**Comparing two means in a randomized experiment** Does polyester decay?

*Research question:* How quickly do synthetic fabrics such as polyester decay in landfills?

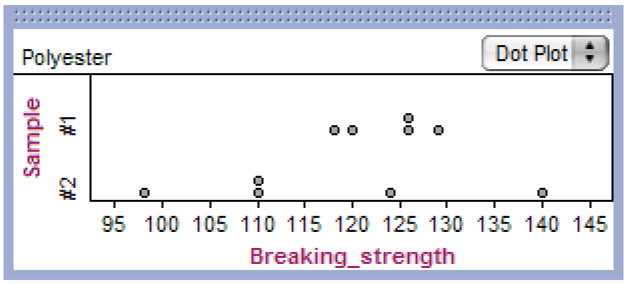
*Data production:* A researcher buried polyester strips in the soil for different lengths of time, then dug up the strips and measured the force required to break them. Breaking strength is easy to measure and is a good indicator of decay. Lower strength means the fabric has decayed.

Part of the study buried 10 strips of polyester fabric in well-drained soil in the summer. Five of the strips, chosen at random, were dug up after 2 weeks; the other 5 were dug up after 16 weeks. Here are the breaking strengths in pounds:[1]

| | | | | | |
|---|---|---|---|---|---|
| Sample 1 (2 weeks) | 118 | 126 | 126 | 120 | 129 |
| Sample 2 (16 weeks) | 124 | 98 | 110 | 140 | 110 |

Do the data give good evidence that polyester decays more in 16 weeks than in 2 weeks?

*Data Analysis:*




Polyester

| | Sample | | Row Summary |
|---|---|---|---|
| | #1 | #2 | |
| Breaking_strength | 5 | 5 | 10 |
| | 4.6043458 | 16.087262 | 11.817595 |
| | 2.059126 | 7.1944423 | 3.7370517 |
| | 0 | 0 | 0 |
| | 118 | 98 | 98 |
| | 120 | 110 | 110 |
| | 126 | 110 | 122 |
| | 126 | 124 | 126 |
| | 129 | 140 | 140 |
| | 123.8 | 116.4 | 120.1 |

S1 = count ( )
S2 = stdDev ( )
S3 = stdError ( )
S4 = count ( missing ( ) )
S5 = min ( )
S6 = Q1 ( )
S7 = median ( )
S8 = Q3 ( )
S9 = max ( )
S10 = mean ( )

It does appear that the center of the breaking strength distribution for the specimens in sample 1 is higher than for sample 2, which would suggest that the polyester could be decaying. But could this difference simply be due to the chance involved in the random assignment of specimens to the two groups?

Notice also that the specimens in sample 2 show greater variation in breaking strengths than those in sample 1.

*Probability models:*

Suppose that the length of time in the ground has no effect on the breaking strength of the polyester specimens. Then the specimens would have the same breaking strength regardless of whether they were in group 1 or group 2. In that case, we could examine the results of repeated reassignments of the subject specimens to the two treatment groups. How often does the difference in sample means from the random reassignments exceed the one found in this study (7.4)?

Due to the small group sizes, this re-rerandomization could be done as a physical simulation with 10 cards. Simply write the 10 breaking strength measurements on 10 separate cards, shuffle them, and deal them into two piles of 5 cards. Then calculate the difference in the mean breaking strengths for the two groups. Alternatively, each group could use a random digits table to simulate the re-randomization. If each person in the class repeats this process several times, you can then compile results on a dotplot.

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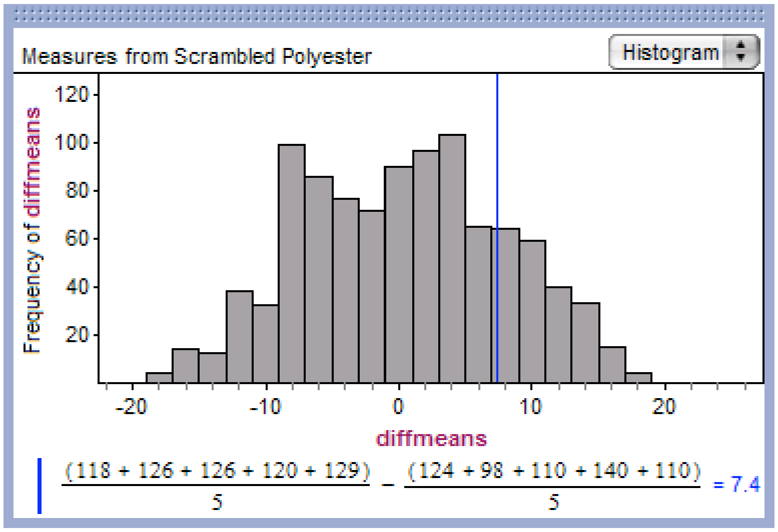
Alternatively, you could let a computer do the re-rerandomizing.




*Inference:* If appropriate conditions for a two-sample *t* test are met, then:

Test of Polyester | Compare Means

First attribute (numeric): Brkstr1

Second attribute (numeric or categorical): Brkstr2

Sample count of **Brkstr1**: **5**
Sample count of **Brkstr2**: **5**
Sample mean of **Brkstr1**: **123.8**
Sample mean of **Brkstr2**: **116.4**
Standard deviation of **Brkstr1**: **4.60435**
Standard deviation of **Brkstr2**: **16.0873**
Standard error of the mean of **Brkstr1**: **2.05913**
Standard error of the mean of **Brkstr2**: **7.19444**
Alternative hypothesis: The population mean of **Brkstr1** is greater than that of **Brkstr2**

The test statistic, Student's t, using unpooled variances , is **0.9889**. There are **4.65096** degrees of freedom.

If it were true that the population mean of **Brkstr1** were equal to that of **Brkstr2** (the null hypothesis), and the sampling process were performed repeatedly, the probability of getting a value for Student's t this great or greater would be **0.19**.

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But what if the conditions aren't met?

Suppose the 98 in group 2 became a 68.