

Potential Problems with Sampling

1. A school wants to determine students' opinions about the quality of the cafeteria. The principal surveys only students who eat lunch in the cafeteria. What is the most likely problem?

- A. Voluntary response bias
- B. Undercoverage
- C. Response bias
- D. Nonresponse bias

2. A newspaper asks readers to visit its website and vote on whether taxes should be increased. Thousands of people participate. What problem is most likely?

- A. Undercoverage
- B. Nonresponse bias
- C. Voluntary response bias
- D. Response bias

3. A university randomly selects 1,000 graduates and sends them a survey. Only 180 graduates complete the survey. What potential problem does this create?

- A. Undercoverage
- B. Nonresponse bias
- C. Voluntary response bias
- D. Sampling variability

Sampling	抽样
Population	总体
Sample	样本
Bias	偏差
Undercoverage	覆盖不足
Nonresponse	无回应
Nonresponse Bias	无回应偏差
Voluntary Response Bias	自愿回应偏差
Response Bias	回应偏差
Sampling Variability	抽样变异

- **Undercoverage** occurs when some groups in the population are left out.
- **Nonresponse** happens when selected individuals do not participate.
 - **Response bias** occurs when participants give inaccurate answers.
- **Voluntary response samples** tend to overrepresent strong opinions.
- **Convenience samples** often fail to represent the population accurately.

A school district wants to determine the percentage of high school students who regularly exercise for at least 30 minutes per day. The district has 4,000 high school students.

The district randomly selects 300 students and emails them a survey. Of the 300 students selected, 180 complete the survey. The results show that 72% of the students who responded exercise regularly.

(a) Identify the population of interest in this study.

(b) Identify the sample.

(c) Describe one potential source of bias in this study.

(d) ↳ Explain why the 72% result may not accurately represent the percentage of all students in the district who exercise regularly.

(e) Suppose the district instead posts the survey online and asks students to voluntarily complete it.

↳ Explain why this sampling method could introduce bias.

(f) ↳ Describe one improvement the district could make to reduce the potential for bias.

(g) ↳ Explain why increasing the sample size alone would not necessarily eliminate bias in this study.

(a) Population: All 4,000 high school students in the district.

(b) Sample: The 300 randomly selected students.

(c) Potential bias: **Nonresponse bias** because 120 selected students did not respond.

(d) The 120 nonrespondents may exercise at different rates than respondents, so the 72% may not represent the population.

(e) **Voluntary response bias**: students with strong opinions or particular exercise habits may be more likely to participate.

(f) ↳ Follow up with nonrespondents and encourage them to complete the survey.

(g) A larger sample reduces **sampling variability**, but it does not eliminate **bias**.

Stretch and Challenge Questions — Potential Problems with Sampling

1. Random Sampling vs. Nonresponse

A researcher randomly selects 1,000 people but only 250 respond. Explain why the study can still suffer from bias despite using a random sample.

2. Voluntary Response

A survey of 10,000 people finds that 68% support a new policy. The survey was conducted using an online poll that anyone could complete. Can the researcher generalize the result to the entire population? Explain.

3. Undercoverage

A school surveys 500 students about homework. Students who are absent on the survey day are not included. Identify the potential problem and explain how it could affect the results.

4. Sample Size vs. Bias

A researcher claims, "Our sample is unbiased because it contains 5,000 people." Explain why this statement may be incorrect.

1. **Random Sampling vs. Nonresponse:** Nonresponse bias may occur if responders differ from nonresponders.
2. **Voluntary Response:** No. People self-select, creating potential voluntary response bias.
3. **Undercoverage:** Absent students are excluded and may differ from those present.
4. **Sample Size vs. Bias:** A large sample can still be biased if the sampling method is biased.

Experimental Design

Experiment

实验

Experimental Unit

实验单位

Subject

研究对象

Treatment

处理

Control Group

对照组

Control

控制

Random Assignment

随机分配

Replication

重复

Placebo

安慰剂

Blinding

盲法

1. **Random Assignment** — Use chance to assign subjects to treatment groups, helping create comparable groups.
2. **Control Group** — Provides a baseline for comparison with the treatment group.
3. **Control of Variables** — Keep other factors consistent so the effect of the treatment can be measured.
4. **Replication** — Use enough subjects/experimental units to make results more reliable.
5. **Placebo** — An inactive treatment used to account for the placebo effect.
6. **Blinding** — Prevent subjects or researchers from knowing which treatment is being given.
7. **Double-Blind** — Neither the subjects nor the researchers interacting with them know the treatment assignments.
8. **Statistically Significant** — Results are unlikely to have occurred simply because of random chance.
9. **Cause-and-Effect** — A well-designed randomized experiment can provide evidence that a treatment causes a change in the response variable.
10. **Random Sampling vs. Random Assignment** — Random sampling allows generalization to a population; random assignment allows stronger conclusions about cause and effect.

A researcher wants to determine whether a new study app improves students' mathematics test scores. The researcher recruits **100 students** from a high school.

The students are randomly assigned to one of two groups. Group A uses the new study app for four weeks, while Group B uses the school's usual study materials. At the end of four weeks, all students take the same mathematics test.

- (a) Identify the experimental units in this study.
- (b) Identify the treatment being studied.
- (c) Explain how **random assignment** helps the researcher.
- (d) Identify the control group and explain its purpose.
- (e) Explain why replication is important in this experiment.
- (f) The researcher wants to make the experiment **double-blind**. Explain what this would mean.
- (g) If students using the app score significantly higher than students using the usual materials, can the researcher conclude that the app **caused** the higher scores? Explain.
- (h) Can the researcher generalize the results to all high school students? Explain.

- (a) The 100 students.
- (b) The new study app.
- (c) Creates comparable groups and reduces confounding.
- (d) Group B; provides a baseline for comparison.
- (e) Makes results more reliable and reduces the effect of chance.
- (f) Neither students nor researchers know which treatment each student receives.
- (g) Yes. Random assignment allows a **cause-and-effect** conclusion.
- (h) No. The students were not randomly sampled, so generalization to all high school students is not justified.

TRUE or FALSE

- A placebo helps control for expectations.

TRUE or FALSE

- Blinding can reduce response bias and expectation effects.

TRUE or FALSE

- Double-blinding is where neither subjects nor relevant researchers know the assignments..

Key Words

1. Lationpopu → _____
2. Maspel → _____
3. Susence → _____
4. Veysur → _____
5. Servationob → _____
6. Mentexperi → _____
7. Domran Plesam → _____
8. Sabi → _____
9. Lingsam Mefra → _____
10. Sponsere Terra → _____