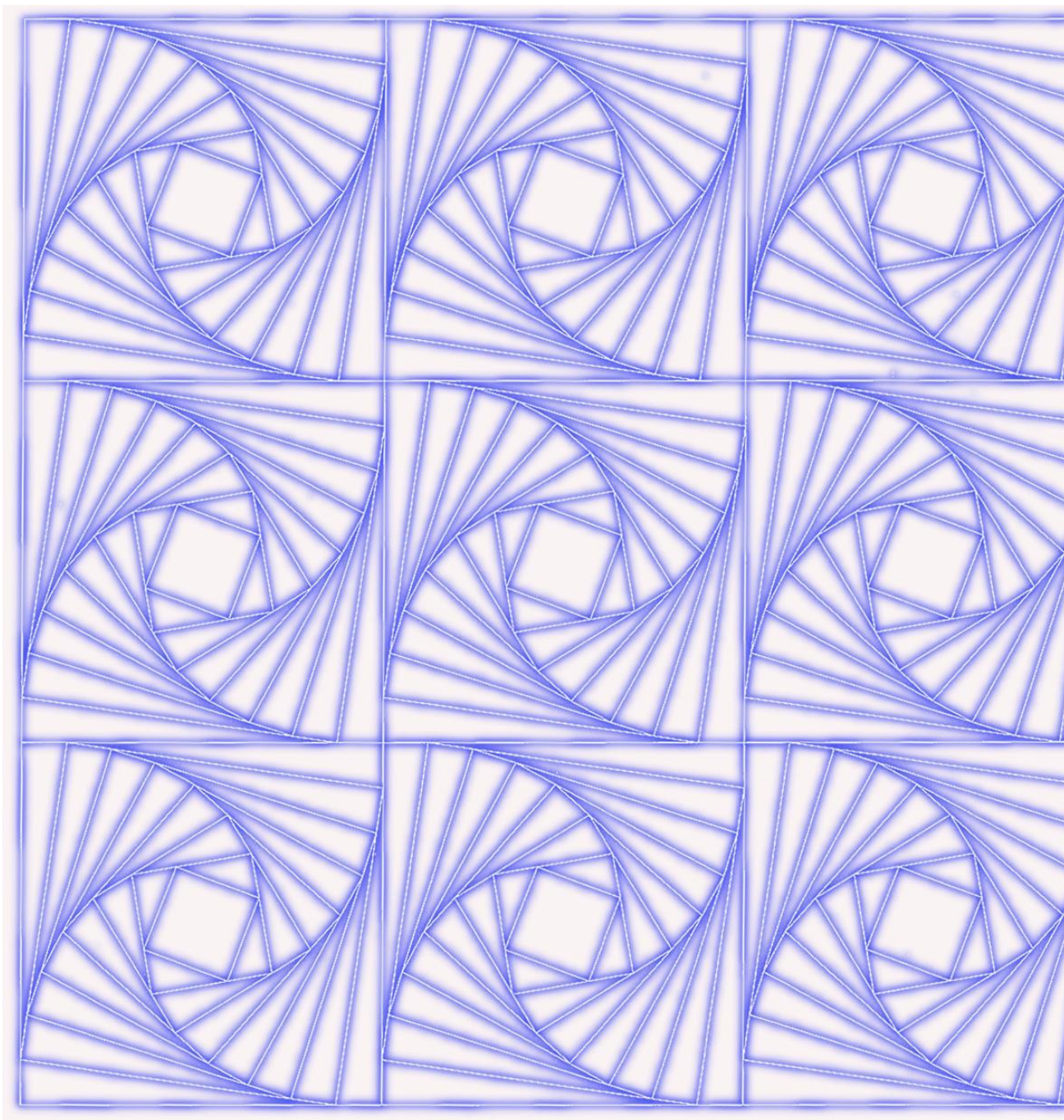# MATHEMATICS
Undergraduate Program

2014-2015
THE DEPARTMENT OF MATHEMATICS
UNIVERSITY OF SOUTH CAROLINA—COLUMBIA

FURTHER ASSISTANCE IS AVAILABLE FROM:

Dr. Douglas Meade
Undergraduate Director
  LeConte 300E
  Phone: 777-5313
  E-mail: ugraddir@math.sc.edu

Sherry Maw
Undergraduate Program Administrator
  LeConte 413
  Phone: 777-5313
  E-Mail: mawsl@mailbox.sc.edu

Dr. Anton Schep
Chair
  LeConte 409
  Phone: 777-4225
  E-mail: chair@math.sc.edu

Dr. Michael Filaseta
Assistant Chair
  LeConte 300C
  Phone: 777-6190
  E-mail: achair@math.sc.edu

Dr. Loren W. Knapp
Assistant Dean
  Flinn Hall
  Phone: 777-2505
  E-mail: lwknapp@cas.sc.edu

Dr. Ognian T. Trifonov
Graduate Director
  LeConte 411
  Phone: 777-4224
  E-mail: graddir@math.sc.edu

MT and MAT Advisors Department of Education

Dr. Edwin Dickey
  Wardlaw 226
  Phone: 777-6235
  E-mail: ed.dickey@sc.edu

Dr. Jan Yow
  Wardlaw 224
  Phone: 777-2472
  E-mail: yow@mailbox.sc.edu

Note: *Students interested in the Master of Arts in Teaching (MAT) degree may also obtain information from the Department of Mathematics Graduate Director.*

IMPORTANT USC WEBSITES

Self-Service Carolina	**http://ssb.onecarolina.sc.edu/**
Blackboard	**https://blackboard.sc.edu/**
VIP	**https://vip.sc.edu/**
Student Success Center	**http://www.sc.edu/ssc/**
Supplemental Instruction	**http://www.sa.sc.edu/supplementalinstruction/**
Career Center	**http://www.sc.edu/career/**
Department of Mathematics	**http://www.math.sc.edu/**
College of Arts and Sciences	**http://www.cas.sc.edu/**
University of South Carolina	**http://www.sc.edu/**

DegreeWorks

DegreeWorks is a web-based tool for you to monitor your academic progress toward degree completion by reviewing a degree audit. It allows you and your advisor to plan future coursework. DegreeWorks reorganizes your transcript chronologically and categorically, easily identifying courses you have completed and what courses you still need in order to fulfill your degree requirements. While efforts have been made to ensure accuracy; final responsibility for meeting requirements resides with the student. DegreeWorks is accessed from the Student tab within Self-Service Carolina.

A GUIDE FOR UNDERGRADUATE MAJORS
IN
MATHEMATICS

WHAT IS MATHEMATICS

Did you ever notice those little whirlpools, or vortices, that are swept downstream from the piers of a bridge, or that spin off the end of your oar when you are rowing a boat? That same thing happens in the slipstream of a car or an airplane, or in the wind blowing past a tall building. In some instances, it may be a small effect, but at higher velocities, they may affect the drag on a car or an airfoil and in extreme cases, the resonance produced may be large enough to bring down bridges or the cooling towers of a power station. In studying the case of a wind tunnel or any other situations, a scale model has to be built and modified every time changes are desired.

Here is where the mathematics comes in; we build a mathematical model. The only real construction that goes on here is in our minds. By formulating the mathematical equations that govern the process, we can attempt to solve them mathematically to obtain a description of what will happen in the real world. This is not always an easy process. Often the models have to be so complicated to take into account all the factors involved that solving them explicitly is impossible. However, sophisticated mathematical techniques can be used to generate approximate solutions on high-speed computers. The mathematics allows us to build the model, to go as far as we can with theoretical means to solve it, to organize it in a suitable form for computer processing, and to analyze the results. Frequently, the results obtained provide new insights into the mechanisms involved, thereby enabling the mathematical model to be improved.

The process is called computer simulation. It is used extensively in the design of automobiles and airplanes, in energy resource discovery and recovery, and to understand complex industrial processes such as chemical reactions or the reactions that occur inside a nuclear reactor. This is mathematics at work. Remember that the computer only does what it is told to do (very quickly, of course), and so highly trained mathematical scientists, teamed with specialists from other areas, are essential to the success of such ventures. Industry is increasingly turning to mathematical modeling and computer simulation as the primary tools in its research and development operations, particularly since the advent of the supercomputer.

Does all of mathematics require the use of a computer? Not at all, but the process of discovery in any area of mathematics is similar to that in modeling and simulation. The problem is formulated in mathematical terms, modeled, analyzed, perhaps only partially resolved, modified, analyzed again, and so on, until a solution is obtained. And all of science is so inherently mathematical that expertise in mathematics is essential nowadays in virtually every branch of science and engineering, and even in business administration and the social sciences. Mathematics is indeed the language of science, the universal means of expression, and the source of communication between diverse disciplines.

CAREER OPPORTUNITIES IN MATHEMATICS

In today's world of rapidly expanding technology, there are many career opportunities for the well-qualified mathematician. Business, government, and industry have strong needs for mathematicians in areas such as operations research, optimization, numerical analysis, computer programming, systems analysis, communications, statistics, and information and actuarial science. Whether it be in operations research, systems analysis, computer software and hardware development, modeling and simulation, numerical analysis, development and test of algorithms, cryptology, or teaching, some familiarity with computers and the mathematics of computation is usually essential. The mathematics degree, at the baccalaureate, masters, or doctoral level, provides the grounding in analytical thinking and the scientific skills necessary to function in today's interdisciplinary environment. The Bachelor of Science degree is a sound preparation for graduate study in mathematics or any of the mathematical sciences, but also for advanced degrees in business administration and some of the quantitative social sciences. A bachelor's degree in mathematics can also provide entry to careers in fields such as management, engineering, banking, insurance, government service, the military, and geology.

An excellent source for information about careers in the mathematical sciences is the Mathematical Association of America (MAA). The pamphlets "Careers in the Mathematical Sciences" and "More Careers in the Mathematical Sciences" provide an indication of the variety of careers available to persons with interest and preparation in the mathematical sciences. Copies may be obtained from the Department of Mathematics Undergraduate Office in LeConte College 413. The following websites are excellent sources of career information in mathematics, applied mathematics and actuarial science:

www.maa.org/students/careers/   www.beanactuary.com
www.ams.org/careers/   www.whydomath.org
www.siam.org/careers/   weusemath.com

The following is a partial list of employers who were recruiting math majors on campus during recent years:

Accenture	Microsoft Corporation	United States Air Force
AT&T	National Security Agency	United States Bureau of Labor Statistics
Blue Cross/Blue Shield of South Carolina	Naval Air Systems Command	United States Bureau of the Census
Central Intelligence Agency	Naval Surface Weapons Center	United States Coast Guard
Colonial Life	National Cash Register (NCR)	United States Department of Energy
Computer Services Corporation (CSC)	South Carolina Department of Education	United States General Accounting Office
Computer Task Group	Spring Industries	United States Office of Comptroller of the Currency
Duke Power Company	State Farm Insurance	Westinghouse
Hawkes Learning Systems	Texas Instruments	Xerox
Kennedy Space Center		

The Undergraduate Program webpage, www.math.sc.edu/undergraduate/, includes an electronic version of this document with active hyperlinks to employment information at many of the above corporations and agencies. Be sure to visit the "Career advice for math majors" link. The US Department of Labor, Bureau of Labor Statistics, maintains an Occupation Outlook Handbook at http://www.bls.gov/ooh/. This is an excellent source of general information about almost any career.

Job prospects depend on your educational background and personal interest. Mathematics majors are encouraged to take several courses in a field that uses or is closely related to mathematics. Popular choices include education, statistics, biology or other physical science, business, finance, and computer science. A double major in mathematics and computer science, or mathematics and statistics, is particularly attractive to employers. The actuarial emphasis combines a major in mathematics with a strong background in statistics and business (accounting, economics, and finance). This program is particularly suited for students interested in becoming an actuary or other finance-related career.

MATHEMATICS AT USC

The University of South Carolina is fast evolving into one of the premier mathematics research centers in the Southeast. The distinguished faculty has attracted national and international recognition through the quality of its research program. The Department has particular strengths in mathematical analysis, discrete mathematics, linear algebra, differential geometry, commutative algebra, logic, number theory, topology, and numerical analysis. It is thus uniquely poised to provide undergraduate and graduate students with the broad background in pure and applied mathematics necessary to perform in today's high-tech environment, whether in an industrial, business, governmental, or academic setting. The Department also maintains a strong commitment to excellence in teaching and proudly counts a number of award-winning teachers among its ranks.

Department computing facilities are excellent. In addition to various University mainframe and workstation computers available via the campus network and in numerous satellite laboratories, the Department houses a number of computer-equipped classrooms and open computer labs. A large collection of mathematical and statistical software is installed on these computers for use in courses and research.

DEGREE PROGRAMS

The Department of Mathematics offers the Bachelor of Science degree in Mathematics. The major is completed with 120 semester hours of overall coursework. Mathematics majors may select from one of four emphases:

- **General Mathematics** – Requires 24 semester hours of mathematics courses beyond calculus (comprising the required core of 15 semester hours and nine semester hours of mathematics electives).

- **Mathematics Education** – Leads to a bachelor's degree in mathematics, with a 12-semester hour education cognate. Certification is obtained upon completion of the Master of Teaching degree program in Secondary Education. In addition to the five core courses, the program requires courses in number theory and geometry and one mathematics elective.

- **Applied Mathematics** – Offers specialization in applied or computational mathematics. A one-semester hour computational lab is added to the 15-semester hour core and nine hours of mathematics electives required in such disciplines as numerical analysis, optimization, and partial differential equations. Applied mathematics majors are encouraged to select a cognate, minor, or second major in computer science, statistics, one of the physical sciences, or engineering.

- **Actuarial Mathematics** – Offers a program of study designed to prepare students for the actuarial profession in the insurance and financial securities industries. In addition to the required five core mathematics courses, this track includes a mathematical optimization course, two mathematics electives, and a minimum of eight courses in Business Administration and Statistics. Depending on the specific collection of courses selected, a cognate and/or minor can be obtained in Statistics and/or Risk Management and Insurance. Some actuarial students chose to pursue double majors in Mathematics and Statistics.

In addition to the major requirements, each student is required to complete a minor (18 hours of courses related to a common topic) or a cognate (12 hours of integrated courses from a single department) in a discipline related to, but distinct from the major. Note that the Actuarial and Education emphases automatically include a cognate and/or minor.

The **B.S. in Mathematics with Distinction** is awarded to students who complete an additional 12 semester hours of upper-division mathematics courses approved by the Undergraduate Director, an undergraduate research experience, and an undergraduate thesis.

The department also offers a five-year program of study leading to a Bachelor of Science degree and a Master of Science degree in Mathematics. The program is designated to permit an outstanding student to obtain both a bachelor's degree and a master's degree in mathematics in five years. Students interested in pursuing this option should contact the Graduate Director during the first two years of undergraduate studies.

ADVISING

When you enroll as mathematics major, the Director of Undergraduate Studies will initially advise you. You will have a Lower-Level Advisor until you have completed the three-semester calculus sequence (MATH 141, 142, and 241). An Upper-Level Advisor will be assigned to you as you make the transition to upper division mathematics courses (by taking MATH 300). Your advisor will assist in formulating your program of study and preparing you for the beginning of your career (or further education). While the advisor's role is to provide guidance, the student has final responsibility for staying fully informed on University deadlines and relevant academic policies.

It is essential that you meet with your advisor each semester so that you can plan your course of studies for the following semester. The advisement process must be completed before the student can register for the next semester. Most advisement appointments are made through the Undergraduate Office (LeConte 413). You should receive an e-mail from the Undergraduate Director or Program Administrator concerning advisement procedure. If you have not been notified by mid-semester, please see the Undergraduate Program Administrator in LeConte 413. *To increase your likelihood of getting the courses you want and need, please be certain to be advised during the regular advisement period.*

Academic and personal problems do arise, of course, and we encourage you to discuss them with your advisor at any time. When you have a special problem that is beyond your advisor's authority (such as variations on requirements or special cognates), or when your advisor is not available and you need assistance, contact the Undergraduate Program Admistrator in LeConte 413 to set up an appointment with the Director of Undergraduate Studies.

A *Senior Records Check* needs to be completed one year before you plan to graduate. When you have earned approximately 95 credit hours, ask your advisor to complete a *Major Program Card*. This involves listing all major and cognate/minor courses that you intend to take to fulfill the degree requirements. When this has been completed, call the Assistant Dean's Office (777-2505) to request a *Senior Records Check*. The purpose of this check is to identify all unfulfilled graduation requirements while you still have time to complete them without delaying your graduation.

AWARDS AND SCHOLARSHIPS

The Department of Mathematics and College of Arts and Sciences recognize continuing and graduating students at the end of each academic year. The current list of awards and scholarships, with brief descriptions, is shown below. The Undergraduate Advisory Council solicits applications from interested students each spring; the awards are announced and presented at Undergraduate Awards Day.

Outstanding Undergraduate Student in Mathematics Education
... presented yearly to an outstanding undergraduate student in mathematics education who has exhibited excellence in the mathematics program.

Outstanding Undergraduate Student in Mathematics
... presented yearly to an outstanding undergraduate student who has exhibited excellence in the mathematics program.

College of Arts and Sciences Rising Senior Award
... awarded annually by the College of Arts and Sciences to a rising senior mathematics major who has demonstrated excellence in mathematics and has a cumulative GPA of at least 3.50.

James Bruce Coleman Mathematics Scholarship
... awarded annually by the Department of Mathematics to an outstanding mathematics major from South Carolina. The scholarship was established in 1992 by Joseph Harold Burckhalter (Class of 1934), in memory of the late James Bruce Coleman, who was a professor of mathematics and head of the department from 1915—1942.

Thomas Markham Mathematics Scholarship
... awarded annually to an outstanding mathematics major who also has significant extracurricular mathematical activities. The scholarship was established in 1999 in honor of Professor Emeritus Thomas Markham, who was a professor of mathematics from 1968—1999 and undergraduate director 1996—1999.

Victor W. Laurie Undergraduate Research Scholarship
... provides monetary support for an undergraduate student interested in being involved with mathematical research. This is a competitive award based on proposals submitted by all interested students.

Dr. Edwin R. and Mrs. Elizabeth F. Jones Endowed Scholarship
... awarded cooperatively by the Departments of Chemistry, Mathematics, and Physics to South Carolina resident majoring in one or more of chemistry, mathematics, and physics. The Jones family created this scholarship in 2013 to recognize students in chemistry, mathematic, s and physics. The application for this scholarship can be obtained from the College of Arts and Sciences.

Lovelace Endowed Scholarship
... awarded bi-annually by the Department of Mathematics to an outstanding undergraduate mathematics major who had demonstrated excellence in mathematics. The Lovelace family created this scholarship in 2013 to recognize students in mathematics and physics. Awards alternate between mathematics and physics.

Pi Mu Epsilon Award
... presented annually to an outstanding member of Pi Mu Epsilon based on performance in mathematics courses and service to the department. The Undergraduate Advisory Council, in conjunction with the Pi Mu Epsilon advisor, selects the recipient.

Polston Family Mathematics Scholarship
... is awarded to undergraduate mathematics students who are excelling in the mathematics program. The Polston family established the scholarship in 2008.

Cary K. Smith, Jr., Mathematics Scholarship
... awarded annually by the Department of Mathematics to an outstanding undergraduate mathematics major who has demonstrated excellence in mathematics and leadership. The scholarship was established in 1998 in memory of Cary Kincaid Smith, Jr., an Honors graduate of USC who died while performing his duties as a pilot in the U.S. Marine Corps.

Wyman L. Williams Scholarship
... awarded to an undergraduate mathematics major at the University of South Carolina. Can be renewed for not more than 3 additional years of undergraduate study. Wyman L. Williams came to the University in 1919 as a freshman, joined the Mathematics Department faculty in 1924 and retired in 1970 as Distinguished Professor Emeritus. The Wyman L. Williams Mathematics Scholarship Fund was established in 1975.

Jeong S. Yang Award for Excellence in Undergraduate Mathematics
... awarded yearly to outstanding undergraduate mathematics majors at the University of South Carolina selected from students who have earned at least 100 credit hours and have completed at least 4 of the 5 core mathematics courses required for the major with a GPA of at least 3.70 in all upper-division mathematics courses. The award was established by the Department of Mathematics in memory of the late Professor Jeong S. Yang, undergraduate director 1984—1995.

MATHEMATICS FACULTY

PROFESSORS

Stephen J. Dilworth, Ph.D.,
Cambridge University, 1985

Michael A. Filaseta, Ph.D.,
Assistant Chair
University of Illinois, 1984

Maria Girardi, Ph.D.,
University of Illinois, 1990

Jerrold R. Griggs, Ph.D.,
Massachusetts Institute of Technology, 1977

Ralph E. Howard, Ph.D.,
California Institute of Technology, 1982

Lili Ju, Ph.D.,
Iowa State University, 2002

Andrew Kustin, Ph.D.,
University of Illinois, 1979

Linyuan (Lincoln) Lu,
Ph.D., University of California, San Diego, 2002

George F. McNulty, Ph.D.,
University of California, Berkeley, 1972

Matthew Miller, Ph.D.,
University of Illinois, 1979,

Peter J. Nyikos, Ph.D.,
Carnegie-Mellon University, 1971

Pencho Petrushev, Ph.D.,
University of Sofia, 1977

Anton R. Schep, Ph.D.,
Chair,
University of Leiden, 1977

László A. Székely, Ph.D.,
Eötvös University, 1983

Vladimir Temlyakov, Ph.D.,
Carolina Distinguished Professor
Steklov Institute, 1981

Hong Wang, Ph.D.,
University of Wyoming, 1992

Qi Wang, Ph.D.,
Ohio State University, 1991

ASSOCIATE PROFESSORS

George Androulakis, Ph.D.,
University of Texas, 1996

Peter G. Binev, Ph.D.,
University of Sofia, 1985

Matthew Boylan, Ph.D.,
University of Wisconsin at Madison, 2002

Joshua N. Cooper, Ph.D.,
University of California, San Diego, 2003

Eva Czabarka, Ph.D.,
University of South Carolina, 1998

Daniel B. Dix, Ph.D.,
University of Chicago, 1988

Xinfeng Liu, Ph.D.,
State University of New York, 2006

Douglas B. Meade, Ph.D.,
Undergraduate Director,
Carnegie-Mellon University, 1989

Ognian T. Trifonov, Ph.D.,
Graduate Director
University of Sofia, 1990

Adela Vraciu, Ph.D.,
University of Michigan, 2000

Xian Wu, Ph.D.,
Harvard University, 1986

Xiaofeng Yang, Ph.D.,
Purdue University 2007

ASSISTANT PROFESSORS

Matthew R. Ballard, Ph.D.,
University of Washington, 2008

Jesse Kass, Ph.D.,
Harvard University, 2009

Yi Sun, Ph.D.,
Princeton University, 2006

Frank Thorne, Ph.D.,
University of Wisconsin at Madison, 2008

Paula A. Vasquez, Ph.D.,
University of Delaware, 2007

Zhu Wang, Ph.D.,
Virginia Polytechnic Institute, 2012

Sean Yee, Ph.D.,
Kent State University, 2012

CLINICAL ASSOCIATE PROFESSOR

Debra Geddings, Ph.D.,
University of South Carolina, 2003

SENIOR INSTRUCTOR

Ronda Sanders, M.S.,
University of South Carolina, 2004

INSTRUCTORS

Courtney Baber, M.S.,
Virginia Tech, 2009

Scott Dunn, Ph.D.,
University of South Carolina, 2014

Ivan Haynes, M.S.,
University of South Carolina, 2008

Francisco Blanco-Silva, Ph.D.,
Purdue University, 2007

RESEARCH ASSOCIATE PROFESSOR

Borislav Karaivanov, Ph.D.,
University of South Carolina, 2001

ADJUNCT FACULTY

Edwin M. Dickey, Professor, Ph.D.,
University of South Carolina, 1982

Don Jordan, Ph.D.,
University of South Carolina

PART TIME INSTRUCTORS

Alexandru Atim, Ph.D.,
University of North Texas, 2008

Elena BoguslavskyPh.D.,
Ukrainian Academy of Sciences, 1986

Rita Hipp, M.S.,
University of South Carolina, 2011

Bruce Jones, Ph.D.,
The Ohio State University, 1997

Kathy Kustin, M.S.,
University of Illinois-Urbana, 1979

Patrick Mutungi, Ph.D.,
Iowa State University, 2004

VISITING PROFESSORS

Ryan Causey, Ph.D.,
Texas A&M University, 2014

Weis Lutz, Ph.D.,
Universitat Bonn, 1974

DISTINGUISHED PROFESSORS EMERITI

Colin Bennett, Ph.D.,
University of Newcastle upon Tyne, 1971

Ronald A. DeVore, Ph.D.,
Robert L. Sumwalt Distinguished Professor Emeritus
Ohio State University, 1967

Thomas L. Markham, Ph.D.,
Auburn University, 1967

James W. Roberts, Ph.D.,
Rutgers University, 1970

H. Edward Scheiblich, Ph.D.,
University of Texas, 1966

Robert M. Stephenson Jr., Ph.D.,
Tulane University, 1967

Robert C. Sharpley, Ph.D.,
University of Texas, 1972

Manfred Stoll, Ph.D.,
Pennsylvania State University, 1971

David P. Sumner, Ph.D.,
University of Massachusetts, 1971

FACULTY EMERITI

Peter W. Harley III, Ph.D.,
University of Georgia, 1966

Richard H. Hudson, Ph.D.,
Duke University, 1971

George W. Johnson III, Ph.D.,
University of Tennessee, 1971

Karl H. Matthies,
Dr. Rerum Naturalium,
University of Freiburg, 1956

Charles A. Nicol Jr., Ph.D.,
University of Texas, 1954

Mary Ellen O'Leary, M.A.,
University of Michigan, 1967

Konstantin Oskolkov, Ph.D.,
Steklov Institute, 1978

THE B.S. PROGRAM IN MATHEMATICS

1. Carolina Core Plus College of Arts and Sciences

COLLEGE CORE PLUS COLLEGE OF ARTS AND SCIENCES

I. **Effective, Engaged, and Persuasive Communication (CMW)**   **6 hrs**

ENGL 101	Composition	(CMW)
ENGL 102	Composition and Literature	(CMW & INF, when taken at USC)

ENGL 101 and 102 **must each be passed with a grade of C or higher**, and must be completed within the first sixty hours of the degree in order to be counted toward the total needed for graduation.

II. **Analytical Reasoning and Problem Solving (ARP)**   **15 hrs**

Students pursuing a Bachelor of Science degree in Mathematics must complete 15 hours as described below.

MATH 141 and 142	(ARP – CC)
CSCE 145 or 206	(ARP – AS)
STAT 509, 512, or 515 (or equivalent)	(ARP – AS)

III. **Scientific Literacy (SCI)**   **8 hrs**

Two Carolina Core-approved[1] laboratory courses selected from Anthropology, Astronomy, Biological Science, Chemistry, Environmental Science, Geography 201, 202 (for Bachelor of Arts degrees only) **Geology, Marine Science, and Physics.** Each science course must have a co-requisite laboratory. The two courses need not be taken in the same term. Lab credit cannot be applied unless its co-requisite lecture is also applied. Some of the more commonly selected courses appear in the following list – it is not exhaustive.

ANTH	161
ASTR	101
BIOL	101/L, 102/L , 110 or 120/L , 200/L or 270/L
CHEM	102, 105, 107, 111/L (or 141), 112/L (or 142)
	Note: Credit cannot be given for both CHEM 111 and 141 or for CHEM 112 and 142.
ENVR	101/L or 200/L
GEOG	201 or 202
GEOL	101, 102, 103, or 215/L
MSCI	101, 102, 210 & 210L, or 215/L
PHYS	101/L, 102/L, 151/L, 153/L, 155/L, 201/L, 202/L, 211/L, or 212/L
	Note: Credit cannot not be given for both PHYS 151 and 153 or for both PHYS 151 and 155.

IV. **Global Citizenship and Multicultural Understanding: Language (GFL)**   **0-9 hrs**

Proficiency in one foreign language is equivalent to the minimal passing grade on the exit examination in the 122 course. Students can demonstrate this proficiency by successfully completing Phase II of the Proficiency Test or by successfully completing the 122 course, including the exit exam administered as part of that course.

V. **Global Citizenship and Multicultural Understanding: Historical Thinking (GHS)   6 hrs**

HIST 10x	Non-US History	(GHS – AS)
HIST 11x	US History	(GHS – CC)

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[1] The full list of Carolina Core- approved courses can be found at http://www.sc.edu/carolinacore/courses.php.

VI. Global Citizenship and Multicultural Understanding (GSS)   **6 hrs**

Two Carolina Core-approved[2] social science courses selected from African-American Studies (AFAM), Anthropology (ANTH), Criminal Justice (CRJU), Economics (ECON), Geography (GEOG), Linguistics (LING), Political Science (POLI), Psychology (PSYC), Sociology (SOCY), Southern Studies (SOST), and Women & Gender Studies (WGST).

VIIa. Aesthetics and Interpretive Understanding (AIU)   **3 hrs**

Fine Arts or Literature:

Excluding 399, internships, Senior Seminar and Senior thesis courses

a) **Fine Arts**

A Carolina Core-approved[2] course dealing with the study and/or practice of the visual and performing arts. Students may take a course in art studio, art design, art history and appreciation, film, media arts, music history and appreciation, music theory and performance, theatre history and appreciation, acting, stagecraft, theatre design, and dance to fulfill this requirement.

Courses in speech (SPCH) apply to the humanities requirement, but **DO NOT** satisfy the fine arts requirement. Theatre production laboratories (THEA 119, 120, 121, 122, 123, 219, 220, 221), one-hour credits for participation in music organizations (band, chorus, orchestra), DANC 177, 577, and MART 302 do NOT apply to the fine arts requirement or to the humanities requirement.

b) **Literature**

A Carolina Core-approved[2] literature course numbered 200 or higher, or a comparative literature course and literature course taught in a foreign language.

VIIb. College of Arts and Sciences Fine Arts and Humanities Requirement (AIU)   **3 hrs**

One additional course in the humanities. This does not have to be a Carolina Core-approved course, but does need to be approved by the College of Arts and Sciences. Some of the more common choices are listed below:

AFAM
ARTS
ARTE   {excluding 465, 471, 565, 595}
ARTH
CLAS
COLA   {pending content}
CPLT
DANC {excluding DANC177, 577}
ENGL
EURO
FILM
HIST
LANG   {ARAB, CHIN, FREN, GERM, GREK, ITAL, JAPA, LATN, PORT, RUSS, SPAN, (excluding 1xx, 315)}
LASP   {LASP 201, 301, 341, 342, 361, 371, 398 pending content, 441, 442, 447, 471, 481, 501, 541 only}
LING   {LING 301, 405 pending content, 421, 431, 440, 441, 442, 502, 503, 504, 505 pending content, 512, 514, 530, 540, 565, 600, 610, 620, 627, 650 only}
MART   {excluding MART 302}
MUSC   {excluding one-hour credits for participation in music organizations, 399}
PHIL   {excluding 110, 111, 511}
RELG
SOST   {298, 299, 301, 302 pending content, 305, 405 pending content}
SPCH
THEA   {excluding THSP 119, 120, 121, 122, 123, 219, 220, 221}
WGST   {111, 307, 308, 320, 321, 376, 379, 437, 464, 485, 535 pending content, only)

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[2] The full list of Carolina Core-approved courses can be found at http://www.sc.edu/carolinacore/courses.php.

VIII. Overlay   3-9 hrs

Two of the three overlay courses[3] can fulfill General Education requirements. At least one overlay course must stand alone. Overlay courses cannot be used to fulfill a major/cognate/minor requirement.

   a. Effective, Engaged, and Persuasive communication: Spoken Component **(CMS)**
   b. Information Literacy **(INF)**
   c. Values, Ethics, and Social Responsibility **(VSR)**

TOTAL HOURS in Carolina Core Plus for College of Arts and Sciences: 52-68 hrs

2. Pre-Major requirements

The following pre-major courses may fulfill some requirements of the Carolina Core Plus for CAS.
   a) MATH 141, MATH 142, MATH 241, and MATH 300 (each with a grade of C or better)
   b) at least one of CSCE 145 or CSCE 206
   c) at least one of STAT 509, STAT 512, or STAT 515

3. Major Requirements

RETENTION

*A grade of **C** or better is required in each major course and in each of MATH 141, 142, 241, and 300. A student may enroll in each major course and in each of MATH 141, 142, 241, and 300 a maximum of two times. (**Enrolled in a course is interpreted to mean that a grade, including W, has been recorded**). A student may repeat a maximum of three mathematics courses (receiving a grade of **W** is not considered a repeat).*

Students who violate the retention policy can file a petition in the Dean's Office requesting an exception to this policy. Otherwise, the student will have to find a new major.

PROGRAM OPTIONS

There are five program options offered in Mathematics, each leading to a Bachelor of Science degree.

Note: *Only one of MATH 526 and 544 may be applied toward major credit.*

General Mathematics Emphasis (24-25 hrs)
 a) Core: MATH 520, 526 or 544, 546, 554, 574
 b) Flexible Major Elective: At least one course selected from MATH 534, 550, 552
 c) Major Electives: 6 hours in MATH numbered above 500, selected in consultation with the advisor

Math Education Emphasis (24 – 25 hrs)
 a) MATH 544 (or 526), 546, 554, 574
 b) MATH 580 and either MATH 531 or 532
 c) Six (6) hours chosen from MATH 511, 520, 531, 532, 550, 552
 d) For the cognate, students must take EDFN 300, EDTE 400 (1 hr), EDPY 401 and 401P (1 hr), and EDSE 402 (4 hrs)

Applied Mathematics Emphasis (25 hrs)
 a) MATH 520, 526 (recommended) or 544, 546, 554, and 574
 b) Three additional courses chosen from the following five categories:
   i) Differential Equations and Modeling: MATH 521, 522, 523
   ii) Discrete Mathematics: MATH 570, 575, 587 {=CSCE 557), 541, and 576
   iii) Financial Mathematics and Probability: MATH 511 {=STAT 511}, 514, 515
   iv) Optimization and Computation: MATH 524, 527, 570
   v) Analysis: MATH 550, 552

Note: *Two courses must be chosen from one category and the third must be chosen from a different category.*

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[3] The full list of Carolina Core- approved courses can be found at http://www.sc.edu/carolinacore/courses.php.

Actuarial Mathematics Emphasis (24-25 hrs)
a) MATH 511, 520, 546, 554, 574,
b) One of 524 or 570,
c) One of 526 or 544,
d) Three hours in MATH at the 500 level.

Other Requirements (27 hours that may satisfy Pre-Major, Minor, 2nd Major, or General Education Requirements):
  i. Mathematical Statistics (3 hours): STAT 512
  ii. Statistical Models (6 hours): STAT 513 and ECON 436
  iii. Economics and Corporate Finance (12 hours): ACCT 225, ECON 221, 222, and FINA 363
  iv. Finance and Stochastic Processes (3-6 hours): FINA 469, 471, 475, or STAT 521
  v. Risk Management and Insurance (0-3 hours): FINA 341
  vi. Advanced Computing (3 hours): CSCE 146, MGSC 390, or STAT 540

Notes:
  i. *As of May 2012 the required courses in i), ii), and iii) cover material on Exam P and award VEE credit in Applied Statistics, Corporate Finance, and Economics. The courses in iv) apply to later SOA exams.*
  ii. *The Minor in Risk Management and Insurance requires iii) and all of FINA 469, 471, and 475 in iv).*
  iii. *When double majoring in mathematics and statistics MATH/STAT 511 can apply towards both degrees.*

B.S. with Distinction

Available to students majoring in mathematics who wish to participate in significant research with a faculty mentor.

Prerequisite
A minimum GPA of 3.60 in upper division (500 and above) major courses and 3.30 overall when the student applies to enter the departmental undergraduate research track.

Requirements
The student should apply to enter the departmental undergraduate research track and choose the members of the thesis committee as early as possible, but in all cases at least one year before submitting and defending the thesis. The thesis committee will consist of a thesis advisor, who must be a tenure-track faculty member in mathematics, and one or two other tenure-track or research faculty members in Mathematics or any other department, as approved by the Undergraduate Advisory Council. The senior thesis will produce a piece of original research and a public presentation of the research in a venue approved by the research advisor. The student may use their senior thesis to simultaneously fulfill other requirements as well (e.g., Magellan Scholarship, Honors College Thesis, etc.), at the discretion of the thesis advisor.

By the end of the semester in which the student is admitted into the research track, a brief research plan must be agreed upon by the thesis committee and the student, and filed in the Department of Mathematics and College of Arts and Sciences. Before submitting and defending the thesis, the student must have completed three credit hours of MATH 499 (Undergraduate Research) under the supervision of the thesis advisor, and at least 12 hours of upper-level (500 and above) mathematics credit beyond their major requirements approved by the Undergraduate Director.

Students who successfully fulfill all of these requirements with a GPA of at least 3.60 in upper division (500 and above) major courses and 3.30 overall, will be awarded their degree with "Distinction in Mathematics" upon graduation.

4. Cognates, Minors, Double Majors and Dual Degrees

MINORS
You may replace the cognate with a minor if you so desire. The minor consists of eighteen hours of coursework instead of the twelve needed for the cognate. The minor is also more structured. All courses in the minor must be passed with grades of C or better. Students who are planning to minor in a subject area need to go to the Dean's office and fill out the appropriate forms to declare the minor.

Four minors that are popular with mathematics majors are as follows:

- MINOR IN RISK MANAGEMENT AND INSURANCE
  1. Prerequisite Course (3 hrs)
     a) ECON 221
  2. Required Courses: (18 hrs)
     a) ECON 222
     b) ACCT 225,
     c) FINA 363,
     d) FINA 469, 471, and 475,

- MINOR IN EDUCATION
  1. EDFN 300, EDTE 400, EDPY 401 and 401P, and EDTE 402 and 402P
  2. Two courses (6 credit hours) chosen from your area of educational specialization.

- MINOR IN STATISTICS
  1. Required Courses: Six 500-level STAT courses approved by the Undergraduate Director of Statistics. *Only one of STAT 509 and STAT 515 may be counted for minor credit.*

- MINOR IN COMPUTER SCIENCE
  1. Required Foundation Courses: (8 hrs): CSCE 145 and 146
  2. Intermediate Level Courses (6 hrs): Two of the following courses: CSCE 210, 211, 212, 240, and 242
  3. Advanced Courses: Any two CSCE courses at the 300 level or above with the exception of CSCE 500. Recommended tracks are listed on the CSCE website at http://www.cse.sc.edu/acadinfo/CSMinor.html. Note that some CSCE courses have MATH or STAT prerequisites.

COGNATES

The cognate consists of 12 hours of upper-division courses selected in consultation with, and approved by, your advisor. Mathematics majors may satisfy this requirement by passing 12 credit hours of cognate eligible courses offered by the College of Arts and Sciences or Department of Computer Science and Engineering. Cognates selected from other disciplines should be supportive***** of the major and must be in <u>one field</u> selected with and approved by the student's academic advisor. The Undergraduate Director must approve all exceptions <u>in advance</u>.

> * *If a discipline is not supportive of the major, then the student should pursue a minor in that subject area.*

Here is a partial list of cognate-eligible courses:

Accounting (ACCT):
   All numbered 403 and above
Aeronautics (AERO):
   301, 302, 401, 402
Anthropology (ANTH)
   All except 101 and 102
Army ROTC (ARMY):
   All numbered 301 and above
Astronomy (ASTR):
   All numbered 211 and above
Biology (BIOL):
   All courses numbered 300 through 600 levels
Chemistry (CHEM):
   All except 101, 102, 105, 106, 111, 112, 118
Computer Science (CSCE):
   All numbered 212 and above except 500
Economics (ECON):
   All numbered 300 and above
Education (all designators):
   EDFN 300, EDTE 400, EDPY 401 and 401P, and EDTE 402
Engineering (all designators):
   All numbered 200 and above except EECE 200
English (ENGL):
   All numbered 300 and above except 450, 461, 462, 463, 620
Environmental Studies (ENVR):
   221 (cross-listed with ENHS)
Exercise Science (EXSC)
   All numbered 303 and above except 315, 316
Finance (FINA):
   All numbered 311 and above
Foreign Languages (all designators):
   All numbered 300 and above except 315, 316
Geography (GEOG):
   All numbered 200 and above except 531
Geology (GEOL):
   All numbered 300 and above

History (HIST):
   All numbered 300 and above
International Business (IBUS)
   All numbered 401 and above
Journalism (JOUR)
   All numbered 300 and above except 310
Management (MGMT):
   All numbered 371 and above
Marine Science (MSCI):
   All courses numbered 311 and above
Marketing (MKTG):
   Al numbered 350 and above
Music (MUSC)
   All numbered 200 and above except 565 and applied music
Navy (NAVY):
   All numbered 300 and above
Nursing (NURS):
   All numbered 300 and above
Pharmacy (PHAR):
   All numbered 500 and above
Philosophy (PHIL):
   All numbered 200 and above
Physics (PHYS):
   207, 208 and all numbered 212 and above
Political Science (POLI):
   All numbered 300 and above
Psychology (PSYC):
   All numbered 300 and above except 594-599
Religious Studies (RELG):
   All numbered 300 and above
Sociology (SOCY):
   All numbered 300 and above
Theater (THEA):
   All numbered 561 and above
Statistics (STAT):
   All numbered 500 and above. *Only one of STAT 509 and 515 may be used for cognate credit*

DOUBLE MAJORS AND DUAL DEGREES

Instead of selecting a cognate (12 hours) or a minor (18 hours), some students complete a second major. If the second discipline is in the College of Arts and Sciences, or Computer Science (in the College of Engineering and Computing), they will graduate with double majors.

Students interested in other combinations of degrees must pursue dual degrees. This means that students must satisfy all requirements for each degree. The same courses can be applied towards the Carolina Core Plus requirements for each degree; no course may be counted towards the Major Requirements for more than one degree, except that MATH/STAT 511 can be used to fulfill a major requirement for both Mathematics and Statistics.

Double majors and dual degrees must be approved by the Dean and usually can be accommodated within the required 120-hours if the decision is made reasonably early, say in the second year. The most common double majors are Mathematics and Statistics and Mathematics and Computer Science.

5. Electives

Requirements for the baccalaureate degree in the College of Arts and Sciences include at least 120 hours in academic subjects. Students in the College of Arts and Sciences may elect acceptable courses offered in other colleges of the University. Elective credits for participation in the University chorus, orchestra, or band may be counted up to a maximum of 4 credits.

6. Honors Courses

Honors sections of the calculus courses (141, 142, and 241), are offered every Fall and Spring semester. Honors section of other courses, MATH 242, 544, 546, 547, 550, 554, 555, 574, and 575, are offered once each academic year. Honors MATH courses are available to highly qualified students regardless of whether they are in the South Carolina Honors College. Non-Honors College students must receive approval from the Undergraduate Director prior to being permitted to register for an honors MATH course.

7. Five-Year Program

This program of study is designed to permit an outstanding mathematics student to obtain both a bachelor's degree, as described above, and a master's degree in mathematics in five years, while at the same time receiving undergraduate and graduate assistant support during the last two years.

Program Guidelines

1. To be considered for the program, the student must have earned at least 103 hours by the start of his senior year, and must have completed one of the preparatory undergraduate sequences MATH 546-547 or MATH 554-555. This is easily accomplished if the student has received undergraduate credit through advanced placement examinations, or enrolls for one or more summer sessions.

2. During their senior year, the student takes, for graduate credit, the basic graduate sequence, MATH 700-701 (or 706) or MATH 703-704 corresponding to the undergraduate sequence they have already taken. In addition, the student will complete the other preparatory undergraduate course sequence. The remaining 9 hours in the fall semester of the senior year will consist of additional undergraduate or graduate courses. This will leave the student 10 hours short of his bachelor's degree, which will be completed in the spring semester.

3. For the spring semester of the senior year, the student is conditionally admitted into the graduate program. Final acceptance into the program will be contingent upon receipt of the bachelor's degree at the end of spring semester. To be considered for ad-mission, except for lacking the bachelor's degree, the student must meet all other requirements for admission to the graduate program.

Admission into the program

The prospective student will normally be considered for admission into the program during the fall semester of their senior year. A recommendation from their undergraduate advisor is a critical part of the application. It is expected that the prospective student will have attained a 3.5 overall GPA, a 3.5 on all mathematics courses taken, and will have taken the GRE examination by the end of October of their senior year.

By November 1, the prospective student must submit an application with all supporting material to the Graduate School for admission into the M.S. program in Mathematics for the following spring semester. A decision on admission into the graduate program will be made prior to the start of the spring semester. Prior to registration for 700-level courses, the student must be approved for Accelerated Bachelor's/Graduate Study (G-BGCA and G-BGPA) .

Note: *Students considering the Five-Year Program should discuss their plans with the Graduate Director, in addition to their regular advisor. This discussion should begin as early as possible, typically during the student's sophomore year.*

c) Financial Aid

Upon admission to the program, the student will be eligible for financial assistance from the department as follows: During the fall semester of the senior year, the student will receive consideration for employment as an undergraduate assistant for 10 hours per week, and during the spring semester of the senior year, the student will receive consideration for a quarter-time graduate assistantship. In the fifth year and the first and second summer of graduate study, the student will be eligible for a halftime graduate teaching assistantship.

DESCRIPTIONS OF UNDERGRADUATE MATHEMATICS COURSES

111 **Basic College Mathematics. (3)** (Prereq: Placement code MB2 required; earned by Algebra Placement Test) Basic college algebra; linear and quadratic equations, inequalities, functions and graphs of functions, exponential and logarithm functions, systems of equations. Credit may not be received for both MATH 111 and 115.

111I **Intensive Basic College Mathematics. (4)** (Prereq: Placement code MB1 required; earned by Algebra Placement Test) An intensive treatment of the topics covered in MATH 111.

112 **Trigonometry. (2)** (Prereq: Placement code MB4-9 required; earned by grade of **C** or better in MATH 111 or 111I, or Algebra Placement Test) Topics in trigonometry specifically needed for MATH 141, 142, 241. Circular functions, analytic trigonometry, applications of trigonometry. Credit may not be received for both MATH 112 and 115.

115 **Precalculus Mathematics. (4)** (Prereq: Placement code MA2 or MC0-9; earned by grade of C or better in MATH 111or 111I, or by Precalculus Placement Test) Topics in algebra and trigonometry specifically needed for MATH 141, 142, 241. Subsets of the real line, absolute value; polynomial, rational, inverse, logarithmic, exponential functions; circular functions; analytic trigonometry. Credit may not be received for both MATH 111 and 115 or both MATH 112 and 115.

116 **Brief Precalculus Mathematics. (2)** (Prereq: Placement code MA4-9 [or by Departmental Permission] required; earned by grade of C or better in MATH 115 or by Precalculus Placement Test) Essential algebra and trigonometry topics for Calculus, including working with equations that involve polynomials, rational functions, exponential and logarithmic functions, and trigonometric and inverse trigonometric functions. Intended for students with prior experience in Precalculus, but not ready for MATH 141.

122 **Calculus for Business Administration and Social Sciences. (3)** (Prereq: Placement code MB4-9 required; earned by grade of C or better in MATH 111 or 111I, or by Algebra Placement Test) Derivatives and integrals of elementary algebraic, exponential, and logarithmic functions. Maxima, minima, rate of change, motion, work, area under a curve, and volume.

141 **Calculus I. (4)** (Prereq: Placement code MA4-9 or MD0-9 required; earned by grade of C or better in Math 112, 115, or 116, or by Precalculus Placement Test.) Four classroom hours and one laboratory hour per week. Functions, limits, derivatives, introduction to integrals, the Fundamental Theorem of Calculus, applications of derivatives and integrals.

142 **Calculus II. (4)** (Prereq: Qualification through placement or a grade of **C** or better in MATH 141) Four classroom hours and one laboratory hour per week. Methods of integration, sequences and series, approximations.

151 **Calculus Workshop I. (2)** (Coreq: MATH 141) Small study group practice in applications of calculus. For elective credit only. Two 2-hour sessions per week.

152 **Calculus Workshop II. (2)** (Coreq: MATH 142) Small study group practice in applications of calculus. For elective credit only. Two 2-hour sessions per week.

170 **Finite Mathematics. (3)** (Prereq: Placement code MA4-9, MC0-9 required; earned by grade of C or better in MATH 111/111I, or by Algebra Placement Test) Elementary matrix theory; systems of linear equations; permutations and combinations; probability and Markov chains; linear programming and game theory.

172 **Mathematical Modeling for the Life Sciences. (3)** (prereq: **C** or better ii MATH 122 or 144) Modeling with difference equations; vectors, trigonometry, polar coordinates, matrices, eigenvalues and eigenvectors; addition and multiplication in combinatorics, permutations, combinations, introduction to probability theory (discrete, continuous); techniques of integration, symmetry. Credit may not be received for both MATH 172 and either MATH 170 or 174.

174   Discrete Mathematics for Computer Science. (3) (Prereq: qualification through placement or a grade of **C** or better in MATH 112 or 115) Induction, complexity, elementary counting, combinations and permutations, recursion and recurrence relations, graphs and trees; discussion of the design and analysis of algorithms--with emphasis on sorting and searching.

198   Introduction to Careers and Research in the Mathematical Sciences. (1) (Prereq: qualification through placement in MATH 142 or higher, or a grade of C or better in MATH 141) An overview of different areas of mathematical research and career opportunities for Mathematics majors.

221   Basic Concepts of Elementary Mathematics I. (3) (Prereq: Placement code MB4-9 or MD0-9 required; earned by grade of C or better in MATH 111/111I, or by Algebra Placement Test) The meaning of number, fundamental operations of arithmetic, the structure of the real number system and its subsystems, elementary number theory. Open only to students in elementary or early childhood teacher certification.

222   Basic Concepts of Elementary Mathematics II. (3) (Prereq: Grade of C or better in MATH 221, or consent of the instructor) Informal geometry and basic concepts of algebra. Open only to students in elementary or early childhood teacher certification.

241   Vector Calculus. (3) (Prereq: qualification through placement or a grade of **C** or better in MATH 142) Vector algebra, geometry of three-dimensional space; lines, planes, and curves in space; polar, cylindrical, and spherical coordinate systems; partial differentiation, max-min theory; multiple and iterated integration, line integrals, and Green's theorem in the plane.

242   Elementary Differential Equations. (3) (Prereq: qualification through placement or a grade of **C** or better in MATH 142) Ordinary differential equations of first order, higher order linear equations, Laplace transform methods, series methods; numerical solution of differential equations. Applications to physical sciences and engineering.

300   Transition to Advanced Mathematics. (3) (Prereq: Grade of C or better in MATH 142) Rigor of mathematical thinking and proof writing via logic, sets, and functions. Intended to bridge the gap between lower-level (computational-based) and upper-level (proof-based) mathematics courses.

374   Discrete Structures. (3) (Prereq: MATH 142 and CSCE 146) Propositional and predicate logic; proof techniques; recursion and recurrence relations; sets, combinatorics, and probability; functions, relations, and matrices; algebraic structures.

399   Independent Study. (3-9) Contract approved by instructor, advisor, and department chair is required for undergraduate students.

401   Conceptual History of Mathematics. (3) (Prereq: MATH 122, or 141, or consent of the department) Topics from the history of mathematics emphasizing the 17th century to the present. Various mathematical concepts are discussed and their development traced. For elective or Group II credit only.

499   Undergraduate Research. (1-3) Research on a specific mathematical subject area. The specific content of the research project must be outlined in a proposal that must be approved by the instructor and the Undergraduate Director. Intended for students pursuing the B.S. in Mathematics with Distinction (Pass-Fail grading only.)

511   Probability. {= STAT 511} (3) (Prereq: a grade of C or higher in either MATH 241) Probability and independence; discrete and continuous random variables; joint, marginal, and conditional densities, moment generating functions; laws of large numbers; binomial, Poisson, gamma, univariate, and bivariate normal distributions.

514   Financial Mathematics I. {=STAT 522} (3) (Prereq: a grade of **C** or better in either MATH 241) Probability spaces. Random variables. Mean and variance. Geometric Brownian Motion and stock price dynamics. Interest rates and present value analysis. Pricing via arbitrage arguments. Options pricing and the Black-Scholes formula.

515   Financial Mathematics II. {=STAT 523} (3) (Prereq: MATH 514 or STAT 522 with a grade of **C** or better) Convex sets. Separating Hyperplane Theorem. Fundamental Theorem of Asset Pricing. Risk and expected return. Minimum variance portfolios. Capital Asset Pricing Model. Martingales and options pricing. Optimization models and dynamic programming.

520   Ordinary Differential Equations. (3) (Prereq: MATH 544 or 526; or consent of department) Differential equations of the first order, linear systems of ordinary differential equations, elementary qualitative properties of nonlinear systems.

521   Boundary Value Problems and Partial Differential Equations. (3) (Prereq: MATH 520 or 241 and 242) Laplace transforms, two-point boundary value problems and Green's functions, boundary value problems in partial differential equations, eigenfunction expansions and separation of variables, transform methods for solving PDE's, Green's functions for PDE's, and the method of characteristics.

522   **Wavelets. (3)** (Prereq: MATH 544 or 526 or consent of department) Basic principles and methods of Fourier transforms, wavelets, and multiresolution analysis; applications to differential equations, data compression, and signal and image processing; development of numerical algorithms. Computer implementation.

523   **Mathematical Modeling of Population Biology. (3)** (Prereq: MATH 142, BIOL 301, or MSCI 311 recommended) Applications of differential and difference equations and linear algebra modeling the dynamics of populations, with emphasis on stability and oscillation. Critical analysis of current publications with computer simulation of models.

524   **Nonlinear Optimization. (3)** (Prereq: MATH 526 or 544 or consent of department) Descent methods, conjugate direction methods, and Quasi-Newton algorithms for unconstrained optimization; globally convergent hybrid algorithm; primal, penalty, and barrier methods for constrained optimization. Computer implementation of algorithms.

525   **Mathematical Game Theory. (3)** (Prereq: MATH 526 or 544) Two-person zero-sum games, minimax theorem, utility theory, n-person games, market games, stability.

526   **Numerical Linear Algebra. (4)** (Prereq: MATH 241) Matrix algebra, Gauss elimination, iterative methods; overdetermined systems and least squares; eigenvalues, eigenvectors; numerical software. Computer implementation. Three lectures and one laboratory hour per week. Credit may not be received for both MATH 526 and MATH 544.

527   **Numerical Analysis. {=CSCE 561} (3)** (Prereq: MATH 242 or 520) Interpolation and approximation of functions; solution of algebraic equations; numerical differentiation and integration; numerical solutions of ordinary differential equations and boundary value problems; computer implementation of algorithms.

531   **Foundations of Geometry. (3)** (Prereq: MATH 241) The study of geometry as a logical system based upon postulates and undefined terms. The fundamental concepts and relations of Euclidean geometry developed rigorously on the basis of a set of postulates. Some topics from non-Euclidean geometry.

532   **Modern Geometry. (3)** (Prereq: MATH 241) Projective geometry, theorem of Desargues, conics, transformation theory, affine geometry, Euclidean geometry, non-Euclidean geometries, and topology.

533   **Elementary Geometric Topology. (3)** (Prereq: MATH 241) Topology of the line, plane, and space, Jordan curve theorem, Brouwer fixed point theorem, Euler characteristic of polyhedra, orientable and non-orientable surfaces, classification of surfaces, network topology.

534   **Elements of General Topology. (3)** (Prereq: MATH 241) Elementary properties of sets, functions, spaces, maps, separation axioms, compactness, completeness, convergence, connectedness, path connectedness, embedding and extension theorems, metric spaces, and compactification.

540   **Modern Applied Algebra. (3)** (Prereq: MATH 241) Finite structures useful in applied areas. Binary relations, Boolean algebras, applications to optimization, and realization of finite state machines.

541   **Algebraic Coding Theory. (3)** (Prereq: MATH 526 or MATH 544 or consent of department) Error-correcting codes, polynomial rings, cyclic codes, finite fields, BCH codes.

544   **Linear Algebra. (3)** (Prereq: MATH 241) Matrix algebra, solution of linear systems; notions of vector space, independence, basis, dimension; linear transformations, change of basis; eigenvalues, eigenvectors, Hermitian matrices, diagonalization; Cayley-Hamilton theorem. Credit may not be received for both MATH 526 and MATH 544.

546   **Algebraic Structures I. (3)** (Prereq: MATH 241) Permutation groups; abstract groups; introduction to algebraic structures through study of subgroups, quotient groups, homomorphisms, isomorphisms, direct product; decompositions; introduction to rings and fields.

547   **Algebraic Structures II. (3)** (Prereq: MATH 546) Rings, ideals, polynomial rings, unique factorization domains; structure of finite groups; topics from: fields, field extensions, Euclidean constructions, modules over principal ideal domains (canonical forms).

550   **Vector Analysis II. (3)** (Prereq: a grade of C or higher in either MATH 241) Vector fields, line and path integrals, orientation and parametrization of lines and surfaces, change of variables and Jacobians, oriented surface integrals, theorems of Green, Gauss, and Stokes; introduction to tensor analysis.

551   **Introduction to Differential Geometry. (3)** (Prereq: MATH 241) Parametrized curves, regular curves and surfaces, change of parameters, tangent planes, the differential of a map, the Gauss map, first and second fundamental forms, vector fields, geodesics, and the exponential map.

552 **Applied Complex Variables. (3)** (Prereq: MATH 241) Complex integration, calculus of residues, conformal mapping, Taylor and Laurent Series expansions, applications.

554 **Analysis I. (3)** (Prereq: MATH 241) Least upper bound axiom, the real numbers, compactness, sequences, continuity, uniform continuity, differentiation, Riemann integral and fundamental theorem of calculus.

555 **Analysis II. (3)** (Prereq: MATH 554 or consent of department) Riemann-Stieltjes integral, infinite series, sequences and series of functions, uniform convergence, Weierstrass approximation theorem, selected topics from Fourier series or Lebesgue integration.

561 **Introduction to Mathematical Logic. (3)** (Prereq: MATH 241) Syntax and semantics of formal languages; sentential logic, proofs in first order logic; Godel's completeness theorem; compactness theorem and applications; cardinals and ordinals; the Lowenheim-Skolem-Tarski theorem; Beth's definability theorem; effectively computable functions; Godel's incompleteness theorem; undecidable theories.

562 **Theory of Computation. {=CSCE 551} (3)** (Prereq: CSCE 350 or MATH 526 or 544 or 574) Basic theoretical principles of computer science as modeled by formal languages and automata; computability and computational complexity. Major credit may not be received for both CSCE 355 and CSCE 551.

570 **Discrete Optimization. (3)** (Prereq: MATH 526 or 544) Discrete mathematical models. Applications to such problems as resource allocation and transportation. Topics include linear programming, integer programming, network analysis, and dynamic programming.

574 **Discrete Mathematics I. (3)** (Prereq: MATH 142) Mathematical models; mathematical reasoning; enumeration; induction and recursion; tree structures; networks and graphs; analysis of algorithms.

575 **Discrete Mathematics II. (3)** (Prereq: MATH 574) A continuation of MATH 574. Inversion formulas; Polya counting; combinatorial designs; minimax theorems; probabilistic methods; Ramsey theory; other topics.

576 **Combinatorial Game Theory. (3)** (Prereq: MATH 526, 544, or 574) Winning in certain combinatorial games such as Nim, Hackenbush, and Domineering. Equalities and inequalities among games, Sprague-Grundy theory of impartial games, games which are numbers.

580 **Elementary Number Theory. (3)** (Prereq: MATH 241) Divisibility, primes, congruences, quadratic residues, numerical functions. Diophantine equations.

587 **Introduction to Cryptography. {=CSCE 557} (3)** (Prereq: CSCE 145, MATH 241, and either CSCE 355 or MATH 574) Design of secret codes for secure communication, including encryption and integrity verification: ciphers, cryptographic hashing, and public key cryptosystems such as RSA. Mathematical principles underlying encryption. Code-breaking techniques. Cryptographic protocols.

590 **Undergraduate Seminar. (1-3)** (Prereq: consent of instructor) A review of literature in specific subject areas involving student presentations. Content varies and will be announced in the *Master Schedule of Classes* by suffix and title. Pass-fail grading. For undergraduate credit only.

599 **Topics in Mathematics. (1-3)** Recent developments in pure and applied mathematics selected to meet current faculty and student interest.

602 **An Inductive Approach to Geometry. (3)** (Prereq: MATH 122 or 141) This course is designed for middle level pre-service mathematics teachers. This course covers geometric reasoning, Euclidean geometry, congruence, area, volume, similarity, symmetry, vectors, and transformations. Dynamic software will be utilized to explore geometric concepts. This course cannot be used towards a major in mathematics.

603 **Inquiry Approach to Algebra. (3)** (Prereq: A grade of C or higher in MATH 122 or MATH 141 or equivalent) This course introduces basic concepts in number theory and modern algebra that provide the foundation for middle level arithmetic and algebra. Topics include: algebraic reasoning, patterns, inductive reasoning, deductive reasoning, arithmetic and algebra of integers, algebraic systems, algebraic modeling, and axiomatic mathematics. This course cannot be used for credit towards a major in mathematics.

650 **Calculus for Teachers (3)** (Prereq: current secondary high school teacher certification in mathematics and at least 6 hours of calculus) A thorough study of the topics to be presented in AP calculus, including limits of functions, differentiation, integration, infinite series, and applications. (Not intended for degree programs in mathematics.)

PLANNING YOUR DEGREE PROGRAM

A general schedule for the offering of upper-division mathematics courses is shown below. A collection of sample programs of study and a graduation checklist are also included in this document. Additional programs of study, including a blank form for you to use to plan and monitor your personal progress can be found under the Undergraduate Program link on the Department of Mathematics homepage (http://www.math.sc.edu/).

Tentative Schedule of Regularly-Offered Upper-Division MATH Courses

Course	Fall (odd)	Spring (even)	Summer (even)	Fall (even)	Spring (odd)	Summer (odd)
300	X	X		X	X	
374	X	X		X	X	
511	X	X	X	X	X	X
514	X			X		
515		X				
520	X	X		X	X	
521					X	
522				X		
523	X					
524				X		
526	X	X		X	X	
527		X				
531	X			X		
532		X			X	
534	X					
544	X	X + Xh	X	X	X + Xh	X
546	Xh	X	X	X + Xh	X	X
547		Xh			Xh	
550	X	X + Xh		X	X + Xh	
552		X			X	
554	X + Xh	X	X	X + Xh	X	X
555		Xh			Xh	
570	X					
574	X + Xh	X	X	X + Xh	X	X
575		Xh			Xh	
580	X		X	X		X
587				X		

Legend:	
Xh	restricted enrollment for students intending to take second course in sequence; offered for honors credit in alternate years (546 in even years, 554 in odd years)
bold	required for all Mathematics degrees at USC
italics	only one of 526 and 544 can be counted for graduation credit

Note:
Whether a course actually runs in each of the indicated
semesters is dependent upon enrollment and staffing.

Individual Program of Study for
B. S. in Mathematics

Major Emphasis: __ **General** ___   Cognate/Minor: _____

	Fall Semester	Role	Hrs	Spring Semester	Role	Hrs	Total Hrs
Freshman	MATH 141	ARP - CC	4	MATH 142	ARP - CC	4	
	ENGL 101	CMW - CC	3	ENGL 102	CMW+INF - CC	3	
	Lab Science	SCI - CC	4	Lab Science	SCI - CC	4	
	HIST 10x / 11x	GHS - CC	3	HIST 11x / 10x	GHS - CC	3	
	UNIV 101	Elective	3	Humanity / Fine Art	AIU - CC	3	
	Semester Total		17			17	34
							34
Sophomore	MATH 241	Pre-Major	3	MATH 544 / 526	Major Core	3	
	MATH 300	Pre-Major	3	MATH 574	Major Core	3	
	For Lang 121	GFL - CC	4	For Lang 122	GFL - CC	3	
	Social Science	GSS - CC	3	Social Science	GSS - AS	3	
	CSCE 145 / 206	ARP - AS	4	SPCH 140	CMS - CC	3	
	Semester Total		17			15	32
							66
Junior	MATH 520	Major Core	3	MATH 546 / 554	Major Core	3	
	MATH 5xx	Major Elec	3	STAT 509 / 512 / 515	ARP - AS	3	
	Fine Art / Lit	AIU - CC	3	Val, Eth, Soc Res	VSR - CC	3	
	Cognate / Minor		3	Cognate / Minor		3	
	Elective		3	Elective		3	
	Semester Total		15			15	30
							96
Senior	MATH 554 / 546	Major Core	3	MATH 5xx	Major Elec	3	
	MATH 5xx	Major Elec	3	Cognate / Minor		3	
	Cognate / Minor		3	Minor / Elective		3	
	Minor / Elective		3	Elective		3	
	Elective		3	Elective		3	
	Semester Total		15			15	30
							126

Individual Program of Study for
B. S. in Mathematics

Major Emphasis: __ **Education** ___   Cognate/Minor: _ **Secondary Educa**tion _

	Fall Semester	Role	Hrs	Spring Semester	Role	Hrs	Total Hrs
Freshman	MATH 141	ARP - CC	4	MATH 142	ARP - CC	4	
	ENGL 101	CMW - CC	3	ENGL 102	CMW+INF - CC	3	
	Lab Science	SCI - CC	4	Lab Science	SCI - CC	4	
	HIST 10x / 11x	GHS - CC	3	HIST 11x / 10x	GHS - CC	3	
	UNIV 101	Elective	3	Humanity / Fine Art	AIU - CC	3	
	Semester Total		17			17	34
							34
Sophomore	MATH 241	Pre-Major	3	MATH 544 / 526	Major Core	3	
	MATH 300	Pre-Major	3	MATH 574	Major Core	3	
	For Lang 121	GFL - CC	4	For Lang 122	GFL - CC	3	
	Social Science	GSS - CC	3	SPCH 140	CMS - CC	3	
	EDFN 300	Cognate	3	EDPY 401	Cognate	3	
	EDTE 400	Cognate	1	EDPY 401P	Cognate	1	
	Semester Total		17			16	33
							67
Junior	MATH 5xx	Major Core	3	MATH 546 / 554	Major Core	3	
	MATH 580	Major Elec	3	STAT 509 / 512 / 515	ARP - AS	3	
	Fine Art / Lit	AIU - CC	3	Val, Eth, Soc Res	VSR - CC	3	
	EDSE 402	Cognate	4	Social Science	GSS - AS	3	
	CSCE 145 / 206	ARP - AS	4	Minor / Elective		3	
	Semester Total		17			15	32
							99
Senior	MATH 554 / 546	Major Core	3	MATH 5xx / 532	Major Elec	3	
	MATH 531 / 5xx	Major Elec	3	Elective		3	
	Minor / Elective		3	Elective		3	
	Elective		3	Elective		3	
	Elective		3	Elective		3	
	Semester Total		15			15	30
							129

Individual Program of Study for
B. S. in Mathematics

Major Emphasis: __ **Applied** ___   Cognate/Minor: _____

	Fall Semester	Role	Hrs	Spring Semester	Role	Hrs	Total Hrs
Freshman	MATH 141	ARP - CC	4	MATH 142	ARP - CC	4	
	ENGL 101	CMW - CC	3	ENGL 102	CMW+INF - CC	3	
	Lab Science	SCI - CC	4	Lab Science	SCI - CC	4	
	HIST 10x / 11x	GHS - CC	3	HIST 11x / 10x	GHS - CC	3	
	UNIV 101	Elective	3	Humanity / Fine Art	AIU - CC	3	
	Semester Total		17			17	34
							34
Sophomore	MATH 241	Pre-Major	3	MATH 526 / 544	Major Core	3	
	MATH 300	Pre-Major	3	MATH 574	Major Core	3	
	For Lang 121	GFL - CC	4	For Lang 122	GFL - CC	3	
	Social Science	GSS - CC	3	Social Science	GSS - AS	3	
	CSCE 145 / 206	ARP - AS	4	SPCH 140	CMS - CC	3	
	Semester Total		17			15	32
							66
Junior	MATH 520	Major Core	3	MATH 546 / 554	Major Core	3	
	MATH 5xx	Major Elec	3	STAT 509 / 512 / 515	ARP - AS	3	
	Fine Art / Lit	AIU - CC	3	Val, Eth, Soc Res	VSR - CC	3	
	Cognate / Minor		3	Cognate / Minor		3	
	Elective		3	Elective		3	
	Semester Total		15			15	30
							96
Senior	MATH 554 / 546	Major Core	3	MATH 5yy	Major Elec	3	
	MATH 5xx	Major Elec	3	Cognate / Minor		3	
	Cognate / Minor		3	Minor / Elective		3	
	Minor / Elective		3	Elective		3	
	Elective		3	Elective		3	
	Semester Total		15			15	30
							126

Individual Program of Study for
B. S. in Mathematics

Major Emphasis: __ **Actuaria**l ___   Cognate/Minor: _ **Risk Mgmt & Ins** _

	Fall Semester	Role	Hrs	Spring Semester	Role	Hrs	Total Hrs
Freshman	MATH 141	ARP - CC	4	MATH 142	ARP - CC	4	
	ENGL 101	CMW - CC	3	ENGL 102	CMW+INF - CC	3	
	Lab Science	SCI - CC	4	Lab Science	SCI - CC	4	
	HIST 10x / 11x	GHS - CC	3	HIST 11x / 10x	GHS - CC	3	
	UNIV 101	Elective	3	ACCT 225	Minor	3	
	Semester Total		17			17	34
							34
Sophomore	MATH 241	Pre-Major	3	MATH 300	Pre-Major	3	
	MATH 511	Major	3	STAT 512	ARP - AS	3	
	For Lang 121	GFL - CC	4	For Lang 122	GFL - CC	3	
	ECON 221	GSS - CC	3	ECON 222	Minor	3	
	Fine Art / Lit	AIU - CC	3	CSCE 145 / 206	ARP - AS	4	
	Semester Total		16			16	32
							66
Junior	MATH 544 / 526	Major Core	3	MATH 520	Major Core	3	
	MATH 574	Major Core	3	MATH 546 / 554	Major Core	3	
	STAT 513	Other Req.	3	SPCH 140	CMS - CC	3	
	FINA 363	Minor	3	ECON 436	Other Req.	3	
	Humanity / Fine Art	AIU - CC	3	FINA 341	Other Req.	3	
	Semester Total		15			15	30
							96
Senior	MATh 524 / 570	Major	3	MATH 554 / 546	Major Core	3	
	MATH 5xx	Major Elec	3	FINA 475	Minor	3	
	FINA 469	Minor	3	FINA 471	Minor	3	
	Val, Eth, Soc Resp	VSR - CC	3	Adv. Computing	Other Req.	3	
	Social Science	GSS - AS	3	Elective		3	
	Semester Total		15			15	30
							126

Individual Program of Study for
B. S. in Mathematics

Major Emphasis: **General w Distinction**   Cognate/Minor: _____

	Fall Semester	Role	Hrs	Spring Semester	Role	Hrs	Total Hrs
Freshman	MATH 141	ARP - CC	4	MATH 142	ARP - CC	4	
	ENGL 101	CMW - CC	3	ENGL 102	CMW+INF - CC	3	
	Lab Science	SCI - CC	4	Lab Science	SCI - CC	4	
	HIST 10x / 11x	GHS - CC	3	HIST 11x / 10x	GHS - CC	3	
	UNIV 101	Elective	3	Humanity / Fine Art	AIU - CC	3	
	Semester Total		17			17	34
							34
Sophomore	MATH 241	Pre-Major	3	MATH 544 / 526	Major Core	3	
	MATH 300	Pre-Major	3	MATH 574	Major Core	3	
	For Lang 121	GFL - CC	4	For Lang 122	GFL - CC	3	
	Social Science	GSS - CC	3	Social Science	GSS - AS	3	
	CSCE 145 / 206	ARP - AS	4	SPCH 140	CMS - CC	3	
	Semester Total		17			15	32
							66
Junior	MATH 520	Major Core	3	MATH 547 / 555	Major Core	3	
	MATH 546 / 554	Major Elec	3	MATH 5xx	Major Elec	3	
	Fine Art / Lit	AIU - CC	3	STAT 509 / 512 / 515	ARP - AS	3	
	Cognate / Minor		3	Val, Eth, Soc Res	VSR - CC	3	
	Social Science	GSS - CC	3	Cognate / Minor		3	
	Semester Total		15			15	30
							96
Senior	MATH 554 / 546	Major Core	3	MATH 555 / 547	Major Elec	3	
	MATH 5xx	Distinction	3	MATH 5xx	Distinction	3	
	MATH 5xx	Distinction	3	MATH 5xx	Distinction	3	
	Elective		3	MATH 499	Distinction	3	
	Elective		3	Cognate / Minor		3	
	Semester Total		15			15	30
							126

Individual Program of Study for
B. S. in Mathematics

Major Emphasis: _____   Cognate/Minor: _____

	Fall Semester	Hrs	Spring Semester	Hrs	Summer Semester	Hrs	Total
Freshman							
	Semester Total	0		0		0	0
							0
Sophomore							
	Semester Total	0		0		0	0
							0
Junior							
	Semester Total	0		0		0	0
							0
Senior							
	Semester Total	0		0		0	0
							0
Fifth Year							
	Semester Total	0		0		0	0
							0

Graduation Checklist for B.S. in Mathematics (2014-2015)

Emphasis: _____   Cognate/Minor: _____

	Course	Credit Hrs	Grade	Note
Effective & Persuasive Communic: Writing	ENGL 101			CMW - CC
	ENGL 102			CMW - CC
Analytical Reasoning & Problem Solving	MATH 141			ARP - CC
	MATH 142			ARP - CC
STAT 509, 512, or 515	STAT			ARP - AS
CSCE 145 or 206	CSCE			ARP - AS
Scientific Literacy				SCI - CC
				SCI - CC
2 lab sequences (8 hrs)				SCI - CC
				SCI - CC
Global Citizenship: Foreign Language				GFL - CC
				GFL - CC
thru 122 (0-9 hrs)				GFL - CC
Global Citizenship: Historical Thinking	HIST 10_			GHS - CC
	HIST 11_			GHS - CC
Global Citizenship: Historical Thinking				GSS - CC
				GSS - AS
Fine Arts / Literature Humanity / Fine Arts				AIU - CC
				AIU - CC
*Comm: Speech				CMS - CC
*Information Literacy				INF - CC
*Values, Ethics, Soc Resp				VSR - CC

* 2 of CMS, INF, and VSR can be overlays
total hrs depends on GFL & overlays

Hrs Earned	0
Hrs Req'd	53 -- 68

	Course	Credit Hrs	Grade
Pre-Major	MATH 241		
	MATH 300		

Hrs Earned	0
Hrs Req'd	6

	Course	Credit Hrs	Grade
Major	MATH 520		
	MATH 544/526		
	MATH 546		
	MATH 554		
	MATH 574		
	MATH 5__		
	MATH 5__		
	MATH 5__		

Hrs Earned	0
Hrs Req'd	24--25

	Course	Credit Hrs	Grade
Cognate or Minor			

Hrs Earned	0
Hrs Req'd	12--18

	Course	Credit Hrs	Grade
Elective			

Hrs Earned	0
Hrs Req'd	3 -- 25

Total Hours Earned	0
Total Hours Req'd	120

An electronic copy of this document can be found on the Undergraduate section of the Department of Mathematics website:

http://www.math.sc.edu/undergraduate/

This page contains lots of information about courses, advising, summer opportunities, scholarships and awards, etc.

The direct URL to this Undergraduate Booklet is

http://www.math.sc.edu/undergraduate/2014ugradbooklet.pdf

The Sample and Individual Programs of Study and Graduation Checklist are available as Excel spreadsheets from

http://www.math.sc.edu/undergraduate/2014UgradSampleProgChecklist.xlsx