0.1 Correct Interpretation of Limits of Agreement as Intervals

hamilton2010 criticises the incorrect use of Bland and Altman's reference intervals.

Intervals in Statistical Theory

In statistical theory, Confidence Intervals are the most commonly encountered interval estimate. However it is not the only type of interval.

Confidence Intervals for LoAs

BA99 provides estimates

The intention to provide confidence interval for the derives estimates is commendable. However, the usefulness is not clear.

The BlandAltman method can even include estimation of confidence intervals for the bias and limits of agreement, but these are often omitted in research. (Myles)

What is a reference interval?

A reference limit defines a value where a given proportion of reference values from the distribution are less than or equal to, or greater than or equal to, the value. A reference interval defines the interval between a lower and upper reference limit that includes a given proportion of the reference values.

The B&A plot analysis is a simple way to evaluate a bias between the mean differences, and to estimate an agreement interval, within which 95% of the differences of the second method, compared to the first one, fall. Data can be analyzed both as unit differences plot and as percentage differences plot.

The B&A plot method only defines the intervals of agreements, it does not say whether those limits are acceptable or not. Acceptable limits must be defined a priori, based on clinical necessity, biological considerations or other goals.

0.1.1 Confidence Intervals

A confidence interval covers a population parameter with a stated confidence, that is, a certain proportion of the time. Confidence limits are limits within which we expect a given population parameter, such as the mean, to lie. Statistical tolerance limits are limits within which we expect a stated proportion of the population to lie.

0.1.2 Tolerance Intervals

A tolerance interval is a statistical interval within which, with some confidence level, a specified proportion of a sampled population falls.

A two-sided tolerance interval consists of two limits between which a given proportion β of the population falls with a given confidence level 1α. A one-sided tolerance interval is similar, but consists of a single upper or lower limit.

Let $\{X_1, X_2, \ldots, X_n\}$, be a random sample for a population with distribution function F(X). A $(\beta, 1\alpha)$ two-sided β -content tolerance interval (T_L, T_U) , is defined by

$$\Pr[F(T_U) - F(T_L) \geq \beta]1\alpha$$

0.1.3 Prediction Intervals

A prediction interval is an interval associated with a random variable yet to be observed, with a specified probability of the random variable lying within the interval.

A prediction interval is an estimate of an interval in which future observations will fall, with a certain probability, given what has already been observed. Prediction intervals are often used in regression analysis.

A prediction interval has the following interpretation. A 95% prediction interval is one where, if you sample some data, construct an interval from that data, and then sample one new data point, there is a 95% chance that the interval will contain that data point. What's crucial here is that this is 95% of the time you repeat the whole procedure. If you have an iterated process, this will have the expected interpretation.