

Psychometrics and test construction

GRE · GRE Subject Test · GRE Psychology

Scope and prerequisites

Supported GRE topic 10 (MM.1). Use the overview measurement lesson VI when interpreting research evidence. Existing official questions are traced in `bank_review_form.yaml`; original tasks below are not ETS items.

Concepts and method

standard error of measurement : The expected spread of observed scores around the true score, $SD \times \sqrt{1-r}$. **construct validity** : Convergent and discriminant evidence that a score reflects the intended trait.

Reliability is consistency, and its type is named by the design that produced it: the same test twice gives test-retest reliability; two similar forms give alternate-forms reliability; consistency within one sitting (split-half, Cronbach alpha) is internal consistency; agreement between scorers is inter-rater reliability. The Spearman-Brown formula $r_{full} = 2r / (1+r)$ rescales a half-test correlation to full test length: $r = .80$ becomes about .89.

Validity is evidence for the proposed interpretation, not of the test itself: content validity asks whether items cover the domain; criterion validity relates scores to an outcome, concurrently or predictively; construct validity assembles convergent and discriminant evidence that the score tracks the intended trait. Reliability caps validity but never establishes it: a consistent scale can systematically measure something else.

Standard scores re-express raw scores against a norm group: $z = (X - \text{mean}) / SD$, $T = 50 + 10z$, and Wechsler deviation $IQ = 100 + 15z$. A z of +2 gives IQ 130 and about the 98th percentile. The standard error of measurement $SEM = SD \times \sqrt{1-r}$ converts reliability into a score band: $SD = 15$ with $r = .91$ gives $SEM = 15 \times \sqrt{.09} = 4.5$.

Item analysis checks each item: difficulty p is the proportion answering correctly, and discrimination is the item-total correlation. Items that nearly everyone or no one answers correctly carry little information; negative discrimination flags a likely miskeyed or misleading item.

Choose the reliability coefficient by the source of variation being studied. A standard error of measurement concerns measurement uncertainty under a model; it is not the standard error of a sample mean. The Spearman-Brown estimate assumes sufficiently comparable halves; a formula cannot repair unrelated item content. Standard scores describe relative position and do not show that a test measures the intended construct fairly across groups.

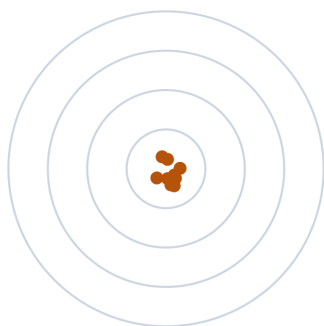
Worked reasoning

Two similar vocabulary tests given a week apart with $r=.90$ show alternate-forms reliability, not test-retest, because the form changed. With $SD=15$ and reliability $.91$, $SEM=4.5$ points. A z of $+2$ corresponds to IQ 130. A split-half correlation of $.80$ corrects to $2 \times .80 / 1.80 \approx .89$ at full length.

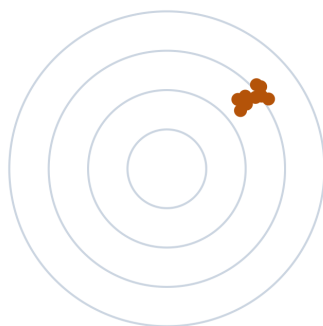
A fictional scale has mean 50 points, SD 10 points and reliability $.84$. A score is 65. Compute z and SEM , showing the formulas.

$z = (X - \text{mean}) / SD$; $z = (65 \text{ points} - 50 \text{ points}) / (10 \text{ points}) = 1.5$, dimensionless.
 $SEM = SD \sqrt{1 - r}$; $SEM = (10 \text{ points}) \sqrt{1 - .84} = 4 \text{ points}$. SEM is a model-based uncertainty measure, not proof of validity. $T = 50 + 10z$; $T = 50 + 10(1.5) = 65$ on the T scale.

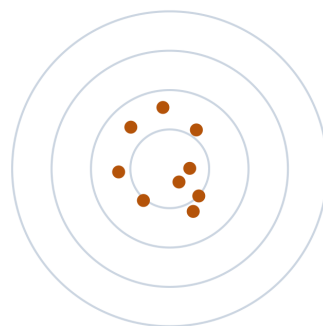
Reliable + valid



Reliable, not valid



Unreliable



Independent transfer

Two raters repeatedly disagree by five points but rank scripts identically. Does a high correlation establish agreement? Suggest a check.

Attempt independently, then use the matching skill sheet solution.

Review and source limits

Avoid this error: Calling a two-different-forms correlation test-retest reliability, or citing high reliability as if it were validity evidence. Teaching scope comes from `teaching.yaml` and the `source/key/crop` review in `bank_review_form.yaml`. Detailed current diagnostic criteria require an authenticated manual; neither historical ETS practice nor this educational reference certifies them.