**Large–Sample Confidence Interval for $\mu$**

$$\overline{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$$

**Large–Sample Test of Hypothesis about $\mu$**

One-Tailed Test

$H_0 : \mu = \mu_0$
$H_a : \mu < \mu_0$
(or $H_a : \mu > \mu_0$)

Two-Tailed Test

$H_0 : \mu = \mu_0$
$H_a : \mu \neq \mu_0$

Test statistic: $z = \frac{\overline{x}-\mu_0}{\sigma/\sqrt{n}}$

Rejection region: $z < -z_\alpha$
(or $z > z_\alpha$ when $H_a : \mu > \mu_0$)

Rejection region: $|z| > z_{\alpha/2}$

**Small–Sample Confidence Interval for $\mu$**

$$\overline{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

where $t_{\alpha/2}$ is based on $(n-1)$ degrees of freedom

**Small–Sample Test of Hypothesis about $\mu$**

One-Tailed Test

$H_0 : \mu = \mu_0$
$H_a : \mu < \mu_0$
(or $H_a : \mu > \mu_0$)

Two-Tailed Test

$H_0 : \mu = \mu_0$
$H_a : \mu \neq \mu_0$

Test statistic: $t = \frac{\overline{x}-\mu_0}{s/\sqrt{n}}$

Rejection region: $t < -t_\alpha$
(or $t > t_\alpha$ when $H_a : \mu > \mu_0$)

Rejection region: $|t| > t_{\alpha/2}$

where $t_\alpha$ and $t_{\alpha/2}$ are based on $(n-1)$ degrees of freedom

**Large–Sample Confidence Interval for Population Proportion $p$**

$$\widehat{p} \pm z_{\alpha/2} \sqrt{\frac{pq}{n}} \approx \widehat{p} \pm z_{\alpha/2} \sqrt{\frac{\widehat{p}\widehat{q}}{n}}$$

where $\widehat{p} = x/n$ and $\widehat{q} = 1 - \widehat{p}$

**Large–Sample Test of Hypothesis about Population Proportion $p$**

One-Tailed Test

$H_0 : p = p_0$
$H_a : p < p_0$
(or $H_a : p > p_0$)

Two-Tailed Test

$H_0 : p = p_0$
$H_a : p \neq p_0$

Test statistic: $z = \frac{\widehat{p}-p_0}{\sigma_{\widehat{p}}}$, where $\sigma_{\widehat{p}} = \sqrt{\frac{p_0 q_0}{n}}$ and $q_0 = 1 - p_0$

Rejection region: $z < -z_\alpha$
(or $z > z_\alpha$ when $H_a : p > p_0$)

Rejection region: $|z| > z_{\alpha/2}$

**Large–Sample Confidence Interval for $(\mu_1 - \mu_2)$ (Independent Samples)**

$$(\overline{x}_1 - \overline{x}_2) \pm z_{\alpha/2}\sigma_{(\overline{x}_1-\overline{x}_2)} = (\overline{x}_1 - \overline{x}_2) \pm z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

**Large–Sample Test of Hypothesis about $(\mu_1 - \mu_2)$ (Independent Samples)**

One-Tailed Test

$H_0 : (\mu_1 - \mu_2) = D_0$
$H_a : (\mu_1 - \mu_2) < D_0$
(or $H_a : (\mu_1 - \mu_2) > D_0$)

Two-Tailed Test

$H_0 : (\mu_1 - \mu_2) = D_0$
$H_a : (\mu_1 - \mu_2) \neq D_0$

Test statistic: $z = \frac{(\overline{x}_1-\overline{x}_2)-D_0}{\sigma_{(\overline{x}_1-\overline{x}_2)}}$, where $\sigma_{(\overline{x}_1-\overline{x}_2)} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

Rejection region: $z < -z_\alpha$
(or $z > z_\alpha$ when $H_a : (\mu_1 - \mu_2) > D_0$)

Rejection region: $|z| > z_{\alpha/2}$

**Small–Sample Confidence Interval for $(\mu_1 - \mu_2)$ (Independent Samples)**

$$(\overline{x}_1 - \overline{x}_2) \pm t_{\alpha/2}\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

where $s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$ and $t_{\alpha/2}$ is based on $(n_1 + n_2 - 2)$ degrees of freedom

**Small–Sample Test of Hypothesis about $(\mu_1 - \mu_2)$ (Independent Samples)**

One-Tailed Test

$H_0 : (\mu_1 - \mu_2) = D_0$
$H_a : (\mu_1 - \mu_2) < D_0$
(or $H_a : (\mu_1 - \mu_2) > D_0$)

Two-Tailed Test

$H_0 : (\mu_1 - \mu_2) = D_0$
$H_a : (\mu_1 - \mu_2) \neq D_0$

Test statistic: $t = \frac{(\overline{x}_1-\overline{x}_2)-D_0}{\sigma_{(\overline{x}_1-\overline{x}_2)}}$, where $\sigma_{(\overline{x}_1-\overline{x}_2)} = \sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$

Rejection region: $t < -t_\alpha$
(or $t > t_\alpha$ when $H_a : (\mu_1 - \mu_2) > D_0$)

Rejection region: $|t| > t_{\alpha/2}$

where $t_\alpha$ and $t_{\alpha/2}$ are based on $(n_1 + n_2 - 2)$ degrees of freedom

**Large–Sample Paired Difference Confidence Interval for** $\mu_d = (\mu_1 - \mu_2)$

$$\overline{d} \pm z_{\alpha/2}\frac{\sigma_d}{\sqrt{n_d}}$$

**Large–Sample Paired Difference Test of Hypothesis about** $\mu_d = (\mu_1 - \mu_2)$

One-Tailed Test

$H_0 : \mu_d = D_0$
$H_a : \mu_d < D_0$
(or $H_a : \mu_d > D_0$)

Test statistic: $z = \frac{\overline{d} - D_0}{\sigma_d/\sqrt{n_d}}$

Rejection region: $z < -z_\alpha$
(or $z > z_\alpha$ when $H_a : \mu_d > D_0$)

Two-Tailed Test

$H_0 : \mu_d = D_0$
$H_a : \mu_d \neq D_0$

Rejection region: $|z| > z_{\alpha/2}$

**Small–Sample Paired Difference Confidence Interval for** $\mu_d = (\mu_1 - \mu_2)$

$$\overline{d} \pm t_{\alpha/2}\frac{s_d}{\sqrt{n_d}},$$

where $t_{\alpha/2}$ is based on $(n_d - 1)$ degrees of freedom

**Small–Sample Paired Difference Test of Hypothesis about** $\mu_d = (\mu_1 - \mu_2)$

One-Tailed Test

$H_0 : \mu_d = D_0$
$H_a : \mu_d < D_0$
(or $H_a : \mu_d > D_0$)

Test statistic: $t = \frac{\overline{d} - D_0}{s_d/\sqrt{n_d}}$

Rejection region: $t < -t_\alpha$
(or $t > t_\alpha$ when $H_a : \mu_d > D_0$)

Two-Tailed Test

$H_0 : \mu_d = D_0$
$H_a : \mu_d \neq D_0$

Rejection region: $|t| > t_{\alpha/2}$

where $t_\alpha$ and $t_{\alpha/2}$ are based on $(n_d - 1)$ degrees of freedom

**Large–sample Confidence Interval for** $(p_1 - p_2)$

$$(\widehat{p}_1 - \widehat{p}_2) \pm z_{\alpha/2}\sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} \approx (\widehat{p}_1 - \widehat{p}_2) \pm z_{\alpha/2}\sqrt{\frac{\widehat{p}_1 \widehat{q}_1}{n_1} + \frac{\widehat{p}_2 \widehat{q}_2}{n_2}}$$

**Large–Sample Test of Hypothesis about** $(p_1 - p_2)$

One-Tailed Test

$H_0 : (p_1 - p_2) = D_0$
$H_a : (p_1 - p_2) < D_0$
(or $H_a : (p_1 - p_2) > D_0$)

Two-Tailed Test

$H_0 : (p_1 - p_2) = D_0$
$H_a : (p_1 - p_2) \neq D_0$

Test statistic: $z = \frac{(\widehat{p}_1 - \widehat{p}_2) - D_0}{\sigma_{(\widehat{p}_1 - \widehat{p}_2)}}$, where $\sigma_{(\widehat{p}_1 - \widehat{p}_2)} = \sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} \approx \sqrt{\widehat{p}\widehat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$ and $\widehat{p} = \frac{x_1 + x_2}{n_1 + n_2}$

Rejection region: $z < -z_\alpha$
(or $z > z_\alpha$ when $H_a : (p_1 - p_2) > D_0$)

Rejection region: $|z| > z_{\alpha/2}$