SAINT LOUIS UNIVERSITY.

Program-Level Assessment: Annual Report

Program Name (no acronyms): Mathematics	Department: Mathematics & Statistics
Degree or Certificate Level: BA/BS/MA/PhD	College/School: Arts & Sciences
Date (Month/Year): August 2021	Assessment Contact: Anneke Bart
In what year was the data upon which this report is based collected? AY 2020-2021	
In what year was the program's assessment plan most recently reviewed/updated? AY 2020-2021	

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.*
- **PLO #2:** *Graduates will be able to demonstrate an ability to write and comprehend mathematical proofs using both direct and indirect methods.*
- **PLO #5:** *Graduates will be able to demonstrate an ability to communicate mathematical ideas and concepts both orally and in writing.*
- **PLO #4:** *Graduates will be able to demonstrate an ability to write computer programs that implement mathematical or statistical algorithms.*

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 and identify the course(s) in which these artifacts 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). Often, the instructors choose a topic from the course that will be assessed by each instructor; however, during AY2020-2021, instructors were given the flexibility to choose the topic assessed for their section(s). This decision was made to accommodate the wide variety of modalities and testing procedures in use. Generally, the choice of assessment problem(s) for a given program learning outcome will align with one of the course level learning outcomes.

The courses included in this process 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 (beginning in Spring 2021).

Madrid faculty have been fully engaged in this process since Spring 2017.

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** (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. In most cases, faculty members include or attach the text of the problem used for the assessment. The completed forms are submitted to the associate chair and 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)?

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.

Fall 2020 Data by Course:

Course	0	1	2	3	Pct. of 2/3
MATH 1510	11	11	38	109	87.0%
MATH 1520	4	17	13	42	72.4%
MATH 2530	13	21	36	54	72.6%

MATH 2660	1	2	8	14	88.0%
MATH 3120	1	0	2	23	96.2%
MATH 3550	6	7	3	29	71.1%

In Fall 2020, assessment data was provided by 20 of the 28 sections across the above courses, corresponding to a participation rate of 71.4%.

Spring 2021 Data by Course:

Course	0	1	2	3	Pct. of 2/3
MATH 1510	11	16	20	55	73.5%
MATH 1520	5	21	24	48	73.5%
MATH 2530	12	8	16	33	71.0%
MATH 2660	1	1	3	17	90.9%
MATH 3120	0	3	8	17	89.3%
MATH 3550	10	11	21	42	75.0%
STAT 3850	3	5	11	51	88.6%

In Spring 2021, assessment data was provided by 22 of the 27 sections across the above courses, corresponding to a participation rate of 81.5%.

The next table provides a summary of the assessment scores over all courses based on the modality of the course. Asynchronous and synchronous online courses are combined in the Online category, while In-Person Only and In-Person Flex are combined for the In-Person category. In-Person Flex courses with one virtual meeting per week are also included with the In-Person data. This crude evaluation of the percentage of 2 or 3 ratings does not suggest a link to the modality.

		0	1	2	3	2 or 3
Fall 2020	Online	19	37	43	150	77.5%
	In-Person	17	21	57	121	82.4%
Spring 2021	Online	13	31	47	144	81.3%
	In-Person	29	34	56	119	73.5%

5. Findings: Interpretations & Conclusions

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

The table below provides a summary of the assessment data over the past five years. Note that the average in the final column is the simple average of the numbers in the preceding columns rather than the weighted average based on the number of students. The percentage of 2/3 ratings on the 0-1-2-3 scale seems to reliably fall in the 60-80%

range, with occasional data points appearing outside this range. The relatively high fluctuation likely stems from variation in the difficulty of problems that test the same skill. The use of common (or at least equivalent) problems across sections would probably be necessary if a narrower range of outcomes is desired. Notice that only 6 of the 55 numbers in the table fall below the target of 60% and only one of these occurred in the last two years.

Percentage of students earning a 2 or 3 rating on course level assessment reports.	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019	Fall 2019	Spring 2020	Fall 2020	Spring 2021	Average
MATH 1510 Calculus 1	87	63	61	71	74	80	74	90	87	73	76
MATH 1520 Calculus 2	51	60	67	62	57	72	83	75	72	73	67
MATH 2530 Calculus 3	90	78	64	72	69	73	73	79	73	71	74
MATH 2660 Principles of Mathematics			94	59	95			100	88	91	88
MATH 3120 Introduction to Linear Algebra			100	83	92	42	55	80	96	89	80
MATH 3550 Differential Equations	69	58	86	87	68	82	70	77	71	75	74
STAT 3850 Foundation of Statistics										89	89

Other Assessment Activities:

- The assessment plans for the BA and BS Programs in Mathematics were revised over the last two academic years and new plans were approved by the Department in Fall 2020. The new plans were submitted to the Office of the Assessment of Student Learning and included in the most recent version of the Academic Catalog.
    - The new plans address feedback from the Office of the Assessment of Student Learning about the lack of clarity in the prior program learning outcomes.
    - The new plans incorporate some aspects of publicly available assessment plans for mathematics programs at various institutions across the United States that were considered during the process.
    - The new plans reflect changes made to the BA program in AY2016-2017, incorporating statistics and computer programming in the required coursework.
    - The new plans distinguish the BA and BS programs through a program learning outcome related to the difference in mathematical depth in the two programs at the upper level.
- The Department carried out an evaluation of all course syllabi in Fall 2020 using a standard checklist to make sure each syllabus included each required component.
- The Department offered its first large-lecture courses in Spring 2020 with one large section of MATH 1510 Calculus 1 and one large section of STAT 3850 Foundation of Statistics. The cap for traditional sections is usually around 30, while the large sections are typically capped between 45 and 60. Instructors for large sections work with at least one teaching assistant. In calculus, the instructor meets with the students as a large group three days a week, while the TA meets with the students in small groups once each week.
    - The Department has steadily increased the number of large sections for Calculus 1, expanding from one in Spring 2020 to two in Fall 2020 and three in Spring 2021. Overall, GPAs do not seem to differ substantially between small and large sections thus far.
    - A single large section of MATH 1520 Calculus 2 was offered in Fall 2020 and Spring 2021. There is not yet enough data to examine potential differences in student achievement.
    - The Department offered one small section and one large section of STAT 3850 in Spring 2020, Fall 2020, and Spring 2021, although the relative sizes varied due to unusual registration patterns over the last academic year. After three semesters, there appears to be no significant difference in student achievement based on the GPAs for these sections.

- Graduating seniors completing a major in Mathematics & Statistics were invited to complete an exit survey through Qualtrics. Some observations from the feedback are summarized below.
    - There were 11 respondents. Four completed the BS, one completed the BA with a Concentration in Statistics, one completed the BA Teacher Option, and five completed the standard BA. Six of the 11 respondents have an additional major.
    - Six of the 11 respondents indicated that a course in probability or statistics was among the most useful courses. Four indicated that Linear Algebra was among the most useful courses.
    - Only two of the 11 respondents engaged in activities of the Mathematics, Statistics, & Computer Science Club. Only one of the 11 students participated in a mathematics competition during their time in the program.
    - Three of the 11 respondents never met with their faculty mentor. Four met with their faculty mentor rarely and the remaining four met with their faculty mentor at least once per semester.
    - Four of the 11 respondents were extremely satisfied by their mentoring in the program, three were satisfied, two indifferent, and two somewhat dissatisfied.
    - Five of the 11 respondents have been accepted to a graduate program, five have not applied to any graduate program, and one applied, but had not been accepted by a graduate program.
    - Four of the 11 respondents have accepted a job. One graduate has had at least one job interview, but had not yet received an offer.
    - Seven of the 11 respondents were extremely satisfied by their experience as a major in Mathematics & Statistics, while four were satisfied. (No respondents were neutral or dissatisfied.)
    - One respondent suggested that additional coursework be offered for those interested in actuarial science. Another suggested that there be more professional counseling for students in the program.
- Mathematics Placement: The Math-index was not available for all students in Spring-Summer 2021. All students were asked to take the online placement test(s) through WeBWorK. This pilot will be assessed once sufficient number of students have taken Math classes to determine if the cut-scores are appropriate.
- The table below shows the course-wide grade point average for various multi-section courses in Mathematics & Statistics from Fall 2015 to Spring 2021. Any value in red indicates a grade point average that is more than 1.5 standard deviations from the mean for that course over this period. Spring 2020 has more anomalous values (five) than any other term and each represents a high value. Spring 2020 was also noteworthy for a record number of academic honesty cases for the Department. It is reassuring to see that Fall 2020 and Spring 2021 seem closer to "normal" in this regard.

	Fall 2015	Spring 2016	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019	Fall 2019	Spring 2020	Fall 2020	Spring 2021	mean	st. deviation
MATH 1200	2.58	2.49	2.46	2.61	2.61	2.70	2.54	2.60	2.62	2.72	2.77	2.32	2.59	0.123
MATH 1320	2.41	2.55	2.94	2.77	2.70	2.53	2.76	2.38	2.68	2.91	2.85	2.46	2.66	0.193
MATH 1400	2.41	2.07	2.49	2.25	2.62	2.78	2.62	2.67	2.76	3.13	2.79	3.10	2.64	0.311
MATH 1510	2.81	2.64	2.93	2.84	2.81	2.87	2.91	3.07	2.95	2.78	3.03	2.64	2.86	0.134
MATH 1520	2.68	2.43	2.30	2.37	2.73	2.82	2.70	2.75	2.72	3.15	2.94	2.90	2.71	0.245
MATH 2530	2.91	2.81	2.91	2.79	2.81	2.62	2.88	2.54	2.93	3.42	3.01	2.82	2.87	0.217
MATH 2660	2.90	3.16	2.94	2.85	3.11	2.92	3.01	3.02	3.28	3.43	3.05	3.07	3.06	0.167
MATH 3120	2.97	2.98	3.05	3.28	3.25	3.19	2.97	2.76	2.10	3.91	3.50	3.25	3.10	0.434
MATH 3550	2.64	2.79	2.63	3.01	2.95	3.05	3.07	3.00	2.95	3.20	3.14	3.20	2.97	0.193
MATH 3850			3.09	3.07	3.06	3.09	3.23	3.32	3.14	3.13	3.40	3.16	3.17	0.114

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?

Faculty members serving on the departmental assessment committee meet multiple times during each academic year to discuss recent activities, current work, and future goals. All faculty are welcome to attend these meetings as well as review the annual assessment report for the department.

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.

A few examples are given below, some of which are ongoing and have been mentioned in previous reports.

- 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.
- The Department continues to collect data on students who request a waiver for the residency requirement associated with MATH 2530 Calculus 3 for all math majors. Each waiver granted by the Chair is recorded and the plan is to reevaluate the importance of the residency requirement after a few years.
- The success of large sections with recitations in Calculus 1 and Calculus 2 (as discussed above) has prompted the department to continue offering large sections of Calculus 1 and Calculus 2. These large sections involve three weekly meetings with the primary instructor as well as a weekly discussion session led by a teaching assistant. It will be interesting to examine the success of these sections over a period of 4-5 years and perhaps to survey the students about their satisfaction with the learning environment of the large sections.

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?

1) In AY2019-2020, the recommended math index for various courses was updated based on a study of recent student success in these courses.
2) In AY2019-2020, guidelines for credit-bearing internships were developed.
3) In AY2016-2017, new requirements were added to the BA Program in Mathematics. All math majors are now required to take STAT 3850 Foundation of Statistics. Most math majors are required to take one course on computer programming. Students completing the Teacher Option for the BA are not subject to this requirement. These changes were made in response to exit survey information about the jobs and graduate programs pursued by graduates of our programs.

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

1) New data will be gathered over the next few years to evaluate the effect of the changes.

2) The internship guidelines are very new, but the department will collect information over a few years on the involvement and success of students taking internships in Mathematics or Statistics.
3) Recent graduates have indicated that statistics courses are among their favorites and that they find them useful. Some students are requesting that additional statistics courses be introduced, especially courses which may be useful in a job setting.

C. What were the findings of the assessment?

Assessment is ongoing.

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

Data will continue to be collected over the next few years.

IMPORTANT: Please submit any assessment tools (e.g., 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.