

MS MATH ASSESSMENT PLAN

UNIVERSITY OF CENTRAL ARKANSAS ACADEMIC ASSESSMENT PLAN

Requirements

1. Submit with New Program Proposal
 - a. Programs are encouraged to consult with the Office of University Assessment.
 - b. Contact information assessment@uca.edu
2. Send a copy of the Assessment Plan to the Office of University Assessment, Wingo 215.
3. Update the Program Assessment Plan based upon EAPR or Accreditation Cycles.

Basic Information

Program Name:

MS Applied Mathematics

College:

College of Natural Science and Mathematics

Department:

Mathematics

Program Level (check all that apply)

- ☐ Associate's
- ☐ Bachelor's
- ☐ Undergraduate Certificate
- ☒ **Masters**
- ☐ Doctoral
- ☐ Graduate Certificate

Date Plan Submitted: **February 11, 2021**

College Dean & email: **Dr. Stephen Addison (saddison@uca.edu)**

College Curriculum Committee Chairperson & Email: **Dr. Scott Austin (saustin@uca.edu)**

Department Chairperson & email: **Dr. Ramesh Garimella (rameshg@uca.edu)**

Department Curriculum Committee Chairperson & email: **Dr. Garth Johnson (garthj@uca.edu)**

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1. Introduction

- **Purpose**

The purpose of this program is to prepare students to address the mathematical needs of education, business, industry, and government in Arkansas, surrounding states, and the nation. Our high quality, student-centered program integrates critical thinking, problem-solving skills, mentored research, and cutting edge technology. The program prepares our majors to succeed in their chosen professions and/or advanced studies.

- **Unit Mission Statement**

The primary mission of the Department of Mathematics is to prepare students to address the mathematical needs of education, business, industry, and government in Arkansas. In support of this mission, the department creates and delivers relevant instructional programs that enable students to acquire an appropriate foundation of mathematical knowledge. These programs consist of courses designed to enhance students' critical thinking, problem solving, communication, and technology skills, and to prepare our majors for advanced studies. The department supports the professional and academic growth of faculty to ensure that programs are forward thinking and adaptive. The secondary mission of the department is to provide professional services to the university and community at large.

2. Student Outcomes

- **Learning Outcomes by Program (focused on student performance, clearly stated, and measurable)**

Learning Outcome 1: Graduates will have mastered advanced mathematical concepts in the core content areas of Numerical Analysis, Advanced ODE and Mathematical Modeling.

Learning Outcome 2: Graduates will demonstrate advanced problem solving and critical thinking skills.

Learning Outcome 3: Graduates will demonstrate effective communication of mathematics.

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3. Assessment Cycle

- Assessment Cycle will be determined with assistance from the Office of Assessment

Learning Outcome 1: Students will complete an assessment activity in these three required classes when those classes are offered.

- MATH 6342 Mathematical Modeling
- MATH 6345 Advanced Ordinary Differential Equations
- MATH 6348 Numerical Analysis

These classes will be offered on a yearly schedule.

Learning Outcome 2: Students will demonstrate their understanding of advanced problem solving and critical thinking skills when the students take MATH 6342 Mathematical Modeling.

Learning Outcome 3: Students will demonstrate their ability to communicate mathematics on their Comprehensive Exams or Thesis.

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4. Curriculum Map

MS Applied Mathematics Students are given the choice of either taking Comprehensive Exams or completing a Thesis.

This table shows only the specific course and program requirements for students in this program. Students also take many other elective courses.

		Objectives		
	MATH Course number & Name	1. Graduates will have mastered advanced mathematical concepts in the core content areas of Numerical Analysis, Advanced ODE and Mathematical Modeling.	2. Graduates will demonstrate advanced problem solving and critical thinking skills.	3. Graduates will demonstrate effective communication of mathematics.
Core Classes	6342 Mathematical Modeling	A E	R A E	R
	6345 Advanced Ordinary Differential Equations	A E	R A	R
	6348 Numerical Analysis	A E	R A	R
Program Requirement Option	Thesis	A	A	A E
	Comprehensive Exams	A	A	A E

I = Introduction – This skill is introduced in the course. The student is not expected to have prior knowledge in the skill.

R = Reinforced – This skill is reinforced in the course. Students are expected to have some prior knowledge in the skill upon entering the course, but that knowledge may be incomplete.

A = Advanced/Applied – This is applied in the course. Students are expected to apply knowledge into an advanced problem or realistic situation.

E = This course is used for assessment evaluation. Also indicated by bold box.

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5. Assessment Methods and Measures (Formative and Summative recommended)
- Record the assessment measure(s) that evaluate each student learning outcome (note: each learning outcome should have an associated assessment measure).
 - Direct Methods/Measures Preferred/Used at the Course and Program Levels (examples: writing examples, oral examinations, internships, clinicals, quizzes, test, team/group projects and presentations)
 - Indirect Methods/Measures Preferred/Used at the Course and Program Levels (examples: surveys, quantitative data, course grades, alumni surveys, student evaluation of instruction)

Learning Outcome 1: This is evaluated using a direct measure of the students' knowledge in Mathematical Modeling, Advanced Ordinary Differential Equations, and Numerical Analysis.

Learning Outcome 2: This is evaluated using a direct measure of the students' ability to apply advanced problem solving and critical thinking skills.

Learning Outcome 3: This is evaluated using a direct measure of the students' ability to communicate mathematics using a common rubric. This rubric will be used for comprehensive exam and thesis students both.

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6. Data Collection and Review

- When will data be collected for each outcome?
- How will data be collected for each outcome?

Learning Outcome 1: All students in the MS Math Program will be required to take courses in MATH 6342 Mathematical Modeling, MATH 6345 Advanced Ordinary Differential Equations, and MATH 6348 Numerical Analysis. These courses will be offered once per year. Students will be given common assignments embedded within each course.

Learning Outcome 2: All students in the MS Math Program will be required to take a course in MATH 6342 Mathematical Modeling. This course will be offered once per year. Students will be given a common problem assignment embedded within the course.

Learning Outcome 3: All students in the MS program will either take comprehensive exams or complete a thesis toward the end of the program. Students' ability to communicate mathematics will be evaluated from their comprehensive exam or thesis evaluated using a common rubric.

- What will be the benchmark/target for each outcome?

Learning Outcome 1:

- MATH 6342 Mathematical Modeling: At least 80% of students will score 80% or higher in both project report and project presentation using a common rubric.
- MATH 6345 Advanced Ordinary Differential Equations: At least 80% of students will score 75% or better on a common rubric.
- MATH 6348 Numerical Analysis: At least 80% of students will score 80% or higher on a class project.

Learning Outcome 2:

- MATH 6342 Mathematical Modeling: At least 80% of students will score 80% or higher in both project report and project presentation using a common rubric.

Learning Outcome 3:

- At least 80% of the students will score an average of 75% or higher on each student's comprehensive exam or thesis.

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7. Participation in Assessment Process

- Who will participate in carrying out the assessment plan?
- What will be their specific role/s?

The faculty member for each targeted course will administer the evaluations. The specific questions the students work will be created by a committee.

8. Data Analysis

- How and will the data and findings be shared with faculty?

The data and findings will be shared with the fully Mathematics department at an upcoming faculty meeting. The faculty will receive a written and oral presentation on the collected data and findings. This meeting will probably occur early in the fall semester.

- Who was involved in analyzing the results

The assessment committee will analyze the results. Certain other faculty members may be included, for instance if a faculty member's course is targeted in the assessment process.

- How are results aligned to outcomes and benchmarks?

This will be determined once the results are finalized. The assessment committee will make recommendations to the department if any of the student learning outcomes do not meet established benchmarks. These will be included in the assessment report.

9. What are the plans to evaluate students' post-graduate success?

Data will be collected from the UCA's Office of Institutional Research Exit Interview Questionnaire completed by all graduating seniors and alumni.

Our goal is that at least 75% of all graduates will be employed in a mathematics related field within six months of graduation or gain admission to graduate school within three years of graduation.

10. What are the plans to evaluate teaching effectiveness?

All faculty members are evaluated using the standard college-wide student evaluation each term.

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11. Appendices-Required....Curriculum Maps by Program, Assessment Tools (examples: Rubrics, Surveys, Tests, etc.), any other important materials/documentation.

- Curriculum Maps are found earlier in this document.
- Rubrics are found in Appendices A through C.

12. Submit Assessment Plan

- Send completed form electronically to assessment@uca.edu

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13. Appendix A: Rubrics for Learning Objective 1 (Mastered math concepts)

Rubric for MATH 6342 Mathematical Modeling (Two pages)

Note: This rubric is also shared with MATH 4306 Modeling And Simulation

RUBIC FOR MODELING AND SIMULATION

Group Name:

A. Report

Guidelines	Comments	Points Avail.	Points Received
1. Format: Does it have a clear, logical format (including Introduction, Conclusion, paragraphing, font size, etc.) 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20		20	
2. The Proposed Question: a/ Is the question clear and focused? 0 1 2 3 4 5 6 7 8 b/ Is the question meaningful and testable scientifically? 0 1 2 3 4 5 6 7 8		16	
3. Methodology: a/ Is the project well-designed? 0 1 2 3 4 5 6 7 8 9 10 b/ Are the variables, parameters etc. defined, appropriate and complete? 0 1 2 3 4 5 6 7 8 9 10 c/ Is the data collection and analysis systematic and appropriately used? 0 1 2 3 4 5 6 7 8 9 10 d/ Are the conclusions effectively supported? 0 1 2 3 4 5 6 7 8 9 10		40	
4. Thoroughness: a/ Is sufficient background provided? 0 1 2 3 4 5 6 7 b/ Is the supporting document clear and well presented? 0 1 2 3 4 5 6 7		14	
5. Creativity: a/ Does the project show creativity in the proposed problem? 0 1 2 3 4 5 b/ Does the project show creativity in the presented solution? 0 1 2 3 4 5		10	
		Total:	

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RUBIC FOR MODELING AND SIMULATION

Group Name:

Date Presented:

B. Presentation

Guidelines	Comments	Points Avail.	Points Received
1. Slideshow: a/ Is the slideshow composed in a meaningful way? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 b/ Are the slides clean and clear? 0 1 2 3 4 5 6 7 8 9 10 c/ Does it have a professional look? 0 1 2 3 4 5 d/ Does it show creativity in formatting, such as choosing theme, transition, font, etc? 0 1 2 3 4 5		35	
2. Presenting Manner: a/ Do the presenters speak loud and clear? 0 1 2 3 4 5 6 7 8 9 10 b/ Do the presenters project confidence? 0 1 2 3 4 5 6 7 8 9 10 c/ Do the presenters engage the audience (by showing enthusiasm, making eye contact, etc.)? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15		35	
3. Clarity: Is the material clearly presented (symbols are clear, no confusion in reading the slides, etc.)? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15		15	
4. Response to Questions: Are the answer thorough, clear and to the point? 0 1 2 3 4 5 6 7 8 9 10		10	
5. Asking other people: One question or two questions? 2 5		5	
		Total:	

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Rubric for MATH 6345 Advanced Ordinary Differential Equations to be developed (1 page)

Advanced ODE Final Exam Rubric					
Specific Skill	Student Learning Outcomes				
	4	3	2	1	0
Mathematical Content	The student has clearly demonstrated a command of the course material	The student has demonstrated knowledge in most of the key concepts of the course	The student has demonstrated knowledge in the some of the key concepts but lack understanding in others.	The student clearly does not understand most of the course content	Assign a zero for performance that does not meet a score of one (1).
Organization	The student presents the material in a highly organized efficient manner.	The student presents the material in a somewhat organized manner.	The student lacks some of the attributes in presenting the material clearly.	The student lacks most of the attributes in presenting the material clearly.	

Overall, has this student demonstrated appropriate knowledge and skills for this level in this discipline? ___ Yes ___ No

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Rubric for MATH 6348 Numerical Analysis to be developed (1 pages)

Numerical Analysis Project Rubric

Criterion	1-poor	2-below average	3-average	4-above average	5-excellent
Effort (20%)	Student's work showed little preparation, creativity, or effort. Lots of errors and typos.	Student put for minimal effort. Has a few errors and could have added more to the project.	Student gave effort to the project. Met most of expectations. Didn't go above and beyond.	Student spent a lot of time working to make sure the project was well done. Met all expectations.	Student went above and beyond the assignment. Did extra research and work.
Programming Skills (20%)	Student used no figures or tables to compare numerical methods.	Student used figures to compare methods, but left out titles, legends, or axes.	Student used figures and tables to compare methods.	Student used line styles or colors to distinguish methods in the figures.	Figures and tables are all well organized and clearly explained.
Understanding of Concepts (30%)	Student didn't incorporate concepts into the project. Misunderstood the ideas and principles.	Student understood a few of the concepts, but still left out pieces and parts of the assignment.	Student understood most of the concepts and completed all the tasks in the assignment.	Student understood all the concepts and completed all the tasks in the assignment.	Student mastered the concepts and did more than what was expected of him/her.
Correct Answers to Problems (30%)	Most or all of the answers to each problem were incorrect.	Half of the problems were incorrect.	Student got most of the problems correct with only a few errors.	Student got every problem correct.	Student got every problem correct, including the discussion.

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14. Appendix B: Rubrics for Learning Objective 2 (problem solving and critical thinking skills)

Rubric for MATH 6342 Mathematical Modeling (1 page)

Rubric for the Project of Math 6342 – Math Modeling	
Score	Work
100%	<ol style="list-style-type: none"> 1. The problem addressed in the project is very interesting, important, complex, and difficult. 2. Solutions and analysis of the problem are correct, innovative, and creative, and are of high mathematical or scientific value. 3. The paper about the project is well written and elegant, and has a form of a professional article. It could contain sections: 1. Introduction (introducing the general topic, describing the problem to be solved and the techniques to be used to solve the problem); 2. Results (stating results and proofs); 3. Discussion (discussing findings, difficulties in solving problems, unsolved problems, and potential future work); 4. References and sources are properly cited. 4. The presentation of the project is well prepared and organized and can greatly interest audience. It is vivid, accurate, clear, precise, succinct, coherent, and easy to understand. Presenters speak enthusiastically, energetically, and confidently at a moderate speed with varying tones.
80%	<ol style="list-style-type: none"> 1. The problem addressed in the project is interesting, important, complex, and difficult. 2. Solutions and analysis of the problem are correct and are of mathematical or scientific value. 3. The paper about the project is well written and has a form of a professional article. It could contain sections: 1. Introduction (introducing the general topic, describing the problem to be solved and the techniques to be used to solve the problem); 2. Results (stating results and proofs); 3. Discussion (discussing findings, difficulties in solving problems, unsolved problems, and potential future work); 4. References and sources are properly cited. 4. The presentation of the project is well prepared and organized and can interest audience. It is accurate, clear, precise, coherent, and easy to understand.
60%	<ol style="list-style-type: none"> 1. The problem addressed in the project is less interesting, important, complex, and difficult. 2. Solutions and analysis of the problem are mostly correct with a few minor errors and are of some mathematical or scientific value. 3. The paper about the project is written in a professional way, containing sections that describe the problems, solutions to the problems and citations of relevant references, but it is incomplete with some details missing or it contains errors. 4. The project is presented to the class, but not well prepared and organized.
40%	<ol style="list-style-type: none"> 1. The problem addressed in the project is simple and not interesting 2. Solutions and analysis of the problem contain some mistakes. 3. The paper about the project is written poorly. 4. The project is not presented to the class.
20%	<ol style="list-style-type: none"> 1. The problem addressed in the project is very simple and not interesting 2. Solutions and analysis of the problem contains many mistake, almost incorrect. 3. There are some writings on the project. 4. The project is not presented to the class.
0%	Nothing is done

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15. Appendix C: Rubrics for Learning Objective 3 (Communication)

Rubric for LO3 (Communication) (1 page).

Student Learning Outcomes					
Specific Skill or Knowledge Area Related to a Mathematics topic	4	3	2	1	0
Mathematical Content	Student's work is conceptually relevant and sophisticated.	Student's work is conceptually relevant, adequate, and clear.	Student's work may have some factual, interpretive, or conceptual errors or irrelevancies.	Student's work confuses some significant concepts.	Assign a zero for performance that does not meet a score of one (1).
Organization	Organizational pattern is clear and consistent, polished, and makes the mathematics content cohesive.	Organizational pattern is clear and consistent.	Organizational pattern is partially developed.	Organizational pattern is poorly developed and unclear.	
Supporting Material /Evidence	Student provides substantial, well-chosen evidence used strategically; apt definitions.	Student provides sufficient and appropriate evidence and makes effort to contextualize it.	Student provides some evidence but not always relevant, sufficient, or integrated into the response.	Student evidence is mostly narrative or anecdotal; awkwardly or incorrectly incorporated.	
Communicates Effectively	Demonstrates clear control of notation and mechanics that skillfully communicates understanding to readers. Work is virtually error-free.	Uses syntax and mechanics that generally conveys understanding to readers with clarity. The language has few errors. Work includes a few errors in language or notation.	Exhibits substantive errors in syntax and mechanics which, at times, impedes the clarity of the work.	Shows a serious pattern of error in notation and mechanics that interferes with meaning.	
Overall, has this student demonstrated appropriate knowledge and skills for this level in this discipline? __ Yes __ No __ This student did not turn in an acceptable response to the assignment (e.g., failed to turn in a paper, plagiarized, etc.)					