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| **Assurance of Student Learning Report**  **2021-2022** | |
| Ogden College of Science & Engineering | Department of Mathematics |
| 049 Master of Arts in Mathematics | |
| Hope Marchionda | |

***Is this an online program***?  Yes  No

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| ***Use this page to list learning outcomes, measurements, and summarize results for your program. Detailed information must be completed in the subsequent pages.*** | | | | |
| **Student Learning Outcome 1:** Students will be able to communicate mathematics in a written form at a level commensurate with that of students completing a master’s degree. | | | | |
| **Instrument 1** | Discussion boards, regularly assigned quizzes, a midterm, and a final from MATH 501, Introduction to Probability and Statistics I. A score of 8 or higher on a 10-point multipart rubric will demonstrate students’ ability to communicate mathematically. We expect at least 75% of students to meet this learning outcome. | | | |
| **Based on your results, check whether the program met the goal Student Learning Outcome 1.** | | | **Met** | **Not Met** |
| **Student Learning Outcome 2:** Students will be able to write proofs of theorems in mathematics. | | | | |
| **Instrument 1** | Assessments from MATH 503, Introduction to Analysis. A score of 8 or higher on a 10-point multipart rubric for problems given on assessments will indicate that students are able to use multiple strategies in problem-solving situations. We expect at least 75% of students to meet this learning outcome. | | | |
| **Based on your results, check whether the program met the goal Student Learning Outcome 2.** | | | **Met** | **Not Met** |
| **Student Learning Outcome 3:** Students will demonstrate their capacity to use multiple strategies and appropriate technology to apply mathematics in problem-solving situations and will justify their solutions with sound logic. | | | | |
| **Instrument 1** | Assessments from MATH 512, Geometry from an Advanced Perspective. A score of 8 or higher on a 10-point multipart rubric will demonstrate students’ ability to choose appropriate strategies, including the use of technology, to solve problems and justify their solutions. We expect at least 75% of students to meet this learning outcome. | | | |
| **Based on your results, check whether the program met the goal Student Learning Outcome 3.** | | | **Met** | **Not Met** |
| **Student Learning Outcome 4:**  Students will demonstrate their capacity for collaboration in the mathematics classroom as a learner and as a teacher. | | | | |
| **Instrument 1** | | Discussion boards from MATH 511, Algebra from an Advanced Perspective. A score of 8 or higher on a 10-point multipart rubric will demonstrate students’ ability to collaborate when working towards solutions to problems. We expect at least 75% of students to meet this learning outcome. | | |
| **Based on your results, check whether the program met the goal Student Learning Outcome 3.** | | | **Met** | **Not Met** |
| **Program Summary (Briefly summarize the action and follow up items from your detailed responses on subsequent pages.)** | | | | |
| Recently, the Master of Arts in Mathematics underwent a program revision. The old program included 18 hours of mathematics and 16 hours of Teacher Leader courses and therefore housed in two departments. The new program is housed completely in the Mathematics Department. Since there is much overlap in the coursework students take in the old and new versions of the program, this will be last year that we focus solely on the four Student Learning Ourcomes listed above. The program evaluation next year will include revisions and additions to the Student Learning Outcomes listed above. We plan to take a more focused approach to assessing the outcomes above instead of a holistic approach. Specifically, we will separate out the instruments for each individual outcome instead of assessing them as a whole. Since our program revision included three new required courses, one of which is a capstone course, outcomes will be added to assess that component of the program. In addition, the curriculum map for this program will change to include more courses in the program since it will be housed completely in our department. | | | | |

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| **Student Learning Outcome 1** | | | | | |
| **Student Learning Outcome** | Students will be able to communicate mathematics in a written form at a level commensurate with that of students  completing a master’s degree. | | | | |
| **Measurement Instrument 1** | Discussion boards, regularly assigned quizzes, a midterm, and a final from MATH 501, Introduction to Probability and Statistics I | | | | |
| **Criteria for Student Success** | A score of 8 or higher on a 10-point multipart rubric will demonstrate students’ ability to communicate  mathematically. | | | | |
| **Program Success Target for this Measurement** | | 75% | **Percent of Program Achieving Target** | 100% | |
| **Methods** | The artifacts from all enrolled students (n=9) that were used to assess this SLO were required discussion boards, regularly assigned quizzes, a midterm, and a final. | | | | |
| **Based on your results, highlight whether the program met the goal Student Learning Outcome 1.** | | | | **Met** | **Not Met** |
| **Actions** (Describe the decision-making process and actions for program improvement. The actions should include a timeline.) | | | | | |
| The structure of this course was highly similar to what it was the previous year, with particular emphasis on students being able to provide statistically precise interpretations for given situations. The 100% of students who met the goal grew with respect to and demonstrated this ability regularly throughout the semester on discussion boards, quizzes, and exams. In the past, the students who did not meet the SLO either completed discussion boards sporadically, regularly engaged in bare minimum levels of interpretation, or both. | | | | | |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.) | | | | | |
| While we will continue to monitor student success on this learning outcome, we will separate out the instruments and look at those individually and as a whole during the next academic year. | | | | | |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome) | | | | | |
| The course used to assess this outcome is a core course in the MA in Mathematics Program, and it is offered once a year. This will be assessed again during the spring 2023 semester when the course is taught again. | | | | | |

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| **Student Learning Outcome 2** | | | | | |
| **Student Learning Outcome** | Students will be able to write proofs of theorems in mathematics. | | | | |
| **Measurement Instrument 1** | Assessments from MATH 503, Introduction to Analysis. | | | | |
| **Criteria for Student Success** | A score of 8 or higher on a 10-point multipart rubric for problems given on assessments will indicate that students  are able to use multiple strategies in problem-solving situations. | | | | |
| **Program Success Target for this Measurement** | | 75% | **Percent of Program Achieving Target** | 83.3% | |
| **Methods** | The artifacts from all enrolled students (n=6) that were used to assess this SLO were homework, midterm, final. There were two students who withdrew from the course and are not included in the total above since they did not complete all of the items assessed. | | | | |
| **Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 2.** | | | | **Met** | **Not Met** |
| **Actions** (Describe the decision-making process and actions planned for program improvement. The actions should include a timeline.) | | | | | |
| During this academic year, we revised the MA in Mathematics program. This new program will still include MATH 503 as one of the core classes required for the program. | | | | | |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.) | | | | | |
| We will continue to monitor student success on this learning outcome. | | | | | |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome) | | | | | |
| The course used to assess this outcome is a core course in the MA in Mathematics Program, and it is offered once a year. This will be assessed again during the fall 2022 semester when the course is taught again. During the next academic year, we will separate out the instruments and look at those individually and as a whole. In addition, we will discuss if this is the best course to assess this outcome. This course is the most challenging course in the program (as expected), but there have been students who have left the program because of this course. While that is not necessarily unusal, we need to gather information and decide if there are ways to make the course more accessible for those without a strong theoretical background. | | | | | |

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| **Student Learning Outcome 3** | | | | | |
| **Student Learning Outcome** | Students will demonstrate their capacity to use multiple strategies and appropriate technology to apply mathematics in problem-solving situations and will justify their solutions with sound logic. | | | | |
| **Measurement Instrument 1** | Assessments from MATH 512, Geometry from an Advanced Perspective. | | | | |
| **Criteria for Student Success** | A score of 8 or higher on a 10-point multipart rubric will demonstrate students’ ability to choose appropriate strategies, including the use of technology, to solve problems and justify their solutions. | | | | |
| **Program Success Target for this Measurement** | | 75% | **Percent of Program Achieving Target** | 100% | |
| **Methods** | The artifacts from all enrolled students (n=9) that were used to assess this SLO were the midterm and final | | | | |
| **Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 3.** | | | | **Met** | **Not Met** |
| **Actions** (Describe the decision-making process and actions for program improvement. The actions should include a timeline.) | | | | | |
| During this academic year, we implemented a new curriculum for MATH 512. However, after consultation with other program faculty members, we have decided to return to a previous textbook for this course in 2022-2023 academic year. | | | | | |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.) | | | | | |
| We will continue to monitor student success on this learning outcome. | | | | | |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome) | | | | | |
| The course used to assess this outcome is a core course in the MA in Mathematics Program, and it is offered once a year. This course is still a required course for the new program and will be assessed again during the spring 2023 semester when the course is taught again. | | | | | |

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| **Student Learning Outcome 4** | | | | | |
| **Student Learning Outcome** | Students will demonstrate their capacity for collaboration in the mathematics classroom as a learner and as a  teacher. | | | | |
| **Measurement Instrument 1** | Discussion boards and assignments from MATH 511, Algebra from an Advanced Perspective. | | | | |
| **Criteria for Student Success** | A score of 8 or higher on a 10-point multipart rubric will demonstrate students’ ability to collaborate when working towards solutions to problems. We expect at least 75% of students to meet this learning outcome. | | | | |
| **Program Success Target for this Measurement** | | 75% | **Percent of Program Achieving Target** | 88.9% | |
| **Methods** | The artifacts from all enrolled students (n=9) that were used to assess this SLO were assignments and discussion boards. | | | | |
| **Based on your results, circle or highlight whether the program met the goal Student Learning Outcome 3.** | | | | **Met** | **Not Met** |
| **Actions** (Describe the decision-making process and actions for program improvement. The actions should include a timeline.) | | | | | |
| During this academic year, we implemented a new curriculum for MATH 511. However, after consultation with other program faculty members, we have decided to return to a previous textbook for this course in 2022-2023 academic year. | | | | | |
| **Follow-Up** (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.) | | | | | |
| We will continue to monitor student success on this learning outcome. | | | | | |
| **Next Assessment Cycle Plan** (Please describe your assessment plan timetable for this outcome) | | | | | |
| The course used to assess this outcome is a core course in the MA in Mathematics Program, and it is offered once a year. This course is still a required course for the new program, and will be assessed again during the fall 2022 semester when the course is taught again. | | | | | |

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| **CURRICULUM MAP 049** | | |  |  |  |  |
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| **Program name:** | Master of Arts in Mathematics | | |  |  |  |
| **Department:** | Mathematics | | |  |  |  |
| **College:** | Ogden College of Science & Engineering | | |  |  |  |
| **Contact person:** | Hope Marchionda | | |  |  |  |
| **Email:** | [hope.marchionda@wku.edu](mailto:hope.marchionda@wku.edu) | | |  |  |  |
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| **KEY:** | |  |  |  |  |  |
| **I = Introduced** | |  |  |  |  |  |
| **R = Reinforced/Developed** | |  |  |  |  |  |
| **M = Mastered** | |  |  |  |  |  |
| **A = Assessed** | |  |  |  |  |  |
|  |  |  | **Learning Outcomes** |  |  |  |
|  |  |  | **LO1:** | **LO2:** | **LO3:** | **LO4:** |
|  |  |  | Communicate mathematics in a written form at a level commensurate with that of students completing a master’s degree | Write proofs of theorems in mathematics | Demonstrate their capacity to use multiple strategies and appropriate technology to apply mathematics in problem-solving situations and will justify their solutions with sound logic | Demonstrate their capacity for collaboration in the mathematics classroom as a learner and as a teacher |
| **Course Subject** | **Number** | **Course Title** |  |  |  |  |
| MATH | 501 | Introduction to Probability and Statistics I | R/M/A |  | I/R | I/R |
| MATH | 503 | Introduction to Analysis | I/R | R/M/A |  | I/R |
| MATH | 511 | Algebra from an Advanced Perspective | I/R | I/R | I/R | R/M/A |
| MATH | 512 | Geometry from an Advanced Perspective | I/R | I/R | R/M/A | I/R |

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| **MATH 501 Rubric**  In this class, it is expected that you will engage substantially in discussion boards and provide substantial evidence of understanding on the midterm, final exam, and paper/project. As part of the MA program, it is expected that you will develop the ability to communicate mathematics in the written form as is expected for a master’s level student. As such, your written work (as compared to numerical answers) on these assessments will be analyzed according to the following rubric.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 10 | 8 | 5 | 2 | 0 | | Surpasses Standard (Mastery plus Connections) | Meets Standard (Mastery) | Approaching Standard | Not Yet Approaching Standard | No Attempt | | Explanations show mastery of content and deeper analysis/understanding of the content. Uses specific references to add to explanation. Makes connection to teaching of mathematics/statistics in a thoughtful way, considering student thinking and understanding. | Explanations show some analysis. Explanations show mastery and understanding of content. Minor or no connection to teaching of mathematics/statistics is made. | Explanations show some understanding of essential content, facts, but is lacking in greater analysis and evidence. | Explanations do not show understanding of basic content.  Explanations are incomplete or inaccurate.  Answers show that mastery of the general content is missing. | Product does not address the assignment, is off topic, or was not submitted. |   **More explanation:**  1.       A “0” means that the student either turned in an explanation that did not address the question/content or did not turn in an assignment at all.  2.      A”2” means that a student provided explanations, but there was not enough evidence of understanding.  This typically means that a student did not elaborate well enough or had some factual/procedural errors or major conceptual errors, which did not provide enough evidence or comprehension of the material.  3.       A “5” means that a student has shown basic understanding of content and material.  The base material is present and correct.  A student who earns a “5” has an understanding of the concepts presented in class.  To improve from “5” a student should include analysis or evaluation of the content.  Elaborate beyond “How do you get this answer” toward “Why does this work?”  4.      An “8” means that a student has mastered the content and is analyzing the content rather than just stating answers.    An “8” typically means that a student is venturing into more abstract ideas and concepts and is attempting to relate them to their teaching of mathematics/statistics.  5.       A “10” means that a student’s explanation is clear, directed and evidence driven.  Students who earn 10’s are writing with the content as their guide to create analytical responses.  Students who earn 10’s show understanding of content and relate this understanding to the teaching of this content in their current or future mathematics/statistics classrooms.  10’s consider their future students’ thinking, including conceptions and misconceptions. |

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| **MATH 503: Introduction to Analysis**  **10-Point Rubric**  In this class, it is expected that you will engage substantially in discussion boards and provide substantial evidence of understanding on assignments, midterm, and final exam. As part of the MA program, it is expected that you will develop the ability to communicate mathematics in the written form as is expected for a master’s level student. As such, your written work (as compared to numerical answers) on these assessments will be analyzed according to the following rubric.  Table 1: Rubric 1 for non-proof problems:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 10 | 8 | 5 | 2 | 0 | | Surpasses Standard (Mastery plus Connections) | Meets Standard (Mastery) | Approaching Standard | Not Yet Approaching Standard | No Attempt | | Demonstrates complete understanding and gives correct solution that is identified and includes work/explains thinking.  . | Demonstrates understanding, shows work/explains thinking, and has a correct solution that is not identified, or “units” are not included or demonstrates understanding, shows work/explains thinking, but gets a slightly wrong answer. | Demonstrates some understanding and gives incorrect solution but shows work and provides explanations/justify thoughts. | Attempts the problem but demonstrates little or no understanding **or** gives correct solution but shows no work and/or provides no answer to back up correct solution. | Product does not address the assignment, is off topic, or was not submitted. |   Table 1: Rubric 1 for problems with proofs:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 10 | 8 | 5 | 2 | 0 | | Surpasses Standard (Mastery plus Connections) | Meets Standard (Mastery) | Approaching Standard | Not Yet Approaching Standard | No Attempt | | Demonstrates complete understanding. A correct and  complete proof is given. Some irrelevant information  may be included but does not affect the intended proof. | Demonstrates complete understanding. A correct approach to proving the theorem is attempted. Some statements may  be unjustified or improperly justified, but errors are minor and could be fixed given time to polish the proof. | Demonstrates understanding of theorem to be proved, but proof is incomplete or does not prove the intended result.  Statements linked into a reasonable (though perhaps  misguided) attempt to prove the theorem. The proof may be left incomplete or may depend upon a major unjustified leap. | Attempts the proof but demonstrates little or no understanding. | Product does not address the assignment, is off topic, or was not submitted. |   **More explanation:**  1.       A “0” means that the student either turned in an explanation that did not address the question/content or did not turn in an assignment at all.  2.      A”2” means that a student provided explanations, but there was not enough evidence of understanding.  This typically means that a student did not elaborate well enough or had some factual/procedural errors or major conceptual errors, which did not provide enough evidence or comprehension of the material.  3.       A “5” means that a student has shown basic understanding of content and material.  The base material is present and correct.  A student who earns a “5” has an understanding of the concepts presented in class.  To improve from “5” a student should include analysis or evaluation of the content.  Elaborate beyond “How do you get this answer” toward “Why does this work?”  4.      An “8” means that a student has mastered the content and is analyzing the content rather than just stating answers.    An “8” typically means that a student is venturing into more abstract ideas and concepts and is attempting to relate them to their teaching.  5.       A “10” means that a student’s explanation is clear, directed and evidence driven.  Students who earn 10’s are writing with the content as their guide to create analytical responses.  Students who earn 10’s show understanding of content and relate this understanding to the teaching of this content in their current or future math classrooms.  10’s consider their future students’ thinking, including conceptions and misconceptions. |

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| **MATH 512: Geometry from an Advanced Perspective**  **10-Point Rubric**  In this class, it is expected that you will engage substantially in discussion boards and provide substantial evidence of understanding on assignments, midterm, and final exam. As part of the MA program, it is expected that you will develop the ability to communicate mathematics in the written form as is expected for a master’s level student. As such, your written work (as compared to numerical answers) on these assessments will be analyzed according to the following rubric.  Table 1: Rubric 1 for non-proof problems:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 10 | 8 | 5 | 2 | 0 | | Surpasses Standard (Mastery plus Connections) | Meets Standard (Mastery) | Approaching Standard | Not Yet Approaching Standard | No Attempt | | Demonstrates complete understanding and gives correct solution that is identified and includes work/explains thinking.  . | Demonstrates understanding, shows work/explains thinking, and has a correct solution that is not identified, or “units” are not included or demonstrates understanding, shows work/explains thinking, but gets a slightly wrong answer. | Demonstrates some understanding and gives incorrect solution but shows work and provides explanations/justify thoughts. | Attempts the problem but demonstrates little or no understanding **or** gives correct solution but shows no work and/or provides no answer to back up correct solution. | Product does not address the assignment, is off topic, or was not submitted. |   Table 1: Rubric 1 for problems with proofs:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | 10 | 8 | 5 | 2 | 0 | | Surpasses Standard (Mastery plus Connections) | Meets Standard (Mastery) | Approaching Standard | Not Yet Approaching Standard | No Attempt | | Demonstrates complete understanding. A correct and  complete proof is given. Some irrelevant information  may be included but does not affect the intended proof. | Demonstrates complete understanding. A correct approach to proving the theorem is attempted. Some statements may  be unjustified or improperly justified, but errors are minor and could be fixed given time to polish the proof. | Demonstrates understanding of theorem to be proved, but proof is incomplete or does not prove the intended result.  Statements linked into a reasonable (though perhaps  misguided) attempt to prove the theorem. The proof may be left incomplete or may depend upon a major unjustified leap. | Attempts the proof but demonstrates little or no understanding. | Product does not address the assignment, is off topic, or was not submitted. |   **More explanation:**  1.       A “0” means that the student either turned in an explanation that did not address the question/content or did not turn in an assignment at all.  2.      A”2” means that a student provided explanations, but there was not enough evidence of understanding.  This typically means that a student did not elaborate well enough or had some factual/procedural errors or major conceptual errors, which did not provide enough evidence or comprehension of the material.  3.       A “5” means that a student has shown basic understanding of content and material.  The base material is present and correct.  A student who earns a “5” has an understanding of the concepts presented in class.  To improve from “5” a student should include analysis or evaluation of the content.  Elaborate beyond “How do you get this answer” toward “Why does this work?”  4.      An “8” means that a student has mastered the content and is analyzing the content rather than just stating answers.    An “8” typically means that a student is venturing into more abstract ideas and concepts and is attempting to relate them to their teaching.  5.       A “10” means that a student’s explanation is clear, directed and evidence driven.  Students who earn 10’s are writing with the content as their guide to create analytical responses.  Students who earn 10’s show understanding of content and relate this understanding to the teaching of this content in their current or future math classrooms.  10’s consider their future students’ thinking, including conceptions and misconceptions. |