitivity and specificity of medical diagnostics

I. Probability
   A. A probability is a numerical value expressing the degree of uncertainty regarding the occurrence of an event

   B. Examples
      1. What is the probability of picking a red card?
      2. What is the probability of picking a queen?
      3. What is the probability of rolling a three on a six-sided dice?

   C. There are *unconditional probabilities*, which is what you're used to from grade/middle/high school.

II. Conditional probabilities
   A. There are also *conditional probabilities* that depend on the observer having some piece of information
      1. Read the equation as "the probability of A given B".

B. Here are some examples:

C. The identity or formula for conditional probabilities is called the *conditional probability identity*:

III. Joint probability table

A. Here is the breakdown of the School of Engineering at Ole Miss:

B. Now, imagine you stop a random student on campus. What are the following probabilities?

   Pr[undergrad]

   Pr[undergrad and SoE]

   Pr[SoE | undergrad]

   Pr[undergrad | SoE]

C. Joint probability tables are useful in biomedical engineering when we want to analyze diagnostics and tests
D. Here is a table that can be used to analyze diagnostics:

E. Here are some of the things that you can figure out with this table:
   1. Prevalence (number of cases of a disease at a given time):

2. Sensitivity (probability of a positive test result when the disease is present)

3. Specificity (prob of a negative test result when the disease is not present)

4. Positive predictive value, PPV (ratio of patients who test positive to all who have disease)

5. Negative predictive value, NPV (ratio of nondiseased patients to all who test negative)

F. Student examples.
   1. A test has 90% sensitivity and 80% specificity. If 50 people actually have the disease and 600 people are not affected, find TP, FP, TN, and FN.

2. 1% of women at age forty who participate in routine screening have breast cancer. 80% of women with breast cancer will get positive mammograms. 9.6% of women without breast cancer will also get positive mammograms. A woman in this age group had a positive mammography in a routine screening. What is the probability that she actually has breast cancer?