Normal Distribution and Central Limit Theorem

Confidence Intervals and Levels of Significance

Confidence Interval	Level of Significance	One-Tail Z_{α}	Two-Tail $Z_{\alpha/2}$
90 %	10 %	1.28	1.645
95	5	1.645	1.96
98	2	2.055	2.33
99	1	2.33	2.575

Central Limit Theorem

Given a Normal Distribution with Mean = μ, Variance = σ^2, and Standard Deviation = σ,
The Sampling Distribution of all possible Sample Means X of Sample Size n,
is normally distributed with

Mean : $\mu_{\overline{X}} = \mu$ Variance : $\sigma_{\overline{X}}^2 = \sigma^2/n$ Standard Deviation : $\sigma_{\overline{X}} = \sigma/\sqrt{n}$.

Hypothesis Testing

If population standard deviation (σ) is known, use Z_{test} regardless of sample size.

If population standard deviation (σ) is unknown, assume σ = s.
If sample size is n ≥ 30, use Z_{test};
if sample size is n < 30, use t_{test}.

Note: Montgomery & Runger suggest that sample size n = 40 is the appropriate large sample criteria.

$$Z_{test} = \frac{\overline{X} - \mu}{s/\sqrt{n}} \qquad t_{test} = \frac{\overline{X} - \mu}{s/\sqrt{n}}$$

$$\text{Margin of Error} = \frac{s}{\sqrt{n}} Z_{\alpha/2}$$

Tolerance Interval

$$\mu = \overline{X} \pm \frac{\sigma}{\sqrt{n}} Z_{\alpha/2} \qquad \mu = \overline{X} \pm \frac{s}{\sqrt{n}} t_{\alpha/2}$$

$$\overline{X} - \frac{\sigma}{\sqrt{n}} Z_{\alpha/2} \le \mu \le \overline{X} + \frac{\sigma}{\sqrt{n}} Z_{\alpha/2} \qquad \overline{X} - \frac{s}{\sqrt{n}} t_{\alpha/2} \le \mu \le \overline{X} + \frac{s}{\sqrt{n}} t_{\alpha/2}$$

$$\text{Minimum Sample Size} = \left[\frac{s\, Z_{\alpha/2}}{E}\right]^2$$