

Collecting Data: Sampling Plans and Experiments

Grade 12 – AP Statistics math · Worksheet Answer Key · Standards: AP Statistics Unit 1 (2026-27)

The answer key names each method or bias, explains the reasoning in context and gives the final answer in bold. Written designs mention random assignment, control and the comparison that will be made.

Standards: AP Statistics Unit 1 (2026-27) · **Level:** Grade 12 AP Statistics

Problem 1 Statistical or Not

(a) The roster has one count, so no variability is expected: not statistical. (b) Students will give many different counts: statistical. (c) The heights differ from player to player, so the question anticipates variability: statistical.

(a) not statistical, (b) statistical, (c) statistical

Problem 2 Systematic Sampling

The plan picks a random start and then every 20th name: a systematic sample. It is not an SRS because not every group of 40 students can occur; for example, two students who are next to each other on the list can never both be chosen.

Systematic sample; not every possible group of students has the same chance

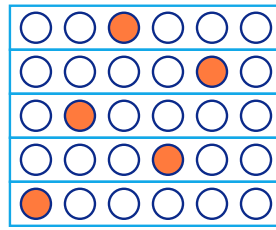
Problem 3 Identifying Cluster Sampling

Entire groups (routes) were chosen at random and everyone in them surveyed: a cluster sample. Advantage: it is cheaper than visiting riders on all 36 routes. Risk: if the routes differ (for example, rural versus city) the 5 chosen routes may not represent the county.

Cluster sample

Problem 4 Stratified Sample Design

Selected



One member from each row.

The population is split into groups (rows) and one member is selected from each group: a stratified sample. It guarantees every membership type is represented and reduces variability when the types differ in their opinions.

Stratified sample; it guarantees representation of every membership type

Problem 5 Voluntary Response Bias

This is a voluntary-response sample. People with strong opinions are most likely to call, and only listeners of that station can respond. The result may be far from the city's true proportion. (361/412 = 0.876.)

Voluntary-response bias (and undercoverage): the sample is not representative

Problem 6 Undercoverage

Adults without a listed landline have no chance of being selected: undercoverage. Younger adults are less likely to have landlines, so they are underrepresented. If they support the bond more, the estimate will probably be too low.

Undercoverage; the estimate is likely too low

Problem 7 Wording and Response Bias

(a) The wording is leading and loaded; it pushes respondents toward answering no, which is response bias. (b) A neutral version: "Should the cafeteria continue to sell pizza? (yes / no)".

Leading wording causes response bias; ask a neutral, balanced question

Problem 8 Observational Study or Experiment

(a) No treatment is imposed: observational. (b) The coach assigns the warm-up routines: experiment. (c) Nothing is imposed: observational.

(a) observational, (b) experiment, (c) observational

Problem 9 Confounding Variables

Explanatory: number of cups of tea per day. Response: heart disease rate. People who drink tea may also work out more or smoke less; that lifestyle difference could produce the lower rate, so the effect of tea cannot be separated from it.

Explanatory: cups of tea; response: heart disease; possible confounder: overall healthy lifestyle

Problem 10 Random Assignment with Random Numbers

Reading left to right and skipping repeats gives: 3, 13, 1, 17, 20, 4, 11, 5, 16, 18. These 10 hikers receive the new boots; the remaining hikers (2, 6, 7, 8, 9, 10, 12, 14, 15, 19) get the standard boots.

New boots: 1, 3, 4, 5, 11, 13, 16, 17, 18, 20

Problem 11 Parts of an Experiment

The experimental units are the 36 patients. The explanatory variable is the type of pill, with two treatments: drug X and placebo. The response variable is the reduction in the number of headaches.

Units: 36 patients; treatments: drug X and placebo; response: reduction in headaches

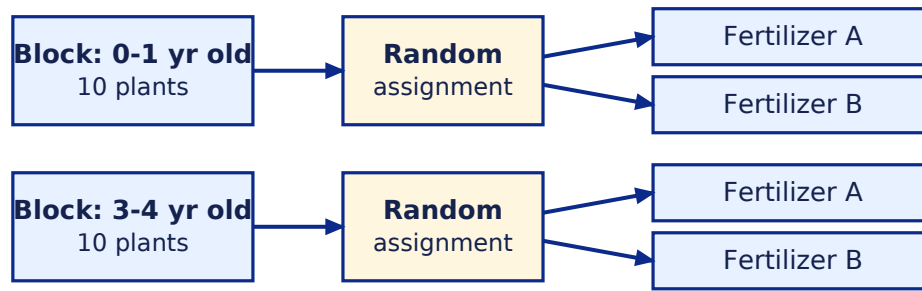
Problem 12 Why Blinding Matters

If patients know their group, expectations can change their reported pain. If the doctor knows, the rating may be influenced. In a double-blind design both the patients and the doctor rating the pain do not know which group each patient is in, so group knowledge cannot affect the responses or the ratings.

Blind the patients and the evaluating doctor

Problem 13 Randomized Block Design

Age affects growth, so in a completely randomized design a chance imbalance of young plants could hide or fake a fertilizer effect. Blocking compares fertilizers within plants of the same age group. Randomize separately in each block: randomly assign 5 of the 10 young plants to fertilizer A and the other 5 to B, then do the same for the mature plants.



Plants blocked by age.

Block by age; randomly assign 5 plants to each fertilizer within each block

Problem 14 Matched Pairs Design

Each runner runs a 5K in one brand and, on another day, in the other brand. A coin flip decides which brand each runner uses first, which balances order and learning effects. For each runner, compute the difference in finishing times and analyze the 15 differences.

Each runner tests both brands in random order; compare the 15 paired differences

Problem 15 Scope of Inference

(a) Random sample, no assignment: generalize to the 1,500 students; no cause and effect. (b) Volunteers, random assignment: cause and effect for those volunteers only. (c) Random sample and random assignment: both.

(a) generalize only, (b) cause and effect only, (c) both

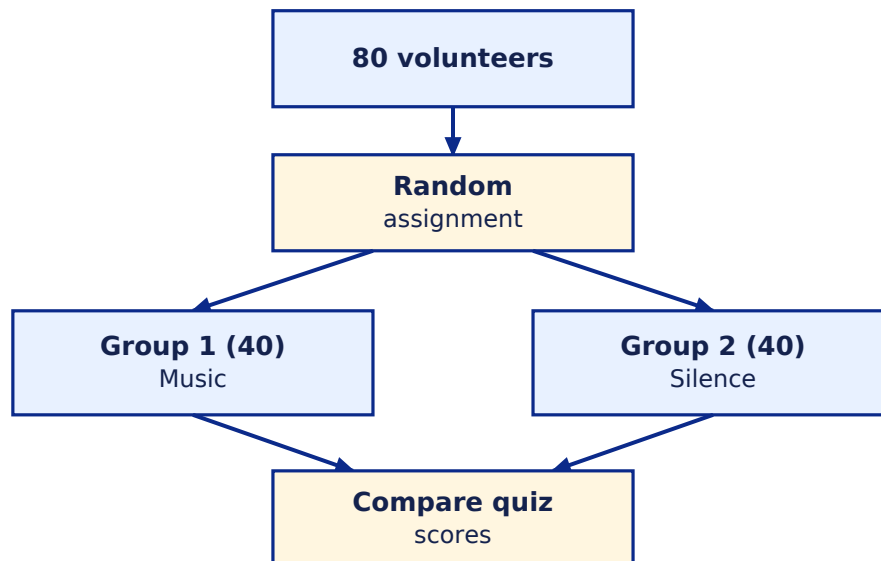
Problem 16 Sample Size and Variability

The larger samples produce estimates closer together, so variability decreases as the sample size increases. A larger sample does not fix bias: a biased sampling method gives results that are consistently off, just with less spread.

Larger samples reduce variability, but not bias

Problem 17 Design an Experiment

Treatments: study for 20 minutes with instrumental music, or study for 20 minutes in silence (control). Label the volunteers 01 to 80 and use a random number generator to select 40 labels for the music group; the remaining 40 form the silent group. All students study the same word list in the same room at the same time of day, and the same quiz is graded by someone who does not know the group. Compare the quiz score distributions of the two groups.



A completely randomized design.

Randomly assign 40 volunteers to music and 40 to silence; compare quiz scores

Problem 18 Critique a Flawed Experiment

The students were not randomly assigned, and period is confounded with the treatment: time of day, class composition and teacher energy differ too. Any score difference could come from those variables. Improvement: randomly assign individual students (or randomly assign within each period, using period as a block) to flashcards or no flashcards.

Confounded with class period; use random assignment (blocking by period)

Problem 19 Multiple Sources of Bias

Nonresponse: only 9% responded, and responders may be those with strong feelings, so results may not represent all customers. Response bias: the wording is leading and pushes toward positive answers. The leading wording clearly pushes satisfaction higher. The direction of the nonresponse bias is uncertain: it depends on whether pleased or unhappy customers were more likely to return the form, so it could push the result either way.

Nonresponse and leading wording; the wording likely overstates satisfaction; nonresponse could push either way

Problem 20 Interpreting a Study Result

Because treatments were randomly assigned, other variables are balanced between groups, so a difference this large is evidence that the walking caused the higher scores for these volunteers. The students were volunteers, not a random sample, so the results can be extended only to students like them.

Walking likely caused the higher scores for these volunteers; not generalizable to all students