1. Bayes' Rule and Testing

2. You should be familiar with finding the probability of events in a variety of ways. In this lesson, we will find the probability that a test subject is infected with a certain disease, given that they tested positive.

3. Here is the standard problem. In a community of 10,000 people, 2% of the population is infected with dragon pox. There is a test to determine whether or not an individual has dragon pox that is quite accurate. If you have dragon pox, the test will correctly determine that 99% of the time. It will read a 'false negative' only 1% of the time. Similarly, if you do not have the disease, the test will correctly determine that 97% of the time and will give a 'false positive' reading to 3% of disease-free individuals. If you test positive for dragon pox, how likely are you to actually have the disease?

   Intuitively, it would seem quite likely that you are infected, after all, the test is highly reliable. However, the fact that prior to testing, you were not likely to be infected plays an important role.

4. (a) The key is to calculate the number of people in each category, rather that relying on the percents.

   (b) The 10000 people are divided into two categories, those infected and those not infected.

   (c) We are given information across the rows, we know how accurate the test is for infected individuals, and how accurate the test is for infected individuals.

   (d) We wish to find information about the columns, what fractions of those testing positive are actually infected.

   (e) Let's start calculating the numbers of individuals in each category. Of the 10000 people, 2% or 200 are infected. 98% or 9800 are not infected.

   (f) When the 200 infected individuals are tested, 99% of them, or 198 test positive. For 2 individuals, the test incorrect shows that they are healthy. Of the 9800 healthy individuals, 3% of them, which is 294 individuals have the test incorrectly showing that they are diseased. 9506 correct test as healthy.

   (g) Altogether, there are 492 individuals that tested positive.

   (h) We now want to know what percent of the population that tested positive actually has the disease. Of the 492 that tested positive, 198 have dragon pox, which is 40.2% of those that tested positive. Even though you tested positive, it is still more likely that you are healthy.

5. Note that we didn't need to know the population, we could do these same calculations using just the percents.