Mason Core Assessment: Quantitative Reasoning
Spring 2025

Quantitative Reasoning (QR) courses develop students' ability to apply mathematical and statistical concepts to analyze and interpret data, recognize patterns and relationships, and evaluate problems, enabling informed decision-making across personal, academic, and professional contexts.

Student Learning Outcomes (SLOs)
1. *Interpret Quantitative Information*: Students will be able to interpret quantitative information (i.e., formulas, graphs, tables, models, and schematics) and draw inferences from them.
2. *Formulate a Problem Quantitatively*: Students will be able to formulate a problem quantitatively and use appropriate arithmetical, algebraic, and/or statistical methods to solve the problem.
3. *Evaluate Logical Arguments*: Students will be able to evaluate logical arguments using quantitative reasoning.
4. *Communicate Quantitative Results*: Students will be able to communicate and present quantitative results effectively.

Assessment Method
Population
- Undergraduate degree-seeking students enrolled in QR courses during the 2022-2024 assessment period. 443 sections across 14 QR courses served 19,414 students (see Appendix A, Table 1 for the number of sections offered and students enrolled).
- Instructors teaching courses in this category were asked to submit 3 to 15 randomly selected student artifacts and indicate the relevant SLO(s) aligned with the assignment. In total, 122 course sections (28%) submitted 1,756 artifacts for assessment (see Appendix A, Table 2 for the number of artifacts submitted and assessed by SLOs).

Sample
- Student artifacts from the 2022-2024 assessment period were randomly selected using a process designed to ensure all learning outcomes and sections were represented.
- The final representative sample included 240 student artifacts across four QR SLOs (see Appendix A, Table 3 for the representativeness of the assessed sample).

Ratings
- Selected artifacts were evaluated by faculty raters using a standardized rubric (see Appendix A, Table 4 for the rubric).
- Each rater assessed about 40 artifacts, and final scores were determined through consensus among two or more raters (see Appendix A, Table 5 for the results).
- Descriptive analyses were conducted on the finalized scores to examine frequencies and determine the extent to which students demonstrated achievement of the learning outcomes.

Are students demonstrating achievement of the defined learning outcomes?
- Artifacts were rated as Capstone, Milestone, Benchmark, or No Evidence.
- Artifacts rated as Capstone, Milestone, or Benchmark were considered as meeting the learning outcomes.
- Artifacts rated as No Evidence were either:
    - No Evidence-Not Mapped: Artifacts not mapped to learning outcomes do not suggest students did not learn. However, the lack of mapping highlights the need for targeted faculty support to improve assignment alignment with learning outcomes.
    - No Evidence-Mapped: This finding suggests students did not meet the expectations of learning.
    - These findings suggest different approaches to improving both student learning and assessment processes.
- A baseline target of 70% was established in this round of assessment. Targets can and will be modified as both assessment processes and continuous improvement efforts are implemented.
- Figure 1 and Table 1 illustrate findings from the assessment of student artifacts for the four QR SLOs. The target of 70% was met for SLOs 1 and 2, but not for SLOs 3 and 4.

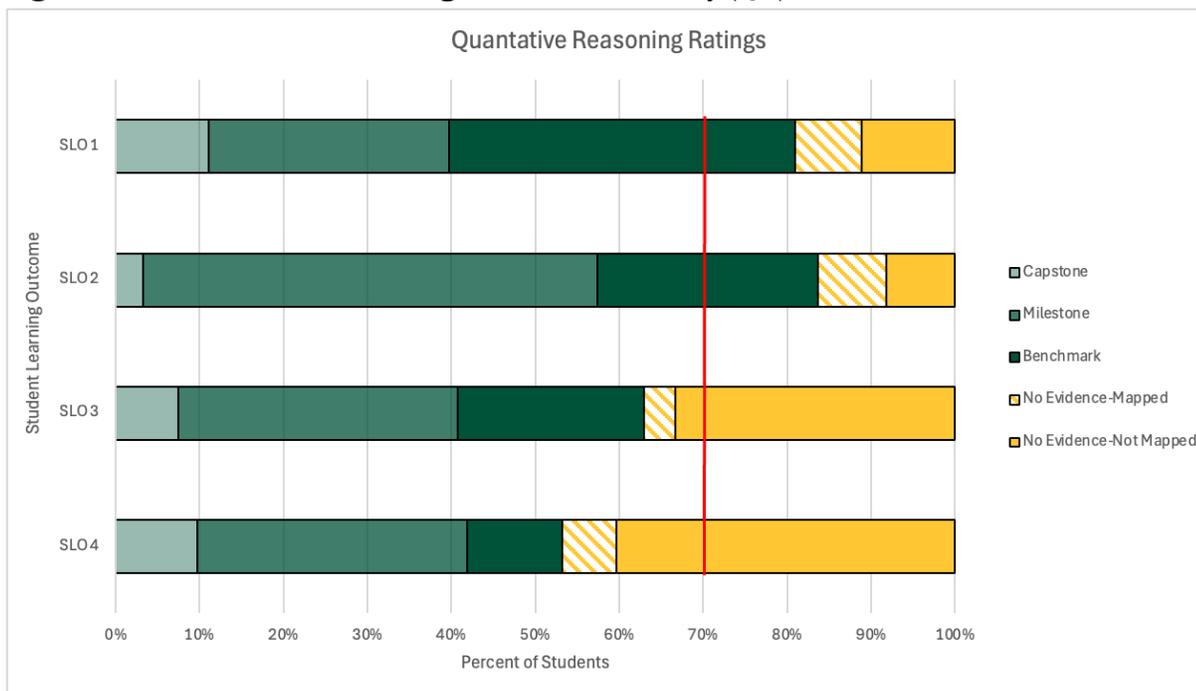**Figure 1.** Student Artifacts Ratings – Visual Summary (QR)

Table 1. Assessment Findings (QR)

Student Learning Outcome	Assessment Findings	Score
SLO 1: Interpret Quantitative Information	• 11% of artifacts showed no evidence of learning due to the assignments being not mapped to the learning outcome. • An additional 8% showed no evidence of learning.	81%
SLO 2: Formulate a Problem Quantitatively	• 8% of artifacts showed no evidence of learning due to the assignments being not mapped to the learning outcome. • An additional 9% showed no evidence of learning.	84%
SLO 3: Evaluate Logical Arguments	• 33% of artifacts showed no evidence of learning due to the assignments being not mapped to the learning outcome. • An additional 4% showed no evidence of learning.	63%
SLO 4: Communicate Quantitative Results	• 40% of artifacts showed no evidence of learning due to the assignments being not mapped to the learning outcome. • An additional 6% showed no evidence of learning.	53%

How has student learning changed since the previous assessment cycle?

The comparison of findings across the two assessment periods can be challenging given the modifications made from one cycle to another. Table 2 illustrates the revisions to the learning outcome statements and highlights the percentage of students meeting Benchmark or higher across both assessment periods.

Table 2. SLO Scores by Assessment Cycle

2022-2024 (n=240)	Score	2017-2020 (n=123)	Score
SLO 1: Interpret Quantitative Information	81%	**SLO 1: Interpretation**	92%
Students will be able to interpret quantitative information (i.e., formulas, graphs, tables, models, and schematics) and draw inferences from them.		Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).	
N/A		**SLO 2: Representation**	91%
		Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words).	
N/A		**SLO 3: Calculation**	97%
SLO 2: Formulate a Problem Quantitatively	84%	**SLO 4: Application/Analysis**	92%
Students will be able to formulate a given problem quantitatively and use appropriate arithmetical, algebraic, and/or statistical methods to solve the problem.		Ability to make judgements and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis.	
SLO 3: Evaluate Logical Arguments	63%	**SLO 5: Assumptions**	35%
Students will be able to evaluate logical arguments using quantitative reasoning.		Ability to make and evaluate important assumptions in estimation, modeling, and data analysis.	
SLO 4: Communicate Quantitative Results	53%	**SLO 6: Communication**	63%
Students will be able to communicate and present quantitative results effectively.		Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized).	

What changes do the findings suggest for continuous improvement?

- SLO 1
  - **Recommendation:** Continued focus on increasing student proficiency.
- SLO 2
  - **Recommendation:** Continued focus on increasing student proficiency.
- SLO 3
  - The learning outcome uses the verb *evaluate*, which may need to be redefined to ensure raters can identify clear evidence of learning.
  - **Recommendation:** Revise the learning outcome to capture student learning more effectively at both the course and category levels to ensure that the full scope of the learning is assessed.
- SLO 4
  - The learning outcome uses the verbs *communicate* and *present*, which may need to be clarified to ensure raters can identify clear evidence of learning.
  - **Recommendation:** Revise the learning outcome to capture student learning more effectively at both the course and category levels to ensure that the full scope of the learning is assessed.

Mason Core Action Plan: 2025-2027	
Quantitative Reasoning	
Rubric	By May 2025, revise the QR Mason Core Assessment rubric to improve clarity and usability by simplifying the proficiency level descriptions and eliminating redundant language, resulting in a version that is more accessible and user-friendly for both instructors and raters.
Learning Outcomes	By December 2026, revise the two learning outcomes (SLO 3 and SLO 4) where fewer than 70% of students meet the benchmark by revising multi-barreled language and ensuring the revised outcomes are clear, assessable, and achievable for a wide range of instructors and students.
Assignment Alignment	By May 2027, provide targeted support, including workshops and resource guides, to faculty teaching QR courses to improve assignment alignment with learning outcomes for the upcoming assessment cycle.

Appendix A. Quantitative Reasoning

Table 1. Course Sections and Student Enrollment (QR Fall 2022-Spring 2024)

	Course Name	Sections Offered	Students Enrolled
BUS 210	Business Analytics I	58	2,397
CDS 292	Introduction to Social Network Analysis	9	206
EDRS 220	Introduction to Applied Quantitative Analysis	9	125
MATH 106	Quantitative Reasoning	57	2,434
MATH 108	Introductory Calculus with Business Applications	27	1,687
MATH 110	Introductory Probability	10	377
MATH 111	Linear Mathematical Modeling	19	761
MATH 113	Analytic Geometry and Calculus I	114	4,764
MATH 115	Analytic Geometry and Calculus I (Honors)	14	149
MATH 124	Calculus with Algebra/Trigonometry, Part B	20	551
MATH 125	Discrete Mathematics I	34	2,426
MATH 272	Mathematics for the Elementary School Teachers II	2	29
SOCI 313	Statistics for the Behavioral Sciences	24	470
STAT 250	Introductory Statistics I	46	3,038
	TOTAL	**443**	**19,414**

Table 2. Artifacts Submitted and Assessed by SLO (QR)

	Submitted	Assessed
SLO 1	515	63
SLO 2	506	61
SLO 3	346	54
SLO 4	389	62
Total	1,756	240

Table 3. Student Demographics (QR)

Quantitative Reasoning: Demographics		Sample (n=240)		Population (N=19414)	
		n	%	N	%
Gender					
	Female	114	47%	8216	42%
	Male	126	52%	11182	58%
	Unknown	0	0%	16	0%
Race/Ethnicity					
	American Indian	2	1%	25	0%
	Asian American	48	20%	5005	26%
	Black	21	9%	2346	12%
	Hispanic American	34	14%	2726	14%
	White	81	34%	5664	29%
	Two or More Races	20	8%	1042	5%
	Non Resident Alien	24	10%	2032	10%
	Native Hawaiian/Pacific Islander	0	0%	8	0%
	Unknown	10	4%	566	3%
Domicile					
	In State	182	76%	15502	80%
	Out of State	58	24%	3912	20%
Level					
	First Time Freshmen	32	13%	5376	28%
	Other Freshmen	38	16%	4776	25%
	Sophomore	93	39%	4756	24%
	Junior	41	17%	3055	16%
	Senior	35	15%	1236	6%
	UG Extended Studies	1	1%	213	1%
	UG Certificate	1	1%	2	0%
College					
	Carter School for Peace and Conflict Resolution	2	1%	104	1%
	College of Visual and Performing Arts	8	3%	639	3%
	College of Public Health	6	2%	741	4%
	College of Science	44	18%	2328	12%
	Costello College of Business	54	22%	2876	15%
	College of Education and Human Development	20	8%	522	3%
	College of Engineering and Computing	55	23%	8143	42%
	College of Humanities and Social Sciences	43	18%	2929	15%
	Schar School of Policy and Government	4	2%	406	2%
	University (Provost)	4	2%	726	4%
Campus					
	Fairfax Campus	154	64%	13664	70%
	Mason Square	0	0%	83	0%
	Mason Korea	15	6%	1059	5%
	Loudon Campus	6	2%	16	0%
	Online	65	27%	4426	23%
	Prince William Campus	0	0%	166	1%
	Science and Technology Campus	0	0%	0	0%
First Generation					
	Yes	32	13%	3873	20%
	No	195	81%	14110	73%
	Unknown	13	5%	1431	7%
Housing					
	On Campus	80	33%	6365	33%
	Off Campus	160	66%	13049	67%
Load					
	Full Time	225	93%	17670	91%
	Part Time	15	6%	1744	9%
Pell					
	Yes	47	20%	5270	27%
	No	193	80%	14144	73%

Table 4. Rubric (QR)

Quantitative Reasoning	Capstone	Milestone	Benchmark	No Evidence
	3	**2**	**1**	**0**
SLO 1 Interpret Quantitative Information	Student provides accurate explanations of quantitative information presented in mathematical or graphical forms, and consistently draws inferences based on that information.	Student provides accurate explanations of quantitative information presented in mathematical or graphical forms, and mostly draws inferences based on that information.	Student provides explanations of quantitative information presented in mathematical or graphical forms, but sometimes makes minor errors related to computations or units.	There is no evidence that the student can interpret quantitative information and draw inferences.
SLO 2 Formulate a Problem Quantitatively	Student formulates a problem into quantitative or mathematical terms and uses appropriate methods to solve the problem accurately all of the time.	Student formulates a problem into quantitative or mathematical terms and uses appropriate methods to solve the problem most of the time.	Student formulates a problem into quantitative or mathematical terms some of the time, but may make errors in calculation.	There is no evidence that the student can interpret quantitative information and draw inferences.
SLO 3 Evaluate Logical Arguments	Student uses quantitative reasoning as the basis for constructing thoughtful judgments and produces strongly supported conclusions from this work	Student uses quantitative reasoning to analyze arguments and produces supported conclusions from this work.	Student uses quantitative reasoning to understand arguments and produces basic statements that are not fully supported conclusions from this work.	There is no evidence that the student can interpret quantitative information and draw inferences.
SLO 4 Communicate Quantitative Results	Student uses quantitative information to consistently communicate the results in an effective format so that the audience understands the results.	Student uses quantitative information to mostly communicate the results in an effective format so that the audience understands the results.	Student uses quantitative information to sometimes communicate the results in an effective format so that the audience understands the results.	There is no evidence that the student can interpret quantitative information and draw inferences.

Table 5. Student Artifact Ratings – Counts and Percentages (QR)

Quantitative Reasoning	Capstone		Milestone		Benchmark		No Evidence: Mapped		No Evidence: Not Mapped		Total
	n	%	n	%	n	%	n	%	n	%	n
SLO 1 Interpret Quantitative Information	7	11%	18	29%	26	41%	5	8%	7	11%	63
SLO 2 Formulate a Problem Quantitatively	2	3%	33	54%	16	26%	5	8%	5	8%	61
SLO 3 Evaluate Logical Arguments	4	7%	18	33%	12	22%	2	4%	18	33%	54
SLO 4 Communicate Quantitative Results	6	10%	20	32%	7	11%	4	6%	25	40%	62