LESSON MAKER PRO

Chance or Change?

Test a difference between randomized groups

HIGH SCHOOL · MT.PLUS.DATA.INF.3

MT.PLUS.DATA.INF.3 "Use data from a randomized experiment to test the hypothesis that two groups are equal by: Interpreting the difference or ratio between the group means as the observed effect between the groups..."

NAME _____ DATE _____

THE BIG IDEA

Subtract the group means to find the observed effect. If the groups are equal, reshuffling the observed outcomes can still produce a difference. The fraction of reshuffles with an absolute difference at least as large as the observed one estimates how often chance alone could produce a result this extreme.

WORKED EXAMPLE

Find A minus B and the fraction of reshuffles at least as extreme.

RANDOMIZED EXPERIMENT

A mean	B mean	Extreme reshuffles	Total reshuffles
12	8	9	100

1. Subtract the means: 12 - 8 = 4.
2. Use 4 as the cutoff for the absolute differences from reshuffling.
3. Divide the extreme reshuffles by the total: 9/100.

Answer: A minus B is 4; the reshuffle fraction is 9/100.

PRACTICE 4 problems

1 Group A's mean is 15; group B's is 11. Of 20 reshuffles, 6 have a difference at least as extreme. Find A minus B and the reshuffle fraction.

ANSWER _____

2 Group A's mean is 18; group B's is 13. Of 25 reshuffles, 2 are at least as extreme. Find A minus B and the reshuffle fraction.

ANSWER _____

3 Group A's mean is 7; group B's is 10. Of 20 reshuffles, 3 are at least as extreme. Find A minus B and the reshuffle fraction.

ANSWER _____

_____

4 Group A's mean is 21; group B's is 16. Of 50 reshuffles, 1 is at least as extreme. Find A minus B and the reshuffle fraction.

ANSWER _____

_____

APPLY IT Show your work

1 Students were randomly assigned to study with music or in silence. Find music minus silence and the reshuffle fraction. Does the result give evidence that the study conditions differ?

QUIZ RESULTS

Music mean	Silence mean	Extreme reshuffles	Total reshuffles
14	10	2	40

ANSWER _____

2 Students were randomly assigned to use a phone-notification limit or no limit while studying. Their focus scores averaged 17 with the limit and 19 without it. In 40 reshuffles, 16 differences were at least as extreme. Find limit minus no limit and the reshuffle fraction. Is there strong evidence of a difference?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Two randomized tests compared versions of a study app. Find new minus old and the reshuffle fraction for each test. Which test gives stronger evidence that its versions differ? Explain.

APP TEST RESULTS

Test	New mean	Old mean	Extreme / total
X	24	20	3/30
Y	32	27	15/30

WORK SPACE AND ANSWER

Chance or Change?

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Group A's mean is 15; group B's is 11. Of 20 reshuffles, 6 have a difference at least as extreme. Find A minus B and the reshuffle fraction.	**4; 6/20 = 3/10**
2	Group A's mean is 18; group B's is 13. Of 25 reshuffles, 2 are at least as extreme. Find A minus B and the reshuffle fraction.	**5; 2/25**
3	Group A's mean is 7; group B's is 10. Of 20 reshuffles, 3 are at least as extreme. Find A minus B and the reshuffle fraction.	**-3; 3/20**
4	Group A's mean is 21; group B's is 16. Of 50 reshuffles, 1 is at least as extreme. Find A minus B and the reshuffle fraction.	**5; 1/50**

PART 2 · APPLY IT

1. **4 points; 2/40 = 1/20. Yes, the small reshuffle fraction gives evidence of a difference, though chance is still possible.** Subtract 10 from 14. Only 2 of 40 reshuffles were at least as extreme, so this result would be uncommon if the conditions were equal.
2. **-2 points; 16/40 = 2/5. No, this result is common in the reshuffles.** Subtract 19 from 17. A difference at least this extreme occurred in 2/5 of the reshuffles, so the observed difference gives little evidence against equal groups.

CHALLENGE

X: 4 and 3/30 = 1/10. Y: 5 and 15/30 = 1/2. X gives stronger evidence because an effect at least as extreme occurred less often in its reshuffles, even though X's observed effect is smaller.

Accept equivalent fractions or percentages. Interpret reshuffle fractions as evidence under equal groups, not as the probability that equal groups are true.