

Estimator Properties

Mathematics

The four properties an estimator is judged on, and how they interact.

An estimator is a rule that turns a sample into a guess at a population parameter.

SAMPLE VARIANCE DIVISOR

$n - 1$, for unbiasedness

STANDARD ERROR OF A MEAN

$\sigma/\sqrt{n}$

MEAN SQUARED ERROR

Variance + bias²

- Unbiased: its expectation is the true parameter
- Consistent: it converges to the truth as n grows
- Efficient: least variance within a stated class
- Sufficient: it uses all the information in the sample
- $MSE = \text{variance} + \text{bias}^2$, so both terms matter
- An unbiased estimator can still be a poor one

LOOK FOR IT

Dividing by $n - 1$ rather than n is what makes the sample variance unbiased.

Unbiasedness and consistency are independent properties. An estimator can have either one without the other. Educational reference.