

# 1 One-sample and Two-sample t-test

## ✦ What does it test?

Equality of the population mean.

## ✓ Assumptions:

### Independence of observations

- Observations within the sample are independent.
- In the two-sample test, the groups are independent.

### Normality in the population

- The data (or residuals) are normally distributed.
- For larger samples (approximately  $n > 30$ ), the Central Limit Theorem helps.

### Equality of variances (only for the classical two-sample t-test)

If this assumption is violated → **Welch's t-test** is used (it does not require equal variances).

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# 2 Paired t-test

Used for “before–after” measurements.

## ✓ Assumptions:

- Dependent measurements (the pairing is meaningful).
- Normality of the differences (not of the original data).
- Independence between individual pairs.

This is a common mistake students make – normality is checked for the differences.

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# 3 Chi-square ( $\chi^2$ ) Goodness-of-fit / Test of Independence

## ✦ What does it test?

- Agreement with a theoretical distribution
- Independence of categorical variables

✓ **Assumptions:**

- Independent observations
- Sufficiently large expected frequencies
  - Usually at least 5 in each cell
  - At most 20% of cells may have expected counts below 5

If violated → **Fisher's exact test** (for small contingency tables).

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## 4 ANOVA (Analysis of Variance)

✦ **What does it test?**

Equality of more than two population means.

✓ **Assumptions:**

- Independence of observations
- Normality within each group
- Homogeneity of variances ( $\sigma_1^2 = \sigma_2^2 = \dots$ )

If violated:

- Welch's ANOVA (unequal variances)
  - Kruskal–Wallis test (non-normal data)
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## 5 Correlation (Pearson)

✓ **Assumptions:**

- Linearity of the relationship
- Normality (for both variables)
- Homoscedasticity
- Independence of observations

If violated → **Spearman correlation**.

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## ◆ Summary Didactic Table

Test	Normality	Equal Variances	Independence
t-test (1 sample)	✓	–	✓
t-test (2 samples)	✓	✓	✓
Welch	✓	✗	✓
Paired t-test	differences	✓ –	✓ (between pairs)
ANOVA	✓	✓	✓
$\chi^2$	✗	✗	✓

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### Remark

Violation of normality is usually less serious than violation of independence.