Answer on Question #44242, Math, Statistics and Probability

9.9: Explain what a p-value is, and explain how it is used to test a hypothesis.

Solution:

In statistical significance testing, the **p-value** is the probability of obtaining a test statistic result at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. A researcher will often "reject the null hypothesis" when the p-value turns out to be less than a predetermined significance level, often 0.05 or 0.01. Such a result indicates that the observed result would be highly unlikely under the null hypothesis. Many common statistical tests, such as chi-squared tests or Student's t-test, produce test statistics which can be interpreted using p-values.

In a statistical test, sample results are compared to possible population conditions by way of two competing hypotheses: the *null hypothesis* is a neutral or "uninteresting" statement about a population, such as "no change" in the value of a parameter from a previous known value or "no difference" between two groups; the other, the *alternative* (or *research*) *hypothesis* is the "interesting" statement that the person performing the test would like to conclude if the data will allow it. The p-value is the probability of obtaining the observed sample results (or a more extreme result) when the null hypothesis is actually true. If this p-value is very small, usually less than or equal to a threshold value previously chosen called the significance level (traditionally 5% or 1%), it suggests that the observed data is inconsistent with the assumption that the null hypothesis is true, and thus that hypothesis must be rejected and the other hypothesis accepted as true.

An informal interpretation of a p-value, based on a significance level of about 10%, might be:

- $p \leq 0.01$: very strong presumption against null hypothesis
- $0.01 < p \leq 0.05$: strong presumption against null hypothesis
- $0.05 < p \leq 0.1$: low presumption against null hypothesis
- $p > 0.1$: no presumption against the null hypothesis