Summary of Confidence Interval and Hypothesis Testing Formulae

Setting	Estimate	Standard Error	Confidence Interval	Test Statistic	Distribution
Population Mean					
— σ known	$\bar{x}$	$\text{SE} = \frac{\sigma}{\sqrt{n}}$	$\bar{x} \pm z^* \text{SE}$	$z = \frac{\bar{x}-\mu_0}{\text{SE}}$	$\text{Normal}(0,1)$
— σ unknown	$\bar{x}$	$\widehat{\text{SE}} = \frac{s}{\sqrt{n}}$	$\bar{x} \pm t^* \widehat{\text{SE}}$	$t = \frac{\bar{x}-\mu_0}{\widehat{\text{SE}}}$	$\text{t}(n-1)$
Difference Between Population Means					
— σ_1 and σ_2 known	$\bar{x}_1 - \bar{x}_2$	$\text{SE} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$	$\bar{x}_1 - \bar{x}_2 \pm z^* \text{SE}$	$z = \frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\text{SE}}$	$\text{Normal}(0,1)$
— $\sigma_1 = \sigma_2$ unknown	$\bar{x}_1 - \bar{x}_2$	$\widehat{\text{SE}} = s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$	$\bar{x}_1 - \bar{x}_2 \pm t^* \widehat{\text{SE}}$	$t = \frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\widehat{\text{SE}}}$	$\text{t}(n_1+n_2-2)$
— $\sigma_1 \neq \sigma_2$ unknown	$\bar{x}_1 - \bar{x}_2$	$\widehat{\text{SE}} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$	$\bar{x}_1 - \bar{x}_2 \pm t^* \widehat{\text{SE}}$	$t = \frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\widehat{\text{SE}}}$	$\text{t}(f)$
Paired Samples					
— σ_d known	$\bar{d} = \bar{x}_1 - \bar{x}_2$	$\text{SE} = \frac{\sigma_d}{\sqrt{n}}$	$\bar{d} \pm z^* \text{SE}$	$z = \frac{\bar{d}-\mu}{\text{SE}}$	$\text{Normal}(0,1)$
— σ_d unknown	$\bar{d} = \bar{x}_1 - \bar{x}_2$	$\widehat{\text{SE}} = \frac{s_d}{\sqrt{n}}$	$\bar{x} \pm t^* \widehat{\text{SE}}$	$t = \frac{\bar{x}-\mu}{\widehat{\text{SE}}}$	$\text{t}(n-1)$
Population Proportion					
— confidence intervals	$\hat{p}$	$\widehat{\text{SE}} = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$	$\hat{p} \pm z^* \widehat{\text{SE}}$		
— hypothesis tests	$\hat{p}$	$\widehat{\text{SE}} = \sqrt{\frac{p_0(1-p_0)}{n}}$		$z = \frac{\hat{p}-p_0}{\widehat{\text{SE}}}$	$\text{Normal}(0,1)$
Difference Between Population Proportions					
— confidence intervals	$\hat{p}_1 - \hat{p}_2$	$\widehat{\text{SE}} = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$	$\hat{p}_1 - \hat{p}_2 \pm z^* \widehat{\text{SE}}$		
— hypothesis tests	$\hat{p}_1 - \hat{p}_2$	$\widehat{\text{SE}} = \sqrt{\bar{p}(1-\bar{p}_1)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$		$z = \frac{(\hat{p}_1-\hat{p}_2)-0}{\widehat{\text{SE}}}$	$\text{Normal}(0,1)$

For a confidence interval with confidence level C, z^* is the value such that the area between $-z^*$ and z^* under the standard normal distribution is C.

For a confidence interval with confidence level C, t^* is the value such that the area between $-t^*$ and t^* under a t distribution with the indicated degrees of freedom is C.

$s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$ is a weighted average of the two sample variances weighted by their degrees of freedom and is used to estimate the common unknown population standard deviation.

$$f = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1-1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2-1}}$$

is a (non-integer) estimate of the degrees of freedom of the t distribution that best approximates the actual sampling distribution of the test statistic in the case that the population standard deviations are different and unknown.

s_d is the sample standard deviation of the matched differences.

$\bar{p} = \frac{X_1+X_2}{n_1+n_2}$ is the combined sample proportion of successes.