Two-Sample t-Test (Welch) from Summary Statistics

Welch's t statistic, degrees of freedom and two-sided p-value for the difference between two means from their sample means, standard deviations and sizes.

Method: Welch's unequal-variance t test

Input parameters

Unit system: SI

Parameter	Value	Unit
Mean of sample 1	52.300	
Standard deviation of sample 1	4.1000	
Size of sample 1	12.000	
Mean of sample 2	48.900	
Standard deviation of sample 2	5.3000	
Size of sample 2	15.000	
Significance level	5.0000	%

Calculated results

Parameter	Value	Unit
Difference of means	3.4000	
Welch t statistic	1.8792	
Welch–Satterthwaite degrees of freedom	24.985	
Two-sided p-value	0.071931	
Significant difference (1 = yes)	0	

Notes for this case

• Welch's test does not assume equal variances: t = (x̄₁ − x̄₂)/√(s₁²/n₁ + s₂²/n₂) with ν = (s₁²/n₁ + s₂²/n₂)²/[(s₁²/n₁)²/(n₁ − 1) + (s₂²/n₂)²/(n₂ − 1)] degrees of freedom; p is two-sided from Student's t. A small p says the means very probably differ; it says nothing about whether the difference matters in practice, so report the difference too. Samples must be independent and roughly normal (or large).

Formula and method

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s_1^2/n_1 + s_2^2/n_2}}, \quad \nu = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}$$

Variables

$\bar{x}_1$	Mean of sample 1	-
s_1	Standard deviation of sample 1	-
n_1	Size of sample 1	-
$\bar{x}_2$	Mean of sample 2	-
s_2	Standard deviation of sample 2	-
n_2	Size of sample 2	-
α	Significance level	-
$\bar{x}_1 - \bar{x}_2$	Difference of means	-
t	Welch t statistic	-
ν	Welch–Satterthwaite degrees of freedom	-
p	Two-sided p-value	-

$p < \alpha$	Significant difference (1 = yes)	-

Method and standards

t-test.

Assumptions and limits

- Independent samples; approximately normal data.

References

Welch's unequal-variance t test

Report details

Report reference	FCC-31H0-PZEQ (the same inputs always give the same reference)
Generated	23 November 2026, 18:08 UTC
Calculator	Two-Sample t-Test (Welch) from Summary Statistics
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/general/geometry/two-sample-t-test

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Reopens the calculator with the inputs of this report.