Standard Error of Measurement

- The standard deviation of a person's error scores (equal to their observed score variance) from infinite administrations of the same instrument
- Conceptually the likely level of difference between a person's observed score and true score
- Expressed in terms of individual scores, not group scores (like the reliability coefficient)
- Used to compute a "score band" or confidence interval about the person's true score
- Guards against too much emphasis on a single numeric score
- The margin of error to be expected in a person's True Score due to imperfect reliability

Example

Janet's observed score = 100
Mean of scores for the test = 85
Standard Deviation of scores for the test = 15
Reliability Coefficient for the test, $\alpha = 0.89$

Steps:

1. Decide how accurate you want the estimate to be (i.e., the confidence level)
   a. In our case we will use the 95% confidence level

2. Determine the Standard Error of Measurement (SEM), employing the formula

   $$S_e = S_x \sqrt{1 - r_{xx}}$$

   a. In our case, SEM = $15\sqrt{1-0.89} = 5.0$

3. Estimate the True Score, employing the formula

   $$T' = r_{xx}\left(X - \bar{X}\right) + \bar{X}$$

   a. In our case, $T' = 0.89(100 - 85) + 85 = 98.4$

4. Determine the confidence interval for the True Score estimate employing the formula

   $$T' \pm k(S_e)\sqrt{r_{xx}}$$

   a. In our case, $98.4 \pm 1.96(5.0)\sqrt{0.89} = 98.4 \pm 9.2$, yielding a 95% confidence interval of (89.2, 107.6).

Standard Error of the Estimate

- The standard deviation of the errors of prediction (the difference between what the regression line predicts and what we actually observe)
- Conceptually the likely level of difference between a person's observed score and their predicted score
- Expressed in terms of individual scores, not group scores (like the correlation or regression coefficient)
- Used to compute a confidence interval about a person's predicted score
- Guards against too much emphasis on a single numeric score
- The margin of error to be expected in a person's predicted score due to imperfect relationships between measures (imperfect validity)

Example

Janet's Observed quantitative score on the GRE = 680
Janet's GPA = 3.6
Mean GRE = 500, SD = 100
Mean GPA = 2.5, SD = 0.6
Correlation between GRE and GPA = 0.65

Steps:

1. Decide how accurate you want the estimate to be (i.e., the confidence level)
    a. In our case we will use the 95% confidence level

2. Determine the Standard Error of Estimate employing the formula

   $$S_{Y \bullet X} = S_y \sqrt{1-(r_{xy})^2}$$

    a. In our case, $S_{Y \bullet X} = 100\sqrt{1-(0.65)^2} = 58$

3. Estimate the predicted score, employing the formula

   $$\hat{Y} = r_{xy} \frac{S_y}{S_x}\left(X - \overline{X}\right) + \overline{Y}$$

    a. In our case, $\hat{Y} = 0.65\frac{100}{0.6}(3.6-2.5)+500 = 619$

4. Determine the confidence interval for the predicted score estimate employing the formula $\hat{Y} \pm k(S_{Y \bullet X})$
    a. In our case, $619 \pm 1.96(58) = 619 \pm 114$, yielding a 95% confidence interval of (505, 733)