



THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE

Mathematics

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Mathematics Graduate Program At the University of Arizona



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About Our Department

Members of the department create, communicate, and apply mathematics of the highest caliber through activities such as internationally recognized research and graduate education, award winning undergraduate programs, and extensive outreach to local schools.

The department's faculty includes two Regents' Professors, three University Distinguished Professors, and numerous recipients of national and international awards. Over the last five years, a large percentage of the faculty has been awarded grants and contracts from external funding agencies, with total awards averaging about \$5 million per year.

The department offers PhD, MS, and MA programs in Mathematics and Mathematics Education, and it provides major contributions to the Graduate Interdisciplinary Degree Programs in Applied Mathematics and Statistics. It also offers several unique post-doctoral opportunities for recent PhDs planning careers in research and education.

At the undergraduate level, the department provides more than 46,000 credit hours of instruction per year and offers its more than 500 majors unparalleled opportunities for research, tutoring experiences, and internships. The undergraduate, graduate, and GIDP programs have recently been recognized with two 5-year, \$3.5 million VIGRE training grants from the National Science Foundation, a distinction very few programs in the country can match.

The department has a long and excellent tradition of outreach to schools in Tucson, ranging from programs supporting high school teachers to a research center focusing on improving the mathematics education of low-income Latino students.

Through the breadth and quality of its programs, the Department of Mathematics makes major contributions to the mission of the University of Arizona and to the quality of life in Tucson and beyond.

The central goal of the Department of Mathematics at the University of Arizona is to provide intellectual leadership in the mathematical sciences that is of direct benefit to the state and its citizens and commands national and international respect for its depth of scholarship.

Department Mission Statement

Specifically our goals are:

- to communicate the beauty, utility, and excitement of mathematics and to be at the frontiers of new discoveries;
- to prime the pipeline pump and prepare a broad and ethnically diverse spectrum of entering students, enabling them to meet the challenges of University programs whose quality will continue to climb;
- to build a first-rate, enthusiastic and vigorous faculty blending youth and maturity in a variety of overlapping fields across the broad spectrum of mathematical sciences with the dual aims that each individual is internationally recognized for the depth and originality of his or her contributions and that the collaborations lead to an environment in which the whole is greater than the sum of the parts;
- not to do all things, but to do well those things we do;
- to provide flexible yet solid undergraduate and graduate programs which challenge the intellect, cater to the diverse interests of our majors and which complement, particularly at the graduate level, our internationally recognized Interdisciplinary Program in Applied Mathematics;
- to encourage and foster creativity and scholarship in their broadest possible interpretations;
- to encourage students in the belief that they gain most from the university experience by developing self-discipline, self-reliance and, under appropriately supervised conditions, by giving full rein to their own creativity;
- to embrace the notion that change such as is manifested in computer technology and educational reform can be beneficial, enhance learning and enrich the intellectual environment;
- to be a resource in the mathematical sciences for other disciplines whose own activities have an ever-increasing need for the power of mathematics;
- to work closely, not only with colleagues from other disciplines within the University, but also with colleagues from the local schools and community colleges who share the responsibility of ensuring the flow of a mathematically literate and confident generation of new Students;
- to be part of a University which aspires to be the best and which pursues policies compatible with this goal.

Ph. D. Requirements

This section describes the requirements for completing the Ph.D. degree. Information about satisfactory progress through the program is in a separate section entitled “Satisfactory Progress,”

Students should refer to the graduate catalog, available on the [Graduate College web site](#), for more details on graduate college requirements for PhD candidates.

A. Course Requirements

Students are required to complete 36 units of graduate credit in the major and 9 to 12 units in a supporting minor (as determined by the minor program), which may be declared in Mathematics, although outside minors are encouraged. In addition, 18 units of dissertation (Math 920) must be completed. Students cannot register for 920 until they have passed their oral comprehensive exam. This rule can be waived by the Director of Graduate Studies in exceptional circumstances.

Traditional Core Courses

For each of the traditional core courses, Algebra ([MATH 511A-B](#)), Real Analysis ([MATH 523A-B](#)), and Geometry–Topology ([MATH 534A-B](#)), students must either take the course and receive a grade of B or better in both semesters or earn a high pass on the corresponding written qualifying exam. The material in these courses is essential knowledge for all mathematicians, and it is assumed in all further advanced course work in the department.

Students are encouraged to write a term paper in lieu of a midterm exam in one of their core courses in the spring semester. Such a paper gives the student an opportunity to demonstrate his or her skills beyond the standard course and exam measures and is valuable training for future large-scale writing. Term papers may be presented at a mini-conference at the end of the spring semester and will be used in the overall evaluation of the qualifying exam.

Further Mathematics Coursework

Two year-long Mathematics course sequences that are not co-convened and are not part of the required core of algebra, real analysis, and geometry-topology are required. Students should seek advice on appropriate courses from their advisor (if they have one already), faculty in the area in which they plan to do research or the director of the graduate program. For many students Complex Analysis ([MATH 520A-B](#)) is a good choice for one of these sequences.

Outside of Department Courses

Students must take two courses (6 units) outside the mathematics department. These may be applied toward the minor, if appropriate. The spirit of the outside course requirement is that students should learn to communicate with and appreciate the perspectives of users and producers of mathematics in other disciplines. Courses which fulfill this requirement should (a) have significant content in mathematics or mathematics education; and (b) not be substantially equivalent to courses in the mathematics department. We maintain a [list of a priori acceptable courses](#). A priori unacceptable courses include those cross-listed in mathematics or taught by a mathematics faculty member. An exception is that courses offered by the math department in mathematics education may be used by students in mathematics proper (i.e., not students pursuing the math education options) to satisfy the outside course requirement.

Minor

The University requires that PhD students declare a minor. PhD students in Mathematics may declare their minor in mathematics or in a supporting discipline. Requirements for the minor are determined by the minor department, but usually entail a program of 9 to 12 units. Students contemplating a minor other than Mathematics should consult with the Director of Graduate Studies and their thesis advisor regarding the suitability of their plans. Typical minors include Statistics, Computer Science, Education, Physics, and Applied Mathematics, though others may be considered.

Program of study

Each student must present a coherent collection of courses in which the work outside of Mathematics is related to part of the studies in Mathematics. There are many such possibilities, including: algebra, and computer science or discrete methods in operations research; probability, and statistics or reliability/quality control; numerical mathematics, and computer science or computational science; mathematical foundations and history, and education; analysis, and physics or optics; etc.

B. Research Tutorial Groups

Students must enroll in MATH 596G and complete a research tutorial group (RTG) project starting in the spring semester of their first or second year of enrollment. In the spring, MATH 596G is a one-unit course in which faculty members present short lecture series on research topics of current interest. In the following fall, students choose one of the proposed topics and work with the corresponding faculty member on a research project. This project and a presentation of it at the end of the fall semester is the basis for three more units of credit in MATH 596G. The RTG project is meant to be an early introduction to research in mathematics and forms part of the evaluation of the qualifying exam.

C. Qualifying Examination

The qualifying examination is based on the following assessment options:

- A written exam in algebra
- A written exam in analysis
- A written exam in geometry and topology
- An MS thesis

Students must attempt at least three assessment options. Two of the assessments must be chosen from the traditional core exams (the first three options). Each written exam is offered in August and January. There is no limit to the number of attempts for the written exams. Students may attempt more than three assessment options. Students with prior preparation may attempt the examinations upon entrance to the program, or after one semester.

Each of the options has three possible grades: fail, pass, and high pass. In general, a grade of high pass indicates the student is ready to go on to advanced course work and to prepare the comprehensive exam. For the MS thesis option the meaning of pass is that the thesis is acceptable for the MS degree. The meaning of high pass is that the quality of the thesis indicates the student is capable of PhD level work. The thesis need not contain original work, but the quality should indicate that the student has the potential for such work. The grade for the MS thesis is determined by the thesis committee. Prior to scheduling your thesis defense, you will need to get your MS committee approved by submitting the [Committee Approval form](#) to the Graduate Office. Once your committee is approved, you will need to print out the

[Results of the MS thesis form](#) and take this to your thesis defense for a final grade. Both forms can be found on the forms page on our [website](#).

The written exams in algebra, analysis and geometry/topology cover material from the traditional core courses, Algebra ([MATH 511A-B](#)), Real Analysis ([MATH 523A-B](#)), and Topology–Geometry ([MATH 534A-B](#)). They also include a small amount of undergraduate level material. For the algebra exam this undergraduate material is from linear algebra. For the analysis exam it is from rigorous advanced calculus. For the geometry/topology exam it is from undergraduate complex analysis. Short lists of topics on the exams and copies of recent examinations are available [on the web](#).

To successfully complete the Ph.D. qualifying examination, a student is expected to obtain a result of high pass in two of the assessment options and a result of pass or high pass in a third. The Graduate Committee will be responsible for making the final determination as to whether the student has successfully completed the Ph.D. qualifying examination and may take into account all factors relating to the student's work.

Students must successfully complete the qualifying exams before the end of their sixth semester to continue in the PhD program. Students who fail to do so will be ineligible for funding and will be recommended for disqualification from the program. For appeals, see the section on Appeals Procedure in the Satisfactory Progress section.

D. Comprehensive Examination

The purpose of the comprehensive examination is to determine whether the student has mastered the necessary general and specialized knowledge required to carry out dissertation research. The comprehensive exam has written and oral parts. To complete the written part, students write a short paper which may give an account of a research problem of interest, a significant example, or significant computations. An updated CV must also be submitted. The written part must be approved by the examining committee, which consists of a minimum of 4 tenured or tenure-track faculty, at least two weeks before the oral examination. The oral examination consists of a talk by the student, typically lasting one hour, followed by questions from the examining committee.

The Oral Comprehensive Examination is primarily, but not exclusively, on material in the area of concentration. The examination covers background material for the general area together with advanced references in a more specific sub-specialty.

E. Prospectus

After completing the comprehensive exam, students are expected to prepare a prospectus in consultation with their advisor. The prospectus is a detailed plan for the last years of their program. This plan should include a discussion of the research being undertaken as well as courses to take, seminars to participate in, faculty beyond the dissertation advisor to interact with, and possibly conferences to attend and professional development activities to undertake. Students must complete a departmental approval form.

F. Professional Development Requirements

PhD students must complete two professional development requirements chosen from this list:

- a foreign language requirement,
- a computing requirement, and
- a communication skills requirement.

Details of each requirement are given below. The requirements have been designed so that to a great extent they should be satisfied by activities that would normally be undertaken by any good PhD student. The need for foreign language and computing skills varies considerably among fields of mathematics and so students should consult with their advisors on which requirements would be the best choice. Advisors may also suggest that students complete more than the minimum of two of these requirements. Students are urged to complete the professional development requirements as early in their programs as possible. In all cases, they must be completed before advancement to candidacy. Failure to do so will delay advancement to candidacy and may delay the dissertation defense.

Foreign Language Requirement

A substantial portion of the mathematical literature is written in languages other than English, principally French, German, and Russian. Knowledge of Spanish is important for some fields of Mathematics Education. Being able to read and accurately translate these texts is a valuable skill in Mathematics and Mathematics Education research.

In order to fulfill the foreign language requirement, students will demonstrate their abilities to read and accurately translate mathematical texts in French, German, or Russian, (or, for students in Mathematics Education, texts relevant to that field in Spanish) by passing an examination given by a faculty member approved by the graduate committee. The student will prepare a careful, written translation of a text chosen by the examining faculty member (typically 5–10 pages) in a limited amount of time (typically 48–72 hours), with the aid of a dictionary and language reference works, but without the assistance of computers or other people. As a minimum standard, the translation must be mathematically accurate. We maintain a [list of approved examiners](#).

Grading of language examinations is a significant burden on faculty and students should not make frivolous attempts to pass the examination without sufficient preparation. Faculty members may administer an oral “pre-test” to gauge whether the student appears to be prepared for the examination.

Results of foreign language examinations should be communicated to the graduate office by the examining faculty member using the [language examination form](#).

Computing Requirement

Machine computation is an increasingly important component of mathematical research. Students for whom such computation will be relevant should master the needed programming skills and software packages during their graduate careers.

To fulfill the computing requirement, students should demonstrate their mastery of the relevant skills by carrying out a significant computing project under the supervision of a mathematics faculty member. This project might be tied to course work, the student's MS thesis, or his or her dissertation research. The precise nature of the project will be determined by the student and the sponsoring faculty member, but

projects must have substantial mathematical content and should typically involve the following aspects of computing:

- formatted input and output
- appropriate use of data structures and algorithms
- use of structured programming techniques, possibly including calls to externally provided subroutines or functions.

Projects may be written in a standard programming language such as C or Fortran, or may use software packages such as Matlab, Maple, GAP or Pari.

At the conclusion of the project, working code and documentation must be made available on the department's web site. The completion of the requirement should be communicated to the graduate office by the sponsoring faculty member using the [computing examination form](#).

Communication Skills Requirement

The ability to communicate effectively, both verbally and in writing and to audiences of varying levels of sophistication, is essential to a successful career in industry, research, or teaching. The communication skills requirement gives students an opportunity to develop their capabilities in a variety of directions. To complete the requirement students must:

- prepare a basic web page containing information on the student's research, teaching, and other professional activities and make this page available on the department's web site
- prepare a professional CV and post it on the web site
- write articles or proposals and give lectures or presentations for audiences of various levels of sophistication so that at least one activity occurs in each row and column of the following table of examples:

	Verbal	Written
non-mathematical audience	<ul style="list-style-type: none"> • HS visit • Galileo circle talk • Math Inst Colloq 	<ul style="list-style-type: none"> • CATTS or space grant • Dept newsletter article • An essay, intended for undergraduates on your research
general mathematical audience	<ul style="list-style-type: none"> • Colloquium talk • MS thesis defense • poster session 	<ul style="list-style-type: none"> • grant proposal • survey article
specialist audience	<ul style="list-style-type: none"> • seminar talk • conference talk • poster session 	<ul style="list-style-type: none"> • research paper • MS thesis • Math review article • paper for a course

The entries in the table are meant to be illustrative and do not exhaust the possibilities. Written components should use TeX or other scientific text processing software. Verbal components may involve the use of such technologies as overhead transparencies or presentation software. Each component must be sponsored by a faculty member who will review the text or presentation and provide constructive feedback. When the sponsoring faculty member is satisfied with a student's performance on a component

of the requirement, this fact should be communicated to the graduate office using the [communication skills progress form](#).

G. Advancement to Candidacy

A student may advance to candidacy once they have completed all program requirements other than the dissertation. Students must advance to candidacy at least one semester prior to their dissertation defense. Failure to do so will delay the date of the dissertation defense.

H. Dissertation

The dissertation is a polished written account of a substantial new contribution to the mathematical sciences, publishable in a reputable journal. It is evaluated by an internal committee of at least 4 members who must be tenured or tenure-track faculty members or approved as equivalent by the Graduate College. One member may come from the minor department. Otherwise the members must be from the Mathematics Department. (Exceptions to this last rule may be granted by the Graduate Committee.) The dissertation committee approves the dissertation after a final oral defense. An updated CV must also be submitted. Students have the option of also including an external reviewer who is not on the faculty of the University of Arizona. The inclusion of such an outside reviewer can provide the student with valuable feedback as well as help make the student's research known outside the local community. Students should register for Math 920 while working on their dissertation. The Graduate College requires 18 units of Math 920.

The dissertation is by far the most important component of the PhD program and its quality and originality will have a major impact on the beginning of the student's professional career. Writing a quality dissertation should be the student's top priority.

I. Final Oral Examination

The final oral examination is a presentation and defense of the student's dissertation; the first part of the exam is open to the public.

Ph.D. Degree Requirements: MATHEMATICS EDUCATION OPTION

A. Course Requirements

The course requirements are 36 units of graduate credit in the major and a minor in Education (or related field).

Courses in Mathematics

Students will normally either take the first year graduate core courses in Algebra ([MATH 511A-B](#)), Real Analysis ([MATH 523A-B](#)), and Topology–Geometry ([MATH 534A-B](#)), or otherwise learn this material by the end of their first year of Ph.D. studies for the Qualifying Examinations. The remaining 18 units will be chosen in consultation with an advisor. These remaining units will include one year-long Mathematics course sequence that is not co-convened and is not part of the required core of algebra, real analysis, and topology-geometry. Some of the units will include relevant courses in Mathematics Education research (to be discussed with an advisor).

Courses in Education (or related field)

The 12 units in Education (or related) will be chosen in consultation with an advisor to ensure a coherent program of study. The courses will primarily be in Education. Courses in psychology, anthropology, sociology, women's studies, etc., may also be appropriate, depending on the student's research focus. Some suggested Education courses are listed below. EDUC 500, 501, 600, 601, 602; TTE 521, 524, 532, 545, 621, 640. Two courses in research design and methods (e.g., EDUC 600, 601, 602, or appropriate research methods courses in other fields such as sociology, anthropology, agriculture, ...) are required.

Teaching Experience or Practicum

Two or more years of pre-college teaching experience are required. Students can fulfill this requirement through 9 units of practicum in local schools. Such students will take 3 units per semester to complete one practicum at the elementary school level, one at the middle school level, and one at the high school level. (Note: these 9 units do not apply toward the required 36 units of mathematics nor the 12 minor units.)

B. Program of Study

The same stipulations as given for the [Ph.D. program in Mathematics](#).

C. Qualifying Examination

Same as for the [Ph.D. program in Mathematics](#).

D. Comprehensive Examination

Similar guidelines to those for the [Ph.D. program in Mathematics](#), but the area of concentration will be in Mathematics Education.

E. Prospectus

The same stipulations as given for the [Ph.D. program in Mathematics](#).

F. Professional Development Requirements

Same as for the [Ph.D. program in Mathematics](#) except that the foreign language requirement may be satisfied in Spanish or American Sign Language as well as French, German, or Russian.

G. Advancement to Candidacy

The same stipulations as given for the [Ph.D. program in Mathematics](#).

H. Dissertation

Same guidelines as for the [Ph.D. program in Mathematics](#). The dissertation will be in Mathematics Education.

I. Final Oral Examination

Same as for the [Ph.D. program in Mathematics](#).

Satisfactory Progress - Ph.D. program

Variations

The following discussion is a template which assumes the student enters in the fall semester and does not already have a Master's degree in Mathematics. Satisfactory progress policies for students in unusual situations, for example those entering in the spring semester or those entering with a Master's degree, will be decided on an individual basis and agreed upon in writing at the time of entrance to the program.

Progress in the first three years

Admission to the PhD program implies a three-year initial commitment by the department, provided that satisfactory academic progress is made and teaching obligations are met. Satisfactory progress is defined as being enrolled for at least 9 units of graduate or approved credit in each semester, maintaining a GPA of at least 3.0 in each semester, and meeting the following expectations.

Students are expected to complete the core courses and qualifying exams as expeditiously as possible. They are encouraged to attempt any part of the qualifying exam for which they may be ready in August before the first semester of enrollment. A failure on such an attempt will not prejudice any future evaluation of qualifying exam results.

It is expected that students will enroll in at least one of the traditional core courses during the first year and attempt the corresponding part of the qualifying exam in August following the first year of enrollment. Students are expected to have passed at least one part of the qualifying exam at the "high pass" level by January of the second year of enrollment and to have completed the core courses and attempted all three parts of the qualifying exam by August before the third year of enrollment. Students must successfully complete the qualifying exams by the start of their sixth semester to continue in the PhD program.

Progress in later years

Continuation in the PhD program beyond the third year implies a commitment on the part of the department to two, or possibly three, more years of support, provided that satisfactory academic progress is made and teaching obligations are met. Satisfactory progress is defined as being enrolled for at least 6 units of graduate or approved credit in each semester, maintaining a GPA of at least 3.0 in each semester, and making adequate progress toward the dissertation as determined by the faculty.

Students are encouraged to complete the written and oral comprehensive examination as early as possible. In all cases, this exam must be complete by the end of February of the fourth year of enrollment. Failure to meet this deadline would be a violation of the "adequate progress" requirement in the preceding paragraph.

Funding and continuation in the program for a sixth year will be determined by the graduate committee, based on the sense of the faculty regarding the student's progress. Funding and continuation in the program beyond the sixth year will be possible only in some circumstances, as determined by the Graduate Committee. Examples of such circumstances may include leave of absence, maternity/paternity leave, or health problems. For appeals, see the section on Appeal Procedure.

Appeal Procedure

If a student wishes to appeal any of the requirements mentioned above, the appeal should be made in writing to the Director of Graduate Studies. The appeal will be reviewed by the Graduate Committee and requires a majority vote to succeed. The Committee may place additional requirements/deadlines on the student as a prerequisite for continuing in the program.

Students who wish to appeal the decision of the Graduate Committee must submit an appeal in writing to Head of the Mathematics Department, who will make a decision in consultation with other faculty, as appropriate.

M.A./M.S. Requirements

Course Requirements

MA Degree: 30 units of approved graduate credit, including up to 6 units of thesis credit; 9 to 12 units must be in courses from departments other than Mathematics. At least one year-long course sequence in mathematics which is not dual-numbered must be included.

MA Degree (Teaching Option): 30 units of approved graduate credit, including up to 6 units of thesis credit; 9 to 12 units should be outside the Department of Mathematics or from the following list of graduate mathematics courses: Math 504, 530, and 596E (Topics in Mathematics for Secondary Teachers – contents will vary, the course may be repeated). At least 12 units of mathematics should not be from that list, and should include a year long course sequence which is not co-convened. Each candidate's course of study should be established in consultation with a member of the Mathematics Education Committee. Please consult the [Mathematics Education Research](#) website.

MS Degree: 30 units of approved graduate credit, including up to 6 units of thesis credit. The 30 units must include at least 18 units of courses that are not co-convened, including a year long course sequence in mathematics. The 30 units must also include 6 units in courses from departments other than Mathematics. As with the PhD degree, the requirement of 6 units from outside the Math department may also be satisfied with an internship. See the "Outside of Department Courses or Internship" section of the [PhD requirements](#) for more details.

Program of Study

Each student must present a coherent collection of courses in which the work outside of Mathematics is related to part of the studies in Mathematics. There are many such possibilities, including: algebra, and computer science or discrete methods in operations research; probability, and statistics or reliability/quality control; numerical mathematics, and computer science or computational science; mathematical foundations and history, and education; analysis, and physics or optics; etc.

Thesis

A Master's thesis is required for which students may receive up to 6 units of graduate credit. PhD candidates may substitute successful completion of the Comprehensive Examination for the Master's thesis.

Professional Development Requirements

MA and MS students must complete one professional development requirement chosen from this list:

- foreign language requirement
- computing requirement
- communication skills requirement

The details of each requirement are the same as for the PhD program and may be found [here](#). Students should consult with their advisors on which requirement would be the best choice given their area of study and career plans. Advisors may also suggest that students complete more than one of these requirements. Students are urged to complete the professional development requirement as early in their programs as possible.

Examinations

Successful performance is required of all MA and MS recipients on either a Final Oral Examination which covers work presented for the Master's Degree and defense of the thesis, or the Comprehensive Oral Examination for the PhD degree.

Graduate Courses in Mathematics

This page explains the various types of graduate courses in mathematics at the University of Arizona.

Core courses and regular courses

The core courses (511AB—Algebra, 523AB—Real Analysis, and 534AB—Topology-Geometry) constitute the foundation on which the rest of the program is built. These courses are normally taken in the first year and cover the material to be mastered for the qualifying exams.

“Regular courses” are by definition the more advanced courses taught for the most part in the traditional lecture format. These courses serve to take the student from the foundation provided by the core courses to more specialized knowledge required for dissertation research.

RTGs

“Research Tutorial Groups” introduce graduate students to mathematical research at the end of the first year and beginning of the second year, typically well in advance of formal dissertation research. In the spring of the first year, students listen to short lecture series on topics of current interest (usually three or four series of three or four lectures, one hour per week). In the following fall, students choose one of the topics and work on a research problem with the sponsoring faculty member and a small group of fellow students. The spring lecture series is one credit hour while the fall research group is three credit hours.

Co-convened courses

“Co-convened” courses are advanced undergraduate courses (400 level) which are also given a 500 level number. (E.g., Symbolic Logic is both Math 401A and Math 501A.) The point is that graduate students may take these courses for graduate credit. They are mainly populated by senior level undergraduates and graduate students from other departments, but mathematics graduate students sometimes take these courses to fill in missing background or in Masters level coursework. A limited number of dual-numbered credits are applicable to the PhD.

Topics courses, seminar courses, and independent studies

Special topics courses are offered each term by faculty, usually in areas of particular expertise (although sometimes the inspiration is that the subject is hot and the faculty member wants to learn about it as well). They are typically one-time only offerings and may lead to dissertation topics.

Graduate students may also get credit for participation in research seminars. The courses Math 596 and Math 697 are a frequently used formal mechanism for this to come about.

Independent studies are arranged between faculty and students at the discretion of the faculty member. In a typical such course, the student would study a book or paper and meet weekly with the faculty member to discuss the work and related problems.

Identifying Special Topics courses

The following university course catalog numbers are reserved for Special Topics courses: 518, 519, 529, 538, 577, 588.

When a Special Topics course is announced, it will be open but with the designation TBA. If there is sufficient student demand for the course, and the department has the resources to cover all its other teaching obligations, the course will be properly scheduled. Otherwise the course will be cancelled.

Outside department courses

Not surprisingly, these are courses offered by other departments. Graduate degrees in mathematics all have requirements for a certain number of courses outside the department. The outside course page explains the philosophy behind the requirement and lists some courses that fulfill it.

Graduate Assistant/Associate Guidelines

GA Classifications, Salary, and Promotion

Graduate Assistants/Associates in Teaching & Research (GAs) are officially classified into four categories:

Category	Academic year pay (0.50 Appointment)
Level I Graduate Assistant	\$18,000
Level II Graduate Assistant	\$18,400
Graduate Associate	\$18,800

The pay rates given here are current. Increases correspond to annual University budgetary guidelines.

Graduate Assistant I

New GAs start as Graduate Assistant I.

Graduate Assistant II

To be promoted to Graduate Assistant II, a student must both

1. complete the Qualifying Exam portion of the Ph.D. program and
2. have satisfactory teaching or research performance.

Satisfactory teaching performance means that the GA received positive evaluations in all aspects of teaching responsibility. All teaching activities of GAs are under the supervision of an assigned member of the department. The supervisor will evaluate the performance of the GA and will submit a written report to the Graduate Committee and to the Undergraduate Committee. The evaluation is not considered confidential and may be discussed with the GA.

Satisfactory research performance is determined by the professor with whom the GA worked. We have [additional information on satisfactory progress](#).

Graduate Associate

To be promoted to Graduate Associate, a student must both

3. pass the [comprehensive exam](#), and
4. have satisfactory teaching or research performance.

Promotions will normally take place in August following achievement of milestones.

Appeals

Appeals will follow the same procedure as outlined in the Satisfactory Progress section.

Duties of a Half-Time (50%) Graduate Assistant or Associate in Teaching (GA):

1. First-year Graduate Assistant duties will include:
 1. Teaching four (4) **units** per semester or equivalent time spent on tutoring, grading, or proctoring examinations.
 2. Mandatory completion of the University's Teaching Assistant/Associate Training Online (TATO) as well as the Mathematics Department orientation of three half-days.
 3. Mandatory enrollment in MATH 596T.
2. For Graduate Assistants/Associates in their second or later years, duties will include:
 1. Teaching nine (9) **units** per year or equivalent time spent on tutoring, grading, or proctoring examinations.

Units of Teaching are determined as follows:

1. If the teaching assistant/associate has total responsibility for a class then each hour per week of teaching counts as one unit.
2. Each hour per week spent in the tutoring room counts as 2/5 unit.
3. Each hour per week spent grading counts as 1/3 unit for undergraduate courses, or 2/5 unit for graduate courses.
4. For a student holding a Graduate Assistantship/Associateship in Teaching for a percentage of time other than 50%, the duties are assigned proportionately (e.g., the work load for a 25% GTA is half of that for a 50% GTA).

Conditions for a Graduate Assistant or Associate in Teaching (GA):

Employment as a GA is contingent upon the following:

1. Maintaining at least a 3.0 grade point average in your graduate courses;
2. Successful completion of at least nine units of credit towards your degree program during each semester of this appointment;
3. Satisfactory evaluation of your performance as a teaching assistant;
4. If you have passed the Qualifying Examination at the PhD level, that you make satisfactory progress towards identifying an advisor, forming your Oral Comprehensive Examination Committee, and preparing for your Oral Comprehensive Exam;
5. If you have already completed your Oral Comprehensive Exam, that you have identified a dissertation topic and are making good progress on your dissertation research;
6. While employed as a GA, students may not hold other employment at the University of Arizona or elsewhere which involves 10 hours per week or more without prior, written approval from the Director of Graduate Studies.