

Collecting Data

AP Statistics ■ Unit 3

AP Statistics



Collecting Data

What we will cover

- 1 Trusting the data
- 2 Observational vs experiment
- 3 Random sampling
- 4 When sampling goes wrong
- 5 Designing experiments
- 6 Scope of inference



1 Trust

Collecting Data

└ Trust

Trusting the data

The *method* of collection decides what we may claim. We study a **sample** 样本 to learn about a **population** 总体.

- **bias** 偏差 tilts a sample systematically off the truth

Good data comes first – a clever calculation cannot rescue a badly collected sample.



Clinical trial lab

2 Observational

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└ Observational

Observational vs experiment

- an **observational study** 观察性研究 watches – shows only **association** 关联
- an **experiment** 实验 applies a **treatment** 处理 – can prove **cause** 因果关系

A **confounding variable** 混杂变量 tied to both explanatory and response is why observation can't claim cause.



Random dice

3 Sampling

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└ Sampling

Random sampling

Let **chance**, not the researcher, choose – four random designs:

SRS 简单随机抽样: every group of n equally likely

Stratified 分层: SRS within similar **strata** 层

Cluster 整群: pick whole **clusters** 群

Systematic 系统: every k -th individual



Sampling bias crowd

Random selection lets us **generalize** 推广 the sample result to the whole population.

4 Wrong

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└ Wrong

When sampling goes wrong

Even a “random” plan can bias:

- **undercoverage** 覆盖不足: groups left out
- **voluntary response** 自愿回应: only strong feelings
- **nonresponse** 无回应, **response bias** 回应偏差, wording

A bigger sample does not fix bias – it just makes a bigger biased sample. Method beats size.



5 Experiments

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└ Experiments

Designing experiments

Three principles:

- **control** 控制: hold other variables equal
- **randomization** 随机化: balances unknowns
- **replication** 重复: many units per treatment

A **placebo** 安慰剂 + **double-blind** 双盲 design separate the real effect from belief.



6 Scope

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└ Scope

Scope of inference

Two uses of randomness set what you may claim:

- random **assignment** 随机分配
⇒ cause
- random **selection** 随机选择
⇒ generalize

Blocking 区组化 / **matched pairs** 配对设计 remove a known source of variability.

select: no select: yes	
cause, these only	cause + generalize
assoc., these only	assoc., generalize

7 Recap

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└ Recap

Worked example – spotting the bias

A school emails a survey to all students; 80 of 1000 reply, and 70 say they want a later start. Identify the flaw.

- Everyone *could* reply, so this is a **voluntary response** sample, not a random one.
- Only students who **care strongly** bother – and those wanting a later start care most.
- So the 87.5% is **biased upward**; you cannot generalise to all 1000.
- Fix: take a **simple random sample** and follow up non-responders ⇒ a **representative estimate**.

Name the bias and say **which direction** it pushes the estimate – that is where the marks are. A big sample does **not** fix bias; only good **selection** does.

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└ Recap

Unit 3 – key takeaways

1 Study type

observation shows association; experiment proves cause

2 Sampling

SRS, stratified, cluster, systematic; bias ≠ fixed by size

3 Experiments

control, randomize, replicate; placebo + blinding

4 Scope

assignment → cause; selection → generalize

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└ Recap

Check yourself

- 1 Which study type can prove cause and effect?
- 2 What sampling method takes an SRS within each stratum?
- 3 Does a larger sample remove bias?
- 4 What must be random to generalize to a population?

cause	both
assoc.	gen.

Answers 1. a randomized experiment 2. stratified 3. no 4. random selection