LESSON MAKER PRO

Chance or Change?

Use reshuffled data to judge an experimental result.

HIGH SCHOOL · MT.PLUS.DATA.INF.3.b

MT.PLUS.DATA.INF.3.b "Use data from a randomized experiment to test the hypothesis that two groups are equal by: Understanding that an observed effect may be due to randomization and using a randomization test (repeatedly reshuffling the observed data into new..."

NAME _____ DATE _____

THE BIG IDEA

If two treatments have the same effect, random assignment can still produce a gap between group averages. Reshuffle the observed outcomes into groups of the original sizes. The fraction of reshuffles with a gap at least as extreme as the observed gap estimates how often randomization alone could produce that result.

WORKED EXAMPLE

A randomized experiment produced the results below. Estimate the probability of a gap at least as large as the observed gap, assuming the treatments have the same effect.

EXPERIMENT RESULTS

Measure	Value
Observed gap, in points	13
Reshuffles with a gap of 13 or more	7
Total reshuffles	40

1. Count the reshuffles with a gap of 13 or more: 7.
2. Divide by the total number of reshuffles: 7/40.

Answer: The estimated probability is 7/40.

PRACTICE 4 problems

1 In 12 reshuffles, 2 gaps are at least as large as the observed gap. Estimate the randomization probability.

ANSWER _____

2 The observed gap is 4 points. In 24 reshuffles, 3 gaps are 4 points or more. Estimate the randomization probability.

ANSWER _____

3 The observed gap is 8 points. In 30 reshuffles, 1 gap is 8 points or more. Estimate the probability. Is it below 1/10?

ANSWER _____

4 The observed gap is 2 points. In 36 reshuffles, 18 gaps are at least 2 points. Estimate the probability. Is this gap unusual under randomization alone?

ANSWER _____

APPLY IT Show your work

1 Students are randomly assigned to study with music or in silence. Find the music-minus-silence gap and the randomization probability of a gap this large or larger.

QUESTIONS COMPLETED

Result	Value
Music group average	10
Silence group average	8
Reshuffled music-minus-silence gaps of 2 or more	4
Total reshuffles	32

ANSWER _____

2 A school randomly assigns students to a new lunch line or the usual line. The new line averages 4 minutes less waiting. In 25 reshuffles, 1 gap is at least 4 minutes in favor of the new line. Estimate the randomization probability. Does the result give evidence that the new line is faster?

WORK SPACE

ANSWER _____

CHALLENGE One step up

An experiment's observed difference, new minus usual, is -4. Of 28 reshuffles, 2 differences are -4 or less and 3 are 4 or more. For a test of any difference between treatments, estimate the randomization probability. Explain why both sets count.

WORK SPACE AND ANSWER

ANSWER KEY

Chance or Change?

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	In 12 reshuffles, 2 gaps are at least as large as the observed gap. Estimate the randomization probability.	**2/12 = 1/6**
2	The observed gap is 4 points. In 24 reshuffles, 3 gaps are 4 points or more. Estimate the randomization probability.	**3/24 = 1/8**
3	The observed gap is 8 points. In 30 reshuffles, 1 gap is 8 points or more. Estimate the probability. Is it below 1/10?	**1/30; yes, 1/30 < 1/10.**
4	The observed gap is 2 points. In 36 reshuffles, 18 gaps are at least 2 points. Estimate the probability. Is this gap unusual under randomization alone?	**18/36 = 1/2; no, it is not unusual.**

PART 2 · APPLY IT

1. **The gap is 2 questions; the estimated probability is 4/32 = 1/8.** Subtract the group averages: 10 - 8 = 2. Divide the 4 qualifying reshuffles by 32.
2. **1/25; yes, the small probability gives evidence that the new line is faster, but it does not prove it.** One of 25 reshuffles has a gap at least as favorable to the new line. Such a gap is uncommon under equal effects.

CHALLENGE

5/28. Count both sets because differences of -4 or less and 4 or more are both at least as far from zero as the observed difference.

Accept unsimplified fractions equivalent to the answers. For the challenge, accept an explanation that compares the absolute sizes of the differences.