If you are working with proportions:

Means, $\sigma$ known

$\sigma_x = \sigma / \sqrt{n}$

$z = \frac{X - \mu}{\sigma_x} = \frac{X - \mu}{\sigma / \sqrt{n}}$

$e = z_{a/2} \sigma_x = z_{a/2} \frac{\sigma}{\sqrt{n}}$

$n = \left( \frac{z_{a/2} \sigma}{e} \right)^2$

$\mu = \bar{X} \pm e = \bar{X} \pm z_{a/2} \sigma_x = \bar{X} \pm z_{a/2} \sqrt{\frac{\sigma}{n}}$

Proportions

$\sigma_p = \sqrt{\frac{p(1-p)}{n}}$

$z = \frac{\bar{p} - p}{\sigma_p} = \frac{\bar{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$

$e = z_{a/2} \sigma_p = z_{a/2} \sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

$n = \frac{z_{a/2}^2 p(1-p)}{e^2}$

If you’re working with means, determine if $\sigma$ is known or if $\sigma$ is unknown, determine the sample size $n$

Means, $\sigma$ unknown, $n \geq 30$

$s_x = \frac{s}{\sqrt{n}}$

$z = \frac{\bar{X} - \mu}{s_x} = \frac{\bar{X} - \mu}{s / \sqrt{n}}$

$e = z_{a/2} s_x = z_{a/2} \frac{s}{\sqrt{n}}$

$n = \left( \frac{z_{a/2} s}{e} \right)^2$

$\mu = \bar{X} \pm e = \bar{X} \pm z_{a/2} s_x = \bar{X} \pm z_{a/2} \sqrt{\frac{s}{n}}$

Means, $\sigma$ unknown, $n < 30$

$s_x = \frac{s}{\sqrt{n}}$

$t = \frac{\bar{X} - \mu}{s_x} = \frac{\bar{X} - \mu}{s / \sqrt{n}}$

$e = t_{a/2} s_x = t_{a/2} \frac{s}{\sqrt{n}}$

$n = \left( \frac{t_{a/2} s}{e} \right)^2$

$\mu = \bar{X} \pm e = \bar{X} \pm t_{a/2} s_x = \bar{X} \pm t_{a/2} \sqrt{\frac{s}{n}}$
**More Statistical Formulas**

Standardized Score (z-score) – \[ z = \frac{X - \mu}{\sigma} \]

**Testing Differences Between Two Means (\(\mu_1 - \mu_2\))**

for large independent samples where \(\sigma_1\) and \(\sigma_2\) are known

\[
z = \frac{\bar{X}_1 - \bar{X}_2}{\sigma_{\bar{X}_1 - \bar{X}_2}}
\]

\[
\sigma_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}
\]

\[
\mu_1 - \mu_2 = (X_1 - X_2) \pm z_{\alpha/2} \sigma_{\bar{X}_1 - \bar{X}_2}
\]

for small independent samples where \(\sigma_1\) and \(\sigma_2\) are unknown but assumed equal

\[
t = \frac{\bar{X}_1 - \bar{X}_2}{s_{\bar{X}_1 - \bar{X}_2}}
\]

\[
s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}
\]

\[
\mu_1 - \mu_2 = (X_1 - X_2) \pm t_{\alpha/2} s_{\bar{X}_1 - \bar{X}_2}
\]

for large independent samples where \(\sigma_1\) and \(\sigma_2\) are unknown but assumed not equal

\[
t = \frac{\bar{X}_1 - \bar{X}_2}{s_{\bar{X}_1 - \bar{X}_2}}
\]

\[
s_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}
\]

\[
\mu_1 - \mu_2 = (X_1 - X_2) \pm t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}
\]

\[
df = n_1 + n_2 - 2
\]

**Testing Paired Differences Between Two Means**

\[ d = x_1 - x_2 \]

\[ \bar{d} = \frac{\sum d}{n} \]

\[ s_d = \sqrt{\frac{\sum (d - \bar{d})^2}{n-1}} \]

\[ t = \frac{\bar{d} - \mu_d}{s_d / \sqrt{n}} \]

\[ \mu_d = \bar{d} \pm t_{\alpha/2} \frac{s_d}{\sqrt{n}} \]

**Testing Differences Between Two Population Proportions (\(p_1 - p_2\))**

\[
\bar{p} = \frac{n_1 \bar{p}_1 + n_2 \bar{p}_2}{n_1 + n_2}
\]

\[
z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\bar{p}(1-\bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}
\]

\[
p_1 - p_2 = (\bar{p}_1 - \bar{p}_2) \pm z_{\alpha/2} \sqrt{\bar{p}_1(1-\bar{p}_1) \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}
\]