Converting confidence intervals to p values December 2015

This Excel spreadsheet converts means or ratios with 95% confidence intervals to p values. It's based on the idea that, under a normal-distribution assumption, a 95% confidence interval is about 4 standard errors wide (or, more accurately, 2*1.96 SE's wide). So it's possible to estimate the SEM for each group from the CI around each mean. Once you have that, the SE for the difference between the two group means can be calculated from the SE's of the two groups as SE(B-A) = sqrt(SE(B)^2 + SE(A)^2), and once you have the SE for the difference, you can get the p-value by calculating z = (B-A) / SE, and then just look up the p value in a Normal Distribution table.

The above procedure works when a journal has quoted the mean and CI around the mean for each of two independent groups, and when the data can be considered at least approximately normally distributed. (The more formal statistical jargon is that the *sampling distribution of the group means* must be nearly normally distributed.)

For ratios, there's the complication that ratios generally tend to have a log-normal sampling distribution, which is like saying that the logarithms of the ratios are normally distributed. And, in fact, the CI's you quoted were calculated on the basis of this assumption, which is how CI's are almost always calculated for rate ratios, risk ratios, odds ratios, relative risks, hazard ratios, etc.). You may have noticed that the confidence limits were not equally spaced around the observed ratio as they would have been in the case of CI's around simple means. They're “geometrically” spaced, with the observed ratio being the geometric mean of the upper and lower confidence limits.

So for ratios, we have to modify the formulas to take logarithms to estimate the SE's. And we don't calculate the difference between ratios for two groups, we calculate the ratio of the ratios, which, again, turns out to be log-normally distributed. We then ask whether the ratio of the ratios is significantly different from 1, which is equivalent to asking whether the log of the ratio of the ratios is significantly different from 0.

The Excel file has two worksheets -- one for means (which I loaded with a dummy example), and one for ratios (which I loaded with your example). The blue cells are where you can enter your data; the black cells have formulas, and I've protected them against accidental erasure.

I've allowed for other confidence levels besides 95%, in case you happen to see an article where 90% or 98% or other confidence limits were quoted. Normally, you can just leave the 95% in these cells.

I calculate three p values -- one (in Cell B9) for whether the Group A ratio is significantly different from 1; one (in Cell C9) for whether the Group B ratio is significantly different from 1; and one (in Cell B17) for whether the ratio of the ratios is significantly different from 1 (that is, whether the ratios are different for Group A vs Group B.

I also calculate a CI around the ratio of the ratios, which might be useful to know. I allow you to set the confidence level (in Cell B14) for this new CI to anything you want, although you'll probably want to leave it at 95%.

Let me know how it works out, or if you have any questions. If I can get a chance, I'll create a web page that does the same calculations, and add it to my StatPages site.

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