Common Formulas

The following formulas are in the order in which you learn about them in this textook. Use the Table of Contents to look for a specific equation.

Descriptive Statistics

Mean

$$\bar{X} = \frac{\sum X}{N} \tag{1}$$

Standard Deviation

$$s = \sqrt{\frac{\sum (X - \overline{X})^2}{N - 1}} \tag{2}$$

Which is also: $s = \sqrt{\frac{\sum (X - \overline{X})^2}{N - 1}} = \sqrt{\frac{SS}{df}}$

Some instructors prefer this formula because it is easier to calculate (but more difficult to see what's happening):

$$\sqrt{\frac{\left(\sum (X^2) - \frac{(\sum X)^2}{N}\right)}{(N - 1)}} \tag{3}$$

z-score

To find the z-score when you have a raw score:

$$z = \frac{X - \bar{X}}{s} \tag{4}$$

To find a raw score when you have a z-score:

$$x = zs + \overline{X} \tag{5}$$

t-tests

One-Sample t-test

These are the same formulas, but formatted slightly differently.

$$t = \frac{(\bar{X} - \mu)}{\left(\frac{s}{\sqrt{n}}\right)} \tag{6}$$

Confidence Interval

$$\text{Margin of Error } = t \times \left(\frac{s}{\sqrt{N}}\right)$$

$$\text{Confidence Interval } = \overline{X} \pm (t \times \left(\frac{s}{\sqrt{N}}\right)) \tag{7}$$

Independent Sample t-test

Unequal N

You can always use this formula:

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\left[\frac{(n_1 - 1) \times s_1^2 + (n_2 - 1) \times s_2^2}{n_1 + n_2 - 2}\right] \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{8}$$

Equal N

You should only use this formula when your two independent groups are the same size (N), meaning the same number of people in each group.

$$\frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\left(\frac{s_1^2}{N_1}\right) + \left(\frac{s_2^2}{N_2}\right)}} \tag{9}$$

Dependent Sample t-test

Conceptual Formula (symbols)

$$t = \frac{\overline{\overline{X}}_D}{\left(\frac{s_D}{\sqrt{\overline{N}}}\right)} \tag{10}$$

Full Formula

$$t = \frac{\left(\frac{\Sigma D}{N}\right)}{\sqrt{\left(\frac{\sum\left((X_D - \overline{\overline{X}}_D)^2\right)}{(N-1)}\right)/\sqrt{N}}} \tag{11}$$

ANOVA

Sums of Squares for Between Groups Designs

Between Groups

$$SS_B = \sum_{EachGroup}\left[\left(\overline{X}_{group} - \overline{\overline{X}}_T\right)^2 \times (n_{group})\right] \tag{12}$$

Within Groups

$$SS_W = \sum_{EachGroup}\left[\sum\left(\left(X - \overline{X}_{group}\right)^2\right)\right] \tag{13}$$

Total

$$SS_T = \sum\left[\left(X - \overline{\overline{X}}_T\right)^2\right] \tag{14}$$

Tukey's HSD for Pairwise Comparison

$$HSD = q \times \sqrt{\frac{\overline{MSw}}{n_{group}}} \tag{15}$$

Sums of Squares for Repeated Measures Designs

Between Groups

Same as above.

Participants

$$SS_{Ps} = \left[\sum\left(\frac{(\sum X_{Ps})^2}{k}\right)\right] - \frac{\left((\sum X)^2\right)}{N} \tag{16}$$

Within Groups (Error)

$$SS_{WG} = SS_T - SS_{BG} - S_P$$

Total

Same as above.

Pearson's r (Correlation)

The following formulas are the same. Use the first one when you already have the standard deviation calculated.

These are paired data, so *N is the number of pairs*.

SD Already Calculated:

$$r = \frac{\left(\frac{\sum((x_{Each} - \bar{X}_x) \times (y_{Each} - \bar{X}_y))}{(N-1)}\right)}{(s_x \times s_y)} \tag{17}$$

SD Not Calculated:

$$r = \frac{\left(\frac{\sum((x - \bar{X}_x) \times (y - \bar{X}_y))}{(N-1)}\right)}{\left(\sqrt{\frac{\sum\left((x - \overline{X_x})^2\right)}{N-1}}\right) \times \left(\sqrt{\frac{\sum\left((y - \overline{X_y})^2\right)}{N-1}}\right)} \tag{18}$$

Regression Line Equation

$$\widehat{\mathrm{Y}} = \mathrm{a} + (\mathrm{b} \times X) \tag{19}$$

a (intercept):

$$\mathrm{a} = \overline{X_y} - (\mathrm{b} \times \overline{X_x}) \tag{20}$$

b (slope):

$$\frac{\sum(Diff_x \times Diff_y)}{\sum({Diff_X}^2)} \tag{21}$$

In which "Diff" means the differences between each score and that variable's mean.

Pearson's χ^2 (Chi-Square)

$$\chi^2 = \sum_{Each}\left(\frac{(E-O)^2}{E}\right) \tag{22}$$

Expected Frequencies

Goodness of Fit:

$$\frac{N}{k} \tag{23}$$

Test of Independence:

$$E_{EachCell} = \frac{RT \times CT}{N} \tag{24}$$

In which RT = Row Total and CT = Column Total