Summary of One-Sample Hypothesis-Testing Procedures

Case	Null Hypothesis	Test Statistic	Alternative Hypothesis	Fixed Significance Level Criteria for Rejection	P-value	O.C. Curve Parameter	O.C. Curve Appendix Chart VII
1.	H_0: $\mu = \mu_0$ σ^2 known	$z_0 = \dfrac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$	H_1: $\mu \neq \mu_0$	$\lvert z_0 \rvert > z_{\alpha/2}$	$P = 2[1 - \Phi(z_0)]$	$d = \lvert\mu - \mu_0\rvert/\sigma$	a, b
			H_1: $\mu > \mu_0$	$z_0 > z_\alpha$	Probability above z_0 $P = 1 - \Phi(z_0)$	$d = (\mu - \mu_0)/\sigma$	c, d
			H_1: $\mu < \mu_0$	$z_0 < -z_\alpha$	Probability below z_0 $P = \Phi(z_0)$	$d = (\mu_0 - \mu)/\sigma$	c, d
2.	H_0: $\mu = \mu_0$ σ^2 unknown	$t_0 = \dfrac{\bar{x} - \mu_0}{s/\sqrt{n}}$	H_1: $\mu \neq \mu_0$	$\lvert t_0 \rvert > t_{\alpha/2, n-1}$	Sum of the probability above $\lvert t_0\rvert$ and below $-\lvert t_0\rvert$	$d = \lvert\mu - \mu_0\rvert/\sigma$	e, f
			H_1: $\mu > \mu_0$	$t_0 > t_{\alpha, n-1}$	Probability above t_0	$d = (\mu - \mu_0)/\sigma$	g, h
			H_1: $\mu < \mu_0$	$t_0 < -t_{\alpha, n-1}$	Probability below t_0	$d = (\mu_0 - \mu)/\sigma$	g, h
3.	H_0: $\sigma^2 = \sigma_0^2$	$x_0^2 = \dfrac{(n-1)s^2}{\sigma_0^2}$	H_1: $\sigma^2 \neq \sigma_0^2$	$\chi_0^2 > \chi^2_{\alpha/2, n-1}$ or $\chi_0^2 < \chi^2_{1-\alpha/2, n-1}$	See text Section 9.4.	$\lambda = \sigma/\sigma_0$	i, j
			H_1: $\sigma^2 > \sigma_0^2$	$\chi_0^2 > \chi^2_{\alpha, n-1}$		$\lambda = \sigma/\sigma_0$	k, l
			H_1: $\sigma^2 < \sigma_0^2$	$\chi_0^2 < \chi^2_{1-\alpha, n-1}$		$\lambda = \sigma/\sigma_0$	m, n
4.	H_0: $p = p_0$	$z_0 = \dfrac{x - np_0}{\sqrt{np_0(1-p_0)}}$	H_1: $p \neq p_0$	$\lvert z_0 \rvert > z_{\alpha/2}$	$P = 2[1 - \Phi(z_0)]$	—	—
			H_1: $p > p_0$	$z_0 > z_\alpha$	Probability above z_0 $P = 1 - \Phi(z_0)$	—	—
			H_1: $p < p_0$	$z_0 < -z_\alpha$	Probability below z_0 $P = \Phi(z_0)$	—	—

Summary of One-Sample Confidence Interval Procedures

Case	Problem Type	Point Estimate	Two-sided $100(1 - \alpha)$ Percent Confidence Interval
1.	Mean μ, variance σ^2 known	$\bar{x}$	$\bar{x} - z_{\alpha/2}\sigma/\sqrt{n} \le \mu \le \bar{x} + z_{\alpha/2}\sigma/\sqrt{n}$
2.	Mean μ of a normal distribution, variance σ^2 unknown	$\bar{x}$	$\bar{x} - t_{\alpha/2, n-1}s/\sqrt{n} \le \mu \le \bar{x} + t_{\alpha/2, n-1}s/\sqrt{n}$
3.	Variance σ^2 of a normal distribution	s^2	$\dfrac{(n-1)s^2}{\chi^2_{\alpha/2, n-1}} \le \sigma^2 \le \dfrac{(n-1)s^2}{\chi^2_{1-\alpha/2, n-1}}$
4.	Proportion or parameter of a binomial distribution p	$\hat{p}$	$\hat{p} - z_{\alpha/2}\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}} \le p \le \hat{p} + z_{\alpha/2}\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}}$

Summary of Two-Sample Hypothesis-Testing Procedures

Case	Null Hypothesis	Test Statistic	Alternative Hypothesis	Fixed Significance Level Criteria for Rejection	*P*-value	O.C. Curve Parameter	O.C. Curve Appendix Chart VII
1.	$H_0: \mu_1 - \mu_2 = \Delta_0$ σ_1^2 and σ_2^2 known	$z_0 = \dfrac{\bar{x}_1 - \bar{x}_2 - \Delta_0}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$	$H_1: \mu_1 - \mu_2 \neq \Delta_0$	$\lvert z_0\rvert > z_{\alpha/2}$	$P = 2[1 - \Phi(z_0)]$	$d = \dfrac{\lvert\mu_1 - \mu_2 - \Delta_0\rvert}{\sqrt{\sigma_1^2 + \sigma_2^2}}$	a, b
			$H_1: \mu_1 - \mu_2 > \Delta_0$	$z_0 > z_\alpha$	Probability above z_0 $P = 1 - \Phi(z_0)$	$d = \dfrac{\mu_1 - \mu_2 - \Delta_0}{\sqrt{\sigma_1^2 + \sigma_2^2}}$	c, d
			$H_1: \mu_1 - \mu_2 < \Delta_0$	$z_0 < -z_\alpha$	Probability below z_0 $P = \Phi(z_0)$	$d = \dfrac{\mu_2 - \mu_1 - \Delta_0}{\sqrt{\sigma_1^2 + \sigma_2^2}}$	c, d
2.	$H_0: \mu_1 - \mu_2 = \Delta_0$ $\sigma_1^2 = \sigma_2^2$ unknown	$t_0 = \dfrac{\bar{x}_1 - \bar{x}_2 - \Delta_0}{s_p\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$	$H_1: \mu_1 - \mu_2 \neq \Delta_0$	$\lvert t_0\rvert > t_{\alpha/2, n_1+n_2-2}$	Sum of the probability above $\lvert t_0\rvert$ and below $-\lvert t_0\rvert$	$d = \lvert\Delta - \Delta_0\rvert/2\sigma$	e, f
			$H_1: \mu_1 - \mu_2 > \Delta_0$	$t_0 > t_{\alpha, n_1+n_2-2}$	Probability above t_0	$d = (\Delta - \Delta_0)/2\sigma$	g, h
			$H_1: \mu_1 - \mu_2 < \Delta_0$	$t_0 < -t_{\alpha, n_1+n_2-2}$	Probability below t_0	$d = (\Delta_0 - \Delta)/2\sigma$ where $\Delta = \mu_1 - \mu_2$	g, h
3.	$H_0: \mu_1 - \mu_2 = \Delta_0$ $\sigma_1^2 \neq \sigma_2^2$ unknown	$t_0 = \dfrac{\bar{x}_1 - \bar{x}_2 - \Delta_0}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$ $v = \dfrac{\left(\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}\right)^2}{\dfrac{(s_1^2/n_1)^2}{n_1 - 1} + \dfrac{(s_2^2/n_2)^2}{n_2 - 1}}$	$H_1: \mu_1 - \mu_2 \neq \Delta_0$	$\lvert t_0\rvert > t_{\alpha/2, v}$	Sum of the probability above $\lvert t_0\rvert$ and below $-\lvert t_0\rvert$	—	—
			$H_1: \mu_1 - \mu_2 > \Delta_0$	$t_0 > t_{\alpha, v}$	Probability above t_0	—	—
			$H_1: \mu_1 - \mu_2 < \Delta_0$	$t_0 < -t_{\alpha, v}$	Probability below t_0	—	—
4.	Paired data $H_0: \mu_D = 0$	$t_0 = \dfrac{\bar{d}}{s_d/\sqrt{n}}$	$H_1: \mu_d \neq 0$	$\lvert t_0\rvert > t_{\alpha/2, n-1}$	Sum of the probability above $\lvert t_0\rvert$ and below $-\lvert t_0\rvert$	—	—
			$H_1: \mu_d > 0$	$t_0 > t_{\alpha, n-1}$	Probability above t_0	—	—
			$H_1: \mu_d < 0$	$t_0 < -t_{\alpha, n-1}$	Probability below t_0	—	—
5.	$H_0: \sigma_1^2 = \sigma_2^2$	$f_0 = s_1^2/s_2^2$	$H_1: \sigma_1^2 \neq \sigma_2^2$	$f_0 > f_{\alpha/2, n_1-1, n_2-1}$ or $f_0 < f_{1-\alpha/2, n_1-1, n_2-1}$	See text Section 10-5.2.	$\lambda = \sigma_1/\sigma_2$	o, p
			$H_1: \sigma_1^2 > \sigma_2^2$	$f_0 > f_{\alpha, n_1-1, n_2-1}$		$\lambda = \sigma_1/\sigma_2$	q, r
6.	$H_0: p_1 = p_2$	$z_0 = \dfrac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1 - \hat{p})\left[\dfrac{1}{n_1} + \dfrac{1}{n_2}\right]}}$	$H_1: p_1 \neq p_2$	$\lvert z_0\rvert > z_{\alpha/2}$	$P = 2[1 - \Phi(z_0)]$	—	—
			$H_1: p_1 > p_2$	$z_0 > z_\alpha$	Probability above z_0 $P = 1 - \Phi(z_0)$	—	—
			$H_1: p_1 < p_2$	$z_0 < -z_\alpha$	Probability below z_0 $P = \Phi(z_0)$	—	—

Summary of Two-Sample Confidence Interval Procedures

Case	Problem Type	Point Estimate	Two-Sided 100(1 − α) Percent Confidence Interval
1.	Difference in two means μ_1 and μ_2, variances σ_1^2 and σ_2^2 known	$\bar{x}_1 - \bar{x}_2$	$\bar{x}_1 - \bar{x}_2 - z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \le \mu_1 - \mu_2$ $\le \bar{x}_1 - \bar{x}_2 + z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$
2.	Difference in means of two normal distributions $\mu_1 - \mu_2$, variances $\sigma_1^2 = \sigma_2^2$ and unknown	$\bar{x}_1 - \bar{x}_2$	$\bar{x}_1 - \bar{x}_2 - t_{\alpha/2, n_1+n_2-2} s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \le \mu_1 - \mu_2$ $\le \bar{x}_1 - \bar{x}_2 + t_{\alpha/2, n_1+n_2-2} s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$ where $s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$
3.	Difference in means of two normal distributions $\mu_1 - \mu_2$, variances $\sigma_1^2 \ne \sigma_2^2$ and unknown	$\bar{x}_1 - \bar{x}_2$	$\bar{x}_1 - \bar{x}_2 - t_{\alpha/2, v}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \le \mu_1 - \mu_2$ $\le \bar{x}_1 - \bar{x}_2 + t_{\alpha/2, v}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$ where $v = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}$
4.	Difference in means of two normal distributions for paired samples $\mu_0 = \mu_1 - \mu_2$	$\bar{d}$	$\bar{d} - t_{\alpha/2, n-1} s_d/\sqrt{n} \le \mu_D \le \bar{d} + t_{\alpha/2, n-1} s_d/\sqrt{n}$
5.	Ratio of the variances σ_1^2/σ_2^2 of two normal distributions	$\frac{s_1^2}{s_2^2}$	$\frac{s_1^2}{s_2^2} f_{1-\alpha/2, n_2-1, n_1-1} \le \frac{\sigma_1^2}{\sigma_2^2} \le \frac{s_1^2}{s_2^2} f_{\alpha/2, n_2-1, n_1-1}$ where $f_{1-\alpha/2, n_2-1, n_1-1} = \frac{1}{f_{\alpha/2, n_1-1, n_2-1}}$
6.	Difference in two proportions of two binominal parameters $p_1 - p_2$	$\hat{p}_1 - \hat{p}_2$	$\hat{p}_1 - \hat{p}_2 - z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1 - \hat{p}_1)}{n_1} + \frac{\hat{p}_2(1 - \hat{p}_2)}{n_2}}$ $\le p_1 - p_2 \le \hat{p}_1 - \hat{p}_2 + z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1 - \hat{p}_1)}{n_1} + \frac{\hat{p}_2(1 - \hat{p}_2)}{n_2}}$