

Comprehensive Reference Sheet: Statistical Tests

I. Parametric Tests

1. Z-Test

Use: Population mean with known variance.

$$Z = \frac{\bar{X} - \mu_0}{\sigma/\sqrt{n}}$$

Assumptions:

- Normal population or large sample size
- Known population variance
- Random sample

CI:

$$\bar{X} \pm Z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{n}}$$

2. One-Sample T-Test

$$t = \frac{\bar{X} - \mu_0}{s/\sqrt{n}} \quad \text{df} = n - 1$$

Assumptions:

- Normal population
- Random sampling

CI:

$$\bar{X} \pm t_{\alpha/2, n-1} \cdot \frac{s}{\sqrt{n}}$$

3. Two-Sample T-Test (Independent)

Equal Variance:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

Unequal Variance: Use Welch's test and adjusted df.

Assumptions:

- Independence
- Normality in both groups
- Equal variance unless using Welch's

4. Paired T-Test

$$t = \frac{\bar{D}}{s_D/\sqrt{n}} \quad \text{df} = n - 1$$

Assumptions:

- Normality of differences
- Pairs are dependent, observations within pairs are independent

5. Test of Two Proportions

$$Z = \frac{p_1 - p_2}{\sqrt{p(1-p) \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \quad p = \frac{x_1 + x_2}{n_1 + n_2}$$

CI:

$$(p_1 - p_2) \pm Z_{\alpha/2} \cdot \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$

Assumptions:

- Independence
- $np_i > 5$, $n(1-p_i) > 5$

II. Assumption Checks

- **Normality:** Shapiro-Wilk, Anderson-Darling, Q-Q plot
- **Equal Variance:** Levene's test, Bartlett's test

III. Non-Parametric Tests

1. Sign Test

Use: One-sample or paired test of medians

Assumptions:

- Directional data
- No symmetry required

2. Wilcoxon Signed-Rank

Use: Paired samples, test of median

Assumptions:

- Symmetric differences
- Paired design

3. Mann-Whitney U

Use: Two independent samples

Assumptions:

- Independent groups
- Similar shapes

4. Kruskal-Wallis

Use: > 2 independent groups

Assumptions:

- Independence
- Similar distribution shapes

5. Friedman Test

Use: > 2 repeated/paired groups

Assumptions:

- Repeated measures
- Ordinal or continuous data

IV. Confidence Intervals: Non-Parametric

- **Bootstrap CI:** Resampling-based
- **Rank-based CI:** Uses order statistics or test-specific distributions

V. Summary Table (Single Column)

Test	When to Use and Assumptions
Z-Test	One mean, known σ ; normal or large n
One-sample T-Test	One mean, unknown σ ; normality assumed
Two-sample T-Test	Compare 2 means; assume equal or unequal variance
Paired T-Test	Paired means; differences must be normal
2-Proportion Z-Test	Compare 2 proportions; large n ; independence
Wilcoxon Signed-Rank	Paired medians; symmetric differences
Mann-Whitney U	Two independent groups; similar shapes
Kruskal-Wallis	> 2 independent groups; similar shapes
Friedman Test	> 2 paired/repeated measures; ordinal/continuous