

Quantitative Reasoning (Version 2.5 10/20/2006)

What is Quantitative Reasoning? QR is a set of abilities for recognizing, evaluating, and using forms of quantitative information in order to support a position or argument. It includes the ability to express quantitative information mathematically, graphically, orally, and in writing. It involves problem solving, especially with problems derived from actual data. Although it is not the same as mathematics or statistics, it may include aspects of both, as well as aspects of information literacy. *The Mathematical Association of America has published guidelines and recommendations for Quantitative Reasoning in an on-line report Quantitative Reasoning for College Graduates: A Complement to the Standards (http://www.maa.org/past/ql/ql_toc.html). The report indicates that*

“...every college graduate should be able to apply simple mathematical methods to the solution of real-world problems. A quantitatively literate college graduate should be able to:

- 1. Interpret mathematical models such as formulas, graphs, tables, and schematics, and draw inferences from them.*
- 2. Represent mathematical information symbolically, visually, numerically, and verbally. Use arithmetical, algebraic, geometric and statistical methods to solve problems.*
- 3. Estimate and check answers to mathematical problems in order to determine reasonableness, identify alternatives, and select optimal results.*
- 4. Recognize that mathematical and statistical methods have limits.*

These five capabilities could be attained at varying levels. In particular the level intended here is beyond that normally attained in the high school experience. Explicitly college-bound high school students are generally expected to have three, and encouraged to have four, years of college preparatory high school mathematics. A quantitatively literate college graduate should be expected to have deeper and broader experiences than those who only graduate from high school. The level of sophistication and maturity of thinking expected of a college student should extend to a capability for quantitative reasoning which is commensurate with the college experience. College students should be expected to go beyond routine problem solving to handle problem situations of greater complexity and diversity, and to connect ideas and procedures more readily with other topics both within and outside mathematics.”

(http://www.maa.org/past/ql/ql_part2.html)

The MAA recommends that a College level QR experience consists of remediation (if necessary), a foundational QR course, and an advanced level course with a focus on QR.

Goal alignment: the QR subcommittee recommends:

UND's QR program be somewhat less than recommended by the MAA. We recommend that all incoming students have demonstrated mathematical and quantitative skills as appropriate for high school graduates. (See documents from ND DPI on H.S. Mathematics standards.) And all UND graduates have a college level QR approved course at the advanced level (course numbers in the range 200-400) as approved by their major department.

To implement QR at UND, we recommend

* As a first choice, a separate QR goal should be adopted within general education, and a QR course requirement (roughly parallel to the communication goals and course requirement) should be adopted.

* As a second choice, QR could be included with specific language, perhaps drawn from this document, within the critical thinking goal. In that case, we recommend that the QR course requirement still be adopted.

TEXT FOR STUDENTS AND THE PUBLIC

Sample Goal Wording: Quantitative Reasoning. Students will be able to find, understand, and use relevant quantitative information within a meaningful context.

Rationale: We are increasingly surrounded by quantitative information. Using that information appropriately is a foundation for further learning, as well as for personal and professional growth.

You will improve your quantitative reasoning when your ES courses ask you to practice the following:

- * apply empirical data to a specific problem or issue;
- * draw conclusions based on quantitative information;
- * analyze graphical information and use it to solve problems.

TEXT FOR FACULTY VALIDATING/REVALIDATING QR COURSES

Philosophy: Courses qualifying for a QR designation include quantitative thinking as a core component of the course. QR courses, by design, are integrative and include both quantitative concepts and contexts (or examples) that root the quantitative work within a disciplinary context. They are planned to provide students with experience in finding, understanding, and using relevant quantitative information within a meaningful context. Through these courses, students gain experience in understanding, constructing, and critiquing quantitative arguments

Pedagogy: These courses are by their nature centered around making sense of and communicating about quantitative ideas, which means that students need opportunities for first-hand experience with data. Courses qualifying as QR are expected to include appropriate practice, for individual students and for groups of students, in finding and using quantitative information in context. Quantitative data and conclusions should be communicated mathematically, visually, orally, and in writing, and students should be able to translate from one

form to another. Students are expected to use basic computational skills, but the focus of a QR course is on thinking about using quantitative information in context rather than on the computation itself. Class size for a QR course is capped (**Question for Task Force: at 25, 50 or higher students?**), making it possible for faculty to incorporate the kinds of active learning that are expected.

Course Content: Any *advanced level* course designated as QR must include elements related to reasoning, chance, arithmetic/basic algebra, and data analysis/interpretation. QR courses will often also include elements related to statistics and modeling. Some QR courses may contain elements related to computers.

Pre-requisites: Because QR courses ask students to do significant intellectual work involving the elements listed above, they should not be mistaken for courses in basic math or computation. Students should bring these mathematical/computational skills into the QR course, which means the courses will have a pre-requisite of ~~Math 103~~ *High School Mathematics competency* (or *as determined by* an ACT score, AP/CLEP score, placement test score, or transfer credit acceptable to the Math Department for ~~Math 103~~ *basic QR* equivalency). *For students not initially meeting the basic Math/QR pre-requisite a Fundamentals of Quantitative Reasoning course would be required. (Questions for Task Force: GER credit or not? Graduation credit or not?)*

Assessment/Grading: Quantitative reasoning must be a significant element in the course, as demonstrated by its importance in assessment and grading. Generally, quantitative reasoning skills should contribute to 30% or more of the grade in the course, and the teacher should analyze student learning related to quantitative reasoning as part of his or her assessment of learning in the course. As such, assessment of student learning in relation to the QR content will be an essential component of revalidation.

Designation as a QR Course: Courses must be approved by the General Education Committee for designation as a QR course. In order to receive that designation, an application must be submitted which demonstrates that the course meets stipulations related to content, methods, and assessment/grading. The stipulations are summarized below:

1. The course provides practice, for individual students and groups of students, in finding and using quantitative information in context.
2. The course includes practice with communicating quantitative data. Data may be communicated mathematically, visually, orally, and in writing, as well as translated among the various forms.
3. The course includes content related to reasoning, chance, arithmetic/basic algebra, and data analysis/interpretation. The course may contain other elements, including but not limited to modeling, statistical interpretation, and use of computers as a quantitative reasoning tool.
4. The importance of quantitative reasoning within the course should be reflected in the grade; it should contribute to 30% or more of the grade for the course. In addition, the teacher regularly analyzes student learning related to quantitative reasoning as part of his/her assessment

of the course for Gen Ed revalidation and as part of a process for improving teaching and learning.

5. Course size does not exceed 50 students, unless there is a satisfactory explanation of how necessary practice and feedback can be provided within the larger group (e.g., with systematic use of TAs).

During validation or revalidation of a QR course, a copy of the course syllabus should be submitted to document these requirements. Where the syllabus does not fully demonstrate satisfaction of the criterion, the teacher should submit explanatory notes.

Effect on Resources: No significant effect on advanced level course resources since the QR component could be incorporated into existing class offerings. In some cases, class size might need to be reduced if we maintain a cap on class size. To implement the basic H.S. Math/QR testing and placement additional resources may be required to write, administer, score and document the test(s) and results. The **Fundamentals of Quantitative Reasoning** course could consist of a redesigned Math 102 (Intermediate Algebra) course or Math 103 (College Algebra) courses. This may require additional resources since such a course should be taught in sections of no more than 25 students in order to accomplish the learning goals, and because such a course makes heavy demands on instructors. If GTAs are used to teach such a course, they would need additional mentoring and supervision as well as time to acclimate to teaching the course.

Program/requirements effects: No significant effect on other advanced level program requirements since this could be an “overlay” with other courses taken for gen ed or the major. Depending on how the basic QR level requirement is implemented credits may or may not be added to the GER total.