2015-2016 LONG SIGNATURE SHEET

RECEIVED 11-04-15

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UNC CHARLOTTE

Proposal Number: MATH 09-28-15

Proposal Title: Major Changes to MS-MATH Program of Study

Originating Department: Mathematics and Statistics

TYPE OF PROPOSAL: UNDERGRADUATE_____ GRADUATE__X__ UNDERGRADUATE & GRADUATE____
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
09/28/2015	09/28/2015	09/28/2015	*Approved*	DEPARTMENT CHAIR Yuanan Diao
			Approved 11-24-15	COLLEGE CURRICULUM COMMITTEE CHAIR Janet E. Levy [print name here:] Janet E Levy
			Approved	COLLEGE FACULTY CHAIR (if applicable) Elizabeth Stearns [print name here:] Elizabeth Stearns
			Approved	COLLEGE DEAN [print name here:] Shawn Long
			Approved	GENERAL EDUCATION (if applicable; for General Education courses) [print name here:]
			Approved	HONORS COLLEGE (if applicable; for Honors courses & programs) [print name here:]
			Approved	UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR (for undergraduate content)
12/7/15	1/5/16	2/2/16	*Approved*	GRADUATE COUNCIL CHAIR (for graduate content) Dennis Livesay
	[redacted]			FACULTY GOVERNANCE ASSISTANT (Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)

UNC CHARLOTTE

LONG FORM
COURSE AND CURRICULUM PROPOSAL

To: Dr. Dennis Livesay, Chair of The Graduate Council

From: Department of Mathematics and Statistics

Date: September 28, 2015

Re: Major Changes to MS-MATH Program of Study

Please find the attached proposal to modify the Master of Science in Mathematics program.

MATH 09-28-15

University of North Carolina at Charlotte

Revised Graduate

Course and Curriculum Proposal from: Department of Mathematics and Statistics

Title: Major Changes to MS-MATH Program of Study

II. CONTENT OF PROPOSAL

A. PROPOSAL SUMMARY

1. PROPOSAL SUMMARY

The Department of Mathematics and Statistics proposes the following changes to the Master of Science in Mathematics (MS-MATH) program of study and the Graduate Catalog.

1.1. Add a new concentration Mathematics Education into the MS-MATH program. The new concentration will replace the recently discontinued Master of Arts in Mathematics Education (MA-MAED) program. The relevant course creation and revision include

1.1.1. Creating one new course: MATH 6108/STAT 6108 - Probability and Statistics for Secondary Mathematics Teachers;

1.1.2. Combining the topics of the current MATH 6100, 6101, and 6102 course sequence in Foundations and Advanced Calculus into a pair of Real Analysis courses MATH 6101 and 6102; and

1.1.3. Re-titling the 6000-level courses in Algebra and Geometry to indicate that these are for secondary high school mathematics teachers.

1.2. Add a new Mathematical Finance course group for the General Mathematics concentration

1.3. Revise the MS-MATH catalog description reflecting and/or regarding:

1.3.1. Addition of the new Mathematics Education concentration;

1.3.2. Addition of the new Mathematical Finance course group for the General Mathematics concentration;

1.3.3. Discontinuation of OPRS courses 5111, 5112, 5113, and 5114; and

1.3.4. Correction of some editorial errors in the current catalog.

B. JUSTIFICATION

1. Identify the need addressed by the proposal and explain how the proposed action meets the need.

In proposing to add a new MS-MATH concentration in Mathematics Education, we have as our main need/goal to establish a more rigorous Masters program for high school mathematics teachers than was offered under the previous MA-MAED program. On the other hand, revisions to the current MS-MATH catalog are needed to make it more consistent and more explicit as well as to keep it updated with the current course offering.

a. Addition of the Mathematics Education concentration: The proposed concentration includes a combination of current and revised courses from the previous MA-MAED program that will: (1) Increase the Core content requirements of the previous MA-MAED program from 18 to 21 hours by adding a new course in probability and statistics (MATH 6108/STAT 6108: Probability and Statistics for Secondary Mathematics Teachers); (2) Revise and reorganize the 18 hours of mathematics content requirements into a format that provides students with both a stronger program of study as well as increased opportunities to choose from among a greater variety of graduate mathematics classes than was offered under the MA-MAED program; and (3) Revise the Professional Requirements from the previous MA-MAED program by deleting one course (RSCH 6101: Introduction to Educational Research).

In developing this proposal, we reviewed existing MS programs for high school mathematics teachers with particular focus on those offered within Mathematics departments. Based on our review of these programs, we believe that the proposed addition of a new Mathematics Education concentration into the MS-MATH program is the best option for the department to continue to offer a high quality master's degree to high school mathematics teachers. Justification for each of the proposed three specific actions is provided as follows:

1) Increase MATH Core Content Requirements. Since the last formal revision of the MA-MAED program in 1998, the professional organizations in mathematics education (such as MAA, MSEB, and NCTM) have extended their recommendations for high school mathematics teachers to include content expertise in subjects outside of the traditional areas of analysis, algebra, and geometry. By adding a new course in probability and statistics (MATH 6108/STAT 6108: Probability and Statistics for Secondary Mathematics Teachers), we follow the recommendations of the National Council of Teachers of Mathematics (NCTM) that graduate programs for secondary school mathematics teachers include rigorous coursework in probability and statistics.

2) Revise and Reorganize the Formal Mathematics Requirements. In our planning meetings we focused on strategies that would allow us to make use of existing master's level MATH classes thus avoiding the need to develop a large collection of new courses. In addition, we discussed ways to streamline the existing master's program courses. In particular, we propose to re-title the 6000-level courses in

Algebra and Geometry to indicate that these are for secondary high school mathematics teachers, and thus distinguish the courses from our other graduate mathematics courses. We also propose to give students more options for satisfying the formal mathematics content requirements. For example, we will now provide opportunities for students to take a class in Number Theory and History of Mathematical Thought. The revision of these courses together with the new course in Probability and Statistics will help make our program more rigorous and more consistent with MS programs in Mathematics departments at institutions such as the University of Wisconsin, the University of Minnesota, the University of Georgia, and Portland State University.

3) Revise the Professional Requirements from the previous MA-MAED program. We propose to delete a course from the Professional Requirements, RSCH 6101: Introduction to Research in Education. This course has not been very useful to our students. It has typically been taught as an introduction to statistical methods, a set of quantitative method topics that our students would have already completed as undergraduates. In addition, the most important purpose of the course is to introduce teachers to action research methods that will prepare them to conduct research in their respective classrooms. This topic is covered in greater detail and in a more appropriate mathematics education context in our own master's course, MAED 6123: Research in Mathematics Education.

b. **Addition of the Mathematical Finance course group for the General Mathematics concentration:** Since the last formal revision of the MS-MATH program, we have developed a series of math finance courses and have actually been allowing our MS-MATH students in the General Mathematics concentration to take these courses and use them to fulfill the 15 credit hours in 7000-level courses. Separating these math finance courses from other applied math courses to establish a Mathematical Finance course group for the General Mathematics concentration is to recognize the fact that Mathematical Finance has become a major and important field of applied mathematics.

e. **Revisions needed to make the catalog more accurate and more consistent:** Several places in the current catalog must be and have been revised in the proposal to reflect the addition of the Mathematics Education concentration into the MS-MATH program and the addition of the Mathematical Finance course group for the General Mathematics concentration. Also, the catalog description of the Applied Statistics concentration should be and has been re-organized in the proposal so as to be more consistent with the catalog descriptions of the other three concentrations. In addition, since the department has basically stopped offering OPRS courses, it would be misleading to still include them in the catalog so we propose to remove all OPRS courses from the MS catalog. Finally, some editorial errors introduced during the transition from the paper catalog to the online catalog must be and have been corrected in the proposal.

2. **Discuss prerequisites/corequisites for course(s) including class-standing, admission to the major, GPA, or other factors that would affect a student's ability to register.**

   The prerequisite for each of the three new or revised courses (MATH 6101, MATH 6102, and MATH 6108/STAT 6108) can be found from their catalog descriptions that are included in **Attachment III.** A common prerequisite for the three courses is the Admission into the M.S. in Mathematics with the Mathematics Education concentration.

3. **Demonstrate that course numbering is consistent with the level of academic advancement of students for whom it is intended.**

   The UNC Charlotte course numbering guidelines have been followed both for proposed new course and for revision of existing courses. The proposed course numbers are appropriate for graduate level coursework. More specifically, we have been using a course number MATH 610X for courses designed for secondary high school mathematics teachers.

4. **In general, how will this proposal improve the scope, quality and/or efficiency of programs and/or instruction?**

   The proposed change of adding the Mathematics Education concentration into the MS-MATH program will enhance the quality of our math education program in general. On the other hand, the proposed changes will not affect course offerings and instructions of any non-MAED courses and hence will not affect the quality of the three existing concentrations of the MS-MATH program.

5. **If course(s) has been offered previously under special topics numbers, give details of experience including number of times taught and enrollment figures.**

   None of the three courses MATH 6101, MATH 6102, and MATH 6108/STAT 6108 has been previously offered as special topics. However, the three courses based on which MATH 6101 and MATH 6102 are developed had been offered many times every other year and the typical enrollment had been about 5-8.

C. IMPACT.

1. **What group(s) of students will be served by this proposal? (Undergraduate and/or graduate; majors and/or non-majors, others? Explain). Describe how you determine which students will be served.**

   The proposal contains the changes only to the MS-MATH program, so only students interested in this program, including those secondary school mathematics teachers who are interested in pursuing a master's degree in Mathematics Education, will be impacted.

We expect that the addition of the MS degree concentration in Mathematics Education will improve our recruitment of students by offering a more attractive degree option for secondary mathematics teachers than what was offered under the previous MA-MAED program. At the same time, we do not anticipate the new concentration to compete with or draw from existing three MS concentrations in Mathematics and Statistics.

2. What effect will this proposal have on existing courses and curricula?

a. When and how often will added course(s) be taught?

The three courses MATH 6101, MATH 6102, and MATH 6108/STAT 6108 will be offered once every other year. More specifically, MATH 6101 and MATH 6102 are anticipated to be offered in fall and spring semesters, respectively.

b. How will the content and/or frequency of offering of other courses be affected?

The three courses are intended only for students admitted into the Mathematics Education concentration. As such, the content and the frequency of offering of the existing graduate-level courses in the MS-MATH program will not be affected by this proposal.

c. What is the anticipated enrollment in course(s) added (for credit and auditors)?

Enrollment in the proposed courses is anticipated to be 8 to 12 students.

d. How will enrollment in other courses be affected? How did you determine this?

It is expected that the enrollment in the existing non-MAED graduate-level courses in the MS-MATH program will not be affected at all since the three courses are intended only for students admitted into the Mathematics Education concentration.

c. Identify other areas of catalog copy that would be affected, including within other departments and colleges (e.g., curriculum outlines, requirements for the degree, prerequisites, articulation agreements, etc.)

The revised MS-MATH catalog copy can be found in **Attachment IV**. Catalog entries of other programs are not affected by this proposal.

III. Resources Required to Support Proposal.

A. Personnel

No new personnel resources are required to implement the proposed changes. Any of our stat faculty are qualified in teaching the proposed probability and statistics course MATH 6108/STAT 6108, while our math faculty who had been teaching the MATH 6100, 6101, and 6102 sequence will continue to teach the revised MATH 6101 and 6102 courses.

B. PHYSICAL FACILITY.

No additional facilities required.

C. EQUIPMENT AND SUPPLIES:

No additional equipment and supplies required.

D. COMPUTER.

No additional computer resources required.

E. AUDIO-VISUAL.

No additional audio and visual resources required.

F. OTHER RESOURCES.

Not applicable

G. SOURCE OF FUNDING

Not applicable

IV. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

A. LIBRARY CONSULTATION.

The Department consulted with Alison Bradley at the J. Murrey Atkins Library and was ensured that the present library holdings are adequate to support the proposed changes, in particular, the addition of the Mathematics Education concentration into the MS-MATH program. A copy of Consultation on Library Holdings can be found in **Attachment I**.

B. CONSULTATION WITH OTHER DEPARTMENTS OR UNITS

The Department consulted with the College of Education and a copy of their supporting letter of establishing the Mathematics Education concentration into MS-MATH is attached in **Attachment II**.

The Department also consulted with Dr. Weidong Tian, Director of the MS in Mathematical Finance program and Professor at the Department of Finance in the Belk College of Business. A copy of his supporting letter of adding the Mathematical Finance course group for the General Mathematics concentration of the MS-MATH program is attached in **Attachment II**.

C. HONORS COUNCIL CONSULTATION

The proposal does not involve Honors programs as well as any Honors courses. As such, no consultation with the Honors Council is conducted.

V. Initiation, Attachments and Consideration of the Proposal

A. Originating Unit

Discussion regarding the addition of a new Mathematics Education concentration into the MS-MATH program initiated during the 2014-2015 academic year among the Mathematics Education Committee, the department Chair, and the department Graduate Coordinator. The initial proposal was presented to the department Graduate Curriculum Committee (GCC) for consultation on May 6, 2015. The GCC fully supported the concept with some recommendations that have been incorporated into the latest proposal.

The Mathematics Education Committee, including Drs. Victor Cifarelli (Chair), Anna Athanasopoulou, Anthony Fernandes, Kim Harris, Adalira Saenz-Ludlow, and Michelle Stephan, voted 6-0 in favor of the specific proposal of adding a new MS concentration in Mathematics Education into the MS-MATH program. A copy of the committee's supporting letter can be found in **Attachment II-A**.

The Graduate Curriculum Committee, including Drs. Shaozhong Deng (Chair), Joel Avrin, Wei Cai, Victor Cifarelli, Anthony Fernandes, Jiancheng Jiang, Shaoyu Li, and Weihua Zhou, voted 8-0 in favor of the proposed MS-MATH catalog revision on September 25, 2015. A copy of the committee's supporting letter can be found in **Attachment II-B**.

B. Credit Hour (Mandatory if new and/or revised course in proposal)

☒ The appropriate faculty committee has reviewed the course outline/syllabus for each of the three courses (MATH 6101, MATH 6102, and MATH 6108/STAT 6108) and has determined that the assignments are sufficient to meet the University definition of a credit hour.

C. Attachments

1. Consultation

   A copy of Consultation on Library Holdings can be found in **Attachment I**.

   A copy of Consultation with the College of Education can be found in **Attachment II-C.**

   A copy of Consultation with the Department of Finance can be found in **Attachment II-D.**

2. Course Outline/Syllabus

   Outlines/syllabi for the proposed new or revised courses can be found in **Attachment III**.

3. PROPOSED CATALOG COPY

The proposed complete catalog copy for the revised MS-MATH program can be found in **Attachment IV**.

The proposed catalog copy for each of the three new or revised courses (MATH 6101, MATH 6102, and MATH 6108) can be found in **Attachment III.**

a. For MATH 6101, check all the statements that apply:
____ This course will be cross listed with another course.
__X_ There are prerequisites for this course.
____ There are corequisites for this course.
____ This course is repeatable for credit.
____ This course will increase/decrease the number of credits hours currently offered by its program.
__X_ This proposal results in the deletion of an existing course(s) from the degree program and/or catalog. (Namely, MATH 6100)

a. For MATH 6102, check all the statements that apply:
____ This course will be cross listed with another course.
__X_ There are prerequisites for this course.
____ There are corequisites for this course.
____ This course is repeatable for credit.
____ This course will increase/decrease the number of credits hours currently offered by its program.
__X_ This proposal results in the deletion of an existing course(s) from the degree program and/or catalog. (Namely, MATH 6100)

a. For MATH 6108, check all the statements that apply:
__X_ This course will be cross listed with another course. (Namely, STAT 6108)
__X_ There are prerequisites for this course.
____ There are corequisites for this course.
____ This course is repeatable for credit.
____ This course will increase/decrease the number of credits hours currently offered by its program.
____ This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.

4. ACADEMIC PLAN OF STUDY (UNDERGRADUATE ONLY)

☐ Yes.
☐ No.

5. STUDENT LEARNING OUTCOMES (UNDERGRADUATE & GRADUATE)

☐ Yes.
☒ No.

6. TEXTBOOK COSTS

☒ Yes. Briefly explain below.
☐ No. Briefly explain below.

Electronic textbooks, textbook rentals, and the buyback program have been considered in this proposal.

Attachment I: Consultation on Library Holdings

UNC CHARLOTTE

J. Murrey Atkins Library

Consultation on Library Holdings

To: Victor Cifarelli

From: Alison Bradley

Date: 9/16/15

Subject: MS concentration in Math Education

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley **Date:** 9/16/15

Check One:

1. Holdings are superior ____
2. Holdings are adequate __x__
3. Holdings are adequate only if Dept. purchases additional items. ____
4. Holdings are inadequate ____

Comments:
Library holdings should be adequate to support student research for this proposed curriculum revision, particularly as many classes (see list of items held by subject heading below). Students will have access to relevant databases including ERIC, Education Research Complete, MathSciNet, and many others.

LC Subject Heading	Books	Journals
Mathematics - Study and teaching	1441	67
Mathematics - Methodology	160	4
Mathematical analysis	3165	68
Number theory	524	1

Evaluator's Signature

9/16/15

Date

Attachment II-A: Supporting Letter from MAED Committee

UNC CHARLOTTE
College of Liberal Arts & Sciences
Mathematics and Statistics
9201 University City Blvd. Charlotte, NC 28223-0001
t/ 704.687.0620 f/ 704.687.1302 ms.li@uncc.edu

TO: Shanzhong Deng, Chair, Graduate Curriculum Committee, Dept. of Mathematics & Statistics

FROM: Vic Cifarelli, Coordinator, Mathematics Education, Dept. of Mathematics & Statistics

RE: Proposal to Add New MS Concentration in Mathematics Education

DATE: September 16, 2015

The Mathematics Education Committee has met and votes 6-0 in favor of the proposal to add a new MS concentration in Mathematics Education.

Please feel free to contact me at 704-687-0632 or vvcifarc@uncc.edu if you have any questions.

Attachment II-B: Supporting Letter from GCC

UNC CHARLOTTE
College of Liberal Arts & Sciences
Mathematics and Statistics
9201 University City Blvd, Charlotte, NC 28223-0001
t/ 704.687.0620 f/ 704.687.1392 math@uncc.edu

TO: Yuanan Diao, Chair, Dept. of Mathematics and Statistics

FROM: Shaozhong Deng, Chair, Graduate Curriculum Committee. J. Deng
Dept. of Mathematics and Statistics

RE: Major Changes to MS-MATH program of study

DATE: September 27, 2015

The 2015-2016 Graduate Curriculum Committee has met and approved by a 8-0 vote the proposed changes to the Master of Science in Mathematics program of study.

Please feel free to contact me at 704-687-0634 or shaodeng@uncc.edu if you have any questions.

Attachment II-C: Supporting Letter from College of Education

UNC CHARLOTTE
College of Education

Office of the Dean
9201 University City Blvd., Charlotte, NC 28223-0001
(704) 687-8722, www.uncc.edu

Memorandum

To: Dr. Vic Cifarelli, Coordinator, Mathematics Education
Department of Mathematics & Statistics, College of Liberal Arts and Sciences

From: Dr. Melba Spooner, Senior Associate Dean
College of Education

Date: 11/24/15

Re: Proposal to establish a new course in Mathematics Education within the Existing MS in Mathematics

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The College of Education supports the development of the proposal to establish a new concentration in Mathematics Education within the existing Master of Science Degree in Mathematics. We have reviewed the proposal and conferred with the Dean and Associate Deans of the CLAS. In that conversation we discussed and agreed upon the need to address multiple pathways for candidates who want to pursue a master's degree in secondary teacher education (advanced preparation). It was agreed upon at that time that the COED would pursue establishing a mathematics concentration under the existing M.Ed. in Middle/ Secondary Education as well. A proposal was developed last spring and given temporary approval for two cohorts of candidates.

These pathways (MS and M.Ed.) will help to better direct candidates in the path they desire – heavier content focus or heavier pedagogy focus. We believe by expanding these options we, as a campus can better advise and direct candidates to assist them in meeting their career and professional goals with a program of study that is directly relevant to those goals.

We look forward to our continued work together to offer coursework and programming that helps the respective programs and the university meets its goal of serving our state and region in preparing quality educators. Please do continue to reach out to Dr. Hart as the blueprint for licensure will need to be approved by the State Board of Education. Please let me know if you need additional information or consultation regarding this proposal.

Attachment II-D: Supporting Letter from Finance Department

UNC CHARLOTTE

BELK COLLEGE of BUSINESS

Department of Finance

9201 University City Blvd, Charlotte, NC 28223-0001
t/ 704.687.5375 f/ 704.687.1412 www.belkcollege.uncc.edu

TO: Shaozhong Deng, Chair, Graduate Curriculum Committee, Department of Mathematics & Statistics

FROM: Weidong Tian, Program Director, Master of Science in Mathematical Finance Program, Department of Finance, Belk College of Business

RE: Proposal to Add New MS Concentration in Mathematics Education

DATE: January 29, 2015

I am in favor of the proposal to add a new Mathematical Finance course group for the General Mathematics concentration of the Master of Science in Mathematics program. It will help the education of the Master of Science in Mathematical Finance Program and also recognize the importance of Mathematical Finance as a field of applied mathematics.

Please feel free to contact with me at 704-687-7702 or wtian1@uncc.edu if you have any question.

Attachment III:

Course Descriptions and Syllabi
Course Descriptions and Syllabi

MATH 6101 - Real Analysis for Secondary Mathematics Teachers I

Course Description (Proposed Catalog Copy)

MATH 6101. Real Analysis for Secondary Mathematics Teachers I (3). Prerequisite: Admission into the M.S. in Mathematics with the Mathematics Education concentration; successful completion of undergraduate calculus sequence; experience in writing formal mathematical proofs. Study of the axiomatic method and characteristics of axiomatic systems. Axiomatic and historical development of real and complex numbers. Introduction to transfinite numbers. Rigorous development of limits and continuity of functions. (*Fall, alternate years*)

Course Objectives

The mathematics courses in the Mathematics Education concentration are different from standard graduate courses in mathematics. Rather than studying new and more advanced topics in mathematics, students in this concentration participate in a more advanced study of some of topics from the secondary school curriculum and the undergraduate mathematics curriculum. In this course, students will develop their understanding of the real and complex number systems using an axiomatic approach. They will take a detailed look at mathematical functions and develop a richer understanding of the concepts of limits and continuity. As a result of a more rigorous approach to the foundations of calculus, students will develop their own abilities to understand and write their own mathematical proofs.

Upon completion of this course, the successful student will be able to:

1. Discuss the components of the axiomatic method and the characteristics of an axiomatic system.
2. Explain the difference between finite and infinite sets and countable and uncountable sets and provide examples of each.
3. Prove that the set of rational numbers is countable and the set of real numbers is uncountable.
4. Use the Peano Postulates and Dedekind cuts to construct the set of integers from natural numbers, the rational numbers from integers, and the real numbers from rational numbers.
5. Discuss the properties of real numbers and provide examples and proofs.
6. Construct the set of complex numbers from the real numbers, and discuss the properties of the set of complex numbers.
7. Provide rigorous definitions for the limit of a function and the continuity of a function. Discuss properties and examples with appropriate proofs.
8. Explain the Intermediate Value Theorem and the Extreme Value Theorem and discuss instance of each theorem.

Instructional Method

The primary format for instruction will be lectures and discussions. Students will also work in pairs and small groups when appropriate.

Means of Student Evaluation

Student performance will be evaluated by two tests, homework assignments, and a cumulative final exam. (The weight of these components will be at the discretion of the course instructor.) It is anticipated that final letter grades will be awarded as follows:

A = 90% to 100%, B = 80% to 89%, C = 70% to 79%, U = <70%

Course Policies

- Academic Integrity: Students have the responsibility to know and observe the requirements of the UNC Charlotte Code of Student Academic Integrity. This code forbids cheating, fabrication, or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any special requirements or permission regarding academic integrity in this course will be stated by the instructor and are binding on all students. Academic evaluations in this course include judgments that student work is free from academic dishonesty of any type and grades in this course will be adversely affected by violations of this code. The normal penalty for a first offense is zero credit on the work involving dishonesty and possible further reduction in course grade. In most cases the course grade is reduced to F. Standards of academic integrity will be enforced in this course. I will follow the guidelines for faculty in enforcing the code. The Code of Student Academic Integrity is explained in detail at the website, http://legal.uncc.edu/policies/up-407. If you have not read the Code of Student Responsibility, I would recommend that you read that as well.

- Attendance: Attendance is very important, and attendance will be noted at each class meeting. The effect of unexcused absences on the final course grade will be at the discretion of the course instructor.

- Additional policies

  - Check your email regularly. Your UNCC email will be used for all course correspondence. Moodle will be used as a class management system – NOT A CLASS REPLACEMENT SYSTEM. Check http://moodle2.uncc.edu regularly for course information.
  - Treat all other classmates (and your instructor) with the same respect and courtesy with which you want to be treated. Classroom discussion is meant to allow us to hear a variety of viewpoints. This can only happen if we respect each other – our differences and our opinions.

- Classroom discussion should be civilized and respectful to everyone as well as relevant to the topic we are discussing.
- Disruptive movement and talking is not acceptable. Coming to class late and leaving early are disruptive.
- Turn off your cell phones and put them away.
- Classroom Diversity: UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.
- Disability Services: UNC Charlotte is committed to access to education. If you have a disability and need academic accommodations, please provide a letter of accommodation from Disability Services early in the semester. For more information on accommodations, contact the Office of Disability Services at 704-687-0040 or visit their office at Fretwell 230.

Textbooks and Resources

Bloch, E. D. (2013). *The real numbers and real analysis*. New York: Springer.

Eves, H. (1997). *Foundations and fundamental concepts of mathematics* (3rd ed.). Mineola, NY: Dover.

Rudin, W. (2006). *Principles of mathematical analysis* (3rd ed.). Columbus, OH: McGraw-Hill.

Stoll, R. R. (1979). *Set theory and logic*. New York: Dover.

Wilder, R. L. (1983). *The foundations of mathematics* (2nd ed.). Malabar, FL: Robert E. Krieger Publishing.

Course Outline

I. Modern Axiomatic Method
   A. Components – Undefined terms, axioms, definitions, theorems
   B. Properties – Equivalence, consistency, independence, completeness, categoricalness

II. Set Theory
   A. Finite and infinite sets
   B. Cardinal numbers of finite and infinite sets
   C. Countable and uncountable sets
   D. Continuum hypothesis

III. Construction of the Set of Real Numbers
   A. Axioms for natural numbers

B. Construction of the set of integers
C. Axioms for integers
D. Construction of the set of rational numbers
E. Dedekind cuts
F. Construction of the set of real numbers

IV. Properties of the Set of Real Numbers
A. Axioms for the set of real numbers
B. Algebraic properties of the set of real numbers
C. Induction and recursion
D. Least upper bound property
E. Uniqueness
F. Decimal expansion of real numbers

V. Limits
A. Rigorous ($\varepsilon - \delta$) definition
B. Properties of limits

VI. Continuity of Functions
A. Rigorous definition
B. Continuity of sums, products, quotients, and compositions of functions
C. Intermediate Value Theorem
D. Extreme Value Theorem

MATH 6102 - Real Analysis for Secondary Mathematics Teachers II

Course Description (Proposed Catalog Copy)

MATH 6102. Real Analysis for Secondary Mathematics Teachers II (3). Prerequisite: Successful completion of MATH 6101. A rigorous approach to differentiation and integration of functions of one variable. Special emphasis on logarithmic, exponential, and trigonometric functions. (*Spring, alternate years*)

Course Objectives

The mathematics courses in the Mathematics Education concentration are different from standard graduate courses in mathematics. Rather than studying new and more advanced topics in mathematics, students in this concentration participate in a more advanced study of some of topics from the secondary school curriculum and the undergraduate mathematics curriculum. In this course, students will develop their understanding of the basic processes of calculus – differentiation and integration. They will take a detailed look at transcendental mathematical functions, in particular logarithmic, exponential, and trigonometric functions. As a result of a more rigorous approach to the foundations of calculus, students will develop their own abilities to understand and write their own mathematical proofs.

Upon completion of this course, the successful student will be able to:

1. State and explain the derivative of a function.
2. Derive and apply the power rule, product rule, quotient rule, and chain rule for finding derivatives of functions.
3. State and apply the Mean Value Theorem.
4. Explain how the derivative is related to increasing and decreasing functions, local and global extrema, and concavity.
5. Use Riemann sums to explain the integral.
6. Explain the Fundamental Theorem of Calculus and the relationship between the derivative and integral.
7. Compute definite integrals and represent an indefinite integral as a function.
8. Use integration to find area and arc lengths.
9. Explain transcendental functions.
10. For exponential, logarithmic, and trigonometric functions, discuss domains, ranges, properties, and relationships.

Instructional Method

The primary format for instruction will be lectures and discussions. Students will also work in pairs and small groups when appropriate.

Means of Student Evaluation

Student performance will be evaluated by two tests, homework assignments, and a cumulative final exam. (The weight of these components will be at the discretion of the course instructor.) It is anticipated that final letter grades will be awarded as follows:

A = 90% to 100%, B = 80% to 89%, C = 70% to 79%, U = <70%

Course Policies

- Academic Integrity: Students have the responsibility to know and observe the requirements of the UNC Charlotte Code of Student Academic Integrity. This code forbids cheating, fabrication, or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any special requirements or permission regarding academic integrity in this course will be stated by the instructor and are binding on all students. Academic evaluations in this course include judgments that student work is free from academic dishonesty of any type and grades in this course will be adversely affected by violations of this code. The normal penalty for a first offense is zero credit on the work involving dishonesty and possible further reduction in course grade. In most cases the course grade is reduced to F. Standards of academic integrity will be enforced in this course. I will follow the guidelines for faculty in enforcing the code. The Code of Student Academic Integrity is explained in detail at the website, http://legal.uncc.edu/policies/up-407. If you have not read the Code of Student Responsibility, I would recommend that you read that as well.

- Attendance: Attendance is very important, and attendance will be noted at each class meeting. The effect of unexcused absences on the final course grade will be at the discretion of the course instructor.

- Additional policies
  - Check your email regularly. Your UNCC email will be used for all course correspondence. Moodle will be used as a class management system – NOT A CLASS REPLACEMENT SYSTEM. Check http://moodle2.uncc.edu regularly for course information.
  - Treat all other classmates (and your instructor) with the same respect and courtesy with which you want to be treated. Classroom discussion is meant to allow us to hear a variety of viewpoints. This can only happen if we respect each other – our differences and our opinions.
  - Classroom discussion should be civilized and respectful to everyone as well as relevant to the topic we are discussing.

- Disruptive movement and talking is not acceptable. Coming to class late and leaving early are disruptive.
- Turn off your cell phones and put them away.
- Classroom Diversity: UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.
- Disability Services: UNC Charlotte is committed to access to education. If you have a disability and need academic accommodations, please provide a letter of accommodation from Disability Services early in the semester. For more information on accommodations, contact the Office of Disability Services at 704-687-0040 or visit their office at Fretwell 230.

Textbooks and Resources

Bloch, E. D. (2013). *The real numbers and real analysis*. New York: Springer.

Morgan, F. (2005). *Real analysis*. Providence, RI: American Mathematical Society.

Rudin, W. (2006). *Principles of mathematical analysis* (3rd ed.). Columbus, OH: McGraw-Hill.

Course Outline

VII. Differentiation
- A. Limit definition of the derivative
- B. Derive rules for finding derivatives – power rule, product rule, quotient rule, and chain rule
- C. Mean Value Theorem
- D. Applications of the derivative

VIII. Integration
- A. The Riemann Integral
- B. Upper sums and lower sums
- C. Properties of the Riemann Integral
- D. Fundamental Theorem of Calculus
- E. Computing antiderivatives
- F. Area and arc length

IX. Transcendental Functions
- A. Logarithmic and exponential functions
- B. Trigonometric functions

MATH 6108/STAT 6108
Probability and Statistics for Secondary Mathematics Teachers

Course Description (Proposed Catalog Copy)

MATH 6108/STAT 6108. Probability and Statistics for Secondary Mathematics Teachers (3). Prerequisite: Admission into the M.S. in Mathematics with the Mathematics Education concentration. Topics from probability and statistics appropriate for high school mathematics teachers. Topics in probability include discrete and continuous random variables, probability distributions, sums and functions of random variables, the law of large numbers, and the central limit theorem. Topics in statistics include sample mean and variance, estimating distributions, correlation, regression, and hypothesis testing. (*Alternate years*)

Course Objectives

Upon completion of this course, students will be able to demonstrate the following:

- basic concepts of probability theory including the axioms of probability, independence, and conditional probability;
- the concept of random variables, properties of common types of random variables, how to identify them and use them to solve probabilistic problems;
- evaluation and interpretation of descriptive statistics, which include a variety of graphical displays (bar, line, picture, circle, scatterplot, box and whisker, stem and leaf) and numerical descriptive statistics such as mean, variance, etc.;
- the idea of constructing statistical models;
- basic problems of inferential statistics such as confidence interval, hypotheses testing and regression analysis.

Instructional Method

This course will be taught using a variety of methods, including lecture/discussion, collaborative groups, and other formats appropriate to the content and goals of the course.

Means of Student Evaluation

Student performance will be evaluated based on in-class exams and a variety of assignments that could include individual or group projects, take-home exams and other types of homework, quizzes and class presentations. (The evaluation and weight of these components are at the discretion of the individual instructor.) It is anticipated that final letter grades will be awarded as follows:

A = 90% to 100%, B = 80% to 89%, C = 70% to 79%, U = <70%

Course Policies

- Academic Integrity: Students have the responsibility to know and observe the requirements of the UNC Charlotte Code of Student Academic Integrity. This code forbids cheating, fabrication, or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any special requirements or permission regarding academic integrity in this course will be stated by the instructor and are binding on all students. Academic evaluations in this course include judgments that student work is free from academic dishonesty of any type and grades in this course will be adversely affected by violations of this code. The normal penalty for a first offense is zero credit on the work involving dishonesty and possible further reduction in course grade. In most cases the course grade is reduced to F. Standards of academic integrity will be enforced in this course. I will follow the guidelines for faculty in enforcing the code. The Code of Student Academic Integrity is explained in detail at the website, http://legal.uncc.edu/policies/up-407. If you have not read the Code of Student Responsibility, I would recommend that you read that as well.

- Attendance: Attendance is very important, and attendance will be noted at each class meeting. The effect of unexcused absences on the final course grade will be at the discretion of the course instructor.

- Additional policies
  - Check your email regularly. Your UNCC email will be used for all course correspondence. Moodle will be used as a class management system – NOT A CLASS REPLACEMENT SYSTEM. Check http://moodle2.uncc.edu regularly for course information.
  - Treat all other classmates (and your instructor) with the same respect and courtesy with which you want to be treated. Classroom discussion is meant to allow us to hear a variety of viewpoints. This can only happen if we respect each other – our differences and our opinions.
  - Classroom discussion should be civilized and respectful to everyone as well as relevant to the topic we are discussing.
  - Disruptive movement and talking is not acceptable. Coming to class late and leaving early are disruptive.
  - Turn off your cell phones and put them away.
  - Classroom Diversity: UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socio-economic status.
  - Disability Services: UNC Charlotte is committed to access to education. If you have a disability and need academic accommodations, please provide a letter of accommodation from Disability Services early in the semester. For more information on accommodations, contact the Office of Disability Services at 704-687-0040 or visit their office at Fretwell 230.

Textbook

The textbook will be selected by the instructor. Potential textbooks include:

- *Statistics*, 4th Edition, by David Freedman, Robert Pisani, Roger Purves.
- *Probability and Statistics for Engineering and the Sciences*, 8th Edition by J.L. Devore.
- *A Modern Introduction to Probability and Statistics,* by Dekking, Kraaikamp, Lopuhaa, and Meester

Content Outline (tentative)

Chapter 1: Introduction

- What is Statistics?
- The importance of Statistics
- Population vs Sample, Parameter vs Statistic, Descriptive vs Inferential statistics
- What is a good sample?
- Type of data

Chapter 2: Descriptive Statistics

- Graphic tools to describe qualitative data
- Graphic tools to describe quantitative data
- Numerical tools to describe quantitative data
  - Measure of central tendency
  - Measure of variation
  - Measure of position
- Empirical Rule and Chebychev's Theorem
- Z-score

Chapter 3: Probability

- What is probability?
- Some basic facts about probability
- Permutation and combination
- Dependence and independence, conditional probability

Chapter 4: Random Variables and Discrete Probability Distribution

- Type of random variables
- Discrete distribution, the mean and standard deviation
- Binomial distribution
- Poisson distribution

Chapter 5: Normal Distribution

- The distribution for a continuous random variable
- The Normal distribution
- Some calculation based on the normal distribution
- Normal Approximation for Binomial Distributions

Chapter 6: Sampling Distribution

- What is the sampling distribution?
- The Central Limit Theorem
- The distribution of sample mean $\bar{x}$
- The distribution of sample proportion $\hat{p}$

Chapter 7: Estimating with Confidence

- Confidence Intervals: The Basics.
- Confidence Interval for the Population Mean
  - Large sample case
  - Small sample case
- Confidence Interval for the Difference of Two Population Means
  - Large samples case
  - Small samples case
- Confidence Interval for the Population Proportion: One and Two sample problems

Chapter 8: Tests with Hypotheses for a single sample

- Hypotheses testing: The Basics
- Testing for the Population Mean
  - One sample z-test (large sample)
  - One sample t-test (small sample)
- Testing for the Population Proportion

Chapter 9: Comparing two populations or groups

- Tests for two independent samples
  - Large samples case
  - Small samples case
- Tests for two dependent (paired) samples

Chapter 10: Simple linear regression

- Scatterplots and Correlation
- The simple linear regression model
- The least square estimate (LSE)
- Statistical inference for LSE
- Residual analysis and Q-Q plot.

Chapter 11: Multiple linear regression

- The multiple linear regression model
- The least square estimate
- Some basic statistical inferences

Chapter 12: Chi-square Goodness-of-fit test and One Way ANOVA

- Goodness-of-fit test
- One-way ANOVA

Attachment IV: Proposed MS-MATH Catalog (clean version)

Mathematics, M.S.

The Master of Science Degree in Mathematics is organized into four concentrations:

1. Concentration in General Mathematics
2. Concentration in Applied Mathematics
3. Concentration in Applied Statistics
4. Concentration in Mathematics Education

The Concentration in General Mathematics is a robust but flexible program that allows a student to develop a broad background in Mathematics ranging over a variety of courses chosen from both pure and applied areas, or to tailor a program toward a particular focus that may not be as closely covered by the department's other degree concentrations (e.g., one that is interdisciplinary in nature).

The Concentration in Applied Mathematics develops analytical and computational skills focused toward applications of mathematics in the physical sciences as encountered in industry, government, and academia.

The Concentration in Applied Statistics provides theoretical understanding of, and training in, statistical analysis and methods applicable to particular areas of business, industry, government, and academia.

The Concentration in Mathematics Education is designed primarily for secondary school mathematics teachers interested in professional growth in mathematics teaching. Emphasis in this program is given to developing depth and breadth in mathematics teaching and learning, appropriate to the role of the secondary school teacher.

Degree Requirements

All candidates, regardless of which concentration is chosen, are required to take two courses in mathematical or statistical analysis and a comprehensive exam. Students in all concentrations except for the Mathematics Education concentration may also choose a thesis option for 3-6 credit hours towards the required credit hour total.

Concentration In General Mathematics

The Master of Science degree concentration in General Mathematics is designed both to provide advanced skills and knowledge for persons seeking positions in industry, government, or teaching at the community college level, and to provide professional development to persons currently in such positions. Qualified graduates are also prepared to enter directly into at least the second year of a Ph.D. program in mathematics, applied mathematics, or statistics, depending on the particular course of study.

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for the concentration in General Mathematics:

- Applicants must present evidence of the satisfactory completion of at least 27 credit hours of mathematics approved by the department Graduate Committee.
- A satisfactory score is required on at least the Quantitative portion of the general Graduate Record Examination.
- It is recommended that the student have a basic knowledge of at least two of the areas of algebra, real analysis, and topology.

Concentration Requirements

The Master of Science degree concentration in General Mathematics requires successful completion of at least 30 credit hours of graduate work approved by the department Graduate Committee, including: MATH 5143 and MATH 5144 or their equivalents; at least one course each from two of the groups I, II, III, V, and VI below; and at least 15 credit hours in 7000-level courses. No credit shall be given for 6000-level math courses other than math finance courses in the group V. With the approval of the department Graduate Committee, a 3 credit hour 6000-level course in another department of a theoretical nature or a 3 credit hour 6000-level math finance course may be applied toward the 15 credit hours in the 7000-level courses. Candidates for the degree concentration must demonstrate, to the satisfaction of the department Graduate Committee, competence on general knowledge in at least three of six groupings of courses listed below. This may be accomplished by (a) successful performance on a written or oral comprehensive examination or (b) successful completion of courses in these areas.

Group I Applied Mathematics

- MATH 5165 - Numerical Linear Algebra (3)
- MATH 5171 - Numerical Solution of Ordinary Differential Equations (3)
- MATH 5172 - The Finite Element Method (3)
- MATH 5173 - Ordinary Differential Equations (3)
- MATH 5174 - Partial Differential Equations (3)
- MATH 5176 - Numerical Methods for Partial Differential Equations (3)
- MATH 7172 - Partial Differential Equations (3)
- MATH 7176 - Advanced Numerical Analysis (3)
- MATH 7177 - Applied Optimal Control (3)
- MATH 7178 - Computational Methods for Fluid Dynamics (3)
- MATH 7273 - Advanced Finite Element Analysis (3)

Group II Probability-Statistics

- STAT 5123 - Applied Statistics I (3)
- STAT 5124 - Applied Statistics II (3)
- STAT 5126 - Theory of Statistics I (3)
- STAT 5127 - Theory of Statistics II (3)
- STAT 7027 - Topics in Statistics (3)
- STAT 7122 - Advanced Statistics I (3)
- STAT 7123 - Advanced Statistics II (3)
- STAT 7127 - Linear Statistical Models (3)
- STAT 7133 - Multivariate Analysis (3)
- MATH 5128 - Applied Probability I (3)
- MATH 5129 - Applied Probability II (3)
- MATH 7120 - Probability Theory I (3)
- MATH 7121 - Probability Theory II (3)
- MATH 7125 - Stochastic Processes I (3)

Group III Algebra-Topology

- MATH 5163 - Modern Algebra (3)
- MATH 5164 - Abstract Linear Algebra (3)
- MATH 5181 - Introduction to Topology (3)
- MATH 7163 - Modern Algebra I (3)
- MATH 7164 - Modern Algebra II (3)

Group IV Analysis

- MATH 5143 - Analysis I (3)
- MATH 5144 - Analysis II (3)
- MATH 7141 - Complex Analysis I (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7144 - Real Analysis II (3)

Group V Mathematical Finance

- MATH 6202 - Derivatives II: Partial Differential Equations for Finance (3)
- MATH 6203 - Stochastic Calculus for Finance I (3)
- MATH 6204 - Numerical Methods for Financial Derivatives (3)
- MATH 6205 - Financial Computing (3)
- MATH 6206 - Stochastic Calculus for Finance II (3)

Group VI Computer Science

All 5000- and 6000-level Computer Science courses

Assistantships

A number of graduate assistantships are available each year (with nationally-competitive stipends) for qualified applicants. A limited number of fellowship awards can be applied to supplement these stipends for especially qualified students.

Thesis

Completion of a thesis is optional. With the approval of the department Graduate Committee, a candidate may receive up to six of the 15 hours required at the 7000 level for the writing of a master's thesis on an approved topic. This thesis may be original work, work of an expository nature, or the mathematical formulation and solution of a particular industrial or business problem suggested by the career interests of the student. A candidate may receive no more than six of the hours required at the 7000 level for course and thesis work in another department. If the thesis option is selected, the candidate will be required to defend his/her thesis in an oral examination.

Comprehensive Examination

A candidate must perform satisfactorily on a written or oral comprehensive examination over his/her program of study.

Concentration in Applied Mathematics

The Master of Science degree concentration in Applied Mathematics is designed to develop critical thinking, intuition, and advanced experience in the techniques of mathematical analysis and their application to the problems of industry and technology. Skills are developed to deal with technical problems encountered in industry, business, and government and to hold leadership positions therein; to teach Applied Mathematics at the undergraduate or community college level; and to potentially study Applied Mathematics leading to the Ph.D. degree.

Concentration Requirements

A candidate for the Master of Science degree concentration in Applied Mathematics must complete at least 30 credit hours of graduate work approved by the department Graduate Committee to include:

Core Courses (21 credit hours)

- MATH 5143 - Analysis I (3)
- MATH 5144 - Analysis II (3)
- MATH 5165 - Numerical Linear Algebra (3)

Numerical Analysis Courses

Select one of the following:

- MATH 5171 - Numerical Solution of Ordinary Differential Equations (3)
- MATH 5172 - The Finite Element Method (3)
- MATH 5176 - Numerical Methods for Partial Differential Equations (3)

Advanced Analysis Courses

Select one of the following:

- MATH 7141 - Complex Analysis I (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7144 - Real Analysis II (3)

Advanced Applied Mathematics Courses

Select two of the following:

- MATH 7172 - Partial Differential Equations (3)
- MATH 7176 - Advanced Numerical Analysis (3)
- MATH 7177 - Applied Optimal Control (3)
- MATH 7178 - Computational Methods for Fluid Dynamics (3)
- MATH 7179 - Advanced Finite Difference Methods (3)
- MATH 7273 - Advanced Finite Element Analysis (3)

Elective Courses (6 credit hours)

Advanced Elective Courses

Select one of the following:

- MATH 7141 - Complex Analysis I (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7144 - Real Analysis II (3)
- MATH 7172 - Partial Differential Equations (3)
- MATH 7176 - Advanced Numerical Analysis (3)
- MATH 7177 - Applied Optimal Control (3)
- MATH 7178 - Computational Methods for Fluid Dynamics (3)
- MATH 7179 - Advanced Finite Difference Methods (3)
- MATH 7273 - Advanced Finite Element Analysis (3)
- MATH 7893 - Thesis (0-3)

Mathematics or Application Elective Courses

Select one Mathematics or suitable area of application course with the approval of the student's advisor. Suggested electives include:

- STAT 5123 - Applied Statistics I (3)
- MEGR 6116 - Fundamentals of Heat Transfer and Fluid Flow (3)
- MEGR 6141 - Theory of Elasticity I (3)
- MEGR 7112 - Radiative Heat Transfer (3)
- MEGR 7114 - Advanced Fluid Mechanics (3)

Research Seminar (3 credit hours)

All candidates for the degree concentration must complete three hours of a Research Seminar course in which they carry out an independent project under the supervision of a member of the graduate faculty. The project could involve a specific application to a concrete problem of techniques identified in the literature or studied in other courses. All projects are subject to prior approval of the department Graduate Committee and must be successfully defended before a committee of three graduate faculty members appointed by the department Graduate Committee.

- MATH 7691 - Research Seminar (1-3)

Assistantships

A number of graduate assistantships are available each year (with nationally-competitive stipends) for qualified applicants. A limited number of fellowship awards can be applied to supplement these stipends for especially qualified students.

Thesis

A student may choose to expand the work begun in MATH 7691 into a master's thesis by registering for three hours of MATH 7893 to fulfill the advanced elective requirement described above. This thesis option affords the student the opportunity to do professional/scholarly work demonstrating proficiency in the area of Applied Mathematics.

Comprehensive Examination

Each candidate for the degree concentration in Applied Mathematics must perform satisfactorily on a final comprehensive examination. This examination will be set and administered by a committee appointed by the department Graduate Committee. It may be in either written or oral form, and it will cover those areas of study and/or research deemed appropriate by the committee.

Concentration in Applied Statistics

The Master of Science degree concentration in Applied Statistics is designed to provide advanced skills and knowledge in the planning, design, testing, and implementation of statistical methods. Skills are developed to deal with problems encountered in statistical applications in business, industry, and government; to hold administrative positions requiring planning and implementation of statistical analysis; to teach statistics at the undergraduate or community college level; and to potentially study statistics leading to the Ph.D. degree.

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for the concentration in Applied Statistics:

- An overall GPA of at least 3.0 on all previous college work including a GPA of at least 3.0 in courses prerequisite to the area of applied statistics.
- Evidence of undergraduate preparation in mathematics and computer science including: 12 credit hours of calculus at the level of MATH 1241, MATH 1242, MATH 2241, and MATH 2242; 3 credit hours of linear algebra at the level of MATH 2164; 3 credit hours of differential equations at the level of MATH 2171; 6 credit hours of probability and statistics at the level of MATH 3122 and MATH 3123; and 3 credit hours of computer programming at the level of ITCS 1214.

Concentration Requirements

A candidate for the Master of Science degree concentration in Applied Statistics must complete a minimum of 33 credit hours of graduate work approved by the department Graduate Committee, including:

Core Courses (21 credit hours)

- STAT 5123 - Applied Statistics I (3)
- STAT 5124 - Applied Statistics II (3)
- STAT 5126 - Theory of Statistics I (3)
- STAT 5127 - Theory of Statistics II (3)
- STAT 7027 - Topics in Statistics (3)
- STAT 7127 - Linear Statistical Models (3)
- STAT 7133 - Multivariate Analysis (3)

Note:

Students who, because of their undergraduate work or other experience, can demonstrate sufficient knowledge of the material in one or more of the core courses may be exempted from taking the course or courses. Exemption from a course carries no credit towards the degree concentration.

Elective Courses (9 credit hours)

MATH/STAT or Applied Elective Courses

Select two courses from an approved list. Examples include:

- STAT 7027 - Topics in Statistics (3)
- MATH 5128 - Applied Probability I (3)
- MATH 5129 - Applied Probability II (3)
- MATH 5143 - Analysis I (3)
- MATH 5165 - Numerical Linear Algebra (3)
- MATH 7120 - Probability Theory I (3)
- MATH 7121 - Probability Theory II (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7692 - Research Seminar (1-3)

MATH or STAT Elective Course

Select any MATH or STAT course at the 7000-level.

Research Seminar (3 credit hours)

All candidates for the Master of Science degree concentration in Applied Statistics are required to complete 3 credit hours of a Research Seminar in which they carry out an independent project under the supervision of a member of the graduate faculty. The project could involve a specific application of techniques identified in the literature or studied in other courses. All projects are subject to the prior approval of the department Graduate Committee and must be successfully defended before a committee of three graduate faculty members appointed by the department Graduate Committee.

- MATH 7691 - Research Seminar (1-3)

Assistantships

A number of graduate assistantships are available each year (with nationally-competitive stipends) for qualified applicants. A limited number of fellowship awards can be applied to supplement these stipends for especially qualified students.

Thesis

A student may choose to expand the work begun in MATH 7691 into a master's thesis by registering for 3 hours of MATH 7893 to fulfill the MATH/STAT 7000-level elective course requirement above. This thesis option affords the student the opportunity to do professional and scholarly work demonstrating proficiency in the area of applied statistics.

Comprehensive Examination

Each candidate for the Master of Science degree concentration in Applied Statistics must perform satisfactorily on an oral comprehensive examination over the candidate's program of study.

Concentration In Mathematics Education

The Master of Science degree concentration in Mathematics Education is designed primarily for secondary school mathematics teachers interested in professional growth in mathematics teaching. Emphasis in this program is given to developing depth and breadth in mathematics teaching and learning, appropriate to the role of the secondary school teacher.

By the end of his/her first semester in the program, each student will select a member of the Mathematics Education faculty who will serve as his/her Graduate Advisor throughout the program. Approval of the program of each student and provision of advice regarding progress toward the degree are the responsibility of the Graduate Advisor.

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for graduate study in Mathematics Education:

1. Twenty-seven hours of undergraduate coursework in Mathematics beyond the freshman level, or evidence of equivalent academic preparation.
2. Possession of a North Carolina "A" teacher's license or the equivalent from another state. An applicant may be admitted on the condition that he/she satisfies the Class "A" requirements early in his/her course of study. Work applied to the Class "A" deficiency may not be applied toward the degree.
3. Two years of full-time experience teaching mathematics in a secondary school or other acceptable teaching experience.
4. A satisfactory score is required on the general Graduate Record Examination.

Concentration Requirements

Candidates for the Master of Science degree concentration in Mathematics Education must complete a minimum of 33 semester hours of graduate credit or the equivalent. Of these, 18 hours must be in courses numbered 6000 or above. Programs of study beyond these 33 hours may be required to remove deficiencies in undergraduate programs or to develop areas of need, interest, or desired experience.

Core Content Requirements (21 hours)

21 hours of graduate-level mathematics courses selected in consultation with the Graduate Advisor, covering Real Analysis, Mathematical Foundations and Algebra, Geometry, Probability and Statistics, and the History of Mathematics.

- MATH 5109 - History of Mathematical Thought (3)
- MATH 6101 - Real Analysis for Secondary Mathematics Teachers I (3)
- MATH 6102 - Real Analysis for Secondary Mathematics Teachers II (3)
- MATH 6108/STAT 6108 - Probability and Statistics for Secondary Mathematics Teachers (3)
- MATH 6118 - Non-Euclidean Geometry (3)

Mathematical Foundations and Algebra Courses

Select two of the following:

- MATH 5161 - Number Theory (3)
- MATH 6106 - Modern Algebra for Secondary Mathematics Teachers (3)
- MATH 6107 - Linear Algebra for Secondary Mathematics Teachers (3)

Mathematics Education Requirements (9 hours)

9 hours of graduate-level courses covering mathematics education learning theory, research, and contemporary topics in secondary mathematics teaching.

- MAED 6122 - Theoretical Foundations of Learning Mathematics (3)
- MAED 6123 - Research in Mathematics Education (3)
- MAED 6124 - Issues in the Teaching of Secondary School Mathematics (3)

Professional Education Requirements (3 hours)

3 hours of graduate-level professional education coursework:

- MDSK 6260 Principles of Teacher Leadership (3)

Basic Portfolio

Each student must complete a Basic Portfolio consisting of documents and artifacts that provides evidence of the student's professional growth during the program.

Substitutions to satisfy any of the Concentration Requirements must be approved by the Graduate Advisor and the Mathematics Education Coordinator.

Comprehensive Examination

Upon successful completion of all coursework, each candidate for the MS degree with concentration in Mathematics Education must pass a comprehensive final exam consisting of two parts. The student must pass an oral exam on the mathematics content courses. The second part of the exam involves the student presenting documentation that demonstrates his/her professional growth as teachers and educational researchers. The student has the option of presenting either a research-based project or a comprehensive portfolio. The Graduate Advisor will advise and assist the student in planning his/her Comprehensive Portfolio or Final Research Report.

List of MATH Courses

- MATH 5000 - Topics in Foundations or History of Mathematics
- MATH 5040 - Topics in Analysis
- MATH 5060 - Topics in Algebra
- MATH 5080 - Topics in Geometry and Topology
- MATH 5109 - History of Mathematical Thought
- MATH 5128 - Applied Probability I
- MATH 5129 - Applied Probability II
- MATH 5143 - Analysis I
- MATH 5144 - Analysis II
- MATH 5161 - Number Theory
- MATH 5163 - Modern Algebra
- MATH 5164 - Abstract Linear Algebra
- MATH 5165 - Numerical Linear Algebra
- MATH 5171 - Numerical Solution of Ordinary Differential Equations
- MATH 5172 - The Finite Element Method
- MATH 5173 - Ordinary Differential Equations
- MATH 5174 - Partial Differential Equations
- MATH 5176 - Numerical Methods for Partial Differential Equations
- MATH 5181 - Introduction to Topology
- MATH 5691 - Seminar
- MATH 5692 - Seminar
- MATH 6004 - Topics in Analysis
- MATH 6008 - Topics in Geometry and Topology
- MATH 6050 - Topics in Mathematics

- MATH 6101 - Real Analysis for Secondary Mathematics Teachers I
- MATH 6102 - Real Analysis for Secondary Mathematics Teachers II
- MATH 6103 - Computer Techniques and Numerical Methods
- MATH 6105 - Problem Solving in Discrete Mathematics
- MATH 6106 - Modern Algebra for Secondary Mathematics Teachers
- MATH 6107 - Linear Algebra for Secondary Mathematics Teachers
- MATH 6108 - Probability and Statistics for Secondary Mathematics Teachers
- MATH 6118 - Non-Euclidean Geometry
- MATH 6171 - Advanced Applied Mathematics I
- MATH 6172 - Advanced Applied Mathematics II

- MATH 6202 - Derivatives II: Partial Differential Equations for Finance
- MATH 6203 - Stochastic Calculus for Finance I
- MATH 6204 - Numerical Methods for Financial Derivatives
- MATH 6205 - Financial Computing
- MATH 6206 - Stochastic Calculus for Finance II
- MATH 6609 - Seminar
- MATH 7028 - Topics in Probability
- MATH 7050 - Topics in Mathematics
- MATH 7065 - Topics in Applied Algebra and Algebraic Structures
- MATH 7070 - Topics in Numerical Analysis
- MATH 7071 - Topics in Differential Equations
- MATH 7120 - Probability Theory I

- MATH 7121 - Probability Theory II
- MATH 7125 - Stochastic Processes I
- MATH 7126 - Stochastic Processes II
- MATH 7141 - Complex Analysis I
- MATH 7142 - Complex Analysis II
- MATH 7143 - Real Analysis I
- MATH 7144 - Real Analysis II
- MATH 7147 - Applied Functional Analysis
- MATH 7148 - Functional Analysis
- MATH 7163 - Modern Algebra I
- MATH 7164 - Modern Algebra II
- MATH 7172 - Partial Differential Equations
- MATH 7173 - Evolution Equations
- MATH 7174 - Linear and Nonlinear Waves
- MATH 7175 - Inverse Problems
- MATH 7176 - Advanced Numerical Analysis
- MATH 7177 - Applied Optimal Control
- MATH 7178 - Computational Methods for Fluid Dynamics
- MATH 7179 - Advanced Finite Difference Methods
- MATH 7181 - Topology I
- MATH 7182 - Topology II
- MATH 7184 - Differential Geometry I
- MATH 7185 - Differential Geometry II
- MATH 7273 - Advanced Finite Element Analysis
- MATH 7275 - Dynamical Systems I
- MATH 7276 - Dynamical Systems II
- MATH 7277 - Bifurcation Theory
- MATH 7691 - Research Seminar
- MATH 7692 - Research Seminar
- MATH 7890 - Industrial Internship
- MATH 7893 - Thesis
- MATH 8028 - Topics in Probability
- MATH 8050 - Topics in Mathematics
- MATH 8065 - Topics in Applied Algebra and Algebraic Structures
- MATH 8070 - Topics in Numerical Analysis
- MATH 8071 - Topics in Differential Equations
- MATH 8120 - Probability Theory I
- MATH 8121 - Probability Theory II
- MATH 8125 - Stochastic Processes I
- MATH 8126 - Stochastic Processes II
- MATH 8141 - Complex Analysis I
- MATH 8142 - Complex Analysis II
- MATH 8143 - Real Analysis I
- MATH 8144 - Real Analysis II
- MATH 8147 - Applied Functional Analysis
- MATH 8148 - Functional Analysis
- MATH 8163 - Modern Algebra I
- MATH 8164 - Modern Algebra II
- MATH 8172 - Partial Differential Equations
- MATH 8173 - Evolution Equations
- MATH 8174 - Linear and Nonlinear Waves

- MATH 8175 - Inverse Problems
- MATH 8177 - Applied Optimal Control
- MATH 8178 - Computational Methods for Fluid Dynamics
- MATH 8179 - Advanced Finite Difference Methods
- MATH 8181 - Topology I
- MATH 8182 - Topology II
- MATH 8184 - Differential Geometry I
- MATH 8185 - Differential Geometry II
- MATH 8202 - Partial Differential Equations for Finance
- MATH 8203 - Stochastic Calculus for Finance
- MATH 8204 - Numerical Methods for Financial Derivatives
- MATH 8273 - Advanced Finite Element Analysis
- MATH 8275 - Dynamical Systems I
- MATH 8276 - Dynamical Systems II
- MATH 8277 - Bifurcation Theory
- MATH 8691 - Research Seminar
- MATH 8692 - Research Seminar
- MATH 8890 - Industrial Internship
- MATH 8994 - Doctoral Research and Reading
- MATH 8999 - Doctoral Dissertation Research

List of STAT Courses

- STAT 5123 - Applied Statistics I
- STAT 5124 - Applied Statistics II
- STAT 5126 - Theory of Statistics I
- STAT 5127 - Theory of Statistics II
- STAT 6027 - Topics in Statistics
- STAT 6108 - Probability and Statistics for Secondary Mathematics Teachers
- STAT 6113 - Cross-Section and Time-Series Econometrics
- STAT 6127 - Introduction to Biostatistics
- STAT 7027 - Topics in Statistics
- STAT 7122 - Advanced Statistics I
- STAT 7123 - Advanced Statistics II
- STAT 7124 - Sampling Theory
- STAT 7127 - Linear Statistical Models
- STAT 7133 - Multivariate Analysis
- STAT 7890 - Industrial Internship
- STAT 8027 - Topics in Statistics
- STAT 8110 - Applied Biostatistics: Regression
- STAT 8111 - Applied Biostatistics: Multivariate Methods
- STAT 8122 - Advanced Statistics I
- STAT 8123 - Advanced Statistics II
- STAT 8124 - Sampling Theory
- STAT 8127 - Linear Statistical Models
- STAT 8133 - Multivariate Analysis
- STAT 8890 - Industrial Internship

Attachment IV: Proposed Catalog (version with track changes)

Mathematics, M.S.

The Master of Science Degree in Mathematics is organized into four concentrations:

1. Concentration in General Mathematics
2. Concentration in Applied Mathematics
3. Concentration in Applied Statistics
4. Concentration in Mathematics Education

The Concentration in General Mathematics is a robust but flexible program that allows a student to develop a broad background in Mathematics ranging over a variety of courses chosen from both pure and applied areas, or to tailor a program toward a particular focus that may not be as closely covered by the department's other degree concentrations (e.g., one that is interdisciplinary in nature).

The Concentration in Applied Mathematics develops analytical and computational skills focused toward applications of mathematics in the physical sciences as encountered in industry, government, and academia.

The Concentration in Applied Statistics provides theoretical understanding of, and training in, statistical analysis and methods applicable to particular areas of business, industry, government, and academia.

The Concentration in Mathematics Education is designed primarily for secondary school mathematics teachers interested in professional growth in mathematics teaching. Emphasis in this program is given to developing depth and breadth in mathematics teaching and learning, appropriate to the role of the secondary school teacher.

Degree Requirements

All candidates, regardless of which concentration is chosen, are required to take two courses in mathematical or statistical analysis and a comprehensive exam. Students in all concentrations except for the Mathematics Education concentration may also choose a thesis option for 3-6 credit hours towards the required credit hour total.

Concentration In General Mathematics

The Master of Science degree concentration in General Mathematics is designed both to provide advanced skills and knowledge for persons seeking positions in industry, government, or teaching at the community college level, and to provide professional development to persons currently in such positions. Qualified graduates are also prepared to enter directly into at least the second year of a Ph.D. program in mathematics, applied mathematics, or statistics, depending on the particular course of study.

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for the concentration in General Mathematics:

- Applicants must present evidence of the satisfactory completion of at least 27 credit hours of mathematics approved by the department Graduate Committee.
- A satisfactory score is required on at least the Quantitative portion of the general Graduate Record Examination.
- It is recommended that the student have a basic knowledge of at least two of the areas of algebra, real analysis, and topology.

Concentration Requirements

The Master of Science degree concentration in General Mathematics requires successful completion of at least 30 credit hours of graduate work approved by the department Graduate Committee, including: MATH 5143 and MATH 5144 or their equivalents; at least one course each from two of the groups I, II, III, V, and VI below; and at least 15 credit hours in 7000-level courses. No credit shall be given for 6000-level math courses other than math finance courses in the group V. With the approval of the department Graduate Committee, a 3 credit hour 6000-level course in another department of a theoretical nature or a 3 credit hour 6000-level math finance course may be applied toward the 15 credit hours in the 7000-level courses. Candidates for the degree concentration must demonstrate, to the satisfaction of the department Graduate Committee, competence on general knowledge in at least three of six groupings of courses listed below. This may be accomplished by (a) successful performance on a written or oral comprehensive examination or (b) successful completion of courses in these areas.

Group I Applied Mathematics

- MATH 5165 - Numerical Linear Algebra (3)
- MATH 5171 - Numerical Solution of Ordinary Differential Equations (3)
- MATH 5172 - The Finite Element Method (3)
- MATH 5173 - Ordinary Differential Equations (3)
- MATH 5174 - Partial Differential Equations (3)
- MATH 5176 - Numerical Methods for Partial Differential Equations (3)
- MATH 7172 - Partial Differential Equations (3)
- MATH 7176 - Advanced Numerical Analysis (3)
- MATH 7177 - Applied Optimal Control (3)
- MATH 7178 - Computational Methods for Fluid Dynamics (3)
- MATH 7273 - Advanced Finite Element Analysis (3)

Group II Probability-Statistics

- STAT 5123 - Applied Statistics I (3)
- STAT 5124 - Applied Statistics II (3)
- STAT 5126 - Theory of Statistics I (3)
- STAT 5127 - Theory of Statistics II (3)
- STAT 7027 - Topics in Statistics (3)
- STAT 7122 - Advanced Statistics I (3)
- STAT 7123 - Advanced Statistics II (3)
- STAT 7127 - Linear Statistical Models (3)
- STAT 7133 - Multivariate Analysis (3)
- MATH 5128 - Applied Probability I (3)
- MATH 5129 - Applied Probability II (3)
- MATH 7120 - Probability Theory I (3)
- MATH 7121 - Probability Theory II (3)
- MATH 7125 - Stochastic Processes I (3)

Group III Algebra-Topology

- MATH 5163 - Modern Algebra (3)
- MATH 5164 - Abstract Linear Algebra (3)
- MATH 5181 - Introduction to Topology (3)
- MATH 7163 - Modern Algebra I (3)
- MATH 7164 - Modern Algebra II (3)

Group IV Analysis

- MATH 5143 - Analysis I (3)
- MATH 5144 - Analysis II (3)
- MATH 7141 - Complex Analysis I (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7144 - Real Analysis II (3)

Group V Mathematical Finance

- MATH 6202 - Derivatives II: Partial Differential Equations for Finance (3)
- MATH 6203 - Stochastic Calculus for Finance I (3)
- MATH 6204 - Numerical Methods for Financial Derivatives (3)
- MATH 6205 - Financial Computing (3)
- MATH 6206 - Stochastic Calculus for Finance II (3)

Group VI Computer Science

All 5000- and 6000-level Computer Science courses

Assistantships

A number of graduate assistantships are available each year (with nationally-competitive stipends) for qualified applicants. A limited number of fellowship awards can be applied to supplement these stipends for especially qualified students.

Thesis

Completion of a thesis is optional. With the approval of the department Graduate Committee, a candidate may receive up to six of the 15 hours required at the 7000 level for the writing of a master's thesis on an approved topic. This thesis may be original work, work of an expository nature, or the mathematical formulation and solution of a particular industrial or business problem suggested by the career interests of the student. A candidate may receive no more than six of the hours required at the 7000 level for course and thesis work in another department. If the thesis option is selected, the candidate will be required to defend his/her thesis in an oral examination.

Comprehensive Examination

A candidate must perform satisfactorily on a written or oral comprehensive examination over his/her program of study.

Concentration in Applied Mathematics

The Master of Science degree concentration in Applied Mathematics is designed to develop critical thinking, intuition, and advanced experience in the techniques of mathematical analysis and their application to the problems of industry and technology. Skills are developed to deal with technical problems encountered in industry, business, and government and to hold leadership positions therein; to teach Applied Mathematics at the undergraduate or community college level; and to potentially study Applied Mathematics leading to the Ph.D. degree.

Concentration Requirements

A candidate for the Master of Science degree concentration in Applied Mathematics must complete at least 30 credit hours of graduate work approved by the department Graduate Committee to include:

Core Courses (21 credit hours)

- MATH 5143 - Analysis I (3)
- MATH 5144 - Analysis II (3)
- MATH 5165 - Numerical Linear Algebra (3)

Numerical Analysis Courses

Select one of the following:

- MATH 5171 - Numerical Solution of Ordinary Differential Equations (3)
- MATH 5172 - The Finite Element Method (3)
- MATH 5176 - Numerical Methods for Partial Differential Equations (3)

Advanced Analysis Courses

Select one of the following:

- MATH 7141 - Complex Analysis I (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7144 - Real Analysis II (3)

Advanced Applied Mathematics Courses

Select two of the following:

- MATH 7172 - Partial Differential Equations (3)
- MATH 7176 - Advanced Numerical Analysis (3)
- MATH 7177 - Applied Optimal Control (3)
- MATH 7178 - Computational Methods for Fluid Dynamics (3)
- MATH 7179 - Advanced Finite Difference Methods (3)
- MATH 7273 - Advanced Finite Element Analysis (3)

Elective Courses (6 credit hours)

Advanced Elective Courses

Select one of the following:

- MATH 7141 - Complex Analysis I (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7144 - Real Analysis II (3)
- MATH 7172 - Partial Differential Equations (3)
- MATH 7176 - Advanced Numerical Analysis (3)
- MATH 7177 - Applied Optimal Control (3)
- MATH 7178 - Computational Methods for Fluid Dynamics (3)
- MATH 7179 - Advanced Finite Difference Methods (3)
- MATH 7273 - Advanced Finite Element Analysis (3)
- MATH 7893 - Thesis (0-3)

Mathematics or Application Elective Courses

Select one Mathematics or suitable area of application course with the approval of the student's advisor. Suggested electives include:

- STAT 5123 - Applied Statistics I (3)
- MEGR 6116 - Fundamentals of Heat Transfer and Fluid Flow (3)
- MEGR 6141 - Theory of Elasticity I (3)
- MEGR 7112 - Radiative Heat Transfer (3)
- MEGR 7114 - Advanced Fluid Mechanics (3)

Research Seminar (3 credit hours)

All candidates for the degree concentration must complete three hours of a Research Seminar course in which they carry out an independent project under the supervision of a member of the graduate faculty. The project could involve a specific application to a concrete problem of techniques identified in the literature or studied in other courses. All projects are subject to prior approval of the department Graduate Committee and must be successfully defended before a committee of three graduate faculty members appointed by the department Graduate Committee.

- MATH 7691 - Research Seminar (1-3)

Assistantships

A number of graduate assistantships are available each year (with nationally-competitive stipends) for qualified applicants. A limited number of fellowship awards can be applied to supplement these stipends for especially qualified students.

Thesis

A student may choose to expand the work begun in MATH 7691 into a master's thesis by registering for three hours of MATH 7893 to fulfill the advanced elective requirement described above. This thesis option affords the student the opportunity to do professional/scholarly work demonstrating proficiency in the area of Applied Mathematics.

Comprehensive Examination

Each candidate for the degree concentration in Applied Mathematics must perform satisfactorily on a final comprehensive examination. This examination will be set and administered by a committee appointed by the department Graduate Committee. It may be in either written or oral form, and it will cover those areas of study and/or research deemed appropriate by the committee.

Concentration in Applied Statistics

The Master of Science degree concentration in Applied Statistics is designed to provide advanced skills and knowledge in the planning, design, testing, and implementation of statistical methods. Skills are developed to deal with problems encountered in statistical applications in business, industry, and government; to hold administrative positions requiring planning and implementation of statistical analysis; to teach statistics at the undergraduate or community college level; and to potentially study statistics leading to the Ph.D. degree.

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for the concentration in Applied Statistics:

- An overall GPA of at least 3.0 on all previous college work including a GPA of at least 3.0 in courses prerequisite to the area of applied statistics.
- Evidence of undergraduate preparation in mathematics and computer science including: 12 credit hours of calculus at the level of MATH 1241, MATH 1242, MATH 2241, and MATH 2242; 3 credit hours of linear algebra at the level of MATH 2164; 3 credit hours of differential equations at the level of MATH 2171; 6 credit hours of probability and statistics at the level of MATH 3122 and MATH 3123; and 3 credit hours of computer programming at the level of ITCS 1214.

Concentration Requirements

A candidate for the Master of Science degree concentration in Applied Statistics must complete a minimum of 33 credit hours of graduate work approved by the department Graduate Committee, including:

Core Courses (21 credit hours)

- STAT 5123 - Applied Statistics I (3)
- STAT 5124 - Applied Statistics II (3)
- STAT 5126 - Theory of Statistics I (3)
- STAT 5127 - Theory of Statistics II (3)
- STAT 7027 - Topics in Statistics (3)
- STAT 7127 - Linear Statistical Models (3)
- STAT 7133 - Multivariate Analysis (3)

Note:

Students who, because of their undergraduate work or other experience, can demonstrate sufficient knowledge of the material in one or more of the core courses may be exempted from taking the course or courses. Exemption from a course carries no credit towards the degree concentration.

Elective Courses (9 credit hours)

MATH/STAT or Applied Elective Courses

Select two courses from an approved list. Examples include:

- STAT 7027 - Topics in Statistics (3)
- MATH 5128 - Applied Probability I (3)
- MATH 5129 - Applied Probability II (3)
- MATH 5143 - Analysis I (3)
- MATH 5165 - Numerical Linear Algebra (3)
- MATH 7120 - Probability Theory I (3)
- MATH 7121 - Probability Theory II (3)
- MATH 7143 - Real Analysis I (3)
- MATH 7692 - Research Seminar (1-3)

MATH or STAT Elective Course

Select any MATH or STAT course at the 7000-level.

Research Seminar (3 credit hours)

All candidates for the Master of Science degree concentration in Applied Statistics are required to complete 3 credit hours of a Research Seminar in which they carry out an independent project under the supervision of a member of the graduate faculty. The project could involve a specific application of techniques identified in the literature or studied in other courses. All projects are subject to the prior approval of the department Graduate Committee and must be successfully defended before a committee of three graduate faculty members appointed by the department Graduate Committee.

- MATH 7691 - Research Seminar (1-3)

Assistantships

A number of graduate assistantships are available each year (with nationally-competitive stipends) for qualified applicants. A limited number of fellowship awards can be applied to supplement these stipends for especially qualified students.

Thesis

A student may choose to expand the work begun in MATH 7691 into a master's thesis by registering for 3 hours of MATH 7893 to fulfill the MATH/STAT 7000-level elective course requirement above. This thesis option affords the student the opportunity to do professional and scholarly work demonstrating proficiency in the area of applied statistics.

Comprehensive Examination

Each candidate for the Master of Science degree concentration in Applied Statistics must perform satisfactorily on an oral comprehensive examination over the candidate's program of study.

Concentration In Mathematics Education

The Master of Science degree concentration in Mathematics Education is designed primarily for secondary school mathematics teachers interested in professional growth in mathematics teaching. Emphasis in this program is given to developing depth and breadth in mathematics teaching and learning, appropriate to the role of the secondary school teacher.

By the end of his/her first semester in the program, each student will select a member of the Mathematics Education faculty who will serve as his/her Graduate Advisor throughout the program. Approval of the program of each student and provision of advice regarding progress toward the degree are the responsibility of the Graduate Advisor.

Additional Admission Requirements

In addition to the general requirements for admission to the Graduate School, the following are required for graduate study in Mathematics Education:

5. Twenty-seven hours of undergraduate coursework in Mathematics beyond the freshman level, or evidence of equivalent academic preparation.
6. Possession of a North Carolina "A" teacher's license or the equivalent from another state. An applicant may be admitted on the condition that he/she satisfies the Class "A" requirements early in his/her course of study. Work applied to the Class "A" deficiency may not be applied toward the degree.
7. Two years of full-time experience teaching mathematics in a secondary school or other acceptable teaching experience.
8. A satisfactory score is required on the general Graduate Record Examination.

Concentration Requirements

Candidates for the Master of Science degree concentration in Mathematics Education must complete a minimum of 33 semester hours of graduate credit or the equivalent. Of these, 18 hours must be in courses numbered 6000 or above. Programs of study beyond these 33 hours may be required to remove deficiencies in undergraduate programs or to develop areas of need, interest, or desired experience.

Core Content Requirements (21 hours)

21 hours of graduate-level mathematics courses selected in consultation with the Graduate Advisor, covering Real Analysis, Mathematical Foundations and Algebra, Geometry, Probability and Statistics, and the History of Mathematics.

- MATH 5109 - History of Mathematical Thought (3)
- MATH 6101 - Real Analysis for Secondary Mathematics Teachers I (3)
- MATH 6102 - Real Analysis for Secondary Mathematics Teachers II (3)
- MATH 6108/STAT 6108 - Probability and Statistics for Secondary Mathematics Teachers (3)
- MATH 6118 - Non-Euclidean Geometry (3)

Mathematical Foundations and Algebra Courses

Select two of the following:

- MATH 5161 - Number Theory (3)
- MATH 6106 - Modern Algebra for Secondary Mathematics Teachers (3)
- MATH 6107 - Linear Algebra for Secondary Mathematics Teachers (3)

Mathematics Education Requirements (9 hours)

9 hours of graduate-level courses covering mathematics education learning theory, research, and contemporary topics in secondary mathematics teaching.

- MAED 6122 - Theoretical Foundations of Learning Mathematics (3)
- MAED 6123 - Research in Mathematics Education (3)
- MAED 6124 - Issues in the Teaching of Secondary School Mathematics (3)

Professional Education Requirements (3 hours)

3 hours of graduate-level professional education coursework:

- MDSK 6260 Principles of Teacher Leadership (3)

Basic Portfolio

Each student must complete a Basic Portfolio consisting of documents and artifacts that provides evidence of the student's professional growth during the program.

Substitutions to satisfy any of the Concentration Requirements must be approved by the Graduate Advisor and the Mathematics Education Coordinator.

Comprehensive Examination

Upon successful completion of all coursework, each candidate for the MS degree with concentration in Mathematics Education must pass a comprehensive final exam consisting of two parts. The student must pass an oral exam on the mathematics content courses. The second part of the exam involves the student presenting documentation that demonstrates his/her professional growth as teachers and educational researchers. The student has the option of presenting either a research-based project or a comprehensive portfolio. The Graduate Advisor will advise and assist the student in planning his/her Comprehensive Portfolio or Final Research Report.

List of MATH Courses

- MATH 5000 - Topics in Foundations or History of Mathematics
- MATH 5040 - Topics in Analysis
- MATH 5060 - Topics in Algebra
- MATH 5080 - Topics in Geometry and Topology
- MATH 5109 - History of Mathematical Thought
- MATH 5128 - Applied Probability I
- MATH 5129 - Applied Probability II
- MATH 5143 - Analysis I
- MATH 5144 - Analysis II
- MATH 5161 - Number Theory
- MATH 5163 - Modern Algebra
- MATH 5164 - Abstract Linear Algebra
- MATH 5165 - Numerical Linear Algebra
- MATH 5171 - Numerical Solution of Ordinary Differential Equations
- MATH 5172 - The Finite Element Method
- MATH 5173 - Ordinary Differential Equations
- MATH 5174 - Partial Differential Equations
- MATH 5176 - Numerical Methods for Partial Differential Equations
- MATH 5181 - Introduction to Topology
- MATH 5691 - Seminar
- MATH 5692 - Seminar
- MATH 6004 - Topics in Analysis
- MATH 6008 - Topics in Geometry and Topology
- MATH 6050 - Topics in Mathematics
-
- MATH 6101 - Real Analysis for Secondary Mathematics Teachers I
- MATH 6102 - Real Analysis for Secondary Mathematics Teachers II
- MATH 6103 - Computer Techniques and Numerical Methods
- MATH 6105 - Problem Solving in Discrete Mathematics
- MATH 6106 - Modern Algebra for Secondary Mathematics Teachers
- MATH 6107 - Linear Algebra for Secondary Mathematics Teachers
- MATH 6108 - Probability and Statistics for Secondary Mathematics Teachers
- MATH 6118 - Non-Euclidean Geometry
- MATH 6171 - Advanced Applied Mathematics I
- MATH 6172 - Advanced Applied Mathematics II
-
- MATH 6202 - Derivatives II: Partial Differential Equations for Finance
- MATH 6203 - Stochastic Calculus for Finance I
- MATH 6204 - Numerical Methods for Financial Derivatives
- MATH 6205 - Financial Computing
- MATH 6206 - Stochastic Calculus for Finance II
- MATH 6609 - Seminar
- MATH 7028 - Topics in Probability
- MATH 7050 - Topics in Mathematics
- MATH 7065 - Topics in Applied Algebra and Algebraic Structures
- MATH 7070 - Topics in Numerical Analysis
- MATH 7071 - Topics in Differential Equations
- MATH 7120 - Probability Theory I

- MATH 7121 - Probability Theory II
- MATH 7125 - Stochastic Processes I
- MATH 7126 - Stochastic Processes II
- MATH 7141 - Complex Analysis I
- MATH 7142 - Complex Analysis II
- MATH 7143 - Real Analysis I
- MATH 7144 - Real Analysis II
- MATH 7147 - Applied Functional Analysis
- MATH 7148 - Functional Analysis
- MATH 7163 - Modern Algebra I
- MATH 7164 - Modern Algebra II
- MATH 7172 - Partial Differential Equations
- MATH 7173 - Evolution Equations
- MATH 7174 - Linear and Nonlinear Waves
- MATH 7175 - Inverse Problems
- MATH 7176 - Advanced Numerical Analysis
- MATH 7177 - Applied Optimal Control
- MATH 7178 - Computational Methods for Fluid Dynamics
- MATH 7179 - Advanced Finite Difference Methods
- MATH 7181 - Topology I
- MATH 7182 - Topology II
- MATH 7184 - Differential Geometry I
- MATH 7185 - Differential Geometry II
- MATH 7273 - Advanced Finite Element Analysis
- MATH 7275 - Dynamical Systems I
- MATH 7276 - Dynamical Systems II
- MATH 7277 - Bifurcation Theory
- MATH 7691 - Research Seminar
- MATH 7692 - Research Seminar
- MATH 7890 - Industrial Internship
- MATH 7893 - Thesis
- MATH 8028 - Topics in Probability
- MATH 8050 - Topics in Mathematics
- MATH 8065 - Topics in Applied Algebra and Algebraic Structures
- MATH 8070 - Topics in Numerical Analysis
- MATH 8071 - Topics in Differential Equations
- MATH 8120 - Probability Theory I
- MATH 8121 - Probability Theory II
- MATH 8125 - Stochastic Processes I
- MATH 8126 - Stochastic Processes II
- MATH 8141 - Complex Analysis I
- MATH 8142 - Complex Analysis II
- MATH 8143 - Real Analysis I
- MATH 8144 - Real Analysis II
- MATH 8147 - Applied Functional Analysis
- MATH 8148 - Functional Analysis
- MATH 8163 - Modern Algebra I
- MATH 8164 - Modern Algebra II
- MATH 8172 - Partial Differential Equations
- MATH 8173 - Evolution Equations
- MATH 8174 - Linear and Nonlinear Waves

- MATH 8175 - Inverse Problems
- MATH 8177 - Applied Optimal Control
- MATH 8178 - Computational Methods for Fluid Dynamics
- MATH 8179 - Advanced Finite Difference Methods
- MATH 8181 - Topology I
- MATH 8182 - Topology II
- MATH 8184 - Differential Geometry I
- MATH 8185 - Differential Geometry II
- MATH 8202 - Partial Differential Equations for Finance
- MATH 8203 - Stochastic Calculus for Finance
- MATH 8204 - Numerical Methods for Financial Derivatives
- MATH 8273 - Advanced Finite Element Analysis
- MATH 8275 - Dynamical Systems I
- MATH 8276 - Dynamical Systems II
- MATH 8277 - Bifurcation Theory
- MATH 8691 - Research Seminar
- MATH 8692 - Research Seminar
- MATH 8890 - Industrial Internship
- MATH 8994 - Doctoral Research and Reading
- MATH 8999 - Doctoral Dissertation Research

List of STAT Courses

- STAT 5123 - Applied Statistics I
- STAT 5124 - Applied Statistics II
- STAT 5126 - Theory of Statistics I
- STAT 5127 - Theory of Statistics II
- STAT 6027 - Topics in Statistics
- STAT 6108 - Probability and Statistics for Secondary Mathematics Teachers
- STAT 6113 - Cross-Section and Time-Series Econometrics
- STAT 6127 - Introduction to Biostatistics
- STAT 7027 - Topics in Statistics
- STAT 7122 - Advanced Statistics I
- STAT 7123 - Advanced Statistics II
- STAT 7124 - Sampling Theory
- STAT 7127 - Linear Statistical Models
- STAT 7133 - Multivariate Analysis
- STAT 7890 - Industrial Internship
- STAT 8027 - Topics in Statistics
- STAT 8110 - Applied Biostatistics: Regression
- STAT 8111 - Applied Biostatistics: Multivariate Methods
- STAT 8122 - Advanced Statistics I
- STAT 8123 - Advanced Statistics II
- STAT 8124 - Sampling Theory
- STAT 8127 - Linear Statistical Models
- STAT 8133 - Multivariate Analysis
- STAT 8890 - Industrial Internship