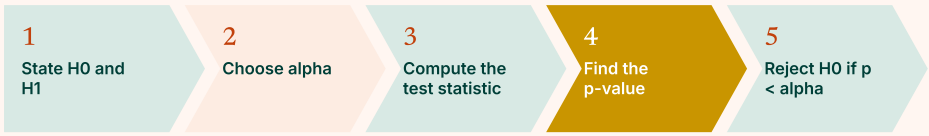
Hypothesis testing

CHEATSHEET

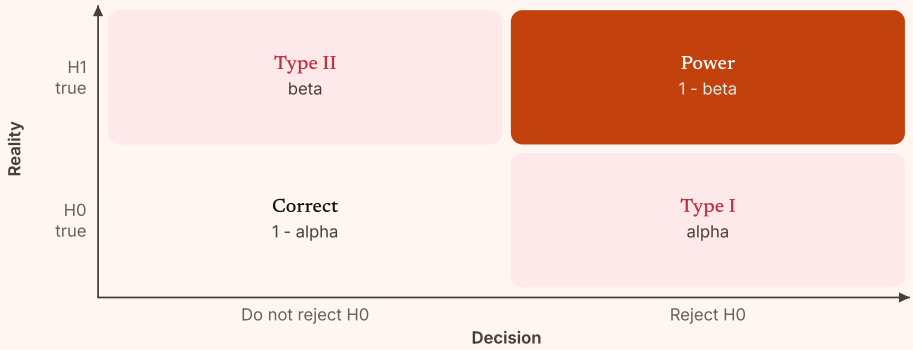
Exam Mon, 7 Dec 2026

EXAM LIKELIHOOD p-value **97%** · t-test (one-sample, two-sample, paired) **95%** · Analysis of variance (ANOVA) and F-test **93%** · Chi-square test: goodness of fit and independence **92%** · Type I and Type II error **92%** · Likert item versus Likert scale (composite score) **90%**

Hypothesis test steps



Type I and Type II errors



M 01 Formulas (formula sheet or know)

- t = (x-bar – mu0) / (s / sqrt(n)), df = n – 1 (formula sheet)
- z (proportion) = (p-hat – p0) / sqrt(p0 (1 – p0) / n) (formula sheet)
- CI = estimate +/- critical value x SE (formula sheet)
- chi-square = sum of (O – E)^2 / E; E = row total x column total / total; df = (r – 1)(c – 1) (formula sheet)
- Cronbach's alpha: formula sheet. The F formula and the p-value calculation are not on it.
- Flipping a reverse coded item: (max + min) – score; 1 to 5 gives 6 – score

M 02 Recipe

- H1 first (what you expect), H0 is the opposite. Hypotheses are about population parameters.
- Choose alpha (usually 0.05), test statistic, critical value or p-value, conclusion.
- Reject H0 if p <= alpha (or statistic in rejection region). Otherwise: maintain H0.
- two-sided: alpha/2 per tail; one-sided: one tail (right-tail or left-tail).

M 03 p-value

- Probability of an outcome as extreme as or more extreme, assuming H0 is true.
- Not: the probability that H0 is true. A large p does not prove H0.

M 04 Errors

- Type I: rejecting H0 while true (probability alpha, false positive).
- Type II: maintaining H0 while false (probability beta, false negative). Power = 1 – beta (often 80%).
- Lower alpha: Type I down, Type II up. Both down: larger n.

M 05 Choosing a test

- One mean against a value: one-sample t. Two groups: two-sample t (Welch if var.equal = FALSE). Pairs (before/after): paired t.
- Three or more groups: ANOVA (H0: all means equal). Significant F: post-hoc (Tukey).
- Proportion or known sigma: z-test.
- Two categorical variables: chi-square (H0: independent).

M 06 Reading R output

- t.test: t, df, p-value, 95 percent confidence interval, sample estimates. "alternative hypothesis" is H1.
- Interval contains the H0 value: not significant at alpha = 0.05 (two-sided).
- aov: summary gives Df, Sum Sq, F value, Pr(>F).
- chisq.test: X-squared, df, p-value.

M 07 Likert and Cronbach's alpha

- Likert: items, rating scale, instruction. Flip reverse coded items first.
- alpha above 0.7 acceptable. Negative: forgot to flip. "alpha if item dropped" finds weak items.
- Quality: attention checks, remove flatliners.

! Pitfalls

- Linked data with a two-sample t-test. Several t-tests for three groups.
- Not significant is not no effect. Significant is not important.