



Chapter 10 / Capítulo 10

Evidence-based biomedicine: methodology for research, standardization, and scientific procedural aspects (English Edition)

ISBN: 978-9915-704-43-2

DOI: 10.62486/978-9915-704-43-2.Ch10

Pages: 57-59

©2025 The authors. This is an open access article distributed under the terms of the Creative Commons Attribution (CC BY) 4.0 License.

Probability / Probabilidad

Diagnostic tests often involve some uncertainty, which can be quantified by calculating probabilities. A basic way to define probability is as the frequency with which an event occurs if an experiment is repeated many times.

In a random experiment, different outcomes can be obtained. The set of all these possible outcomes is called the sample space (E). Interest in the occurrence of a specific outcome refers to an event. The complementary event of A ($\bar{A}$) is the one that represents the opposite outcome ($P(\bar{A}) = 1 - P(A)$). The union of events A and B includes all outcomes that belong to A , B , or both. In the case of two events A and B , the fundamental operations of union and intersection are illustrated in a corresponding figure.

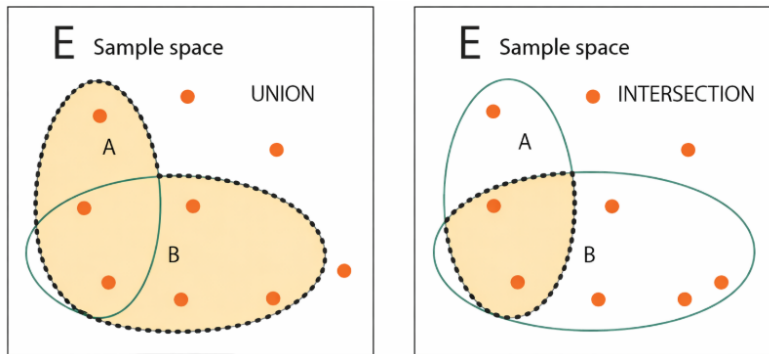


Figure 10.1. Intersection and union of events

Probability is defined as a function P that assigns each event A a numerical value $P(A)$. The rules governing this probability function are:

- The probability assigned to an event that is certain to occur is 1.
- Probability values range from 0 to 1.
- The probability assigned to an impossible event is 0.

10.1 Medical tests

The most commonly used frequency measures are Prevalence and Incidence. Prevalence refers to the probability that a person has a disease, while Incidence indicates the number of new cases that occur in a given period.

Medical tests are designed to determine whether or not a disease is present, but they are not perfect. The quality of a test can be assessed using two measures:

Sensitivity (S): The probability that a person with the disease will test positive. It represents the test's ability to identify positive cases correctly.

Specificity (E): The probability that a person without the disease will test negative. It indicates the test's ability to classify negative cases correctly.

In addition, the probability of having the disease can be estimated after the diagnostic test results are known. The main measures for this are:

Positive predictive value (PPV): The probability that a person who tests positive has the disease. It is the probability of correctly identifying positive cases.

Negative predictive value (NPV): The NPV is the probability that a person who tests negative does not have the disease. It indicates the probability of correctly classifying negative cases.

Positive likelihood ratio (PLR): The PLR indicates the likelihood that a positive result indicates disease among sick people compared to healthy people.

It is the ratio of the proportion of sick people identified by the test to the proportion of healthy people identified as sick by the test.

Negative likelihood ratio (NLR): The NLR indicates how likely it is that a negative result will occur among sick people compared to those who are not sick. It represents the ratio between the probability of obtaining a negative result when you have the disease and the probability of obtaining a negative result when you do not have the disease. An NPP of 8,5, for example, means that the probability of obtaining a negative result in a healthy person is 8,5 times that in a sick person.

Relative Risk (RR) is calculated as the ratio between the risk in the treatment group and the risk in the control group. To avoid values below 1, it is defined as the ratio of the risk in the group with the highest risk to that in the group with the lowest risk.

Absolute Risk Reduction (ARR) refers to the difference between the risk in the control group and the risk in the treatment group.

Relative Risk Reduction (RRR) is obtained by dividing the Absolute Risk Reduction by the risk in the control group.

The Number Needed to Treat (NNT) indicates the number of individuals who must receive the experimental treatment to prevent or cause an additional event, compared with those receiving the control treatment. It is calculated as the inverse of the Absolute Relative Risk (ARR).

The Odds Ratio is another measure of a classifier's accuracy and is based on the odds of an event occurring and the odds of it not occurring (its complement). It indicates how much more likely an event is to occur than not, and can range from 0 to infinity.

There are two types of odds of interest for evaluating the performance of a classifier, which can be calculated from sensitivity and specificity (see the table). If the value is 0, there is no association between the variables. If it is greater than 1, it indicates a positive association, i.e., the presence of the factor is related to a higher probability of the event occurring. When the value is 1, there is no association between the presence of the factor and the event. For example, if a drug compared to a placebo has an odds ratio of 1,3, it means that the drug is 1,3 times more effective than the placebo.