Confidence Intervals: How They Work

A confidence interval (CI) is an interval estimate of a population parameter and is used to indicate the reliability of an estimate and can be interpreted as the range of values that would contain the true population value 95% of the time if the survey were repeated on multiple samples. The following is a description of how to use confidence intervals to determine whether or not two estimates are statistically significantly different.

Using confidence intervals to determine if estimates are significantly different

If confidence intervals do not overlap then the difference between the estimates is statistically significant.

How to see if one estimate is significantly higher than the other

1. Determine which estimate is larger.
2. Look at the lower limit of the confidence interval associated with that estimate.
3. Compare that to the upper limit of the confidence interval associated with the lower estimate.
4. If the lower limit is above or higher than the upper limit, then the difference is significant. That is, the larger estimate is significantly higher than the smaller estimate.

How to see if one estimate is significantly lower than the other

1. Determine which estimate is smaller.
2. Look at the upper limit of the confidence interval associated with that estimate.
3. Compare that to the lower limit of the confidence interval associated with the higher estimate.
4. If the upper limit is below (less than) than the lower limit, then the difference is significant. That is, the smaller estimate is significantly lower than the larger estimate.

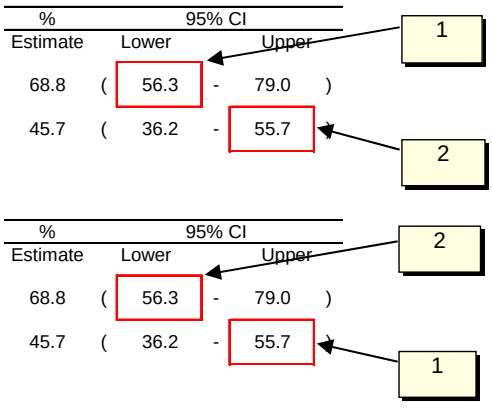
Using confidence intervals to determine if estimates are not significantly different

If the confidence intervals overlap, for general reporting purposes the two estimates are deemed to be not significantly different. However, it should be noted that this is a conservative test of significance that is appropriate when reporting multiple comparisons (when undertaking multiple comparisons, it is more likely a statistically significant result will occur by chance) but the rates may still be significantly different at the 0.05 significance level even if the confidence intervals overlap. When investigating a single (*a priori*) hypothesis, formal statistical testing (eg Chi-square, ANOVA etc.) should be undertaken.

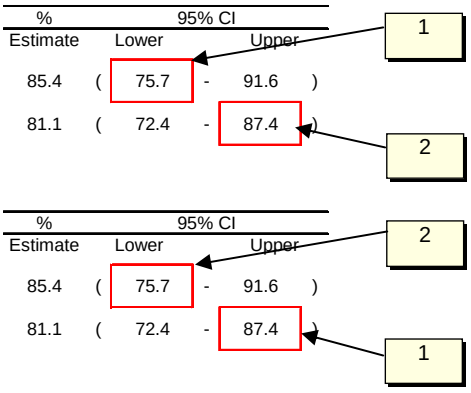
How to see if confidence intervals overlap

1. Look at the lower limit of the confidence interval associated with the estimate.
2. Compare that to the upper limit of the confidence interval associated with the other estimate.
3. If the lower limit of one estimate is less than the upper limit of the other estimate, then the confidence interval overlap.

Example 1



Example 2



In Example 1, the top table shows how to find out whether or not a higher estimate is significantly higher and the bottom table shows how to find out whether or not a lower estimate is significantly lower.

In the top table of Example 1, the original estimate of 68.8% is higher than 45.7%, but is it significantly higher? To find out, look at cell 1 (56.3% – the lower confidence limit of the higher estimate), note that it is higher than cell 2 (55.7% – the higher confidence limit of the lower estimate) so the confidence intervals do not overlap. Therefore the prevalence estimates are significantly different.

In the bottom table of Example 1, the original estimate of 45.7% is lower than 68.8%. Look at cell 1 (55.7% – the higher confidence limit of the lower estimate), note that it is lower than cell 2 (56.3% – the lower confidence limit of the higher estimate) so the confidence intervals do not overlap. Therefore the prevalence estimates are significantly different.

In the top table of Example 2, the original estimate of 85.4% is higher than 81.1%. Look at cell 1 (75.7% – the lower confidence limit of the higher estimate), note that it is lower than cell 2 (87.4% – the higher confidence limit of the lower estimate) so the confidence intervals overlap. Therefore for general reporting purposes, the prevalence estimates are deemed to be not significantly different (although formal statistical testing is required to determine significance at the 0.05 level).

In the bottom table of Example 2, the original estimate of 81.1% is lower than 85.4%. Look at cell 1 (87.4% – the higher confidence limit of the lower estimate), note that it is higher than cell 2 (75.7% – the lower confidence limit of the higher estimate) so the confidence intervals overlap. Therefore for general reporting purposes, the prevalence estimates are deemed to be not significantly different (although formal statistical testing is required to determine significance at the 0.05 level).