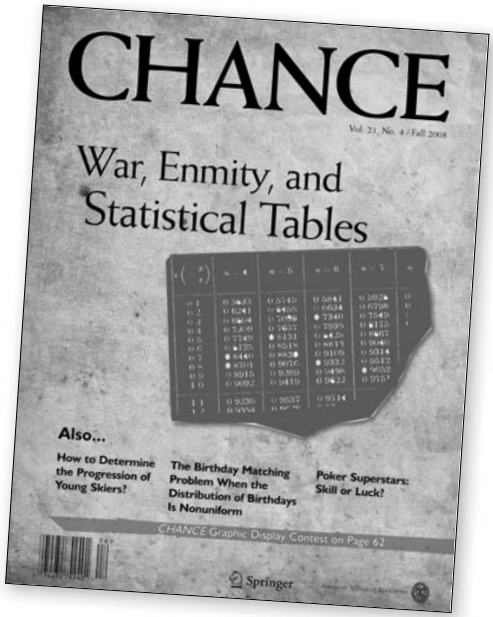
Dear Editor,

In *CHANCE* Volume 21, Issue 4, the articles "War, Enmity, and Statistical Tables" by Brian Clauser and "Fisher and the 5% Level" by Stephen Stigler provided insight into the dysfunctional relationship between R. A. Fisher and Karl Pearson. Hidden within those articles was an equally interesting interaction between William Gosset and Karl Pearson. Gosset had the enviable position of brew master at Guinness Brewery, which objected to him publishing his statistical work under his own name, hence his pseudonym "student." I thought I would use the Excel TDIST command to duplicate the probabilities in Clauser's Figure 1, showing a fragment of Gosset's (Student's) table from "The Probable Error of a Mean," *Biometrica*, 6(1), published March 1908. Gosset's table is parameterized using $z = x/s$, where x is the difference from the mean and s is the standard deviation of n observations. I assumed that Gosset used the unbiased s^2, found by dividing by n–1 when estimating the variance of n independent observations. To find t, as is common practice today, I divided the square root of the unbiased s^2 (multiplied z) by the $\sqrt{n}$. With n–1 degrees of freedom, TDIST did not duplicate Gosset's probabilities. For example, in Table 1 with z=.1 and n = 4, then t would be the $\sqrt{4}$ times .1 or .2 with n–1 = 3 degrees of freedom. The cumulative probability using TDIST is 0.5729, not 0.5633. Also, with z =.5 and n = 6, then t would be the square root of 6 times .5 or 1.225 with n–1 = 5 degrees of freedom. The cumulative probability from TDIST is 0.8624, not 0.8428.

I realized that Gosset must have used the biased s^2, found by dividing by n; hence, it was necessary to find t by dividing the square root of the biased s^2 (multiplying z) by the $\sqrt{n-1}$. With n–1 degrees of freedom, TDIST duplicated Gosset's probabilities. For n = 4 observations, the values in column one are multiplied by the square root of 3 to get t and using 3 degrees of freedom, we get all the values in column 2. Similarly, for the n = 5 column, the values in column one are multiplied by the square root of 4 to get t and using 4 degrees of freedom, we get all the values in column 3.

I downloaded a copy of Gosset's 1908 paper, and indeed, on page 3, the variance s^2 was found by dividing by n; but why? The answer is contained in "Student's z, t, and s: What If Gosset Had *R*?" by Hanley, Julien and Moodie in *The American Statistician*, 62(1), February 2008. Here is what they wrote:

"Gosset defined s^2 as the sum of squared deviations divided by n, rather than n–1 (suggested in Airy's textbook) that yields an unbiased estimator of s^2–*a* decision influenced by his professor Karl Pearson. Gosset would have preferred to use n–1: he wrote to a Dublin colleague in May 1907, 'when you only have quite small numbers I think the formula with the divisor of n–1 we used



is better.' Even in 1912 Karl Pearson—still a large sample person—remarked to him that it made little difference whether the sum of squares was divided by n or n–1 'because only naughty brewers take n so small that the difference is not the order of the probable error' (Pearson 1939)."

True to his pseudonym, Gosset was the dutiful student to his professor, Karl Pearson. It is noteworthy that "Student" effectively parameterized his own t different from today's practice.

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Correction

In Volume 21, Issue 3, part of the "Children 2–5 year olds" graph for Figure 6 is missing from the article "Healthy for Life: Accounting for Transcription Errors Using Multiple Imputation—Application to a study of childhood obesity."