Def

sample mean.

population: it consists of the totality of the observations

sample: a fraction of population

rample sampling: each observation is made independently and randomly

statistic: a function of the random sample $X_1, X_2, \cdots, X_n$.

Sample mean:

✓ $$\bar{X} = \frac{\sum_{i}^{n} X_i}{n}.$$

Sample variance:

✓ $$S^2 = \frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}$$

$$= \frac{\sum_{i=1}^{n} X_i^2 - n \cdot \bar{X}^2}{n-1}.$$

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sampling distribution:

the probability distribution of statistic.

△ $\bar{X}$:

CLT.

if $X_1, X_2, \cdots, X_n$ are n i.i.d.

$E(X_i) = \mu$.

$Var(X_i) = \sigma^2$.

then. $\sum_{i=1}^{n} X_i \sim N(\underline{mean}, \underline{var})$.

mean $= \sum \mu = n\mu$.

var $= n\sigma^2$

sample mean. $\underline{\bar{X}} = \frac{1}{n} \cdot \underline{\sum X_i}$.

$\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$.

$E(\bar{X}) = \frac{1}{n} \cdot E(\sum X_i) = \frac{1}{n} \cdot n\mu = \mu$.

$Var(\bar{X}) = \frac{1}{n^2} Var(\sum X_i) = \frac{1}{n^2} \cdot n \cdot \sigma^2 = \frac{\sigma^2}{n}$.

3 areas in Statistical Inference.

→ ① parameter estimation. $\square$

② hypothesis testing $\square$

③ prediction on the future data

Q. How do we find the estimators?

Maximum Likelihood Estimation.

(MLE)

How done estimation ~~sample~~ population mean ?

~~Sam~~ population variance ?

Sample mean → population mean.

Sample variance → population variance

CI

Q How well is your estimator?