Bayes’ Theorem Example #1

You might be interested in finding out a patient’s probability of having liver disease if they are an alcoholic. “Being an alcoholic” is the **test** (kind of like a litmus test) for liver disease.

* **A** could mean the event “Patient has liver disease.” Past data tells you that 10% of patients entering your clinic have liver disease. P(A) = 0.10.
* **B** could mean the litmus test that “Patient is an alcoholic.” Five percent of the clinic’s patients are alcoholics. P(B) = 0.05.
* You might also know that among those patients diagnosed with liver disease, 7% are alcoholics. This is your **B|A:** the probability that a patient is alcoholic, given that they have liver disease, is 7%.

Bayes’ theorem tells you:



**P(A|B) = (0.07 \* 0.1)/0.05 = 0.14**  
In other words, if the patient is an alcoholic, their chances of having liver disease is 0.14 (14%). This is a large increase from the 10% suggested by past data. But it’s still unlikely that any particular patient has liver disease.

Bayes’ Theorem Example #2

1% of people have a certain [genetic defect](https://www.genome.gov/10001204).  
90% of tests for the gene detect the defect (true positives).  
9.6% of the tests are [false positives](https://www.statisticshowto.datasciencecentral.com/false-positive-definition-and-examples/).  
If a person gets a positive test result, **what are the odds they actually have the genetic defect?**

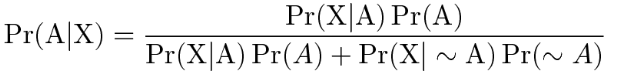
The first step into solving Bayes’ theorem problems is to assign letters to events:

* A = chance of having the faulty gene. That was given in the question as 1%. That also means the probability of *not* having the gene (~A) is 99%.
* X = A positive test result.

So:

1. P(A|X) = Probability of having the gene given a positive test result.
2. P(X|A) = Chance of a positive test result given that the person actually has the gene. That was given in the question as 90%.
3. p(X|~A) = Chance of a positive test if the person *doesn’t* have the gene. That was given in the question as 9.6%

Now we have all of the information we need to put into the equation:



P(A|X) = (.9 \* .01) / (.9 \* .01 + .096 \* .99) = 0.0865 (8.65%).

The probability of having the faulty gene on the test is 8.65%.

