

QTaxon Quantile Measures



The Quantile Framework[®] for Mathematics Linking Assessment with Mathematics Instruction

In order to use the Quantile Framework to examine the difficulty of skills and concepts and the complexity of resources, the Quantile measure of each QTaxon must be estimated. The Quantile measure of a QTaxon estimates its solvability, or a prediction of how difficult the skill or concept will be for the learner with a Quantile measure of his or her own. The QTaxons fall into knowledge clusters along a content continuum.

The Quantile measures and knowledge clusters for QTaxons are determined by a group of three to five subject-matter experts (SMEs). Each SME has had classroom experience at multiple developmental levels, has completed graduate-level courses in mathematics education, and understands basic psychometric concepts and assessment issues.

Knowledge Clusters. Knowledge clusters are a family of skills, like building blocks, that depend one upon the other to connect and demonstrate how skills are founded, supported, and extended along the continuum. The knowledge clusters illustrate the interconnectivity of the Quantile Framework and the natural progression of mathematical skills (content trajectory) needed to solve increasingly complex problems.

Each QTaxon is classified as having precursory and supportive QTaxons or as being a Foundational QTaxon by the SMEs. The SMEs examine each QTaxon to determine where the specific QTaxon comes in the content continuum based on classroom experience, instructional resources (e.g., textbooks), and other curricular frameworks (e.g., NCTM Standards). A QTaxon that is classified as foundational means this QTaxon describes a skill or concept that only requires readiness to learn. Readiness is based upon the learner's cognitive experiences rather than knowledge of specific mathematical concepts. It is the base for which other QTaxons are built.

Once the knowledge cluster for a QTaxon is established, the information is used when determining the Quantile measure of a QTaxon. If necessary, knowledge clusters are reviewed and refined if the Quantile measures of the QTaxons in the cluster are not monotonically increasing or there is not an instructional explanation for the pattern.

Quantile measures of QTaxons. To determine the Quantile measure of a QTaxon, actual performance by examinees is used. While expert judgment alone could be used to scale the QTaxons, empirical scaling is more replicable. Items and resulting data from two national field studies were used in the process:

- Quantile Framework field study (685 items, $N = 9,647$, grades 2 through Algebra II); and
- PASeries Mathematics field study (7,080 items, $N = 27,329$, grades 2 through 9/Algebra I) which is described in the PASeries Mathematics Technical Manual (MetaMetrics, 2005).

The items initially associated with each QTaxon were reviewed by SEMs and accepted for inclusion in the set of items, moved to another QTaxon, or not included in the set. The following criteria were used:

- Psychometric (responded to by at least 50 examinees, administered at the target grade level, point-biserial correlation greater than or equal to 0.16);
- Matched grade level of introduction of concept/skill from national review of curricular frameworks; and
- Appropriate for instruction of concept (first nights homework) based on consensus of the SEMs.

Once the set of items meeting the inclusion criteria is identified, the set of items is reviewed to ensure that the curricular breadth of the QTaxon is covered. If the group of SMEs considers the set of items to be acceptable, then the Quantile measure of the QTaxon is calculated. The Quantile measure of a QTaxon is defined as the mean Quantile measure of items that met the criteria. The standard deviation of the item difficulties is also calculated (mean standard deviation of item difficulties across QTaxons is 177.3Q). The final step in the process is to review the Quantile measure of the QTaxon in relationship to the Quantile measures of the QTaxons identified as precursory and supporting to the QTaxon. If the group of SMEs does not consider the set of items to be acceptable, then the Quantile measure of the QTaxon is estimated and assigned a Quantile zone. (Quantile zone is the suggested range of Quantiles at which the student is ready for instruction. The Quantile Range for a student is from 50Q above her or his Quantile measure to 50Q below.) By assigning a Quantile zone instead of a Quantile measure to these QTaxons, the SMEs are able to provide a valid estimate of the skill or concept's difficulty.

QTaxon Quantile measures are used in the calibration of resources (e.g., textbooks, instructional materials, supplemental materials, work-place documents, everyday documents) used with the Quantile Framework.

For more information on The Quantile Framework for Mathematics, call 1-888-539-4537 or visit www.Quantiles.com.