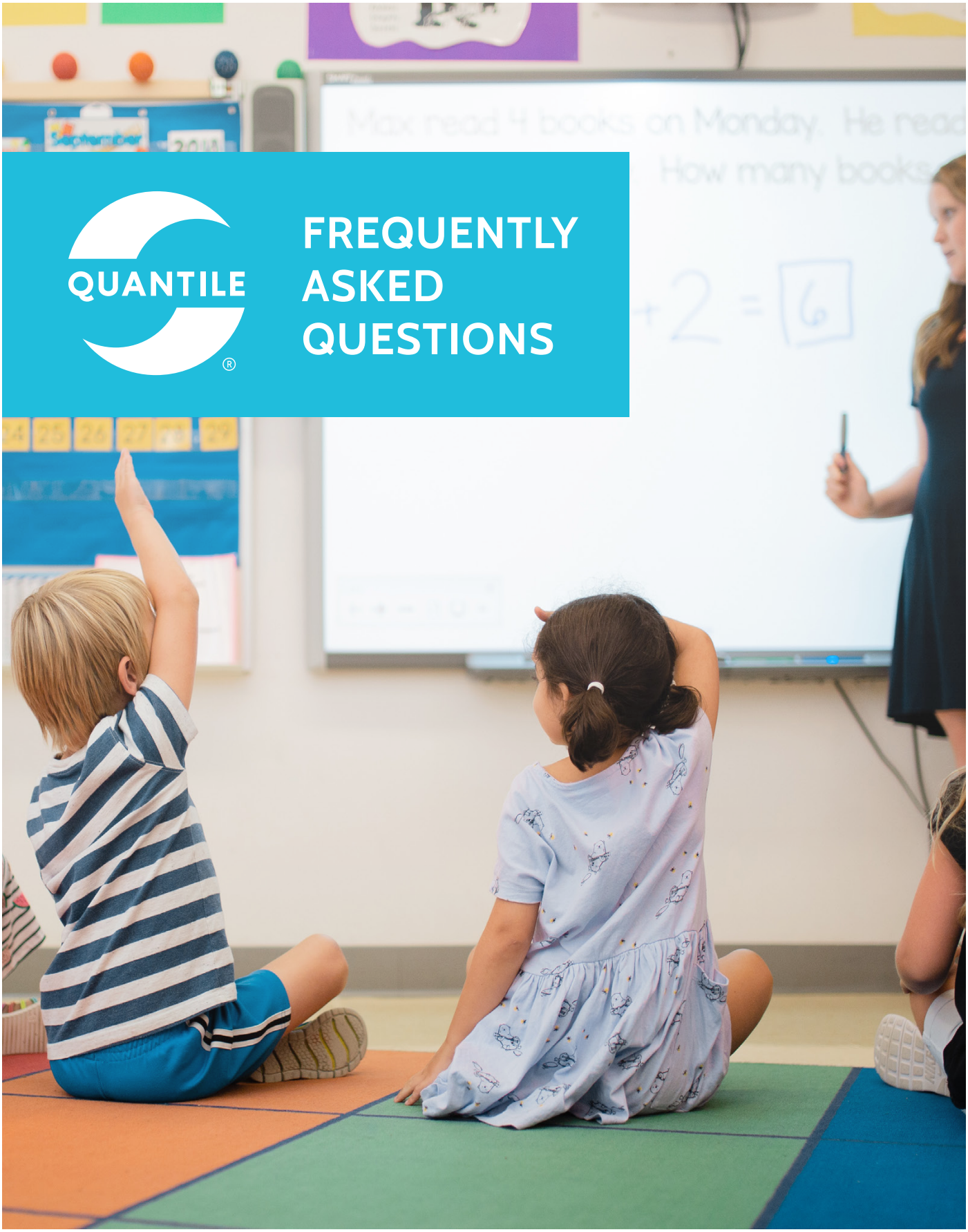

QUANTILE®

FREQUENTLY ASKED QUESTIONS

MetaMetrics®

QUANTILE® FRAMEWORK FOR MATHEMATICS

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Partner Help
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What is the Quantile Framework for Mathematics?

The Quantile Framework for Mathematics is a scientific approach that evaluates two facets of mathematics learning:

- The difficulty of a mathematical skills and concept in learning materials.
- A student's ability to learn new mathematical concepts.

Each facet can have a Quantile measure but both types of measures are on a single scale so that the skill demand and student ability can be matched for targeting instruction.

What is a Quantile measure?

A Quantile measure is a number followed by the letter "Q." Quantile measures range from below 0Q to above 1600Q and span the skills and concepts taught in kindergarten through high school.

What does a student Quantile measure mean?

A student Quantile measure indicates the student's ability to successfully work with the math materials that have with a similar Quantile measure. A student Quantile measure is an indicator of ability when the student's interaction with the mathematics skill is accompanied with instruction.

A Quantile measure for mathematics materials indicates the level of mathematical difficulty of the materials. This type of Quantile measure is based on the over 500 skills and concepts defined in the Quantile Framework for Mathematics. Each skill/concept has a measure, and each measure shows how difficult one skill/concept is in relation to the others.

As the Quantile measure of a student increases, the mathematics materials he/she is ready to learn becomes more difficult.

How does a student get a Quantile measure?

A student receives a Quantile measure by taking an assessment which reports results as a Quantile measure. Some assessments are developed by MetaMetrics for partners to report student Quantile measures, while other assessments are linked to the Quantile Framework by MetaMetrics so that the assessment results can report student Quantile measures. Many state departments of education report student Quantile measures from their year-end accountability assessments.

How do math materials get a Quantile measure?

The skills and concepts presented in mathematics instructional materials can be measured by MetaMetrics on the Quantile scale. The types of mathematics materials that can receive a Quantile measure include textbook lessons, problem sets, lesson plans, online activities, videos and games. These Quantile measures for materials give educators information about the best way to use materials to accelerate learning for their students.

What does "EM" stand for?

Quantile measures with the designation "EM" are below 0Q. For example, a Quantile measure of -120 is reported as EM120Q where "EM" stands for "Emerging Mathematician" and replaces the negative sign in the number. Quantile measures beginning with "EM" are predominantly seen for material and student measures at the early grade levels.

What does "NMQ" stand for?

The term NMQ (Not Measurable in Quantile Framework) may be given for the Quantile measure of a mathematics lesson or other materials that cannot be measured. The term is used for content that is extensively diverse in QSCs or strands so it cannot be classified within the Quantile Framework. Some examples are quizzes, tests, riddles, review sheets/activities and process skills such as working backwards, justifying, drawing pictures, etc.

What does "HMC" stand for?

The term HMC (Higher Mathematical Content) may be given for the Quantile measure of a mathematics lesson or other materials that contain skills or concepts that have not received a measure. Content that receives this term has skills or concepts that have not yet been researched to identify their Quantile measures. Content that receives this term has skills and concepts in higher-level statistics and calculus.

What is the research behind the development of the Quantile Framework for Mathematics?

The Quantile Framework is a scale that describes a student's mathematical achievement. Similar to how degrees on a thermometer measure temperature, the Quantile Framework uses a common metric — the Quantile measure — to scientifically measure a student's ability to reason mathematically, monitor a student's readiness for mathematics instruction, and locate a student on its taxonomy of mathematical skills, concepts and applications.

The Quantile Framework uses this common metric to measure many different aspects of education in mathematics. The same metric can be applied to measure the materials used in instruction, to calibrate the assessments used to monitor instruction and to interpret the results that are derived from the assessments. The result is an anchor to which resources, concepts, skills and assessments can be connected.

To learn more, read the research paper **The Quantile Framework for Mathematics Development and Validity Evidence**.

Why does a student only receive one Quantile measure and not a measure for each domain/strand?

All content strands are woven together to form the field called mathematics. The Quantile measure indicates overall mathematics ability, so it is given as a single value and does not disaggregate into various domains or strands of mathematics.

How do grade levels relate to Quantile measures?

Quantile measures help educators and parents track student growth in mathematics over time, regardless of grade level. Within any classroom, students will have varying mathematical abilities and students may have a wide range of Quantile measures. Quantile measures do not translate specifically to grade levels.

To better understand Quantile ranges and grade levels, view MetaMetrics' national student Quantile norms using the **Quantile® Grade Levels Charts** tool. There you can view Quantile measures and student norms for kindergarten through Grade 12 at different times of the year and at different student percentile ranks.

If a student has a significantly higher Quantile measure than their peers, should that student be placed in a higher level mathematics course?

Any decisions made about student placement in their course work should not be made based upon a single measure or test result. Many factors can impact a student's readiness for more complex concepts in mathematics. Those factors include background knowledge, academic motivation and the ability to independently problem-solve at an abstract level.

The Quantile measure indicates a student is probably ready for the difficulty of material presented at a particular level but is not an indicator of mastery. Students need to be ready for the demand of the material, which is what the Quantile measure shows. In the discipline of mathematics, however, students also need to have learned and been successful with previous material in the curriculum. Mathematics concepts are highly dependent on one another. The Quantile measure demonstrates readiness for instruction but does not indicate which math topics have been learned.

What is the expected growth in Quantile measures for a student?

Educators, parents and students often want to understand the expected growth a student should show from year to year in terms of Quantile measures. However, academic growth varies from student to student and is dependent on many variables. From a student's position in their learning journey to the specific instructional methods to time spent in practice many forces can shape growth.

Typically, expected growth estimates are made available by companies that develop instructional programs. They are best able to communicate the results anticipated if their program is implemented as intended. To learn more about typical student growth in Quantile measures for summative assessments, see page 31 in the research paper **Novel Interpretations of Academic Growth**.

Why do Quantile measures indicate "readiness" for instruction and introductory problems, such as the first night's homework for a lesson?

A student's Quantile measure indicates their readiness for math instruction. A student Quantile measure does not indicate that a student has mastered all of the material at or below the student's Quantile measure.

Introductory problems tend to be straightforward assessments of concept knowledge. More advanced problems that blend with other concepts cloud the picture in terms of predicting the difficulty of the primary concept. Therefore, a student's Quantile measure indicates that the student is ready for the mathematics demand of a skill or concept at an introductory level.

What does a Quantile measure of a particular math skill mean?

The Quantile Framework for Mathematics is based on a taxonomy of over 550 math components, called Quantile Skills and Concepts, or QSCs. This taxonomy of math skills, concepts and applications was developed through field studies and other research efforts in order to determine a difficulty measure for each QSC. The Quantile measure of a QSC indicates the difficulty of that math skill or concept at an introductory level (first night's homework).

What does the QSC ID mean? (Example: QSC166)

Along with a Quantile measure and a short description, each QSC has an identification number that consists of two elements — the letters "QSC" followed by a unique 1-to-4 digit identifying number. For example QSC166 has the description "Divide using single-digit divisors with and without remainders." and the Quantile measure 450Q.

What is a Knowledge Cluster?

Every Quantile Skill and Concept (QSC) in the Quantile Framework is interconnected through its Knowledge Cluster. The Knowledge Cluster for a QSC consists of a single Focus QSC with Prerequisite, Impending and Supporting QSCs. These connections to the Focus QSC are a "mini-vertical alignment" built to inform a mathematical progression of the difficulty of skills and concepts.

Knowledge Clusters allow educators to scaffold instruction by identifying necessary prerequisite skills and concepts to close gaps in students' mathematical backgrounds. Additionally, the Knowledge Cluster enriches instruction by informing the interconnectivity of the skills and concepts and the progression of their difficulties.

What are Prerequisite QSCs?

Prerequisite QSCs describe skills and concepts that are important for students to learn before beginning instruction on the Focus QSC. For example, the Focus QSC described as "Divide using single-digit divisors with and without remainders." has these Prerequisite QSCs:

- Know and use division facts related to multiplication facts through 144.
- Multiply a multi-digit whole number by a 1-digit whole number or a 2-digit multiple of 10.

What are Supporting QSCs?

Supporting QSCs represent skills that are not necessary but could be useful to enrich a lesson, make connections across topics as well as strands and help students integrate different mathematical concepts. For example, the Focus QSC described as "Divide using single-digit divisors with and without remainders." has these Supporting QSCs:

- Represent fractions concretely and symbolically, including representing whole numbers as fractions.
- Identify and use the rules for divisibility (2, 3, 4, 5, 6, 9 and 10).

What are Impending QSCs?

Impending QSCs are new QSCs that students will likely learn in their future mathematics studies as they logically progress through their coursework. For example, the Focus QSC described as "Divide using single-digit divisors with and without remainders." has these Impending QSCs (as well as four others):

- Estimate and solve division problems with multi-digit divisors; explain solution.
- Represent division of whole numbers as a fraction in number and word problems.

This insight provides a more global perspective of the process, connections and relationships that support a student's understanding of mathematics.

What resources are available for families to help their child in mathematics?

A couple of resources are available for families including:

- ***Quantile*® Math@Home**: A search tool for families that provides access to a variety of mathematical resources, such as games, activities, websites, tutorials and videos that are targeted to a child's mathematical ability on the Quantile scale. By entering the student Quantile measure and selecting appropriate mathematics topics, families can find instructional resources and activities that support student learning outside of the classroom.
- The ***Quantile*® Summer Math Challenge**: A free math skills maintenance program based on grade-level standards that help lessen the summer learning slide. The program is targeted to students who have just completed grades 1 through 8 and is designed to help students retain math skills learned during the previous school year. For six weeks in the summer families will receive daily emails with fun activities and links to educational resources. When the program ends families can print an award certificate to celebrate their child's summer math accomplishment!

Can educators and families still find Quantile resources if a student doesn't have a Quantile measure?

It is possible to use the Quantile Framework to gain insights into the difficulty and the content sequencing of curricula even without a Quantile measure handy. These Quantile tools include:

QUANTILE MATH@HOME

QUANTILE MATH SKILLS DATABASE

QUANTILE SUMMER MATH CHALLENGE

QUANTILE TEACHER ASSISTANT

How can educators use the *Quantile*® Math Skills Database?

The **Math Skills Database** is a search tool that allows educators to search for resources aligned to state mathematics standards. The search results list each state standard and its alignment to the Quantile Skills and Concepts (QSCs). By clicking through the search results list to a QSC's individual description page, you will find resources aligned to that skill/concept as well as to related skills/concepts in its Knowledge Cluster. Related QSCs are all hyperlinked to their respective detail pages. Educators can match the Quantile measure of a QSC to a student Quantile measures to find resources most appropriate for that student.

How can educators use the *Quantile*® Teacher Assistant?

Time is short and math instruction needs to be focused. The **Quantile Teacher Assistant** helps educators to use the Quantile Framework for Mathematics to differentiate math instruction and to locate resources that can help identify those skills/concepts that are most relevant to the topic of the day. This tool has been aligned with state mathematics standards. Prerequisite and Supporting QSCs from the Knowledge Clusters are offered along with resources that can supplement instruction in the classroom.

What is the mathematics demand of materials a student will likely encounter in each grade?

MetaMetrics studied the difficulty of lessons in mathematics textbooks commonly used in the United States to help understand the mathematics demand that students will likely encounter in their elementary through high school mathematics courses. Results are shown in the table below.

Grade	Lessons Complexity Beginning of Year	Lessons Complexity End of Year
1	EM50Q*	80Q
2	40Q	300Q
3	240Q	490Q
4	390Q	680Q
5	560Q	810Q
6	680Q	890Q
7	800Q	950Q
8	840Q	1050Q
9	900Q	1150Q
10	1070Q	1230Q
11	1100Q	1350Q

**** When a Quantile measure is below 0Q, an EM (Emerging Mathematician) code is reported with the measure.***

Read our research brief describing this work: **A Quantitative Task Continuum for K-12 Mathematics.**

What Quantile measure does a student need to attain in order to be college-and career-ready?

MetaMetrics research indicates that the mathematics ability needed for college and career readiness ranged from approximately 1220Q to 1440Q, and the median mathematics demand for college and career readiness was 1350Q. So a student with a Quantile measure of at least 1350Q would be able to handle the math needed in college and most careers. Read our research brief describing this work in **The Quantile Framework for Mathematics Quantifies the Mathematics Ability Needed for College and Career Readiness**.

How do Lexile and Quantile measures compare to each other?

The Lexile® Framework for Reading and the Quantile Framework for Mathematics are both scientific measurement systems that make the measurement of student performance and the measurement of material complexity on a single scale possible. Both are based on empirical (observed) relationships between learners and materials.

The Lexile and Quantile scales accurately describe measures for students and materials from beginning to advanced learners and lessons. The scales are independent, meaning that student and material measures can be produced from many assessments and for reading and math materials from many sources.

Lexile and Quantile measures differ with respect to the academic skill and material measured. On the learner or student side, the Lexile Framework for Reading measures a learner's reading ability, or overall reading comprehension, and the Quantile Framework measures a learner's readiness to learn math skills and concepts. On the materials side, the Lexile Framework measures the complexity of prose text based on quantifiable text features while the Quantile Framework measures the complexity of math materials based on the mathematical demand of the skill and concepts in the materials.

What impact does the reading level (Lexile measure) of a math lesson or activity have on the difficulty levels of the mathematics?

There is a considerable amount of discussion and research about the type of text that is used in mathematics. The readability of technical text is very different from such reading experiences as reading trade books, novels, magazines or newspapers.

In order to minimize the reading demand of some mathematics materials, materials can be developed with a reading demand that is traditionally below expected reading levels of the students addressing the work. The reason for this effort is to minimize the reading demand in order to ensure that the mathematics demand is what is being measured.

What is the difference between a Quantile range for instruction and a Lexile range?

Students are encouraged to read within their Lexile range. When students read books and materials in their Lexile range, they will comprehend what they are reading without getting frustrated. A student's Lexile range spans from 100L below to 50L above their Lexile measure. For example, a student with a Lexile measure of 500L will have a Lexile reading range of 400L to 550L.

A student's Lexile range is based on the fact that the student reads independently (without instructional help), so the meaning of a Lexile measure is set at the 75% comprehension rate. For example, a student with a certain Lexile measure can read a book at the same Lexile measure and is expected to comprehend 75% of what they read.

A student's Quantile range is different, based on the differences between how a student reads and how they learn mathematics. Students generally do not learn math without instruction of some kind (a teacher, a video, an activity) so the meaning of Quantile measures was set at the level where a student will understand at the 50% comprehension rate. At this rate, a student will likely be ready for instruction on a lesson at that same Quantile measure.

So, a student's Quantile range spans from 50Q below to 50Q above their Quantile measure. For example, a student with a Quantile measure of 500Q will have a Quantile range of 450Q to 550Q and be ready for instruction on a math materials that have a Quantile measure in this range.

Why might a student's Quantile measures fluctuate?

It's important to look at test scores in aggregate – data trends over time rather than single test scores. Individual test scores fluctuate. Test trends over time is what is important.

Student-related factors that might cause fluctuations in test scores include:

- Motivation.
- Attention.
- Alertness.
- Fatigue.
- State of mind.

Test-related factors that might cause fluctuations in test scores include:

- Purpose and type of test.
- Test administration.
- Standard error of measurement.
- Regression to the mean.
- Range restriction.

Test scores offer an estimate of a student's ability. The ***Quantile*® Measures Manager** tool helps educators determine a student's optimal measure when assessments taken within 30 days of each other show unexpected different Quantile measures.

Your customers might be interested in accessing the Quantile Measures Manager at **hub.lexile.com/quantile-measures-manager**.

For additional information on multiple measures and available resources for how to best manage them, visit our Managing Multiple Measures Resource Center, located at **quantiles.com/managing-multiple-measures**.

Why do test scores in general fluctuate?

Better understand why test scores fluctuate and what you can do to help students perform at their best on a test in the following questions and answers.

How does the purpose and type of test impact test score fluctuation?

While all tests serve to assess information about a student's learning, different test types are specifically designed for different purposes and contain unique properties that support these purposes. For example, a progress-monitoring test or interim assessment will provide different information about a student's learning than an end-of-year summative test used to make a judgment about the quality of performance at the end of an instructional unit or course.

Students often perform differently on a 20-minute interim assessment compared to a summative test or high stakes assessment. Research shows that there is generally less Standard Error of Measurement (the difference between what a test score indicates and a student's actual knowledge and abilities or "true" score) associated with the results of high stakes assessments than that associated with the results of interim assessments.

High stakes or summative tests cover a broad range of curriculum, allowing students of all abilities to answer at least some questions so there is less range restriction. Interim assessments tend to be shorter in length, cover only portions of the curriculum and may restrict scores for students at the higher and lower ends of the spectrum.

Other factors that affect test scores include how well the test is targeted to match the abilities of the students, the length of the test, and the personalization or differentiation of the test items.

How does test administration impact test score fluctuation?

How a test is administered can affect student performance. Factors that can affect test results include:

- Distractions.
- Clarity of the directions.
- The interaction between the student and the test.
- The overall testing environment.
- Test security.

How do home and student factors influence test score fluctuation?

Home and student factors influence test score fluctuation in several ways. Factors such as if the test date was communicated in advance, if the student had a good night's sleep or if the student had breakfast that morning can impact performance. The student's mental state can also be a factor. If a student went through something traumatic (such as a personal loss) or simply wasn't motivated, it can affect performance.

What can be done to reduce inconsistencies between tests that result in fluctuating test scores?

To reduce inconsistencies in multiple assessment results and more confidently identify a student's optimal reading range:

- Collect more test data over time, across a variety of assessments.
- Maintain consistent test practices across all test administrations and avoid days or times where there will be known distractions.
- Encourage students to do their best on all tests and communicate tips for test-taking success.
- Motivate students through praise and encouragement. Highly motivated students perform better and see less variation in their test scores. Studies show that students achieve at higher levels when they feel competent and when they see a direct link between their actions and an outcome.
- For partners implementing the MetaMetrics® Score Interpreter, the Bayesian feature of the Scoring API makes it possible for student scores to be smoothed out so that you do not see drastic fluctuation in a student's Quantile measures. For instance, a student who had a bad testing day might have gotten a low Quantile measure, but because Bayesian scoring was applied the Quantile measure would be adjusted to represent the student's true mathematical ability.

What is Bayesian scoring?

Bayesian scoring gets its name from Thomas Bayes, an English statistician and philosopher. This type of assessment scoring produces student Quantile measures informed by past performance for a smoothed score over multiple testing events to better estimate a student's "true" mathematics ability.

What is the difference between content standards and performance standards?

Content standards are curricular frameworks that specify what should be taught at each grade level, such as state curriculum standards and the Common Core State Standards. Performance standards are what students must do to demonstrate proficiency with respect to the specific content.

What is a criterion-referenced test score interpretation?

Increasingly, educators and parents want to know more than just how a student's performance compares with that of other students: they ask, "What level of performance does a score represent?" and "How good is good enough?"

To be able to adequately answer these questions, criterion-referenced interpretations are required. A criterion-referenced interpretation of a test score compares the specific knowledge and skills measured by the test to the student's proficiency with the same knowledge and skills. Criterion-referenced scores have meaning in terms of what the student knows or can do, rather than in relation to the scores produced by some external reference group (norm-referenced interpretation). Criterion-referenced standards describe what students should be able to do at a specific level of performance.

When performance standards are developed, typically a group of experts in the field (e.g., curriculum specialists, test developers, business leaders) evaluate the test items and determine what level of mastery is necessary to be at each performance level in the content area. Increasingly, four or five performance levels are established to describe a student's level of mastery: below basic, basic, proficient, advanced (and perhaps one additional level). The "proficient" level is often designated as "passing," or showing adequate mastery of the content area. Performance standards reflect the judgment of the persons setting the standards and may change over time as higher (or lower) standards are set.

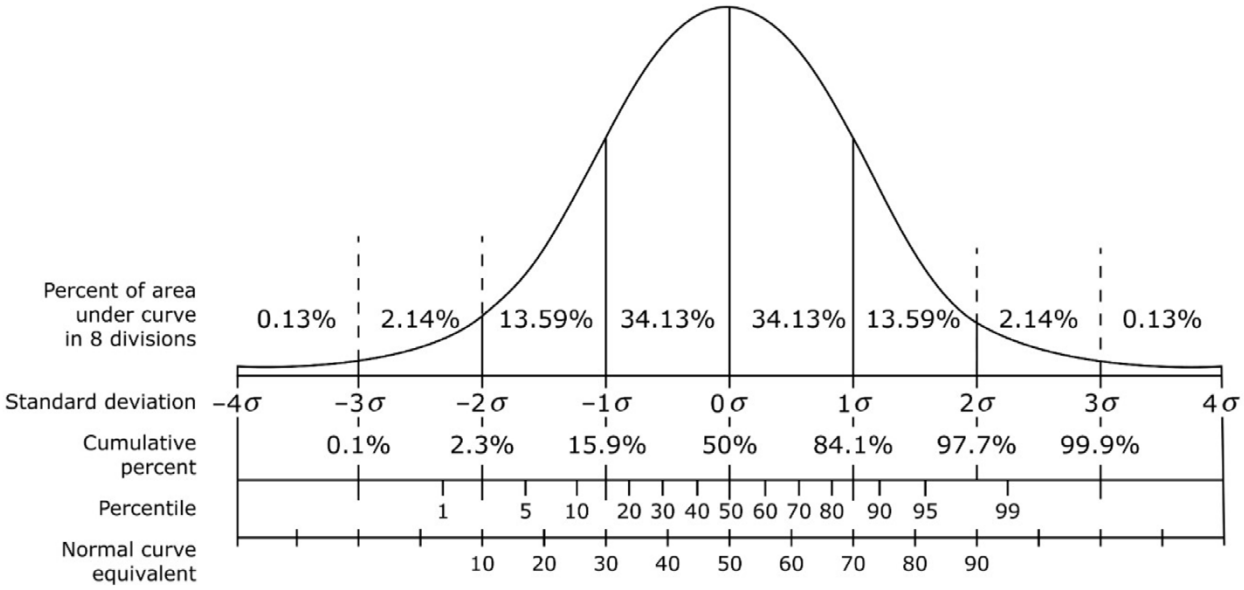
Each test developer or state department determines its own performance standards. As a result, the Quantile measure indicating a passing score in one state may be different than the measure that indicates passing in another state or on another test linked with the Quantile Framework.

What is a norm-referenced test score interpretation?

A norm-referenced interpretation of a test score expresses how a student performed on the test compared to other students of the same age or grade. Norm-referenced interpretations of test results, however, do not provide any information about what a student can or cannot read or how well a student understands mathematics. Norm-referenced interpretations simply compare student performances without regard to specific content. For accountability purposes, percentiles, normal curve equivalents (NCEs) and stanines are often used to report test results when making comparisons (norm-referenced interpretations). For a comparison of these measures, refer to the figure below and the following descriptions.

Although norm-referenced interpretations provide useful information about how a student's score compares to the scores of a comparison group (e.g., same age or grade students), norm-referenced interpretations do not tell us whether a student has mastered the material for a particular course or grade. Norm-referenced standards do not describe what students can do at a specific level of performance. A criterion-referenced test and interpretations as well as performance standards do provide this frame of reference.

Normal distribution of scores described in scale scores, percentiles, stanines and NCEs.



QUANTILE GRADE LEVEL CHARTS

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