

Assessment of Majors/General Education Competency Template

Assessment of Quantitative Reasoning

Program/Department: Mathematical Sciences

Submitted by: Jennifer Wilson

Key Learning Outcomes: What should students be able to do AFTER completing this program? State learning outcomes simply and in measurable terms. Please limit the number of outcomes to five or fewer. If your department reports on General Education competency areas (writing, foreign language, quantitative reasoning, scientific reasoning), please use this form to report on those areas in a separately generated document.

The Department of Mathematical Sciences requires that students demonstrate they have acquired the skills to understand and solve problems given in quantitative terms. More specifically, students completing the general education requirement in mathematics should have the skills to:

- (*Conceptual Understanding*) - Identify a problem given in quantitative terms and demonstrate conceptual understanding of the problem;
- (*Strategy*) - Develop and carry out an appropriate strategy to solve the problem; and
- (*Communication*) - Effectively communicate the solution of the problem, including a demonstrated understanding that the solution reached is reasonable.

Please link learning outcomes to the College's Desired Accomplishments/Goals.

These skills comport with the College's stated goal that "teaching and learning at the University of Virginia's College at Wise are transformational experiences" by enabling students to continue to educate themselves (goal 1.1), assume responsibility of citizenship (1.2), and understand the value of education (1.5). In addition, the teaching and learning of these skills contributes to the accomplishment of goals 2.7 (the College offers nationally recognized science and technology programs, which have a strong foundation in the liberal arts) and 3.3 (the College continues to strengthen the quality of K-12 education in Southwest Virginia in partnership with local schools).

How will you assess how well your students are learning? List standards/performance indicators, etc., taking care to provide quantifiable means (for example, all students should earn a minimum 50% on exit exam; 65 % should earn a minimum 70%; with a rubric, indicate the scale used, the levels of competence, what is identified as "competent," and what constitutes competence for each outcome measure, what percentage of students you would expect to see at each level, etc.). Be sure to spell out criteria

The Department has established the following performance indicators and rubric to assess students' quantitative reasoning skills.

Performance Indicators:

- **Conceptual Understanding** - This indicator includes the ability to interpret a problem and determine essential information to develop a method or strategy for solving the problem. Evidence of conceptual understanding would be demonstrated through the ability to make connections between the problem situation, relevant information pertaining to the problem, the mathematical concepts relevant to the problem and logical responses to the problem.
- **Strategy** – This indicator includes the ability to demonstrate appropriate use and application of mathematical concepts. Evidence of proper procedure or method includes modeling the problem, supporting the model with appropriate justification, and modifying the procedure to address factors inherent with the given problem. Evidence of proper application includes the use of mathematical skills, often in combinations, coupled with clearly focused reasoning that leads to a correct solution of the problem.
- **Communication** – This indicator includes the ability to demonstrate understanding of the procedure or method applied to the solution of the problem as well as the ability to evaluate whether a solution is reasonable. Evidence of effective communication includes the fluency with which the student explains concepts and procedures used in the problem solving process and evaluation of the answer.

Conceptual Understanding
3. The student uses all relevant information to solve the problem. The student translates the problem into appropriate mathematical language The student’s answer is consistent with the problem.
2. The student captures the essence of the problem, but is unable to use relevant information to completely solve the problem. The student is able to make some connections between concepts related to the problem. The student’s answer is not completely related to the problem.
1. The student translates the problem into inappropriate mathematical language. The student uses incorrect procedures and methods, clearly demonstrating a lack of understanding of the concepts related to the problem.
Problem Solving Strategy
3. The student uses appropriate and insightful procedures and methods. The student applies mathematical principles correctly and precisely, and methods demonstrate insightful thinking. The student solves the problem correctly providing all supporting calculations and necessary verifications.
2. The student applies a method or procedure which is only partially useful. The student’s method or procedure is not fully executed and does not include supporting calculations and verifications. The student starts the problem with an appropriate strategy, but applies procedures or methods incorrectly.
1. The student applies an inappropriate method or procedure, resulting in an incorrect solution, or a correct solution is given without any support.
Communication

<p>3. The student uses mathematical language precisely and effectively communicates his/her thinking. The solution process is organized and includes strong support. The student verifies the solution is correct and reasonable and gives a complete response to the question.</p>
<p>2. The student uses terminology inconsistently or misuses appropriate terminology. The solution process includes some support, but explanations are unclear or not complete. The student checks the solution, but does not provide support that the solution is reasonable.</p>
<p>1. The student does not use appropriate mathematical terminology. The solution process does not include explanation or the student's explanations are not understandable and focused. The student fails to verify the solution and provides no support that the solution is reasonable.</p>

Rubric Scale: 3 – More than competent
2 – Satisfactory / Competent
1 – Unsatisfactory / Not competent

Through what courses/assignments will you ensure that all students have the opportunity to learn this? List key courses, capstones, internships, experiences, etc.

All students pursuing an undergraduate degree are required to complete 6 semester hours in mathematics as part of the general education core. The department believes this requirement contributes to the foundational development of formal quantitative reasoning skills, thus ensuring that all students have the opportunity to meet the key quantitative reasoning learning outcomes.

The courses most students complete to fulfill the general education mathematics requirement are two courses from the following: MATH 100: Introduction to Algebra (3 hrs), MATH 101: College Algebra (3 hrs), MATH 102: Finite Mathematics (3 hrs), MATH 111: Pre-calculus I (3 hrs), MATH 112: Pre-calculus II (3 hrs), MATH 118: Elementary Probability and Statistics (4 hrs), and MATH 204: Calculus I (4 hrs). A student may not receive credit for both MATH 100 and MATH 101, nor can a student receive credit for MATH 111 and one of MATH 100 or MATH 101; thus, all students must complete at least one course beyond MATH 100, MATH 101, or MATH 111. Therefore, the department designates MATH 102, 112, 118, and 204 as terminal courses for the general education requirement.

Please list all tools used for assessing student achievement (CRTs, MFTs, capstones, exit interviews, external reviews, etc.) and frequency of assessment.

Assessment of student achievement for the indicated quantitative reasoning outcomes will be carried out in the general education terminal mathematics courses as follows:

- Quantitative reasoning questions that are specific to the terminal courses for the mathematics general education requirement (MATH 102, 112, 118, and 204) will be included on the final exam in all sections of these courses. Two questions will be selected randomly from a question bank developed by members of the department for each terminal course.
- Evaluation committees, composed of members of the department, will be selected by the chair of the department for each of the terminal courses. The committees will evaluate student work using the rubric and an average score for the three performance indicators will be determined and student achievement will be ranked as follows:

How will you assess how well your students are learning? List standards/performance indicators, etc., taking care to provide quantifiable means (for example, all students should earn a minimum 50% on exit exam; 65 % should earn a minimum 70%; with a rubric, indicate the scale used, the levels of competence, what is identified as “competent,” and what constitutes competence for each outcome measure, what percentage of students you would expect to see at each level, etc.). Be sure to spell out criteria.

Average Score N	Rank
$2.5 < N \leq 3$	More than competent
$1.5 < N \leq 2.5$	Competent
$N \leq 1.5$	Unsatisfactory

The Department has established the following initial goals for performance standards:

- 65 % of students should earn an average score that ensures a competent rank.
- 15 % of students should earn an average score that ensures a more than competent rank.

Action Plan: What plans have you for the future based on the data gathered that will aim to improve student learning/achievement? Should students perform at less than the standard expected, what steps will the department take to improve their learning/performance? What steps does the department anticipate to improve the program otherwise?

The Department has also established the following plan of action to improve student achievement should the performance standards not be met:

- The Department will review the placement vehicle to ensure that students are beginning the mathematics sequence in an appropriate course.
- The Department will evaluate the quantitative reasoning questions to determine if the unsatisfactory performance level was due to an anomaly (e.g. the question was poorly worded or not appropriate for the given terminal course) in the question rather than student learning.

- The Department will review course content to determine if there is a correlation between unsatisfactory performance on particular questions (i.e. less than 65 % of students earn an average score that ensures a competent rank) and the emphasis on the tested concepts in the terminal courses. If such a correlation is found, the Department would realign course content to rectify the indicated deficiency in student performance.
- The Department is currently in the process of developing a terminal course for those students pursuing a degree other than mathematics, computer science, management information systems, software engineering, natural science or accounting. The course will be an applied mathematics course and will include topics from the foundations of applied mathematics with emphasis on problem solving and quantitative methods. The Department believes this course will further ensure that students have the opportunity to meet the key quantitative reasoning learning outcomes via means more relevant to their interests.
- The Department recently developed the MATH 111: Pre-calculus I and MATH 112: Pre-calculus II sequence for students who do not place in MATH 204: Calculus I, but are pursuing a degree within the departments of mathematical sciences or the natural sciences. The courses in this sequence were designed to ensure that students have the skills to successfully complete the calculus sequence and thus providing students the opportunity to meet key quantitative reasoning outcomes in a relevant context for their majors.