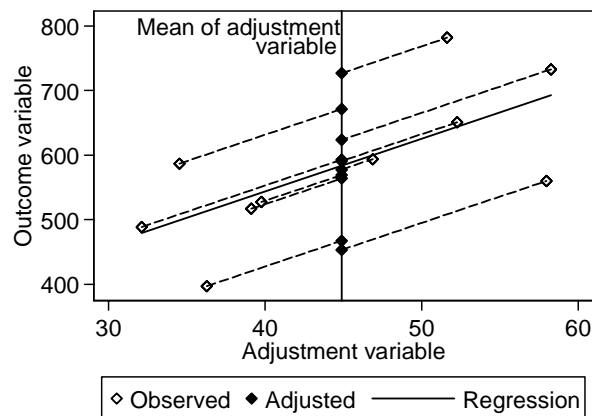


Measurement in Health and Disease

Suggested Answers to Exercise: Measurement error

1. The authors give three statistics for the measurement error: 'standard error of measurement', '95% confidence interval for a single measurement' and '95% confidence interval for a change in measurement'. What do each of these mean and how can they be interpreted for the intratester results? The 'standard error of measurement' is the standard deviation of repeated observations on the same subject, the within-subject standard deviation. We assume that this is a constant for all subjects. The '95% confidence interval for a single measurement' is the 95% confidence interval for the subject's true value, the mean of all possible observations, as estimated from a single measurement. It is 1.96 times the within-subject standard deviation. The '95% confidence interval for a change in measurement' is the repeatability, which is $1.96\sqrt{2}$ times the within-subject standard deviation. For the intratester results, we can conclude that about 2/3 of observations on a subject will be within 1.03 mm of the subject's true or average posterior tibial displacement; that 95% of measurements will be within 2.02 mm of the subject's true posterior tibial displacement, and that 95% of pairs of measurements chosen at random would be less than 2.86 mm apart.
2. What is the 'intraclass correlation coefficient' and how can we interpret an $ICC = 0.95$? The intraclass correlation coefficient is the correlation between pairs of repeated measurements. It is also the ratio of the variance of the true values of posterior tibial displacement to the variance of measured values.
3. How are 'standard error of measurement' and 'intraclass correlation coefficient' related? The ICC is equal to the variance of the true values to the variance of the true values plus the standard error of measurement squared. Large ICCs arise from relatively small standard error of measurement.
4. What do they mean by 'values were corrected for plasma cholesterol'? A regression method has been used to adjust the plasma alpha-tocopherol concentrations to what they would be estimated to be if the subjects all had the same plasma cholesterol:



This makes the variation less.

5. Why did the ICC go down once values were corrected for plasma cholesterol? The true values of alpha-tocopherol will be related to cholesterol, but the measurement error will not be. The variation in the true values will be reduced by the adjustment. The variation due to measurement error will not be affected. Hence the ICC will be reduced by the adjustment.