SAINT LOUIS UNIVERSITY.

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 2022	Assessment Contact: Anneke Bart

In what year was the data upon which this report is based collected? AY 2021-22

In what year was the program's assessment plan most recently reviewed/updated? AY 2020-2021

Is this program accredited by an external program/disciplinary/specialized accrediting organization? No

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle? (Please list the full, complete learning outcome statements and not just numbers, e.g., Outcomes 1 and 2.)

Program assessment for the academic year 2020-2021 focused primarily on the following program student learning outcomes for the B.A. and B.S. programs:

- **PLO #1:** *Graduates will be able to demonstrate conceptual competency in foundational areas of mathematics by developing problem solving skills and solving problems in these areas of mathematics/statistics.*
- **PLO #2:** *Graduates will be able to demonstrate an ability to write and comprehend mathematical proofs using both direct and indirect methods.*
- **PLO #4:** *Graduates will be able to demonstrate an ability to write computer programs that implement mathematical or statistical algorithms.*
- **PLO #5:** *Graduates will be able to demonstrate an ability to communicate mathematical (or statistical) ideas and concepts both orally and in writing.*

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 and identify the course(s) in which they were collected. 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 as usual with the St. Louis and Madrid faculty. Madrid faculty have been fully engaged in this process since Spring 2017.

This year we also sent the assessment forms to our 1818 affiliated instructors.

The courses included in this process are as follows:

- STAT 1100 Introduction to Statistics (new in the assessment cycle)

- MATH/STAT 1300 Elementary Statistics with Computers (new in the assessment cycle)
- 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 as well as STAT 1100 and 1300 apply to PLOs #1 and #5. Recall that PLO #1 focuses on the development of a body of knowledge in mathematics (or statistics), while PLO #5 deals with the effective communication of mathematical (or statistical) 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 program. The result 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 2020/21 and 2019/20 have been included for comparison.

Course	0	1	2	3	# students	% 2 or 3 scores	*2020/21 results*	*2019/20 results*
STAT 1100 - SLU	11	18	34	49	112	74%	*n/a*	*n/a*
MATH/STAT 1300 - SLU	7	21	14	33	75	63%	*n/a*	*n/a*
MATH/STAT 1300-1818	10	12	39	89	150	85%	*n/a*	*n/a*
MATH 1510 - SLU	38	41	71	168	318	75%	*82%*	*78%*
MATH 1510 - 1818	28	72	152	400	652	85%	*n/a*	*n/a*
MATH 1520 - SLU	32	52	34	85	203	59%	*73%*	*77%*
MATH 1520 - 1818	1	2	21	90	114	97%	*n/a*	*n/a*
MATH 2530 - SLU	18	27	60	73	178	75%	*72%*	*77%*
MATH 2530 - 1818	0	0	5	9	14	100%	*n/a*	*n/a*
MATH 2660 - SLU	0	5	4	3	12	58%	*89%*	*100%*
MATH 3120 - SLU	1	5	7	18	31	81%	*93%*	*83%*
MATH 3550 - SLU	4	6	26	37	73	86%	*745*	*75%*
STAT 3850 - SLU	8	14	25	32	79	72%	*89%*	*n/a*

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
- It seemed like more than the usual number who were on the low end of math background and study skills
- Student background both in terms of mathematical concepts and study skills coming into the course were weaker than expected (presumably due to 1.5 years of pandemic learning).

In Calculus I the 1818 instructors reported the following
- Decent job by students, mostly arithmetic errors for several students.
- The most common error was students not interpreting the decreasing rate as a negative value when setting up the problem.
- The difficulty for my students is two-fold. Forgetting geometric formulas and struggling with implicit differentiation
- Results were better for me than in past years on this type of problem.

In Calculus II comments from St. Louis and Madrid campus instructors included
- It was a group with very different backgrounds. Some of them started barely knowing how to integrate a polynomial. Their performance on in-class tests was much better, but a comprehensive final exam that requires to show competence in many different outcomes was too much for them.

- It has been an extraordinarily weak course, with a poor background in Calculus I due to the pandemic (and online mode of delivery, probably)

In Calculus II the 1818 instructors reported the following

- I felt students were eager to understand content and worked diligently toward that goal. The college credit and grade were secondary to this, yet important motivation.

Comparison of large (capped at 50 students) versus small (capped at 30 students) class size

Please note that for Calculus II, one of the large sections includes the assessment of three outcomes (instead of the usual one outcome)

Course	0	1	2	3	# students	% 2 or 3 scores
MATH 1510- Calculus I - Large	7	4	16	62	89	88%
MATH 1510- Calculus I - Small	31	37	55	106	229	70%
MATH 1520- Calculus II - Large	22	38	24	75	159	62%
MATH 1520- Calculus II - Small	10	14	10	10	44	45%

Exit Survey for Majors and Minors

The number of responses was small. The responses included 4 majors (one primary and three secondary majors) and 6 minors.

- All of the responses indicated students are extremely satisfied with the overall program
- The secondary mathematics majors were pursuing degrees in data science, education and neuroscience as their primary major.
- Minors were pursuing a degree in STEM fields (4 out of 6) and business (2 out of 6)
- Three of the minors were a mathematics minor, while 2 were engineering mathematics minors, the remaining student received an actuarial mathematics minor.
- Suggested improvements included offering more statistics courses and a combinatorics course.

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you?

I. General

Calculus II and Principles of Mathematics show low scores on the student learning outcomes. Calculus II is generally considered a challenging course for students. Principles of Mathematics is a proof course. It is not clear what factors into the lower scores. There are many factors at play right now. The long term effect of the pedagogical challenges seen during the pandemic seems to have (at least temporarily) lead to a cohort of students who are not as well prepared as their cohorts from previous years. The mental health crises on campus may have had an effect on students as well.

II. Small (~30 students) versus large (~50 students) classes in Calculus I and II

The student learning outcomes suggest students do slightly better in the large classes. 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. The reported overall outcomes for Calculus I (ignoring class size) do show student performance dropping off slightly compared to the last two years.

Another issue is the drop rates in the courses. If we compensate for the number of students who dropped (estimated from the overall *drop: no drop* ratio of those respective sections over the academic year), and hence can be seen as not mastering the student learning outcomes we obtain the following set:

	W	0	1	2	3	Total	% 2 or 3 scores
MATH 1510- Calculus I - Large	19	7	4	16	62	108	72%
MATH 1510- Calculus I - Small	39	31	37	55	106	268	60%

Course	W	0	1	2	3	# students	% 2 or 3 scores
MATH 1520- Calculus II - Large	18	22	38	24	75	177	58%
MATH 1520- Calculus II - Small	15	10	14	10	10	59	34%

When considering the DFW rates for instance, the students are showing significantly increased DFW rates over the previous years. In Calculus I the DFW rate in large classes is almost 10 percentage points higher than in our standard size classes. It is difficult to determine what the exact cause is. We have many conflicting variables. These include later drop dates, the effects of the pandemic, different class sizes and faculty vs adjunct staffing in the courses.

The Spring of 2022 was particularly concerning when looking at class DFW rates.
MATH 1510 Calculus I (Cognos and final grades in Banner are the source of this data)

	GPA	DFW	Total # students
Total for Sp 2022	2.66	30.4 %	240
Large classes	2.69	34.3 %	140
Standard classes	2.62	25.0 %	100
Adjuncts	2.58	30.2 %	53
Faculty	2.68	30.5 %	187

MATH 1520 Calculus II (Cognos and final grades in Banner are the source of this data)

	GPA	DFW	Total # students
Total for Sp 2022	3.16	18.8 %	138
Large classes	3.42	8.2 %	49
Standard classes	3.00	24.7 %	89
Adjuncts	2.74	34.0 %	47
Faculty	3.36	11.0 %	91

In Calculus II students seem to do slightly better in the large classes, but again this is difficult to interpret because we cannot discount the effect of faculty assigned to the sections. In Calculus II we also see that faculty appear to assign higher grades (as opposed to adjuncts). Considering that final exams are cumulative and cover significant number of student learning outcomes this does suggest students have mastered the outcomes more thoroughly when taught by experienced faculty. The reported overall outcomes for Calculus II (ignoring class size) do show student performance dropping off compared to the last two years.

Additional Data for the MATH 1510 Calculus I and MATH 1520 Calculus II classes pulled from Cognos reports and class final grade records:

	Spring 2022			***Fall 2021***			***Spring 2021***			***Fall 2020***		
	N	***GPA***	***DFW***	***N***	***GPA***	***DFW***	***N***	***GPA***	***DFW***	***N***	***GPA***	***DFW***
MATH 1510	240	2.66	30%	328	2.89	23%	229	2.65	28%	320	3.03	20%
MATH 1520	138	3.16	19%	92	3.06	21%	129	2.89	13%	103	3.02	13%

Tableau Data indicates that pre-pandemic (Fall 2015 – Fall2019) the DFW rate for Calculus I was 18.5% and for Calculus II the DFW rate was 26.3%.

The data suggest that our students may benefit from smaller classes in Calculus I, while the faculty assigned in Calculus II may have the larger impact. Increasing success and learning in Calculus I may have a positive trickle-down effect in Calculus II. It is not clear we have the resources to put a plan like this in action.

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 2660 Principles of MATH. The outcomes are below 60% success (scores of 2 and 3)
- STAT 3850 Foundations of Statistics. We only have one other year of data, but it will be interesting to see what the success rate will be in the future.

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 and the extended time instructors have to go over the materials with their students.

V. Other

We've made a few curricular decisions recently that affect our majors & 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 discussed the rule that Calculus III needs to be taken at SLU, and have not changed our policy.
- We discussed the Actuarial Math Minor, and have not changed or removed the program.
- We've had an ongoing discussion about how students with MATH 3110 can substitute it for MATH 3120. Departmental guidelines were discussed to create a coherent policy.
- We implemented a new a 2+SLU transfer program for STLCC students to be SLU math majors
- We are in our fourth year piloting a capstone course and will adapt it to a Core Collaborative Inquiry course
- We created a new ABM program
- We continue to have regular meetings for calculus instructors. At the beginning of the semester the meetings are held weekly, later in the semester they are generally held bi-weekly. Issues related to pedagogy and student success are discussed.

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

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

The draft report was first shared with the chair and the members of the program and assessment report. The edited version based on that discussion was shared with the entire department and discussed at our department meeting in September.

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.

We will monitor the courses that showed the greatest reduction in students learning outcomes. A one-year data set is not enough to immediately implement plans for change. Even over multiple years, there are too many confounding variables to determine what changes might be implemented and if significant changes are even appropriate.

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 assessment data?

Departmental exit surveys with graduating seniors over the last several years have included numerous requests for internship opportunities. This has led the Department to develop internship guidelines and, consequently, more students are pursuing for-credit internships.

B. How has this change/have these changes been assessed?

The changes have not been officially assessed. We have kept tabs on the number of internships however.

C. What were the findings of the assessment?

Official course numbers have been created for internships in mathematics and statistics. The enrollments are small with a bias towards mathematics

Semester	STAT 3910	STAT 4910	MATH 5910
Spring 2022	--	--	1
Fall 2021	--	--	1
Spring 2021	--	--	--

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

We will continue to offer the internships and monitor enrollments.

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