Pearson’s Parametric Correlation
Equations taken from Zar, 1984

\[ r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}} \]

where
\[ \sum x^2 = \sum X^2 - \frac{(\sum X)^2}{n} \]
\[ \sum y^2 = \sum Y^2 - \frac{(\sum Y)^2}{n} \]
\[ \sum xy = \sum XY - \frac{(\sum X)(\sum Y)}{n} \]

\[ t = \frac{r}{s_r} \quad \text{where} \quad s_r = \sqrt{\frac{1-(r)^2}{n-2}} \quad \text{df} = n-2 \]

Example: Temperature and dissolved oxygen readings were taken at Burd Run over a period of days. Our hypothesis is that temperature and oxygen co-vary, meaning that as one increases or decreases, the other increases or decreases in a linear manner. With correlation we only concerned with strength with which the variables are associated, we can not make predictions of the value of one variable based on the value of another. In correlation we test the 2-tailed hypothesis that the population correlation is significantly different than zero, based on our sample. 1-tailed hypotheses state that the correlation coefficient is either positive or negative. The correlation coefficient ranges from -1 to +1, negative numbers meaning that the relationship is inverse (as one increases the other decreases).

H₀: There is no significant inverse correlation between temperature and oxygen.
Hₐ: There is a significant inverse correlation between temperature and oxygen.

\[ \alpha = 0.05 \quad \text{df} = 13-2 = 11 \]
\[ \sum X = 93.22 \quad \sum Y = 193.93 \quad \text{(sum of the columns)} \]
\[ \sum X^2 = 680.39 \quad \sum Y^2 = 2899.79 \quad \text{(sum of the squared observations)} \]
\[ \sum XY = 1383.12 \quad \text{(multiply X and Y, then sum)} \]
\[ \sum x^2 = 680.39 - \frac{(93.22)^2}{13} = 11.93 \quad \sum y^2 = 2899.79 - \frac{(193.93)^2}{13} = 6.80 \]
\[ \sum xy = 1383.12 - \frac{(93.22)(193.93)}{13} = -7.51 \]

\[ r = \frac{-7.51}{\sqrt{(11.93)(6.80)}} = -0.83 \]

\[ s_r = \sqrt{\frac{1-(-0.83)^2}{13-2}} = \sqrt{\frac{0.311}{11}} = 0.168 \quad t = \frac{-0.83}{0.168} = -4.94 \quad \text{(ignore the sign)} \]

\[ t_{Critical} = 1.796 \quad 4.94 > 1.796 \quad \text{therefore reject } H_0 \]

There is a significant inverse correlation \((r = -0.83)\) between temperature and dissolved oxygen \((t_{-4.94}, p < 0.005)\).