Quantitative Reasoning: Course Criteria and Learning Outcomes

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Overview

Quantitative Reasoning is the process of forming conclusions, judgments or inferences from quantitative information. There are many aspects to quantitative reasoning. These include the recognition and construction of valid mathematical models that represent quantitative information; the analysis and manipulation of these models; the drawing of conclusions, predictions or inferences on the basis of this analysis; and the assessment of the reasonableness of these conclusions.

At UW-Madison, Quantitative Reasoning is divided into two categories, Quantitative Reasoning Part A and Part B. Broadly speaking, Quantitative Reasoning Part A courses provide students with broad quantitative skills that they will later need to apply in a Quantitative Reasoning Part B course. Quantitative Reasoning Part B courses require students to think critically and apply quantitative skills to interpret data, draw conclusions, and solve problems within a disciplinary or interdisciplinary context.

This document clarifies details about these requirements and articulates connections and distinctions between them by describing courses and learning outcomes. Examples are provided to illustrate courses that do and do not meet these requirements. In addition, implementation notes are also provided, to assist in administration of QR-A and B.

Quantitative Reasoning Part A (QR-A)

Description: A Quantitative Reasoning Part A course is an introductory course in college-level mathematics, computer science, statistics or formal logic that prepares students for more advanced work in a disciplinary context.

Quantitative Reasoning Part A Learning Outcomes: Using quantitative information and the tools of college-level mathematics, computer science, statistics or formal logic, students will develop skills to:

- solve problems
- draw conclusions
- develop models and/or interpret data and/or devise algorithms

Examples:

- A College Algebra course
- An introductory math course that emphasizes mathematical reasoning and its application and relevance to daily life.

- An introductory statistics, programming, or formal logic course.

Quantitative Reasoning Part A Implementation Notes:

- Quantitative Reasoning Part A courses are offered for a minimum of three credits.
- Students must complete Quantitative Reasoning Part A within their first 60 credits, and prior to enrolling in Quantitative Reasoning Part B.
- Students may satisfy the Quantitative Reasoning Part A requirement through demonstrated learning as indicated by reaching the required scores on the mathematics placement exam or accepted AP and IB exams.
- Students may satisfy the Quantitative Reasoning Part A requirement with transfer credits of a Quantitative Reasoning Part B course in Mathematics. This provision is limited to Quantitative Reasoning Part B courses in the Mathematics subject listing.
- Quantitative Reasoning Part A courses must include and enforce the prerequisite that students have satisfied or placed beyond remedial mathematics.

Quantitative Reasoning Part B (QR-B)

Description: A Quantitative Reasoning Part B course builds on the tools of college-level mathematics, computer science, statistics or formal logic that are acquired by achieving the Quantitative Reasoning Part A learning outcomes. Quantitative Reasoning Part B courses may be offered at any level, provided that the material challenges students to think critically and apply quantitative skills to develop models, interpret data, draw conclusions, and solve problems within a disciplinary or interdisciplinary context.

Quantitative Reasoning Part B Learning Outcomes: In the disciplinary or interdisciplinary context of a Quantitative Reasoning Part B course, students will:

- Manipulate quantitative information to create models, and/or devise solutions to problems using multi-step arguments, based on and supported by quantitative information.
- Evaluate models and arguments using quantitative information.
- Express and interpret in context models, solutions, and/or arguments using verbal, numerical, graphical, algorithmic, computational or symbolic techniques.

Quantitative Reasoning Part B Implementation Notes:

- Quantitative Reasoning Part B courses are offered for a minimum of 3 credits.
- Because the learning outcomes of Quantitative Reasoning Part B courses depend on Quantitative Reasoning Part A quantitative skills, prerequisites for Quantitative Reasoning Part B courses must include satisfaction of Quantitative Reasoning Part A, and these requisites must be enforced.

- For a course to be certified as a Quantitative Reasoning Part B course, the Quantitative Reasoning Part B content must be a substantive component of the course on which students are evaluated. Course content must directly address the Quantitative Reasoning Part B learning outcomes listed above, and application of quantitative tools and skills must be integrated into what students do to understand, analyze, and communicate about the main subject of the course.

Examples:

- "Quantitative Information" should not be narrowly defined to mean columns of data found in spreadsheets. Rather, courses that meet the criteria for Quantitative Reasoning Part B teach students to use quantitative information to make hypotheses, create logical arguments and conclusions and assess the reasonableness of such arguments. For example, in a Quantitative Reasoning Part B computer science course students may write computer programs to solve a problem, and they also evaluate their work by testing and "debugging" a program to determine if they have developed a functional model.
- Courses that do *not* satisfy the criteria for Quantitative Reasoning Part B courses include those that deal with quantitative information only in one or more of the following ways:

  - Students are given a model (equations, formulas, ...) and are merely required to produce a numerical or qualitative answer through routine calculations or symbolic manipulation.
  - Students are required to use a computer package to perform calculations or carry out a study without subjecting their results to critical analysis, comparing them to other numerical data, arriving at conclusions, predictions or inferences, and assessing their reasonableness.
  - Students are required to deal with quantitative information in primarily descriptive or conceptual ways. For example, courses in "research methods" that lack a substantial reasoning component based on tools covered in a Quantitative Reasoning Part A course would not be certified.

Assessment

As noted in the original documentation about Quantitative Reasoning Part A and B, assessment provides an opportunity to measure the degree to which the Quantitative Reasoning Part A and Quantitative Reasoning Part B courses meet the objectives for general education and those outlined for these QR requirements.

Departments with courses that have been approved as meeting the Quantitative Reasoning Part A or Quantitative Reasoning Part B requirement should expect to cooperate in efforts to assess student learning relativel to the goals of Quantitative Reasoning Part A and Quantitative

Reasoning Part B. These assessment activities will generally be undertaken on a representative sampling basis, using in a variety of outcomes assessments with regard to QR courses and the QR learning outcomes. Among the techniques that may be used will be embedded questions, portfolios, course exit interviews, senior exit interviews, and alumni surveys as well as other tools that may become available.