# How Accurate Are the STAR National Percentile Rank Scores for Individual Students?–An Interpretive Guide

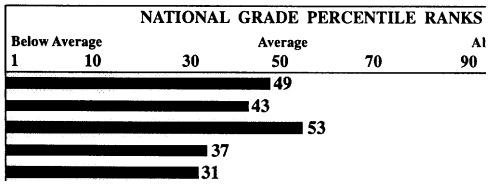
**Version 1.0 August 1999**

**David Rogosa**
**Stanford University**
rag@stat.stanford.edu

# 1. Introduction

Parents and others use test scores from standardized testing programs like STAR to answer, at least in part, the basic question, How is my kid doing in school? For the Stanford 9 part of the STAR testing, the National Percentile Rank Scores are the main information provided in the 1999 STAR *Parent Report*. These percentile rank scores, which provide a comparison of the student's score to a national sample, are also featured in the 1998 *Home Report* and in the more extensive *Student Report*. For reference, below is an excerpt from a sample 1999 Grade 10 STAR *Parent Report* showing the percentile rank reporting for the Stanford 9. For readers unfamiliar with current California activities, basic information on the STAR testing program and the score reports is available from CDE: *Reporting 1999 STAR Results to Parents/Guardians Assistance Packet*.

| *SUBTESTS AND TOTALS* | Number of Items | Number Correct | National %ile |
|---|---|---|---|
| Total Reading | 84 | 58 | **49** |
| Vocabulary | 30 | 19 | **43** |
| Reading Comp. | 54 | 39 | **53** |
| Mathematics | 48 | 19 | **37** |
| Language | 48 | 25 | **31** |




Percentile rank reporting from a sample 1999 Grade 10 STAR Parent Report.

There is a public perception that these numbers are pretty solid. For example, last year in a discussion of the interpretation of individual scores:

> "Dan Edwards, the education spokesman for Gov. Pete Wilson, ..... said parents and policymakers should focus on a **hard number**, 'the national percentile rank, grade by grade'."*Los Angeles Times*, July 16, 1998

The whole idea of this interpretive guide is to apply some common-sense descriptions of accuracy to these National Percentile Rank Scores. The main question to be addressed is, How solid are these numbers?

## Some Teasers

♦What are the chances that a student who "really belongs" at the 50th percentile in the national norms obtains a score more than 5 percentile points away from the 50th percentile?

For Math grade 9 it's 70%, for Reading grade 4 it's 58%.

♦What are the chances that a student who really improved 10 percentile points from year1 (1998) to year2 (1999) obtains a lower percentile rank in year2 than year1?

For a student really at the 60th percentile in year1 and at the 70th percentile in year2, it's 26% for Math grade 9 to grade 10
and 22% for Reading grade 4 to grade 5.

♦What are the chances that two students with "identical real achievement" obtain scores more than 10 percentile points apart?

For two students really at the 45th percentile for Math grade 9, it's 57%.
For two students really at the 45th percentile for Reading grade 4, it's 42%.

The above are examples of the kind of statements that I think are useful for interpreting these individual percentile rank scores. In contrast, the traditional way to discuss test accuracy or quality of measurement is by use of an index called a reliability coefficient; the reliability coefficient is a fraction between 0 and 1 (see Trochim, 1999, for background on reliability). For example, the reliability coefficients for Stanford 9 Total Reading raw scores are between .94 and .96 for Grades 2-11 (listed in the Stanford 9 *Technical Data Report* from HEM). These reliability numbers appear quite impressive–one might think that a 9.5 on a 10 point scale is plenty good enough for accurate individual scores. Similarly, the listed score reliabilities for Total Math are .94 or .95 for Grades 2-8, but fall to between .87 to .91 for Grades 9-11 (as the Math test is much shorter in the higher grades).

## The Next Sections

This guide presents numbers and discussion of the accuracy of the national percentile rank scores for grades 2-11 and also for some year1-year2 comparisons. These calculations use norms and measurement information for two tests–Reading total and Math total for Stanford Achievement Test Series, Ninth Edition, Form T (Stanford 9). The specific norms and measurement information were provided by Harcourt Educational Measurement (most of this information is also in HEM publications). Reading total and Math total are the most accurate subject-specific scores, mainly by virtue of having the most items or longest testing times; scores for shorter tests such as Spelling, Science, and Social Science, or for the Math and Reading subscores, will be far less accurate.

Because this guide is taking a different approach to the assessment of accuracy, I'll try to build up slowly to the probability calculations based on these ideas of accuracy. The next section is an attempt to describe common-sense formulations of accuracy using some disparate, real-life examples. Following that is the main event–calculations and results for the accuracy of Stanford 9 percentile rank scores with some summary tables. The final portion of the guide is an archive of more detailed tables for Stanford 9, plus some additional related topics. All of this requires patience with the exposition and fortitude in looking at lots of numbers. The theme throughout is to describe accuracy of the individual percentile rank score in terms of how close the score is to some (idealized) gold-standard measurement.

# 2. Accuracy in Real-life

Accuracy follows the common-sense interpretation of how close you come to the target. For some of us, television represents real-life, and that's the source of these examples of common-sense accuracy. Example 1 is from *Good Housekeeping Institute*, on the accuracy of home body-fat testers, and example 2 is from the Pentagon, on the accuracy of cruise missiles. The first example is communicated by Sylvia Chase, ABC News, and the second example by Brian Williams on MSNBC. For the home body-fat testers, the accuracy is expressed in terms of the discrepancy between the home body-fat assessment and the body-fat assessment obtained from much better quality of measurement–a "gold standard" clinical assessment using a body scan. For cruise missiles, the accuracy is stated in terms of the probability that the missile lands "close" (quantified in terms of a tolerance) to its target.

## Home Body-Fat Testers

The first illustration of accuracy is provided by that venerable authority on psychometrics, *Good Housekeeping*. The example is a study of home body-fat testers, conducted by the *Good Housekeeping Institute* reported in the September 1998 issue and also described in the ABC News television program *PrimeTime Live* in August 1998. From the *Good Housekeeping* (p. 42) print description:

> Three recent new gizmos promise to calculate your body-fat percentage at home. To test their accuracy, Institute chemists sent two female staffers to the weight control unit at St. Luke's-Roosevelt hospital in New York City have their body fat professionally analyzed. The clinic's results were compared with those of the Tanita body fat monitor and scale, the Omron Body Logic, and the Omron Body Pro.

*Good Housekeeping*'s summative evaluation: "Don't bother, the fat percentages measured by the devices were inconsistent with the clinic's findings."

*PrimeTime Live* repeated the *Good Housekeeping* tests with an additional 5 volunteers. As in the *Good Housekeeping* trials, the "gold standard Dexa reading" is obtained from the "weight control clinic at New York's St. Luke's Roosevelt Hospital, [with] the Rolls Royce of body-fat analyzers–the Dexa, considered the most accurate of fat measuring devices.... The Dexa scans the body, sorting out what's fat and what's not"(*Primetime Live* 8/12/98). For one female subject the Dexa gave 33 percent body fat (recommended upper

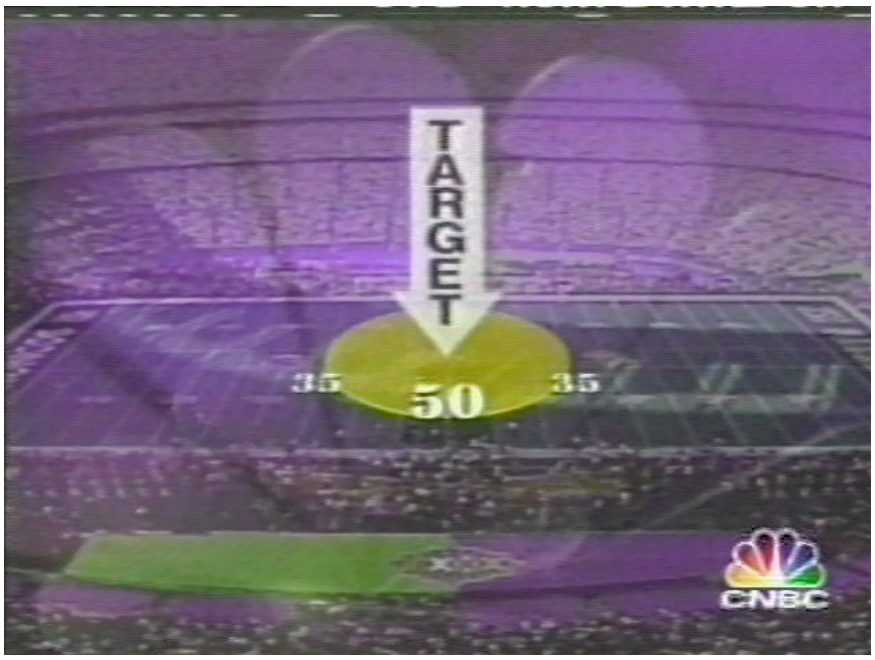
limit 25 percent). However, the Omron gave a 24 percent reading and the health club skin-fold with calipers also gave 24 percent. For one male subject, the Dexa gave 15.9 percent, whereas skin-fold gave 5 percent.

The intended lesson from the body-fat example is that the accuracy of a measurement, whether it be a percentile rank score from a standardized test or a reading from a home body-fat tester, is evaluated by the discrepancy between the gold-standard assessment (here the Dexa reading) and the field reading (here the home device). If the home tester produces scores close to clinical body-fat evaluation, then it's a good buy. Whether the observed discrepancies are acceptably small is a matter for judgement; in these trials it seems a discrepancy of 10 percent body fat is viewed as much too large to recommend the home devices or skin-fold. Extending this example, envision a far more extensive evaluation of the home body-fat testers, in which, say, 1,000 individuals had a gold-standard reading from the Dexa and measurements from each of the home devices. From those hypothetical data, for each device the proportion of measurements within 5 percentage points of the Dexa, within 10 percentage points of the Dexa, etc. could be tabulated. That's the type of assessment (via probability calculations) that will be presented in the next section for the Stanford 9 percentile rank score.

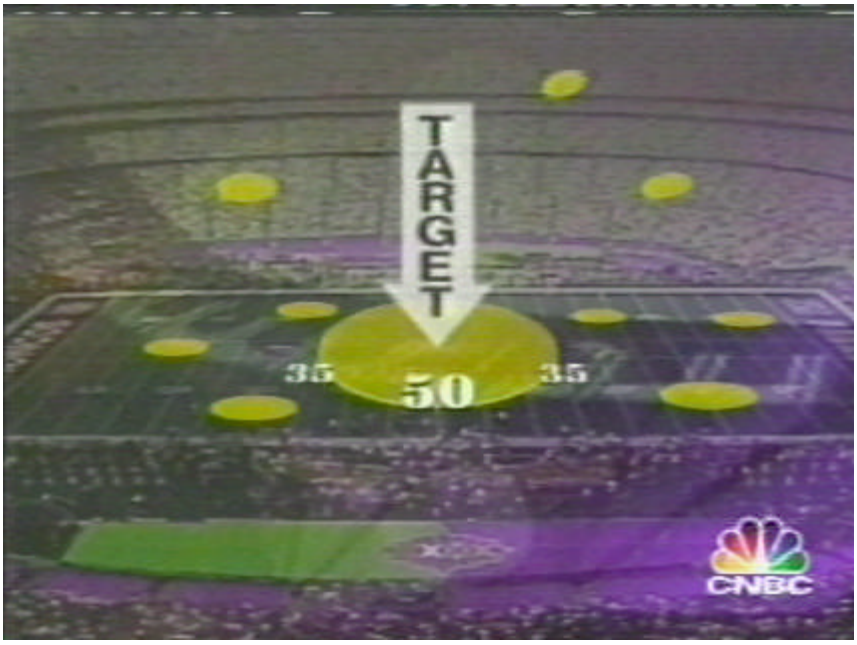
Please go to next page

## Cruise Missile Accuracy

The second illustration of accuracy is provided by descriptions of the accuracy of the Tomahawk cruise missile in a November 12, 1998, segment of the CNBC/ MSNBC program *News with Brian Williams*, titled Tomahawk Diplomacy. The screenshots below accompany the narration at the right.




"The Pentagon uses the idea of a football field. Says if the target were the 50 yard line, half the missiles would hit within fifteen yards




most of the rest [fall] on the field, but a few in the stands or even outside the stadium"

(CNBC/MSNBC, Nov. 12, 1998).

What about the Stanford 9 ? To recast in the terms we will use for the accuracy of percentile rank test scores, the top frame indicates the hit-rate is .50 for the target set at the 50-yard-line, and tolerance set to be 15 yards. In military jargon, the acronym is CEP, which stands for Circular Error Probable–a measure of the radius of the circle into which 50 percent of weapons should impact. The bottom frame isn't exactly quantifiable in terms of hit-rate, but roughly we could say: hit-rate is large (e.g., $\gtrsim .9$) for a strike within the confines of the playing field, and hit-rate is very large (e.g., $\gtrsim .98$) for a strike within the stadium. A narrative version of this description of Tomahawk cruise missile accuracy is provided, for example, by a DOD News Briefing by K. Bacon, 9/6/96. The analogy that is used here for the accuracy of percentile rank scores is, What's the probability that the obtained Stanford 9 percentile rank score is within 5 percentile points of the target?, or within 10 percentile points of the target? Defining the target for the Stanford 9 calculations is similar to the body-fat example; the target is a (hypothetical) gold-standard measurement obtained from a far more extensive testing protocol (or repeated testings) of student achievement.

Please go to next page

# 3. Accuracy of Stanford 9 Percentile Rank Scores

Four kinds of calculations are presented for the accuracy of Stanford 9 percentile rank scores: hit-rate, test-retest, comparing two different students, and year1-year2 comparisons. First, each of these terms is described, and then the resulting calculations are illustrated with some summary tables in this section. Additional tables for each test are contained in the Archive.

## Accuracy Scenarios

### hit-rate

Hit-rate is the probability that the discrepancy between the observed-score percentile rank and the percentile the student really belongs at is less than or equal to a specified tolerance. The cruise missile accuracy depiction illustrates the hit-rate idea. For example, hit-rate with tolerance 5 is the probability that a student who really belongs at the 50$^{th}$ percentile obtains a score within 5 points of the 50$^{th}$ percentile (i.e., percentiles between 45 and 55). The percentile that the student really belongs at can be thought of as obtained from a hypothetical gold-standard measurement, as in the body-fat stories; in the language of measurement texts it is the percentile (obtained from the test's norming distribution) corresponding to the student's true-score.

### test-retest

Following the amateur handyman dictum: "*measure twice, cut once*" (the title of Norm Abrams' fine text), one version of accuracy is how close together (or far apart) two measurements on the same student would be; if you measured a board twice and the two measurements were not close, you may not be satisfied with the quality of your measurement. The Parent Assistance Packet from CDE gives the following caption for interpreting the National Percentile Rank Scores:

> "No single number can exactly represent a student's level of achievement. If a student were to take a different form of the test within a short period of time, that score could vary from the first score." (page TM-15).

The question answered here for the Stanford 9 is, How close would two (contemporaneous) percentile rank scores be? The retest probability in the tables gives the probability that size of the discrepancy between two (contemporaneous) scores from a single student is less than or equal to a specified tolerance.

Another story for this same calculation is "identical twins separated at test-time". For example, consider two kids (e.g., next-door-neighbors) with identical achievement (both really belong at the same percentile). What's the chances of their Stanford 9 scores being more than 10 percentile points different?

## comparing two different students

An elaboration of the test-retest story is two kids (e.g., next-door-neighbors) with somewhat different achievement levels: One kid is, say, really 10 percentile points higher than the other. What's the chance of a reversal? (i.e., the lower achieving student receiving a higher percentile rank score). What's the chance of the lower achieving student receiving a score that is at least 10 percentile points higher?

## year1-year2 comparisons

Now that a second year of STAR results are available, questions about year-to-year progress (or lack thereof) arise. That is, a variant on the basic question, How is my kid doing in school? is, What progress is my kid making in school? The accuracy calculations address questions such as: For a student who really maintained the same percentile rank over two years (one possible definition of adequate yearly progress), what's the probability that the student shows a decline of 10 percentile points or more? For a student who really improved 10 percentile points from year1 to year2, what's the probability that student obtains a lower percentile rank at year2 than year1?

---

Technical detail: A small complication in carrying out and, in particular, expressing these hit-rate, retest, and year1-year2 calculations arises from the Harcourt reporting of percentile ranks as (rounded) integers. (Rounding to an integer entails, for example, expressing any number between 64.5 and 65.499 as 65.) Thus there is a potential complication in the probability calculations when the tolerance or bound is set to an integer. When tolerance is not an integer (e.g., 2.5, 7.5) this issue does not arise. In the reported probabilities the mass that lies exactly at the boundary (range –.5 to .5 reported as the identical integer percentile rank) is split into halves–half to be outside the boundary and half within. Expressed another way, for tolerance set to 5, the reported hit-rate or retest probability can be thought of as the average of that probability using tolerance 4.99 and that same probability using tolerance 5.01.
If the above strategy/explanation is unpersuasive, one could take a very conservative view and designate that "all approximate ties go to the test." This can be accomplished by a rewording of the explanation of the probabilities to exclude the boundaries. For example, in the teasers replace "more than 5 percentile points away from the 50$^{th}$ percentile" with "at least 5 percentile points away from the 50$^{th}$ percentile."

Please go to next page

## Navigating the Numbers

The accuracy stories give rise to a series of tables showing some of the results for the Stanford 9. The goal here is to provide some assistance, by means of narrated examples, in digesting the content of these tables. Even more information is contained in the Archive section.

### hit-rate and retest tables

Each table in this set of three has the same structure; the first table is for a student "really" at the 50th percentile, the second for a student at the 25th percentile, and the third for a student at the 75th percentile. The accuracy of the percentile rank score does vary across different locations in the score distribution; a full display of this is provided by the hit-rate and retest tables in the Archive section.

To explain these entries a little more, focus first on the 50th percentile table and the hit-rate columns. For Stanford 9 Math grade 9 a student who "really belongs" at the 50th percentile in the national norms has probability .70 (7 out of 10) of obtaining a score more than 5 percentile points away from the 50th percentile; that is, the chances are only 30% that the obtained percentile rank will be within 5 percentile points of the 50th percentile. Increasing the tolerance to 10 increases the hit-rate to .567, but still the probability that the obtained score is more than 10 percentile points from the 50th percentile is .433. (The Math9 hit-rate table in the archive shows that increasing the tolerance to 15 improves the hit-rate to .777, so still chances are almost 1 in 4 that the obtained percentile rank is more than 15 percentile points from the 50th percentile.)

For Reading at most grade levels the hit-rates are noticeably better than Math grade 9. Reading grade 2 has the highest values, as it is the longest of all the tests (see "test length rules" in the discussion below). Picking Stanford 9 Reading grade 4 as a further example, for a student who "really belongs" at the 50th percentile, the hit-rate for tolerance of 5 is .421 and for tolerance 10 is .733; i.e., the chances are better than 1 in 4 that the obtained percentile rank score is more than 10 percentile points from the 50th percentile.

Turning to the test-retest numbers in these summary tables, these numbers can be interpreted using the "measure twice" or "comparing identical kids" stories described above. The retest probabilities are roughly two-thirds to three-quarters as large as the comparable hit-rate probabilities. For Reading grade 4, for a student who "really belongs" at the 50th percentile, the probability that the two percentile rank scores are within 10 percentile

points of each other is .572; for Math grade 9 this probability is less than one-half, .434 (from the Archive table, probability the two scores are within 15 points of each other is .611).

Other percentiles. The hit-rate and retest probabilities improve somewhat (but not uniformly) when we move away from the 50th percentile student (the full tables in the Archive give the details). Repeating the Stanford 9 Reading grade 4 example, now for a student who "really belongs" at the 75th percentile, the hit-rate for tolerance of 5 is .516 (vs. .421 for 50th percentile student), and for tolerance 10 the hit-rate is .797 (vs. .733 for 50th percentile student). In the idealized textbook situation the 25th and 75th percentile results would be identical (see the classical test theory results in the Archive), but in the real-life Stanford 9 these do differ some. For Stanford 9 Reading, hit-rate and retest results are higher for the 25th percentile student than for the 75th percentile student. (This is largely due to Reading scores having smaller measurement error for lower scores than for higher scores; e.g., for Stanford 9 Reading grade 4, the scaled score standard error of measurement is smallest for scores between the 15th and 40th percentiles.) For Stanford 9 Math, the 25th percentile results are better in the lower grades, 75th percentile results better in the upper grades. But, to repeat, the hit-rate and retest probabilities are better at the 75th and 25th percentiles than at the 50th; the tables provide the quantification.

A further look is provided by plots of the hit-rate and retest probabilities, shown for Reading grade 4 and Math grade 9, which follow these summary tables. Each plot shows the accuracy probability, hit-rate or retest, as a function of increasing tolerance. Each plot shows the results for 5 different student levels: students at the 15th, 25th, 50th, 75th, and 85th percentiles. These plots illustrate the level of accuracy for a specified tolerance, the amount of increase in the accuracy probability for increases in tolerance, and the different effects of different percentile locations (e.g., p50 vs. p75, p25) for the two tests.

### comparing two different students tables

A snippet of results is given using two Stanford 9 tests, Math grade 9 and Reading grade 4. One illustration is to start with two students, one really at the 40th percentile and the other at the 50th percentile. For Math grade 9 the probability is .314 that the lower student receives a higher percentile rank score. For Reading grade 4, the same probability is .203. Furthermore, the Table shows a 11.7% chance that a grade 9 student really at the 45th

percentile obtains a lower score on Math than his classmate who is really at the 25th percentile.

### year1-year2 comparison tables

There are two sets of tables: one set for Math grades 9-11 (allowing year1-year2 calculations for Math9-Math10, and Math10-Math11), and one set for Reading grades 3-6 (allowing year1-year2 calculations for Reading3-Reading4, Reading4-Reading5, and Reading5-Reading6). For each content area, the first tables consider a student who maintained his-or-her percentile rank over the two years: e.g., really at 60th percentile in year1 and 60th percentile in year2. For Math that student has a 10% chance of showing a decline of at least 20 percentile points and more than a 25% chance of showing a decline of at least 10 percentile points. (Lack of accuracy may also giveth, as well as taketh away, in that the same student also has about a 10% chance of showing an improvement of at least 20 percentile points.) Similarly, for Reading in the lower grades (the most accurate tests in these analyses and the Stanford 9 battery), the student maintaining a 60th percentile level has about a 20% chance of showing a decline of at least 10 percentile points.

Conditional sidenote. These score decline calculations shown in the tables do allow for the student to have received much too high a score in year1 so that the score in year2 shows a big decline. But a further calculation can be done as follows: Take a student who really belongs at the 60th percentile each year and fix the obtained the year1 score at exactly the 60th percentile. Even with this restriction on the observed year1 score, the probability that this student shows a decline of at least 15 percentile points is .104 for Math9-to-Math10, and .128 for Math10-to-Math11.

The final tables for each content area examine students who made real improvements (10 or 20 percentile points) or suffered real declines (10 percentile points) from an initial percentile which is indicated by p1. From the Math table, a student who really declines from the 50th to the 40th percentile has a 1 in 3 chance of showing an improvement from year1 to year2. Also for Math, a student actually improving from the 25th to 45th percentiles has a 12 or 13% chance of showing a decline from year1 to year2. For Reading, a student making a real improvement of 10 percentile points has a 20% or more chance of showing a decline (for p1 in the range 40-60th percentiles). Even a student actually improving from the 75th to 85th percentiles has about a 15% chance of showing a decline in year1-year2

Reading percentile rank scores.

## Comments on Science, Social Studies and Subtests

Although complete accuracy calculations can't be done because I don't have measurement information, some approximate statements about the Stanford 9 Science and Social Science tests that are given in grades 9-11 can be attempted. The strategy is to use the Stanford 9 Math and Reading accuracy results, the HEM reported reliabilities for Stanford 9 Science and Social Science, and the classical test theory results presented in the Archive. Stanford 9 Social Science has reported score reliabilities between .77 and .81 and Stanford 9 Science has reported score reliabilities between .79 and .82. Taking an intermediate reliability of .8 and using the classical test theory results to proportionately adjust the calculations for Stanford 9 Reading and Math, some rough numbers for Stanford 9 Science and Social Science tests for students at the $50^{th}$ and $75^{th}$ percentiles are:

| p | hitrate, tolerance 10 | retest, tolerance 10 |
|---|---|---|
| 50 | .42 | .32 |
| 75 | .58 | .41 |

The Stanford 9 Language test has listed score reliabilities around .91, so one rough approximation would be to refer to results for Stanford 9 Math grade 11. Stanford 9 Spelling has listed reliabilities ranging between .8 and .9, so accuracy, which appears to vary considerably for different years, can be bracketed roughly by results for Math grade 9 and Social Science. (Perhaps interest in this Accuracy Guide will motivate Harcourt to provide the information needed to present accuracy calculations for these Stanford 9 components and other previously requested information.) Also, subtests for Stanford 9 Total Reading (Vocabulary, Comprehension) have listed reliabilities between .85 and .9. Consequently, rough estimates for the accuracy of those subtests could be bracketed above by Math grade 9 and below (weakly) by the estimates given above for Science and Social Science.

Please go to next page

## Summary Comments

♦"it's your call"

The aim here is to motivate readers to peruse the tables and draw their own conclusions about test accuracy. What is adequate accuracy for an individual score? for what purpose? High-stakes purposes, such as school promotion or remediation assignment of a student, may dictate one standard for accuracy of individual scores; parental pleasure/displeasure may or may not have a different standard. It's not a dodge to refrain from stating some standard for adequate accuracy. The hope is that a reader will know inaccuracy if and when one sees it; that's the purpose of the extensive and somewhat redundant displays of this guide.

♦"test length rules"

Stanford 9 Reading grade 2 exhibits the best accuracy properties of all the grade levels because

a. The most money and resources were expended on that test.
b. Reading is easier to assess at grade 2 than at the other grades.
c. Reading grade 2 has 118 items and 85 minutes testing time, whereas Reading at all other grade levels has 84 items and 70 minutes testing time.

Stanford 9 Mathematics for grades 9-11 show accuracy properties noticeably lower than for grades 2-8 because

a. Students pay less attention to math tests in the higher grades.
b. The content tested in the higher grades is more complex.
c. Math grades 9-11 has 48 items and 45 minutes testing time, whereas grades 2-8 have 74-82 items and 80 minutes testing time.

The answer of (c) to both items should be easy. Especially in the context of current concern about the total time devoted to school testing, the implications of these answers are more difficult. For example, if the accuracy properties of Stanford 9 Math grades 9-11 (given some emphasis in this exposition) are not seen to be acceptable, then the shortening of the Math test beginning at grade 9 (presumably to provide time for Science, Social Science) becomes an issue.

Composites. In the 1999 *Parent Report*, there is the option, if all subtests are given, to report percentile rank scores for overall composites such as Thinking Skills, Basic Battery, Complete Battery, each with over 200 items included.

Information is not available to me to conduct accuracy calculations on these (composite) percentile rank scores, but certainly it is expected that these overall scores would have properties considerably better than the best subject-specific results shown here.

### ♦"more, rather than less"

There's no intention that these accuracy results be interpreted as opposing testing programs. It's not pure spin to interpret these results as indicating that we may need more testing, rather than less, especially if readers interpret these results to indicate that current tests do not have adequate accuracy. Based on the conventional criteria for quality of measurement, namely reliability coefficients, it would seem difficult to argue that tests with mid-nineties reliability coefficients need to be expanded to obtain more accurate individual scores. The "news," if any, in this guide says that even tests with listed reliability .95 or so have more room for improvement than is typically thought.

**Summary Tables Follow:**
**There are even more tables and further topics in the Archive Section after these tables**

## Student at 50th Percentile

| | HITRATE tolerance | | TEST-RETEST tolerance | | Score Reliability Coefficient from HBEM |
|---|---|---|---|---|---|
| | 5 | 10 | 5 | 10 | |
| MATH | | | | | |
| gr2 | 0.342 | 0.657 | 0.296 | 0.553 | .94 |
| gr3 | 0.408 | 0.716 | 0.263 | 0.499 | .94 |
| gr4 | 0.421 | 0.733 | 0.306 | 0.568 | .94 |
| gr5 | 0.342 | 0.654 | 0.266 | 0.503 | .94 |
| gr6 | 0.38 | 0.708 | 0.29 | 0.544 | .94 |
| gr7 | 0.394 | 0.736 | 0.308 | 0.569 | .94 |
| gr8 | 0.411 | 0.736 | 0.308 | 0.571 | .95 |
| gr9 | 0.3 | 0.567 | 0.227 | 0.434 | .87 |
| gr10 | 0.294 | 0.56 | 0.232 | 0.438 | .88 |
| gr11 | 0.265 | 0.508 | 0.215 | 0.405 | .91 |
| READ | | | | | |
| gr2 | 0.567 | 0.88 | 0.413 | 0.723 | .96 |
| gr3 | 0.418 | 0.798 | 0.342 | 0.625 | .96 |
| gr4 | 0.421 | 0.733 | 0.308 | 0.572 | .95 |
| gr5 | 0.421 | 0.733 | 0.306 | 0.568 | .95 |
| gr6 | 0.444 | 0.761 | 0.323 | 0.595 | .94 |
| gr7 | 0.421 | 0.733 | 0.306 | 0.569 | .95 |
| gr8 | 0.421 | 0.733 | 0.306 | 0.568 | .96 |
| gr9 | 0.421 | 0.733 | 0.306 | 0.568 | .96 |
| gr10 | 0.319 | 0.623 | 0.258 | 0.487 | .94 |
| gr11 | 0.336 | 0.635 | 0.26 | 0.492 | .94 |

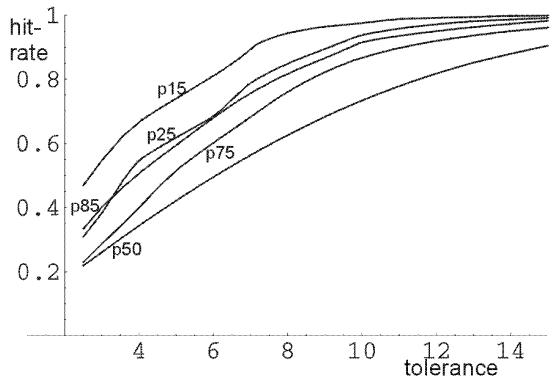
## Student at 25th Percentile

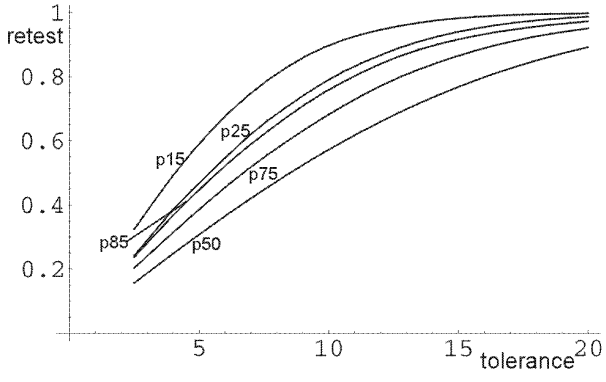
| | HITRATE tolerance | | TEST-RETEST tolerance | | Score Reliability Coefficient from HBEM |
|---|---|---|---|---|---|
| | 5 | 10 | 5 | 10 | |
| MATH | | | | | |
| gr2 | 0.528 | 0.841 | 0.385 | 0.679 | .94 |
| gr3 | 0.528 | 0.861 | 0.405 | 0.708 | .94 |
| gr4 | 0.531 | 0.834 | 0.391 | 0.691 | .94 |
| gr5 | 0.575 | 0.864 | 0.413 | 0.711 | .94 |
| gr6 | 0.524 | 0.819 | 0.369 | 0.655 | .94 |
| gr7 | 0.492 | 0.806 | 0.356 | 0.636 | .94 |
| gr8 | 0.575 | 0.864 | 0.412 | 0.711 | .95 |
| gr9 | 0.357 | 0.707 | 0.284 | 0.529 | .87 |
| gr10 | 0.351 | 0.638 | 0.261 | 0.491 | .88 |
| gr11 | 0.351 | 0.643 | 0.26 | 0.491 | .91 |
| READ | | | | | |
| gr2 | 0.683 | 0.946 | 0.504 | 0.827 | .96 |
| gr3 | 0.651 | 0.925 | 0.479 | 0.794 | .96 |
| gr4 | 0.618 | 0.937 | 0.468 | 0.791 | .95 |
| gr5 | 0.618 | 0.903 | 0.46 | 0.77 | .95 |
| gr6 | 0.547 | 0.875 | 0.42 | 0.725 | .94 |
| gr7 | 0.62 | 0.918 | 0.46 | 0.774 | .95 |
| gr8 | 0.618 | 0.903 | 0.46 | 0.77 | .96 |
| gr9 | 0.62 | 0.907 | 0.452 | 0.766 | .96 |
| gr10 | 0.583 | 0.885 | 0.423 | 0.732 | .94 |
| gr11 | 0.583 | 0.875 | 0.434 | 0.734 | .94 |

## Student at 75th Percentile

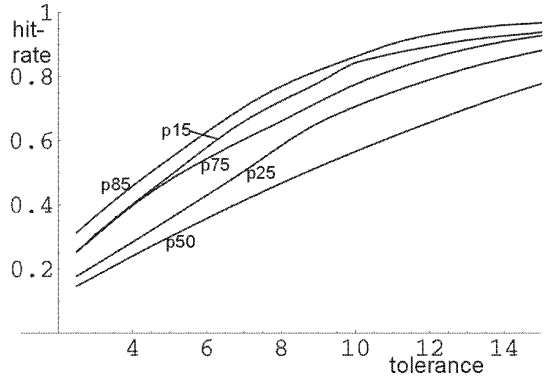
| | HITRATE tolerance 5 | HITRATE tolerance 10 | TEST-RETEST tolerance 5 | TEST-RETEST tolerance 10 | Score Reliability Coefficient from HBEM |
|---|---|---|---|---|---|
| **MATH** | | | | | |
| gr2 | 0.434 | 0.76 | 0.323 | 0.59 | .94 |
| gr3 | 0.493 | 0.795 | 0.348 | 0.629 | .94 |
| gr4 | 0.516 | 0.797 | 0.356 | 0.641 | .94 |
| gr5 | 0.451 | 0.789 | 0.342 | 0.619 | .94 |
| gr6 | 0.53 | 0.89 | 0.422 | 0.731 | .94 |
| gr7 | 0.529 | 0.849 | 0.396 | 0.696 | .94 |
| gr8 | 0.595 | 0.878 | 0.414 | 0.725 | .95 |
| gr9 | 0.478 | 0.776 | 0.337 | 0.611 | .87 |
| gr10 | 0.447 | 0.762 | 0.327 | 0.595 | .88 |
| gr11 | 0.451 | 0.744 | 0.319 | 0.582 | .91 |
| **READ** | | | | | |
| gr2 | 0.654 | 0.92 | 0.476 | 0.789 | .96 |
| gr3 | 0.476 | 0.848 | 0.374 | 0.669 | .96 |
| gr4 | 0.516 | 0.867 | 0.386 | 0.682 | .95 |
| gr5 | 0.485 | 0.801 | 0.356 | 0.638 | .95 |
| gr6 | 0.471 | 0.769 | 0.331 | 0.606 | .94 |
| gr7 | 0.463 | 0.752 | 0.327 | 0.594 | .95 |
| gr8 | 0.494 | 0.796 | 0.349 | 0.632 | .96 |
| gr9 | 0.439 | 0.783 | 0.333 | 0.606 | .96 |
| gr10 | 0.417 | 0.761 | 0.318 | 0.585 | .94 |
| gr11 | 0.413 | 0.741 | 0.31 | 0.567 | .94 |

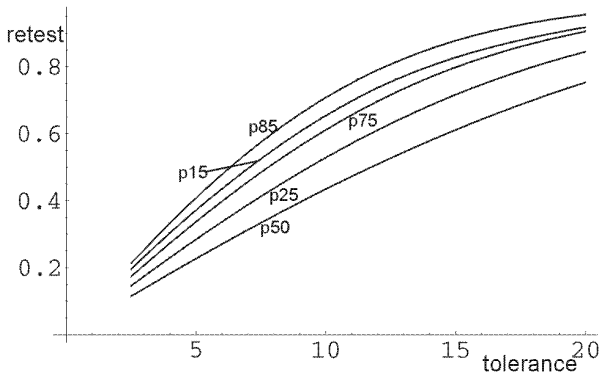
Reading grade 4




Math grade 9



## Comparing Two Different Students

### Math grade 9

Prob kid1 > kid2

| p1 | p2=p1+5 | p2=p1+10 | p2=p1+20 |
|---|---|---|---|
| 25 | 0.373 | 0.26 | 0.117 |
| 40 | 0.402 | 0.314 | 0.132 |
| 50 | 0.379 | 0.264 | 0.102 |
| 60 | 0.373 | 0.262 | 0.061 |
| 75 | 0.326 | 0.178 | 0.015 |

### Reading grade 4

Prob kid1 > kid2

| p1 | p2=p1+5 | p2=p1+10 | p2=p1+20 |
|---|---|---|---|
| 25 | 0.268 | 0.107 | 0.023 |
| 40 | 0.338 | 0.203 | 0.048 |
| 50 | 0.347 | 0.216 | 0.059 |
| 60 | 0.347 | 0.206 | 0.039 |
| 75 | 0.318 | 0.124 | 0.008 |

---

## Year1-Year2 Math grade 9, grade 10

### maintain percentile p

Prob change in percentile rank is less than

| p | -20 | -10 | 10 | 20 |
|---|---|---|---|---|
| 25 | 0.0895 | 0.253 | 0.761 | 0.916 |
| 40 | 0.127 | 0.281 | 0.7 | 0.859 |
| 50 | 0.131 | 0.293 | 0.729 | 0.884 |
| 60 | 0.0954 | 0.255 | 0.745 | 0.903 |
| 75 | 0.0554 | 0.208 | 0.811 | 0.954 |
| 90 | 0.00701 | 0.0882 | 0.9 | 0.99 |

## Year1-Year2 Math grade 10, grade 11

### maintain percentile p

Prob change in percentile rank is less than

| p | -20 | -10 | 10 | 20 |
|---|---|---|---|---|
| 25 | 0.0959 | 0.255 | 0.746 | 0.905 |
| 40 | 0.14 | 0.291 | 0.697 | 0.851 |
| 50 | 0.136 | 0.291 | 0.711 | 0.867 |
| 60 | 0.107 | 0.261 | 0.741 | 0.9 |
| 75 | 0.0625 | 0.222 | 0.809 | 0.95 |
| 90 | 0.00791 | 0.0946 | 0.919 | 0.993 |

## Probability of percentile rank decline with real p1 in year1, p2 in year2

| | math9,10 | | | math10,11 | | |
|---|---|---|---|---|---|---|
| p1 | p2=p1+10 | p2=p1+20 | p2=p1-10 | p2=p1+10 | p2=p1+20 | p2=p1-10 |
| 25 | 0.259 | 0.119 | 0.75 | 0.261 | 0.131 | 0.737 |
| 40 | 0.325 | 0.128 | 0.725 | 0.349 | 0.157 | 0.726 |
| 50 | 0.26 | 0.102 | 0.669 | 0.258 | 0.0927 | 0.651 |
| 60 | 0.258 | 0.0659 | 0.747 | 0.249 | 0.0569 | 0.742 |
| 75 | 0.171 | 0.013 | 0.783 | 0.171 | 0.0103 | 0.757 |
| 90 | | | 0.865 | | | 0.87 |

## Year1-Year2 Reading grade 3, grade 4

maintain percentile p

Prob change in percentile rank is less than

| p | -20 | -10 | 10 | 20 |
|---|---|---|---|---|
| 25 | 0.00539 | 0.107 | 0.899 | 0.993 |
| 40 | 0.0242 | 0.159 | 0.829 | 0.971 |
| 50 | 0.0456 | 0.204 | 0.802 | 0.957 |
| 60 | 0.0377 | 0.185 | 0.811 | 0.962 |
| 75 | 0.0259 | 0.163 | 0.839 | 0.974 |
| 90 | 0.00869 | 0.11 | 0.916 | 0.994 |

## Year1-Year2 Reading grade 4, grade 5

maintain percentile p

Prob change in percentile rank is less than

| p | -20 | -10 | 10 | 20 |
|---|---|---|---|---|
| 25 | 0.00609 | 0.0998 | 0.881 | 0.988 |
| 40 | 0.0331 | 0.183 | 0.828 | 0.972 |
| 50 | 0.0554 | 0.214 | 0.785 | 0.944 |
| 60 | 0.0456 | 0.201 | 0.786 | 0.945 |
| 75 | 0.0351 | 0.174 | 0.834 | 0.971 |
| 90 | 0.00906 | 0.103 | 0.89 | 0.991 |

## Year1-Year2 Reading grade 5, grade 6

maintain percentile p

Prob change in percentile rank is less than

| p | -20 | -10 | 10 | 20 |
|---|---|---|---|---|
| 25 | 0.0121 | 0.126 | 0.873 | 0.985 |
| 40 | 0.0362 | 0.187 | 0.816 | 0.966 |
| 50 | 0.0524 | 0.209 | 0.79 | 0.947 |
| 60 | 0.0536 | 0.213 | 0.784 | 0.943 |
| 75 | 0.0407 | 0.191 | 0.812 | 0.957 |
| 90 | 0.0143 | 0.121 | 0.904 | 0.991 |

## Probability of percentile rank decline with real p1 in year1, p2 in year2

read3,4

| p1 | p2=p1+10 | p2=p1+20 | p2=p1-10 |
|---|---|---|---|
| 25 | 0.111 | 0.0232 | 0.924 |
| 40 | 0.194 | 0.0437 | 0.857 |
| 50 | 0.206 | 0.051 | 0.815 |
| 60 | 0.19 | 0.032 | 0.794 |
| 75 | 0.13 | 0.00936 | 0.83 |
| 90 | | | 0.897 |

read4,5

| p1 | p2=p1+10 | p2=p1+20 | p2=p1-10 |
|---|---|---|---|
| 25 | 0.131 | 0.0278 | 0.902 |
| 40 | 0.204 | 0.048 | 0.825 |
| 50 | 0.215 | 0.067 | 0.798 |
| 60 | 0.217 | 0.0358 | 0.782 |
| 75 | 0.144 | 0.0102 | 0.806 |
| 90 | | | 0.866 |

read5,6

| p1 | p2=p1+10 | p2=p1+20 | p2=p1-10 |
|---|---|---|---|
| 25 | 0.159 | 0.027 | 0.905 |
| 40 | 0.195 | 0.048 | 0.815 |
| 50 | 0.215 | 0.0575 | 0.796 |
| 60 | 0.213 | 0.0482 | 0.79 |
| 75 | 0.165 | 0.0125 | 0.785 |
| 90 | | | 0.838 |

# Archive: Additional Tables and Related Topics

The first two parts of this Archive supplement some of the main tables above with more detailed listings for each test. The last two parts present some secondary, supplemental topics and content.

## A1. Total Mathematics, Hit-rate and Retest Tables

For each of the 10 Math total tests (grades 2-11) analyzed there are two tables. The first table gives values of the hit-rate–probability the discrepancy between the observed-score percentile rank and the percentile the student really belongs at is less than a specified tolerance. For each test, the hit-rate probability is shown for true percentile ranks 10 though 90 in increments of 5 and for tolerances {5, 7.5, 10, 12.5, 15}. The second table for each grade level, labeled Retest, gives values of probability that the discrepancy between two percentile rank scores obtained from the same true percentile rank level of achievement is within the stated tolerance. For each test, the retest probability is shown for true percentile ranks 10 though 90 in increments of 5 and for tolerances {5, 7.5, 10, 12.5, 15}.

## A2. Total Reading, Hit-rate and Retest Tables

For each of the 10 Reading total tests (grades 2-11) analyzed there are two tables. The first table gives values of the hit-rate–probability the discrepancy between the observed-score percentile rank and the percentile the student really belongs at is less than a specified tolerance. For each test, the hit-rate probability is shown for true percentile ranks 10 though 90 in increments of 5 and for tolerances {5, 7.5, 10, 12.5, 15}. The second table for each grade level, labeled Retest, gives values of probability that the discrepancy between two percentile rank scores obtained from the same true percentile rank level of achievement is within the stated tolerance. For each test, the retest probability is shown for true percentile ranks 10 though 90 in increments of 5 and for tolerances {5, 7.5, 10, 12.5, 15}.

## A3. Classical Test Theory: Hit-rate and Retest Tables

For reference and to give some rough projections for the tests that were not analyzed (measurement data not available), hit-rate and retest results for what I'll call a "generic textbook test" are presented. Under the simplified assumptions of the classical test theory setting (constant error variance, Gaussian distributions) exact results and correspondences for these accuracy calculations can be developed; those results are the content of a separate CRESST report (Rogosa, 1999).

The Stanford 9 tests are not constrained to follow classical test theory restrictions. For Stanford 9 tests, the standard error of measurement varies over levels of achievement and the norming distribution is empirically determined (although most are rather close to Gaussian). Because the Stanford 9 tests do have their own specific properties, the accuracy calculations for each test presented in this guide seemed necessary, rather than just applying the corresponding classical test theory results. How much difference results from the specific Stanford 9 tests?

The hit-rate and retest tables labeled *Generic "textbook" test* present the classical test theory calculations for values of reliability coefficients from .80 to .96, spanning the reported score reliabilities for the Stanford 9 tests (from Stanford 9 *Technical Data Report*). The hit-rate tables are computed from Equation 3.2 in Rogosa (1999), and the retest tables are computed from Equation 4.2 in Rogosa (1999). Separate tables are presented for a student at the 50$^{th}$ percentile, the 25$^{th}$ or 75$^{th}$ percentiles, and the 10$^{th}$ or 90$^{th}$ percentiles.

Consider the hit-rate and retest tables for a student at the 50$^{th}$ percentile. For the hit-rate table using tolerance 10, reliabilities in the range .94 to .96 produce hit-rates between .7 and .8. Now look at Stanford 9 Reading grades 3-9; these tests have corresponding hit-rates .73 to .8. For retest calculations using tolerance 10 , the same reliabilities yield values between .54 and .63; these values match pretty well with the Reading grades 3-9 values between .57 and .62. There's also a pretty good match between classical test theory values for reliabilities .87 to .91 and Stanford 9 Math grades 9-11. But these correspondences are far from exact or general; for example the match is less close for calculations using students at the 25$^{th}$ or 75$^{th}$ percentiles.

## A4. Sidebar on Confidence Intervals: National Grade Percentile Bands

Parents or others who receive the *Student Report* are provided with some limited information on the accuracy of the percentile rank scores through the display of "National Grade Percentile Bands." The discussion here interprets those bands in terms of our hit-rate calculations.

## Archive Tables Follow

## A1. Stanford 9 Math Archive: Hit-rate and Test-Retest Tables for Grades 2-11

HITRATE math2

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.502 | 0.773 | 0.92 | | | |
| 15 | 0.317 | 0.641 | 0.848 | | | |
| 20 | 0.298 | 0.596 | 0.765 | 0.892 | 0.952 | 0.977 |
| 25 | 0.309 | 0.528 | 0.711 | 0.841 | 0.911 | 0.957 |
| 30 | 0.228 | 0.457 | 0.662 | 0.792 | 0.886 | 0.942 |
| 35 | 0.219 | 0.421 | 0.602 | 0.755 | 0.868 | 0.931 |
| 40 | 0.219 | 0.421 | 0.595 | 0.736 | 0.83 | 0.9 |
| 45 | 0.197 | 0.387 | 0.531 | 0.654 | 0.769 | 0.852 |
| 50 | 0.178 | 0.342 | 0.515 | 0.657 | 0.769 | 0.852 |
| 55 | 0.178 | 0.342 | 0.515 | 0.657 | 0.769 | 0.851 |
| 60 | 0.197 | 0.387 | 0.531 | 0.653 | 0.768 | 0.864 |
| 65 | 0.185 | 0.359 | 0.516 | 0.677 | 0.78 | 0.854 |
| 70 | 0.178 | 0.382 | 0.554 | 0.692 | 0.81 | 0.889 |
| 75 | 0.246 | 0.434 | 0.62 | 0.76 | 0.851 | 0.913 |
| 80 | 0.248 | 0.477 | 0.658 | 0.784 | 0.876 | 0.925 |
| 85 | 0.261 | 0.515 | 0.726 | | | |
| 90 | 0.344 | 0.609 | 0.814 | | | |

HITRATE math3

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.446 | 0.754 | 0.891 | | | |
| 15 | 0.298 | 0.626 | 0.827 | | | |
| 20 | 0.321 | 0.593 | 0.764 | 0.887 | 0.961 | 0.982 |
| 25 | 0.305 | 0.528 | 0.763 | 0.861 | 0.928 | 0.965 |
| 30 | 0.297 | 0.495 | 0.703 | 0.815 | 0.91 | 0.953 |
| 35 | 0.215 | 0.46 | 0.647 | 0.776 | 0.883 | 0.935 |
| 40 | 0.219 | 0.421 | 0.593 | 0.757 | 0.861 | 0.923 |
| 45 | 0.219 | 0.421 | 0.595 | 0.733 | 0.834 | 0.915 |
| 50 | 0.211 | 0.408 | 0.578 | 0.716 | 0.82 | 0.892 |
| 55 | 0.197 | 0.383 | 0.547 | 0.683 | 0.788 | 0.871 |
| 60 | 0.197 | 0.383 | 0.545 | 0.692 | 0.817 | 0.897 |
| 65 | 0.195 | 0.397 | 0.596 | 0.745 | 0.843 | 0.91 |
| 70 | 0.266 | 0.482 | 0.648 | 0.779 | 0.865 | 0.926 |
| 75 | 0.252 | 0.493 | 0.657 | 0.795 | 0.885 | 0.935 |
| 80 | 0.249 | 0.504 | 0.714 | 0.847 | 0.931 | 0.964 |
| 85 | 0.309 | 0.521 | 0.748 | | | |
| 90 | 0.339 | 0.646 | 0.832 | | | |

HITRATE math4

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.451 | 0.797 | 0.918 | | | |
| 15 | 0.326 | 0.648 | 0.827 | | | |
| 20 | 0.317 | 0.529 | 0.763 | 0.897 | 0.952 | 0.977 |
| 25 | 0.281 | 0.531 | 0.73 | 0.834 | 0.924 | 0.965 |
| 30 | 0.261 | 0.492 | 0.664 | 0.792 | 0.89 | 0.939 |
| 35 | 0.219 | 0.419 | 0.626 | 0.776 | 0.87 | 0.929 |
| 40 | 0.219 | 0.421 | 0.595 | 0.732 | 0.851 | 0.923 |
| 45 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 50 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 55 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 60 | 0.219 | 0.421 | 0.595 | 0.732 | 0.847 | 0.914 |
| 65 | 0.197 | 0.381 | 0.569 | 0.705 | 0.816 | 0.904 |
| 70 | 0.227 | 0.417 | 0.593 | 0.76 | 0.855 | 0.915 |
| 75 | 0.231 | 0.516 | 0.68 | 0.797 | 0.889 | 0.939 |
| 80 | 0.301 | 0.505 | 0.698 | 0.838 | 0.913 | 0.955 |
| 85 | 0.295 | 0.555 | 0.782 | | | |
| 90 | 0.33 | 0.639 | 0.849 | | | |

HITRATE math5

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.38 | 0.759 | 0.91 | | | |
| 15 | 0.35 | 0.595 | 0.825 | | | |
| 20 | 0.354 | 0.651 | 0.821 | 0.918 | 0.967 | 0.988 |
| 25 | 0.291 | 0.575 | 0.739 | 0.864 | 0.932 | 0.968 |
| 30 | 0.245 | 0.468 | 0.681 | 0.842 | 0.915 | 0.954 |
| 35 | 0.219 | 0.421 | 0.59 | 0.708 | 0.83 | 0.903 |
| 40 | 0.212 | 0.382 | 0.558 | 0.68 | 0.779 | 0.86 |
| 45 | 0.176 | 0.343 | 0.505 | 0.653 | 0.778 | 0.866 |
| 50 | 0.151 | 0.342 | 0.5 | 0.654 | 0.778 | 0.866 |
| 55 | 0.206 | 0.382 | 0.532 | 0.68 | 0.776 | 0.861 |
| 60 | 0.219 | 0.423 | 0.586 | 0.708 | 0.797 | 0.888 |
| 65 | 0.219 | 0.421 | 0.591 | 0.757 | 0.846 | 0.911 |
| 70 | 0.193 | 0.417 | 0.576 | 0.726 | 0.848 | 0.913 |
| 75 | 0.241 | 0.451 | 0.662 | 0.789 | 0.873 | 0.932 |
| 80 | 0.321 | 0.524 | 0.711 | 0.831 | 0.919 | 0.954 |
| 85 | 0.246 | 0.536 | 0.786 | | | |
| 90 | 0.398 | 0.624 | 0.816 | | | |

## HITRATE math6

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.485 | 0.781 | 0.93 | | | |
| 15 | 0.338 | 0.623 | 0.854 | | | |
| 20 | 0.307 | 0.595 | 0.758 | 0.888 | 0.951 | 0.977 |
| 25 | 0.262 | 0.524 | 0.679 | 0.819 | 0.898 | 0.948 |
| 30 | 0.217 | 0.421 | 0.625 | 0.792 | 0.876 | 0.94 |
| 35 | 0.231 | 0.444 | 0.621 | 0.762 | 0.865 | 0.932 |
| 40 | 0.245 | 0.471 | 0.635 | 0.762 | 0.865 | 0.93 |
| 45 | 0.197 | 0.379 | 0.562 | 0.708 | 0.817 | 0.892 |
| 50 | 0.197 | 0.38 | 0.562 | 0.708 | 0.817 | 0.892 |
| 55 | 0.219 | 0.424 | 0.579 | 0.706 | 0.816 | 0.902 |
| 60 | 0.219 | 0.421 | 0.594 | 0.758 | 0.841 | 0.914 |
| 65 | 0.217 | 0.458 | 0.624 | 0.787 | 0.875 | 0.936 |
| 70 | 0.261 | 0.518 | 0.682 | 0.815 | 0.912 | 0.958 |
| 75 | 0.303 | 0.53 | 0.772 | 0.89 | 0.948 | 0.974 |
| 80 | 0.336 | 0.59 | 0.801 | 0.883 | 0.944 | 0.971 |
| 85 | 0.397 | 0.671 | 0.822 | | | |
| 90 | 0.306 | 0.725 | 0.912 | | | |

## HITRATE math7

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.379 | 0.705 | 0.866 | | | |
| 15 | 0.26 | 0.547 | 0.775 | | | |
| 20 | 0.301 | 0.565 | 0.708 | 0.842 | 0.926 | 0.969 |
| 25 | 0.261 | 0.492 | 0.675 | 0.806 | 0.883 | 0.94 |
| 30 | 0.245 | 0.466 | 0.682 | 0.828 | 0.915 | 0.958 |
| 35 | 0.245 | 0.468 | 0.653 | 0.78 | 0.876 | 0.931 |
| 40 | 0.247 | 0.456 | 0.611 | 0.736 | 0.846 | 0.917 |
| 45 | 0.186 | 0.382 | 0.582 | 0.738 | 0.848 | 0.919 |
| 50 | 0.206 | 0.394 | 0.578 | 0.736 | 0.846 | 0.918 |
| 55 | 0.245 | 0.468 | 0.624 | 0.744 | 0.845 | 0.925 |
| 60 | 0.245 | 0.468 | 0.651 | 0.81 | 0.882 | 0.935 |
| 65 | 0.23 | 0.482 | 0.652 | 0.801 | 0.887 | 0.948 |
| 70 | 0.26 | 0.495 | 0.659 | 0.815 | 0.906 | 0.949 |
| 75 | 0.268 | 0.529 | 0.752 | 0.849 | 0.926 | 0.966 |
| 80 | 0.373 | 0.563 | 0.778 | 0.892 | 0.962 | 0.982 |
| 85 | 0.276 | 0.587 | 0.817 | | | |
| 90 | 0.435 | 0.768 | 0.886 | | | |

HITRATE math8

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.415 | 0.738 | 0.891 | | | |
| 15 | 0.329 | 0.563 | 0.833 | | | |
| 20 | 0.318 | 0.595 | 0.758 | 0.866 | 0.946 | 0.977 |
| 25 | 0.292 | 0.575 | 0.739 | 0.864 | 0.931 | 0.967 |
| 30 | 0.244 | 0.468 | 0.681 | 0.842 | 0.918 | 0.957 |
| 35 | 0.245 | 0.468 | 0.652 | 0.772 | 0.881 | 0.936 |
| 40 | 0.248 | 0.44 | 0.622 | 0.736 | 0.846 | 0.918 |
| 45 | 0.201 | 0.383 | 0.583 | 0.739 | 0.849 | 0.92 |
| 50 | 0.191 | 0.411 | 0.578 | 0.736 | 0.846 | 0.918 |
| 55 | 0.245 | 0.468 | 0.613 | 0.755 | 0.852 | 0.925 |
| 60 | 0.245 | 0.468 | 0.667 | 0.81 | 0.887 | 0.944 |
| 65 | 0.269 | 0.507 | 0.708 | 0.843 | 0.919 | 0.965 |
| 70 | 0.315 | 0.584 | 0.753 | 0.885 | 0.94 | 0.974 |
| 75 | 0.287 | 0.595 | 0.748 | 0.878 | 0.947 | 0.976 |
| 80 | 0.321 | 0.593 | 0.821 | 0.929 | 0.971 | 0.99 |
| 85 | 0.425 | 0.671 | 0.862 | | | |
| 90 | 0.365 | 0.81 | 0.934 | | | |

HITRATE math9

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.311 | 0.612 | 0.795 | | | |
| 15 | 0.254 | 0.49 | 0.694 | | | |
| 20 | 0.214 | 0.42 | 0.571 | 0.708 | 0.821 | 0.893 |
| 25 | 0.178 | 0.357 | 0.545 | 0.707 | 0.809 | 0.881 |
| 30 | 0.18 | 0.351 | 0.504 | 0.633 | 0.753 | 0.843 |
| 35 | 0.181 | 0.34 | 0.479 | 0.599 | 0.698 | 0.783 |
| 40 | 0.148 | 0.301 | 0.44 | 0.564 | 0.678 | 0.778 |
| 45 | 0.135 | 0.268 | 0.412 | 0.56 | 0.683 | 0.78 |
| 50 | 0.147 | 0.3 | 0.441 | 0.567 | 0.679 | 0.777 |
| 55 | 0.182 | 0.344 | 0.479 | 0.598 | 0.699 | 0.781 |
| 60 | 0.18 | 0.351 | 0.506 | 0.63 | 0.74 | 0.829 |
| 65 | 0.179 | 0.348 | 0.524 | 0.681 | 0.792 | 0.869 |
| 70 | 0.205 | 0.413 | 0.578 | 0.716 | 0.813 | 0.89 |
| 75 | 0.254 | 0.478 | 0.632 | 0.776 | 0.872 | 0.927 |
| 80 | 0.249 | 0.504 | 0.718 | 0.849 | 0.918 | 0.955 |
| 85 | 0.314 | 0.544 | 0.739 | | | |
| 90 | 0.331 | 0.62 | 0.863 | | | |

HITRATE math10

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.302 | 0.626 | 0.805 | | | |
| 15 | 0.209 | 0.409 | 0.596 | | | |
| 20 | 0.177 | 0.351 | 0.54 | 0.7 | 0.822 | 0.907 |
| 25 | 0.18 | 0.351 | 0.502 | 0.638 | 0.764 | 0.852 |
| 30 | 0.18 | 0.352 | 0.5 | 0.619 | 0.71 | 0.784 |
| 35 | 0.174 | 0.327 | 0.457 | 0.568 | 0.661 | 0.74 |
| 40 | 0.13 | 0.262 | 0.392 | 0.51 | 0.627 | 0.738 |
| 45 | 0.114 | 0.233 | 0.378 | 0.537 | 0.673 | 0.78 |
| 50 | 0.14 | 0.294 | 0.433 | 0.56 | 0.676 | 0.777 |
| 55 | 0.202 | 0.371 | 0.504 | 0.617 | 0.712 | 0.79 |
| 60 | 0.197 | 0.383 | 0.551 | 0.673 | 0.761 | 0.841 |
| 65 | 0.197 | 0.381 | 0.545 | 0.706 | 0.826 | 0.893 |
| 70 | 0.178 | 0.382 | 0.563 | 0.699 | 0.81 | 0.888 |
| 75 | 0.258 | 0.447 | 0.621 | 0.762 | 0.855 | 0.918 |
| 80 | 0.26 | 0.518 | 0.711 | 0.84 | 0.91 | 0.948 |
| 85 | 0.302 | 0.589 | 0.775 | | | |
| 90 | 0.392 | 0.688 | 0.867 | | | |

HITRATE math11

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.275 | 0.591 | 0.782 | | | |
| 15 | 0.204 | 0.382 | 0.579 | | | |
| 20 | 0.163 | 0.331 | 0.498 | 0.639 | 0.774 | 0.879 |
| 25 | 0.18 | 0.351 | 0.503 | 0.643 | 0.765 | 0.847 |
| 30 | 0.18 | 0.351 | 0.506 | 0.628 | 0.718 | 0.79 |
| 35 | 0.181 | 0.339 | 0.468 | 0.571 | 0.659 | 0.741 |
| 40 | 0.134 | 0.266 | 0.387 | 0.509 | 0.628 | 0.735 |
| 45 | 0.0898 | 0.206 | 0.35 | 0.504 | 0.637 | 0.744 |
| 50 | 0.136 | 0.265 | 0.387 | 0.508 | 0.627 | 0.735 |
| 55 | 0.179 | 0.338 | 0.467 | 0.57 | 0.658 | 0.74 |
| 60 | 0.18 | 0.352 | 0.504 | 0.627 | 0.718 | 0.785 |
| 65 | 0.18 | 0.351 | 0.504 | 0.637 | 0.783 | 0.86 |
| 70 | 0.179 | 0.351 | 0.566 | 0.706 | 0.808 | 0.885 |
| 75 | 0.26 | 0.451 | 0.609 | 0.744 | 0.844 | 0.905 |
| 80 | 0.247 | 0.53 | 0.714 | 0.833 | 0.913 | 0.95 |
| 85 | 0.314 | 0.556 | 0.765 | | | |
| 90 | 0.382 | 0.678 | 0.874 | | | |

RETEST math2

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.335 | 0.613 | 0.788 | | | |
| 15 | 0.257 | 0.492 | 0.676 | | | |
| 20 | 0.223 | 0.428 | 0.604 | 0.738 | 0.839 | 0.904 |
| 25 | 0.199 | 0.385 | 0.546 | 0.679 | 0.782 | 0.857 |
| 30 | 0.176 | 0.344 | 0.494 | 0.624 | 0.731 | 0.814 |
| 35 | 0.163 | 0.319 | 0.462 | 0.589 | 0.697 | 0.784 |
| 40 | 0.156 | 0.306 | 0.445 | 0.568 | 0.674 | 0.762 |
| 45 | 0.137 | 0.269 | 0.393 | 0.507 | 0.609 | 0.697 |
| 50 | 0.135 | 0.263 | 0.386 | 0.499 | 0.6 | 0.689 |
| 55 | 0.135 | 0.264 | 0.386 | 0.499 | 0.601 | 0.69 |
| 60 | 0.139 | 0.271 | 0.397 | 0.512 | 0.614 | 0.703 |
| 65 | 0.138 | 0.27 | 0.395 | 0.51 | 0.611 | 0.699 |
| 70 | 0.146 | 0.285 | 0.415 | 0.533 | 0.635 | 0.721 |
| 75 | 0.167 | 0.323 | 0.466 | 0.59 | 0.692 | 0.775 |
| 80 | 0.177 | 0.342 | 0.491 | 0.618 | 0.72 | 0.799 |
| 85 | 0.205 | 0.39 | 0.551 | | | |
| 90 | 0.248 | 0.462 | 0.632 | | | |

RETEST math3

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.323 | 0.583 | 0.758 | | | |
| 15 | 0.25 | 0.47 | 0.653 | | | |
| 20 | 0.226 | 0.43 | 0.608 | 0.745 | 0.844 | 0.911 |
| 25 | 0.209 | 0.405 | 0.573 | 0.708 | 0.809 | 0.881 |
| 30 | 0.192 | 0.374 | 0.532 | 0.664 | 0.768 | 0.846 |
| 35 | 0.173 | 0.338 | 0.486 | 0.616 | 0.722 | 0.807 |
| 40 | 0.162 | 0.317 | 0.46 | 0.586 | 0.694 | 0.782 |
| 45 | 0.157 | 0.308 | 0.448 | 0.573 | 0.68 | 0.768 |
| 50 | 0.151 | 0.296 | 0.431 | 0.553 | 0.658 | 0.747 |
| 55 | 0.142 | 0.279 | 0.408 | 0.526 | 0.63 | 0.719 |
| 60 | 0.147 | 0.288 | 0.42 | 0.54 | 0.645 | 0.734 |
| 65 | 0.159 | 0.309 | 0.447 | 0.569 | 0.675 | 0.762 |
| 70 | 0.177 | 0.342 | 0.489 | 0.615 | 0.719 | 0.802 |
| 75 | 0.18 | 0.348 | 0.5 | 0.629 | 0.734 | 0.816 |
| 80 | 0.198 | 0.38 | 0.543 | 0.678 | 0.783 | 0.861 |
| 85 | 0.216 | 0.407 | 0.577 | | | |
| 90 | 0.262 | 0.477 | 0.651 | | | |

RETEST math4

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.336 | 0.605 | 0.791 | | | |
| 15 | 0.251 | 0.473 | 0.657 | | | |
| 20 | 0.218 | 0.421 | 0.596 | 0.733 | 0.834 | 0.903 |
| 25 | 0.201 | 0.391 | 0.557 | 0.691 | 0.793 | 0.868 |
| 30 | 0.179 | 0.35 | 0.503 | 0.633 | 0.739 | 0.822 |
| 35 | 0.166 | 0.325 | 0.47 | 0.598 | 0.706 | 0.793 |
| 40 | 0.158 | 0.311 | 0.452 | 0.577 | 0.685 | 0.773 |
| 45 | 0.156 | 0.306 | 0.446 | 0.57 | 0.676 | 0.764 |
| 50 | 0.156 | 0.306 | 0.445 | 0.568 | 0.674 | 0.762 |
| 55 | 0.156 | 0.306 | 0.445 | 0.569 | 0.676 | 0.763 |
| 60 | 0.158 | 0.309 | 0.45 | 0.575 | 0.682 | 0.77 |
| 65 | 0.149 | 0.292 | 0.427 | 0.548 | 0.653 | 0.742 |
| 70 | 0.163 | 0.315 | 0.458 | 0.582 | 0.687 | 0.773 |
| 75 | 0.187 | 0.356 | 0.511 | 0.641 | 0.743 | 0.822 |
| 80 | 0.199 | 0.377 | 0.539 | 0.673 | 0.774 | 0.849 |
| 85 | 0.224 | 0.425 | 0.598 | | | |
| 90 | 0.263 | 0.486 | 0.66 | | | |

RETEST math5

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.314 | 0.568 | 0.752 | | | |
| 15 | 0.244 | 0.474 | 0.654 | | | |
| 20 | 0.248 | 0.483 | 0.659 | 0.792 | 0.881 | 0.934 |
| 25 | 0.212 | 0.413 | 0.577 | 0.711 | 0.812 | 0.883 |
| 30 | 0.188 | 0.367 | 0.524 | 0.657 | 0.764 | 0.845 |
| 35 | 0.154 | 0.302 | 0.439 | 0.561 | 0.665 | 0.752 |
| 40 | 0.143 | 0.28 | 0.409 | 0.525 | 0.627 | 0.715 |
| 45 | 0.137 | 0.268 | 0.392 | 0.506 | 0.608 | 0.696 |
| 50 | 0.136 | 0.266 | 0.39 | 0.503 | 0.605 | 0.694 |
| 55 | 0.141 | 0.276 | 0.402 | 0.517 | 0.619 | 0.707 |
| 60 | 0.15 | 0.294 | 0.427 | 0.546 | 0.649 | 0.736 |
| 65 | 0.159 | 0.31 | 0.451 | 0.575 | 0.681 | 0.768 |
| 70 | 0.156 | 0.303 | 0.442 | 0.563 | 0.668 | 0.755 |
| 75 | 0.179 | 0.342 | 0.493 | 0.619 | 0.723 | 0.805 |
| 80 | 0.204 | 0.385 | 0.548 | 0.681 | 0.782 | 0.855 |
| 85 | 0.223 | 0.415 | 0.581 | | | |
| 90 | 0.263 | 0.477 | 0.647 | | | |

RETEST math6

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.34 | 0.618 | 0.792 | | | |
| 15 | 0.254 | 0.486 | 0.671 | | | |
| 20 | 0.223 | 0.429 | 0.603 | 0.739 | 0.834 | 0.901 |
| 25 | 0.19 | 0.369 | 0.524 | 0.655 | 0.759 | 0.838 |
| 30 | 0.17 | 0.333 | 0.479 | 0.608 | 0.715 | 0.8 |
| 35 | 0.167 | 0.327 | 0.472 | 0.601 | 0.708 | 0.795 |
| 40 | 0.171 | 0.332 | 0.48 | 0.608 | 0.716 | 0.801 |
| 45 | 0.149 | 0.29 | 0.423 | 0.543 | 0.649 | 0.738 |
| 50 | 0.149 | 0.29 | 0.423 | 0.544 | 0.649 | 0.739 |
| 55 | 0.152 | 0.298 | 0.434 | 0.556 | 0.661 | 0.75 |
| 60 | 0.159 | 0.311 | 0.452 | 0.577 | 0.684 | 0.771 |
| 65 | 0.17 | 0.333 | 0.48 | 0.608 | 0.716 | 0.801 |
| 70 | 0.192 | 0.371 | 0.531 | 0.661 | 0.767 | 0.845 |
| 75 | 0.223 | 0.422 | 0.598 | 0.731 | 0.831 | 0.897 |
| 80 | 0.235 | 0.443 | 0.619 | 0.748 | 0.843 | 0.906 |
| 85 | 0.261 | 0.492 | 0.679 | | | |
| 90 | 0.301 | 0.534 | 0.727 | | | |

RETEST math7

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.299 | 0.535 | 0.702 | | | |
| 15 | 0.227 | 0.436 | 0.604 | | | |
| 20 | 0.204 | 0.397 | 0.556 | 0.693 | 0.796 | 0.871 |
| 25 | 0.182 | 0.356 | 0.506 | 0.636 | 0.742 | 0.823 |
| 30 | 0.185 | 0.361 | 0.517 | 0.65 | 0.758 | 0.84 |
| 35 | 0.174 | 0.339 | 0.488 | 0.618 | 0.724 | 0.809 |
| 40 | 0.165 | 0.321 | 0.462 | 0.587 | 0.694 | 0.78 |
| 45 | 0.158 | 0.307 | 0.443 | 0.567 | 0.675 | 0.765 |
| 50 | 0.159 | 0.308 | 0.445 | 0.569 | 0.677 | 0.767 |
| 55 | 0.167 | 0.325 | 0.468 | 0.594 | 0.7 | 0.787 |
| 60 | 0.177 | 0.344 | 0.495 | 0.626 | 0.732 | 0.816 |
| 65 | 0.177 | 0.345 | 0.497 | 0.628 | 0.735 | 0.819 |
| 70 | 0.185 | 0.357 | 0.514 | 0.645 | 0.753 | 0.833 |
| 75 | 0.208 | 0.396 | 0.563 | 0.696 | 0.8 | 0.873 |
| 80 | 0.236 | 0.437 | 0.616 | 0.753 | 0.85 | 0.913 |
| 85 | 0.239 | 0.444 | 0.624 | | | |
| 90 | 0.321 | 0.575 | 0.754 | | | |

RETEST math8

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.316 | 0.555 | 0.73 | | | |
| 15 | 0.245 | 0.459 | 0.644 | | | |
| 20 | 0.221 | 0.426 | 0.598 | 0.731 | 0.829 | 0.896 |
| 25 | 0.213 | 0.412 | 0.577 | 0.711 | 0.811 | 0.883 |
| 30 | 0.189 | 0.367 | 0.525 | 0.658 | 0.765 | 0.846 |
| 35 | 0.174 | 0.34 | 0.49 | 0.619 | 0.726 | 0.811 |
| 40 | 0.164 | 0.319 | 0.462 | 0.587 | 0.694 | 0.781 |
| 45 | 0.157 | 0.307 | 0.446 | 0.569 | 0.677 | 0.767 |
| 50 | 0.158 | 0.308 | 0.447 | 0.571 | 0.679 | 0.769 |
| 55 | 0.168 | 0.326 | 0.471 | 0.598 | 0.704 | 0.791 |
| 60 | 0.18 | 0.351 | 0.504 | 0.635 | 0.742 | 0.825 |
| 65 | 0.197 | 0.382 | 0.544 | 0.678 | 0.783 | 0.86 |
| 70 | 0.219 | 0.424 | 0.597 | 0.731 | 0.831 | 0.897 |
| 75 | 0.216 | 0.414 | 0.589 | 0.725 | 0.827 | 0.895 |
| 80 | 0.247 | 0.459 | 0.647 | 0.782 | 0.875 | 0.932 |
| 85 | 0.283 | 0.52 | 0.71 | | | |
| 90 | 0.332 | 0.595 | 0.778 | | | |

RETEST math9

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.239 | 0.444 | 0.602 | | | |
| 15 | 0.196 | 0.372 | 0.525 | | | |
| 20 | 0.155 | 0.299 | 0.431 | 0.549 | 0.65 | 0.732 |
| 25 | 0.146 | 0.284 | 0.413 | 0.529 | 0.63 | 0.716 |
| 30 | 0.131 | 0.257 | 0.376 | 0.486 | 0.584 | 0.671 |
| 35 | 0.121 | 0.239 | 0.35 | 0.454 | 0.549 | 0.634 |
| 40 | 0.115 | 0.227 | 0.334 | 0.435 | 0.528 | 0.612 |
| 45 | 0.114 | 0.224 | 0.33 | 0.429 | 0.522 | 0.606 |
| 50 | 0.115 | 0.227 | 0.334 | 0.434 | 0.527 | 0.611 |
| 55 | 0.121 | 0.237 | 0.349 | 0.452 | 0.547 | 0.632 |
| 60 | 0.128 | 0.253 | 0.37 | 0.478 | 0.576 | 0.662 |
| 65 | 0.139 | 0.272 | 0.397 | 0.51 | 0.611 | 0.698 |
| 70 | 0.152 | 0.297 | 0.43 | 0.549 | 0.652 | 0.737 |
| 75 | 0.174 | 0.337 | 0.484 | 0.611 | 0.716 | 0.798 |
| 80 | 0.197 | 0.38 | 0.54 | 0.673 | 0.777 | 0.854 |
| 85 | 0.213 | 0.408 | 0.575 | | | |
| 90 | 0.259 | 0.484 | 0.663 | | | |

RETEST math10

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.248 | 0.447 | 0.601 | | | |
| 15 | 0.168 | 0.321 | 0.456 | | | |
| 20 | 0.149 | 0.29 | 0.42 | 0.536 | 0.637 | 0.724 |
| 25 | 0.133 | 0.261 | 0.381 | 0.491 | 0.589 | 0.675 |
| 30 | 0.122 | 0.241 | 0.353 | 0.457 | 0.55 | 0.633 |
| 35 | 0.114 | 0.224 | 0.328 | 0.425 | 0.514 | 0.594 |
| 40 | 0.109 | 0.214 | 0.313 | 0.406 | 0.492 | 0.572 |
| 45 | 0.115 | 0.225 | 0.328 | 0.425 | 0.514 | 0.596 |
| 50 | 0.119 | 0.232 | 0.339 | 0.438 | 0.529 | 0.611 |
| 55 | 0.127 | 0.249 | 0.363 | 0.467 | 0.56 | 0.643 |
| 60 | 0.137 | 0.269 | 0.392 | 0.503 | 0.602 | 0.687 |
| 65 | 0.147 | 0.288 | 0.419 | 0.537 | 0.64 | 0.727 |
| 70 | 0.148 | 0.288 | 0.419 | 0.536 | 0.638 | 0.724 |
| 75 | 0.169 | 0.327 | 0.471 | 0.595 | 0.698 | 0.78 |
| 80 | 0.196 | 0.377 | 0.538 | 0.669 | 0.77 | 0.845 |
| 85 | 0.227 | 0.433 | 0.606 | | | |
| 90 | 0.283 | 0.528 | 0.707 | | | |

RETEST math11

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.238 | 0.425 | 0.569 | | | |
| 15 | 0.166 | 0.317 | 0.45 | | | |
| 20 | 0.137 | 0.268 | 0.389 | 0.5 | 0.597 | 0.682 |
| 25 | 0.132 | 0.26 | 0.38 | 0.491 | 0.589 | 0.675 |
| 30 | 0.124 | 0.243 | 0.356 | 0.459 | 0.553 | 0.636 |
| 35 | 0.116 | 0.227 | 0.332 | 0.428 | 0.516 | 0.597 |
| 40 | 0.11 | 0.215 | 0.314 | 0.406 | 0.491 | 0.57 |
| 45 | 0.109 | 0.213 | 0.31 | 0.401 | 0.486 | 0.565 |
| 50 | 0.11 | 0.215 | 0.314 | 0.405 | 0.491 | 0.57 |
| 55 | 0.116 | 0.227 | 0.331 | 0.428 | 0.516 | 0.597 |
| 60 | 0.124 | 0.244 | 0.357 | 0.46 | 0.554 | 0.637 |
| 65 | 0.134 | 0.262 | 0.383 | 0.494 | 0.593 | 0.679 |
| 70 | 0.148 | 0.287 | 0.416 | 0.533 | 0.635 | 0.721 |
| 75 | 0.167 | 0.319 | 0.459 | 0.582 | 0.685 | 0.768 |
| 80 | 0.198 | 0.378 | 0.537 | 0.671 | 0.773 | 0.847 |
| 85 | 0.224 | 0.425 | 0.596 | | | |
| 90 | 0.28 | 0.52 | 0.699 | | | |

## A2. Stanford 9 Reading Archive: Hit-rate and Test-Retest Tables for Grades 2-11

HITRATE read2

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.535 | 0.864 | 0.953 | | | |
| 15 | 0.431 | 0.765 | 0.932 | | | |
| 20 | 0.408 | 0.683 | 0.883 | 0.97 | 0.992 | 0.998 |
| 25 | 0.358 | 0.683 | 0.857 | 0.946 | 0.982 | 0.995 |
| 30 | 0.356 | 0.646 | 0.811 | 0.919 | 0.967 | 0.988 |
| 35 | 0.305 | 0.567 | 0.77 | 0.892 | 0.952 | 0.982 |
| 40 | 0.279 | 0.525 | 0.731 | 0.865 | 0.943 | 0.984 |
| 45 | 0.279 | 0.525 | 0.715 | 0.865 | 0.941 | 0.981 |
| 50 | 0.278 | 0.567 | 0.744 | 0.88 | 0.95 | 0.981 |
| 55 | 0.291 | 0.547 | 0.739 | 0.863 | 0.931 | 0.968 |
| 60 | 0.342 | 0.583 | 0.777 | 0.881 | 0.945 | 0.979 |
| 65 | 0.314 | 0.583 | 0.788 | 0.908 | 0.963 | 0.989 |
| 70 | 0.315 | 0.615 | 0.794 | 0.931 | 0.976 | 0.991 |
| 75 | 0.315 | 0.654 | 0.814 | 0.92 | 0.971 | 0.99 |
| 80 | 0.422 | 0.696 | 0.893 | 0.957 | 0.986 | 0.995 |
| 85 | 0.443 | 0.682 | 0.916 | | | |
| 90 | 0.447 | 0.769 | 0.926 | | | |

HITRATE read3

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.456 | 0.781 | 0.94 | | | |
| 15 | 0.396 | 0.654 | 0.872 | | | |
| 20 | 0.317 | 0.626 | 0.812 | 0.923 | 0.973 | 0.99 |
| 25 | 0.337 | 0.651 | 0.809 | 0.925 | 0.975 | 0.993 |
| 30 | 0.319 | 0.582 | 0.787 | 0.917 | 0.968 | 0.992 |
| 35 | 0.312 | 0.582 | 0.789 | 0.908 | 0.961 | 0.987 |
| 40 | 0.304 | 0.563 | 0.721 | 0.834 | 0.913 | 0.957 |
| 45 | 0.262 | 0.492 | 0.676 | 0.805 | 0.897 | 0.949 |
| 50 | 0.217 | 0.418 | 0.642 | 0.798 | 0.904 | 0.953 |
| 55 | 0.242 | 0.458 | 0.65 | 0.775 | 0.898 | 0.953 |
| 60 | 0.279 | 0.498 | 0.703 | 0.815 | 0.897 | 0.949 |
| 65 | 0.268 | 0.483 | 0.66 | 0.806 | 0.887 | 0.938 |
| 70 | 0.229 | 0.516 | 0.685 | 0.822 | 0.922 | 0.966 |
| 75 | 0.265 | 0.476 | 0.692 | 0.848 | 0.92 | 0.962 |
| 80 | 0.33 | 0.579 | 0.78 | 0.879 | 0.928 | 0.972 |
| 85 | 0.361 | 0.655 | 0.795 | | | |
| 90 | 0.286 | 0.699 | 0.88 | | | |

HITRATE read4

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.446 | 0.767 | 0.937 | | | |
| 15 | 0.469 | 0.739 | 0.926 | | | |
| 20 | 0.389 | 0.679 | 0.865 | 0.948 | 0.985 | 0.996 |
| 25 | 0.309 | 0.618 | 0.821 | 0.937 | 0.976 | 0.99 |
| 30 | 0.34 | 0.618 | 0.774 | 0.893 | 0.953 | 0.981 |
| 35 | 0.291 | 0.543 | 0.731 | 0.854 | 0.923 | 0.965 |
| 40 | 0.245 | 0.468 | 0.681 | 0.828 | 0.915 | 0.961 |
| 45 | 0.219 | 0.421 | 0.595 | 0.733 | 0.851 | 0.923 |
| 50 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 55 | 0.219 | 0.421 | 0.595 | 0.733 | 0.851 | 0.914 |
| 60 | 0.219 | 0.421 | 0.625 | 0.756 | 0.874 | 0.929 |
| 65 | 0.26 | 0.458 | 0.673 | 0.792 | 0.882 | 0.939 |
| 70 | 0.268 | 0.483 | 0.648 | 0.784 | 0.886 | 0.939 |
| 75 | 0.229 | 0.516 | 0.724 | 0.867 | 0.928 | 0.961 |
| 80 | 0.327 | 0.579 | 0.735 | 0.864 | 0.925 | 0.965 |
| 85 | 0.333 | 0.594 | 0.788 | | | |
| 90 | 0.308 | 0.646 | 0.85 | | | |

HITRATE read5

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.42 | 0.792 | 0.93 | | | |
| 15 | 0.402 | 0.736 | 0.882 | | | |
| 20 | 0.354 | 0.651 | 0.854 | 0.948 | 0.978 | 0.991 |
| 25 | 0.367 | 0.618 | 0.807 | 0.903 | 0.959 | 0.982 |
| 30 | 0.291 | 0.543 | 0.744 | 0.854 | 0.931 | 0.967 |
| 35 | 0.245 | 0.468 | 0.681 | 0.828 | 0.919 | 0.961 |
| 40 | 0.245 | 0.468 | 0.651 | 0.789 | 0.895 | 0.953 |
| 45 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 50 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 55 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 60 | 0.219 | 0.421 | 0.595 | 0.733 | 0.839 | 0.914 |
| 65 | 0.219 | 0.42 | 0.603 | 0.756 | 0.86 | 0.929 |
| 70 | 0.207 | 0.417 | 0.593 | 0.744 | 0.856 | 0.916 |
| 75 | 0.251 | 0.485 | 0.683 | 0.801 | 0.885 | 0.938 |
| 80 | 0.334 | 0.553 | 0.739 | 0.863 | 0.925 | 0.963 |
| 85 | 0.269 | 0.571 | 0.756 | | | |
| 90 | 0.307 | 0.64 | 0.839 | | | |

HITRATE read6

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.387 | 0.776 | 0.929 | | | |
| 15 | 0.402 | 0.736 | 0.877 | | | |
| 20 | 0.36 | 0.615 | 0.83 | 0.921 | 0.962 | 0.983 |
| 25 | 0.315 | 0.547 | 0.762 | 0.875 | 0.945 | 0.976 |
| 30 | 0.245 | 0.507 | 0.695 | 0.828 | 0.921 | 0.963 |
| 35 | 0.245 | 0.468 | 0.651 | 0.81 | 0.901 | 0.953 |
| 40 | 0.245 | 0.468 | 0.651 | 0.789 | 0.882 | 0.947 |
| 45 | 0.245 | 0.468 | 0.651 | 0.789 | 0.882 | 0.939 |
| 50 | 0.231 | 0.444 | 0.622 | 0.761 | 0.859 | 0.922 |
| 55 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 60 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 65 | 0.219 | 0.421 | 0.595 | 0.733 | 0.846 | 0.923 |
| 70 | 0.219 | 0.42 | 0.615 | 0.776 | 0.864 | 0.929 |
| 75 | 0.235 | 0.471 | 0.627 | 0.769 | 0.867 | 0.929 |
| 80 | 0.247 | 0.485 | 0.664 | 0.801 | 0.909 | 0.953 |
| 85 | 0.283 | 0.508 | 0.771 | | | |
| 90 | 0.389 | 0.662 | 0.842 | | | |

HITRATE read7

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.504 | 0.805 | 0.938 | | | |
| 15 | 0.424 | 0.736 | 0.92 | | | |
| 20 | 0.39 | 0.651 | 0.853 | 0.948 | 0.979 | 0.994 |
| 25 | 0.309 | 0.62 | 0.797 | 0.918 | 0.967 | 0.987 |
| 30 | 0.259 | 0.531 | 0.691 | 0.829 | 0.91 | 0.955 |
| 35 | 0.263 | 0.456 | 0.652 | 0.792 | 0.878 | 0.939 |
| 40 | 0.219 | 0.419 | 0.627 | 0.755 | 0.864 | 0.929 |
| 45 | 0.219 | 0.421 | 0.595 | 0.732 | 0.852 | 0.914 |
| 50 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 55 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 60 | 0.197 | 0.383 | 0.547 | 0.683 | 0.788 | 0.871 |
| 65 | 0.197 | 0.383 | 0.545 | 0.692 | 0.817 | 0.897 |
| 70 | 0.195 | 0.397 | 0.596 | 0.745 | 0.843 | 0.908 |
| 75 | 0.255 | 0.463 | 0.627 | 0.752 | 0.853 | 0.915 |
| 80 | 0.253 | 0.48 | 0.672 | 0.799 | 0.89 | 0.942 |
| 85 | 0.255 | 0.487 | 0.699 | | | |
| 90 | 0.298 | 0.577 | 0.796 | | | |

HITRATE read8

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.537 | 0.868 | 0.954 | | | |
| 15 | 0.402 | 0.736 | 0.895 | | | |
| 20 | 0.354 | 0.651 | 0.854 | 0.948 | 0.979 | 0.991 |
| 25 | 0.367 | 0.618 | 0.807 | 0.903 | 0.959 | 0.982 |
| 30 | 0.291 | 0.543 | 0.744 | 0.854 | 0.931 | 0.967 |
| 35 | 0.245 | 0.468 | 0.681 | 0.828 | 0.919 | 0.961 |
| 40 | 0.245 | 0.468 | 0.651 | 0.789 | 0.895 | 0.953 |
| 45 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 50 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 55 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 60 | 0.219 | 0.421 | 0.595 | 0.733 | 0.851 | 0.914 |
| 65 | 0.197 | 0.383 | 0.576 | 0.706 | 0.824 | 0.9 |
| 70 | 0.237 | 0.417 | 0.609 | 0.75 | 0.847 | 0.915 |
| 75 | 0.245 | 0.494 | 0.661 | 0.796 | 0.889 | 0.938 |
| 80 | 0.248 | 0.502 | 0.69 | 0.826 | 0.904 | 0.948 |
| 85 | 0.315 | 0.538 | 0.735 | | | |
| 90 | 0.296 | 0.594 | 0.829 | | | |

HITRATE read9

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.468 | 0.839 | 0.973 | | | |
| 15 | 0.489 | 0.761 | 0.907 | | | |
| 20 | 0.337 | 0.665 | 0.865 | 0.952 | 0.979 | 0.991 |
| 25 | 0.339 | 0.62 | 0.787 | 0.907 | 0.961 | 0.983 |
| 30 | 0.292 | 0.543 | 0.731 | 0.854 | 0.926 | 0.967 |
| 35 | 0.245 | 0.466 | 0.682 | 0.828 | 0.915 | 0.961 |
| 40 | 0.245 | 0.468 | 0.651 | 0.787 | 0.895 | 0.953 |
| 45 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 50 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 55 | 0.219 | 0.421 | 0.595 | 0.733 | 0.835 | 0.904 |
| 60 | 0.219 | 0.421 | 0.595 | 0.733 | 0.839 | 0.915 |
| 65 | 0.197 | 0.382 | 0.554 | 0.707 | 0.807 | 0.889 |
| 70 | 0.206 | 0.418 | 0.578 | 0.726 | 0.838 | 0.915 |
| 75 | 0.223 | 0.439 | 0.625 | 0.783 | 0.878 | 0.93 |
| 80 | 0.261 | 0.499 | 0.699 | 0.815 | 0.89 | 0.936 |
| 85 | 0.327 | 0.554 | 0.737 | | | |
| 90 | 0.287 | 0.598 | 0.827 | | | |

HITRATE read10

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.537 | 0.854 | 0.969 | | | |
| 15 | 0.473 | 0.736 | 0.907 | | | |
| 20 | 0.309 | 0.651 | 0.854 | 0.936 | 0.973 | 0.988 |
| 25 | 0.342 | 0.583 | 0.747 | 0.885 | 0.948 | 0.976 |
| 30 | 0.229 | 0.482 | 0.68 | 0.817 | 0.898 | 0.955 |
| 35 | 0.219 | 0.421 | 0.594 | 0.758 | 0.862 | 0.917 |
| 40 | 0.219 | 0.425 | 0.591 | 0.708 | 0.798 | 0.88 |
| 45 | 0.213 | 0.382 | 0.532 | 0.664 | 0.767 | 0.84 |
| 50 | 0.146 | 0.319 | 0.488 | 0.623 | 0.752 | 0.849 |
| 55 | 0.161 | 0.303 | 0.462 | 0.622 | 0.756 | 0.851 |
| 60 | 0.163 | 0.328 | 0.477 | 0.599 | 0.7 | 0.796 |
| 65 | 0.2 | 0.383 | 0.52 | 0.644 | 0.761 | 0.83 |
| 70 | 0.196 | 0.383 | 0.578 | 0.706 | 0.801 | 0.883 |
| 75 | 0.238 | 0.417 | 0.595 | 0.761 | 0.867 | 0.926 |
| 80 | 0.204 | 0.474 | 0.662 | 0.795 | 0.875 | 0.924 |
| 85 | 0.316 | 0.556 | 0.717 | | | |
| 90 | 0.328 | 0.594 | 0.845 | | | |

HITRATE read11

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.474 | 0.841 | 0.946 | | | |
| 15 | 0.374 | 0.704 | 0.889 | | | |
| 20 | 0.394 | 0.618 | 0.839 | 0.931 | 0.971 | 0.988 |
| 25 | 0.311 | 0.583 | 0.774 | 0.875 | 0.945 | 0.976 |
| 30 | 0.244 | 0.507 | 0.692 | 0.842 | 0.925 | 0.963 |
| 35 | 0.219 | 0.421 | 0.594 | 0.756 | 0.841 | 0.909 |
| 40 | 0.219 | 0.421 | 0.569 | 0.692 | 0.795 | 0.885 |
| 45 | 0.184 | 0.359 | 0.527 | 0.674 | 0.776 | 0.848 |
| 50 | 0.168 | 0.336 | 0.5 | 0.635 | 0.753 | 0.851 |
| 55 | 0.183 | 0.339 | 0.484 | 0.626 | 0.757 | 0.851 |
| 60 | 0.153 | 0.327 | 0.498 | 0.635 | 0.737 | 0.814 |
| 65 | 0.202 | 0.372 | 0.51 | 0.633 | 0.76 | 0.848 |
| 70 | 0.197 | 0.381 | 0.571 | 0.711 | 0.817 | 0.882 |
| 75 | 0.211 | 0.413 | 0.609 | 0.741 | 0.844 | 0.901 |
| 80 | 0.278 | 0.496 | 0.665 | 0.79 | 0.881 | 0.932 |
| 85 | 0.258 | 0.512 | 0.718 | | | |
| 90 | 0.308 | 0.601 | 0.794 | | | |

RETEST read2

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.399 | 0.693 | 0.861 | | | |
| 15 | 0.326 | 0.6 | 0.792 | | | |
| 20 | 0.292 | 0.543 | 0.734 | 0.862 | 0.936 | 0.973 |
| 25 | 0.266 | 0.504 | 0.695 | 0.827 | 0.912 | 0.958 |
| 30 | 0.247 | 0.473 | 0.655 | 0.787 | 0.878 | 0.934 |
| 35 | 0.222 | 0.428 | 0.602 | 0.739 | 0.839 | 0.907 |
| 40 | 0.206 | 0.398 | 0.567 | 0.706 | 0.813 | 0.888 |
| 45 | 0.203 | 0.393 | 0.561 | 0.7 | 0.807 | 0.884 |
| 50 | 0.214 | 0.413 | 0.585 | 0.723 | 0.827 | 0.898 |
| 55 | 0.211 | 0.406 | 0.574 | 0.707 | 0.808 | 0.88 |
| 60 | 0.225 | 0.431 | 0.608 | 0.742 | 0.839 | 0.905 |
| 65 | 0.228 | 0.441 | 0.623 | 0.761 | 0.858 | 0.923 |
| 70 | 0.237 | 0.46 | 0.645 | 0.783 | 0.877 | 0.937 |
| 75 | 0.248 | 0.476 | 0.654 | 0.789 | 0.879 | 0.936 |
| 80 | 0.292 | 0.549 | 0.733 | 0.86 | 0.929 | 0.967 |
| 85 | 0.293 | 0.56 | 0.745 | | | |
| 90 | 0.32 | 0.606 | 0.784 | | | |

RETEST read3

| | tolerance | | | | | |
|---|---|---|---|---|---|---|
| | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
| p | | | | | | |
| 10 | 0.346 | 0.616 | 0.8 | | | |
| 15 | 0.277 | 0.518 | 0.709 | | | |
| 20 | 0.243 | 0.469 | 0.649 | 0.787 | 0.879 | 0.936 |
| 25 | 0.246 | 0.479 | 0.658 | 0.794 | 0.887 | 0.942 |
| 30 | 0.229 | 0.448 | 0.628 | 0.765 | 0.865 | 0.928 |
| 35 | 0.225 | 0.439 | 0.619 | 0.757 | 0.854 | 0.919 |
| 40 | 0.198 | 0.386 | 0.551 | 0.684 | 0.786 | 0.861 |
| 45 | 0.184 | 0.359 | 0.515 | 0.646 | 0.752 | 0.835 |
| 50 | 0.175 | 0.342 | 0.494 | 0.625 | 0.735 | 0.822 |
| 55 | 0.178 | 0.347 | 0.498 | 0.63 | 0.738 | 0.824 |
| 60 | 0.19 | 0.369 | 0.526 | 0.66 | 0.764 | 0.844 |
| 65 | 0.181 | 0.35 | 0.503 | 0.636 | 0.741 | 0.824 |
| 70 | 0.191 | 0.367 | 0.529 | 0.665 | 0.77 | 0.852 |
| 75 | 0.195 | 0.374 | 0.535 | 0.669 | 0.772 | 0.853 |
| 80 | 0.228 | 0.431 | 0.602 | 0.734 | 0.829 | 0.896 |
| 85 | 0.251 | 0.469 | 0.652 | | | |
| 90 | 0.283 | 0.501 | 0.688 | | | |

RETEST read4

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.334 | 0.604 | 0.795 | | | |
| 15 | 0.324 | 0.591 | 0.78 | | | |
| 20 | 0.276 | 0.522 | 0.709 | 0.838 | 0.917 | 0.962 |
| 25 | 0.242 | 0.468 | 0.654 | 0.791 | 0.883 | 0.94 |
| 30 | 0.225 | 0.437 | 0.615 | 0.751 | 0.847 | 0.911 |
| 35 | 0.205 | 0.397 | 0.563 | 0.697 | 0.8 | 0.874 |
| 40 | 0.187 | 0.364 | 0.523 | 0.657 | 0.765 | 0.846 |
| 45 | 0.159 | 0.313 | 0.454 | 0.58 | 0.688 | 0.776 |
| 50 | 0.157 | 0.308 | 0.448 | 0.572 | 0.68 | 0.768 |
| 55 | 0.159 | 0.311 | 0.452 | 0.578 | 0.685 | 0.774 |
| 60 | 0.166 | 0.324 | 0.469 | 0.597 | 0.705 | 0.792 |
| 65 | 0.18 | 0.348 | 0.5 | 0.629 | 0.736 | 0.819 |
| 70 | 0.179 | 0.344 | 0.496 | 0.624 | 0.732 | 0.814 |
| 75 | 0.203 | 0.386 | 0.548 | 0.682 | 0.79 | 0.865 |
| 80 | 0.222 | 0.417 | 0.579 | 0.708 | 0.809 | 0.878 |
| 85 | 0.237 | 0.448 | 0.621 | | | |
| 90 | 0.261 | 0.484 | 0.657 | | | |

RETEST read5

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.335 | 0.608 | 0.797 | | | |
| 15 | 0.298 | 0.556 | 0.744 | | | |
| 20 | 0.258 | 0.5 | 0.683 | 0.818 | 0.904 | 0.953 |
| 25 | 0.237 | 0.46 | 0.638 | 0.77 | 0.863 | 0.922 |
| 30 | 0.207 | 0.402 | 0.57 | 0.703 | 0.805 | 0.879 |
| 35 | 0.188 | 0.365 | 0.524 | 0.658 | 0.766 | 0.848 |
| 40 | 0.178 | 0.347 | 0.5 | 0.633 | 0.742 | 0.827 |
| 45 | 0.156 | 0.307 | 0.446 | 0.571 | 0.677 | 0.765 |
| 50 | 0.156 | 0.306 | 0.445 | 0.568 | 0.675 | 0.762 |
| 55 | 0.156 | 0.306 | 0.445 | 0.569 | 0.675 | 0.763 |
| 60 | 0.157 | 0.308 | 0.449 | 0.574 | 0.681 | 0.769 |
| 65 | 0.163 | 0.319 | 0.462 | 0.59 | 0.698 | 0.785 |
| 70 | 0.16 | 0.313 | 0.454 | 0.578 | 0.683 | 0.77 |
| 75 | 0.185 | 0.356 | 0.509 | 0.638 | 0.74 | 0.82 |
| 80 | 0.214 | 0.407 | 0.574 | 0.708 | 0.806 | 0.876 |
| 85 | 0.22 | 0.418 | 0.594 | | | |
| 90 | 0.258 | 0.478 | 0.656 | | | |

RETEST read6

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.324 | 0.592 | 0.784 | | | |
| 15 | 0.295 | 0.548 | 0.737 | | | |
| 20 | 0.246 | 0.475 | 0.658 | 0.789 | 0.879 | 0.933 |
| 25 | 0.217 | 0.42 | 0.592 | 0.725 | 0.825 | 0.894 |
| 30 | 0.191 | 0.371 | 0.532 | 0.666 | 0.773 | 0.854 |
| 35 | 0.179 | 0.349 | 0.503 | 0.636 | 0.745 | 0.83 |
| 40 | 0.175 | 0.343 | 0.494 | 0.626 | 0.734 | 0.818 |
| 45 | 0.175 | 0.342 | 0.493 | 0.623 | 0.731 | 0.815 |
| 50 | 0.165 | 0.323 | 0.467 | 0.595 | 0.702 | 0.788 |
| 55 | 0.156 | 0.306 | 0.444 | 0.568 | 0.674 | 0.762 |
| 60 | 0.156 | 0.306 | 0.445 | 0.57 | 0.676 | 0.764 |
| 65 | 0.158 | 0.31 | 0.451 | 0.576 | 0.684 | 0.772 |
| 70 | 0.166 | 0.323 | 0.468 | 0.596 | 0.704 | 0.791 |
| 75 | 0.172 | 0.331 | 0.478 | 0.606 | 0.713 | 0.797 |
| 80 | 0.186 | 0.356 | 0.512 | 0.643 | 0.749 | 0.831 |
| 85 | 0.217 | 0.411 | 0.579 | | | |
| 90 | 0.268 | 0.496 | 0.664 | | | |

RETEST read7

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.355 | 0.637 | 0.82 | | | |
| 15 | 0.309 | 0.575 | 0.764 | | | |
| 20 | 0.265 | 0.509 | 0.695 | 0.826 | 0.91 | 0.956 |
| 25 | 0.237 | 0.46 | 0.641 | 0.774 | 0.87 | 0.928 |
| 30 | 0.191 | 0.372 | 0.533 | 0.665 | 0.772 | 0.849 |
| 35 | 0.175 | 0.341 | 0.491 | 0.621 | 0.728 | 0.812 |
| 40 | 0.164 | 0.321 | 0.465 | 0.592 | 0.7 | 0.787 |
| 45 | 0.158 | 0.31 | 0.45 | 0.576 | 0.683 | 0.771 |
| 50 | 0.156 | 0.306 | 0.445 | 0.569 | 0.676 | 0.764 |
| 55 | 0.156 | 0.306 | 0.445 | 0.569 | 0.675 | 0.763 |
| 60 | 0.142 | 0.279 | 0.408 | 0.526 | 0.63 | 0.719 |
| 65 | 0.147 | 0.288 | 0.42 | 0.54 | 0.645 | 0.734 |
| 70 | 0.159 | 0.309 | 0.446 | 0.569 | 0.675 | 0.762 |
| 75 | 0.169 | 0.327 | 0.47 | 0.594 | 0.698 | 0.782 |
| 80 | 0.182 | 0.352 | 0.504 | 0.635 | 0.741 | 0.821 |
| 85 | 0.195 | 0.376 | 0.535 | | | |
| 90 | 0.237 | 0.443 | 0.608 | | | |

RETEST read8

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.393 | 0.688 | 0.865 | | | |
| 15 | 0.3 | 0.559 | 0.749 | | | |
| 20 | 0.258 | 0.5 | 0.683 | 0.818 | 0.904 | 0.953 |
| 25 | 0.237 | 0.46 | 0.638 | 0.77 | 0.863 | 0.922 |
| 30 | 0.207 | 0.402 | 0.57 | 0.703 | 0.805 | 0.879 |
| 35 | 0.188 | 0.365 | 0.524 | 0.658 | 0.766 | 0.848 |
| 40 | 0.178 | 0.347 | 0.5 | 0.633 | 0.742 | 0.827 |
| 45 | 0.156 | 0.307 | 0.446 | 0.571 | 0.677 | 0.765 |
| 50 | 0.156 | 0.306 | 0.445 | 0.568 | 0.675 | 0.762 |
| 55 | 0.156 | 0.306 | 0.446 | 0.57 | 0.676 | 0.764 |
| 60 | 0.158 | 0.31 | 0.451 | 0.577 | 0.684 | 0.772 |
| 65 | 0.15 | 0.294 | 0.429 | 0.55 | 0.656 | 0.744 |
| 70 | 0.162 | 0.315 | 0.458 | 0.582 | 0.688 | 0.774 |
| 75 | 0.181 | 0.349 | 0.502 | 0.632 | 0.737 | 0.818 |
| 80 | 0.19 | 0.365 | 0.523 | 0.655 | 0.757 | 0.836 |
| 85 | 0.212 | 0.405 | 0.572 | | | |
| 90 | 0.247 | 0.46 | 0.631 | | | |

RETEST read9

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.364 | 0.657 | 0.849 | | | |
| 15 | 0.334 | 0.6 | 0.784 | | | |
| 20 | 0.267 | 0.507 | 0.694 | 0.826 | 0.91 | 0.957 |
| 25 | 0.235 | 0.452 | 0.63 | 0.766 | 0.86 | 0.92 |
| 30 | 0.207 | 0.397 | 0.562 | 0.697 | 0.8 | 0.874 |
| 35 | 0.187 | 0.362 | 0.52 | 0.654 | 0.762 | 0.845 |
| 40 | 0.177 | 0.346 | 0.499 | 0.631 | 0.74 | 0.825 |
| 45 | 0.156 | 0.306 | 0.446 | 0.57 | 0.677 | 0.765 |
| 50 | 0.156 | 0.306 | 0.444 | 0.568 | 0.674 | 0.762 |
| 55 | 0.156 | 0.306 | 0.445 | 0.569 | 0.675 | 0.763 |
| 60 | 0.157 | 0.308 | 0.448 | 0.573 | 0.68 | 0.768 |
| 65 | 0.147 | 0.288 | 0.42 | 0.54 | 0.646 | 0.734 |
| 70 | 0.156 | 0.305 | 0.444 | 0.567 | 0.674 | 0.761 |
| 75 | 0.172 | 0.333 | 0.479 | 0.606 | 0.712 | 0.795 |
| 80 | 0.192 | 0.367 | 0.519 | 0.646 | 0.748 | 0.825 |
| 85 | 0.214 | 0.408 | 0.573 | | | |
| 90 | 0.244 | 0.456 | 0.628 | | | |

RETEST read10

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.392 | 0.688 | 0.868 | | | |
| 15 | 0.321 | 0.586 | 0.771 | | | |
| 20 | 0.258 | 0.489 | 0.674 | 0.807 | 0.893 | 0.944 |
| 25 | 0.219 | 0.423 | 0.596 | 0.732 | 0.831 | 0.898 |
| 30 | 0.183 | 0.357 | 0.512 | 0.644 | 0.751 | 0.833 |
| 35 | 0.161 | 0.314 | 0.456 | 0.58 | 0.686 | 0.772 |
| 40 | 0.151 | 0.295 | 0.428 | 0.546 | 0.649 | 0.734 |
| 45 | 0.139 | 0.272 | 0.396 | 0.508 | 0.608 | 0.694 |
| 50 | 0.132 | 0.258 | 0.377 | 0.487 | 0.586 | 0.673 |
| 55 | 0.131 | 0.256 | 0.374 | 0.484 | 0.583 | 0.671 |
| 60 | 0.124 | 0.242 | 0.355 | 0.46 | 0.556 | 0.641 |
| 65 | 0.134 | 0.263 | 0.384 | 0.495 | 0.593 | 0.679 |
| 70 | 0.147 | 0.288 | 0.419 | 0.537 | 0.639 | 0.726 |
| 75 | 0.164 | 0.318 | 0.46 | 0.585 | 0.69 | 0.775 |
| 80 | 0.18 | 0.344 | 0.49 | 0.615 | 0.717 | 0.797 |
| 85 | 0.209 | 0.398 | 0.557 | | | |
| 90 | 0.248 | 0.463 | 0.642 | | | |

RETEST read11

| p | tolerance 2.5 | 5 | 7.5 | 10 | 12.5 | 15 |
|---|---|---|---|---|---|---|
| 10 | 0.37 | 0.658 | 0.842 | | | |
| 15 | 0.286 | 0.54 | 0.728 | | | |
| 20 | 0.253 | 0.491 | 0.67 | 0.804 | 0.891 | 0.941 |
| 25 | 0.223 | 0.434 | 0.601 | 0.734 | 0.831 | 0.898 |
| 30 | 0.193 | 0.375 | 0.534 | 0.669 | 0.775 | 0.854 |
| 35 | 0.158 | 0.311 | 0.45 | 0.574 | 0.68 | 0.766 |
| 40 | 0.148 | 0.289 | 0.42 | 0.539 | 0.642 | 0.729 |
| 45 | 0.138 | 0.269 | 0.392 | 0.507 | 0.609 | 0.697 |
| 50 | 0.133 | 0.26 | 0.379 | 0.492 | 0.594 | 0.683 |
| 55 | 0.133 | 0.259 | 0.378 | 0.49 | 0.593 | 0.681 |
| 60 | 0.129 | 0.252 | 0.368 | 0.477 | 0.577 | 0.664 |
| 65 | 0.134 | 0.263 | 0.383 | 0.495 | 0.595 | 0.682 |
| 70 | 0.149 | 0.291 | 0.422 | 0.54 | 0.643 | 0.73 |
| 75 | 0.159 | 0.31 | 0.447 | 0.567 | 0.669 | 0.753 |
| 80 | 0.182 | 0.352 | 0.503 | 0.629 | 0.731 | 0.809 |
| 85 | 0.2 | 0.385 | 0.545 | | | |
| 90 | 0.24 | 0.449 | 0.616 | | | |

## A3. Classical Test Theory Calculations: Hit-rate and Test-Retest Tables

Generic "textbook" test

Hit-rate for student at 50th percentile

| test reliability coefficient | tolerance 2.5 | 5 | 7.5 | 10 | 15 | 20 |
|---|---|---|---|---|---|---|
| .80 | 0.112 | 0.221 | 0.328 | 0.429 | 0.611 | 0.759 |
| .81 | 0.114 | 0.227 | 0.336 | 0.439 | 0.623 | 0.771 |
| .82 | 0.118 | 0.233 | 0.344 | 0.45 | 0.636 | 0.784 |
| .83 | 0.121 | 0.239 | 0.354 | 0.461 | 0.65 | 0.797 |
| .84 | 0.125 | 0.247 | 0.364 | 0.474 | 0.665 | 0.81 |
| .85 | 0.129 | 0.254 | 0.375 | 0.487 | 0.68 | 0.824 |
| .86 | 0.133 | 0.263 | 0.387 | 0.502 | 0.697 | 0.839 |
| .87 | 0.138 | 0.273 | 0.4 | 0.518 | 0.715 | 0.854 |
| .88 | 0.144 | 0.283 | 0.415 | 0.535 | 0.734 | 0.87 |
| .89 | 0.15 | 0.295 | 0.431 | 0.555 | 0.755 | 0.886 |
| .90 | 0.157 | 0.309 | 0.45 | 0.577 | 0.777 | 0.903 |
| .91 | 0.166 | 0.325 | 0.472 | 0.602 | 0.801 | 0.92 |
| .92 | 0.175 | 0.343 | 0.496 | 0.63 | 0.827 | 0.936 |
| .93 | 0.187 | 0.365 | 0.525 | 0.662 | 0.855 | 0.953 |
| .94 | 0.202 | 0.392 | 0.56 | 0.699 | 0.884 | 0.968 |
| .95 | 0.221 | 0.426 | 0.602 | 0.743 | 0.915 | 0.981 |
| .96 | 0.246 | 0.47 | 0.656 | 0.795 | 0.946 | 0.991 |

Generic "textbook" test

Hit-rate for student at 75th or 25th percentile

| test reliability coefficient | tolerance 2.5 | 5 | 7.5 | 10 | 15 | 20 |
|---|---|---|---|---|---|---|
| .80 | 0.138 | 0.273 | 0.402 | 0.521 | 0.718 | 0.847 |
| .81 | 0.142 | 0.28 | 0.411 | 0.532 | 0.731 | 0.857 |
| .82 | 0.146 | 0.287 | 0.422 | 0.545 | 0.743 | 0.866 |
| .83 | 0.15 | 0.296 | 0.433 | 0.558 | 0.757 | 0.876 |
| .84 | 0.155 | 0.304 | 0.445 | 0.572 | 0.771 | 0.886 |
| .85 | 0.16 | 0.314 | 0.458 | 0.587 | 0.785 | 0.896 |
| .86 | 0.165 | 0.325 | 0.472 | 0.603 | 0.8 | 0.906 |
| .87 | 0.172 | 0.336 | 0.488 | 0.621 | 0.816 | 0.916 |
| .88 | 0.179 | 0.35 | 0.506 | 0.641 | 0.833 | 0.927 |
| .89 | 0.187 | 0.364 | 0.525 | 0.662 | 0.85 | 0.937 |
| .90 | 0.196 | 0.381 | 0.546 | 0.685 | 0.868 | 0.947 |
| .91 | 0.206 | 0.4 | 0.57 | 0.71 | 0.887 | 0.957 |
| .92 | 0.218 | 0.422 | 0.598 | 0.738 | 0.906 | 0.967 |
| .93 | 0.233 | 0.448 | 0.63 | 0.77 | 0.925 | 0.976 |
| .94 | 0.251 | 0.48 | 0.667 | 0.804 | 0.944 | 0.984 |
| .95 | 0.275 | 0.519 | 0.711 | 0.843 | 0.962 | 0.991 |
| .96 | 0.306 | 0.569 | 0.764 | 0.886 | 0.978 | 0.996 |

Generic "textbook" test

Hit-rate for student at 90th or 10th percentile

| test reliability coefficient | tolerance 2.5 | 5 | 7.5 | 10 |
|---|---|---|---|---|
| .80 | 0.24 | 0.465 | 0.648 | 0.752 |
| .81 | 0.247 | 0.476 | 0.66 | 0.763 |
| .82 | 0.254 | 0.488 | 0.673 | 0.774 |
| .83 | 0.262 | 0.501 | 0.687 | 0.785 |
| .84 | 0.27 | 0.515 | 0.701 | 0.797 |
| .85 | 0.279 | 0.53 | 0.716 | 0.81 |
| .86 | 0.289 | 0.546 | 0.732 | 0.823 |
| .87 | 0.301 | 0.564 | 0.748 | 0.837 |
| .88 | 0.313 | 0.583 | 0.766 | 0.851 |
| .89 | 0.327 | 0.604 | 0.784 | 0.866 |
| .90 | 0.342 | 0.627 | 0.804 | 0.882 |
| .91 | 0.36 | 0.653 | 0.824 | 0.898 |
| .92 | 0.381 | 0.681 | 0.846 | 0.915 |
| .93 | 0.406 | 0.713 | 0.87 | 0.932 |
| .94 | 0.436 | 0.75 | 0.894 | 0.949 |
| .95 | 0.473 | 0.791 | 0.919 | 0.966 |
| .96 | 0.522 | 0.838 | 0.946 | 0.981 |

## Generic "textbook" test

### Retest for student at 50th percentile

| test reliability coefficient | tolerance 2.5 | 5 | 7.5 | 10 | 15 | 20 |
|---|---|---|---|---|---|---|
| .80 | 0.0832 | 0.166 | 0.246 | 0.324 | 0.471 | 0.6 |
| .81 | 0.0851 | 0.169 | 0.252 | 0.332 | 0.481 | 0.611 |
| .82 | 0.0872 | 0.173 | 0.258 | 0.339 | 0.491 | 0.623 |
| .83 | 0.0895 | 0.178 | 0.264 | 0.348 | 0.502 | 0.635 |
| .84 | 0.092 | 0.183 | 0.271 | 0.357 | 0.514 | 0.649 |
| .85 | 0.0947 | 0.188 | 0.279 | 0.367 | 0.527 | 0.663 |
| .86 | 0.0978 | 0.194 | 0.288 | 0.378 | 0.541 | 0.679 |
| .87 | 0.101 | 0.201 | 0.297 | 0.39 | 0.557 | 0.695 |
| .88 | 0.105 | 0.208 | 0.308 | 0.403 | 0.574 | 0.713 |
| .89 | 0.109 | 0.217 | 0.32 | 0.418 | 0.593 | 0.733 |
| .90 | 0.114 | 0.226 | 0.334 | 0.436 | 0.614 | 0.754 |
| .91 | 0.12 | 0.238 | 0.35 | 0.456 | 0.638 | 0.778 |
| .92 | 0.127 | 0.251 | 0.369 | 0.479 | 0.665 | 0.804 |
| .93 | 0.135 | 0.267 | 0.391 | 0.506 | 0.696 | 0.832 |
| .94 | 0.146 | 0.287 | 0.419 | 0.539 | 0.732 | 0.862 |
| .95 | 0.159 | 0.312 | 0.453 | 0.579 | 0.774 | 0.895 |
| .96 | 0.177 | 0.346 | 0.499 | 0.631 | 0.823 | 0.93 |

## Generic "textbook" test

### Retest for student at 75th or 25th percentile

| test reliability coefficient | tolerance 2.5 | 5 | 7.5 | 10 | 15 | 20 |
|---|---|---|---|---|---|---|
| .80 | 0.102 | 0.201 | 0.297 | 0.388 | 0.551 | 0.683 |
| .81 | 0.104 | 0.206 | 0.304 | 0.397 | 0.562 | 0.696 |
| .82 | 0.107 | 0.212 | 0.312 | 0.407 | 0.574 | 0.708 |
| .83 | 0.11 | 0.217 | 0.32 | 0.417 | 0.587 | 0.722 |
| .84 | 0.113 | 0.223 | 0.329 | 0.428 | 0.601 | 0.736 |
| .85 | 0.117 | 0.23 | 0.339 | 0.44 | 0.615 | 0.751 |
| .86 | 0.12 | 0.238 | 0.35 | 0.453 | 0.631 | 0.767 |
| .87 | 0.125 | 0.246 | 0.361 | 0.468 | 0.649 | 0.783 |
| .88 | 0.13 | 0.256 | 0.375 | 0.484 | 0.668 | 0.801 |
| .89 | 0.135 | 0.266 | 0.389 | 0.502 | 0.688 | 0.82 |
| .90 | 0.141 | 0.278 | 0.406 | 0.522 | 0.711 | 0.84 |
| .91 | 0.149 | 0.292 | 0.426 | 0.545 | 0.735 | 0.861 |
| .92 | 0.158 | 0.309 | 0.448 | 0.572 | 0.763 | 0.883 |
| .93 | 0.168 | 0.328 | 0.475 | 0.602 | 0.793 | 0.906 |
| .94 | 0.181 | 0.353 | 0.507 | 0.638 | 0.827 | 0.929 |
| .95 | 0.198 | 0.383 | 0.547 | 0.682 | 0.864 | 0.952 |
| .96 | 0.22 | 0.424 | 0.597 | 0.735 | 0.904 | 0.973 |

Generic "textbook" test

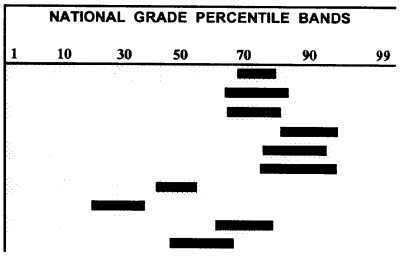
Retest for student at 90th or 10th percentile

| test reliability coefficient | tolerance .025 | .05 | .075 | .10 | .15 | .20 |
|---|---|---|---|---|---|---|
| .80 | 0.17 | 0.327 | 0.463 | 0.578 | 0.748 | 0.856 |
| .81 | 0.175 | 0.335 | 0.475 | 0.591 | 0.762 | 0.867 |
| .82 | 0.18 | 0.345 | 0.487 | 0.605 | 0.776 | 0.879 |
| .83 | 0.186 | 0.355 | 0.501 | 0.62 | 0.79 | 0.89 |
| .84 | 0.192 | 0.366 | 0.515 | 0.636 | 0.805 | 0.902 |
| .85 | 0.198 | 0.378 | 0.531 | 0.653 | 0.821 | 0.913 |
| .86 | 0.206 | 0.391 | 0.547 | 0.672 | 0.837 | 0.925 |
| .87 | 0.214 | 0.406 | 0.566 | 0.691 | 0.854 | 0.936 |
| .88 | 0.223 | 0.422 | 0.586 | 0.712 | 0.871 | 0.947 |
| .89 | 0.233 | 0.44 | 0.607 | 0.734 | 0.888 | 0.957 |
| .90 | 0.244 | 0.46 | 0.631 | 0.758 | 0.905 | 0.967 |
| .91 | 0.258 | 0.482 | 0.658 | 0.784 | 0.923 | 0.976 |
| .92 | 0.273 | 0.508 | 0.688 | 0.812 | 0.94 | 0.983 |
| .93 | 0.292 | 0.539 | 0.721 | 0.842 | 0.956 | 0.99 |
| .94 | 0.314 | 0.575 | 0.759 | 0.873 | 0.971 | 0.995 |
| .95 | 0.343 | 0.619 | 0.802 | 0.907 | 0.984 | 0.998 |
| .96 | 0.381 | 0.674 | 0.851 | 0.94 | 0.993 | 0.999 |

## A4. Sidebar on Confidence Intervals: National Grade Percentile Bands

The one instance of a display of the uncertainty in the individual percentile rank scores provided by HEM reports is the "National Grade Percentile Bands" found in the *Student Report*. The *Student Report* went to some parents in 1998; in 1998 most parents got the *Home Report*, which like the 1999 *Parent Report*, only contains the percentile rank scores. Below is an example of these "National Grade Percentile Bands," excerpted from a sample Student Report.

| *SUBTESTS AND TOTALS* | No. of Items | Raw Score | Scaled Score | National PR-S | National NCE |
|---|---|---|---|---|---|
| Total Reading | 84 | 71 | 671 | 78-7 | 66.3 |
| Vocabulary | 30 | 27 | 678 | 78-7 | 66.3 |
| Reading Comp. | 54 | 44 | 668 | 75-6 | 64.2 |
| Total Mathematics | 78 | 68 | 676 | 90-8 | 77.0 |
| Problem Solving | 48 | 41 | 669 | 87-7 | 73.7 |
| Procedures | 30 | 27 | 686 | 87-7 | 73.7 |
| Language | 48 | 29 | 621 | 43-5 | 46.3 |
| Lang Mechanics | 24 | 10 | 590 | 20-3 | 32.3 |
| Lang Expression | 24 | 19 | 656 | 73-6 | 62.9 |
| Spelling | 30 | 20 | 629 | 54-5 | 52.1 |




*What are these bands*? These bands are ±1 s.e.m. (standard error of measurement) confidence bands about the observed scaled score (S) converted to the percentile rank metric; the band ranges from PR(S – s.e.m.) to PR(S + s.e.m.) So the band can be interpreted as roughly indicating a range of percentile rank scores that yields a hit-rate of .683.

To link these bands with the score accuracy calculations used in this guide, select a hit-rate of .683 and construct a tolerance-equivalence approximately equal to [PR(S + s.e.m.) – PR(S – s.e.m.)]/2 . For the generic textbook test the s.e.m. is proportional to $[(1 - \text{rel})/\text{rel}]^{1/2}$ , and the tolerance-equivalent used to make the hit-rate = .683 in the probability statement can be computed as a function of test reliability.

Tolerance Equivalence

| | Score Percentile | | |
|---|---|---|---|
| rel | 50 | 75 | 90 |
| 0.85 | 15.1 | 12.5 | 7.76 |
| 0.9 | 12.4 | 10.2 | 6.07 |
| 0.95 | 8.85 | 7.15 | 4.11 |

These inversions of the confidence band match up reasonably well with the tables for the Stanford 9 tests–use, for example, Reading grade 3 to match with the reliability .95 row and Math grade 10 to match with the reliability .9 row.

References

*Assistance Packet for Reporting 1999 STAR Test Results to Parents/Guardians*, April 1999, prepared by the Standards, Curriculum, and Assessment Division, California Department of Education.

Harcourt-Brace Educational Measurement (1997). *Technical Data Report*, Stanford Achievement Test Series, Ninth Edition (Stanford 9), San Antonio.

Harcourt-Brace Educational Measurement (1997). *Spring Multilevel Norms Book*, Stanford Achievement Test Series, Ninth Edition (Stanford 9), San Antonio.

Rogosa, D.R. (1999). Accuracy of Individual Scores Expressed in Percentile Ranks: Classical Test Theory Calculations. CRESST Technical Report 509, September, 1999.

Trochim, W. M. *The Research Methods Knowledge Base, 2nd Edition*. Internet WWW page, at URL: http://trochim.human.cornell.edu/kb/index.htm (version current as of April 09, 1999).

The END for now