

What does it mean when a p-value is less than 0.001? Can you provide some examples?

Authored by
stats writer

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A p-value is a statistical measure that determines the likelihood of obtaining results as extreme or more extreme than the observed results, assuming that the null hypothesis is true. When a p-value is less than 0.001, it means that there is a very small probability of obtaining the observed results by chance, assuming that the null hypothesis is true. In other words, the results are highly significant and provide strong evidence against the null hypothesis. This indicates that there is a high level of confidence that the observed results are not due to chance and are instead due to the independent variable being studied.

For example, in a clinical trial testing the effectiveness of a new medication, a p-value of less than 0.001 would indicate that there is a very low probability of the results being due to chance and that the medication is indeed effective. Similarly, in a study comparing the average income of two different cities, a p-value of less than 0.001 would suggest that there is a significant difference in income levels between the two cities.

Interpret a P-Value Less Than 0.001 (With Examples)

A is used to test whether or not some assumption about a is true.

Whenever we perform a hypothesis test, we always define a null and alternative hypothesis:

Null Hypothesis (H₀): The sample data occurs purely from chance. Alternative Hypothesis (H_A): The sample data is influenced by some non-random cause.

If the of the hypothesis test is less than some significance level (e.g. $\alpha = .001$), then we can reject the null hypothesis and conclude that we have sufficient evidence to say that the alternative hypothesis is true.

If the p-value is not less than .001, then we fail to reject the null hypothesis and conclude that we do not have sufficient evidence to say that the alternative hypothesis is true.

The following examples explain how to interpret a p-value less than .001 and how to interpret a p-value greater than .001 in practice.

Example: Interpret a P-Value Less Than 0.001

Suppose a factory claims that they produce batteries with an average weight of 2 ounces.

An auditor comes in and tests the null hypothesis that the mean weight of a battery is 2 ounces vs. the alternative hypothesis that the mean weight is not 2 ounces, using a 0.001 level of significance.

The null hypothesis (H_0): $\mu = 2$ ounces

The alternative hypothesis: (H_A): $\mu \neq 2$ ounces

The auditor conducts a hypothesis test for the mean and ends up with a p-value of 0.0006.

Since the p-value of 0.0006 is less than the significance

level of 0.01, the auditor rejects the null hypothesis.

He concludes that there is sufficient evidence to say that the true average weight of a battery produced at this factory is not 2 ounces.

Example: Interpret a P-Value Greater Than 0.001

Suppose that some crop grows an average of 40 inches during a growing season.

However, an agricultural scientist believes that a certain fertilizer will cause this crop to grow more than 40 inches, on average.

She then performs a hypothesis test using the following hypotheses:

The null hypothesis (H_0): $\mu = 40$ inches (fertilizer will have no effect on the mean growth)

The alternative hypothesis: (H_A): $\mu > 40$ inches (fertilizer will cause mean growth to increase)

Upon conducting a hypothesis test for the mean, the scientist gets a p-value of 0.3488.

Since the p-value of 0.3488 is greater than the significance level of 0.001, the scientist fails to reject the null hypothesis.

She concludes that there is not sufficient evidence to say that the fertilizer leads to an increase in mean crop growth.

The following tutorials provide additional information about p-values and hypothesis tests:

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