LECTURE 34: BAYES' THEOREM III

- I. Bayes' Theorem, Applied
 - a. We want to know "what is the probability that someone who tested positive for drugs is actually a user?" Or, given that the test is positive, how likely is it that they actually use drugs? Or, what is P(U|+)?

$$P(U|+) = \frac{P(+|U)P(U)}{P(+)} = \frac{P(+|U)P(U)}{P(+|U)P(U) + P(+|\sim U)P(\sim U)}$$
$$= \frac{0.8 * 0.01}{0.8 * 0.01 + 0.1 * 0.99} = \frac{0.008}{0.008 + 0.099} = \frac{0.008}{0.107} \approx 0.0748$$

- i. Note the result is as before: 7.48%. Only 7.48% of positive results are actually drug users!
- b. Bayes' Theorem thus tells us two interrelated things:
 - i. When you receive new information, it tells you how much to adjust your estimation of the truth.
 - ii. It reminds you that because no test is 100% accurate, its results should not be weighed too heavily, especially if it is testing for something rare (since the false positives will overwhelm the true positives).
- II. Bayes in Excel
 - a. We can turn Excel into a calculator for this Theorem, allowing us to change parameters and see how the results transform.
 - b. Begin by turning a column into labels: Population Chance; Sensitivity, and Specificity. The adjacent cells will be the values. i. How should we represent those values?
 - c. Below label three cells: P(Y|+), numerator, denominator.
 - d. In class, we'll build this in detail but I want us to work on it together! \odot