Hypothesis Testing Cheat Sheet

CORE DEFINITIONS

Null Hypothesis (H_0)	Default claim stating no effect, no difference, or no relationship in the population.
Alternative Hypothesis (H_a)	Competing claim stating a difference, effect, or relationship exists.
Test Statistic	Numerical value calculated from sample data used to evaluate H_0.
p-value	Probability of observing the sample result if H_0 is true.
Significance Level (α)	Threshold used to judge statistical evidence against H_0. Common value: 0.05.
Standard Error	Measure showing how far a sample statistic may vary from the population value.

HYPOTHESIS TESTING PROCESS

1	Define H_0 (null hypothesis) and H_a (alternative hypothesis).
2	Select a significance level α such as 0.05.
3	Collect sample data from the population.

4	Calculate the test statistic using the sample data.
5	Determine the p-value or critical value.
6	Compare the p-value with α.
7	Reject H_0 or fail to reject H_0.
8	Interpret the result in the context of the research question.

DECISION RULE

Condition	Decision	Interpretation
$p \leq \alpha$	**Reject H_0**	Evidence supports the alternative hypothesis.
$p > \alpha$	**Fail to reject H_0**	Evidence against H_0 remains weak.

TYPES OF ERRORS

Error Type	Meaning	Example
Type I Error	Rejecting **H_0** even though H_0 holds true.	Concluding a new teaching method improves scores when it does not.

Type II Error	Failing to reject H_0 even though a real effect exists.	Missing evidence that tutoring improves exam scores.

ONE TAILED VS TWO TAILED TESTS

Test Type	When Used	Example Alternative Hypothesis
One Tailed Test	Used when testing for change in **one direction**.	Average score **greater than 75**.
Two Tailed Test	Used when testing for **any difference**.	Average score **different from 75**.

COMMON STATISTICAL TESTS

Test	When Used	Example
Z Test	Large samples with known population variance.	Compare sample mean with a known population mean.
T Test	Smaller samples with unknown population variance.	Compare average exam scores between two groups.
Chi Square Test	Categorical variables.	Test relationship between study method and pass rate.
ANOVA	Compare means across three or more groups.	Compare exam scores across multiple classes.

COMMON FORMULAS

Sample Mean	$\bar{x} = \Sigma x / n$
Standard Error	$SE = s / \sqrt{n}$
T Statistic	$t = (\bar{x} - \mu) / (s / \sqrt{n})$
Sample Proportion	$\hat{p} = x / n$
Z Score	$z = (x - \mu) / \sigma$

QUICK EXAMPLE

Research Question	Does tutoring improve exam scores?
Null Hypothesis (H_0)	Average score equals 70.
Alternative Hypothesis (H_a)	Average score greater than 70.
Significance Level	$\alpha = 0.05$
Test Result	p-value = 0.03
Decision	Reject H_0
Interpretation	Sample data support the claim that tutoring increases exam scores.