

Confidence interval

A $1-\alpha$ confidence interval is an interval $[\hat{\theta}^-, \hat{\theta}^+]$ such that

$$\mathbb{P}(\hat{\theta}^- \leq \theta \leq \hat{\theta}^+) \geq 1 - \alpha$$

for all θ .

In other words, there is a $1-\alpha$ probability that the generated confidence interval (random value based on sampling) captures the true value (deterministic).

Gaussian case

Assume:

$$\hat{\theta} \sim N(\theta, \text{se}^2) \sim N(\theta, \hat{\text{se}}^2)$$

Normal tables give us the following:

$$\mathbb{P}\left(\left|\frac{\hat{\theta} - \theta}{\text{se}}\right| \leq 1.96\right) \approx 0.95$$

$$\mathbb{P}(\hat{\theta} - 1.96 \text{se} \leq \theta \leq \hat{\theta} + 1.96 \text{se}) \approx 0.95$$

So the 95% confidence interval is:

$$[\hat{\theta} - 1.96 \text{se}, \hat{\theta} + 1.96 \text{se}]$$

The approximation $\text{se} \approx \hat{\text{se}}$ may cause significant deviation.

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