Program-Level Assessment: Annual Report

Program Name (no acronyms): Mathematics

Department: Mathematics and Statistics

Degree or Certificate Level: BA/BS

College/School: College of Arts and Sciences

Date (Month/Year): September 2023

Assessment Contact: Julianne Rainbolt

In what year was the data upon which this report is based collected? 2022-2023

In what year was the program's assessment plan most recently reviewed/updated? AY 2021-2022

Is this program accredited by an external program/disciplinary/specialized accrediting organization or subject to state/licensure requirements? No

If yes, please share how this affects the program's assessment process (e.g., number of learning outcomes assessed, mandated exams or other assessment methods, schedule or timing of assessment, etc.):

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle? (Please provide the complete list of the program's learning outcome statements and **bold** the SLOs assessed in this cycle.)

The following is a complete list of our program's learning outcome statements. Assessment for the academic year 2022-2023 focused primarily on the outcomes that are in **bold**:

PLO #1: *Demonstrate conceptual competency in foundational areas of mathematics by developing problem solving skills and solving problems in these areas of mathematics.*

PLO #2: *Demonstrate an ability to write and comprehend mathematical proofs using both direct and indirect methods.*

PLO #3: *Demonstrate an ability to analyze data and perform appropriate statistical analyses.*

PLO #4: *Demonstrate an ability to write computer programs that implement mathematical or statistical algorithms.*

PLO #5: *Demonstrate an ability to communicate mathematical ideas and concepts both orally and in writing.*

PLO #6: *Demonstrate an understanding of at least one advanced, in-depth topic in mathematics or statistics.*

These PLOs are common to the B.A. and B.S. assessment plans and can be evaluated through student work on assignments, quizzes, tests or the final exam in various MATH and STAT courses.

2. Assessment Methods: Artifacts of Student Learning

Which artifacts of student learning were used to determine if students achieved the outcome(s)? Please describe the artifacts in detail, identify the course(s) in which they were collected, and if they are from program majors/graduates and/or other students. Clarify if any such courses were offered a) online, b) at the Madrid campus, or c) at any other off-campus location.

The primary source of data for this report consists of student performance on selected problems from various tests and assignments in a range of courses that contribute to the B.A. and B.S. programs. Each semester, the instructors for selected courses are asked to assess at least one program level learning outcome for their section(s). Instructors were given the flexibility to choose the topic assessed for their section(s). Generally, the choice of assessment problem(s) for a given program learning outcome will align with one of the course level learning outcomes.

This year the assessment was solicited using a Google Form. This form was shared with the St. Louis and Madrid faculty as well as instructors in the 1818 program. Madrid faculty have been fully engaged in this process since Spring 2017. Instructors in the 1818 program have been engaged in this process since Spring 2022.

The courses included in this process this year are as follows:

- MATH 1510 Calculus 1
- MATH 1520 Calculus 2
- MATH 2530 Calculus 3
- MATH 2660 Principles of Mathematics
- MATH 3120 Introduction to Linear Algebra
- MATH 3550 Differential Equations
- STAT 3850 Foundation of Statistics

3. Assessment Methods: Evaluation Process

What process was used to evaluate the artifacts of student learning, and by whom? Please identify the tools(s) (e.g., a rubric) used in the process and **include them in/with this report document** (please do not just refer to the assessment plan).

The assessed problems for each section are evaluated by the faculty member responsible for the section and each student is given a score on a 0-3 scale. The typical rubric for this evaluation is given below, although instructors have some flexibility to alter the rubric as necessary. In any case, each student is given a rating on a 0-1-2-3 scale.

Rubric for Final Exam Problem Assessment

3 – Student shows a mastery of the relevant material.
2 – Student shows competence, but not complete mastery of the material.
1 – Student shows a limited understanding of the material.
0 – Student shows no understanding of the material.

Students who achieve a “2” or “3” are deemed to have shown competence for the program learning outcome being assessed with respect to the chosen problem.

Instructors tabulate the scores for their section(s) and complete a form summarizing their findings and providing some background information about the assessment measure used. The completed forms are submitted via Google Forms and the results were later uploaded to a designated folder in the shared drive for archival purposes.

A natural goal for this type of assessment is that scores should fall primarily into the 2 and 3 categories of the rubric. However, the difficulty level of problems in mathematics and statistics can vary substantially even when the core content is identical, so it can also be expected that scores may, at times, fail to meet this expectation simply because the assessed problem is somewhat more difficult than many standard problems testing the same skill. However, by considering the data in aggregate across multiple sections for a single course, it is reasonable to expect that at least 60% of the students who take a given course will receive scores of 2 or 3.

4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off-campus site)?

Aggregate Data

The data for MATH 1510, 1520, 2530, 3120, and 3550 apply to PLOs #1 and #5. Recall that PLO #1 focuses on the development of a body of knowledge in mathematics, while PLO #5 deals with the effective communication of mathematical ideas in writing. The data for MATH 2660 is related to PLO #2, which involves the ability to write and understand both direct and indirect methods of proof. The data for STAT 3850 is related to PLO #1 and PLO #4, which involves the ability to implement statistical algorithms.

The 1818 program also falls under the Saint Louis University mathematical program. The 1818 results are being reported separately because the information may feed into different reports and because we wanted to see if there were any differences in student performance.

Results from 2021/22 and 2020/21 have been included for comparison.

Course	0	1	2	3	# students	% 2 or 3 scores	*2021/22 results*	*2020/21 results*
MATH 1510 - SLU	63	46	74	162	345	68%	*75%*	*82%*
MATH 1510 - 1818	14	35	99	222	370	87%	*85%*	*n/a*
MATH 1520 - SLU	33	24	65	98	220	74%	*59%*	*73%*
MATH 1520 - 1818	4	15	26	72	117	84%	*97%*	*n/a*
MATH 2530 - SLU	19	12	28	56	115	73%	*75%*	*72%*
MATH 2530 - 1818	0	0	4	13	17	100%	*100%*	*n/a*
MATH 2660 - SLU	5	5	10	22	42	76%	*58%*	*89%*
MATH 3120 - SLU	2	7	9	14	32	72%	*81%*	*93%*
MATH 3550 - SLU	12	18	45	54	129	77%	*86%*	*74%*
STAT 3850 - SLU	0	5	4	38	47	89%	*72%*	*89%*

Comments

The assessment form included a place for instructors to leave comments about student performance.

In Calculus I comments from St. Louis and Madrid campus instructors included:

- Students seem to understand the concept, but the problem mostly was to apply the implicit differentiation technique.
- Students have difficulties converting the given scenario into mathematical formulas.
- This semester students seem less prepared.

In Calculus I the 1818 instructors reported the following:

- I have enjoyed working with these students, they have performed at the level I expected and sometimes above the level I expected.
- Performance conformed to my expectations.
- Most of the students had the general idea. Several struggled with execution, and a few just had trouble with simplifying.

In Calculus II comments from St. Louis and Madrid campus instructors included:

- For some of them Calculus II was their first math college course and their background was insufficient.
- Good results on this skill. Most errors were with algebraic simplification to solve for y.

In Calculus II the 1818 instructors reported the following:

- This is about where things usually fall on the subject.

Comparison of SLU North Campus Versus SLU Madrid

Course	0	1	2	3	# students	% 2 or 3 scores
Math 1510 – SLU North Campus	56	36	64	144	300	69%
Math 1510 – SLU Madrid	7	10	10	18	45	62%
Math 1520 – SLU North Campus	23	20	52	86	181	76%
MATH 1520 – SLU Madrid	10	4	13	12	39	64%
Math 2530 – SLU North Campus	12	9	26	36	83	75%
MATH 2530 – SLU Madrid	7	3	2	20	32	69%
Math 3550 – SLU North Campus	9	13	20	41	83	73%
MATH 3550 – SLU Madrid	3	5	25	13	46	83%
STAT 3850 – SLU North Campus	0	5	4	29	38	87%
STAT 3850 – SLU Madrid	0	0	0	9	9	100%

Comparison of Large (capped at 50 students) Versus Small (capped at 30 students) Class Size

Results from 2021/22 have been included for comparison.

Course	0	1	2	3	# students	% 2 or 3 scores	***2021/22 results***
MATH 1510 – Large	28	13	37	78	156	74%	*88%*
MATH 1510 - Small	35	33	37	84	189	64%	*70%*
MATH 1520 - Large	12	10	24	31	77	71%	*62%*
MATH 1520 - Small	21	14	41	67	143	76%	*45%*

Exit Survey for Majors and Minors

The number of responses was small. The responses included 8 majors (4 primary and 4 secondary) and 5 minors.

- Of the majors, three indicated they were extremely satisfied with the overall program, four indicated they were somewhat satisfied, and one was dissatisfied.
- Of the minors all five indicated they were somewhat satisfied with the overall program.
- The secondary mathematics majors were pursuing degrees in biomedical engineering and computer science as their primary major.
- Minors were pursuing a major degree in engineering or computer science.
- Three of the minors were a mathematics minor and 2 were engineering mathematics minors.
- Suggested improvements included offering some applied research opportunities and make the intro courses more standardized.

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you? Address both a) learning gaps and possible curricular or pedagogical remedies, and b) strengths of curriculum and pedagogy.

I. General

Calculus II and Principles of Mathematics showed lower scores on the student learning outcomes in 2021-2022, but the scores have returned this year back to higher levels. Both Calculus I and Math 3120 scores are the lowest they have been over the past three years, although still at acceptable levels. It is unclear why this has occurred and will continue to be monitored. Calculus III, Math 3550 and STAT 3850 scores have been consistently high and stable.

II. Small (capped at 30 students) Versus Large (capped at 50 students) Classes in Calculus I and II

The student learning outcomes suggest students do slightly better in the large classes for Calculus I but better in the smaller classes for Calculus II. This seems to be a rather incomplete view, however. One concern is that the outcomes reported show only a very small cross section of all outcomes in a course and even when narrowed down to as short list (as we do) we have self-selected data sets. Another issue is the withdrawal rates in the courses. If we compensate for the number of students who withdrew and hence can be seen as not mastering the student learning outcomes, we obtain the following data set:

Course	W	0	1	2	3	Total	*% 2 or 3*	*2021/22 results*
MATH 1510 – Large	18	28	13	37	78	174	*66%*	*72%*
MATH 1510 - Small	11	35	33	37	84	200	*61%*	*60%*
MATH 1520 – Large	9	12	10	24	31	86	*64%*	*58%*
MATH 1520 - Small	15	21	14	41	67	158	*68%*	*34%*

The success rates after this adjustment are very similar between large and small class sizes and between Calculus I and Calculus II. Note, however, that there was a large fluctuate in degrees of success two years ago, indicating that this should continue to be tracked.

If we look at all Calculus I and Calculus II courses in the 2022-2023 academic year (not just the sample submitting assessment data), the following table shows the percentage of students withdrawing from Calculus I and II in large classes versus small classes as well as showing the percentage of students failing or withdrawing.

Course	Total Students	W	F	%W	%W or F
MATH 1510 – Large	309	24	31	8%	18%
MATH 1510 - Small	360	26	29	7%	15%
MATH 1520 – Large	86	4	9	5%	15%
MATH 1520 - Small	214	15	17	7%	15%

Note that the withdrawal rate and the failing plus withdrawal rates are similar when comparing Calculus I and II and comparing large and small classes. Some care should be taken when interpreting this data however as care is taken with the assignment of who teaches the large sections.

III. Courses to Pay Attention to in the Future

- We want to pay attention to Calculus I and II because of the impact on students. These are multi-section high enrollment courses.
- MATH 1510 Calculus. The outcomes show a 68% success rate (scores of 2 and 3) which is a lower success rate than the last two years. As this course is a prerequisite for several courses in the department a stronger showing in this course would be ideal.

IV. The 1818 Program

The data indicates students are doing very well in the dual credit program. The higher scores across the board in comparison to SLU St. Louis and Madrid students are likely due to the self-selection of the students, the relatively smaller class sizes and the extended time instructors have to go over the materials with their students.

V. Other

We have made a few curricular decisions recently that affect our majors and minors. These decisions are not based on student learning outcomes. They are the result of a more general assessment of the program and student need.

- We have implemented a new Calculus textbook and online homework system that will be phased in over the next three semesters for Calculus I, II and III.
- We are in our fifth year piloting a capstone course and have now adapted it to a Core Collaborative Inquiry course.

6. Closing the Loop: Dissemination and Use of Current Assessment Findings

A. When and how did your program faculty share and discuss the results and findings from this cycle of assessment?

This assessment report was sent to all regular faculty on September 12, 2023 in an email which also asked for feedback about the report. The department has an assessment committee that will meet during the Fall 2023 semester to discuss this report and the faculty comments received about the report. The committee will also discuss whether or not any changes are needed to how assessment is gathered. This committee consists of at least four regular faculty members and all faculty are welcome to attend the assessment committee meetings.

B. How specifically have you decided to use these findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies	• Course content • Teaching techniques • Improvements in technology • Prerequisites	• Course sequence • New courses • Deletion of courses • Changes in frequency or scheduling of course offerings
Changes to the Assessment Plan	• Student learning outcomes • Artifacts of student learning • Evaluation process	• Evaluation tools (e.g., rubrics) • Data collection methods • Frequency of data collection

Please describe the actions you are taking as a result of these findings.

- In recent years large sections with recitations were introduced first in Calculus I and then in Calculus II. This has had mixed success and needs to continue to be carefully monitored as above.
- A new Calculus I textbook and online homework system has been adopted to be used in Calculus I starting Fall 2023, Calculus II starting Spring 2024 and Calculus III starting Fall 2024. This was in response to the changing dynamics on how this material can most effectively be taught.

If no changes are being made, please explain why.

7. Closing the Loop: Review of Previous Assessment Findings and Changes

A. What is at least one change your program has implemented in recent years **as a result of previous assessment data**?

- Departmental exit surveys with graduating seniors over the last several years have included a number of requests for internship opportunities. This has led the Department to develop internship guidelines and, consequently, more students are pursuing for-credit internships.
- The number of large Calculus I and II sections offered has been reduced.
- A new textbook and online homework system for the Calculus sequence has been implemented.

B. How has the change/have these changes identified in 7A been assessed?

- Data has continued to be collected on exit surveys.
- A Google Form measuring the student success on specific questions on the final exam has continued to be collected.
- A comparison of success in large and small classes has been collected as described above.

C. What were the findings of the assessment?

- Official course numbers have been created for internships in mathematics and statistics. The enrollments are small.

Academic Year	STAT 3910	STAT 4910	MATH 5910
2022-2023	--	--	0
2021-2022	--	--	2

- Data regarding the success of students in large versus small calculus classes has been mixed and needs to continue to be monitored.

D. How do you plan to (continue to) use this information moving forward?

- Exit surveys from our majors and minors will continue to be collected.
- A Google Form collecting relative success on questions on the final exam will continue to be collected from Math 1510, Math 1520, Math 2530, Math 2600, Math 3120, Math 3550 and Stat 3850.

IMPORTANT: Please submit any assessment tools (e.g., artifact prompts, rubrics) with this report as separate attachments or copied and pasted/appended into this Word document. Please do not just refer to the assessment plan; the report should serve as a stand-alone document. Thank you.