Overview of the t-test

Suppose that we want to compare one sample (e.g. batch 1) to another sample (e.g. batch 2) to determine if significant variations exist in the sample means. We use Student's t-distribution and what is known as the t-test. For the following, \( \bar{x}_i \) is the sample mean, \( S_i \) is the sample standard deviation, and \( n_i \) is the number of measurements in the sample for the \( i^{th} \) sample. The procedure is as follows:

1. Find \( t \) for your samples with the following equation

\[
t = \frac{\bar{x}_1 - \bar{x}_2}{\left[ \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} \right]^{1/2}}
\]

2. Use the following equation to find the degrees of freedom, where \( \nu \) is rounded down to the nearest integer.

\[
\nu = \frac{\left[ \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} \right]^2}{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}
\]

\[
\frac{n_1 - 1}{\nu} + \frac{n_2 - 1}{\nu}
\]

3. Use \( \nu \) along with a confidence level, \( C \), to find the critical \( t_{\text{crit}} \) from the Student's t-distribution table. The critical value will be \( t_{\alpha/2,\nu} \), where \( \alpha = 1 - C \).

4. If the value of \( t_{\text{exp}} \leq t_{\text{crit}} \), there is not sufficient evidence that there are statistical differences. Therefore, colloquially, we can say the two samples are statistically the same.