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Are σ_1^2 and σ_2^2 both known?

yes →

Use the z-test with test statistic

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - d_0}{\sqrt{\sigma_1^2/n_1 + \sigma_2^2/n_2}}$$

which has a standard normal distribution. For this case it is not correct to use s_1^2 and s_2^2 as estimates of σ_1^2 and σ_2^2.

no ↓

Can we assume $\sigma_1^2 = \sigma_2^2$?
(Check graphically or with a variance test, p. 1)

yes →

Do a t-test with test statistic

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - d_0}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

which has a t-distribution with $n_1 + n_2 - 2$ degrees of freedom. s_p^2 is called the pooled variance and is calculated from

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

no ↓

Use a t-test with test statistic

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - d_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

which has a t-distribution with ν degrees of freedom where ν is obtained from

$$\nu = \frac{\left(s_1^2/n_1 + s_2^2/n_2\right)^2}{\frac{\left(s_1^2/n_1\right)^2}{n_1 - 1} + \frac{\left(s_2^2/n_2\right)^2}{n_2 - 1}}$$

rounded to the nearest integer.†

† This is Satterthwaite's solution to what has become known as the Behrens-Fisher problem. Other solutions exist.