



Department of  
**MATHEMATICS**

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THE UNIVERSITY OF UTAH

## Majors and Minors



Mathematics Major  
Mathematics Major with Statistics Emphasis  
Mathematics Major with Mathematics of Computation Emphasis  
Applied Mathematics Major  
Mathematics Teaching Major  
Honors Degree in Mathematics

Mathematics Minor  
Mathematics Teaching Minor

*Philosophy is written in this grand book, the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures without which it is humanly impossible to understand a single word of it.*

*--Galileo, 1623*

### **Program Description**

Mathematics majors take Calculus, Linear Algebra, Differential Equations and Foundations of Analysis. Subsequent electives include Statistics and Probability, Complex Variables, Modern Algebra, Mathematical Finance, Number Theory, Real Analysis, Topology, Dynamical Systems, Differential Equations, Applied Math, Numerical Analysis, and Mathematical Biology. Most majors are required to complete a year of physics, and all are urged to take other science, business or engineering courses, a computing course, a probability or statistics course, and to attend the Undergraduate Colloquium Series. Mathematics majors are also encouraged to consider internship and research opportunities.

### **Advising**

We encourage students to seek advising regarding course selection and graduation requirements. Students should initially contact the Undergraduate Advisor, Angie Gardiner. If additional advice regarding course selection is needed, students are encouraged to talk to faculty members about specific interests.

Appointments are encouraged for issues expected to take more than a few minutes, such as (but not limited to) major declaration, mandatory advising visits, and graduation application. For quick questions no appointment is necessary to meet with the undergraduate advisor, simply stop by during drop-in advising office hours which are posted at <http://www.math.utah.edu/ugrad/advising.html>.

### **Career Opportunities**

Mathematics is basic to science, engineering and any analytic endeavor. Mathematicians often work as part of a team of scientists and engineers who conduct research, solve problems, or develop products and systems in technology, industry, finance or business. Others continue studying mathematics in graduate school and conduct basic research in mathematics itself. A mathematics degree also provides a strong background for those who will pursue other interests, such as medicine or law.

Typical careers include actuary, statistician, operations researcher, numerical analyst, data analyst, software engineer/developer, database manager/developer, market researcher, information systems consultant, cryptologist, elementary or high school teacher, college or university professor, and research scientist. In addition, mathematicians occupy many administrative positions in finance and accounting departments and in research operations where computers, statistics and analytical thought play an important role.

Typical employers include research firms, aerospace and oil companies, electronic, biomedical and bioengineering firms, communications laboratories, school systems, investment banking firms, and the National Security Agency. Computer software companies are prime employers, and insurance companies seek mathematicians for actuarial work.

For current information on starting salaries, visit Career Services, 350 SSB. We also encourage you to attend math department career related events.

### **Internship Opportunities**

The Department of Mathematics participates in the University's Career Services Internship Program, which provides internship opportunities for students in business, industry and government. The program involves either full-time employment during a semester when the student is not enrolled in school, or part-time employment during a semester in which the student is enrolled part-time. While exposing students to mathematics in nonacademic settings, the internship enables them to defray part of their education costs and develop a relationship with potential employers.

Interns may register for Math 4910 (approval of undergraduate advisor required) or Ed Psych 3960 (through Career Services) during the semester they are involved with the program if they wish to receive university credit. If the internship is directly related to mathematics, Math 4910 may count as one of the allied courses required by the scientific computing and statistics emphases (advisor approval required). For more information, students may contact the Undergraduate Advisor or see [www.math.utah.edu/ugrad/intern.html](http://www.math.utah.edu/ugrad/intern.html).

## Research Opportunities

Students are encouraged to consider participating in undergraduate research, either through an independent research project with a faculty member or as part of a summer research program. We offer both summer and academic year Research Experiences for Undergraduates (REUs), and other research opportunities are available through the Undergraduate Research Opportunities Program (UROP).

For more information, please see the REU Program Director, or visit [www.math.utah.edu/ugrad/research.html](http://www.math.utah.edu/ugrad/research.html) or <http://urop.utah.edu/>.

Students involved in research may wish to apply for the "Undergraduate Research Scholar Designation" upon graduation. See <http://www.ursd.utah.edu/> for application deadlines and information on requirements.

## Double Majors

To qualify for a double major, a student must satisfy the University requirements, as well as the requirements of both major departments. Especially popular double majors with mathematics include physics, economics, computer science and engineering.

## Combined BS/MS Program

Undergraduate math majors wishing to be admitted to the combined BS/MS program must apply during their junior year. To be eligible for the program a student must have maintained a 3.5 GPA overall and in the major (which must be mathematics), and indications must be that the student will successfully satisfy the requirements for both the Bachelor's and Master's degrees within two years after beginning the program. Interested students must apply to the department's graduate program and submit a detailed program of study that has been prepared with the help of the student's advisor(s). Students wishing to be admitted to this program are strongly encouraged to participate in an REU early in their program of study. Transfer students may be considered for the program only after completing 24 hours of coursework at the University of Utah. For more information see <http://www.math.utah.edu/grad> or talk to the Graduate Program Coordinator.

## Petition for Graduate Credit

Students may be allowed to select certain graduate courses taken while enrolled as an undergraduate for graduate credit. Such credit is limited to six hours or two courses. Credit used to earn the undergraduate degree may not be counted toward a graduate degree. Students are encouraged to seek advance approval of the dean of the The Graduate School. Petition forms are available at the Registrar's Office. If a student seeks retroactive graduate credit for courses taken as an undergraduate, permission may be granted only if a grade of B or better was earned and the courses were taken no more than three years prior to the petition.

## AP Credit

A score of 3, 4 or 5 on the AP Calculus AB test or a score of 3 or 4 on the AP Calculus BC test is awarded six semester hours of credit. A score of 5 on the AP Calculus BC test is awarded eight hours of semester credit. The math department uses AP test scores to determine course placement as follows:

Test	Score	Course
AB	3	Math 1210
AB	4	Math 1220 or 1250
AB	5	Math 1250 or 1220
BC	3	Math 1220
BC	4 or 5	Math 1260 or speak with an advisor

NOTES: Math 1250-1260 covers in two semesters roughly the same material covered by Math 1210-1220-2210 in three semesters. The Math 1250-1260 sequence also covers the material in a more in-depth and theoretical manner. These placement guidelines are for the math department. If you are majoring in something other than mathematics, or are pursuing a double major, please check with your departmental advisor to determine which class you should take.

## Scholarships

The mathematics department offers several scholarships to outstanding students each year, which may take the form of tuition waivers or cash awards. For more information see [www.math.utah.edu/ugrad/scholarships.html](http://www.math.utah.edu/ugrad/scholarships.html).

## Student Involvement

Math majors are encouraged to be involved with the math department outside of simply attending classes. Opportunities include, but are not limited to, employment at the T. Benny Rushing Mathematics Center, becoming a member of the Undergraduate Student Advisory Committee (USAC), attending open houses and workshops, participating in undergraduate contests, attending the Undergraduate Colloquium Series, working on a directed reading, and getting involved in research.

The T. Benny Rushing Mathematics Center houses a drop-in computer lab, tutoring center, group study rooms, individual study desks and a small break room. Computer lab and tutoring center hours during the academic year are Monday - Thursday 8 AM - 8 PM and Friday 8 AM - 6 PM.

## University Graduation Requirements

### Minimum University Requirements

Total Credits	122
Upper division hours	40
U of U credits	30
(20 of last 30 hours must be earned in residence. Independent Study credits do not count as resident credits.)	
General Education credits	see below
Minimum GPA	2.0
Completion of major requirements	see below
Completion of minor (if desired)	see department

### General Education Requirements

**A. Intellectual Explorations:** Two courses must be taken from each of the following areas: Fine Arts, Humanities, and Social Sciences.

**B. Writing:** Wrtg 2010 or ESL 1060

**C. American Institutions:** Hist 1700 or Econ 1740 or Pol S 1100 or Honors 2212

**D. Quantitative Reasoning (QA/QB):** Calculus I fills both the QA and QB requirements (or waived by AP credit).

### Bachelor Degree Requirements

**A. Upper Division Communication/Writing:** One course chosen from an approved list (Math 3010 fulfills this requirement, or you may choose from the list of approved courses in the Undergraduate Bulletin).

**B. Diversity Requirement:** One 3-credit course chosen from an approved list.

**C. International Requirement:** One course chosen from an approved list.

### D. B.S. or B.A. Requirements

B.S. Requirement: two upper division quantitative intensive (QI) courses (math major courses already fulfill both QI requirements) OR

B.A. Requirement: a fourth semester or upper division language course, or credit by special exam.

**E. Courses in the major** (see requirements in this booklet).

Information on university graduation requirements is provided as a service. These requirements may change from time to time. For questions regarding general education and university graduation requirements please see the Undergraduate Advisor.

## Math Department Graduation Requirements

In addition to the required coursework outlined in this publication, all math majors are required to:

**A.** Receive a "C" or better in all math courses (this applies to the minor also) and a "C-" or better in allied courses. Teaching majors must receive a "C+" or better in all math courses and a C or better in physics.

**B.** Maintain a minimum GPA of 2.3 in mathematics courses. Teaching majors must maintain a minimum GPA of 2.8 in mathematics courses.

**C.** Complete at least 18 upper division credit hours of University of Utah mathematics courses.

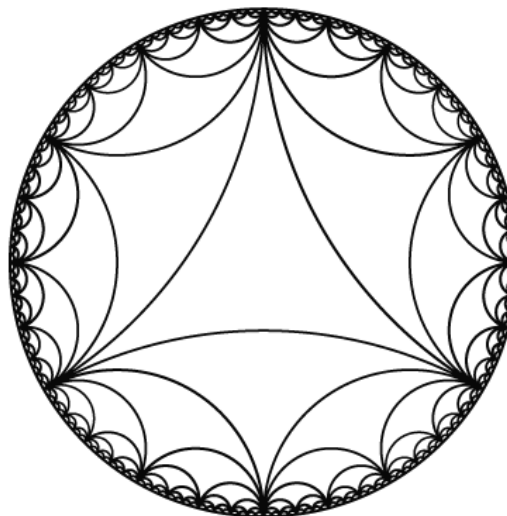
**D.** Successfully pass, with a C or better (C+ or better for teaching majors), all mathematics courses within 3 attempts. Failure to pass any mathematics course with a C or better within 3 attempts will result in dismissal from the major. A withdrawal will be considered an attempt.

**E.** An exit survey is required the semester a student graduates.

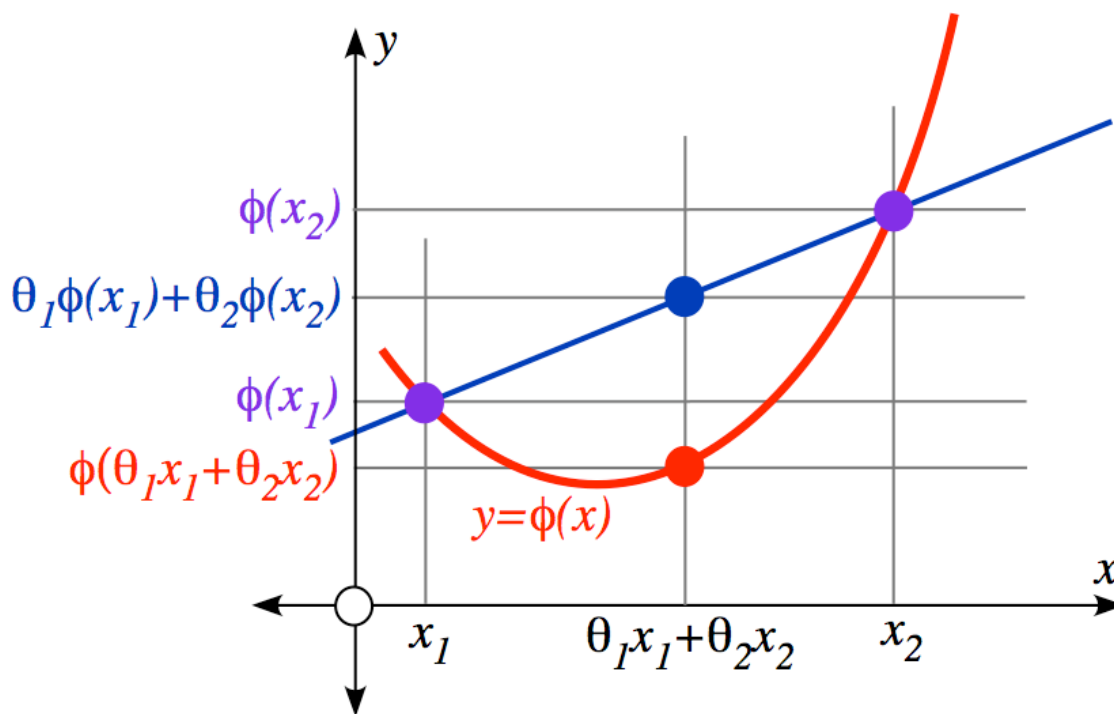
NOTE: Qualified students are encouraged to substitute Math 1250-1260 for Math 1210-1220-2210. Students who have taken courses in the engineering math sequence should see the Undergraduate Advisor to review how those courses will fill requirements in the major.

## Requirement Changes

Students are generally held to the mathematics department graduation requirements in place at the time they declare their major. Students who interrupt their studies may be held to the graduation requirements in place when they reenter the University. Graduation requirements shown on this sheet are deemed to be reliable, however, it is the student's responsibility to check with the advisor periodically concerning possible changes or corrections.



# Mathematics Major



## Required Courses

Math 1210	Calculus I	4
Math 1220	Calculus II	4
Math 2210	Calculus III	3
Math 2270	Linear Algebra	4
Math 2280	Differential Equations	4
Math 3210	Foundations of Analysis I	4
Math 3220	Foundations of Analysis II	4

## Allied Courses

Physics 2210 & 2220 or 3210 & 3220	8
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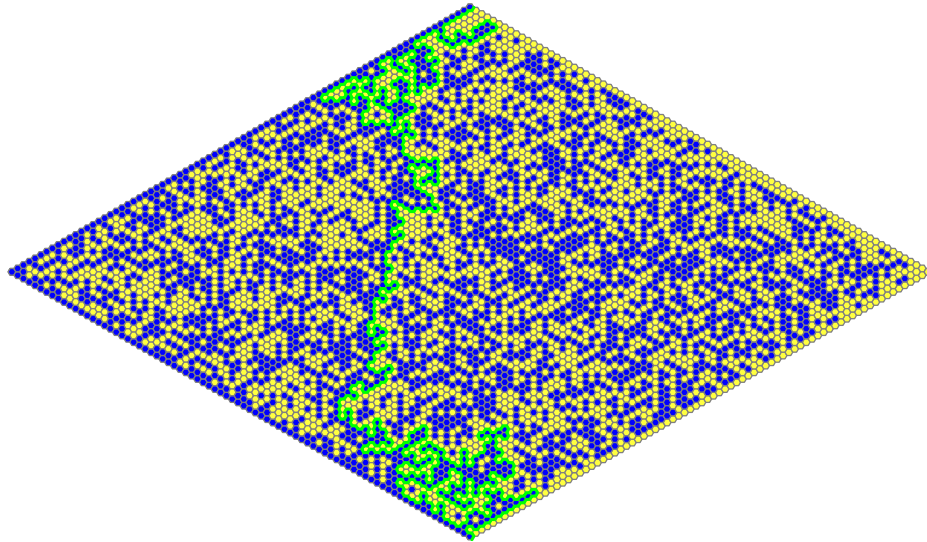
## Elective Courses

Seven different semester courses in mathematics chosen from Math 2200 or CS 2100 and any Math course numbered 4200 or higher, except: 4910 (Internship), 4950 (Departmental Honors Thesis), 4999 (University Honors Thesis), 5000 (Problem Seminar), 5150/5155/5160/5165 (Mathematics Curriculum/Instruction), 5270 (Transformational Geometry), 5700 (Teaching Capstone), 5960 (Special Project), 5969 (Topics in Statistics), 5910 (Supervised Reading).

21-27 hours.

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3.	
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5.	
6.	
7.	

# Mathematics Major with Statistics Emphasis



## Required Courses

Math	1210	Calculus I	4
Math	1220	Calculus II	4
Math	2210	Calculus III	3
Math	2270	Linear Algebra	4
Math	3070	Applied Statistics I	4
Math	3080	Applied Statistics II	3
Math	3210	Foundations of Analysis I	4
Math	3220	Foundations of Analysis II	4
Math	5010	Probability	3
Math	5080	Statistical Inference I	3
Math	5090	Statistical Inference II	3

## Allied Courses

Select two courses from the following list, or see the undergraduate advisor about approval of courses not on this list.

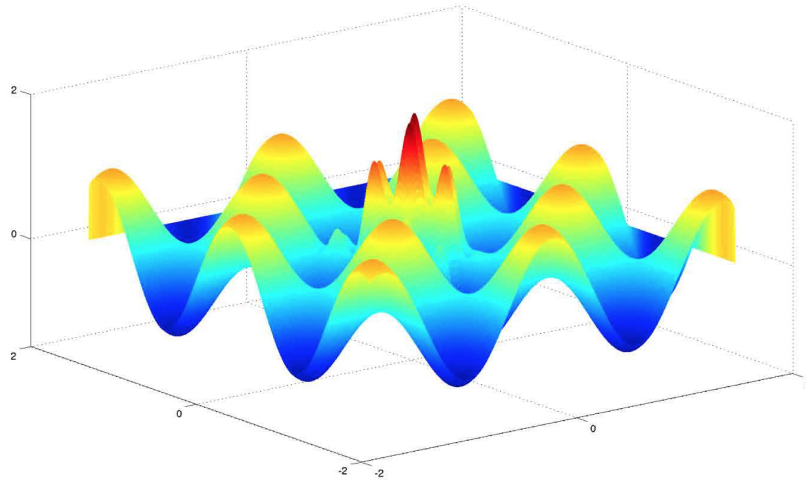
Econ	4010	Microeconomic Analysis	3
Econ	4020	Macroeconomic Analysis	3
Econ	5969	Special Topics in Econ	3
(cross listed as Stat 5969, FCS 5969, etc.)			
Finan	3000	Fundamentals of Investing	3
Finan	3040	Financial Management	3
Finan	3050	Intro to Investments	3
Finan	4330	Credit Institutions	3
Stat	5003	Survey of Statistical Packages	3

## Elective Courses

Select four courses from the following list.

Math	2200	Discrete Mathematics (or CS 2100)	3
Math	4200	Complex Variables	3
Math	4400	Introduction to Number Theory	3
Math	4600	Math in Medicine	4
Math	5030	Actuarial Math	3
Math	5040	Stochastic Processes I	3
Math	5050	Stochastic Processes II	3
Math	5075	Time Series Analysis	3
Math	5210	Real Analysis	4
Math	5405	Codes and Cryptography	3
Math	5410	Differential Equations	4
Math	5420	Dynamical Systems	3
Math	5610	Numerical Analysis I	4
Math	5620	Numerical Analysis II	4
Math	5710	Applied Mathematics I	3
Math	5720	Applied Mathematics II	3
Math	5750	Topics in Applied Math	3
Math	5760	Mathematical Finance I	3
Math	5765	Mathematical Finance II	3
Math	5770	Introduction to Optimization	3

# Mathematics Major with Mathematics of Computation Emphasis



## Elective Courses

Select four courses from the following list.

## Required Courses

Math 1210	Calculus I	4
Math 1220	Calculus II	4
Math 2210	Calculus III	3
Math 2270	Linear Algebra	4
Math 2280	Differential Equations	4
Math 3210	Foundations of Analysis I	4
Math 3220	Foundations of Analysis II	4
Math 5610	Numerical Analysis I	4
Math 5620	Numerical Analysis II	4
Math 5960	Special Project	4

## Allied Courses

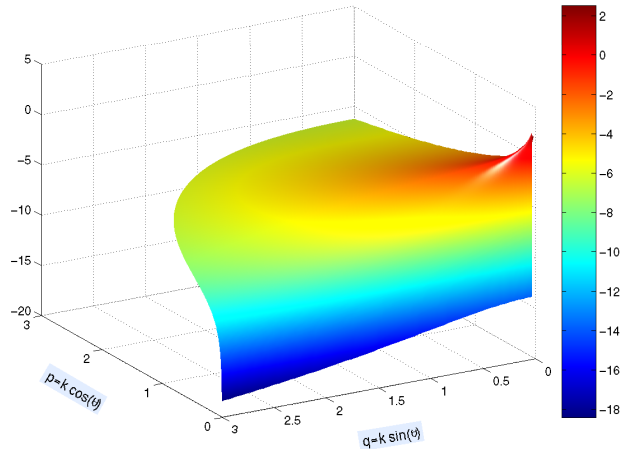
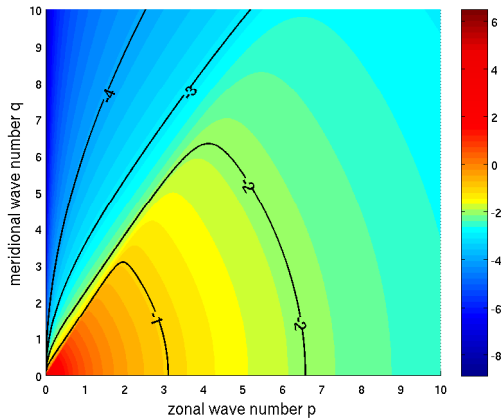
Physics 2210 or 3210	4
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Select at least two courses from the following list:

Physics 2220 or 3220	Physics II	4
CS 1410	Intro to Object-Oriented Prog.	4
CS 2420	Intro to Algorithms and Data Structures	4

Math 2200	Discrete Mathematics (or CS 2100)	3
Math 4400	Introduction to Number Theory	3
Math 4800	Introduction to Research	3
Math 5010	Probability	3
Math 5040	Stochastic Processes I	3
Math 5050	Stochastic Processes II	3
Math 5075	Time Series Analysis	3
Math 5080	Statistical Inference I	3
Math 5090	Statistical Inference II	3
Math 5110	Math Biology I	3
Math 5120	Math Biology II	3
Math 5410	Differential Equations	4
Math 5420	Dynamical Systems	3
Math 5440	Partial Differential Equations	3
Math 5470	Chaos and Nonlinear Systems	3
Math 5710	Applied Mathematics I	3
Math 5720	Applied Mathematics II	3
Math 5740	Mathematical Modeling	3
Math 5750	Topics in Applied Mathematics	3
Math 5760	Mathematical Finance I	3
Math 5765	Mathematical Finance II	3
Math 5770	Introduction to Optimization	3

# Applied Mathematics Major



## Required Courses

Math	1210	Calculus I	4
Math	1220	Calculus II	4
Math	2210	Calculus III	3
Math	2200	Discrete Mathematics (or CS 2100)	3
Math	2270	Linear Algebra	4
Math	2280	Differential Equations	4
Math	3210	Foundations of Analysis I	4
Math	3220	Foundations of Analysis II	4
Math	4200	Complex Variables (or Math 3160)	3/2
Math	5010	Probability/Statistics (or Math 3070)	3
Math	5600	Numerical Analysis (or Math 5610)	4

## Allied Courses

Physics	2210 & 2220 or 3210 & 3220	8
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Select one course from the following list:

CS	1410	Intro to Object-Oriented Prog.	4
PHYS	3730	Intro to Computing in Physics	4

Note: The prerequisite for CS 1410 is CS 1030, or you may contact the Computer Science department regarding testing into CS 1410.

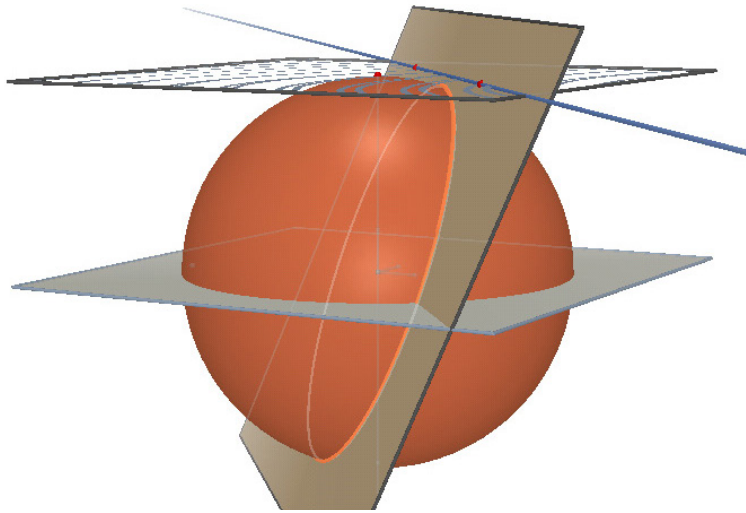
## Elective Courses

Select at least four courses. Up to three courses from other departments may be substituted provided they have significant mathematical content and advisor approval.

Math	4600	Mathematics in Medicine	4
Math	4400	Intro to Number Theory	3
Math	4750	Mathematical Fluid Dynamics	3
Math	4800	Undergraduate Research	3
Math	5030	Actuarial Mathematics	3
Math	5040	Stochastic Processes I	3
Math	5050	Stochastic Processes II	3
Math	5080	Statistical Inference I	3
Math	5090	Statistical Inference II	3
Math	5110	Mathematical Biology I	3
Math	5120	Mathematical Biology II	3
Math	5210	Real Analysis	4
Math	5310	Modern Algebra I	3
Math	5405	Codes and Cryptography	3
Math	5410	Differential Equations	4
Math	5420	Dynamical Systems	3
Math	5440	Intro to PDEs	3
Math	5470	Chaos and Nonlinear Systems	3
Math	5500	Calculus of Variations	3
Math	5510	Intro to Topology	3
Math	5620	Numerical Analysis II	4
Math	5710	Applied Mathematics I	3
Math	5720	Applied Mathematics II	3
Math	5740	Mathematical Modeling	3
Math	5750	Topics in Applied Math	3
Math	5760	Mathematical Finance I	3
Math	5765	Mathematical Finance II	3
Math	5770	Introduction to Optimization	3



# Mathematics Teaching Major



## Required Courses

Math 1210	Calculus I	4
Math 1220	Calculus II	4
Math 2210	Calculus III	3
Math 2200	Discrete Mathematics	3
Math 2270	Linear Algebra	4
Math 2280	Differential Equations	4
Math 3010	History of Mathematics	3
Math 3070	Applied Statistics I	4
Math 3210	Foundations of Analysis I	4
Math 3100	Foundations of Geometry	3
Math 4030	Foundations of Algebra	3
Math 4090	Teaching Secondary School Mathematics	3
Math 4095	Practicum for Secondary Math Teachers	2
Math 5700	Capstone Course	3

## Elective Course

Select one course from the following list, or another course numbered above 4200 except those excluded from the regular mathematics major.

Math 3220	Foundations of Analysis II	4
Math 4400	Intro to Number Theory	3
Math 5270	Transformational Geometry	3

## Allied Courses

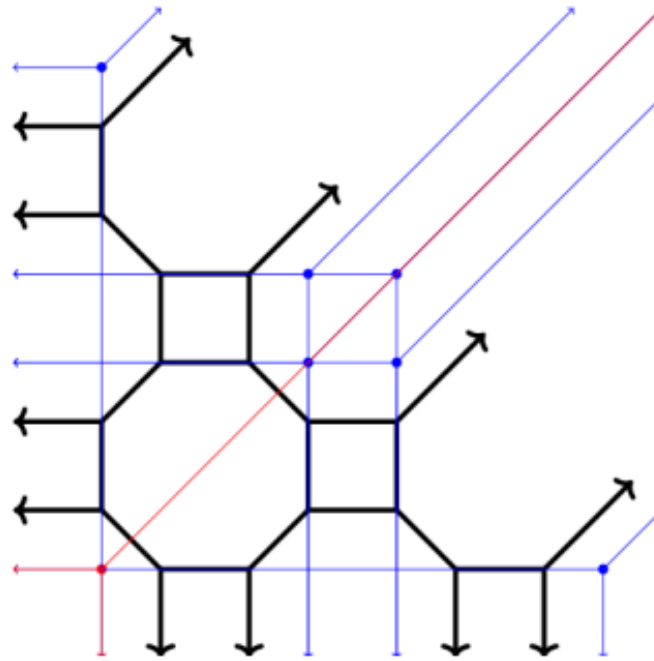
Physics 2210 or 3210 The Math Department strongly advises students to complete the physics sequence	4
Students <b>must</b> complete the Secondary Teacher Licensure Program through the Urban Institute for Teacher Education (UITE). See <a href="http://www.ed.utah.edu/UITE/index.html">http://www.ed.utah.edu/UITE/index.html</a> for details and contact Sara Hatch for an appointment regarding the licensure program ( <a href="mailto:sara.hatch@utah.edu">sara.hatch@utah.edu</a> , 801-581-6818).	
It is strongly recommended that students complete a teaching minor in another subject area.	

## Comprehensive Exam

To graduate with a mathematics teaching major students must receive a score of **165** or higher on the Praxis Exam #5161: "Mathematics: Content Knowledge." To register see [www.ets.org/praxis](http://www.ets.org/praxis).

# Honors Degree in Mathematics

In order to pursue an honors degree in mathematics students must first be admitted to the Honors College, and must complete the coursework required by the Honors College as well as the mathematics coursework. For more information please see the department honors advisor.



## Department Requirements

In addition to the requirements for the mathematics degree you have selected, the following additional requirements apply to those students seeking an Honors Degree:

Math 3000	Undergraduate Colloquium	1
B or better in all courses required for major		
Math GPA of at least 3.5		
Overall GPA of at least 3.5		

## Honors College Requirements

2 Intellectual Traditions courses	6
1 Honors writing course	3
4 Honors electives	
Honors Thesis (Math 4999)	3

Courses offered by the Math Department that fill Honors elective requirements are:

Math 1250	AP Calculus I	4
Math 1260	AP Calculus II	4
Math 3210	Foundations of Analysis I	4
Math 3220	Foundations of Analysis II	4
Math 4200	Intro to Complex Variables	3
Math 4800	Introductions to Research	3
Math 5210	Intro to Real Analysis	4

Students in the Honors College are encouraged to visit with their Honors advisor and Mathematics Department faculty honors advisor in addition to the Mathematics Undergraduate Advisor.

# Mathematics Minor

Mathematics minors must receive a C or better in all math courses.

## Required Courses

Math 1210	Calculus I	4
Math 1220	Calculus II	4
Math 2210	Calculus III	3
Math 3210	Foundations of Analysis I	4
Math 3220 or Math 4200 or higher*	Foundations of Analysis II, or selection from approved upper division courses	4

\*Note: To fulfill requirement, student must take Math 3220 or any Math course numbered 4200 or higher, except: 4910 (Internship), 4950 (Departmental Honors Thesis), 4999 (University Honors Thesis), 5000 (Problem Seminar), 5150/5155/5160/5165 (Mathematics Curriculum/Instruction), 5270 (Transformational Geometry), 5700 (Teaching Capstone), 5960 (Special Project), 5969 (Topics in Statistics), 5910 (Supervised Reading).

## Elective Courses

Select three other mathematics courses with a prerequisite of at least Calculus II. Please have your course choices approved by the Undergraduate Advisor.

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Note: One elective must be Math 2200 (recommended) or Math 2270 or Math 2250 in order to satisfy prerequisites for Foundations of Analysis.



# Mathematics Teaching Minor

The math teaching minor is available only to students completing a teaching major in another subject.  
Teaching minors must receive a C or better in all math courses.

## Required Courses

Math 1210	Calculus I	4
Math 1220	Calculus II	4
Math 2210	Calculus III	3
Math 2270	Linear Algebra	4
Math 3070	Applied Statistics I	4
Math 3100	Foundations of Geometry	3
Math 4030	Foundations of Algebra	3
Math 4090	Teaching Secondary School Mathematics	3
Math 4095	Practicum for Secondary Math Teachers	2

Note: Although Math 2200 is not on this list, it is a prerequisite for some of the courses on this list.



<b>Notes and Planning:</b>		
Fall	Spring	Summer
Fall	Spring	Summer
Fall	Spring	Summer
Fall	Spring	Summer

**FOR MORE INFORMATION, CONTACT:**

**Angie Gardiner**

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