Methods Manual: \textit{t-test - hand calculation} - for independent samples*

1. List the raw scores by group
2. Calculate the sum of the scores for the first group ($\Sigma X$) and for the second group ($\Sigma Y$) (columns 1 and 3).
3. Square each individual score and sum those for each group, $\Sigma X^2$ and $\Sigma Y^2$ (columns 2 and 4)

\begin{align*}
\text{Group A} & \quad \text{Group B} \\
X & \quad Y \\
1 & 4 \\
4 & 5 \\
3 & 5 \\
5 & 6 \\
2 & 4 \\
3 & 7 \\
5 & 4 \\
4 & 5 \\
\text{\textbf{sum}} & 30 & \text{\textbf{sum}} & 30
\end{align*}

\begin{align*}
\text{\textbf{sum}^2} & 195 & \text{\textbf{sum}^2} & 196
\end{align*}

\begin{align*}
N = 10 & \quad N = 9
\end{align*}

4. Use the following formula to calculate the \textit{t-ratio}.

\[
t = \frac{M_x - M_y}{\sqrt{\left(\frac{\Sigma X^2 - \left(\Sigma X\right)^2}{N_x}\right) + \left(\frac{\Sigma Y^2 - \left(\Sigma Y\right)^2}{N_y}\right)} \cdot \left[\frac{1}{N_x} + \frac{1}{N_y}\right]}
\]

$\Sigma$ = sum the following scores  
$M_x$ = mean for Group A  
$M_y$ = mean for Group B  
$X$ = score in Group 1  
$Y$ = score in Group 2  
$N_x$ = number of scores in Group 1  
$N_y$ = number of scores in Group 2
5. Find the probability value \( (p) \) associated with the obtained \( t \)-ratio of -2.19.

   a. Calculate degrees of freedom \( (df) \)

   \[
   df = N_1 - 1 + N_2 - 1 \\
   df = (10-1) + (9-1) = 17
   \]

   b. Use the abbreviated table of Critical Values for \( t \)-test to find the \( p \) value.

For this example, \( t = -2.40, df = 17 \). The obtained value of 2.40 exceeds the cutoff of 2.11 shown on the table at the .05 level. Therefore, \( p < .05 \). In a report the result is shown as \( t(17) = -2.40, p < .05 \).

A plus or minus sign at the end, associated with the \( t \)-ratio, indicates the direction of the difference between the means (Group B had a higher mean than Group A). The \( p \) value remains the same in either direction. Here is the outcome in statistical terms:

* If you have matched samples (i.e., the two sets of scores are from the same individuals or from matched groups), you must use a different formula. See t-test for paired samples.