

Exercise walk-through

5.4

Biased and Unbiased Point Estimates

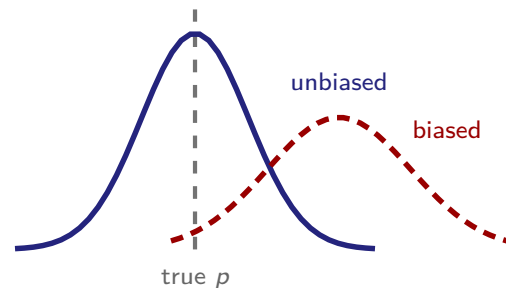
AP Statistics

Bias and variability

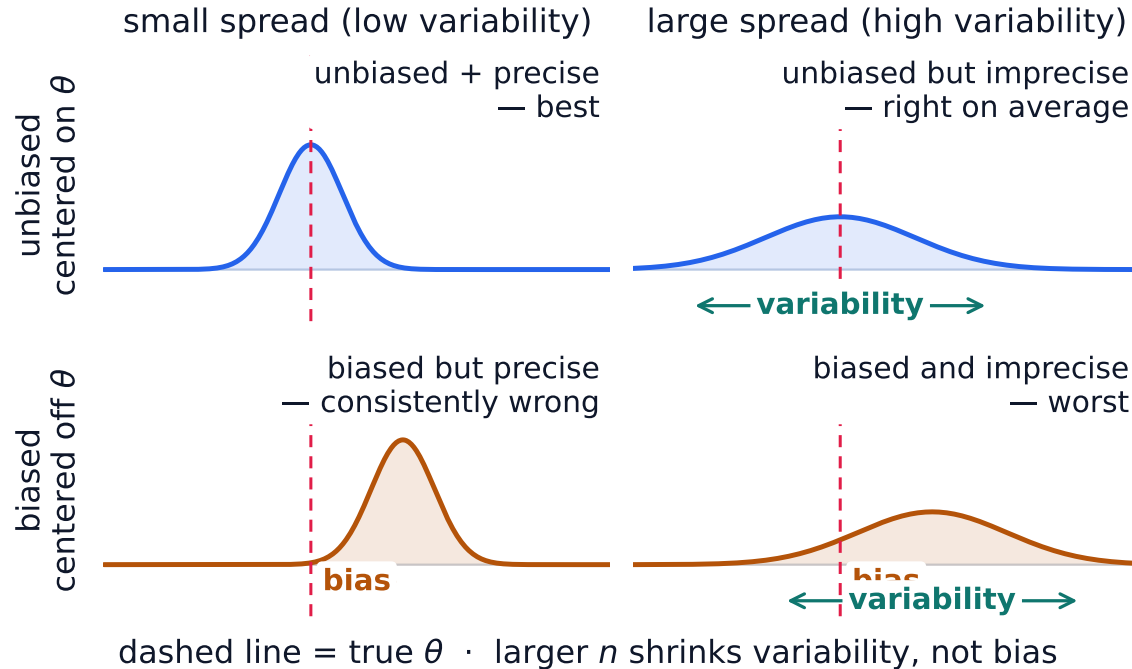
A **point estimate** uses one sample. An **estimator** is **unbiased** when its sampling distribution centers **on** the parameter.

- bias is about *aim*
- **variability** shrinks as n grows

Ideal: unbiased *and* low variability
– a bigger sample buys the second.



Good Guesses and Bad Guesses: Bias



Bias and variability are separate faults. Only the top-left estimator is both centered on θ and tight; the bottom-left one is precise but

Sampling distribution of a proportion

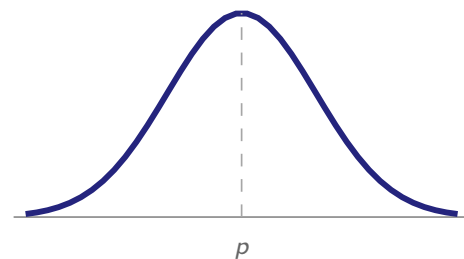
For a sample proportion $\hat{p}$:

$$\mu_{\hat{p}} = p \quad \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$$

Normal when two conditions hold:

- **large counts** : $np \geq 10$ and $n(1-p) \geq 10$
- **10% condition** 10% : $n \leq 0.10 N$

$\hat{p}$ is unbiased; bigger n under the root
 $\Rightarrow$ less bounce.



Centered on p ,
spread $\sigma_{\hat{p}}$.

Exercises 2.1-2.3

2.1 Define a point estimate.

[1]

2.2 State what it means for an estimator to be unbiased.

[1]

2.3 State one example of an unbiased estimator.

[1]

Exercises 2.1-2.3

2.1 Define a point estimate.

[1]

2.1

- a single value from a sample used to estimate a population parameter
-

2.2 State what it means for an estimator to be unbiased.

[1]

2.2

- its sampling distribution is centred on the true parameter
-

2.3 State one example of an unbiased estimator.

[1]

2.3

- the sample mean $\bar{x}$ or the sample proportion $\hat{p}$ (any one)

Exercises 3.1-3.2

3.1 A single value used to estimate a parameter is a

[1]

☐

- A parameter
- B point estimate
- C population
- D census

3.2 An unbiased estimator is centred on the

[1]

☐

- A sample
- B true parameter
- C value zero
- D maximum

Exercises 3.1-3.2

3.1 A single value used to estimate a parameter is a

[1]

☐

- A parameter
- B point estimate
- C population
- D census

3.1 B

- point estimate.

3.2 An unbiased estimator is centred on the

[1]

☐

- A sample
- B true parameter
- C value zero
- D maximum

3.2 B

- true parameter.

Exercise 3.3 (a)

3.3 The sample mean $\bar{x}$ is used to estimate μ .

(a) Name this kind of value.

[1]

Exercise 3.3 (a)

3.3 The sample mean $\bar{x}$ is used to estimate μ .

(a) Name this kind of value.

[1]

(a)

- a point estimate

Exercise 3.3 (b)

3.3 The sample mean $\bar{x}$ is used to estimate μ .

(b) State what "unbiased" means for $\bar{x}$.

[1]

Exercise 3.3 (b)

3.3 The sample mean $\bar{x}$ is used to estimate μ .

(b) State what "unbiased" means for $\bar{x}$.

[1]

(b)

- its sampling distribution is centred at μ

Exercise 3.3 (c)

3.3 The sample mean $\bar{x}$ is used to estimate μ .

(c) State what $\bar{x}$ estimates.

[1]

Exercise 3.3 (c)

3.3 The sample mean $\bar{x}$ is used to estimate μ .

(c) State what $\bar{x}$ estimates.

[1]

(c)

- the population mean μ