LESSON MAKER PRO

Chance or Bias?

Check the evidence behind a reported result.

HIGH SCHOOL · MM.D3D.C.21

MM.D3D.C.21 "Critique the validity of reported conclusions from statistical studies in terms of bias and random error probabilities."

NAME _____ DATE _____

THE BIG IDEA

To judge whether random error could explain a result, divide the number of no-effect simulations with a result at least as extreme as the observed one by the total number of simulations. A small fraction is evidence against no effect, but it does not rule out bias in who was studied or how the study was run.

WORKED EXAMPLE

The table shows results from no-effect simulations. Find the tail fraction. Is it at most 5%?

SIMULATION RESULTS

Result	Count
At least as extreme	7
Less extreme	73

1. Total simulations: 7 + 73 = 80.
2. Tail fraction: 7/80 = 8.75%.
3. 8.75% is greater than 5%.

Answer: The tail fraction is 8.75%, so it is not at most 5%.

PRACTICE 4 problems

1 In 2 of 100 no-effect simulations, the result was at least as extreme as the observed result. Find the tail fraction. Is it at most 5%?

ANSWER _____

2 In 8 of 200 no-effect simulations, the result was at least as extreme as the observed result. Find the tail fraction. Is it at most 5%?

ANSWER _____

3 In 18 of 300 no-effect simulations, the result was at least as extreme as the observed result. Find the tail fraction. Is it at most 5%?

ANSWER _____

4 An app surveys only paid subscribers. In 4 of 250 no-effect simulations, the result was at least as extreme as the survey result. Find the tail fraction. Does it prove the app helps all users? Name one concern.

ANSWER _____

APPLY IT Show your work

1 A school reports that a lunch app shortens wait times. Only volunteers tried it. The table shows no-effect simulation results. Find the tail fraction. At a 5% cutoff, does it suggest the difference is unusual under no effect? Can the school conclude the app caused shorter waits?

SIMULATED WAIT-TIME DIFFERENCES

Result	Count
At least as extreme	1
Less extreme	99

ANSWER _____

2 A creator says a focus playlist raises quiz scores. Students from one class were randomly assigned playlists. In 16 of 400 no-effect simulations, the score gap was at least as extreme as the observed gap. Is it unusual at a 5% cutoff? Can the creator claim the playlist works for all teens?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A fitness app tested 10 goals but reported only its best result. For that goal, 4 of 500 no-effect simulations were at least as extreme as the observed result. Find the reported tail fraction. Explain why it may understate the chance of finding a striking result by random error.

WORK SPACE AND ANSWER

ANSWER KEY

Chance or Bias?

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	In 2 of 100 no-effect simulations, the result was at least as extreme as the observed result. Find the tail fraction. Is it at most 5%?	**2/100 = 2%; yes.**
2	In 8 of 200 no-effect simulations, the result was at least as extreme as the observed result. Find the tail fraction. Is it at most 5%?	**8/200 = 4%; yes.**
3	In 18 of 300 no-effect simulations, the result was at least as extreme as the observed result. Find the tail fraction. Is it at most 5%?	**18/300 = 6%; no.**
4	An app surveys only paid subscribers. In 4 of 250 no-effect simulations, the result was at least as extreme as the survey result. Find the tail fraction. Does it prove the app helps all users? Name one concern.	**4/250 = 1.6%. No; paid subscribers may not represent all users.**

PART 2 · APPLY IT

1. **1/100 = 1%. Yes, it is unusual under no effect. No, volunteers may differ from other students.** Add the counts to get 100 simulations, then divide 1 by 100. The small fraction does not remove the risk of volunteer bias.
2. **16/400 = 4%, so the gap is unusual at a 5% cutoff. No, one class does not establish a result for all teens.** Divide 16 by 400 and compare 4% with 5%. Random assignment helps assess the effect in this study, but the limited sample restricts the broader claim.

CHALLENGE

4/500 = 0.8%. Testing 10 goals creates more chances to find at least one striking result by random error; the reported fraction checks only the selected goal.

Accept equivalent fractions or decimals for the tail fractions. A small fraction is not the probability that the no-effect explanation is true.