

What is the definition of pre-test and post-test probability?

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Pre-test and post-test probability refer to the likelihood or chance of a certain outcome or event occurring before and after a diagnostic or screening test has been performed. Pre-test probability is the estimated probability of a condition or disease being present before any testing is done, based on factors such as symptoms, risk factors, and medical history. Post-test probability, on the other hand, is the revised probability of the condition or disease being present after the test results have been taken into consideration. It takes into account the sensitivity and specificity of the test, as well as the pre-test probability, in order to determine the likelihood of the outcome being true. Pre-test and post-test probabilities are important in making informed decisions about treatment and follow-up care based on the results of diagnostic tests.

What is Pre-Test and Post-Test Probability?

In the medical field, a is used to determine whether or not an individual has a particular disease.

Whenever a diagnostic test is performed, there are always two probabilities of interest:

1. Pre-Test Probability: The probability that an individual has the disease before the diagnostic test is even performed.

This is calculated as the proportion of individuals who are known to have the disease in the population of interest. This can be calculated using data that has been collected in prior studies or it can be roughly estimated by professionals in the field.

2. Post-Test Probability: The probability that an

individual has the disease after testing positive in the diagnostic test.

This is calculated using pre-test probability and the known sensitivity and specificity of the diagnostic test being used. Sensitivity is the "true positive rate" - the percentage of positive cases the model is able to detect. Specificity is the "true negative rate" - the percentage of negative cases the model is able to detect. Both sensitivity and specificity can be calculated using data from prior studies.

The following example shows how to calculate pre-test and post-test probability in practice.

Example: Calculating Pre-Test and Post-Test Probabilities

Suppose it is known that about 7 in 100 individuals in a certain population have disease X.

If we selected an individual from this population at random and performed a diagnostic test to determine if they have disease X, the pre-test probability that they have the disease would be 0.7 or 7%.

Now suppose it's also known that the sensitivity of the

diagnostic test is 0.74 and the specificity is 0.92.

We can use the following formulas to calculate the post-test probability:

Likelihood ratio positive = sensitivity / (1–specificity) =
.92 / (1–.92) = 11.5
Likelihood ratio negative = (1–sensitivity) / specificity = (1–.74) / .92 = .2826
Pre-test odds = pre-test prob. / (1–pre-test prob.) = .07 / (1–.07) =
.0752
Positive post-test odds = .0752 * 11.5 =
0.8648
Positive post-test probability = .8648 / (.8648+1) =
.4637

Here is how to interpret these results:

The pre-test probability is 7%.

This means the probability that a randomly selected individual has disease X is 7%, even before any diagnostic test is performed.

The post-test probability is 46.37%.

For an individual who tests positive on this diagnostic test, the probability that they actually have disease X is 46.37%.

You might be thinking to yourself that a positive test result on the diagnostic test should indicate that an individual definitely has the disease, but keep two things in mind:

1. The probability that a randomly selected individual from the population has the disease (7%) is very low to start.
2. The diagnostic test is known to not be perfect at detecting true positive cases and true negative cases.

Keeping both these facts in mind, it's a little easier to understand how a positive result on the diagnostic test doesn't necessarily mean that the individual actually has disease X.

Additional Resources

The following tutorials provide additional information about topics related to probability: