LESSON MAKER PRO

Designs and Differences

Use percentages to compare results and judge what a study can show.

HIGH SCHOOL · MT.PLUS.DATA.DES.1

MT.PLUS.DATA.DES.1 "Describe the purposes of and differences among sample surveys, experiments, and observational studies and explain how randomization relates to each."

NAME _____ DATE _____

THREE STUDY DESIGNS

A sample survey asks people questions, and random selection helps the sample represent a larger group. An experiment assigns treatments, and random assignment helps make a difference in outcomes evidence of a treatment effect. An observational study records what happens without assigning treatments, so a difference in outcomes alone does not show cause and effect. To compare two groups, find each group's percentage, then subtract.

WORKED EXAMPLE

An after-school club randomly assigns 25 volunteers to work with white noise and 25 to work in silence. In the white-noise group, 7 finish a puzzle. In the silent group, 2 finish. How many percentage points higher is the finish rate with white noise?

1. White noise: 7/25 = 28%.
2. Silence: 2/25 = 8%.
3. Subtract: 28% - 8% = 20 percentage points.

Answer: The finish rate is 20 percentage points higher with white noise. Random assignment supports a causal comparison for these volunteers.

PRACTICE 6 problems

1 A school randomly selects 80 students from its roster for a survey. Of those selected, 44 prefer a later start time. What percentage prefer a later start, and what does random selection help the school do?

ANSWER _____

2 A teacher randomly assigns students to study with instrumental music or no music. Use the table to find how many percentage points higher the finished-task rate is with music. Does random assignment support a causal comparison for these students?

STUDY CONDITIONS

Condition	Students	Finished task
Instrumental music	10	8
No music	10	5

ANSWER _____

3 A cycling club records whether riders wear helmets and finish a route. No one is assigned to wear a helmet. Use the table to find the difference in finish rates. Does the difference show that wearing a helmet causes a rider to finish?

CYCLING CLUB RECORDS

Helmet use	Riders	Finished route
Wore a helmet	24	18
Did not wear a helmet	12	6

ANSWER _____

4 A game studio randomly selects 120 players from its full player list to answer a poll. Does this random step help the studio generalize poll answers to its player list, or show that the poll caused an outcome?

ANSWER _____

5 A nutrition club asks the first 32 students entering the cafeteria which snack they would choose. Of those students, 24 choose fruit. What percentage choose fruit? Were students randomly selected from the school?

ANSWER _____

6 A developer randomly assigns 48 users equally to a new app layout or the original layout. In the new-layout group, 18 find a setting quickly. In the original-layout group, 12 do. What is the difference in success rates? Does random assignment alone justify generalizing the result to all app users?

ANSWER _____

APPLY IT Show your work

1 Your school randomly selects 200 students from its roster to ask whether they use the school library website to study. Of the selected students, 126 say yes. Estimate the percentage of students at the school who use the website to study. Does this survey show that the website improves grades?

WORK SPACE

ANSWER _____

2 Volunteers testing a homework app are randomly assigned to use either a reminder feature or the same app without reminders. Use the table to find the difference in on-time submission rates. Can the study support a causal comparison for the volunteers? Can random assignment alone make the result representative of all students?

HOMEWORK APP TEST

App version	Volunteers	Submitted on time
With reminders	36	27
Without reminders	36	18

ANSWER _____

CHALLENGE One step up

A school randomly selects 100 students from its roster, then randomly assigns 50 to use a study timer and 50 to study without one. Use the table to find the difference in quiz-completion rates. Explain separately what random selection and random assignment help the school conclude.

STUDY TIMER TEST

Study condition	Students	Completed quiz
Used timer	50	39
No timer	50	26

WORK SPACE AND ANSWER

Designs and Differences

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A school randomly selects 80 students from its roster for a survey. Of those selected, 44 prefer a later start time. What percentage prefer a later start, and what does random selection help the school do?	**55%; random selection helps the school use the survey to estimate the preference of students on its roster.**
2	A teacher randomly assigns students to study with instrumental music or no music. Use the table to find how many percentage points higher the finished-task rate is with music. Does random assignment support a causal comparison for these students?	**80% - 50% = 30 percentage points; yes, random assignment supports a causal comparison for these students.**
3	A cycling club records whether riders wear helmets and finish a route. No one is assigned to wear a helmet. Use the table to find the difference in finish rates. Does the difference show that wearing a helmet causes a rider to finish?	**75% - 50% = 25 percentage points; no, this observational study does not show that helmet use causes a rider to finish.**
4	A game studio randomly selects 120 players from its full player list to answer a poll. Does this random step help the studio generalize poll answers to its player list, or show that the poll caused an outcome?	**It helps the studio generalize poll answers to its player list. Players were selected, not assigned a treatment.**
5	A nutrition club asks the first 32 students entering the cafeteria which snack they would choose. Of those students, 24 choose fruit. What percentage choose fruit? Were students randomly selected from the school?	**75%; no, asking the first students to enter is not random selection from the school.**
6	A developer randomly assigns 48 users equally to a new app layout or the original layout. In the new-layout group, 18 find a setting quickly. In the original-layout group, 12 do. What is the difference in success rates? Does random assignment alone justify generalizing the result to all app users?	**18/24 - 12/24 = 75% - 50% = 25 percentage points; no, random assignment alone does not justify generalizing to all app users.**

PART 2 · APPLY IT

1. **63%; no, the survey does not show that the website improves grades.** Compute 126/200 = 63%. Random selection supports an estimate for the school, but the survey does not assign website use or test its effect on grades.
2. **75% - 50% = 25 percentage points; yes, it supports a causal comparison for the volunteers. No, random assignment alone does not make volunteers representative of all students.** Compute 27/36 = 75% and 18/36 = 50%, then subtract. Assignment supports a causal comparison, while the use of volunteers limits generalization.

CHALLENGE

39/50 = 78% and 26/50 = 52%, so the difference is 26 percentage points. Random assignment supports a causal conclusion about the timer's effect. Random selection helps the school generalize the result to students on its roster.

Accept equivalent wording that distinguishes random selection from random assignment. Rate differences must be stated in percentage points, not as percent changes.