

Gosset (Student), who created the  $T$ -distribution, reported on the results of seeding eleven plots with two different kinds of seed. Each type of seed (regular and kiln-dried) was planted in adjacent plots, accounting for 11 plots. The article cited (W.S. Gosset, “The Probable Error of a Mean,” *Biometrika*, 6 (1908), pp 1-25.) is perhaps the most famous in statistical literature and bears reading even today.

The problem of interest was if kiln-drying the seed improved the corn yield. Each plot has both kinds of seed in it, so we can measure the difference between regular and kiln-dried, as shown in the table.

plot	REG	KILN	diff
1	1903	2009	106
2	1935	1915	-20
3	1910	2011	101
4	2496	2463	-33
5	2108	2180	72
6	1961	1925	-36
7	2060	2122	62
8	1444	1482	38
9	1612	1542	-70
10	1316	1443	127
11	1511	1535	24

**Table 1:** Corn yield (lbs/acre) from regular seed (REG), kiln-dried seed (KILN), and the difference ( $\bar{x} = 33.7$ ,  $s = 66.2$ ).

1. First, analyze this using frequentist methods:

- Perform the  $Z$  test, the  $T$  test, the sign test, and the sign rank test. For each test, set up the null and alternate hypothesis, calculate the p-value, and write a brief statement about what the conclusion is. Remember we’re interested in if kiln-drying *improved* the yield.
- There are four different p-values! Explain why.
- Comment on the appropriateness of using each type of test for this data. (Hint: the  $Z$  test is not appropriate.)

2. Now, analyze it using Bayesian methods:

- Using a prior of  $N(0, 20^2)$  for the difference and assuming the difference is normally distributed with 66.2 as the true population standard deviation  $\sigma$ , use the results on page 358 to find the posterior distribution of the difference.
- Under both the prior and the posterior, find the probability that kiln-dried seed improves yield.
- Suppose that a difference of 10 lbs/acre is not practically significant. Find the posterior probability that the difference between regular and kiln-dried seed is not practically significant, that is  $P(-10 < \text{diff} < 10)$ .

If you aren’t comfortable with  $Z$  and  $T$  tests from another class, you may wish to try some extra problems, like 8, 10, or 17.