<table>
<tr><th></th><th>Mean</th><th>Std Dev</th><th>Z-Score</th><th>Assumption of CI</th><th>100(1- α)% CI</th></tr>
<tr><td rowspan="2">Sampling distribution of $\bar{x}$</td><td rowspan="2">$\mu_{\bar{x}} = \mu$</td><td rowspan="2">$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$</td><td rowspan="2">$z = \frac{\bar{x} - \mu_{\bar{x}}}{\sigma_{\bar{x}}} = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$

$t = \frac{\bar{X} - \mu}{S / \sqrt{n}}$</td><td>Large Sample:
Random; n>30</td><td>for μ : $\bar{x} \pm z_{\alpha/2}\sigma_{\bar{x}} = \bar{x} \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$

if σ unknown, n>30, $\bar{x} \pm z_{\alpha/2}\frac{s}{\sqrt{n}}$</td></tr>
<tr><td>Small Sample:
Random; apx. Normal</td><td>If σ unknown, n<30: $\bar{x} \pm t_{\alpha/2}\frac{s}{\sqrt{n}}$, df=n-1</td></tr>
<tr><td rowspan="2">Sampling distribution of $\hat{p}$</td><td rowspan="2">$\hat{p} = p$</td><td rowspan="2">$\sigma_{\hat{p}} = \sqrt{pq/n}$

$0 \text{ or } 1 \notin \left(\hat{p} - 3\hat{\sigma}_{\hat{p}}, \hat{p} + 3\hat{\sigma}_{\hat{p}}\right)$

$\hat{p} \sim N\left(\mu_{\hat{p}} = p, \sigma_{\hat{p}}^2 = \frac{pq}{n}\right)$</td><td rowspan="2"></td><td>Random
$0 \text{ or } 1 \notin \left(\hat{p} - 3\hat{\sigma}_{\hat{p}}, \hat{p} + 3\hat{\sigma}_{\hat{p}}\right)$</td><td>$\hat{p} \pm z_{\alpha/2}\sigma_{\hat{p}} = \hat{p} \pm z_{\alpha/2}\sqrt{pq/n} \approx \hat{p} \pm z_{\alpha/2}\sqrt{\hat{p}\hat{q}/n}$</td></tr>
<tr><td>When n is extremely large</td><td>$\tilde{p} \pm z_{\alpha/2}\sqrt{\frac{\tilde{p}(1-\tilde{p})}{n+4}}$ where $\tilde{p} = \frac{x+2}{n+4}$</td></tr>
</table>

Finding sample size for estimating population mean: $n = \frac{(Z_{\alpha/2})^2\sigma^2}{SE^2}$

Finding Sample size for estimating population proportion $n = \frac{(Z_{\alpha/2})^2(pq)}{SE^2}$

Converting a CI to accommodate a finite population:

$\bar{x} \pm z_{\alpha/2} \cdot \left(\frac{\sigma}{\sqrt{n}} \cdot \sqrt{\frac{N-n}{N}}\right)$, $\bar{x} \pm t_{\alpha/2} \cdot \left(\frac{s}{\sqrt{n}} \cdot \sqrt{\frac{N-n}{N}}\right)$, $\hat{p} \pm z_{\alpha/2} \cdot \left(\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \cdot \sqrt{\frac{N-n}{N}}\right)$ **use when n/N>0.05**

Commonly Used Value of $z_{\alpha/2}$

Confidence Level 100(1- α)	α	α /2	$z_{\alpha/2}$
90%	**0.10**	**0.05**	**1.645**
95%	**0.05**	**0.025**	**1.96**
99%	**0.01**	**0.005**	**2.575**

Reduce confidence level, narrower CI.

Rejection Regions for Common Value of α

α	Lower Tailed	Upper Tailed	Two Tailed
0.10	z < -1.28	z > 1.28	z < -1.645, or z > 1.645
0.05	z < -1.645	z > 1.645	z < -1.96, or z > 1.96
0.01	z < -2.33	z > 2.33	z < -2.575, or z > 2.575

	Assumption	Test Statistic	Alternative	*Reject H_0 if*	p- value
Large Sample: Testing a Population Mean	**Normal, or if *n* is large (≥30),**	$Z = \frac{\overline{X} - \mu}{\sigma / \sqrt{n}}$ **if σ unknown while n is large, replace** $z = \frac{\bar{x} - \mu}{s/\sqrt{n}}$	$H_a: \mu > \mu_0$	$z > z_\alpha$	Area under N(0,1) curve right of z
			$H_a: \mu < \mu_0$	$z < -z_\alpha$	Area under N(0,1) curve left of z
			$H_a: \mu \neq \mu_0$	$\lvert z \rvert > z_{\alpha/2}$	Twice area under N(0,1) curve right of |z|, $z > z_{\alpha/2}$ or $z < -z_{\alpha/2}$
Small Sample: Testing a Population Mean	**Random Apx. Normal**	$\frac{\overline{X} - \mu}{S / \sqrt{n}} \sim t_{n-1}$	$H_a: \mu > \mu_0$	$t > t_\alpha$	Area under t curve right of t
			$H_a: \mu < \mu_0$	$t < -t_\alpha$	Area under t curve left of t
			$H_a: \mu \neq \mu_0$	$\lvert t \rvert > t_{\alpha/2}$	Twice area under t curve right of |t| $t > t_{\alpha/2}$ or $t < -t_{\alpha/2}$
Large-Sample: Testing a Population Proportion	**Random** $p_0 \pm 3\sigma_{\hat{p}} \approx p_0 \pm 3\sqrt{\frac{p_0(1-p_0)}{n}} \in (0,1)$	$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \sim N(0,1)$	$H_a: p > p_0$	$z > z_\alpha$	Area under N(0,1) curve right of z
			$H_a: p < p_0$	$z < -z_\alpha$	Area under N(0,1) curve left of z
			$H_a: p \neq p_0$	$\lvert z \rvert > z_{\alpha/2}$	Twice area under N(0,1) curve right of |z| $z > z_{\alpha/2}$ or $z < -z_{\alpha/2}$
Testing a Population Variance	**Random Apx. Normal**	$\chi^2 = \frac{(n-1)s^2}{\sigma_0^2} \sim \chi^2_{n-1}$	$H_a: \sigma^2 > \sigma_0^2$	$\chi^2 > \chi^2_\alpha$	**100(1-α)% confidence interval for σ^2:** $\left(\frac{(n-1)s^2}{\chi^2_{\alpha/2}}, \frac{(n-1)s^2}{\chi^2_{1-\alpha/2}} \right)$
			$H_a: \sigma^2 < \sigma_0^2$	$\chi^2 < \chi^2_{1-\alpha}$	
			$H_a: \sigma^2 \neq \sigma_0^2$	$\chi^2 > \chi^2_{\alpha/2}$ or $\chi^2 < \chi^2_{1-\alpha/2}$	

	Assumption	Test Statistic	CI	Alternative	Reject H_0 if	p- value
Large Sample: Testing a Population Mean Difference	**Randomly selected in independent manner; Sample size sufficient large**	$z = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \sim N(0,1)$ **if** σ **unknown while n is large, replace** $z = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \sim N(0,1)$	$(\bar{x}_1 - \bar{x}_2) \pm z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$ **If Std unknown while n>30** $(\bar{x}_1 - \bar{x}_2) \pm z_{\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$	$\mu_1 - \mu_2 > D_0$	$z > z_\alpha$	Area under N(0,1) curve right of z
				$\mu_1 - \mu_2 < D_0$	$z < -z_\alpha$	Area under N(0,1) curve left of z
				$\mu_1 - \mu_2 \neq D_0$	$\lvert z \rvert > z_{\alpha/2}$	Twice area under N(0,1) curve right of |z|, $z > z_{\alpha/2}$ or $z < -z_{\alpha/2}$
Small Sample: Testing a Population Mean Difference	**Random, Independent, Apx. Normal** $\sigma_1 = \sigma_2$	$t = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \sim t_{n_1+n_2-2}$ $s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$	$\bar{x}_1 - \bar{x}_2 \pm t_{\alpha/2}s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$ **Where** $\sim t_{n_1+n_2-2}$	$\mu_1 - \mu_2 > D_0$	$t > t_\alpha$	Area under t curve right of t
				$\mu_1 - \mu_2 < D_0$	$t < -t_\alpha$	Area under t curve left of t
				$\mu_1 - \mu_2 \neq D_0$	$\lvert t \rvert > t_{\alpha/2}$	Twice area under t curve right of |t| $t > t_{\alpha/2}$ or $t < -t_{\alpha/2}$
	Random, independent $N(\mu_i, \sigma_i^2), i = 1, 2$ **&** $\sigma_1^2 \neq \sigma_2^2$	$t = \frac{(\bar{x}_1 - \bar{x}_2) - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \sim t_{df}$ **where** $df = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}$				
Paired-Observation Comparisons: Comparing Two Means When the Samples are Dependent	**Random sample from Single normal population of differences**	$z = \frac{\bar{d} - \mu_d}{\sigma_d/\sqrt{n}} \sim N(0,1)$ $t = \frac{\bar{d} - \mu_d}{s_d/\sqrt{n}} \sim t_{n-1}$	$\bar{d} \pm z_{\alpha/2}\frac{\sigma_d}{\sqrt{n}}$ $\bar{d} \pm t_{\alpha/2}\frac{s_d}{\sqrt{n}}$	$\mu_d > D_0$	$t > t_\alpha$	Area under t curve right of t
				$\mu_d < D_0$	$t < -t_\alpha$	Area under t curve left of t
				$\mu_d \neq D_0$	$\lvert t \rvert > t_{\alpha/2}$	Twice area under t curve right of |t| $t > t_{\alpha/2}$ or $t < -t_{\alpha/2}$

	Test Statistic	CI	Alternative	Reject H_0 if	p- value
Large-Sample: Testing a Population Proportion Difference	$z=\frac{(\hat{p}_1-\hat{p}_2)-(p_1-p_2)}{\sqrt{\left(\frac{p_1q_1}{n_1}+\frac{p_2q_2}{n_2}\right)}}\sim N(0,1)$ $z=\frac{(\hat{p}_1-\hat{p}_2)-(p_1-p_2)}{\sqrt{\left(\frac{\hat{p}_1(1-\hat{p}_1)}{n_1}+\frac{\hat{p}_2(1-\hat{p}_2)}{n_2}\right)}}\sim N(0,1)$ **Assumption:** **Two Samples are randomly selected in an independent manner; Samples sizes are both large so that the sampling distribution of the proportion difference will be approximately normal**	$(\hat{p}_1-\hat{p}_2)\pm z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1}+\frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$	**Adjusted CI for very small n:** $\tilde{p}_1-\tilde{p}_2\pm z_{\alpha/2}\sqrt{\frac{\tilde{p}_1(1-\tilde{p}_1)}{n_1+2}+\frac{\tilde{p}_2(1-\tilde{p}_2)}{n_2+2}}$ where $\tilde{p}_i=\frac{x_i+1}{n_i+2}$, for i=1,2.		
		Test Statistic: $H_0: p_1-p_2=0\ (i.e.\ D_0=0)$ $z=\frac{(\hat{p}_1-\hat{p}_2)-0}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$	$p_1-p_2>D_0$	$z>z_\alpha$	Area under N(0,1) curve right of z
			$p_1-p_2<D_0$	$z<-z_\alpha$	Area under N(0,1) curve left of z
		OR $H_0: p_1-p_2=D_0\ (i.e.\ D_0\neq 0)$ $z=\frac{(\hat{p}_1-\hat{p}_2)-D_0}{\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1}+\frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}}$, $where\ \hat{p}=\frac{n_1\hat{p}_1+n_2\hat{p}_2}{n_1+n_2}$	$p_1-p_2\neq D_0$	$\lvert z\rvert>z_{\alpha/2}$	Twice area under N(0,1) curve right of |z| $z>z_{\alpha/2}\ or\ z<-z_{\alpha/2}$
Valid F-Test for Equal Variance	**Assumption:** **Both Sampled Populations are normally distributed; The samples are random and independent.**	$F=\frac{s_1^2}{s_2^2}\sim F\ \ with\ n_1-1\ and\ n_2-1\ dfs$	H_a: $\sigma_1^2>\sigma_2^2$	$F>F_\alpha$ with n_1-1 and n_2-1 *dfs* p-value < α	
		$F=\frac{s_2^2}{s_1^2}\sim F\ \ with\ n_2-1\ and\ n_1-1\ dfs$	H_a: $\sigma_1^2<\sigma_2^2$	$F>F_\alpha$ with n_2-1 and n_1-1 *dfs* p-value < α	
		$F=\frac{\text{larger of } s_1^2 \text{ and } s_2^2}{\text{smaller of } s_1^2 \text{ and } s_2^2}\sim F$ **where** df_1 = {size of sample with larger variance} – 1 df_2 = {size of sample with smaller variance} – 1	H_a: $\sigma_1^2\neq\sigma_2^2$	$F>F_{\alpha/2}$ with df_1 and df_2 dfs *p*-value < α	

Finding sample size for estimating population mean/proportion difference $n=\frac{(z_{\alpha/2})^2(\sigma_1^2+\sigma_2^2)}{e^2}$ **, and** $n=\frac{(z_{\alpha/2})^2(p_1q_1+p_2q_2)}{e^2}$