

Conditions

What is the difference between the null and alternative hypotheses statements in one-tailed and two-tailed tests? What are significance/alpha levels and how does using a one versus a two-tailed test affect significance levels?

Solution

In statistical inference of observed data of a scientific experiment, the null hypothesis refers to a general or default position: that there is no relationship between two measured phenomena, or that a potential medical treatment has no effect. Rejecting or disproving the null hypothesis – and thus concluding that there are grounds for believing that there is a relationship between two phenomena or that a potential treatment has a measurable effect – is a central task in the modern practice of science, and gives a precise sense in which a claim is capable of being proven false.

A different approach was developed by Jerzy Neyman and Egon Pearson, who rather than disproving the null hypothesis, selected between a null hypothesis and a second hypothesis, the alternative hypothesis, which asserts a particular relationship between the phenomena. The alternative need not be the logical negation of the null hypothesis; it predicts the results from the experiment if the alternative hypothesis is true. The use of alternative hypotheses is not part of Fisher's formulation, and Fisher criticized its use, particularly using the complementary hypothesis as alternative hypothesis, arguing that experiment is not "able to prove the opposite hypothesis ... because it is inexact"

A one-tailed hypothesis is a hypothesis in which the value of a parameter is specified as being either:

above or equal to a certain value, or

below or equal to a certain value.

An example of a one-tailed null hypothesis would be that, in a medical context, an existing treatment, A, is no worse than a new treatment, B. The corresponding alternative hypothesis would be that B is better than A. Here if the null hypothesis weren't rejected (i.e. there is no reason to reject the hypothesis that A is at least as good as B), the conclusion would be that treatment A should continue to be used. If the null hypothesis were rejected, i.e. there is evidence that B is better than A, the result would be that treatment B would be used in future. An appropriate hypothesis test would look for evidence that B is better than A, not for evidence that the outcomes of treatments A and B are different. Formulating the hypothesis as a "better than" comparison is said to give the hypothesis directionality.

A two-tailed hypothesis is a hypothesis in which the value of a parameter is specified as being both:

above or equal to a certain value, or

below or equal to a certain value.

The Type I error rate α (false positive rate) of a statistical hypothesis test, the probability of incorrectly rejecting a given null hypothesis in favor of a second alternative hypothesis.

This value is 2 times bigger, when we using 2-tailed test, than when we using 1-tailed test.