# Significance Testing and Confidence Intervals

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*Prerequisites*
Confidence Intervals, Introduction to Hypothesis Testing, Significance Testing

*Learning Objectives*
1. Determine from a confidence interval whether a test is significant
2. Explain why a confidence interval makes clear that one should not accept the null hypothesis

There is a close relationship between confidence intervals and significance tests. Specifically, if a statistic is significantly different from 0 at the 0.05 level, then the 95% confidence interval will not contain 0. All values in the confidence interval are plausible values for the parameter, whereas values outside the interval are rejected as plausible values for the parameter. In the Physicians' Reactions case study, the 95% confidence interval for the difference between means extends from 2.00 to 11.26. Therefore, any value lower than 2.00 or higher than 11.26 is rejected as a plausible value for the population difference between means. Since zero is lower than 2.00, it is rejected as a plausible value and a test of the null hypothesis that there is no difference between means is significant. It turns out that the p value is 0.0057. There is a similar relationship between the 99% confidence interval and significance at the 0.01 level.

Whenever an effect is significant, all values in the confidence interval will be on the same side of zero (either all positive or all negative). Therefore, a significant finding allows the researcher to specify the direction of the effect. There are many situations in which it is very unlikely two conditions will have exactly the same population means. For example, it is practically impossible that aspirin and acetaminophen provide exactly the same degree of pain relief. Therefore, even before an experiment comparing their effectiveness is conducted, the researcher knows that the null hypothesis of exactly no difference is false. However, the researcher does not know which drug offers more relief. If a test of

the difference is significant, then the direction of the difference is established because the values in the confidence interval are either all positive or all negative.

If the 95% confidence interval contains zero (more precisely, the parameter value specified in the null hypothesis), then the effect will not be significant at the 0.05 level. Looking at non-significant effects in terms of confidence intervals makes clear why the null hypothesis should not be accepted when it is not rejected: Every value in the confidence interval is a plausible value of the parameter. Since zero is in the interval, it cannot be rejected. However, there is an infinite number of other values in the interval (assuming continuous measurement), and none of them can be rejected either.

**Question 1 out of 4.**
The null hypothesis for a particular experiment is that the mean test score is 20. If the 99% confidence interval is (18, 24), can you reject the null hypothesis at the .01 level?

- ○ Yes
- ◉ No

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Correct!
You cannot reject the null hypothesis because the confidence interval shows that 20 is a plausible value of the population parameter.

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