

NAME _____

TESTING # _____

PERIOD 1 2 3 4 5 6 7 8

UNIT 1 · PART 2 OF 2

AP® STATISTICS
ALIGNED TO THE 2026 CED

AP® Statistics

1B

Collecting Data

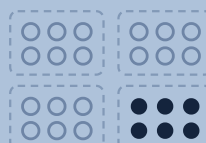
WHERE DATA COME FROM



SIMPLE RANDOM



STRATIFIED



CLUSTER



SYSTEMATIC

Guided Notes Packet

DSAHS 2026-2027 · MR. LEVY

The Investigative Question Revisited & Data Collection

Census, experiments, observational studies, confounding, and who the results apply to.

Where we left off. Every statistical study follows the same four steps. Unit 1B is about step _____.

- ① _____ **questions:** pose a valid investigative question about a population.
- ② _____ **data:** design and carry out a plan for gathering data.
- ③ _____ **data:** organize, display, and summarize what you collected.
- ④ _____ **results:** answer the investigative question in context.

Quick recall from 1A: a **population** is the _____ group we want information about; a **sample** is the _____ we actually collect data from; a **parameter** describes a _____ and a **statistic** describes a _____.

Census Recording information from _____ items or individuals in a population. Usually too expensive, often impossible, sometimes destructive — so we _____ instead.

Planning ahead. Six questions to answer before collecting a single data value:

- 1) What is the question you want to answer?
- 2) Who or what will you collect data from?
- 3) What variable(s) will you measure?
- 4) How will you collect the data?
- 5) What will you do with the data once you have it?
- 6) Who can you generalize your results to?

On the AP® exam, question 4 has only **two** answers:

OBSERVATIONAL STUDY

You watch and record what is already _____. You change nothing.

EXPERIMENT

You deliberately _____ something to the people or things in the study, then see what happens.

Explanatory variable

The variable we think might _____ a change.

Response variable

The _____ we measure on each unit.

Either one can be categorical or quantitative. Some books say “independent” and “dependent” — we will not, because those words already mean something else in statistics.

Does listening to music while studying change quiz scores? Explanatory:
_____ Response: _____

The vocabulary of experiments. In an **experiment**, a researcher _____ conditions (treatments) to experimental units.

EXPERIMENTAL UNIT

The thing a treatment is _____ to. When they are people we call them **subjects** or **participants**.

FACTOR

An _____ variable whose levels are imposed on the units.

LEVELS

The different _____ a factor can take.

TREATMENT

One level of a factor, or a _____ of levels when there is more than one factor.

The **response variable** is what you measure on each unit *after* the treatment has been applied.

Two factors with 3 and 4 levels → _____ × _____ = _____ treatments.

The five-second rule. Rutgers researchers used four foods (watermelon, bread, buttered bread, gummy candy), dropped onto four surfaces (steel, tile, wood, carpet), for four lengths of time (<1 s, 5 s, 30 s, 300 s), with bacteria prepared two different ways.

a) List the factors and the number of levels of each.

b) How many treatments? Show the multiplication.

c) What are the experimental units, and what is the response variable?

Malaria in Kenya. Researchers worked with children in 101 schools, randomly assigning half the schools to receive regular screening and follow-up treatment and the rest to receive no regular screening. All 101 schools were tested for malaria at the end.

a) Identify the treatments.

b) Identify the experimental units. Careful — ask what got *randomly assigned*.

Observational studies. Treatments are _____ imposed — the researcher simply records the values of the variables of interest.

RETROSPECTIVE

Units are chosen now, and data from the _____ are gathered.

PROSPECTIVE

Units are chosen now, and data are gathered now and into the _____.

Survey

An observational study in which data are collected from _____ using a standard set of questions.

Every sample survey you have ever seen — Gallup, Pew, a class poll — is an observational study. Nobody was assigned anything.

Observational study or experiment? Write O or E, and say how you know.

- a) Mothers with morning sickness tend to have children with higher IQs. Researchers looked at 121 children aged 3–7.

- b) The Soffer newspaper staff select a random sample of students in the lunch line and ask what they spent and what they think of the food.

- c) Two hundred 4th graders participated; 100 were *given* flashcards for 6 months while the other 100 used computer practice programs.

- d) Researchers surveyed 402,260 people about daily coffee, then checked death records 15 years later.

Extraneous variable

A variable that is known (or believed) to affect the _____, but is not the explanatory variable being studied.

Confounding variable

Gives an _____ explanation for the relationship you observed, so you cannot say the explanatory variable caused the change.

To be confounding, a variable must satisfy BOTH:

- 1) associated with the _____ variable, **AND**
- 2) associated with the _____ variable.

If you can only argue one of the two, you have named an extraneous variable — not a confounding one. On the AP® exam you must explain both links.

Confounding in action: vitamin D. Hundreds of observational studies show that people with higher vitamin D concentration have a lower risk of diabetes.

Variable	Group 1	Group 2
Vitamin D concentration (explanatory)	High vitamin D concentration	Low vitamin D concentration
Quality of diet	Better diet	Worse diet
Amount of exercise	More exercise	Less exercise
⋮	⋮	⋮
Amount of vitamin supplementation	More likely to take other vitamins	Less likely to take other vitamins
Diabetes status (response)	Less likely to have diabetes	More likely to have diabetes

Pick one variable from the table and explain both links that make it confounding.

Researchers in Norway then ran an **experiment**: 500 people with pre-diabetes randomly assigned to high-dose vitamin D or a **placebo**. After 5 years, about _____ % of *each* group had been diagnosed with diabetes.

What does that tell you about the observational studies?

The fix: run an experiment. Norwegian researchers randomly assigned 500 people with pre-diabetes to a high dose of vitamin D or a placebo. After 5 years, about _____ % of *each* group had been diagnosed with diabetes.

Random assignment A _____ process — not the researcher — decides which unit gets which treatment. (*How to describe one: Topic 1.13.*)

Placebo A treatment with _____ that is otherwise identical to the real one.

Hundreds of observational studies said one thing; one experiment said another. Which do you believe, and why?

Who can we generalize to? A sample is **random** when every unit in it was selected using a _____ process.

RANDOMLY SELECTED

Generalize to _____ .

VOLUNTEERS / HAND-PICKED

Generalize only to individuals
_____ those in the
study.

Sixty 4-year-olds whose parents volunteered were randomly divided into three groups and shown different videos. Largest population we can generalize to?

Understanding check. A National Health Interview Survey asked a **random sample of U.S. adults** about depression symptoms: 21.5% of adults with a high school diploma or less reported them, vs. 12.4% of adults with a college degree.

a) What is the largest population we can generalize to? Why?

b) Can we say education level *causes* a change in depression risk? Why or why not?

Scope of inference. Fill in all four cells. You will use this table for the rest of the year.

		Were units randomly ASSIGNED to treatments?	
		Yes (experiment)	No (observational)
Were units randomly SELECTED?	Yes	Generalize: _____ Cause & effect: _____	Generalize: _____ Cause & effect: _____
	No	Generalize: _____ Cause & effect: _____	Generalize: _____ Cause & effect: _____

Random **selection** buys you the population. Random **assignment** buys you causation. You need both to get both.

The investigative question — revisited. In 1A: a valid investigative question is one based on data that _____. That was the entry ticket. Now the bar goes up.

“How tall are basketball players?” The heights vary... so why is this still a bad investigative question? List everything that is unclear.

The three components of an investigative question. A well-written question does three jobs at once.

1 · VARIABLE(S)

What is measured, on whom, and in what _____? Points to a _____.

Guides the DATA COLLECTION.

2 · ANALYSIS

Are we _____ a parameter, or _____ a claim about it? If a test, which direction?

Guides the ANALYSIS.

3 · CONCLUSION

Which _____ does the answer apply to? Is _____ and effect allowed?

Guides the CONCLUSION.

If you cannot point to all three in the question, the question is not finished.

Component 1 — the variable(s) of interest. *It guides the data collection.* The question has to name what gets _____, on _____, and in what _____ — clearly enough that someone else could go collect the data without asking you a single follow-up question.

In an experiment there are **two** variables to name: the _____ one and the _____ one.

WEAK

"Do students sleep enough?"

STRONG

"What is the mean number of hours of sleep per school night for **all** Soffer students?"

Units count. "Hours" is part of naming the variable — students lose AP® points for parameters with no units.

Component 2 — the type of inference. It guides the choice of analysis.

Name the **parameter**, then say whether we are estimating it or testing a claim about it. The only four parameters this course estimates or tests:

- 1) one population _____
- 2) one population _____
- 3) a _____ of two means
- 4) a _____ of two proportions

ESTIMATE A PARAMETER

Signal words: *estimate, plausible values, how much.*

You need a _____.

TEST A CLAIM

Signal words: *is there convincing evidence that...*

You need a _____.

You do **not** need to know how to build an interval or run a test yet — that is Units 3 and 4. Today you only have to read the question and say which one it is asking for.

Component 2, continued — which way? If the question asks for a test, the wording must also set the **direction**. That is the alternative hypothesis, in plain English, before you have any data.

- greater than / more than / larger than → _____ -sided
- less than / fewer than / reduces / lower → _____ -sided
- differs from / is different from / not equal → _____ -sided
- is there an association / are they independent → _____ (*a later unit*)

The direction has to come from the question, not from the data. You do not get to look at the sample first and then decide.

Component 3 — it guides the conclusion. Two separate questions with two separate answers:

RANDOM SELECTION

Units chosen from a population by chance → you may _____ to that population.

RANDOM ASSIGNMENT

Treatments assigned by chance → you may claim _____.

A study can have one, both, or neither. That is why strong questions say "**all** Soffer students" or "**all** U.S. adults" — the word *all* tells the reader the scope.

The routine — naming the three components. Three lines, every time, in this order. This is exactly what the worksheet asks for.

1. **Variable(s).** What is measured, on whom, in what units? (*In an experiment: explanatory and response.*)
2. **Type of inference.** Which parameter — and estimate it, or test a claim about it? (*If a test: which direction?*)
3. **Type of conclusion.** Which population do the results apply to — and is cause and effect allowed?

If you can answer all three from the question alone, it is well written. If you have to guess at one, that is the missing component.

QUICK DECISION GUIDE — KEEP THIS HANDY ALL YEAR

"Estimate" a parameter, or a difference → _____

"Is there convincing evidence that..." → _____

greater than / less than / differs from → sets the _____

Random **selection** → _____

Random **assignment** → _____

Two model questions worth copying: "What is an estimate of the mean weight, in pounds, of all largemouth bass in Lake Erie?" · "Is there convincing evidence that the proportion of all men in Ohio who own a vehicle is larger than the proportion of all women in Ohio who do?"

Practice: name the three components.

- a) "What is an estimate of the mean number of hours per week that all students at Soffer spend on homework?"

- b) "Does the data provide convincing evidence that more than 60% of all registered voters in Miami-Dade County support the proposed school bond?"

Practice: the hard one — an experiment.

"For all pneumonia patients like the ones in this experiment, do supplemental breathing exercises cause a reduction in the proportion of patients who develop pleurisy, compared with no supplemental breathing exercises?"

1. Variable(s):

2. Type of inference:

3. Type of conclusion:

Why is the word *cause* allowed here — and why does the question still say “like the ones in this experiment”?

Practice: what is missing? Say what is missing, then rewrite it.

a) “Are boys and girls different in how much they text?”

b) “Is there convincing evidence that the 30 fish we caught from the pond have a mean length greater than 15 inches?”

An investigative question is always about a **population** — never about the sample already in your hand.

Practice: write your own. Name the parameter, name the population, make the analysis clear.

a) A coffee shop owner wants a good estimate of how much a typical customer spends, in dollars.

b) A sleep researcher randomly assigns volunteers to a 65°F or a 75°F room and records minutes to fall asleep. Does the cooler room help?

TOPIC 1.11

Random Sampling

Four ways to let chance choose the sample — and how to pick the right one.

Activity: the playlist. Below are the satisfaction scores (0–100) of 50 concertgoers. Circle **5 scores** you think are *representative* of the audience, then compute the mean of your five.

92	89	90	88	95	100	98	93	95	84
82	86	90	88	86	91	90	89	85	83
80	74	80	67	81	82	76	77	74	65
72	68	74	73	70	69	72	70	68	67
69	67	68	68	64	66	63	63	70	68

My five scores: _____
My mean: _____

Class results: the true mean of all 50 scores is _____. Most of the class landed _____.

Why? And would picking 10 songs instead of 5 have fixed it?

Random sampling. A sample is random when a _____ process — not a person — decides who is in it. Choosing by chance rules out both _____ by the sampler and _____ by respondents.

WITHOUT REPLACEMENT

Once a unit is selected it is **not** returned, so it cannot be chosen again. *This is what we do in this course.*

WITH REPLACEMENT

A selected unit **is** returned before the next draw, so it could be chosen again.

Most random number generators sample with replacement. So when you use one to build an SRS you must say that you will _____.

| Simple random sample (SRS) of size n

Every possible _____ of size n has the same chance of being selected.

Read that again — it is about **samples**, not individuals. Line up 20 students alphabetically and flip one coin to take either all the odd positions or all the even positions. Every individual has a 50% chance. Why is this not an SRS?

How to choose an SRS with technology. Say all three steps for full credit.

- 1 _____ . Give every individual a distinct number from 1 to N .
- 2 _____ . Use a random number generator to get n different integers from 1 to N , ignoring repeats.
- 3 _____ . The individuals with those labels are your sample.

There are 28 hotels on the beach strip and a magazine wants an SRS of 4. Write the full description:

| Strata

Non-overlapping groups of individuals who share a characteristic thought to be related to what we are measuring.

| Stratified random sampling

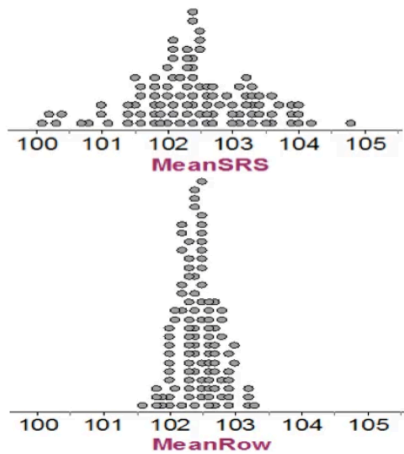
Take an SRS from _____ stratum, then _____ them into one overall sample.

Works best when individuals *within* each stratum are _____ and there are large differences *between* strata. When strata are chosen

wisely, the estimate is more _____ than an SRS of the same size.

Sleep at Soffer: sample size 40, and an SRS might over-select one grade. Describe a stratified plan.

Activity: sampling sunflowers. A 10×10 field, irrigation ditches along the top and bottom, sample of 10 plots. Compare an SRS, one plot per row, and one plot per column.



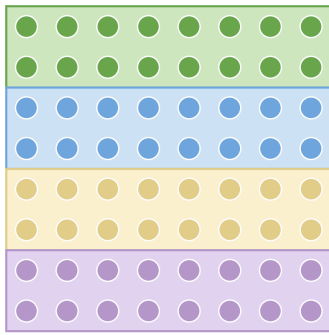
STAPPLET.COM → SAMPLING SUNFLOWERS

- a) How do the **centers** of the three dotplots compare? What does that tell you about bias?
- b) How does the **variability** compare? Which method wins, and why?

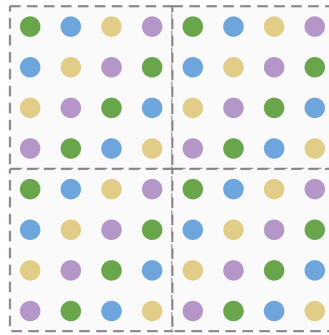
Cluster random sampling

Take an SRS of whole _____, then collect data from _____ individual in the chosen clusters.

Works best when each cluster is _____ — a mini-version of the whole population. Usually chosen for _____ reasons: it saves time and money, and you only need a list of clusters, not of individuals.



STRATA
similar **WITHIN** each group,
different **BETWEEN** groups



CLUSTERS
mixed **WITHIN** each group,
each group mirrors the population

In one sentence each: strata are _____ ; clusters are _____ .

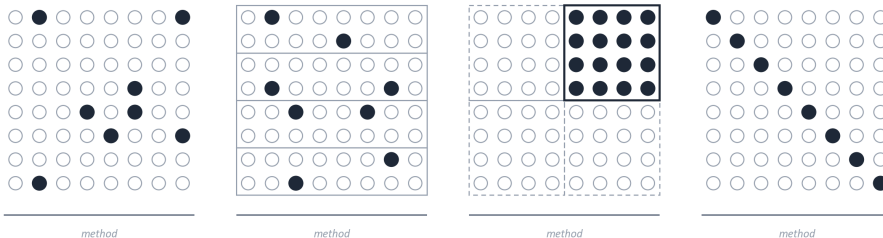
Systematic random sampling

Randomly pick one of the first k individuals, then take every _____ individual after that.

Useful when you cannot list the population in advance — **exit polling** on Election Day is the classic case.

Caution: if there is a pattern in the way the population is ordered that lines up with your interval k , the sample will not be representative. Give an example:

The four random sampling methods. Name each one on the line beneath it.



A **census** is the fifth way to get data from a population — but it is not a sampling method, because you take everybody.

Identify the sampling method.

- ETS divided all colleges into groups of similar type, then randomly selected 3 colleges from *each* group.
- A commissioner randomly selects blocks in her district, then surveys *everyone* on those blocks.
- A manager randomly picks a number 1–10 each night, then surveys that customer and every 10th customer after.
- A teacher puts 30 names in a hat and draws 5 without looking.

Which method should I use?

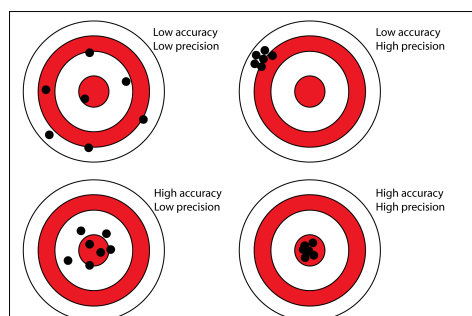
- Full list, no strong subgroups → _____
- Groups that differ a lot, and you want precision → _____
- Population spread out, no list of individuals, save time and money → _____
- Cannot list in advance, but they come by in order → _____

AP® EXAM TIP

"Justify a sampling method" means naming the feature of *this* population that makes *this* method a good fit. "Because it is random" earns nothing.

Understanding check. A warehouse has 100 boxes, each containing 50 identical toys. You want to test 200 toys for quality. Using the framework on the previous page, describe how each method would work, then choose the one you think fits best — and be ready to say why.

Precision vs. accuracy.



Accuracy — is the method centered on the _____? A biased method is inaccurate no matter how big the sample.

Precision — how tightly do repeated samples _____?

Random sampling buys _____. Sample size and good strata buy _____.

TOPIC 1.12

Potential Problems with Sampling

Five different ways a sample can lie to you — and which direction each one lies.

Bias

A _____ error in the sampling procedure that makes the statistic consistently _____ or consistently _____ than the parameter it estimates.

Bias is a property of the **method**, not of one unlucky sample. A bigger sample does _____ fix bias — it just gives a more precise wrong answer.

Convenience sample

Choosing individuals who are _____ to reach.

A gardener counts 53 tomatoes on the 5 plants closest to the house and estimates $53 \times 4 = 212$ for the whole garden. Which way is the estimate off, and why?

Voluntary response sampling

People _____ themselves into the sample by responding to a general invitation.

Examples: internet polls, call-in and text-in polls, "rate us" links, app reviews. Who bothers to respond, and what does that do to the results?

Voluntary response sampling People _____ into the sample by responding to a general invitation.

Internet polls, call-in and text-in polls, write-in surveys, "rate us" links, the review section of any app.

People who bother to respond usually have _____ opinions, and usually _____ ones.

When was the last time you left a restaurant review because the food was exactly as expected?

Undercoverage bias

The sampling method _____ part of the population, or makes part of it less likely to be selected.

Ideally we sample from a **sampling frame** — a list including every member of the population. In practice, that list is usually incomplete.

Nonresponse bias

Individuals _____ for the sample cannot be contacted or refuse to participate.

Do not mix these up. Undercoverage = _____. Nonresponse = _____. Voluntary response = _____.

Nonresponse bias Individuals who were selected cannot be contacted or _____ to participate — and they differ from those who do respond in a way that matters.

UNDERCOVERAGE

You never had a _____ to be picked.

NONRESPONSE

You were _____ and did not answer.

Caution. Nonresponse is not voluntary response. Voluntary response means people invited themselves in.

Response bias

The answers people give tend to differ from the truth _____.

QUESTION WORDING

Confusing or leading questions.

SELF-REPORTING

People round their sleep up and their screen time down.

SOCIAL DESIRABILITY

Answering the way that sounds good.

THE INTERVIEWER

Who is asking, and whether the survey is anonymous.

Response bias can show up even in a **perfect random sample**. Randomizing fixes who you ask, not how you ask.

Question wording in action. A random sample of township residents was asked: "Are you against a Walmart opening in our township, which would increase traffic delays, noise, and pollution?" — 92% said yes.

Explain how the wording creates bias, and say whether 92% is an over- or underestimate.

AP® EXAM TIP — HOW TO DESCRIBE BIAS

If you are asked how a design leads to bias, do **two** things:

1. Describe how the people in the sample would answer *differently* from the rest of the population.
2. Explain whether that leads to an **overestimate** or an **underestimate** of the parameter.

Source of bias? Name the type(s) and the direction.

- a) 1936: *Literary Digest* mailed a survey to 2.8 million people (list built from magazine subscribers, car registrations, telephone directories) and predicted Landon 3-to-2. Roosevelt won 46 of 48 states. Only about 24% of the 10 million surveys mailed came back.

- b) To estimate weekly lunch spending at Soffer, you stand outside the cafeteria one Wednesday and record what students say they spent.

- c) To estimate the average home value in Aventura, you average the asking prices of homes currently listed with one realtor.

2.8 million biased responses lost to 50,000 well-chosen ones. Sample size never fixes bias.

The round-up. Five names, five different failures.

- 1) **Convenience** — _____
- 2) **Voluntary response** — _____
- 3) **Undercoverage** — _____
- 4) **Nonresponse** — _____
- 5) **Response bias** — _____

Random sampling fixes the first _____. Nothing but a better questionnaire fixes the fifth.

TOPIC 1.13

Experimental Design

The four elements, the three designs, and when you are finally allowed to say “caused.”

A bad design. Give 20 students a caffeinated cola, wait 10 minutes, measure their pulse. Their pulse went up.

Their pulse went up compared to what? Name three variables confounded with caffeine here.

The remedy is a **comparative experiment** with two or more groups.

The four elements of a well-designed experiment. Every experiment FRQ is graded against these.

- ① _____ . Compare at least two treatment groups, one of which may be a control group.
 - ② _____ . Use chance to decide which unit gets which treatment.
 - ③ _____ . Use enough experimental units in each group.
 - ④ _____ . Hold other variables the same for every unit.
-

You are going to build one of these. Every August these floors are polished; by December they are scuffed. Tennis balls on the chair legs work, and they are expensive. Is there something cheaper that works just as well? Nobody knows.

Before this topic is over, your period designs a real experiment on a real problem here — and volunteers actually run it.

P3 Chair-leg protectors

P4 The school garden

P6 Cafeteria food waste

P8 Recycling signs

From here on, every element we meet is one you will have to write down for your own study. Take notes accordingly.

Control group

A collection of experimental units created for _____ — a baseline. May get a placebo, a different active treatment, or no treatment at all.

Rwanda assigned school districts to teacher training, teacher training + a community literacy program, or neither. Why was the “neither” group necessary?

Not every experiment needs a control group — but every experiment needs _____ .

Placebo

A treatment with _____ that is otherwise identical to the real treatment.

Placebo effect

The difference between the average response to a placebo and the average response to _____ .

SINGLE-BLIND (SINGLE-MASKED)

The participants do not know which treatment they are getting — **or** the researchers who interact with them do not — but not both.

DOUBLE-BLIND (DOUBLE-MASKED)

Neither the participants **nor** the researchers who interact with them know which treatment each participant is getting.

Blinding protects the study twice. Name both:

Random assignment

Experimental units are assigned to treatments using a _____ process.

Its purpose is to create treatment groups that are as _____ as possible with respect to every extraneous variable — the ones you thought of and the ones you did not. If the groups start out equivalent, the only systematic difference between them is the treatment, and that is what licenses a _____ conclusion.

20 students, caffeinated vs. caffeine-free cola, 10 per group. Describe the random assignment two ways.

a) Using slips of paper:

b) Using technology:

AP® EXAM TIP — STAY AWAY FROM COIN FLIPS

If all 20 students flip a coin, that is a completely randomized design — the groups just will not be exactly 10 and 10. The trouble starts if you **force** equal groups: the last two students in line then almost certainly land in the same group, when they should have only a 50% chance. Just use slips of paper or a random number generator.

Replication

Using _____ experimental units in each treatment group to tell a real difference apart from chance variation in the random assignment.

Caution: in statistics, replication means “use enough units.” In other sciences it means “repeat the whole study somewhere else.” On the AP® exam, use the statistics meaning.

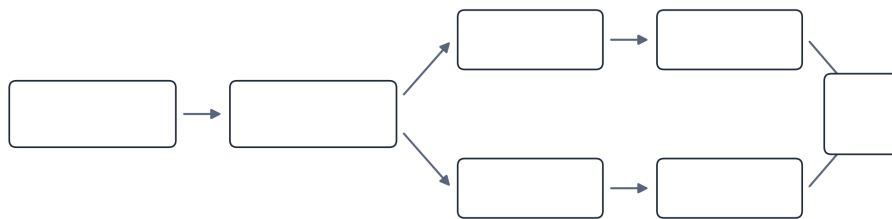
Direct control

Keeping extraneous variables _____ for every experimental unit.

Direct control does two jobs:

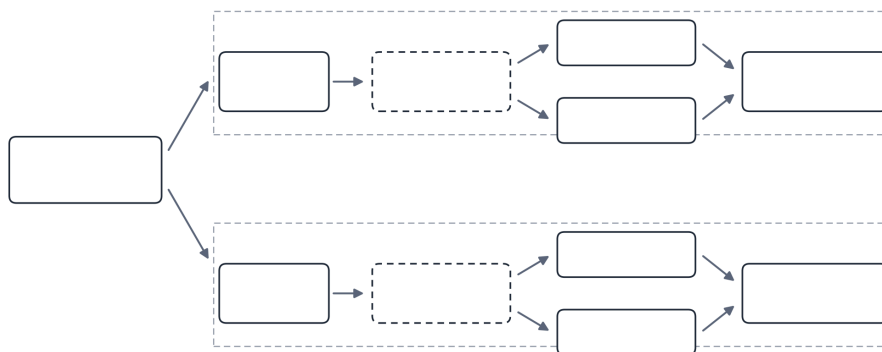
- 1) prevents _____ — a variable held constant cannot explain away your result;
- 2) reduces _____ in the response, which makes a real treatment effect easier to see.

Completely randomized design. Treatments are assigned to experimental units _____ at random, with no restrictions. Label every box.



A diagram by itself is never a complete answer on the AP® exam — you must describe the randomization in words.

Randomized block design. A **blocking variable** is a source of extraneous variation in the response. Group units into **blocks** that are similar with respect to that variable, then randomly assign **all** the treatments **separately within each block**. Label every box.



Blocking is like stratifying — “similar within, different between” — but for **experiments** instead of samples.

Why block? Two students want the fastest route to school. They will test three routes over 15 days. The morning commute is rush hour; the afternoon commute is not.

a) What should they block on, and why?

b) Describe the random assignment within each block.

Control it, block it, or randomize it.

**KNOW IT & CAN
HOLD IT CONSTANT**

→ _____

**KNOW IT, CANNOT
HOLD IT CONSTANT**

→ _____
on it

**DO NOT KNOW
ABOUT IT AT ALL**

→ _____
balances it out

Control what you can, block on what you cannot control, and randomize to balance out the rest.

AP® EXAM TIP — DO NOT MIX THE TWO VOCABULARIES

Sampling words: population, sample, strata, clusters, random *selection*, bias, generalize.

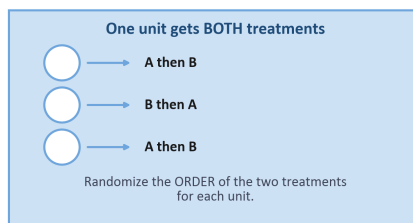
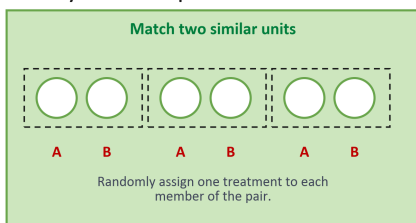
Experiment words: experimental units, treatments, blocks, random *assignment*, confounding, cause and effect.

You lose credit for “use a randomized block design to select the sample” or “randomly assign the treatments using three strata.”

Matched pairs design

A randomized block design with exactly _____ treatments, where the blocks have size _____.

Two ways to build the pairs



Drag suits vs. regular suits, 24 swimmers, 50-metre freestyle. Describe a matched pairs experiment — including how you randomize the **order**.

Which design should I use?

- Units fairly similar, or no big source of variation you can name → _____
- A variable strongly affects the response and you can group units by it → _____
- Exactly two treatments and units can be paired (or each takes both) → _____

Justifying a design means naming the **specific source of variation** in this study that your design handles.

Inference for experiments. When one group does better, there are only two explanations:

- The treatment has no effect, and the difference is just _____ in the random assignment.
- The treatment _____ a difference in the average response.

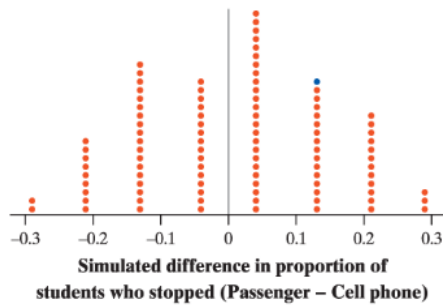
Statistically significant

The observed result is too _____ to be explained by chance alone.

Is a phone worse than a passenger? 48 undergraduates were randomly assigned: half drove a simulator while talking on a phone, half while talking to a passenger. Response: did the driver stop at a specified rest area?

		Treatment		
		Cell phone	Passenger	Total
Response	Stopped at rest area	12	21	33
	Didn't stop	12	3	15
	Total	24	24	48

- Calculate the difference (Passenger – Cell phone) in the proportion who stopped.



100 SIMULATED RANDOM ASSIGNMENTS, ASSUMING NO TREATMENT EFFECT

b) This dotplot has a name: a _____. Explain what one dot represents.

c) Is the observed difference statistically significant? Explain, then say what you may conclude and why.

Scope of inference for experiments. Random assignment allows a cause-and-effect conclusion. But it is often unethical or impossible to randomly *select* experimental units, so most experiments run on _____.

Write the honest conclusion for the driving experiment — including who it applies to:

Ask both questions, every time: **who were the units?** (selection) and **what was done to them?** (assignment).

The one idea to take out of Unit 1B.

Random **SELECTION** decides _____ your answer
is about.

Random **ASSIGNMENT** decides whether you may say

_____.

Neither one is optional, neither substitutes for the other, and no amount of extra data replaces either.