Two-sample pooled \( t \)-test for difference of means

**Why?** To compare two unknown means, \( \mu_1 \) and \( \mu_2 \).

**When?** The following conditions must be present for the test to be accurate and valid.
All of the conditions may have to be assumed to proceed with the test.
1. \( \sigma_1 \) and \( \sigma_2 \) are unknown but **assumed to be equal**.
2. The samples are selected independently.
3. The samples are from normally distributed populations.

**How:**

Preliminary:
- Select the level of significance, \( \alpha \) (use 0.05 unless otherwise stated).
- Define \( \mu_1 \) and \( \mu_2 \) in the context of the problem.

1. State the null hypothesis:
   
   \[ H_0: \mu_1 = \mu_2 \]

2. Calculate the test statistic:
   
   (1) First find the pooled standard deviation:
   
   \[
s_p = \sqrt{s_1^2 + s_2^2 - \frac{1}{n_1 + n_2 - 2}}
   \]
   
   (2) Calculate the test statistic:
   
   \[
t_0 = \frac{(x_1 - x_2)}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}
   \]

3. Find the \( P \)-value (observed significance level): using a \( t \) distribution with \( n_1 + n_2 - 2 \) degrees of freedom.

4. Conclusion: Reject \( H_0 \) if the \( P \)-value is less than the level of significance; otherwise, do not reject \( H_0 \).