Summary of Single-Sample Hypothesis Testing Procedures

Case	Null Hypothesis	Test Statistic	Alternative Hypothesis	*P*-Value	Criteria for Rejection, Fixed-Level Test	*OC* Curve Parameter	*OC* Curve Appendix A Chart V
1.	H_0: $\mu = \mu_0$ σ^2 known	$z_0 = \dfrac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$	H_1: $\mu \neq \mu_0$	$2[1 - \Phi(\lvert z_0 \rvert)]$	$\lvert z_0 \rvert > z_{\alpha/2}$	—	—
			H_1: $\mu > \mu_0$	$1 - \Phi(z_0)$	$z_0 > z_\alpha$	—	—
			H_1: $\mu < \mu_0$	$\Phi(z_0)$	$z_0 < -z_\alpha$	—	—
2.	H_0: $\mu = \mu_0$ σ^2 unknown	$t_0 = \dfrac{\bar{x} - \mu_0}{s/\sqrt{n}}$	H_1: $\mu \neq \mu_0$	Probability above $\lvert t_0 \rvert$ plus probability below $-\lvert t_0 \rvert$	$\lvert t_0 \rvert > t_{\alpha/2,n-1}$	$d = \lvert \mu - \mu_0 \rvert/\sigma$	*a*, *b*
			H_1: $\mu > \mu_0$	Probability above t_0	$t_0 > t_{\alpha,n-1}$	$d = (\mu - \mu_0)/\sigma$	*c*, *d*
			H_1: $\mu < \mu_0$	Probability below t_0	$t_0 < -t_{\alpha,n-1}$	$d = (\mu_0 - \mu)/\sigma$	*c*, *d*
3.	H_0: $\sigma^2 = \sigma_0^2$	$\chi_0^2 = \dfrac{(n-1)s^2}{\sigma_0^2}$	H_1: $\sigma^2 \neq \sigma_0^2$	2 (Probability beyond χ_0^2)	$\chi_0^2 > \chi_{\alpha/2,n-1}^2$ or $\chi_0^2 < \chi_{1-\alpha/2,n-1}^2$	—	—
			H_1: $\sigma^2 > \sigma_0^2$	Probability above χ_0^2	$\chi_0^2 > \chi_{\alpha,n-1}^2$	—	—
			H_1: $\sigma^2 < \sigma_0^2$	Probability below χ_0^2	$\chi_0^2 < \chi_{1-\alpha,n-1}^2$	—	—
4.	H_0: $p = p_0$	$z_0 = \dfrac{x - np_0}{\sqrt{np_0(1 - p_0)}}$	H_1: $p \neq p_0$	$2[1 - \Phi(\lvert z_0 \rvert)]$	$\lvert z_0 \rvert > z_{\alpha/2}$	—	—
			H_1: $p > p_0$	$1 - \Phi(z_0)$	$z_0 > z_\alpha$	—	—
			H_1: $p < p_0$	$\Phi(z_0)$	$z_0 < -z_\alpha$	—	—

Summary of Single-Sample Interval Estimation Procedures

Case	Problem Type	Point Estimate	Type of Interval	100(1 − α)% Confidence Interval
1.	Confidence interval on the mean μ, variance σ^2 known	$\bar{x}$	Two-sided	$\bar{x} - z_{\alpha/2}\sigma/\sqrt{n} \le \mu \le \bar{x} + z_{\alpha/2}\sigma/\sqrt{n}$
			One-sided lower	$\bar{x} - z_{\alpha}\sigma/\sqrt{n} \le \mu$
			One-sided upper	$\mu \le \bar{x} + z_{\alpha}\sigma/\sqrt{n}$
2.	Confidence interval on the mean μ of a normal distribution, variance σ^2 unknown	$\bar{x}$	Two-sided	$\bar{x} - t_{\alpha/2,n-1}s/\sqrt{n} \le \mu \le \bar{x} + t_{\alpha/2,n-1}s/\sqrt{n}$
			One-sided lower	$\bar{x} - t_{\alpha,n-1}s/\sqrt{n} \le \mu$
			One-sided upper	$\mu \le \bar{x} + t_{\alpha,n-1}s/\sqrt{n}$
3.	Confidence interval on the variance σ^2 of a normal distribution	s^2	Two-sided	$\dfrac{(n-1)s^2}{\chi^2_{\alpha/2,n-1}} \le \sigma^2 \le \dfrac{(n-1)s^2}{\chi^2_{1-\alpha/2,n-1}}$
			One-sided lower	$\dfrac{(n-1)s^2}{\chi^2_{\alpha,n-1}} \le \sigma^2$
			One-sided upper	$\sigma^2 \le \dfrac{(n-1)s^2}{\chi^2_{1-\alpha,n-1}}$
4.	Confidence interval on a proportion or parameter of a binomial distribution p	$\hat{p}$	Two-sided	$\hat{p} - z_{\alpha/2}\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}} \le p \le \hat{p} + z_{\alpha/2}\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}}$
			One-sided lower	$\hat{p} - z_{\alpha}\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}} \le p$
			One-sided upper	$p \le \hat{p} + z_{\alpha}\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}}$
5.	Prediction interval on a future observation from a normal distribution, variance unknown	$\bar{x}$	Two-sided	$\bar{x} - t_{\alpha/2,n-1}s\sqrt{1 + \dfrac{1}{n}} \le X_{n+1} \le \bar{x} + t_{\alpha/2,n-1}s\sqrt{1 + \dfrac{1}{n}}$
6.	Tolerance interval for capturing at least γ% of the values in a normal population with confidence level 100 $(1 - \alpha)$%.		Two-sided	$\bar{x} - ks, \bar{x} + ks$

Summary of Two-Sample Hypothesis Testing Procedures

Case	Null Hypothesis	Test Statistic	Alternative Hypothesis	*P*-Value	Criteria for Rejection, Fixed Level Test	*OC* Curve Parameter	*OC* Curve Appendix A Chart IV
1.	H_0: $\mu_1 = \mu_2$ σ_1^2 and σ_2^2 known	$z_0 = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$	H_1: $\mu_1 \neq \mu_2$	$2[1 - \Phi(\lvert z_0 \rvert)]$	$\lvert z_0 \rvert > z_{\alpha/2}$	—	—
			H_1: $\mu_1 > \mu_2$	$1 - \Phi(z_0)$	$z_0 > z_\alpha$	—	—
			H_1: $\mu_1 < \mu_2$	$\Phi(z_0)$	$z_0 < -z_\alpha$	—	—
2.	H_0: $\mu_1 = \mu_2$ $\sigma_1^2 = \sigma_2^2$ unknown	$t_0 = \dfrac{\bar{x}_1 - \bar{x}_2}{s_p\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$	H_1: $\mu_1 \neq \mu_2$	Probability above $\lvert t_0 \rvert$ plus probability below $-\lvert t_0 \rvert$	$\lvert t_0 \rvert > t_{\alpha/2, n_1+n_2-2}$	$d = \lvert \mu - \mu_0 \rvert / 2\sigma$	*a*, *b*
			H_1: $\mu_1 > \mu_2$	Probability above t_0	$t_0 > t_{\alpha, n_1+n_2-2}$	$d = (\mu - \mu_0)/2\sigma$	*c*, *d*
			H_1: $\mu_1 < \mu_2$	Probability below t_0	$t_0 < -t_{\alpha, n_1+n_2-2}$	$d = (\mu_0 - \mu)/2\sigma$	*c*, *d*
3.	H_0: $\mu_1 = \mu_2$ $\sigma_1^2 \neq \sigma_2^2$ unknown	$t_0 = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$ $\nu = \dfrac{\left(\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}\right)^2}{\dfrac{(s_1^2/n_1)^2}{n_1 - 1} + \dfrac{(s_2^2/n_2)^2}{n_2 - 1}}$	H_1: $\mu_1 \neq \mu_2$	Probability above $\lvert t_0 \rvert$ plus probability below $-\lvert t_0 \rvert$	$\lvert t_0 \rvert > t_{\alpha/2, \nu}$	—	—
			H_1: $\mu_1 > \mu_2$	Probability above t_0	$t_0 > t_{\alpha, \nu}$	—	—
			H_1: $\mu_1 < \mu_2$	Probability below t_0	$t_0 < -t_{\alpha, \nu}$	—	—
4.	Paired data H_0: $\mu_D = 0$	$t_0 = \dfrac{\bar{d}}{s_d/\sqrt{n}}$	H_1: $\mu_d \neq 0$	Probability above $\lvert t_0 \rvert$ plus probability below $-\lvert t_0 \rvert$	$\lvert t_0 \rvert > t_{\alpha/2, n-1}$	—	—
			H_1: $\mu_d > 0$	Probability above t_0	$t_0 > t_{\alpha, n-1}$	—	—
			H_1: $\mu_d < 0$	Probability below t_0	$t_0 < -t_{\alpha, n-1}$	—	—
5.	H_0: $\sigma_1^2 = \sigma_2^2$	$f_0 = s_1^2/s_2^2$	H_1: $\sigma_1^2 \neq \sigma_2^2$	2 (Probability beyond f_0)	$f_0 > f_{\alpha/2, n_1-1, n_2-1}$ or $f_0 < f_{1-\alpha/2, n_1-1, n_2-1}$	—	—
			H_1: $\sigma_1^2 > \sigma_2^2$	Probability above f_0	$f_0 > f_{\alpha, n_1-1, n_2-1}$	—	—
			H_1: $\sigma_1^2 < \sigma_2^2$	Probability below f_0	$f_0 > f_{1-\alpha, n_1-1, n_2-1}$	—	—
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: $p_1 \neq p_2$	$2[1 - \Phi(\lvert z_0 \rvert)]$	$\lvert z_0 \rvert > z_{\alpha/2}$	—	—
			H_1: $p_1 > p_2$	$1 - \Phi(z_0)$	$z_0 > z_\alpha$	—	—
			H_1: $p_1 < p_2$	$\Phi(z_0)$	$z_0 < -z_\alpha$	—	—

Summary of Two-Sample Confidence Interval Procedures

Case	Problem Type	Point Estimate	Two-Sided $100(1-\alpha)\%$ 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 $v = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\frac{(s_1^2/n_1)^2}{n_1 + 1} + \frac{(s_2^2/n_2)^2}{n_2 + 1}} - 2$
4.	Difference in means of two distributions for paired samples $\mu_D = \mu_1 - \mu_2$	$\bar{d}$	$\bar{d} - t_{\alpha/2, n-1} s_d/\sqrt{n} \le \mu_D \le \bar{d} + t_{\alpha/2, n-1} s_d/\sqrt{n}$
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 or two binomial parameters $p_1 - p_2$	$\hat{p}_1 - \hat{p}_2$	$\hat{p}_1 - \hat{p}_2 - z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$ $\le p_1 - p_2 \le \hat{p}_1 - \hat{p}_2 + z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$