List of formulae – Confidence intervals and hypothesis testing

Confidence intervals

1. Single mean (Population variance known)

$$\bar{x} \pm z\frac{\sigma}{\sqrt{n}}$$

2. Single mean (population variance unknown)

$$\bar{x} \pm t_{n-1}\frac{s}{\sqrt{n}}$$

3. Single proportion

$$p \pm z\sqrt{\frac{p(1-p)}{n}}$$

4. Difference between 2 means (population variance known)

$$\bar{x}_1 - \bar{x}_2 \quad \pm z\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}$$

5. Difference between 2 means (population variance unknown but assumed to be equal)

$$\bar{x}_1 - \bar{x}_2 \pm t_{n_1+n_2-2}s_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}$$

Pooled variance estimator:

$$S_p^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}$$

6. Difference between 2 means (population variance unknown and unequal)

$$\bar{x}_1 - \bar{x}_2 \pm t_{df}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Degrees of freedom for t distribution, **df** = $\min\{n_1 - 1,\ n_2 - 1\}$ [Approximate]

7. Difference between 2 proportions

$$(p_1 - p_2) \pm z\sqrt{\hat{p}(1 - \hat{p})(\frac{1}{n_1} + \frac{1}{n_2})}$$

Pooled sample proportion, $\hat{p} = \frac{p_1 n_1 + p_2 n_2}{n_1 + n_2}$

Hypothesis testing [Test statistics]

1. Single mean (Population variance known)

$$Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$$

2. Single mean (population variance unknown)

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

3. Single proportion

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

4. Difference between 2 means (population variance known)

$$Z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

5. Difference between 2 means (population variance unknown but assumed to be equal)

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{S_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Pooled variance estimator:

$$S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

Degrees of freedom for t distribution = $n_1 + n_2 - 2$

6. Difference between 2 means (population variance unknown and unequal)

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Degrees of freedom for t distribution = $\min\{n_1 - 1,\ n_2 - 1\}$ [Approximate]

7. Difference between 2 proportions

$$z = \frac{(p_1 - p_2) - (\Pi_1 - \Pi_2)}{\sqrt{\hat{p}(1 - \hat{p})(\frac{1}{n_1} + \frac{1}{n_2})}}$$

Pooled sample proportion, $\hat{p} = \frac{p_1 n_1 + p_2 n_2}{n_1 + n_2}$