

Announcements

Wed. 12/4 - Lecture Probability + Health and Risk

Fri. 12/6 -

- Snapshot 12 + Lab 12
- Extra Credit Survey DUE (mth101.com)
- Final Webwork #13 DUE
- **Sec 22 in B104 Wells Hall this Friday**

Mon. 12/9 - FINAL EXAM 10a-12p - find location info at schedule.msu.edu.

Please check your gradebook scores. If there are any grades that you feel are entered incorrectly, please bring this to my attention by **Thursday 12/5**.

Health and Risk

— Lecture 12 —

Probability

The probability of an event is always between 0 and 1 (inclusive).

A probability of 0 means the event is impossible.

A probability of 1 means the event is certain.

Ex: The probability that it will snow today is 0.25 (25% chance of snow). The probability that it will NOT snow is $1 - 0.25$ or 100-25%.

Imagine we are testing for Lyme disease...

What do we mean when we talk about the **prevalence** of Lyme disease?

Medical Test Terminology

- a POSITIVE test result is not “good”. It means the disease is likely present.
- a NEGATIVE test result is not “bad”. It means the individual tested most likely does not have the disease.

Results fall into the following categories

TRUE POSITIVE	FALSE POSITIVE
FALSE NEGATIVE	TRUE NEGATIVE

PollEverywhere Q1

A false negative in cancer screening means that

- A. A person tested negative but actually has cancer
- B. A person tested negative and does not have cancer
- C. A person tested positive but does not actually have cancer

PollEverywhere Q2

A false positive in a drug test for steroids means that

- A. A person tested negative but actually took steroids
- B. A person tested positive and actually took steroids
- C. A person tested positive but did not actually take steroids

What determines if a medical test is accurate?

Sensitivity -

Specificity -

Estimate the Sensitivity and Specificity: Test for TB

Result	Has TB	Does not have TB
Test Positive	571	8
Test Negative	259	162

Sensitivity:

Specificity:

Estimate the Sensitivity and Specificity: Test for TB

Sensitivity:

$$571/(571+259)=0.688$$

If you have TB, there is a _____% chance you will correctly test positive (true positive).

If you have TB, there is a _____% chance you will incorrectly test negative (false negative).

Specificity:

$$162/(162+8)=0.953$$

If you do not have TB, there is a _____% chance you will correctly test negative (true negative).

If you do not have TB, there is a _____% chance you will incorrectly test positive (false positive).

What determines if a medical test is accurate?

Positive Predictive Value (PPV) -

Negative Predictive Value (NPV) -

Specificity and **Sensitivity** are properties of the _____ and do NOT depend on _____.

PPV and **NPV** do depend on _____.

What determines if a medical test is accurate?

Sensitivity - for people who _____, this is the probability that they receive the correct result (i.e. _____ result).

Specificity - for people who _____, this is the probability that they receive the correct result (i.e. _____ result).

Positive Predictive Value (PPV) - for people who receive a _____ result, this is the probability that they really _____ the condition.

Negative Predictive Value (NPV) - for people who receive a _____ result, this is the probability that they really _____ the condition.

Does a positive mammogram mean cancer?

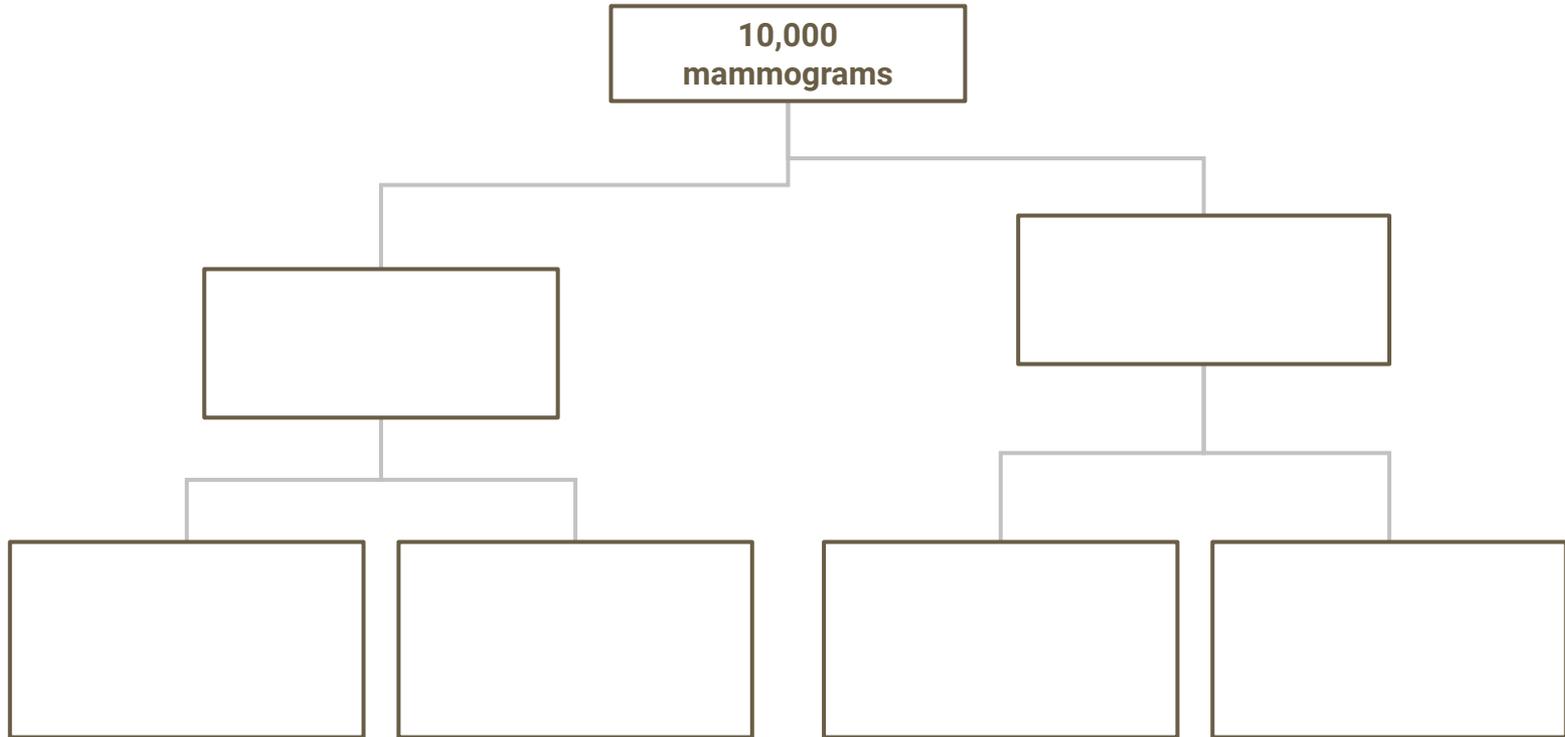
Mammogram screenings are presumed to be about 85% accurate for both positive and negative results, i.e.

- They will correctly give a positive result in 85% of cases in which breast cancer is present (sensitivity)
- They will correctly give a negative result in 85% of cases in which there is no cancer (specificity)

If one gets a positive result, does this mean there is 85% chance she has breast cancer?

Example 1

Assume 1% of women who undergo screening actually have breast cancer.
Assume 10,000 mammograms were performed.



Example 1 Question

If you tested positive, you have a _____%
chance of having breast cancer (PPV)

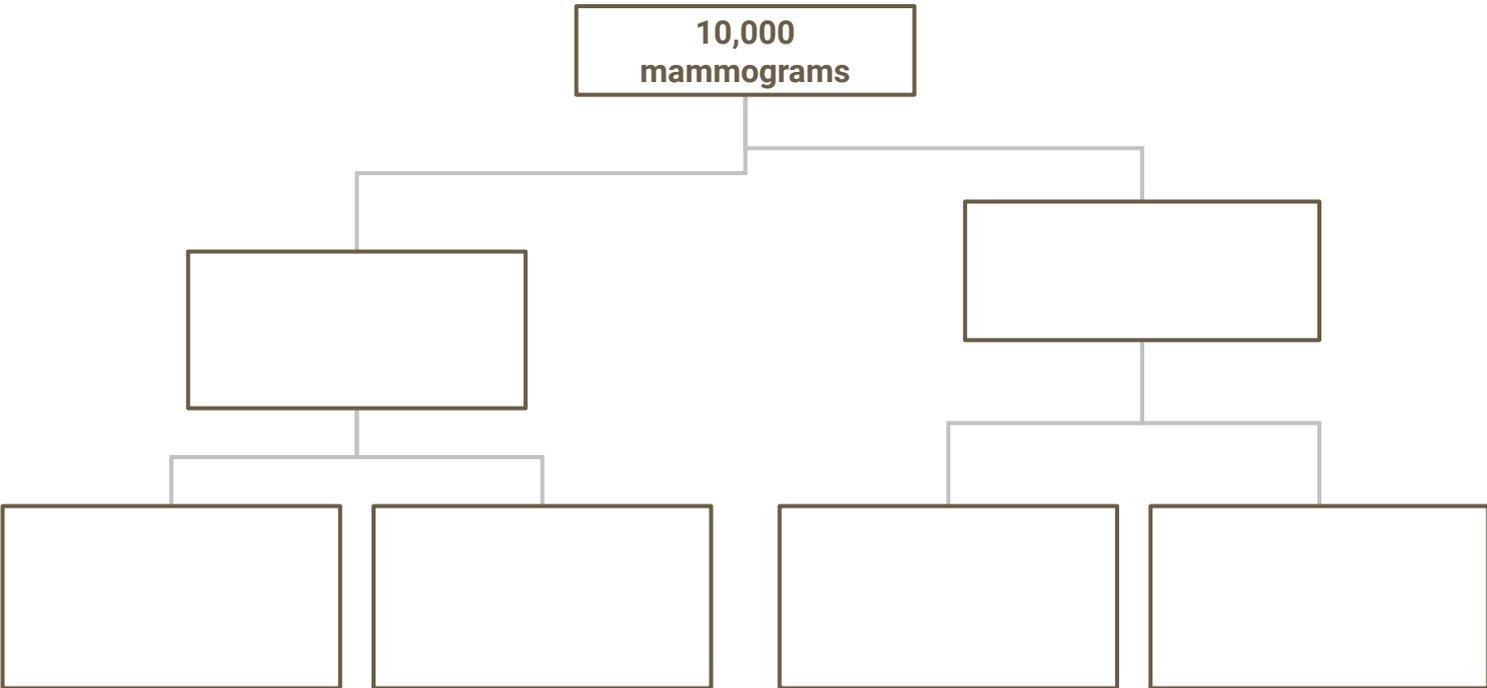
Example 1 Question

If you tested negative, you have a _____%
chance of not having breast cancer (NPV)

Example 2

Assume **5%** of women who undergo screening actually have breast cancer.

Assume 10,000 mammograms were performed.



Example 2 Questions

PPV = true positive / (true positive + false positive)

If prevalence goes _____, PPV goes _____.

If you test positive, there is a _____% chance you do have cancer. (If you have cancer, there is an _____% chance you will test positive).

NPV = true negative / (true negative + false negative)

If prevalence goes _____, NPV goes _____.

If you test negative, there is a _____% chance that you do not have cancer. (If you do not have cancer, there is an _____% chance you will test negative).

Poll Everywhere Q3-Use example 2

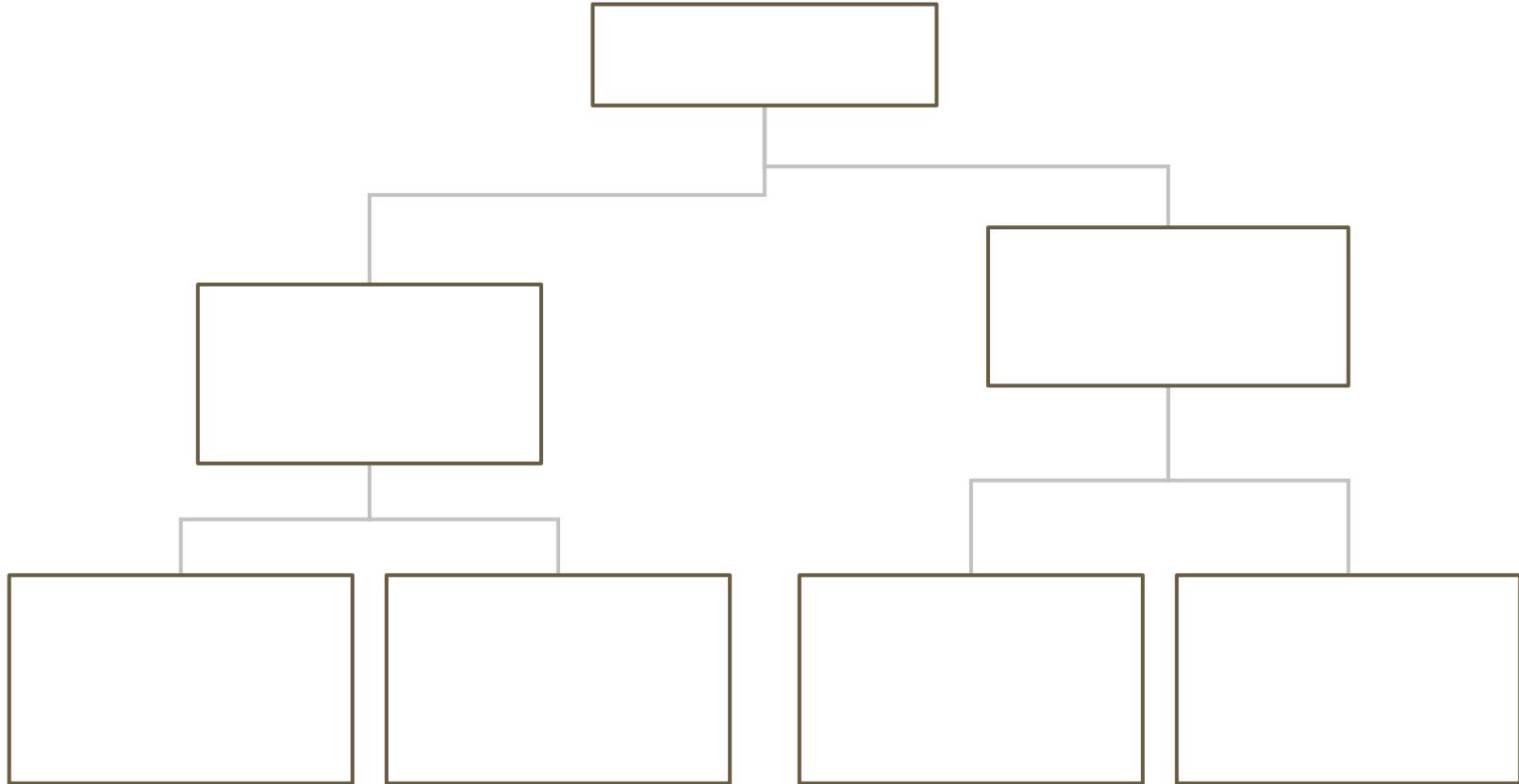
Out of every 400 people who test positive, we'd expect _____ to have the disease, and the other _____ to actually not have the disease (even though they tested positive). Please answer with numbers, not percentages.

- A. 340 ... 60
- B. 85 ... 85
- C. 92 ... 308
- D. 308 ... 92

Example 3

Suppose there is a rare disease that has no clear symptoms until the disease has progressed too far to effectively treat. **This disease affects about 0.2% of the overall population.** There are several forms of tests available to test for this condition, but the cheapest and least painful test is the most popular. It has a **sensitivity of 95%** and a **specificity of 98%**, so this is marketed as a “highly accurate” test.

Complete the following tree diagram.



Answer the following questions based on your tree diagram:

Suppose Amy tested positive using this test. What is the probability that Amy actually has this disease?

Suppose Bob tested negative using this test. What is the probability that Bob does not have this disease?

Out of every 1000 people who test negative, we'd expect _____ to not have the disease, and the other _____ to actually have the disease (even though they tested negative). Please answer with numbers, not percentages.

Do you think it's misleading to call this medical test "highly accurate?"