FOR 496/796 Research Experience 9/20/07

Calculating Detectable Differences

The first paper in which I calculated detectable differences was:
Yanai, R.D., T.G Siccama, M.A. Arthur, C.A. Federer, and A.J. Friedland. 1999. Accumulation and depletion of base cations in forest floors in the northeastern US. Ecology 80:2774-2787.

For example, in the abstract, we say, " To test for loss of base cations from forest floors at the Hubbard Brook Experimental Forest in New Hampshire, we analyzed samples collected at seven times between 1976 and 1997. Calcium and magnesium contents of the forest floor did not decline significantly; a change greater than 0.9% per year would have been detectable."

Here is the statistical part of the methods section:
We report means and standard errors of forest floor properties. For derived variables (cation contents and concentrations per unit organic matter), we calculated products on individual samples and report the mean of the products, not the product of the means. Regressions were conducted on log-transformed variables, as required to normalize the residuals. Linear trends over time were assessed on means by sampling dates. Pairwise comparisons of means were conducted using Fisher's protected least significant difference. Comparisons of two points in time in which the stand was the experimental unit were based on paired t-tests. Comparisons of two points in time in the same stand were based on independent sample t-tests. In addition, for each stand and collection date, we calculated the amount of change that would be detectable by a t-test at a specified value of □, assuming equal sample sizes and standard deviatations. The detectable difference is $\sqrt{2}$ t SE, where t is a percentile of the t-distribution depending on α and sample size and SE is the standard error. For regressions, the SE of the slope can be used to calculate the detectable rate of change (t SE). We used one-tailed t, because we were testing for cation loss over time.

In Excel, you can "insert" "function" "statistical" "TINV". This function has two arguments, α (alpha) and the degrees of freedom. α is the significance level used to compute the confidence, commonly 0.05. The degrees of freedom is one less than the sample size, n. The test can be two-tailed (testing for a difference in either direction, or one-tailed (testing for a difference in a known direction, as in our case, above). If the test is one-tailed, use $2*\alpha$, and you'll have a stronger test. Here's some information about t-tests and TINV in Excel:
http://support.microsoft.com/kb/829247
In case you need to know, the standard error is the standard deviation divided by the square root of the sample size.

As an exercise (this has never been done and we should know the answer), calculate how big a change in heart size we could detect at each of these sites. I'll send you an excel file with the data. You could each do two sites (these are logs in different log yards).
Zach: Tully, Arcade
Garrett: RedField, Troupsburg
Neil: Lyon Mtn, Heinsburg VT

The units of $\sqrt{2}$ t SE are the same as the units of the SE (t is unitless). I find it useful to report the detectable difference as a fraction (or percentage) of the mean. Try that.

Here is a later paper that focuses more on the question of detection:
Yanai, R.D., S.V. Stehman, M.A. Arthur, C.E. Prescott, A.J. Friedland, T.G. Siccama, and D. Binkley. 2003. Detecting change in forest floor carbon. Soil Sci. Soc. Am. J. 67:1583-1593.

By the way, any of my papers can be downloaded from my web site (see "complete publications list")