

Delta method

The Delta method is used to calculate the asymptotic variance of a random variable that is a function of another random variable. The derivative of the function and the mean and asymptotic variance of the second RV are used.

Let Z_n be a sequence of random variables such that

$$\sqrt{n}(Z_n - \theta) \xrightarrow[n \rightarrow \infty]{(d)} \mathcal{N}(0, \sigma^2)$$

where σ^2 is the asymptotic variance, and $\theta \in \mathbb{R}$. This means that Z_n is asymptotically normal.

Given a function $g: \mathbb{R} \rightarrow \mathbb{R}$ that is **continuously differentiable** at θ ,

- $g(Z_n) \xrightarrow[n \rightarrow \infty]{(\text{P})} g(\theta)$
- $(g(Z_n))_{n \geq 1}$ is also asymptotically normal with asymptotic variance $g'(\theta)^2 \sigma^2$
- In other words,

$$\sqrt{n}(g(Z_n) - g(\theta)) \xrightarrow[n \rightarrow \infty]{(d)} \mathcal{N}(0, g'(\theta)^2 \sigma^2)$$

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