

## LECTURE 12: BAYES' THEOREM I

- I. Testing
- a. Suppose you're interested which of your employees are on drugs. This is very rare, of course, but if they work with heavy machinery or sensitive information it's particularly important that they're clean.
  - b. Suppose national surveys reveal that **one out of every 100 people** who work in your industry use drugs.
  - c. The problem is that no drug test is 100% accurate. Still, most can get close. Suppose you use a test which is 90% accurate, or **its sensitivity and specificity are 90%**:
    - i. *Sensitivity*—describes the ability to detect a positive state. For every 10 drug users, 9 will get a (correct) positive test result. Subtracting sensitivity from one tells you the chance of getting a false negative.
    - ii. *Specificity*— describes the ability to detect a negative state. For every 10 non-users, 9 will get a (correct) negative test result. Subtracting specificity from one tells you the chance of getting a false positive.
    - iii. For simplicity, I'm assuming the sensitivity and specificity are the same but it doesn't have to be that way.
    - iv. In practice, there is often a trade-off between the two. A test that is made to be very sensitive often means its specificity decreases. For example, a sensitive metal detector will not only pick up more threats (true positives) but also detect more false positives such as cell phones and belt buckles.
  - d. Let's begin by making a *truth table*, or a table of probabilities with all possible outcomes. Here there are two variables—the drug use of the subject and the result of the test—each with two outcomes—“drug user” or “not drug user” and “positive” or “negative.”

<i>Subject</i>	<i>Test Result</i>	<i>P()</i>
User	Positive	
User	Negative	
Not User	Positive	
Not User	Negative	

- i. For each combination, what is the probability that combination will occur? (Remember how we calculate probabilities!)
- e. We can now determine how likely it is for someone—regardless of actual drug use—to test positive. How do we do that?
- f. Finally, what is the likelihood that a positive test indicates you are a user?