

Probability Theory and Applications
Homework 2 - Independence, Conditional Probability and Bayes Rule

The starred problems (*) are assigned. The rest are practice. Assignment is due in class on Friday September 18. No late assignments.

1. In a study on how people perceive probability, Kahneman and Tversky asked subjects “which of the following two sequences is more likely: H T H T T H or H H H T T T ? ” Most people will say the first sequence. Why do you think they say this?
2. *In a certain city, 30 percent of the people are Conservatives, 50 percent are Liberals, and 20 percent are Independents. Records show that in a particular election, 65 percent of the Conservatives voted. 82 percent of the Liberals voted, and 50 percent of the Independents voted. If a person in the city is selected at random and it is learned that he did not vote in the last election, what is the probability that he is a Liberal?
3. *Bain and Engelhardt number 72 page 52.
4. Bain and Engelhardt number 35 page 47.
5. *Drawer A contains five pennies and three dimes, while drawer B contains three pennies and seven dimes. A drawer is selected at random, and a coin is selected at random from the drawer. a) Find the probability of selecting a dime. b) Suppose a dime is obtained. What is the probability that it came from drawer B?
6. *An article in the New York Times reported that college students are beginning to routinely ask to be tested for the AIDS virus.

The standard test for the HIV virus is the Elias test that tests for the presence of HIV antibodies. It is estimated that this test has a 99.8% sensitivity and a 99.8% specificity. 99.8% specificity means that, in a large scale screening test, for every 1000 people tested who do not have the virus we can expect 998 people to have a negative test and 2 to have a false positive test. 99.8% sensitivity means that for every 1000 people tested who have the virus we can expect 998 to test positive and 2 to have a false negative test.

The Times article remarks that it is estimated that about 2 in every 1000 college students have the HIV virus. Assume that a large group of randomly chosen college students, say 100,000, are tested by the Elias test. If a student tests positive, what is the chance this student has the HIV virus? What would this probability be for a population at high risk where 5% of the population has the HIV virus?

If a person tests positive on an Elias test, then two more Elias tests are carried out. If either is positive then one more confirmatory test, called the Western blot test, is carried out. If this is positive the person is assumed to have the HIV virus. In calculating the probability that a person who tests positive on the set of four tests has the disease, is it reasonable to assume that these four tests are independent experiments?