***T*-Tests for 2 *Independent* Samples**

$H_o: \mu_1 - \mu_2 = D_0 \quad \rightarrow \quad t_s = \dfrac{(\bar{x}_1 - \bar{x}_2) - D_0}{SE_{\bar{x}_1 - \bar{x}_2}}$

- Equal (or Pooled) Variance *T*-test: Assumes $\sigma_1 = \sigma_2$
  - $SE_{\bar{x}_1 - \bar{x}_2} = \sqrt{s_p^2\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}$ $\quad df = n_1 + n_2 - 2$
- Unequal (or Unpooled) Variance *T*-test: Assumes $\sigma_1 \neq \sigma_2$
  - $SE_{\bar{x}_1 - \bar{x}_2} = \sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}$ $\quad$ *df* by Satterthwaite's approximation

Tests of Homogeneity of Variance (HOV)

$H_o: \sigma_1^2 = \sigma_2^2 \qquad H_a: \sigma_1^2 \neq \sigma_2^2$

- Fmax Test: (a.k.a. Hartley's test)
  - $F_{\max,s} = s_{\max}^2 / s_{\min}^2$ $\quad df = n^* - 1$ where $n^* = \max(n_1, n_2)$ (Table 10)
  - Not robust to non-normal populations
- Brown & Forsythe's Test (a.k.a. Levene's median): (for 2 samples)
  - Uses recoded data: $z_{1j} = |x_{1j} - \tilde{x}_1|$, $z_{2j} = |x_{2j} - \tilde{x}_2|$ (Absolute deviations from the median)
  - The test involves a *T*-test on z_1 and z_2 (Equal variance with s_p^2 in the *SE*)
  - Robust to non-normal populations

***T*-Test for 2 *Paired* Samples**

$H_o: \mu_d = 0 \quad \rightarrow \quad t_s = \dfrac{\bar{d} - 0}{s_d / \sqrt{n}}$

- Each individual in sample 1 is matched to one individual in sample2 in order to control for other factors and reduce variability
  - $d_i = x_{1i} - x_{2i}$

Nonparametric Tests

- Do not rely on the assumption of normally distributed populations → Nonparametric
- Use ranks of the observations as opposed to the original values → not influenced by outliers
- 2 *Independent* Samples: Wilcoxon Rank Sum Test (a.k.a. Mann-Whitney Test)
  - T_{WMW} [= Sum of the ranks in sample 1] with a sampling dist. that is approx. normal with
    - $\mu_T = \dfrac{n_1(n_1 + n_2 + 1)}{2}$, $\quad \sigma_T^2 = \dfrac{n_1 n_2}{12}(n_1 + n_2 + 1)$, $\rightarrow$ $z_s = \dfrac{T_{WMW} - \mu_T}{\sigma_T}$
- *Paired* Samples: Wilcoxon Signed Rank Test
  - T_{WSR} [= minimum (T_+, T_-)] with a sampling distribution that is approx. normal with
    - $\mu_T = \dfrac{n^*(n^* + 1)}{4}$, $\quad \sigma_T^2 = \dfrac{n^*(n^* + 1)(2n^* + 1)}{24}$, $\rightarrow$ $z_s = \dfrac{T_{WSR} - \mu_T}{\sigma_T}$