

GEORGE MASON UNIVERSITY
MASON CORE ASSESSMENT REPORT:
QUANTITATIVE REASONING
Spring 2013

The Mason Core (formerly General Education) program at George Mason University organizes courses of study into three main areas. *Foundation* courses build knowledge and skills to promote success in the major and in future pursuits; *core* courses introduce students to a breadth of subject matter and intellectual traditions; and *synthesis* courses encourage the integration of past learning and experiences, develop critical thinking skills, and prepare students for lifelong learning. Student learning outcomes for the Mason Core areas are created and assessed by faculty, primarily through the University Mason Core Committee. Results of assessment activities are reported to the faculty, the Mason community, and the State Council of Higher Education for Virginia (SCHEV) by the Office of Institutional Assessment.

The Quantitative Reasoning (QR) competency is a foundation-level requirement for Mason undergraduates. Students are required to take one 3-credit course from the approved list.

Learning Outcomes

The Quantitative Reasoning learning outcomes are:

1. Students are able to interpret quantitative information (i.e., formulas, graphs, tables, models, and schematics) and draw inferences from them.
2. Given a quantitative problem, students are able to formulate the problem quantitatively and use appropriate arithmetical, algebraic, and/or statistical methods to solve the problem.
3. Students are able to evaluate logical arguments using quantitative reasoning.
4. Students are able to communicate and present quantitative results effectively.

Under each learning goal, instructors teaching Math 106 and Statistics 250 have further defined course-specific learning objectives that align with the subject matter and the quantitative reasoning skills emphasized in these courses (available upon request).

Courses Approved for the Quantitative Reasoning Requirement, 2012-13 Catalog

MATH 106, or if the student has achieved an appropriate placement score on quantitative skills, one of the following: MATH 108, 110, 111, 113, 115, or 125; or STAT 250. (Students are assumed to have achieved satisfactory completion of the high school math required for admission.)

Previous Assessment

The Quantitative Reasoning outcomes were assessed in AY 2007-08 using a faculty-developed pre-post competency assessment exam. The assessment exam was administered to 844 students in MATH 106 in fall 2007 and spring 2008; and 641 students enrolled in STAT 250 in fall 2008. Analysis of results showed that on average, student scores improved significantly during the semester, increasing three points on a 10-point scale from the pre- to post-assessment.

In 2008-09, Mason adopted a course portfolio assessment process for all of the General Education categories. Courses in the respective categories are assessed on a six-year cycle, with adjustments in this schedule made as needed.

Data Collection and Assessment Process

The assessment of the Mason Core QR category was conducted in spring 2013 semester. Three courses were selected for assessment: MATH 106, MATH 108, and STAT 250. These courses were selected because they enrolled more than 70% of all students in QR courses for the target semester. A random sample of all sections was drawn, and twelve course sections were selected to participate in the assessment. See Appendix for course information.

Information sessions were conducted for course instructors in fall 2012, followed by individual consultations upon request. Each instructor was asked to create a course portfolio that consisted of a summary sheet, course syllabus, course map of activities and assessments, selected course assignments, samples of student work, and a brief narrative. The portfolios were due two weeks after the end of the semester, and were submitted via Blackboard. Nine of the twelve instructors submitted portfolios as requested.

Portfolio reviews were conducted in summer 2013. Reviewers were members of the University Mason Core Committee and subject-matter faculty who participated in a training session that covered the review process and criteria. Reviewers entered ratings and text into an online review form. Each portfolio was reviewed twice by independent reviewers.

- Total number of Mason Core QR courses offered in review period: 7 courses (**45** sections) across 2 colleges/academic units
- Total number of students enrolled: **2337**
- Total number of courses/sections selected for assessment: **12**
- Total portfolios collected: **9** portfolios representing 3 courses. The course instructors who created the portfolios taught a total number of **390** students (**16.7%** of the total QR course enrollment)
- Total reviewers: **6**
- Total student work samples reviewed: **62**

Results

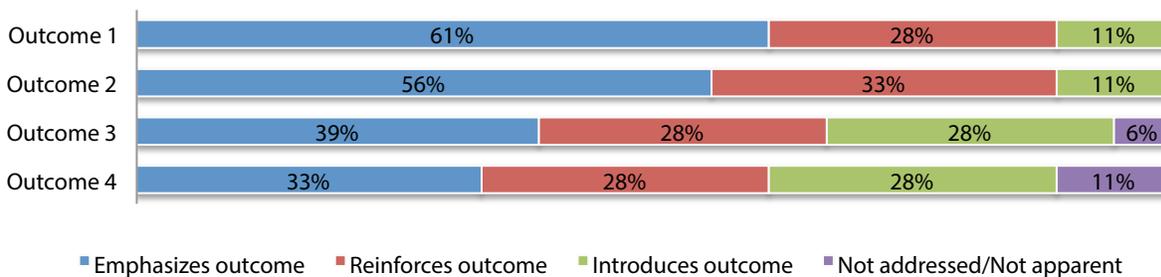
The course portfolio review focused on how well each course addressed the Mason Core student learning outcomes through instruction, assignments/activities, and samples of student work. Portfolios were assessed on how well the instructors articulated the learning outcomes, the congruence of the QR learning outcomes with the course content, the appropriateness of the course material for the Mason Core curriculum, and the appropriateness of the assignments or forms of assessment in relation to the QR learning outcomes. This section presents the aggregated results of the reviews in terms of the learning outcomes, the student work samples, and overall ratings.

Learning Outcomes

Using course materials, reviewers were asked to identify the level that each learning outcome was addressed in each course. “Introduces” indicates that students are introduced to the concept; “reinforces” indicates that students have had some experience with the concept and have opportunities to practice; “emphasizes” indicates that students have had sufficient practice and can now demonstrate mastery. Reviewers evaluated Outcomes 1 (interpret quantitative information) and 2 (formulate the problem) as being either emphasized (61% and 56%, respectively) or reinforced (28% and 33%, respectively) most frequently. Outcomes 3 (evaluate logical arguments) and 4 (communicate quantitative results) were evaluated as emphasizing, reinforcing, or introducing the identified concepts more evenly across the courses; these two outcomes were not addressed or not apparent in 6% (Outcome 3) and 11% (Outcome 4) of sections. Figure 1 illustrates the results.

The identification of levels in course content is important because it provides information about student preparation to instructors who use these courses as prerequisites. It also helps instructors gauge the appropriate level for constructing their course activities.

Figure 1. To what extent are the learning outcomes addressed in the course? (N=18)



Student Work Samples

Course instructors were asked to submit the instructions for three course assignments, projects, or exams. From the three assignments, instructors selected one and provided samples of student work. The Office of Institutional Assessment chose 4-9 students for each section by random selection, and instructors submitted one work sample for each student. Many instructors chose to submit an additional exemplar. A total of 62 work samples were collected. The work samples represented exams, homework assignments, and analysis projects.

Table 1 displays the frequency for which the learning outcomes were targeted in the selected assignments. Instructors were most likely to select assignments that emphasized Outcome 3, but most submitted final exams or projects that covered several, if not all of the learning outcomes.

Table 1. Intended outcome(s) addressed in the selected assignment

	Frequency as identified by the instructor
Outcome 1: Interpret quantitative information and draw inferences	7
Outcome 2: Formulate the problem and use appropriate methods	8
Outcome 3: Evaluate logical arguments using quantitative reasoning	9
Outcome 4: Communicate and present quantitative results	7

The reviewers judged that the assignments gave students the opportunity to demonstrate their competence in the intended outcomes “to a great extent” (69%) or “somewhat” (18%) (see Figure 2). In comparing the student work samples with the assignment instructions, reviewers determined that the work samples demonstrated the intended learning outcomes “completely” (16%) or “mostly” (50%), with another 24% performing “somewhat adequately” (see Figure 3 on page 4). Ten percent of work samples showed the outcomes “inadequately.” Overall, student work samples effectively demonstrated achievement of the intended learning outcomes.

Figure 2. To what extent does the assignment give students the opportunity to demonstrate their competence in the intended outcome(s)?

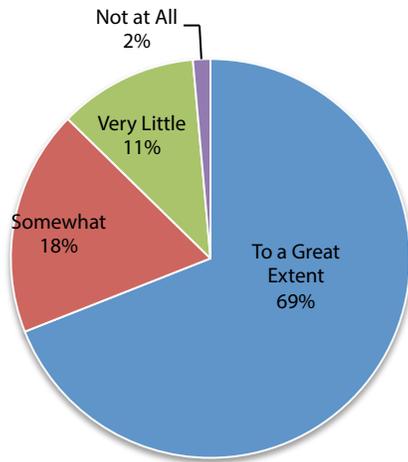
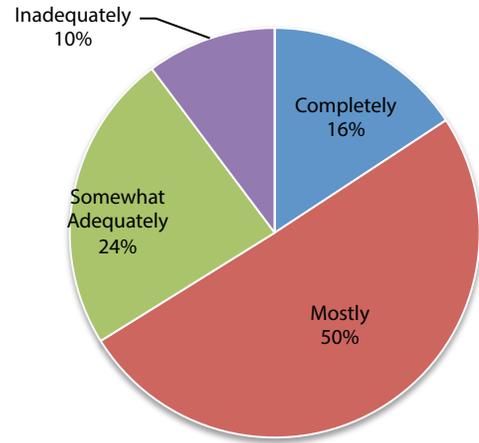


Figure 3. How fully do the student work samples manifest the intended outcomes?



Overall Ratings

Course portfolios were rated holistically in five categories in relation to the Mason Core QR learning outcomes (see Figure 4). Courses were most likely to rate “outstanding” (53%) or “good” (47%) in terms of appropriateness of course material for the Mason Core curriculum, and course structures and procedures (53% “outstanding” and 47% “good”). Courses seemed to face the most challenges in articulating the learning outcomes to students, although the majority (55%) were rated as “outstanding” or “good.” In terms of the overall effectiveness of the course in addressing the QR learning outcomes, 41% were rated “outstanding,” 47% “good”, and only 12% were rated “fair” (see Figure 5 on page 4). The QR courses rated quite highly overall.

Figure 4. Given the mission of the Mason Core program, please rate the course in the following categories:

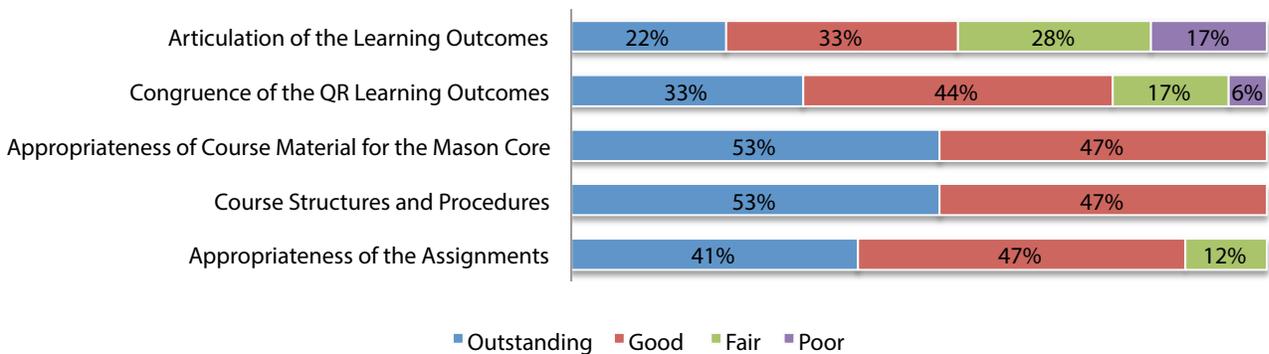
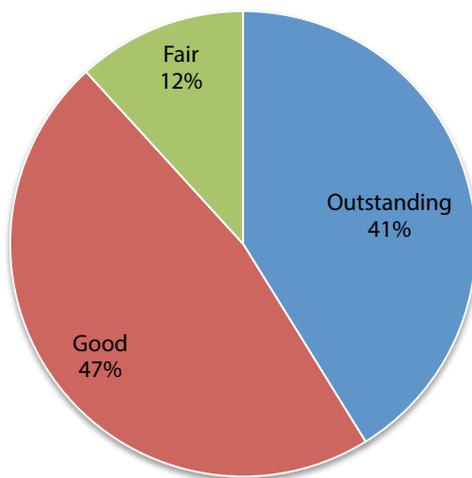


Figure 5. Overall effectiveness of the course in addressing QR learning outcomes



Summary of Faculty Narratives

A key component of the course portfolio is the narrative, in which faculty are asked to discuss their experiences in the course in regard to the student learning outcomes, student learning in the course, unexpected findings, and assessment of learning outcomes. The narrative also addressed the course context, challenges or issues, experimentation or changes that faculty implemented, and the results of those changes.

Most instructors believed that it was beneficial to work with the Mason Core learning outcomes while teaching their courses. Most reported that the outcomes provided a structure on which to plan their learning activities, especially those for students who are not oriented towards mathematics or statistics (non-majors). One instructor said that the outcomes “broadened my perspective a bit,” and another observed, “Being mindful of the course’s quantitative reasoning learning outcomes while preparing to teach and assess students allowed me to produce clearer lectures and assignments.” A few instructors identified additional outcomes that were emphasized in the course, such as critical thinking, information literacy, and mastering information technology. STAT 250 instructors focused on application as a way of reinforcing the course skills.

Instructors used a variety of strategies to help students learn, including multiple kinds of assignments that went well beyond quizzes and exams. All of the courses required graded homework assignments that allowed students to learn from different perspectives. One instructor assigned newspaper articles on mathematics. STAT 250 required a series of “Mini-tabs” projects that gave students practice in analyzing data and reporting results in a structured format. To counter test anxiety, one instructor used open note exams and allowed students to review old exams. Faculty also encouraged students to ask questions in class, and facilitated some group activities so that students could learn from their peers. Many instructors encouraged the use of learning technology like MyMathLab to help students learn in a different way, although one instructor observed that students might leave with an unfavorable perception of mathematics after using it—one that is more based in simply solving equations and not one about using quantitative reasoning to think critically.

There are some common challenges to teaching mathematics and statistics courses in general education. The primary issues that faculty noted were student anxiety with math and the motivation to persist with the courses. Instructors gave students pep talks, and tried to encourage open communication about the kinds of problems students were having. One instructor believed that she was able to reduce anxiety by using informal, ungraded assessment strategies so that she could check in more often with how students were doing. Students in some of the

classes were also able to take practice exams, and walk through their errors step-by-step. Several instructors provided opportunities for students to review their quizzes and exams. Instructors with large enrollments expressed frustration about the limitations of teaching and assessing learning in the large classes.

In thinking about how to improve their courses, instructors had plans for future semesters, including the following:

- Provide more online learning materials, like videos and commercial technology
- Continue to offer group learning projects
- Use more concrete examples of how math and statistics are used to understand real-life issues, such as prevalence and probability of disease
- Emphasize communicating results in written and visual forms
- Implement a peer review process for individual work
- Continue to use or begin using the services of undergraduate learning assistants (LAs) provided by the College of Science

Summary of Reviewers' Comments

Reviewers were given an opportunity to comment on features of the courses and provide recommendations. This section displays summaries of the reviewers' comments.

What elements/features from the course would you recommend to other faculty who teach QR courses?

- Reviewers praised the variety of assignments with multiple opportunities to learn, as well as assignments that are relevant to Mason Core students, and used examples with real-life applications.
- Assessments given at the beginning of the semester helped instructors learn how well prepared students were for the course content, and helped them to adjust their plan of instruction.
- Students learn best when they are given the opportunity to work on problems until they get them right, and are able to articulate why they got it right. The opportunities to practice lead to mastery.
- Faculty used creative activities that were interesting and engaging, even sometimes entertaining.
- Homework projects that encourage students to engage in application are a “simple but effective” way to help students learn the course concepts.

In terms of addressing the intended QR learning outcomes, what suggestions would you give to the faculty member?

- Faculty are asked to include the full Mason Core learning outcomes on the course syllabus, and not just the statement that the course meets a Mason Core requirement. The syllabus should also help students understand how the learning activities in the course map to the outcomes. Reviewers suggested that a “stronger connection” needs to be made between course activities and the learning outcomes.
- Faculty are encouraged to be thoughtful about how the course balances all of the learning outcomes, and make sure that the course is designed to help students meet all of them. Learning outcome 4 (Students are able to communicate and present quantitative results effectively) was specifically addressed as a weak point in some of the sections.

General Comments:

- “The instructor has covered all four learning outcomes in the course and is doing an excellent job of engaging students through the use of practical engaging problems.”
- “I thought it was a great course overall. Very realistic and applicable to real-world situations the students would encounter. I appreciate the fact the instructor attempts to do a pre-course assessment of the level of the student's knowledge.”
- “I am concerned that there was considerable discrepancy in the grading scales and expectations and perhaps the dept./instructors could discuss this.”
- “From a General Education perspective, this is an excellent course. It deals with the desired Gen Ed outcomes and -- at least based on the one sample exam offered - explores relevant concepts and tests students on these concepts.”
- “This course provides very good coverage of the Gen Ed learning outcomes. If there is a weakness it is probably in Outcome 4 -- communicating and presenting results. While there may be opportunities for students to do this in the course, the syllabus and sample exam did not provide much support for this outcome.”
- Reviewers were also concerned about how the outcomes were written, observing that their interpretation may be different from that of the faculty teaching the course. Assessing the effectiveness of the course was challenging in this respect.

Follow-Up Actions

This report, as well as individual course reports will be shared with participating instructors and department chairpersons to address the issues and concerns that were revealed in the assessment process. Course development resources will be made available to support instructors in their efforts to better align their courses with the Mason Core outcomes. Exemplars will be made available to the university community with instructor consent.

APPENDIX

Mason Core Quantitative Reasoning Courses Offered in Spring 2013

Course	Title	Enrollment	% of Total Enrollment	# Portfolios
College of Science, Mathematical Sciences				
MATH 106	Quantitative Reasoning	560	24.0%	5
MATH 108	Intro Calc: Business Applications	356	15.2%	1
MATH 110	Introductory Probability	52	2.2%	NA
MATH 111	Linear Math Modeling	64	2.7%	NA
MATH 113	Analytic Geometry/Calculus I	407	17.4%	NA
MATH 125	Discrete Mathematics I	167	7.1%	NA
Volgenau School of Engineering, Statistics				
STAT 250	Introductory Statistics I	731	31.3%	3
TOTAL		2337	100%	9

"NA" = These courses were not asked to produce a portfolio for this assessment cycle.

Portfolio Review Worksheet

MASON CORE: QUANTITATIVE REASONING

The quantitative reasoning learning outcomes are:

1. Students are able to interpret quantitative information (i.e., formulas, graphs, tables, models, and schematics) and draw inferences from them.
2. Given a quantitative problem, students are able to formulate the problem quantitatively and use appropriate arithmetical, algebraic, and/or statistical methods to solve the problem.
3. Students are able to evaluate logical arguments using quantitative reasoning.
4. Students are able to communicate and present quantitative results effectively.

Under each learning goal, instructors teaching Math 106 and Statistics 250 further define course-specific learning objectives that align with the subject matter and the quantitative reasoning skills emphasized in these courses.

Course: _____

Reviewer: _____

1. To what extent are the above learning outcomes addressed in the course?

	Instructor Intent (I, R, E)	Emphasizes Outcome	Reinforces Outcome	Introduces Outcome	Does not Address/ Not Apparent	Not Enough Information
Outcome 1		3	2	1	0	IN
Outcome 2		3	2	1	0	IN
Outcome 3		3	2	1	0	IN
Outcome 4		3	2	1	0	IN

"Introduces" (I) indicates that students are introduced to the concept.

"Reinforces" (R) indicates that students have some experience with the concept and have opportunities to practice.

"Emphasizes" (E) indicates that students have had sufficient practice and can now demonstrate mastery.

2. Evaluate the following based on the selected assignments and student work samples. Evidence may also be found in the syllabus, course map, and reflective statement. Do not re-grade student work.

Use the table below to answer the following questions:

- a) Intended outcome(s) addressed in the selected assignment (Check all outcomes that apply under "Instructor Intent".)
- b) To what extent does the assignment give students the opportunity to demonstrate their competence in the intended outcome(s)?

	Instructor Intent	To a Great Extent	Somewhat	Very Little	Not at All	Not Enough Information
Outcome 1		3	2	1	0	IN
Outcome 2		3	2	1	0	IN
Outcome 3		3	2	1	0	IN
Outcome 4		3	2	1	0	IN

c) How fully do the student work samples manifest the intended outcomes? (Ignore the instructor's grade and related comments.)

Student Name or Work Sample #	Completely	Mostly	Somewhat Adequately	Inadequately	Unable to Judge
Self-Selected Exemplar (optional)	4	3	2	1	<input type="checkbox"/>
#1	4	3	2	1	<input type="checkbox"/>
#2	4	3	2	1	<input type="checkbox"/>
#3	4	3	2	1	<input type="checkbox"/>
#4	4	3	2	1	<input type="checkbox"/>
#5	4	3	2	1	<input type="checkbox"/>
#6	4	3	2	1	<input type="checkbox"/>

3. Given all available evidence, rate the course overall in the following categories:

	Outstanding	Good	Fair	Poor	Not enough info
Articulation of the Mason Core learning outcomes for students	4	3	2	1	IN
Congruence of the Mason Core learning outcomes with the course content and goals	4	3	2	1	IN
Appropriateness of course material for the Mason Core curriculum	4	3	2	1	IN
Course structures and procedures that contribute to the likely achievement of the Mason Core outcomes by students	4	3	2	1	IN
Appropriateness of the assignments or forms of assessment, in relation to the Mason Core learning outcomes	4	3	2	1	IN
Overall effectiveness of the course in addressing Mason Core learning outcomes	4	3	2	1	IN

4. What elements/features of the course would you recommend to other instructors?

5. In terms of addressing the Mason Core learning outcomes, what suggestions would you give to the instructor?

6. To what extent does the course portfolio demonstrate an exemplary Mason Core course?

- Definitely Yes
 Probably Yes
 Probably Not
 Definitely Not

7. Other comments about the course or the review process: