

Student t Test and One-Way ANOVA

Practical 14 | Pharmacology III

Aim

To study Student t Test and One-Way ANOVA, and interpret the recorded observations.

Principle

- A t test examines a defined mean comparison, while one-way ANOVA examines a mean difference across independent groups under its model. Paired and independent data require different analyses.
- Choose the calculation or statistical model appropriate to the data structure and assumptions.
- Units, paired or independent observations, and the direction of the measured effect must be explicit.
- Standard independent-group ANOVA assumes independent errors and an appropriate common-variance/normal-error model; use a suitable alternative when those conditions are unsuitable.
- An omnibus ANOVA result does not identify which individual groups differ. Any follow-up comparisons need the planned multiplicity approach.

Materials and Apparatus

- Provided grouped or paired dataset and statistical software.
- Instructor-provided dataset and the stated study/model assumptions.
- Calculator or spreadsheet/statistical software and a record sheet.

Method

1. Identify whether observations are paired or independent and define the comparison.
2. Check missing values, distributions and the relevant model assumptions.
3. Summarize each group with its size, mean and standard deviation.
4. Use an appropriate t test for two-group/paired data or an appropriate ANOVA for the stated multiple-group design.
5. Record the statistic, degrees of freedom, p-value and the estimated difference or group means.
6. Interpret against the pre-specified significance level and distinguish statistical significance from effect size.

Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

Observation / parameter	Record / finding
Data structure	_____
Group size	_____
Mean and variability	_____
Test statistic	_____
Degrees of freedom	_____
p-value and effect	_____

Calculations and Interpretation

- Independent unequal-variance comparison: $t = (\text{mean1} - \text{mean2}) / \sqrt{s_1^2/n_1 + s_2^2/n_2}$, with Welch-Satterthwaite degrees of freedom.
- Paired comparison: $t = \text{mean difference} / (\text{SD of differences} / \sqrt{n})$; degrees of freedom = $n - 1$.
- One-way ANOVA: $F = \text{mean square between groups} / \text{mean square within groups}$.

Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: _____

Conclusion: _____

Precautions

- Do not interchange paired and independent analyses.
- Keep unit conversions explicit and round at the final reporting stage.
- A model estimate or p-value does not by itself establish a causal or clinical conclusion.

Viva Questions

1. Why is repeatedly using unadjusted t tests across many groups problematic?

It can inflate the chance of false positive conclusions across the collection of comparisons.

2. Why state assumptions?

An equation or test can give a misleading answer when its underlying assumptions do not hold.

3. Why keep intermediate calculations?

They make the result reproducible and expose unit or transcription errors.

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