Math 338 **Lab Assignment #7** Fall 2019

The ELISA test was an early test used to screen blood donations for antibodies to HIV. A study (Weiss et. al. 1985) found that the conditional probability that a person would test positive given that they had HIV was 0.97, and the conditional probability that a person would test negative given that they did NOT have HIV was 0.926. The World Almanac gives an estimate of the probability of a person in the USA of having HIV to be 0.0026.

**Question #1** Given the numbers in the paragraph above, identify the base rate (prevalence), sensitivity, and specificity of the test.

Prevalence: 0.0026
Sensitivity: 0.97
Specificity: 0.926

**Question #2** Suppose 10000 random people are tested. How many of them do you expect to actually have HIV? How many do you expect not to have HIV?

26 people would be expected to have HIV and 9974 not to have HIV

**Question #3** Of those with HIV, how many do you expect to test positive?

Of the 26, 25 would be expected to have HIV

**Question #4** Of those without HIV, how many do you expect to test negative?

9235.924 out of the 9974 would be expected to test negative

**Question #5** Draw a two-way table to represent this situation. Fill in your answers to **Questions #2-4** in the appropriate cells, then fill in the rest of the table. **<u>Do not solve for a probability yet.</u>**

Yessir.

**Question #6** Draw a tree diagram to represent this situation. Fill in the probabilities on each branch of the tree. **<u>Do not solve for a probability yet.</u>**

Yessir.

Recall that Bayes' Theorem says:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B|A)P(A) + P(B|A^C)P(A^C)}$$

**Question #7** In the situation of testing for HIV, what should Event A be? What should Event B be? How do you know?

Event "A" is having HIV and event "B" is testing for having HIV.

**Question #8** Rewrite Bayes's Theorem for this situation, plugging in the correct numbers for each probability. **<u>Do not solve for a probability yet.</u>**

The amount of people in the testing who have tested positive over the total amount of people you are testing.

**Question #9** Suppose a random person is tested and they test positive. Using the method (two-way table, tree diagram, Bayes's Theorem) that makes the most sense to you, find the conditional probability that this person has HIV given that they test positive.

**Question #10** Based on your results, would you recommend that this be the first and only test used to detect HIV? Why or why not?

This should not be the only test you take to confirm the results given by the aforementioned test. There is significant margin of error in testing false positive.