Introduction to Biostatistics (171:161)
Breheny

Lab #6

In today's lab, we will focus more on practicing probability problems rather than programming. There will be a series of practice problems where you will work on them individually or with your neighbors for about five minutes a problem. Then we will go over the solution as a group so you can get the idea of how to solve problems such as these.

1. The table below contains information on emplyment status and impairments.

Employment Status	Population	Impairments
Currently employed	98,917	552
Currently unemployed	7,462	27
Not in labor force	56,778	368
Total	163,157	947

   (a) Find the probability for being in each status of employment, based on the sample.

   (b) Find the probability that an individual has a hearing impairment due to injury.

   (c) Find the probability that an individual has an impairment from injury, given they are not in the labor force.

   (d) Find the probability that an individual is currently employed, given they have an impairment.

2. The National Institute for Occupational Safety and Health has developed a case definition of carpal tunnel syndrome- an affliction of the wrist-that incorporates three criteria: symptoms of nerve involvement, a history of occupational risk factors, and the presence of physical exam findings. The sensitivity of this definition as a test for carpal tunnel syndrome is 0.67; its specificity is 0.58.

   (a) In a population in which the prevalence of carpal tunnel syndrome is estimated to be 15%, what is the predictive value of a positive test result?

   (b) How does this predictive value change if the prevalence is only 10%? If it is 5

   (c) What is the probability of having a positive test when the prevalance is 15%?

3. The ELISA (Enzyme-Linked Immunosorbent Assay) test is used to screen donated blood for HIV, the virus which causes AIDS. ELISA checks for the presence of an antibody produced when an individual is exposed to HIV. To evaluate the sensitivity and the specificity of the ELISA test, suppose that the test is administered to a group of 500 individuals known to be HIV positive and to a group of 500 individuals known to be HIV negative. Assume the following results are obtained:

HIV Status	Test Result		Total
	Positive	Negative	
Positive	487	13	500
Negative	17	483	500

(a) Obtain estimates of the sensitivity and specificity of the ELISA test.

(b) Assume that the prevalence of HIV in a population of interest is estimated as 0.004. Find an estimate for the predictive value positive (PVP) of the ELISA test for this population.

(c) Suppose the ELISA test is used to screen a large collection of donated blood samples for the presence of HIV. What are the implications of the results in part (b) regarding the efficacy of the test?

4. A medical research team wishes to assess the usefulness of a certain symptom (call it S) in the diagnosis of a particular disease. In a random sample of 775 patients with the disease, 744 reported having the symptom. In an independent random sample of 1380 subjects without the disease, 21 reported that they had the symptom

   (a) In the context of this problem, what is a false positive?

   (b) What is a false negative?

   (c) Compute the sensitivity of the symptom.

   (d) Compute the specificity of the symptom

   (e) Suppose it is known that the rate of the disease in the general population is 0.001. What is the predictive value positive of the symptom?

   (f) What is the predictive value negative of the symptom?

   (g) Find the predictive value positive and the predictive value negative for the symptom for the following hypothetical disease rates: 0.0001, 0.01, and 0.10.

   (h) What do you conclude about the predictive value of the symptom on the basis of the results obtained in part (g)?

5. Consider the following natality statistics for the U.S. population in 1992. According to these data, the probabilities that a randomly selected woman who gave birth in 1992 was in each of the following age groups are as follows

Age	Probability
< 15	0.003
15-19	0.124
20-24	0.263
25-29	0.290
30-34	0.220
35-39	0.085
40-44	0.014
45-49	0.001
Total	1.00

(a) What is the probability that a woman who gave birth in 1992 was 24 years of age or younger?

(b) What is the probability that she was 40 or older?

(c) Given that the mother of a particular child was under 30 years of age, what is the probability that she was not yet 20?

(d) Given that the mother was 35 years of age or older, what is the probability that she was under 40?

This concludes lab #6.