Assessment Cycle 2022 – 2023

Mathematics Bachelor of Science Program

Department of Mathematics

College: Arts and Sciences

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Approved by: Dr. Francene Lemoine, Dean **Date: 6/13/2023**

Northwestern Mission. Northwestern State University is a responsive, student-oriented institution committed to acquiring, creating, and disseminating knowledge through innovative teaching, research, and service. With its certificate, undergraduate, and graduate programs, Northwestern State University prepares its increasingly diverse student population to contribute to an inclusive global community with a steadfast dedication to improving our region, state, and nation.

College of Arts and Sciences' Mission. College of Arts and Sciences' Mission. The College of Arts & Sciences, the largest college at Northwestern State University, is a diverse community of scholars, teachers, and students, working collaboratively to acquire, create, and disseminate knowledge through transformational, high-impact experiential learning practices, research, and service. The College strives to produce graduates who are productive members of society equipped with the capability to promote economic and social development and improve the overall quality of life in the region. The College provides an unequaled undergraduate education in the social and behavioral sciences, English, communication, journalism, media arts, biological and physical sciences, and the creative and performing arts, and at the graduate level in the creative and performing arts, English, TESOL, and Homeland Security. Uniquely, the College houses the Louisiana Scholars' College (the State's designated Honors College), the Louisiana Folklife Center, and the Creole Center, demonstrating its commitment to community service, research, and preservation of Louisiana's precious resources.

Department of Mathematics. The Department of Mathematics is dedicated to the development of students for roles in academic, professional, and research careers in the various areas of the field of mathematics. The department also fosters the mathematical development of all students through our offerings in general education and support courses for other degree programs. We are committed to providing a modern, effective education to all students using traditional practices and current technology throughout our course offerings. The department delivers Bachelor of Science degrees in Mathematics with available concentrations in Healthcare Informatics and Actuarial Mathematics. A minor in Mathematics is also available.

Mathematics Program Mission Statement: The Department of Mathematics offers a Bachelor of Science in Mathematics. The coursework includes a foundation in the classic coursework in mathematics covering Calculus, Foundations, and Algebra which is

enhanced with a strong student research component. All coursework is delivered using appropriate, modern technology. Mathematics coursework is supplemented with a strong selection of courses in the Biological, Physical, and Computer Sciences. Choice of upper-level electives allows for customization of the degree emphasizing preparation for graduate school, a professional career, or a mixture of both. The concentrations in Healthcare Informatics and Actuarial Mathematics also require an internship experience further preparing the student for a professional career.

Methodology: The assessment process for the BS program is as follows:

(1) Data from assessment tools (both direct – indirect, quantitative, and qualitative) are collected and returned to the department head.

(2) The department head will analyze the data to determine whether students have met measurable outcomes.

(3) Results from the assessment will be discussed with the faculty.

(4) The Department Head, in consultation with the Advisory Committee, will propose changes to measurable outcomes, assessment tools for the next assessment period and, where needed, curricula and program changes.

Student Learning Outcomes:

SLO 1. Students will gain a strong understanding of the fundamental ideas, concepts, and applications of mathematics.

Course Map: Tied to course syllabus objectives.

MATH 2110: Analytic Geometry and Calculus II
MATH 3100: Modern Algebra I
MATH 4950: Mathematics – A Capstone Course

Measure 1.1. (Direct – other)

MATH 2110 (Analytic Geometry and Calculus II) is taken at the end of the freshman year. MATH 3100 (Modern Algebra 1) is the last explicitly required course before the student begins taking upper-level electives in mathematics. MATH 4950 (Mathematics – A Capstone Course) is the senior research project course taken shortly before graduation. By looking at the pass rate in each of these courses, we get a sense of whether majors are making progress. The target is that 75% of mathematics majors earn a grade of C or higher in MATH 2110, 90% of mathematics majors earn a grade of C or higher in MATH 3100 and at least 50% of mathematics majors earn a grade of B or higher in MATH 4950.

Finding: Target was not met.

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Analysis: In AC 2021 – 2022, the following results were measured:

- MATH 2110 – 100% met target.
- MATH 3100 – 75% of math majors met the target.
- MATH 4950 – 100% math majors met the target.

Based on the analysis of the AC 2021-2022 results and to drive improvement, faculty implemented the following changes in AC 2022-2023. In MATH 2110 the standardized content was taught, and the new instrument was administered. In MATH 3100, new videos for flipped-classroom pedagogy were recorded and deployed. In MATH 4950, the Unified Rubric (see Attachment 1) was used to give standardized feedback throughout the course.

In AC 2022-2023, our targets were:

- MATH 2110 – 75% or higher of mathematics majors would earn C or better.
- MATH 3100 – 90% or higher of mathematics majors would earn C or better, and 50% would earn a B or better.
- MATH 4950 – 90% or higher of mathematics majors would earn C or better, and 50% would earn a B or better.

The following results were measured.

- MATH 2110 – 100% of mathematics majors earned a C or better. (Fall 2022 no mathematics majors enrolled, Spring 2023 – 1 of 1)
- MATH 3100 – 50% of mathematics majors earned a C or better, 50% of mathematics majors earned a B or better. (Fall 2022 – 1 of 2, Spring 2023 course is not taught)
- MATH 4950 – 100% of mathematics majors earned a C or better, 100% of mathematics majors earned a B or better. (Fall 2022 – 2 of 2, Spring 2023 course is not taught)

The standardization of topics in MATH2110 continues to benefit these students although it is hard to draw conclusions from our very limited data over the last two academic years. Students in MATH3100 continue to benefit from flipped-classroom pedagogy; the one student who did not successfully complete the course was allowed to take the course without its prerequisite to complete her program on time. Results in MATH4950 continue to be strong although as will be seen later in some of the measures that are more granular than this one, their performance was not uniform across all categories.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, faculty will do the following in AC 2023-2024:

- Prerequisites for upper-level courses will be strictly enforced.
- The practice of giving feedback using the format of the unified rubric will be implemented throughout the curriculum.

The faculty believe these changes will contribute to greater student success in these areas.

Measure 1.2. (Indirect – Attitude)

Students make a self-assessment of their preparation in the Reflection Paper Assignment they complete as a part of MATH 4950. We looked at student responses to the prompt "Describe yourself as a mathematician and as a member of the mathematics profession. What can you contribute to the mathematics community and our larger society?"

As a part of our current QEP, Learning for Life, all students participate in a 6-hour Capstone Course. Our students complete a 2-semester, Student Research Project in MATH4940/4950. At the end of their capstone experience, students complete a reflection assignment. We decided to analyze responses in this instrument to measure the students' self-assessment of their readiness to enter the mathematical community. One of the prompts is "Describe yourself as a mathematician and as a member of the mathematics profession. What can you contribute to the mathematics community and our larger society?" Our target is that at least 75% of students will give a response indicating they feel they are capable of contributions to the larger community. Further, we will analyze responses to the prompt the "Describe your strengths and weaknesses as they pertain to mathematical research. What skills do you think helped you through your experiential learning? How do you believe this experience has helped you address your weaknesses?" Our target is that at least 50% of students will report strengths appropriate to the research project.

Finding: Target was met.

Analysis: In AC 2021-2022, we began analyzing the responses from the QEP Reflection Document. 100% of students (Fall 2020 – 0 of 0, Spring 2021 – 1 of 1) reported feeling their experience in completing the mathematics degree would enable them to contribute to the larger mathematical community.

Based on the analysis of the AC 2021-2022 data, the following changes were implemented in AC 2022-2023. Faculty began giving feedback to students using only the benchmarks of the Unified Rubric with particular attention to the mid-term presentation to allow them to better grasp what they need to improve on in their oral communications. We also broadened our analysis to consider responses to the prompt "Describe your strengths and weaknesses as they pertain to mathematical research. What skills do you think helped you through your experiential learning? How do you believe this experience has helped you address your weaknesses?"

As a result, in AC 2022-2023, 100% of students (Fall 2022 – 2 of 2, Spring 2023 course not taught) gave answers indicating that they felt a part of the mathematical community and 50% (Fall 2022 1 of 2, Spring 2023 course not taught) gave answers to indicate that they thought they had the relevant skills.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, faculty will do the following in AC 2023-2024. Discussions will be held about these two questions at the beginning of MATH4950, so that students have a chance to dwell upon the issues as they carry out their projects. Our new target will be that at least 90% of students will give a response indicating they feel they are capable of contributions to the larger community and at least 75% of students will report strengths appropriate to the research project.

Measure: 1.3. **(Direct – Skill/Activity)**

All mathematics majors will take the ETS Major Field Exam in Mathematics during the semester they take MATH 4950. Our target is 75% or more of mathematics majors will score above the 50th percentile on the exam.

Findings: Target not met.

Analysis: This is our first year successfully implementing this measure, so there is no data from AC 2021-2022 to compare.

In AC2022–2023, 0% of students (0 of 2 mathematics majors) scored above the 50th percentile.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, faculty will do the following in AC 2023-2024. This assessment will be discussed with the students in advance, and it will be offered during a regular class meeting.

One of the students assessed this year is one of the stronger students we have had in our program. It is possible that we set an unrealistically high target for this measure. We will continue with at this target for at least one more year then reassess its suitability.

SLO 2. Students will demonstrate a college-level proficiency in oral communication of mathematical concepts.

Course Map: Tied to course syllabus below.

MATH1010: Introduction to Mathematics
MATH2080: Fundamentals of Proof
MATH4950: Mathematics

Measure: 2.1. **(Direct – Skill/Activity)**

All mathematics majors take MATH 1010 (Introduction to Mathematics) the first fall semester they are a declared mathematics major. Their final project in this course is to make a presentation on a career in mathematics which they have researched. Using our evaluating Oral Communications of Mathematical Ideas rubric, students were evaluated in the categories of organization, delivery, and visual support; they are given a score of

0-2 in each category. Our target is that 85% of students will score at least 5 out of 6 possible points, and at least 50% will score 6 out of 6 possible points.

Findings: Target not met.

Analysis: In AC 2021-2022, 100% of students (2 of 2 mathematics majors in this class) scored at least 5 of 6 points. None of students (0 of 2) scored 6 out of 6.

Based on the analysis of the AC 2021-2022 data, the following changes were implemented in AC 2022-2023. Students were introduced to the Oral Communication portion of the Unified Rubric early in the semester. This allowed them to better understand how they would be evaluated.

As a result, in AC 2022-2023, 100% of students (1 of 1 mathematics majors in this class) scored at least 5 of 6 points. None of students (0 of 1) scored 6 out of 6.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, faculty will begin in AC 2023-2024 to dedicate an entire class meeting to a thorough discussion of the Unified Rubric. Feedback on the mid-term presentation using the Unified Rubric will be given. This will give the students more granular feedback and allow them to craft a stronger final presentation. Our target will remain the same.

Measure: 2.2. (Direct – Skill/Activity)

Mathematics majors take MATH 2080 (Fundamentals of Proof) the fall of their sophomore year. In this course, students are required to present solutions of proofs on the board. Student presentations are evaluated using the Unified Rubric for use in evaluating oral communications of mathematical ideas. Students were evaluated in the categories of mathematics and delivery; they were given a score of 0-2 in each category for each presentation. Our target is that 85% of students will have an average score at least 3.25 out of 4 possible points.

Findings: No data collected

Analysis: In AC 2021-2022, 50% of students (1 of 2 enrolled in the course) met the target.

Based on this analysis, the faculty implemented the following changes for AC 2022-2023. We returned to teaching this course with standard lecture pedagogy. Faculty felt that the more traditional approach would be more beneficial to student learning.

In AC 2022-2023, there were no mathematics majors enrolled in MATH2080, so no data was collected.

Decision: Although no data was collected in AC 2022-2023 for this report, we will most likely return to using a flipped-classroom pedagogy in the AC 2023-2024. The instructor did not report any improvement for the non-mathematics majors who were in the class.

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Measure: 2.3. (Direct – Skill/Activity)

All mathematics majors take MATH 4950 (Mathematics – A Capstone Course) either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. We use a Unified Rubric to evaluate oral communications of mathematical ideas. Students were evaluated in all five categories: organization, central message, mathematics, delivery, and visual support; they will be given a score of 1-4 in each category. Our target is that 70% of students will score at least 18 out of 20 possible points.

Findings: Target not met.

Analysis: In AC 2021-2022, 0% (0 of 1 students) scored 18 out of 20. This student only scored 15 out of 20.

Based on the analysis of the AC 2021-2022 data, in AC 2022-2023 faculty began giving feedback to students using only the benchmarks of the Unified Rubric with particular attention to the mid-term presentation to allow them to better grasp what they need to do to improve in their oral communications.

As a result, in AY2022–2023, 50% of mathematics majors met the target (1 of 2 mathematics majors.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, the faculty in AC 2023-2024 will devote most of a class period near the beginning of the semester to discussing the Unified Rubric for Oral Communications, and the level of mastery we are expecting them to display by the end of the course. Feedback will continue to be given using this rubric. Our target will remain the same.

SLO 3. The students will demonstrate proficiency in written communication of mathematical concepts.

Course Map: Tied to course syllabus below.

MATH 3100: Modern Algebra I
MATH 4950: Mathematics – A Capstone Course

Measure 3.1. (Direct – Skill/Activity)

MATH 3100 (Modern Algebra I) is the last required course before majors begin their upper-level elective courses in mathematics. Responses to questions on the final exam will be analyzed to determine if students are writing about mathematics at the appropriate level. Using the Unified Rubric for evaluating written communications of mathematical ideas, students were evaluated on two questions from their final exam using the logical rigor, thoroughness and depth, and conventions sections of the rubric. Each category was

scored from 1-3. Our target was that 100% of students score at least 15 points out of 18 on the assessment and at least 75% score at least 17 out of 18.

Findings: Target not met.

Analysis: In AC 2021-2022, 100% of mathematics majors (3 of 3 students registered in the class) scored 15 points out of 18 or better on the rubric and 67% of students (2 of 3) scored 17 out of 18 or better.

Based on the analysis of the AC 2021-2022 data, in AC 2022-2023, we taught this class via flipped classroom pedagogy with newly recorded videos designed for this purpose.

As a result of these changes in AC 2022-2023, 50% of mathematics majors (1 of 2 students registered in the class) scored 15 points out of 18 or better on the rubric, and 0% of students (0 of 2) scored 17 out of 18 or better.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, the faculty in AC 2023-2024 will devote the majority of a class period near the beginning of the semester to discussing the Unified Rubric for Written Mathematics and the level of mastery we are expecting them to display by the end of the course. Feedback will continue to be given using this rubric. Our target will remain the same.

Measure: 3.2. (Direct – Skill/Activity)

All mathematics majors take MATH 4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. Using the Unified Rubric for evaluating written communications of mathematical ideas, students were evaluated in all five categories: context, organization, logical rigor, thoroughness and depth, and conventions; they are given a score of 1-4 in each category. Our target is that 70% of students will score at least 18 out of 20 possible points.

Findings: Target was met.

Analysis: In AC 2021-2022, the results measured were 100% of students (1 of 1 student registered for the course) scored 18 out of 20 or higher.

Based on the analysis of the AC 2020-2021 data, in AC 2022-2023 faculty began giving feedback to students using the benchmarks of the rubric with particular attention to the mid-term paper to allow them to better grasp what they need to improve in their written communications.

As a result, in AC 2022-2023, the results measured were 50% of students (1 of 2 students registered for the course) scored 18 out of 20 or higher.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, the faculty in AC 2023-2024 will devote the majority of a class period near the beginning of the semester to discussing the Unified Rubric for Written Communication and the level of mastery we are expecting them to display by the end of the course. Feedback will continue to be given using this rubric. Our target is that 90% of students will score at least 18 out of 20 possible points.

SLO 4. Students will demonstrate proficiency in use of technology for problem solving and communication.

Course Map: Tied to course syllabus below.

MATH 2110: Analytic Geometry and Calculus II
MATH 4950: Mathematics – A Capstone Course

Measure 4.1. (Direct – Skill/Activity)

MATH 2110 is the second semester of Calculus. The use of technology is integrated into this course. We are in the process of developing a standard instrument to use to assess competence with computer algebra systems and graphing calculators. Our target is that 75% of students will demonstrate competence.

Findings: Target was met.

Analysis: In AC 2021-2022 were that 100% (1 of 1 student registered in this course) demonstrated competence.

Based on the analysis of AC 2021-2022 data, in AC 2022-2023 a new instrument was designed and implemented.

As a result, in AC 2022-2023 100% (1 of 1 student registered in this course) demonstrated competence.

Decision: Based on the analysis of the AC 2022-2023 results, faculty will review the instrument developed. We will leave our target the same since we had such limited data collected.

Measure 4.2. (Direct – Skill/Activity)

All mathematics majors take MATH 4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation using presentation software. Using the Unified Rubric for evaluating oral communications of mathematical ideas, students were evaluated in all five categories: organization, central message, mathematics, delivery, and visual Support. They are given a score of 1-4 in each category. For this measure, organization and visual support will be used as they cover the technical aspects of the presentation. Our target is

that to 90% of students will score at least 6 out of 8, and 50% will score at least 7 out of 8.

Findings: Target was met.

Analysis: In AC 2021-2021 were 100% of students (1 of 1 student registered) scored 6 points or better and 0% of students (0 of 1 student registered) scored 7 or better.

Based on the analysis of the AC 2021-2021 data, in AC 2022-2023, faculty gave all feedback to students using the benchmarks of this rubric to allow them to better grasp what they need to do to improve in the technical aspects of their presentation.

As a result, in AC 2022–2023 were 100% of students (2 of 2 students registered) scored 6 points or better and 100% of students (2 of 2 students registered) scored 7 or better.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, the faculty in AC 2023-2024 will devote the majority of a class period near the beginning of the semester to discussing the Unified Rubric for oral communications and the level of mastery we are expecting them to display by the end of the course. Feedback will continue to be given using this rubric. Our target will become 100% of students will score at least 6 out of 8 and at least 75% will score at least 7.

Measure 4.3. (Direct – Student Artifact)

All mathematics majors take MATH4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. Using the Unified Rubric for evaluating written communications of mathematical ideas, students were evaluated in all five categories: context, organization, logical rigor, thoroughness and depth, and conventions; they will be given a score of 1-4 in each category. The categories in our rubric covering the technical aspects of writing are context and conventions. Our target is that 70% of students will score at least 6 out of 8 possible points and 50% of students will score 7 or better.

Findings: Target met.

Analysis: In AC 2021-2022 were 100% of students (1 of 1 student registered) scored 6 points or better and 100% of students (1 of 1 student registered) scored 7 or better.

Based on the analysis of the AC 2021-2022 data, in AC 2022-2023, faculty gave all feedback to students using the benchmarks of this rubric to allow them to better grasp what they need to improve in the technical aspects of their paper.

As a result, in AC 2022-2023, 100% of students (2 of 2 students registered) scored 6 points or better, and 50% of students (1 of 2 students registered) scored 7 or better.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, the faculty in AC 2023-2024 will devote the majority of a class period near the beginning of the semester to discussing the Unified Rubric for written mathematics and the level of mastery we are expecting them to display by the end of the course. Feedback will continue to be given using this rubric. Our target will become at least 90% of students will score at least 6 out of 8 possible points and 75% of students will score 7 or better.

SLO 5. Students will develop the ability to think in an analytical fashion.

Course Map: Tied to course syllabus below.

MATH 2080: Fundamentals of Proof
MATH 4950: Mathematics – A Capstone Course

Measure 5.1. (Direct - Skill)

MATH 2080 is the first course in the mathematics major where students are expected to write at length about mathematics. Responses to questions on the final exam in this course will be evaluated based on whether the student can write about mathematics in a clear and logically rigorous manner. Using the Unified Rubric for evaluating written communications of mathematical ideas, students are evaluated in the categories of logical rigor, thoroughness and depth, and conventions; they are given a score of 0-2 in each category. Our target is that 90% of students will score at least 6 out of 6 possible points.

Findings: No data was collected.

Analysis: In AC 2020-2021, 50% of mathematics majors (1 of 2 students enrolled in the course) met the standard.

Based on this analysis, the faculty implemented the following changes for AC 2022-2023. Faculty returned to teaching this course using standard lecture pedagogy. Faculty felt that the more traditional approach might be more beneficial to student learning.

In AC 2022-2023, there were no mathematics majors enrolled in MATH2080, so no data was collected.

Decision: Although no data was collected in AC 2022-2023 for this report, we will most likely return to using a flipped-classroom pedagogy in the AC 2023-2024. The instructor did not report any improvement for the non-mathematics majors who were in the class.

Measure 5.2. (Direct - Knowledge)

All mathematics majors take MATH 4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. Using the Unified Rubric for evaluating written

communications of mathematical ideas, students were evaluated in all five categories: context, organization, logical rigor, thoroughness and depth, and conventions; they are given a score of 1-4 in each category. The categories covering analytical thinking are organization, logical rigor, and thoroughness and depth. Our target is that 90% of students will score at least 9 out of 12 and 50% will score at least 10.

Findings: Target met.

Analysis: In AC 2021-2022 were 100% of students (1 of 1 student registered) scored 9 points or better and 100% of students (1 of 1 student registered) scored 10 or better.

Based on the analysis of the AC 2021-2022 data, in AC 2022-2023, faculty gave all feedback to students using the benchmarks of this rubric to allow them to better grasp what they need to improve in the mathematical content of their paper.

As a result, in AC 2022-2023 100% of students (2 of 2 students registered) scored 9 points or better and 50% of students (1 of 2 students registered) scored 10 or better.

Decision: Based on the analysis of the AC 2022-2023 results and to drive improvement, the faculty in AC 2023-2024 will devote the majority of a class period near the beginning of the semester to discussing the Unified Rubric for written communication and the level of mastery we are expecting them to display by the end of the course. Feedback will continue to be given using this rubric. Our target will become 100% of students will score at least 9 out of 12 and at least 75% will score at least 10.

Comprehensive Summary of Key Evidence of Improvement Based on Analysis of Results. The following reflects all the changes implemented to drive the continuous process of seeking improvement in AC 2022-2023. These changes are based on the knowledge gained through the analysis of AC 2021-2022 results.

- Faculty met during on-call week in August 2022 to review a formal instrument to use in measure 4.1.
- MATH 2080 returned to a traditional lecture format as the flipped classroom did not seem to improve outcomes in this course.
- MATH 3100 used flipped classroom pedagogy, but new lecture videos recorded expressly for this format were created and used.
- Faculty gave a thorough discussion of the uniform rubric at the beginning of appropriate courses to make the basis for their evaluations clear. Faculty began to use the benchmarks of the rubric when giving all feedback in MATH4940 and MATH 4950.

Plan of Action Moving Forward

- Prerequisites for upper-level courses will be strictly enforced.
- MATH 2080 will return to a flipped-classroom format as the return to lecture format did not seem to improve outcomes in this course.
- Students in MATH2080 and MATH 3100 begin to receive feedback on their work using the benchmarks of the Unified Rubric.
- Faculty will give a thorough discussion of the uniform rubric at the beginning of appropriate courses to make the basis for their evaluations clear.
- Faculty will begin to use the benchmarks of the rubric when giving daily feedback in MATH4940 and MATH 4950.
- Discussions will be held at the beginning of MATH4940 and 4950 about the students' feelings about their ability to contribute to the mathematical community and their readiness for mathematical research.