

Exercise Set 10.2: Bayes Theorem

1. A recent New York Times article discussed the recommendation of a special panel concerning mammograms for women in their 40s. About 2% of women aged 40 to 49 years old develop breast cancer in their 40s. But the mammogram used for women in that age group has a high rate of false positives and false negatives. The false positive rate is 0.30 and the false negative rate is 0.25. If a woman in her 40s has a positive mammogram, what is the probability that she actually has breast cancer?
2. Suppose that in 2005 it was estimated that 10% of Olympic athletes use steroids. The test being used then to detect steroids was 93% effective in correctly detecting steroids in users. It yielded false positives in only 2% of the tests. If a country's best weightlifter tested positive, what is the probability that she actually took steroids?
3. Suppose that you are diagnosed with microscopic hematuria (blood in the urine that is only visible under a microscope). This symptom occurs in 10 percent of all people and 100 percent of people with kidney cancer. You would like to know the probability that you have kidney cancer, which occurs in 0.0002 percent of all people.
4. An auditing procedure for income tax returns has the following characteristics: If the return is incorrect, the probability is 90% that it will be rejected; if the return is correct, the probability is 95% that it will be accepted. Suppose that 80% of all income tax returns are correct. If a return is audited and rejected, what is the probability that the return was actually correct?
5. Some branches of the US federal government use lied detector tests to screen applicants. Suppose that a particular testing procedure identifies 80% of lies as lies, but also identifies 12% of true statements as lies. This procedure is used to ask applicants, "Did you tell the truth in all parts of your job application?" If we believe that 95% of all applicants do tell the truth, what is the probability that a person failing the test was actually telling the truth?