Announcements

Tues 12/3 - Lecture Probability + Health and Risk
Thurs 12/5 - Snapshot 13 + Lab 13
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, bring this to the attention of your recitation TA on Thursday.

Health and Risk

Lecture 13

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?

Prevalence - the percentage of people from a specific (risk) group that we expect to actually have the condition.

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 Test result is positive and the patient has the disease	**FALSE POSITIVE** Test result is positive, but the patient does not have the disease
FALSE NEGATIVE Test result is negative but the patient does have the disease	**TRUE NEGATIVE** Test result is negative and the patient does not have the disease

L13 – 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

L13-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 - for people who do have the condition, this is the probability that they receive the correct result (i.e. positive result)

Sensitivity = # of true positive / (# of true positive + # of false negative)

Specificity - for people who do not have the condition, this is the probability that they receive the correct result (i.e. negative result).

Specificity = # of true negative / (# of false positive + # of true negative)

Estimate the Sensitivity and Specificity: Test for TB

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

Sensitivity

$$\frac{571}{571+259} = 0.688 = 68.8\%$$

Specificity

$$\frac{162}{162+8} = 0.953 = 95.3\%$$

Estimate the Sensitivity and Specificity: Test for TB

Sensitivity:
571/(571+259)=0.688

If you have TB, there is a 68.8% chance you will correctly test positive (true positive).

If you have TB, there is a 100-68.8% = 31.2% chance you will incorrectly test negative (false negative).

Specificity:
162/(162+8)=0.953

If you do not have TB, there is a 95.3% chance you will correctly test negative (true negative).

If you do not have TB, there is a 100-95.3%= 4.7% chance you will incorrectly test positive (false positive).

What determines if a medical test is accurate?

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

Negative Predictive Value (NPV) - for people who receive a negative result, this is the probability that they really do not have the condition.

Specificity and Sensitivity are properties of the test and do NOT depend on Prevalence.

PPV and NPV do depend on prevalence.

What determines if a medical test is accurate?

Only depend on the test, not the prevalence

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

Specificity - for people who do not have the condition, this is the probability that they receive the correct result (i.e. negative result).

Depend on the prevalence and the test

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

Negative Predictive Value (NPV) - for people who receive a negative result, this is the probability that they really do not have 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.

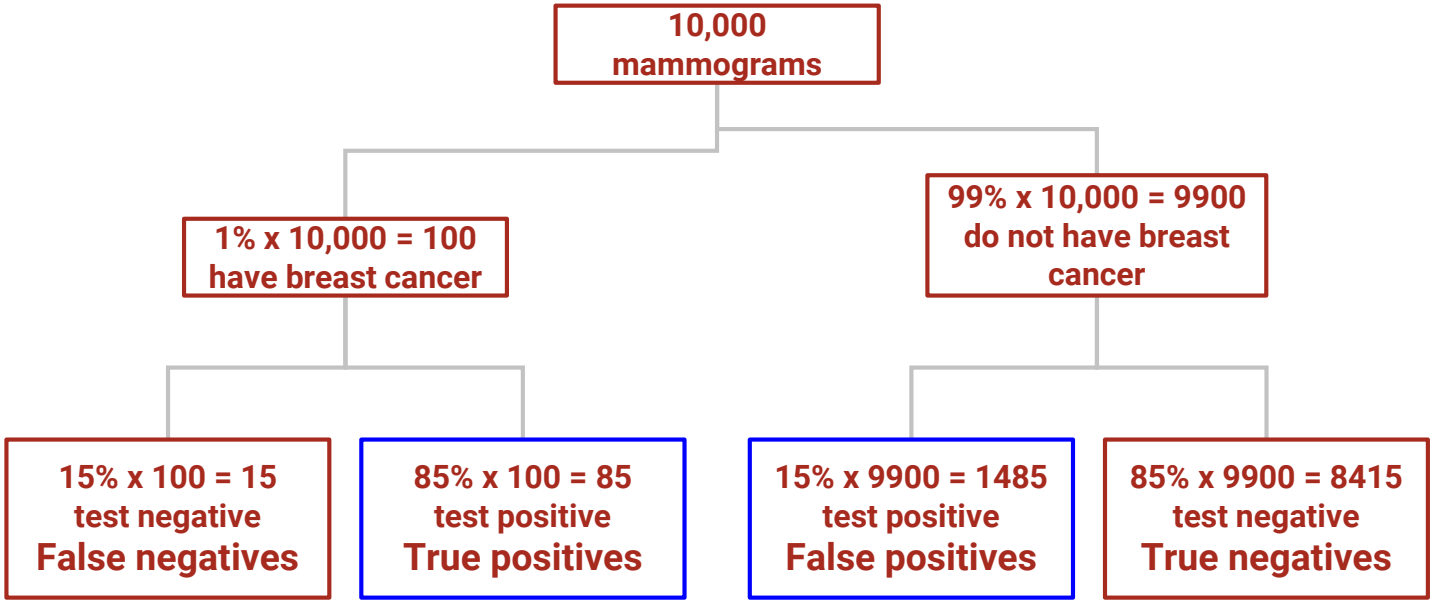
- They will correctly give a positive result in 85% of cases in which breast cancer is present (sensitivity)
- They will correctly give a negative result in 85% of cases in which there is no cancer (specificity)

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

No, this is not PPV

Assume 1% of women who undergo screening actually have breast cancer.

Assume 10,000 mammograms were performed.



Assume 1% of women who undergo screening actually have breast cancer.

85% x 100 = 85 test positive **True positives**	15% x 9900 = 1485 test positive **False positives**

A total of 85+1485 = 1570 people tested positive.

85/1570 = 0.054 = 5.4%

If you tested positive, you have a 5.4% chance of having breast cancer (PPV)

Assume 1% of women who undergo screening actually have breast cancer.

15% x 100 = 15
test negative
False negatives

85% x 9900 = 8415
test negative
True negatives

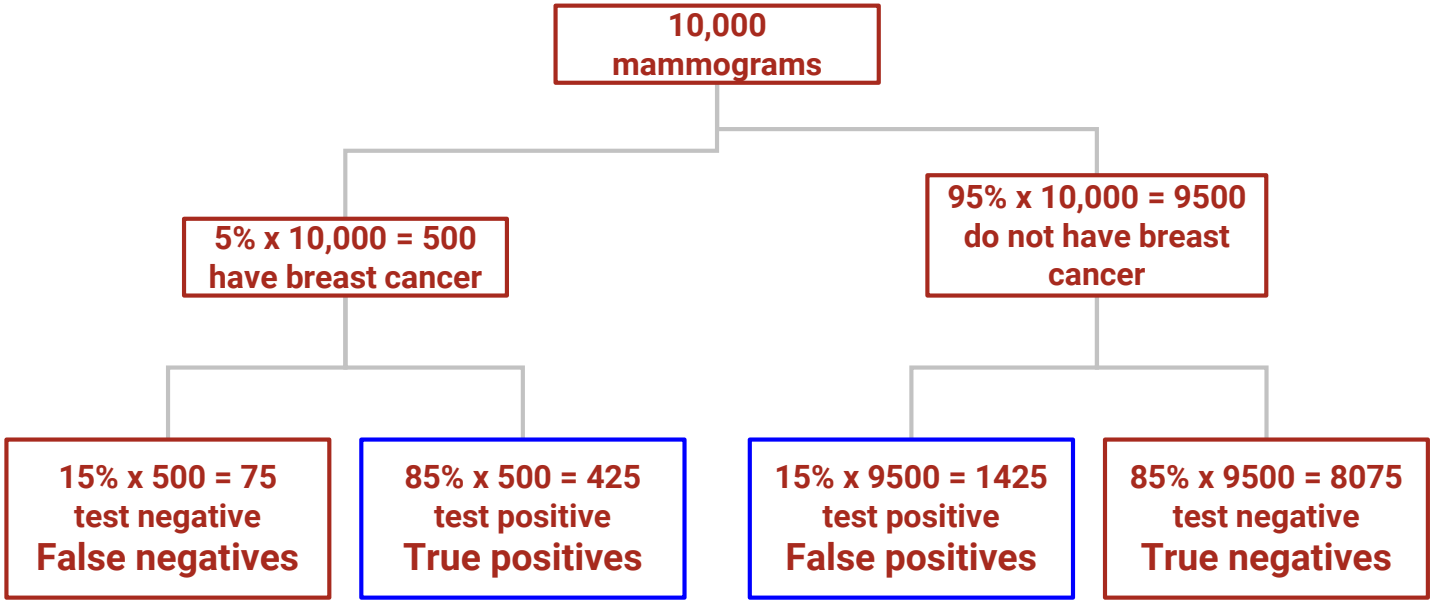
A total of 15+8415 = 8430 people tested negative.

8415/8430 = 0.998 = 99.8%

If you tested negative, you have a 99.8% chance of not having breast cancer (NPV)

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

Assume 10,000 mammograms were performed.



PPV and NPV

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

= 425 / (425 + 1425) = 0.2297 ~ 23% prevalence goes up, PPV goes up

If you test positive, there is a 23% chance you do have cancer. (If you have cancer, there is an 85% chance you will test positive).

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

= 8075 / (75 + 8075) = 0.9907 ~ 99% prevalence goes up, NPV goes down

If you test negative, there is a 99% chance that you do not have cancer. (If you do not have cancer, there is an 85% chance you will test negative).

Example 2 on worksheet