

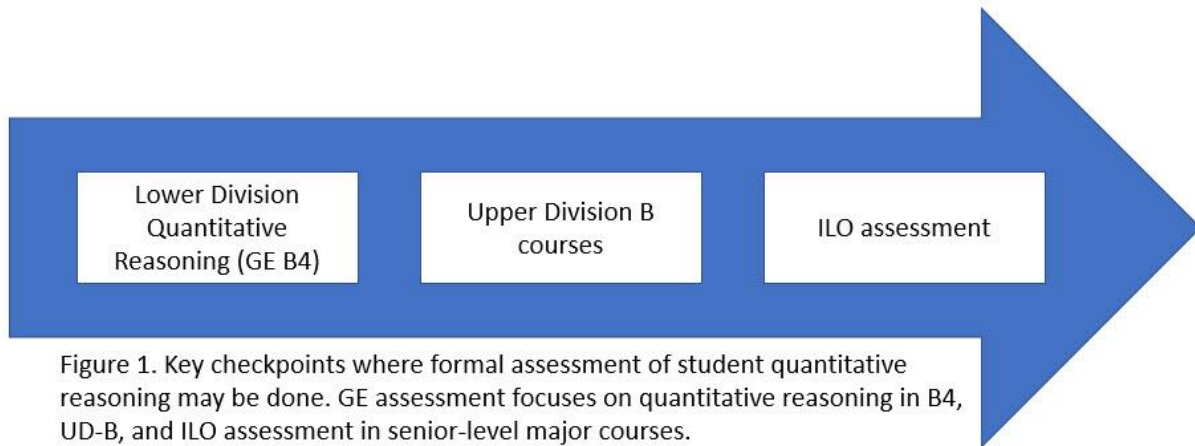
General Education Assessment of Student Learning: GE Area B4 Quantitative Reasoning

Purpose and Background

The overarching purpose of assessment in General Education (GE) is to enhance and improve undergraduate student learning experiences afforded by the GE program at Cal State East Bay. Looking beyond the CSU Chancellor's Office and WASC accreditation requirements which necessitate GE assessment ([EO 1100](#), Section 6.2.5), the true value of GE assessment extends from how we collaboratively make meaning of assessment results to inform improvements in GE.

GE learning outcomes are aligned to the [Institutional Learning Outcomes \(ILOs\)](#), [WASC Core Competencies](#), and [AAC&U's LEAP Essential Learning Outcomes](#), all of which express the knowledge, skills, and values CSUEB graduates are expected to attain. Collectively, CSUEB's GE learning outcomes and ILOs distinguish who we are, what we value, and how we expect students to demonstrate their learning. Thus, the assessment of GE outcomes enables our campus community to gauge how effective we are in helping our students attain these outcomes. The General Education Long-term Assessment Plan for 2018-2026 ([18-19 CAPR 2](#)) details a consistent, rigorous assessment process and necessitates the development of new assessment tools for each GE area.

GE Area B4 Quantitative Reasoning is part of the essential skills or core competencies (previously called the "Golden Four") that form the foundation for GE and major programs. Although assessment of core competencies at the foundational level is not explicitly required by WASC, robust and meaningful assessment of GE at key "checkpoints" (also known as guidepost assessment) is extremely valuable in informing improvements, which help move GE into a more coherent, intentional, and scaffolded program. Performing guidepost assessment of student knowledge allows us to gauge how well students develop the ability to reason quantitatively as they progress through their academic pathways. Such assessment checkpoints include MATH 115, STAT 100/101 and ILO assessment in senior-level major courses.



First-time freshmen at CSUEB are expected to attempt completion of GE Area B4 Quantitative Reasoning during their first year (EO 1110) and are required to pass the B4 course with a minimum C-/CR by the end of their sophomore year

B4 Learning Outcomes	<p>GE Area B4 courses provide practice in computational skills as well as engagement in more complex mathematical work.</p> <p>Upon completion of the GE Area B4 requirement, students will be able to:</p> <ol style="list-style-type: none"> 1. demonstrate a proficient and fluent ability to reason quantitatively; 2. demonstrate a general understanding of how practitioners and scholars collect and analyze data, build mathematical models, and/or solve quantitative problems; and 3. apply quantitative reasoning skills in a variety of real-world contexts, defined by personal, civic, and/or professional responsibilities.
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(EO 1100). Which math or statistics course (B4) pathway students take depends on two criteria: (1) math placement category (Categories I-IV), and (2) major or area of interest. For Category I students in STEM or Business, the major may require math/stat courses beyond the completed GE B4 requirement (See Fig. 1).

The Process

During Spring 2019, faculty members from the Department of Mathematics and the Department of Statistics and Biostatistics developed a scoring rubric for B4 assessment (Appendix I), which included four categories and four performance levels, each performance level with multidimensional performance descriptors. The rubric drew from the established goals/outcomes for GE Area B4 (see text box, right). Student work was collected in Fall 2019 and Fall 2020 in MATH 115 and STAT 100/101. Faculty members serving as B4 assessment evaluators convened to evaluate student work using Blackboard Outcomes. Faculty members met to “debrief” the assessment process, which informed minor revisions to the rubric and assignment (GE B4).

The Rubric

CSUEB GENERAL EDUCATION AREA B4 QUANTITATIVE REASONING RUBRIC

Description: Proficiency in quantitative reasoning at the B4 level is demonstrated by the use of interpretation, representation, calculation, and communication of quantitative information at the college level. B4 courses build upon, and add depth and sophistication to, the quantitative skills that are developed by the required high school curriculum—skills that are evaluated through CSU’s Multiple Measures Protocol (see p. 3 of [EO 1110 FAQs](#)) and are used to determine whether incoming freshmen across the CSU will require additional support in their B4 courses.

Framing Language: This rubric is used to assess established signature assignments, which are aligned to the rubric. The rubric dimensions described below are sequential in nature—a student must first interpret, then represent a method/approach prior to executing/calculating. Each dimension should be evaluated independently, because a student may, for example, make an error in the interpretation and/or development steps, but then correctly execute/calculate their chosen approach. Finally, communication should be demonstrated throughout the solution process, and therefore should be the last dimension assessed.

DIMENSION	PERFORMANCE DESCRIPTORS BY LEVEL			
	4	3	2	1
Interpretation <i>Identifies and organizes relevant information presented in quantitative forms, in order to decide on which approach to take</i>	Clearly identifies and effectively organizes relevant quantitative information, and uses a valid approach.	Adequately identifies and mostly organizes relevant quantitative information, and uses a valid approach.	Has multiple errors or gaps in the identification and organization of relevant quantitative information, or uses a flawed approach.	Does not identify and has little/no organization of relevant quantitative information, and/or uses an incorrect or inappropriate approach.
Representation <i>Converts relevant information into various quantitative forms</i>	Effectively converts relevant information into an appropriate quantitative form.	Mostly converts relevant information into an appropriate quantitative form.	Has multiple errors or gaps in the conversion of relevant information into an appropriate quantitative form.	Does not convert relevant information into an appropriate quantitative form.
Calculation/Application <i>Applies and executes their selected method to solve a quantitative problem</i>	Accurately applies and executes their selected method to solve a quantitative problem.	Makes minor errors in the application and execution of their selected method to solve a quantitative problem.	Makes significant errors in the application and execution of their selected method to solve a quantitative problem.	Fails to apply and execute their selected method to solve a quantitative problem.
Communication <i>Uses quantitative information to explain, justify, and/or summarize an argument</i>	Effectively uses quantitative information to clearly explain, justify, and/or summarize an argument.	Adequately uses quantitative information to acceptably explain, justify, and/or summarize an argument.	Inadequately or inconsistently uses quantitative information to explain, justify, and/or summarize an argument.	Fails to use quantitative information to explain, justify, and/or summarize an argument.

Development: This rubric was developed by faculty in the Departments of Mathematics and Statistics & Biostatistics on May 30, 2019.

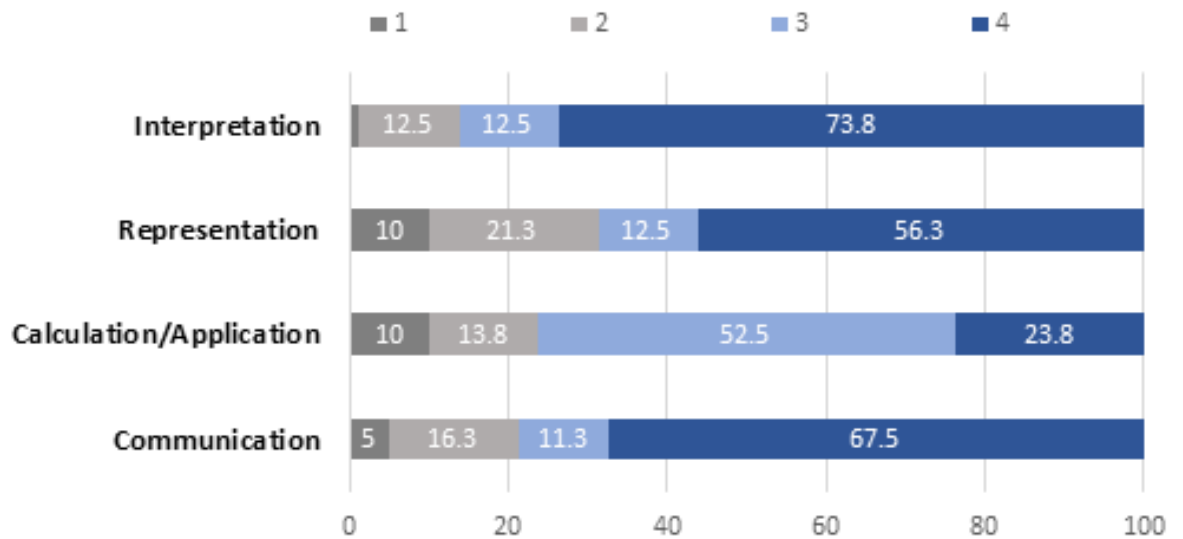
Here is a [direct link to the B4 Quantitative Reasoning Rubric](#).

Assessment results

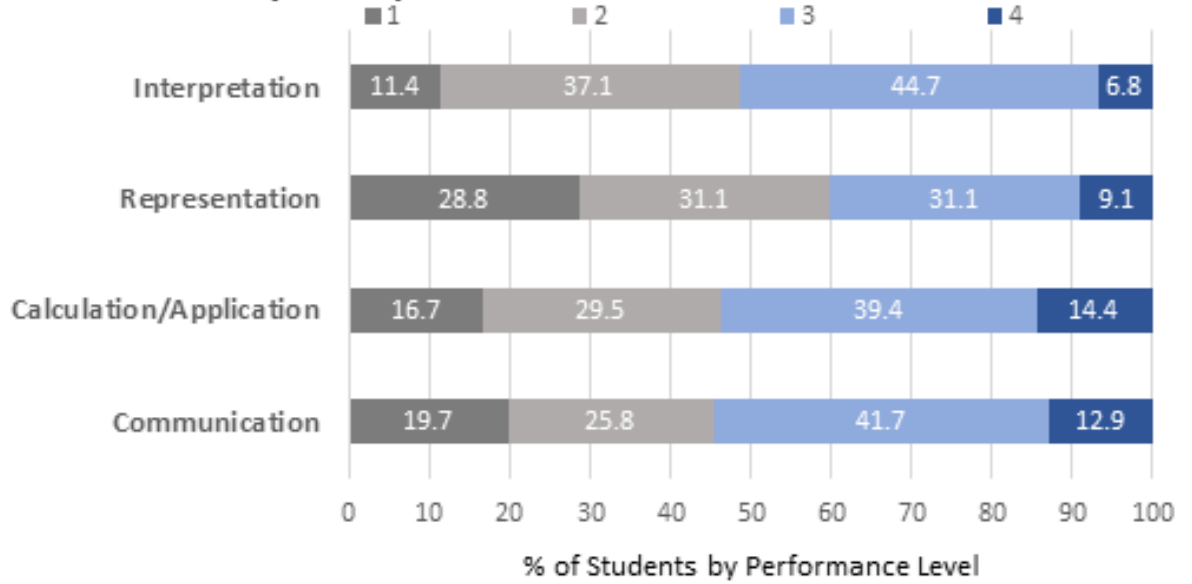
Data for Math 115:

MATH 2019 (N = 40)	% Students by Performance Level				%	
	4	3	2	1	Proficient	Inter-rater reliability
Interpretation	73.8	12.5	12.5	1.3	86.3	100.0
Representation	56.3	12.5	21.3	10.0	68.8	95.0
Calculation/Application	23.8	52.5	13.8	10.0	76.3	97.5
Communication	67.5	11.3	16.3	5.0	78.8	97.5
MATH 2020 (N = 66)	% Students by Performance Level				%	
	4	3	2	1	Proficient	Inter-rater reliability
Interpretation	6.8	44.7	37.1	11.4	51.5	60.6
Representation	9.1	31.1	31.1	28.8	40.2	83.3
Calculation/Application	14.4	39.4	29.5	16.7	53.8	84.8
Communication	12.9	41.7	25.8	19.7	54.6	74.2

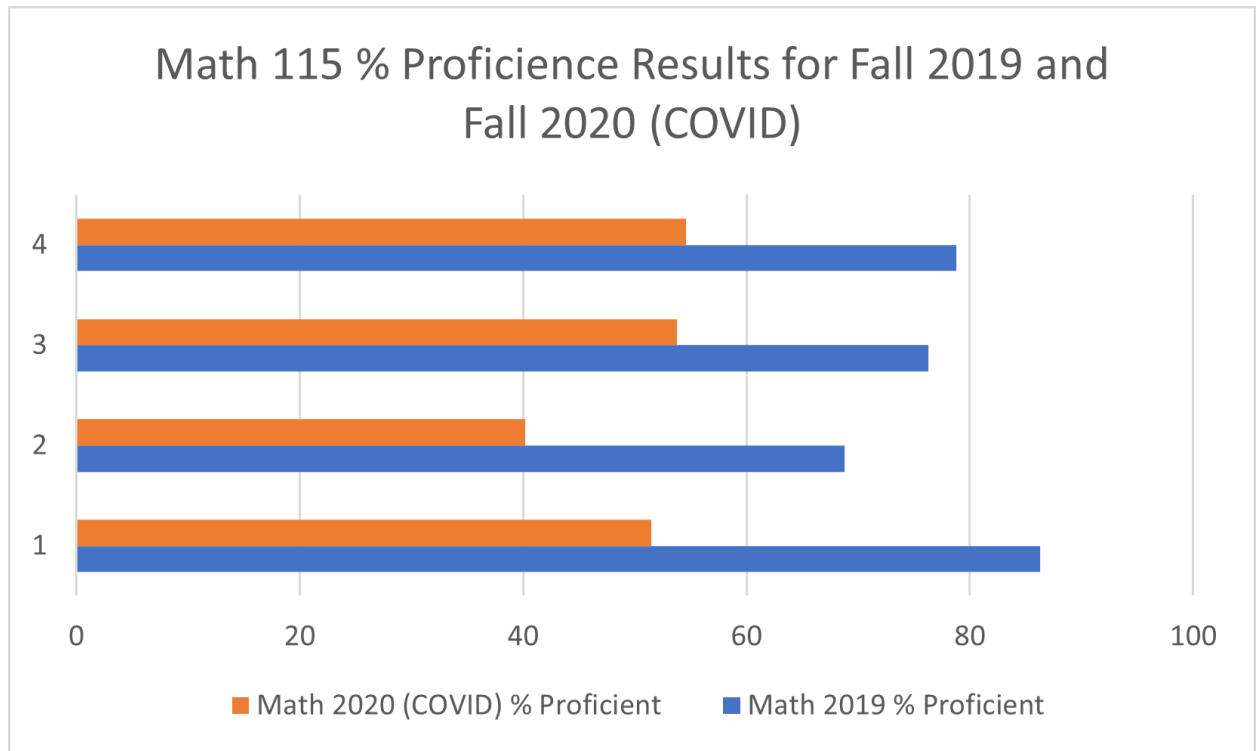
MATH 2019 (N = 40)



MATH 2020 (N = 66)



The following figure shows the proficiency differences in Math 115, Fall 2019 and Fall 2020 (COVID)



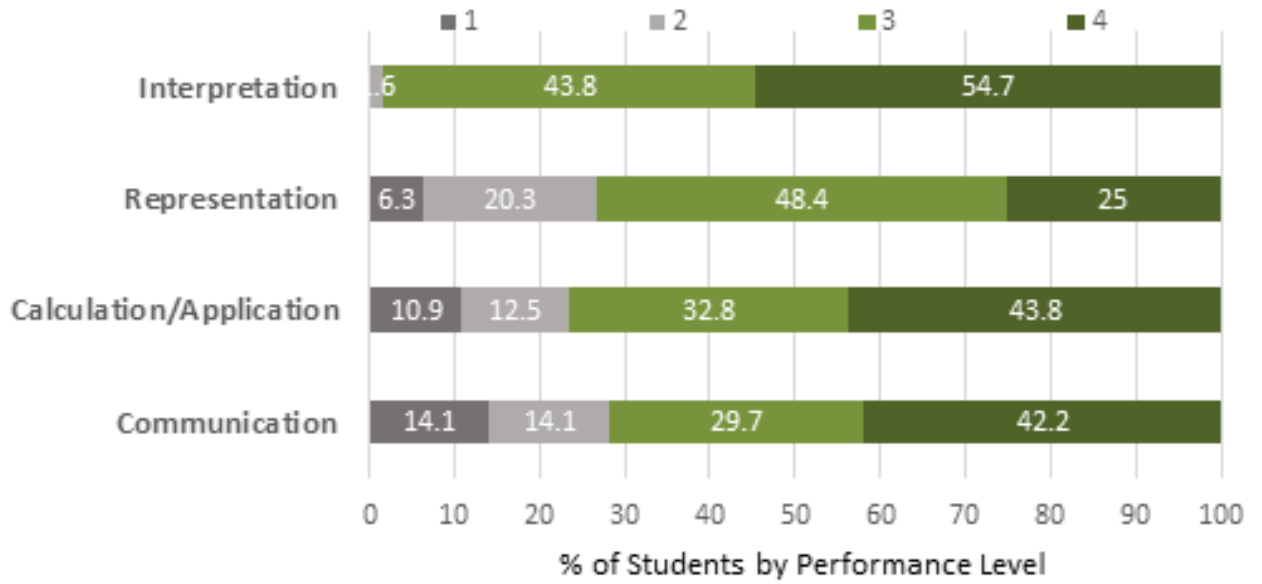
MATH 115 DFW rate for Freshmen on their first attempt at B4

	TOT ENROLL	% PASS (A,B,C,CR)	% NOT PASS (D,F,W,WU,I,NC)
Fall 2019	394	71	29
Spring 2020	92	73	27
Fall 2020	188	74	26
Spring 2021	29	38	62

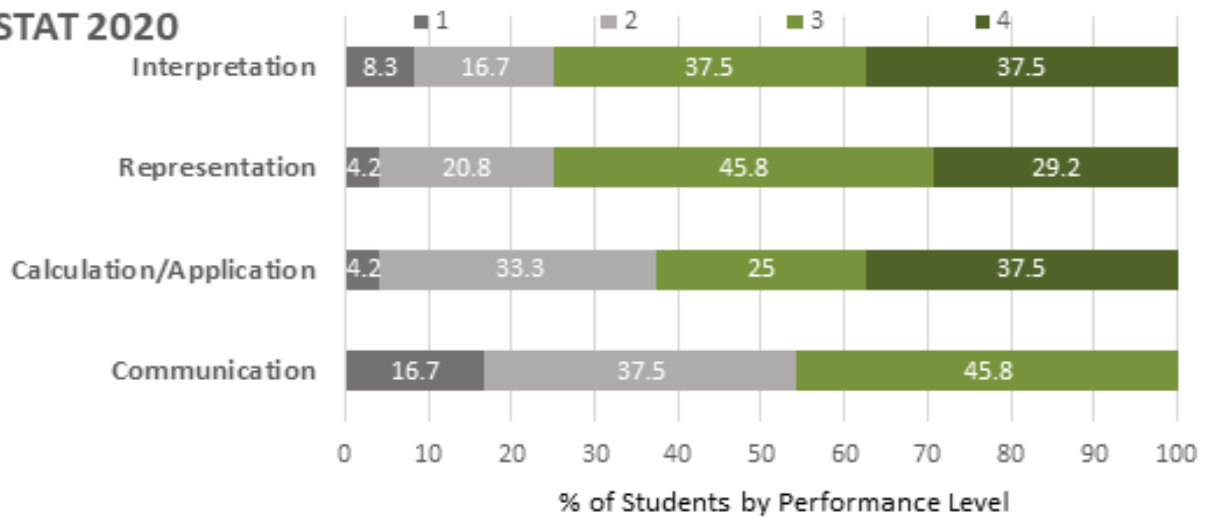
Data for STAT 100

STAT 2019 (N = 32)	% Students by Performance Level				%	
	4	3	2	1	Proficient	Inter-rater reliability
Interpretation	54.7	43.8	1.5	0.0	98.5	96.9
Representation	25.0	48.4	20.3	6.3	73.4	84.4
Calculation/Application	43.8	32.8	12.5	10.9	76.6	90.6
Communication	42.2	29.7	14.1	14.1	71.9	96.9
STAT 2020 (N = 12)	% Students by Performance Level				%	
	4	3	2	1	Proficient	Inter-rater reliability
Interpretation	37.5	37.5	16.7	8.3	75	66.7
Representation	29.2	45.8	20.8	4.2	75	66.7
Calculation/Application	37.5	25.0	33.3	4.2	62.5	41.7
Communication	0.0	45.8	37.5	16.7	45.8	41.7

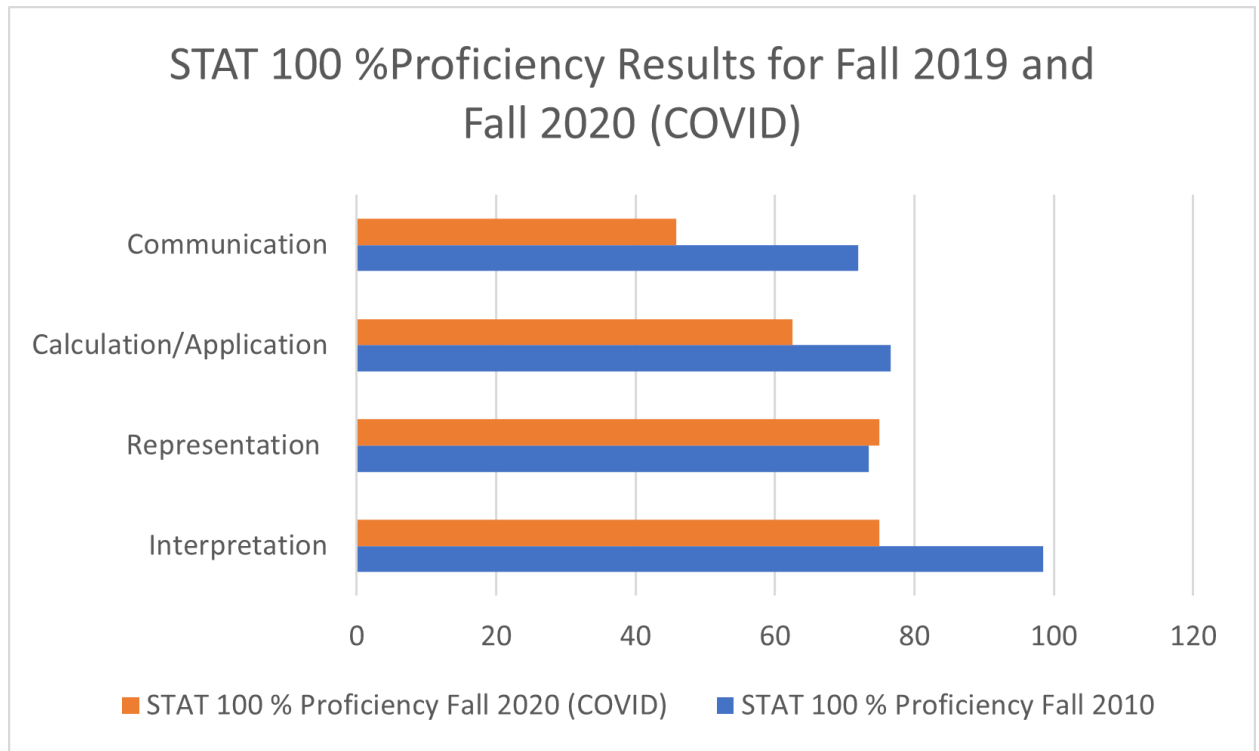
STAT 2019



STAT 2020



The following figure shows the proficiency differences in STAT 100, Fall 2019 and Fall 2020 (COVID)



STAT 100 DFW rate for Freshmen on their first attempt at B4

	TOT ENROLL	% PASS (A,B,C,CR)	% NOT PASS (D,F,W,WU,I,NC)
Fall 2019	404	79	21
Spring 2020	233	83	17
Fall 2020	429	81	19
Spring 2021	236	88	12

Competency occurs when the scoring is a 3 or above. The majority of students were competent across most of the rubric criteria, including interpretation, representation, calculation/application, and communication, at least during 2019. In Fall 2019 Representation was the area that MATH students scored lowest. In Fall 2019 Communication was the area that STAT students scored lowest. Ideally, inter-rater reliability should be 90% or higher. The calibration process involves individually scoring samples of student work and discussing different faculty perspectives and insights and is a good way to find common ground among faculty evaluators. For the 2019 pilot, the level of inter-rater reliability was between 84.4% and 100.0%. For the 2020 pilot the level of inter-rater reliability was between 41.7% and 84.8%. Additional calibration and discussion could improve inter-rater reliability during the next assessment (see Closing the Loop below).

Major differences between the Fall 2019 and Fall 2020 assessment findings for GE Area B4 Quantitative Reasoning may be attributed to impacts of COVID, and the resulting temporary

move to online delivery of MATH 115 and STAT 100. The data shows online delivery did not work for many students and it appears that GE Area B4 courses need to be taught in-person. Inter-rater reliability was 84.4% or higher for each of the criteria in the Fall 2019 assessment, but well below that level for the Fall 2020 assessment.

Differences between the Fall 2019 and Fall 2020 student metrics and assessments:

- a. Significant decrease in student enrollment in MATH 115 in Fall 2020.
- b. Marked decrease in student competency levels in MATH 115 and STAT 100 in Fall 2020.
- c. Low level of inter-rater reliability in Fall 2020.

Assessment Comments by Faculty

Scores for the Calculation/Application rubric criterion were higher than expected, as this is an area of challenge for many students. It would be interesting to analyze student data further to determine if there are equity gaps for this criterion or others.

The rubric and assignments used for assessment purposes should reflect what is actually happening in the classroom. If necessary, changes should be made to improve the authenticity of the rubric/assignments. The value of assessment is having conversations about the data and process and then implementing changes to improve student learning.

Closing the Loop

After the assessment, faculty were asked to give their feedback on the results and give comments about the process, results,

assignment, and how the results can impact future work. The faculty agreed with the rubric criteria and levels of achievement. They agreed that reviewing the rubric and assignment(s) prior to conducting another assessment would be beneficial to see if changes are needed. Involving other department faculty would enhance the discussion.

Additional calibration and practice evaluating student work is needed for future assessments. The process of having faculty evaluate samples of student work independently, and then discussing the results improves consistency of the scores. Faculty evaluators who are engaged in the process, and who focus on evaluation of student work using the B4 Rubric (rather than grading) are important for improving inter-rater reliability.



Next Steps

- Review the B4 Quantitative Reasoning Rubric and possible assignments for the next assessment.
- Additional calibration and discussion to improve inter-rater reliability during the next assessment.
- Explore pass rates and success of students in B4 courses in both MATH and STAT.
- Explore if equity gaps exist for each of the rubric criterion and how to address them.
- Continue to discuss ways to increase the alignment between GE and ILO rubrics.
- A mini retreat for B4 faculty could be scheduled in the future to further engage faculty from Math and Statistics in assessment. Sharing the rubric, assignments, and learning outcomes with faculty teaching MATH 115 and STAT 100 and making revisions as needed will lay the groundwork for future assessments. Reaching out to Community College faculty for Math about B4 learning outcomes and assessment may be valuable as well.
- Assessment of GE Area B4 Quantitative Reasoning should take place more frequently than every five years. In MATH 115 a concept map is being used for the final. If the concept map was used for assessment, it would be easier to ask all faculty teaching the course to use it.
- Other next steps are to revise B4 learning outcomes and develop course characteristics for B4 courses, with a focus on skill development.
- Departments and faculty who teach GE courses need to engage in discussions and actively work to reduce DFW/Equity gap percentages. The goal of the Graduation Initiative 2025 is to have a 0% equity gap in all courses.
- Discussions are needed on a broader level about General Education, to overhaul outcomes, criteria, and analyze what we really want to capture.

