LESSON MAKER PRO

Chance or Change?

Compare treatment results with shuffled results.

HIGH SCHOOL · A2S.DSP.I.33

A2S.DSP.I.33 "Use data from a randomized experiment to compare two treatments; limit to informal use of simulations to decide if an observed difference in the responses of the two treatment groups is unlikely to have occurred due to randomization alone..."

NAME _____ **DATE** _____

THE BIG IDEA

In a randomized experiment, find the gap between the two groups' results. Then compare it with gaps from shuffles that reassign the same results to the groups. If a gap at least that large rarely appears in the shuffles, the treatment may have made a meaningful difference.

WORKED EXAMPLE

Students were randomly assigned to two study methods. The table shows how many in each group improved. Ten shuffles gave gaps of 0, 2, 4, 6, 8, 4, 2, 6, 8, 10. Does the result suggest a meaningful difference?

STUDY METHODS

Method	Improved out of 24
A	19
B	7

1. Observed gap: 19 - 7 = 12.
2. None of the 10 shuffled gaps is at least 12.
3. A gap this large was rare in the shuffles.

Answer: Yes. The result suggests a meaningful difference between the methods.

PRACTICE 4 problems

1 Two groups of 10 were randomly assigned different warm-ups. In one group, 8 improved; in the other, 5 improved. Shuffled gaps: 0, 1, 2, 1, 0, 2, 1, 2, 0, 1. Find the observed gap. Does it suggest a meaningful difference?

ANSWER _____

2 Two groups of 16 were randomly assigned different review games. The numbers who passed were 11 and 9. Shuffled gaps: 0, 2, 4, 2, 0, 4, 2, 6, 0, 2. What fraction of shuffled gaps were at least the observed gap? Is the evidence strong?

ANSWER _____

3 Two groups of 14 were randomly assigned different practice plans. The numbers who met a goal were 12 and 6. Shuffled gaps: 0, 2, 4, 2, 4, 0, 2, 4, 0, 2. How many gaps were at least the observed gap? What does this suggest?

ANSWER _____

4 Two groups of 12 were randomly assigned different playlists. The numbers who finished a task were 7 and 6. Shuffled gaps: 0, 1, 2, 3, 2, 1, 0, 2, 1, 3. How many gaps were at least the observed gap? What does this suggest?

ANSWER _____

APPLY IT Show your work

1 Students were randomly assigned to try one of two phone settings while doing homework. The table shows how many stayed on task. Ten shuffles gave gaps of 0, 2, 4, 6, 2, 4, 6, 0, 4, 2. Does the result suggest that the settings make a meaningful difference?

STAYED ON TASK

Setting	Students out of 20
A	16
B	8

ANSWER _____

2 Students were randomly assigned one of two ways to get concert updates. The table shows how many noticed an update. Ten shuffles gave gaps of 0, 2, 4, 2, 6, 0, 4, 2, 0, 4. Does the result give strong evidence that the methods differ?

NOTICED AN UPDATE

Method	Students out of 18
A	12
B	10

ANSWER _____

CHALLENGE One step up

In a randomized test of two lunch menus, 4 of 10 students offered Menu A chose it again, compared with 8 of 10 offered Menu B. Each shuffle's signed difference means A's count minus B's count. The signed differences were 0, -2, 2, -4, 4, -2, 0, 2, 0, -4. Count gaps at least as large as the observed gap in either direction. Does the result give strong evidence that the menus differ? Explain.

WORK SPACE AND ANSWER

Chance or Change?

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Two groups of 10 were randomly assigned different warm-ups. In one group, 8 improved; in the other, 5 improved. Shuffled gaps: 0, 1, 2, 1, 0, 2, 1, 2, 0, 1. Find the observed gap. Does it suggest a meaningful difference?	**Gap: 3. Yes, none of the 10 shuffled gaps was at least 3.**
2	Two groups of 16 were randomly assigned different review games. The numbers who passed were 11 and 9. Shuffled gaps: 0, 2, 4, 2, 0, 4, 2, 6, 0, 2. What fraction of shuffled gaps were at least the observed gap? Is the evidence strong?	**7/10. No, a gap at least as large appeared often.**
3	Two groups of 14 were randomly assigned different practice plans. The numbers who met a goal were 12 and 6. Shuffled gaps: 0, 2, 4, 2, 4, 0, 2, 4, 0, 2. How many gaps were at least the observed gap? What does this suggest?	**0 of 10. The result suggests a meaningful difference.**
4	Two groups of 12 were randomly assigned different playlists. The numbers who finished a task were 7 and 6. Shuffled gaps: 0, 1, 2, 3, 2, 1, 0, 2, 1, 3. How many gaps were at least the observed gap? What does this suggest?	**8 of 10. The result does not give strong evidence of a meaningful difference.**

PART 2 · APPLY IT

1. **Yes. The observed gap is 8, and 0 of 10 shuffled gaps were at least 8.** Subtract 8 from 16 to get the observed gap. Compare 8 with each shuffled gap.
2. **No. The observed gap is 2, and 7 of 10 shuffled gaps were at least 2.** Subtract 10 from 12. Count the shuffled gaps that are 2 or greater.

CHALLENGE

The observed signed difference is -4, so the gap is 4. Three of the 10 shuffles had a gap of at least 4: -4, 4, and -4. Because this happened in 3 of 10 shuffles, the result does not give strong evidence that the menus differ.

Accept equivalent wording that compares the observed gap with shuffled gaps. A rare gap suggests a difference but does not prove the treatment caused it.