

AC 2020 – 2021 Assessment

Mathematics Bachelor of Science Program

College: Arts and Sciences

Prepared by: Frank Serio

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Approved by: Francene J Lemoine

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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 unequalled 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

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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 or 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.

MATH2110: Analytic Geometry and Calculus II

MATH3100: Modern Algebra I

MATH4950: Mathematics – A Capstone Course

Measure 1.1. (Direct – other)

MATH2110 is taken at the end of the freshman year. MATH3100 is the last explicitly required course before the student begins taking upper-level electives in mathematics. MATH4950 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 targets are 75% of Mathematics majors earn a Grade of C or higher in 2110. 90% of Mathematics majors earn a Grade of C or higher in 3100 and 4950 with at least 50% earning a grade of B or higher.

Finding: Target was met.

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Analysis: In AC 2019 – 2020, the following results were measured:

- MATH2110 – 67% met goal.
- MATH3100 – 100% of math majors met the goal.
- MATH4950 – 100% math majors met the goal.

Based on the analysis of the AC 2019-2020 results, and to drive improvement, faculty implemented the following changes in AC 2020-2021. Discussions were held about standardizing the content of MATH2110; two options were tested in fall and spring. In MATH 3100, adjustments were made to class participation grades with steps taken towards flipped-classroom instruction. In MATH 4950, the unified rubric was used to standardize the evaluation of student work and provide consistent feedback.

In AC 2020-2021, targets were:

- MATH2110 – 75% or higher of mathematics majors would earn C or better.
- MATH3100 – 90% or higher of mathematics majors would earn C or better, and 50% would earn a B or better.
- MATH4950 – 90% or higher of mathematics majors would earn C or better, and 50% would earn a B or better.

The following results were measured.

- MATH2110 – 100% of mathematics majors earned a C or better. (Fall 2020 – 1 of 1, Spring 2021 no mathematics majors enrolled)
- MATH3100 – 100% of mathematics majors earned a C or better, 100% of mathematics majors earned a B or better. (Fall 2020 – 1 of 1, Spring 2021 course is not taught)
- MATH4950 – 100% of mathematics majors earned a C or better, 100% of mathematics majors earned a B or better. (Fall 2020 – 1 of 1, Spring 2021 – 1 of 1)

Decision: In AC 2020-2021, the target was met. Based on the analysis of the AC 2018-2019 results, and to drive improvement, in AC 2021-2022 faculty will do the following:

- Faculty will meet during on-call week in August to finalize the discussion of the topics which are mandatory and which are optional in MATH 2110 based on this year's trials.
- Success with homework assignments is essential for student success in MATH3100. We will begin teaching this course with flipped classroom pedagogy. This will provide the students with greater access to faculty assistance while completing homework assignments.
- Students in MATH4950 will be the first students coming to the course with exposure to the unified rubric in earlier courses. Faculty will give feedback to students using the benchmarks of this rubric to allow them to better grasp what they need to improve in their written and oral communications.

Measure 1.2. (Indirect – Attitude)

Students make a self-assessment of their preparation in the Graduating Senior Survey. We examine responses to questions on the ability to “reason abstractly” and “use

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numerical data and statistics.” Our targets are 75% or more of Mathematics majors will report "Satisfied" or "Very Satisfied" to the questions regarding how their education has helped them in these areas.

Finding: Target not met.

Analysis: In AC 2019-2020, the target was not met (no data collected). In AC 2020-2021, Northwestern began using the Handshake Student Exit Survey instead of the previous Graduating Senior Survey instrument. Comparable data is not available from the new survey. The Department was unaware of this change until the data was requested from Institutional Research. Therefore, there is no data to analyze for AC 2020-2021.

Decision: In AC 2020-2021, the target was not met (no data collected). The faculty will meet during on-call week this fall to discuss how to gather similar information for this measure. An obvious source would be the reflection assignments made as part of their student research project under the current QEP.

Measure: 1.3. (Direct – Skill/Activity)

All mathematics majors will take the ETS Major Field Exam in Mathematics during the semester they take MATH4950. Our target is 75% or more of mathematics majors will score above the 50th percentile on the exam.

Findings: Target not met.

Analysis: In AC 2019-2020, the target was not met (no data collected). Analysis during the previous year of the test results indicates that students are not putting forth the effort because the exam is not connected to any coursework and, therefore, a low priority for them.

Scheduling difficulties exacerbated by COVID-19 capacity restrictions led to this exam not being administered again in AC 2020-2021.

Decision: In AC 2020-2021, the target was not met (no data collected). Based on the analysis of the AC 2020-2021, faculty will schedule a date with testing before the beginning of each semester and devote a day of MATH 4950 to the administration of the exam to increase participation and engagement with the exam.

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

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Measure: 2.1. (Direct – Skill/Activity)

All mathematics majors take MATH1010 the first fall semester they are a major. Their final project is to make a presentation on a career in mathematics which they have researched. Using our unified rubric for evaluating Oral Communications of Mathematical Ideas, students were evaluated in the categories of Organization, Delivery, and Visual Support; they will be given a score of 0-2 in each category. Our goal is that 85% of students will score at least 5 out of 6 possible points.

Findings: Target met.

Analysis: In AC 2019 – 2020, the target was met. Based on the analysis of the AC 2019-2020 data, the following changes were implemented. Students were introduced to the Oral Communication rubric early in the semester. This allowed them the ability to better understand how they would be evaluated.

As a result of these changes, in AC 2020-2021, the target was met. One hundred percent (100%) of students (3 of 3 mathematics majors in this class) scored at least 5 of 6 points.

Decision: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty will give feedback on the mid-term presentation using the unified rubric. This will give the students more granular feedback and allow them to craft a stronger final presentation. In addition to the goal to 85% of students in MATH1010 scoring 5 out of 6 points on the rubric, the Department will add the goal that at least 50% of students score 6 out of 6 on the final presentation.

Measure: 2.2. (Direct – Skill/Activity)

Mathematics majors take MATH2080 the fall of their sophomore year. In this course, students are required to present solutions of proofs on the board. Student presentations were 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 goal is that 85% of students will have an average score at least 3.0 out of 4 possible points.

Findings: Target met.

Analysis: In AC 2019 – 2020, the target was met. Based on this analysis, the faculty implemented the following changes for AC 2020-2021. The rubric was discussed with students early in the class. This allowed them to consider the benchmarks as they made their presentations.

As a result of these changes, in AC 2020-2021, 100% of mathematics majors (2 of 2 enrolled in the course) met the standard.

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Decision: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty will begin teaching this course with flipped classroom pedagogy. This will provide the students with greater access to faculty assistance while completing homework assignments and preparing for presentations. In addition, the department will raise the goal to 85% of students in MATH2080 scoring an average of at least 3.25 out of 4 points on the rubric.

Measure: 2.3. (Direct – Skill/Activity)

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. We use a unified rubric for use in evaluating 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 goal is that 70% of students will score at least 18 out of 20 possible points.

Findings: Target not met.

Analysis: In AC 2019-2020, the target was not met. Based on the analysis of the AC 2019-2020 data, the unified rubric was fully implemented including discussions of its benchmarks and how they would be used to evaluate performance.

As a result of these changes, in AC 2020-2021 the target was not met. Fifty percent (50%) of students (1 of 2 students registered) scored at least 18 out of 20.

Decision: In AC 2020-2021, the target was not met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty will include a discussion of the rubric at the beginning of this course to make the basis for their evaluations clear. In addition, faculty will begin giving feedback to students using the benchmarks of this rubric with particular attention to the mid-term presentation to allow them to better grasp what they need to improve in their oral communications.

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

Course Map: Tied to course syllabus below.

MATH3100: Modern Algebra I

MATH4950: Mathematics – A Capstone Course

Measure 3.1. (Direct – Skill/Activity)

MATH3100 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

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determine if students are writing about mathematics at the appropriate level. Using the unified rubric for use in 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 goal was that 85% of mathematics majors would score at least 15 out of 18 on this assessment.

Findings: Target met.

Analysis: In AC 2019 – 2020, the target was met. Based on the analysis of the AC 2019-2020 data, in AC 2020-2021 a different approach was taken. Class time was restructured to allow for more time in class working on assignments. Homework assignments are essential to students mastering written communication skills.

As a result of these changes in AC 2020-2021, the target was met. One hundred percent (100%) of mathematics majors (1 of 1 student registered in the class) scored 15 points out of 18 or better on the rubric.

Decision: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty will teach this course with flipped classroom pedagogy. This will provide the students with greater access to faculty assistance while completing homework assignments. In addition, the department will raise the goal to 85% of student scoring at least 15 points out of 18 on the assessment and at least 50% scoring 17 out of 18.

Measure: 3.2. (Direct – Skill/Activity)

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 use in 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. Our goal is that 70% of students will score at least 18 out of 20 possible points.

Findings: Target not met.

Analysis: In AC 2019 – 2020, the target was met. Based on the analysis of the AC 2019-2020 data, in AC 2020-2021, the unified rubric was fully implemented including discussions of its benchmarks and how they would be used to evaluate performance.

As a result of these changes, in AC2020-2021 the target was not met. The results measured were 50% of students (1 of 2 students registered for the course) scored 18 out of 20 or higher.

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Decision: In AC 2020-2021, the target was not met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty include a discussion of the rubric at the beginning of this course to make the basis for their evaluations clear. In addition, faculty will give feedback to students using the benchmarks of this rubric with particular attention to the mid-term paper to allow them to better grasp what they need to improve in their written communications.

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

Course Map: Tied to course syllabus below.

MATH2110: Analytic Geometry and Calculus II

MATH4950: Mathematics – A Capstone Course

Measure 4.1. (Direct – Skill/Activity)

MATH2110 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 goal is that 75% of students will demonstrate competence.

Findings: Target met.

Analysis: In AC 2019 – 2020 the target was not met. Based on the analysis of AC 2019-2020 data, in AC 2020-2021, faculty met in August to determine which topics should be included in MATH2110 including which technological skills. Faculty decided to test two different approaches in the fall and spring semesters. A quiz was produced and administered.

As a result of these changes, in AC 2020-2021, the target was met. Results collected in AC 2020-2021 were that 100% (1 of 1 student registered in this course) demonstrated competence.

Decision: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, in AC 2021-2022, faculty will meet during on-call week in August to address the concerns from Measure 4.1 and finalize the discussion of the topics which are mandatory, and which are optional in MATH 2110. Faculty will also develop a formal instrument to use in this measure.

Measure 4.2. (Direct – Skill/Activity)

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

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paper and a public presentation using presentation software. Using the unified rubric for use in evaluating 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. For this measure Organization and Visual Support will be used as they cover the technical aspects of the presentation. Our goal is that to 90% of students will score at least 6 out of 8 and 50% will score at least 7.

Findings: Target met.

Analysis: In AC 2019-2020, target was met. Based on the analysis of the AC 2019-2020 data, in AC 2020-2021, the unified rubric was fully implemented including discussions of its benchmarks and how they would be used to evaluated performance.

As a result of these changes, in AC 2020-2021, the target was met. Results measured in AC 2020-2021 were 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: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty will include a discussion of the rubric at the beginning of this course to make the basis for their evaluations clear. In addition, faculty will give feedback to students using the benchmarks of this rubric with particular attention to the mid-term presentation to allow them to better grasp what they need to improve in the technical aspects of their presentation.

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 use in 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 goal is that 70% of students will score at least 6 out of 8 possible points.

Findings: Target met.

Analysis: In AC 2019-2020, target was met. Based on the analysis of the AC 2019-2020 data, in AC 2020-2021, the unified rubric was fully implemented including discussions of its benchmarks and how they would be used to evaluated performance.

As a result of these changes, in AC 2020-2021, the target was met. Results measured in AC 2020-2021 were 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.

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Decision: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty will include a discussion of the rubric at the beginning of this course to make the basis for their evaluations clear. In addition, faculty will give feedback to students using the benchmarks of this rubric with particular attention to the mid-term paper to allow them to better grasp what they need to improve in the technical aspects of their paper.

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

Course Map: Tied to course syllabus below.

MATH2080: Fundamentals of Proof

MATH4950: Mathematics – A Capstone Course

Measure 5.1. (Direct - Skill)

MATH2080 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 regarding whether the student can write about mathematics in a clear and logically rigorous manner. Using the unified rubric for use in evaluating Written Communications of Mathematical Ideas, students were evaluated in the categories of Logical Rigor, Thoroughness and Depth, and Conventions; they will be given a score of 0-2 in each category. Our goal is that 85% of students will score at least 6 out of 6 possible points.

Findings: Target met.

Analysis: In AC 2019 – 2020, the target was met. Based on the analysis of the AC 2019-2020 data, in AC 2020-2021 the faculty implemented the following changes. The rubric was discussed with students early in the class. This allowed them to consider the benchmarks as they worked on assignments and exams.

As a result of these changes, in AC 2020-2021 the target was met. In AC 2020-2021, 100% of mathematics majors (2 of 2 enrolled in the course) met the standard.

Decision: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022 faculty will begin teaching this course with flipped classroom pedagogy. This will provide the students with greater access to faculty assistance while completing homework assignments and preparing for presentations. In addition, the department will raise the goal to 90% of students in MATH2080 students will score at least 6 out of 6 possible points.

Measure 5.2. (Direct - Knowledge)

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

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paper and a public presentation. Using the unified rubric for use in 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 new rubric covering analytical thinking are Organization, Logical Rigor, and Thoroughness and Depth. Our goal is that 90% of students will score at least 9 out of 12 and 50% will score at least 10.

Findings: Target not met.

Analysis: In AC 2019-2020, the target was met. Based on the analysis of the AC 2019-2020 data, in AC 2020-2021, the unified rubric was fully implemented including discussions of its benchmarks and how they would be used to evaluate performance.

As a result of these changes, in AC 2020-2021, the target was not met. Results measured in AC 2020-2021 were 50% of students (1 of 2 students registered) scored 9 points or better and 50% of students (1 of 2 students registered) scored 10 or better.

Decision: In AC 2020-2021, the target was not met. Based on the analysis of the AC 2020-2021 results, and to drive improvement, in AC 2021-2022, faculty will include a discussion of the rubric at the beginning of this course to make the basis for their evaluations clear. In addition, faculty will give feedback to students using the benchmarks of this rubric with particular attention to the mid-term paper to allow them to better grasp what they need to improve in the mathematical content of their paper.

Comprehensive Summary of Key Evidence of Improvement Based on Analysis of Results. Program faculty made several decisions after examining results of data analysis from AC 2019-2020 which resulted in improved student learning and program improvement in AC 2020-2021

For AC 2019-2020, the Mathematics Bachelor of Science program assessed 13 measures for 5 student learning outcomes (SLOs). Decisions that were implemented in AC 2020-2021 were:

- The Uniform Rubrics for Written and Oral Communication were fully implemented. These documents were discussed in all the relevant classes (MATH1010, 2080, 3100, 4940, and 4950).
- Students began receiving feedback based on the unified rubrics in these classes.
- MATH2080 and 3100 were partially restructured to allow for more in-class time to work on assignments.
- Initial discussions on the standardization of MATH2110 were held. Two different approaches were tried in fall and spring.

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Plan of Action Moving Forward. The program showed improvement in several areas. To help to continue to make and/or solidify progress faculty will make the following changes.

- Faculty will meet during on-call week in August to finalize the topics which are mandatory, and which are optional in MATH 2110.
- The department will finalize a formal instrument to use in measure 4.1.
- MATH2080 and 3100 will be taught using the flipped classroom approach. This will give student access to immediate feedback on their assignments – oral and written – as they work on them.
- Faculty will give a thorough discussion of the rubric at the beginning of this course to make the basis for their evaluations clear.
- Faculty will use the benchmarks of the rubric when giving feedback particularly in MATH4940 and 4950.

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APPENDIX

Uniform Rubrics for Math Paper/Presentations

The descriptions below each category give the expectations to receive an excellent evaluation, i.e. what is expected of our best students.

Written Communication

1. Context

Clear, focused statement of problem or topic; Demonstrates thorough understanding of context, audience, and purpose; Relevant contextual factors addressed; Problem is of a level appropriate to a senior mathematics major; Research plan is well thought out

2. Organization

Clear organization effectively supports the central idea; Introduction includes clear statement of problem; No awkward transitions; Conclusion is thorough and specific; Uses graceful language that skillfully communicates meaning

3. Logical Rigor

Development of topics is clear and logical; Assertions clearly stated and well supported; Mathematics is correct and fully demonstrated; Evaluation of solutions is deep and elegant; Definitions and notation clearly stated or explained; Reaches sound, justified conclusions

4. Thoroughness and Depth

Uses appropriate, relevant, and compelling content to illustrate mastery of the subject; Addresses thoroughly and deeply the contextual factors of the problem; Demonstrates working knowledge and understanding of the mathematics; Reviews results with specific consideration of need for further work

5. Conventions

Voice is appropriate for mathematical writing; Word use is precise and accurate; Document is free of errors; Formatted in an appropriate and professional manner which strengthens the development of the central idea; Sources are cited and quoted appropriately

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Oral Communication

1. Organization

Organization pattern makes the content of the presentation cohesive; Gives clear statement of problem; Sequence of presented material allows listener to follow; Conclusion is thorough and specific; Length is appropriate

2. Central Message

Central message is precisely stated, appropriately repeated and strongly supported; Language is appropriate to audience; Focus is on big concepts more than rote skills; Questions addressed thoroughly

3. Mathematics

Mathematics presented makes sense; Defines unfamiliar terminology and notation; Probes beyond surface material; Examples, explanations, and illustrations establish presenter's credibility and command of subject matter

4. Delivery

Speaks clearly and audibly; Speaker actively engages the audience through eye contact, posture, expressiveness, etc.; Pace is appropriate; Speaker appears polished and confident

5. Visual Support

Prepared visual aids complement the speaker's presentation without distracting from the presentation; Illustrations and typefaces formatted professionally; Slides contain appropriate amount of material