

AP Statistics - Experimental Design and Random Assignment - Answer Key

Common Core AP STAT 3.4, AP STAT 3.5, AP STAT 3.6, HSS-IC.B.3, HSS-IC.B.5 · maths-pdf.fr/en/

Each solution names the design features, shows random assignment steps where digits are given, and states the conclusion the design allows. Descriptions are written in complete sentences, as on the AP exam.

AP Statistics · Common Core State Standards: **AP STAT 3.4, AP STAT 3.5, AP STAT 3.6, HSS-IC.B.3, HSS-IC.B.5**

Exercise 1 - Study or experiment?

(a) No treatments are imposed: observational. (b) Treatments are assigned: experiment. (c) Runners chose their shoes: observational.

(a) observational; (b) experiment; (c) observational.

Exercise 2 - Name the parts

Units: the 60 students. Explanatory variable: study method. Treatments: flash cards, video lesson, no special method (control). Response: quiz score.

60 students; method of studying; 3 treatments; quiz score.

Exercise 3 - Confounding

Students who choose to take a course may be more motivated or have more resources.

Motivation (or family resources) is confounded with the course: it is associated with taking the course and also affects scores, so we cannot attribute the 80 points to the course.

Exercise 4 - Placebo and blinding

The inactive pill is a placebo (control group).

Placebo control; double-blind. Blinding prevents expectations from influencing

reported or rated pain.

Exercise 5 - Random assignment

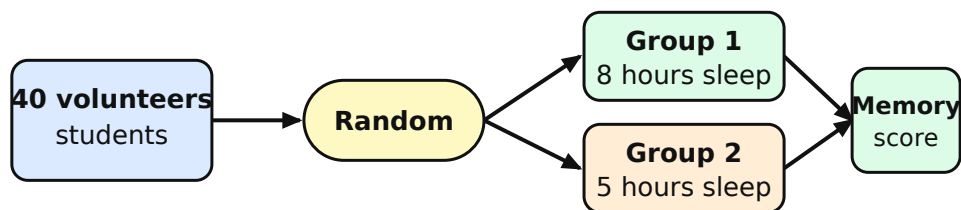
Random digits
05 41 12 07 98 03 12 11 77 09 10 06 04

Random digits for assignment.

05 selected, 41 skipped (out of range), 12 selected, 07 selected, 98 skipped (out of range), 03 selected, 12 skipped (repeat), 11 selected, 77 skipped (out of range), 09 selected.

Fertilizer group: plants 03, 05, 07, 09, 11, 12. The other six plants are the control group.

Exercise 6 - Completely randomized design

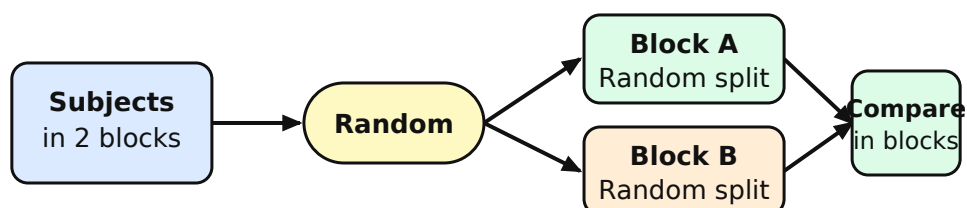


Completely randomized design: random assignment to two treatments, then compare the response.

Randomly assign 20 students to 8 hours and 20 to 5 hours (for example by drawing names), have every group do the same memory test the next day, and compare the mean scores.

Random assignment of 20 students per group, same test for all, compare the group means.

Exercise 7 - Why block?



Randomized block design: randomize within blocks of similar subjects.

Experience strongly affects running time. Blocking compares the shoes within similar runners.

Blocking removes the variation due to experience, making any shoe effect easier to see.

Exercise 8 - Matched pairs

Each student receives both treatments.

Matched pairs design (each student is their own control); it removes person-to-person differences in typing speed.

Exercise 9 - Replication

One cake per oven gives no information about the usual variation.

She needs replication: bake many cakes in each oven, randomly assigned.

Exercise 10 - Scope of inference

	Random assignment	No random assignment
Random selection	Generalize and cause	Generalize only
No random selection	Cause for the sample	Neither

Scope of inference: selection controls generalizing; assignment controls causation.

Random selection supports generalizing to the city. Random assignment supports cause and effect.

They can generalize to all adults in the city and conclude that the difference in results was caused by the diets.

Exercise 11 - Volunteers

Volunteers are not a random sample.

Cause and effect: yes (random assignment). Generalization to all teenagers: no

(volunteers).

Exercise 12 - Statistical significance

A 2% chance is small.

The result is statistically significant: a difference of 6 points is unlikely if tutoring had no effect, so there is evidence tutoring helps.

Exercise 13 - Identify the flaw

Volunteering and class period are not random.

Groups were not formed by random assignment (volunteers differ), and the class period is confounded with the treatment.

Exercise 14 - Design a double-blind test

Randomly assign 25 volunteers to the energy drink and 25 to a look-alike placebo drink. A third person prepares the cups, so neither the volunteers nor the tester knows who got which. Compare mean reaction times.

Random assignment, placebo, double-blind, same test for both groups, compare the means.

Exercise 15 - Control group

Plants grow even without fertilizer.

A control group provides a baseline, so any difference can be attributed to the fertilizer.

Exercise 16 - Lurking variable

Coffee drinkers may differ in income, exercise, or health.

Confounding variables (such as lifestyle or income) could explain the longer life, so causation cannot be concluded.

Exercise 17 - Blocks or strata

Blocks: sprinters and distance runners.

Randomly assign 6 sprinters to plan 1 and 6 to plan 2; do the same for the distance runners. Compare the plans within each block.

Exercise 18 - Equal group sizes

$\frac{60}{3} = 20$ seeds per condition.

20 seeds per condition. Number the seeds 01 to 60, select 20 labels for condition 1, then 20 more for condition 2; the rest go to condition 3.

Exercise 19 - Evaluate a claim

Was there a comparison group, and was assignment random?

There is no control group and no random assignment, so we do not know what would have happened without the pill. Blinding is also not mentioned.

Exercise 20 - Multi-step

A: $\frac{27}{45} = 60\%$. B: $\frac{36}{45} = 80\%$. Difference: 20 percentage points.

B improved at 80% compared with 60% for A. We need to know how likely a 20-point difference is by chance (a significance test) to call it statistically significant.