Guide for Graduate Students in Mathematics

2017–2018

Graduate Office
Department of Mathematics
University of Illinois at Urbana-Champaign
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Foreword

This *Guide* outlines general policies governing the graduate programs of the Department. Graduate students are responsible also for knowing the contents of the:

- ***Graduate College Handbook***
- ***Student Code***

The *Graduate College Handbook* explains your privileges and responsibilities as a graduate student, describes many of the services provided to you by the University, and summarizes the Graduate College regulations that apply to all graduate students. Departmental requirements are in some instances more stringent than those of the Graduate College. Much of the *Handbook* deals with rules and regulations, but it also suggests ways in which exceptions can be requested for good reasons. All graduate students should keep this *Handbook* bookmarked for easy reference.

If discrepancies exist between this *Guide* and the documents listed above, then the Graduate College or University policies take precedence, except in the case of more stringent Department requirements (in which case this *Guide* takes precedence).

In the event that any major changes in departmental requirements occur, continuing graduate students may choose whether they wish to fulfill the requirements in effect when they began graduate study, or the new, revised requirements.

In case of uncertainty regarding the interpretation of any regulation or requirement in this *Guide*, or for questions about the graduate program involving matters not covered here, please consult:

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Helpful Websites

Department of Mathematics Graduate Program .... www.math.illinois.edu/GraduateProgram

Graduate College ....www.grad.illinois.edu

Graduate Fellowship Office... www.grad.illinois.edu/fellowships/about

International Student and Scholar Services (ISSS)...isss.illinois.edu

Office of the Registrar ....registrar.illinois.edu

Office of Diversity, Equity, and Access ....www.diversity.illinois.edu

Campus Counseling Center... counselingcenter.illinois.edu

University Policy

The commitment of the University of Illinois to the most fundamental principles of academic freedom, equality of opportunity, and human dignity requires that decisions involving students and employees be based on individual merit and be free from invidious discrimination in all its forms.

The University of Illinois will not engage in discrimination or harassment against any person because of race, color, religion, sex, national origin, ancestry, age, order of protection status, genetic information, marital status, disability, sexual orientation including gender identity, unfavorable discharge from the military or status as a protected veteran, and will comply with all federal and state nondiscrimination, equal opportunity and affirmative action laws, orders and regulations. This nondiscrimination policy applies to admissions, employment, access to and treatment in the University programs and activities.

University complaint and grievance procedures provide employees and students with the means for the resolution of complaints that allege a violation of this Statement. Members of the public should direct their inquiries or complaints to the appropriate equal opportunity office.

Statement on Academic Integrity

Academic integrity is essential for maintaining the quality of scholarship in the Department and for protecting those who depend on the results of research work performed by faculty and students in the Department. The faculty of the Department of Mathematics expect all students to maintain academic integrity at all times in the classroom and to conduct their academic work in accordance with the highest ethical standards of the mathematics profession. Students are expected to maintain academic integrity by refraining from academic dishonesty, and by refraining from conduct which aids others in academic dishonesty or which leads to suspicion of academic dishonesty. Violations of academic integrity will result in disciplinary actions ranging from failing grades on assignments and courses to probation, suspension or dismissal from the University.

Guide for Graduate Students

1. Orientation and Advising

Orientation Program

An orientation program is offered at the beginning of the Fall semester to introduce incoming graduate students to the Department of Mathematics and its faculty, the operation of the Graduate Program, and the department computer laboratories and facilities. During this time, all teaching assistants participate in required training sessions in which teaching assignments are discussed and practice teaching is done.

Doctoral Advising System

During the first year, all PhD students are advised by the Director of Graduate Studies. During the second year, graduate students choose a faculty adviser whose research interests are similar to their own.

Students are responsible for finding their own adviser. Usually a student will approach a faculty member whose work and interests are known to the student through attendance at courses and seminars. The student can arrange to take a reading course (Math 597) with the faculty member during one or more semesters. While working on that reading course, the student and faculty member will determine whether they should continue working together on a research program leading to a thesis.

Finding an adviser and topic is an important and sometimes difficult process for students. The Director of Graduate Studies can assist and support students at this critical stage, when requested.

Masters Advising System

Actuarial Science MS students are advised by Professor Runhuan Feng, Director of the Actuarial Science Program. All other Masters degree students are advised by the Associate Director of Graduate Studies, Dr. Karen Mortensen.

Course Registration

Students may register online for courses using [UI Enterprise Application](). After the semester begins, you may find that some of the courses in which you are enrolled are not suited to your interests or previous preparation. You may drop such courses and add others after the semester has begun. Please consult your adviser and the Graduate Office about deadlines and restrictions.

All first year PhD students must register in the seminar course Math 499 during both the fall and spring semesters. This seminar course meets once a week and provides an introduction to areas of mathematical research represented by the faculty. It provides an opportunity for the faculty to get to

know the new students and, more importantly, for the new students to hear sample lectures from a large proportion of the faculty. There is ample time for student questions and comments.

Courses taken below the 400-level cannot be counted for graduate credit.

Students are encouraged to take relevant courses outside of Mathematics, as part of their degree program. Please consult your adviser.

Minimum Course Loads

The Graduate College requires all full-time students, except doctoral candidates who have passed the Preliminary Examination, to earn at least 8 hours of credit (other than Math 499) each semester, The requirement is more stringent for full-time students who do not hold an assistantship of 25% or above (in particular, for fellowship students): they must earn at least 12 hours of credit each semester.

The Department of Mathematics has higher expectations. We expect Teaching Assistants to carry a minimum of three courses per semester (12 hours) and we expect Fellowship holders to carry four courses (16 hours). See International Student and Scholar Services (ISSS) for the credit given for language courses. As part of this course load, students with advisers should normally register each semester for 4 or more hours of Math 597 Reading Course (before passing the Prelim exam) or Math 599 Thesis Research (after passing the Prelim exam).

International students on Teaching Assistant or Research Assistant appointments must never let their registration drop below 8 hours, after the first two weeks of the semester. Dropping below 8 hours can automatically terminate your visa status. Your stipend and tuition waiver will be cancelled. These decisions are not under the control of the Mathematics Department, and we cannot reverse them. The process for reinstatement is lengthy and expensive.

International students who intend to drop a course and add a replacement course should do so in the reverse order: (i) add the new course, (ii) wait until the new course shows up online in your registration record, (iii) drop the old course.

To add a graduate course after the first two weeks of the semester you must get a Course Change form from the Mathematics Graduate Office—you cannot do it online.

For complete rules, please see the Academic Deadlines at the Registrar's Office website.

Occasionally, there are reasons for a student to enroll with an underload. Illness or other serious conditions may justify a reduced load, or a course in which a student has enrolled might turn out to be inappropriate. In such cases the Director of Graduate Studies may approve a reduced load.

Maximum Course Loads

Graduate College rules say that a graduate student may enroll in at most 20 credit hours in a Fall or Spring semester, and at most 12 hours in the summer.

GPA Requirements

Students must maintain a cumulative grade-point average (GPA) of at least 3.25 for PhD degree candidates and 3.00 for Masters degree candidates. The cumulative GPA is computed on all courses taken for unit credit except thesis units (in which "DFR" or "deferred" is recorded until the thesis is completed). A cumulative GPA of at least 3.0 is also required in undergraduate courses taken for hours credit.

By departmental policy, all mathematics graduate courses must be taken for a letter grade except for reading courses, literature seminars, and thesis research.

A student's GPA is computed from the letter grade.

Letter grade	A+	A	A–	B+	B	B–	C+	C	C–	D+	D	D–	F
Grade points	4	4	3.66	3.33	3	2.66	2.33	2	1.66	1.33	1	0.66	0

A student who fails to maintain the required GPA is placed on probation. If the student's cumulative GPA is still below the minimum after one semester on probation, then in most cases the student will not be allowed to continue in the Mathematics Graduate Program. Probation status can also lead to loss of funding.

Summer Funding and Tuition Waiver

Summer funding is not guaranteed, although in practice a great many students receive funding (see https://math.illinois.edu/academics/graduate-program/funding/summer-funding)

A summer tuition waiver is available to each student who has an appointment as a TA or RA during the **spring** semester at a level of at least 25%. Note: Students are not required to take courses during the summer.

2. Doctoral Program in Mathematics

Students working toward a PhD in Mathematics usually require from four to six years to complete the degree requirements. Ninety-six hours of credit and a PhD thesis are required. At least 64 hours must be earned in residence. The principal degree requirements are:

1. Comprehensive Requirements
2. Preliminary Examination (Thesis Proposal)
3. Doctoral Thesis
4. Final Examination

PhD students who do not already hold a Masters degree can usually earn an MS on the way to the PhD. See the Associate Director of Graduate Studies for procedures.

Comprehensive Requirements

The Comprehensive Requirements ensure that graduate students acquire a suitable mathematical foundation for undertaking high-level research. The Requirements can be met by coursework or examinations, as explained below. The Progress Review system in Chapter 3 explains the required timetable.

Students must demonstrate competence in five comprehensive courses chosen from the list below. Two of these must be Math 500 (Algebra) and Math 540 (Real Analysis), except for students in the Concentration in Actuarial Science and Risk Analytics (see section below).

MATH 500 – Abstract Algebra I
MATH 511 – Intro to Algebraic Geometry
MATH 518 – Differentiable Manifolds I
MATH 525 – Algebraic Topology I
MATH 530 – Algebraic Number Theory
MATH 531 – Analytic Theory of Numbers I
MATH 540 – Real Analysis
MATH 542 – Complex Variables I
MATH 550 – Dynamical Systems I
MATH 553 – Partial Differential Equations
MATH 561 – Theory of Probability I
MATH 563 – Risk Modeling and Analysis
MATH 570 – Mathematical Logic
MATH 580 – Combinatorical Mathematics

The course syllabi can be found online at https://math.illinois.edu/resources/department-resources/course-syllabi-instructors. For any of the five courses, competence can be demonstrated either by receiving a grade of A- or by passing the associated comprehensive examination. For up to two of the courses, a grade of B+ (instead of A-) in the course is sufficient. In very special circumstances the Director of Graduate Studies may approve the substitution of up to two courses (with final exams) for the listed comprehensive courses.

In addition, students must demonstrate proficiency in undergraduate complex analysis, which can be done in two ways:

1. by getting a grade of B or better in Math 448 or Math 542 (complex analysis), or
2. by doing sufficiently well in the comprehensive examination in complex analysis (Math 542), as judged by the examiners.

Comprehensive examinations are held in August, January and May each year. The examinations for Math 500, 540 and 542 are offered in each of these periods. All other comprehensive examinations are offered only in the period immediately following the course (e.g. if Math 570 is taught in the Fall, then its comprehensive examination will be offered in January, but not in May or August). Students may take the examinations more than once, without penalty. Previously given comprehensive exams can be found at https://math.illinois.edu/academics/graduate-program/coursework-and-exams/comprehensive-exams.

Each of the comprehensive examinations will be prepared and graded by a two- or three-person committee appointed by the Chair of the Department. (In exceptional circumstances, a single faculty member may prepare and/or grade an exam.) For each student, this examination committee will report one of the following grades: Pass or Fail.

In cases where a PhD student's research program contains an interdisciplinary component, the student might be permitted to take one regularly-scheduled PhD comprehensive examination (at the graduate level) from a department other than the Department of Mathematics. This substitution would be subject to the approval of the Graduate Affairs Committee, based on its assessment of the mathematical content of the exam.

All exceptions to the above schedule of examinations and requirements must be approved by the Director of Graduate Studies in consultation with the Graduate Affairs Committee.

Syllabi, course policies, homework, midterms, examinations

At the start of each course, the instructor must make available to students a statement of course policies. These policies must cover grading information, contact information, and office hours. Comprehensive courses (and other basic graduate courses) must involve: regularly assigned and graded homework (returned promptly), at least one midterm exam, and a final examination. Higher level graduate courses can be assessed through homework and/or presentations.

Graduate courses are graded on the basis of competence – there is no "curve" specifying what percentage of students will get a B+ or higher for the course.

Concentration in Actuarial Science and Risk Analytics

Students in this Concentration must demonstrate competence in five comprehensive courses. These courses must consist of:
MATH 540 - Real Analysis
MATH 561 - Theory of Probability I
MATH 563 - Risk Modeling and Analysis
STAT 510 - Mathematical Statistics I

and one additional comprehensive course chosen from the list in the previous section.

Note that Abstract Algebra (MATH 500) is not required for students in this Concentration.

Students must also demonstrate proficiency in undergraduate complex analysis, as specified in the previous section.

Students in the Concentration must demonstrate competence in the following:
MATH 564 - Applied Stochastic Processes
STAT 425 - Applied Regression and Design
FIN 591- Theory of Finance
by getting a grade of B or better. Alternatively, the Director of Actuarial Science may determine competence on the basis of other achievements; for example, the student might have passed a comparably difficult course at another institution.

Students must demonstrate competence in two of the following courses:
MATH 565 - Actuarial Models for Life Contingencies
MATH 567 - Actuarial Models for Financial Economics
MATH 568 - Actuarial Loss Models
by earning a grade of B+ or better or else passing the corresponding professional actuarial exam.

Entering the Concentration

Admission of a newly admitted PhD student to the Concentration is decided by the Director of Actuarial Science with the concurrence of the Director of Graduate Studies. Alternatively, a current Mathematics PhD student may petition the Graduate College to add the Concentration. This petition would need to be approved at the departmental level by both the Director of Actuarial Science and the Director of Graduate Studies.

Leaving the Concentration

A student in the Concentration may petition the Graduate College to drop the Concentration while remaining in the Mathematics PhD program. This petition would need to be approved at the departmental level by the DGS, who will consult with the DAS and will specify the progress requirements and timetable to be satisfied by the transferring student, and the funding promised to the student.

A**dvising**

The Director of Actuarial Science advises students in the Concentration on their program of study, and will certify completion of the Concentration requirements.

Progress requirements for PhD students in the Concentration

Same as for other PhD students, as in the next chapter. Students must complete the additional requirements of the Concentration prior to graduation, and are encouraged to do so during the first three years of their PhD study.

Concentration in Computational Science and Engineering

This option is designed for students who wish to study areas of mathematics with applications to computational science and engineering, including numerical methods for differential equations, symbolic algebra, computational geometry and mathematical graphics.

The Computational Science and Engineering (CSE) program at the University of Illinois emphasizes interdisciplinary graduate education. PhD students in this program are eligible to apply for special CSE fellowships, and to participate in interdisciplinary activities on campus.

Students electing the CSE concentration must meet all requirements for the PhD degree in Mathematics and must complete 8 hours of CSE core courses and 8 hours of CSE application courses (see cse.illinois.edu)

The doctoral thesis must have a significant computational component, and the thesis committee must include at least one CSE-affiliated faculty member.

Each year approximately eight research awards are made campus-wide to students enrolled in the CSE program. Research projects are selected for support on a competitive basis. Proposals are solicited each Spring for the academic year beginning the following Fall. The proposed research must be interdisciplinary and computationally oriented, and the proposal must be submitted jointly with two CSE faculty members from different disciplines. The CSE Fellows selected receive a partial research assistantship in their home department plus a tuition waiver. CSE Fellows present their research results at the annual CSE Symposium.

More information about the CSE program can be found at http://www.cse.illinois.edu.

Preliminary Examination (thesis proposal)

The Preliminary Examination is taken after the Comprehensive Requirements have been completed and after the student has found a potential thesis adviser. The purpose of the exam is (a) to verify that the candidate has chosen a suitable topic for thesis research, (b) to evaluate the candidate's depth of knowledge in a chosen area of specialization and ability to begin (or continue) research in this chosen area, and (c) to formally create the adviser/student relationship for the thesis.

The exam will be administered by a committee appointed by the Dean of the Graduate College upon recommendation of the Director of Graduate Studies. The candidate must set up this committee at least three weeks before the scheduled time of the exam. It must include at least four voting members, three of whom must be members of the Graduate Faculty and two of whom must be tenured. The potential thesis adviser is a member of this committee. See the Prelim Request Form on the graduate program website.

The committee and syllabus for the preliminary examination must be approved by the Director of Graduate Studies. The **syllabus** should explain the thesis research proposal (statement of the problem, known results, possible methods, partial progress), and also give a list of examinable background material. The background material should cover advanced material in the research area. It should not seriously overlap basic material covered in the Comprehensive Requirements. Typically the syllabus is 2-4 pages in length.

The exam will be oral and not longer than two hours. It will consist of a short presentation (typically 40 minutes) by the candidate describing her/his accomplished and proposed research, followed by a question and answer period on the research proposal and on the background material listed in the syllabus.

The Preliminary Examination Committee shall report a grade of pass or fail or decision deferred. The decision of the committee must be unanimous. Failure can be final, or the committee may grant the student another opportunity to take the examination after completing additional course work, independent study, or research. If a second exam is allowed, the student may petition the Director of Graduate Studies to have a written exam on the second attempt. Finally, the committee may defer its decision for up to 180 days and then re-examine the student.

Dissertation Committee

When the Preliminary Examination has been passed, the Preliminary Examination Committee becomes the Dissertation Committee. The purpose of the committee is to provide advice to the student on her/his doctoral research and preparation of the dissertation, and to ensure that the quality of the doctoral dissertation meets a high academic standard. In order for the Dissertation Committee to properly fulfill its advice and oversight functions, students should meet with their committee at least once a year. The first such review should take place no later than one year from the date of the preliminary exam.   The format of the meetings may vary. Students may convene a special meeting of the entire committee, or may meet individually with each committee member, or the student may invite the committee to attend a seminar in which he/she presents his/her latest results.

Thesis Research

The goal of doctoral study is to develop the student into a scholar who can conduct independent research. Students gain the necessary basic knowledge by taking courses. However, many students encounter difficulty making the transition from studying and learning mathematics to creating new mathematics. Problems assigned as homework in advanced courses are usually ones for which the answer is known, whereas problems that are suitable for thesis topics are ones for which the answer is not known and for which the appropriate methods of attack may not be clear. Excellent students may discover at this point that mathematical research is not their true calling, whereas other students may find that they excel in working on a single topic in extraordinary depth. Learning to be a scholar conducting independent research is facilitated by participating in research seminars where this process can be observed in action, but the main responsibility lies with the thesis adviser, who guides the student in conducting a research program on a topic selected in consultation between the student and the adviser.

An original thesis must be written in an approved area, normally chosen from one of the research areas represented in the Department, and must be read and approved by the Dissertation Committee. While conducting research on the chosen topic and also while writing their thesis, a student should consult frequently with their thesis adviser and members of the Dissertation Committee. Learning how to write technical papers (including a thesis) is an important part of the research training of a student. Thus, during the course of the research, the thesis adviser may require the student to write one or more papers to report on the research work. Since one measure of success in a research program is the publication of the results in a reputable technical journal with rigorous review

procedures, the Department expects that the results in a PhD thesis will be published in one or more journal articles.

Subject to advance approval of the Chair, doctoral students may do their thesis research under the direction of members of the graduate faculty in departments other than Mathematics. To obtain such approval, students should consult with the Director of Graduate Studies to arrange a meeting between the Chair, the thesis supervisor, the student, and any other members of the Department of Mathematics as the Chair may indicate. The purpose of this meeting will be to discuss the nature and direction of the intended thesis research.

PhD candidates normally register for Math 599 (Thesis Research) after passing their preliminary examination, while working on their thesis. The Graduate College requires that students be registered in Math 599 for zero or more hours at the time of the Final Examination. A candidate who registers for a term (Fall or Spring semester or Summer session) is considered to have satisfied this requirement if the Final Examination is taken after the end of that term, but before the first day of classes for the following term.

Final Examination (thesis defense)

The final examination is oral, and covers the material in the dissertation. It should last not more than two hours and is administered by a Final Examination Committee consisting of at least four voting members, three of whom must be members of the Graduate Faculty and two of whom must be tenured. See the Graduate College Handbook for the full regulations.

This committee must be set up, at least three weeks before the scheduled time of the exam, by the candidate in consultation with the Director of Graduate Studies. See the Final Exam Request form online.

The committee must receive the dissertation at least 2 weeks before the defense date (or 1 week if the committee members agree). Otherwise the committee may require the defense to be postponed.

The chair of the Final Examination Committee is responsible for convening the committee, conducting the examination and submitting the Final Examination Result Form to the Department of Mathematics and to the Graduate College.

All voting members of the Final Examination Committee must be present at the final exam or participate in the exam via appropriate electronic communication technology. The result of the final examination is recorded on the Final Examination Result Form and signed by the voting members of the Committee. Non-voting members need not be present at the final examination.

PhD degrees are awarded in May, August and December. **Please contact the Graduate Office for information at least three months prior to your planned graduation date.** You must also apply for the degree online using Enterprise near the beginning of the semester in which you intend to graduate.

Graduation Ceremony

Students who have passed the Final Examination (thesis defense) by the end of April are eligible to participate in the Departmental Convocation Ceremony, which is held in May. For more information, see https://math.illinois.edu/academics/convocation-ceremony-departments-mathematics-and-statistics.

3. PhD Progress Requirements

Red/Yellow/Green System

Students submit an annual progress report in February each year. The Director of Graduate Studies evaluates each student's progress using the charts below. Students designated Green and Yellow are encouraged to continue in the program for the following year. A student designated Yellow is at a higher risk to be considered Red the following year and so should "proceed with caution."

For students offered 6 years of funding upon admission:

By Feb 15 of Year	GREEN	YELLOW	RED
1	2 Comps	1 Comp	0 Comps
2	All Comps + EPI	4 Comps + EPI	≤3 Comps or No EPI
3	Prelim Spring	Adv/Top	No Adv/Top
4	Thesis Progress	Prelim, or Publ + Prelim Fall	No Prelim
5	Finish Next Year	Thesis Progress	All others
6	No-one	Special Only	All others

For students offered 5 years of funding upon admission:

By Feb 15 of Year	GREEN	YELLOW	RED
1	3 Comps	2 Comps	≤1 Comps
2	All Comps + EPI + Adv/Top	All Comps + EPI	≤4 Comps or No EPI
3	Prelim, or Publ + Prelim Spring	Prelim Spring, or Publ + Prelim Fall	All others
4	Finish Next Year	Thesis Progress	All others
5	No-one	Special Only	All others

Students must maintain a minimum of 8 credit hours/semester with a GPA of 3.25. The Department expects students to maintain a higher course load: 12 credit hours/semester (or 16 for students on fellowship).

Prelim: The preliminary examination has been passed.
Prelim Spring: The preliminary examination has been passed, or is scheduled for the Spring.
Publ + Prelim Fall: The preliminary examination is expected by the end of the Fall and the student is already making excellent progress towards their thesis (e.g. submitted a paper for publication; has an original result near publishable quality).
No Prelim: The preliminary examination has not been passed. If a student has scheduled their prelim to take place by May 15, then the Graduate Review decision will be deferred until that prelim exam date.
Comp: comprehensive course or exam
EPI: English Proficiency Interview (only applies to International students seeking departmental support who did not satisfy the TA English requirement upon admission)
Adv/Top: Adviser and Topic chosen, and all comps completed
Thesis Progress: Adviser's note indicating good progress on a thesis
Finish Next Year: Adviser's note indicating good probability to finish next year

Designations of Red/Yellow/Green/Finishing will be made by the Director of Graduate Studies, based on the annual progress report. At any time of the year, academic probation imposed by the Graduate College also constitutes grounds for a designation of Red status.

Students will have one week to appeal their designations after being notified, in case an error has been made (e.g. because a student's records are incomplete).

For the purposes of continuation in the program and reappointment with departmental TA funding these designations mean (subject to available funds):

Green: Progress is good. Continued funding is expected, highest priority.
Yellow: Progress is satisfactory. Continued funding is expected, high priority.
Red: Progress is below minimum. Case to be reviewed by Graduate Review Committee.
Finishing: Student is finishing. No further funding.

Priority for departmental fellowships will be given to students designated as Green, but all students are eligible to apply.

Graduate Review Committee

For students designated Red, the Graduate Review Committee will gather relevant information, including a statement from the student, before deciding about continuation in the program and departmental funding. The committee may make one of the following determinations, among others:

1. Due to special circumstances, student to be viewed as Yellow.
2. Continuation in the Mathematics graduate program and/or departmental support dependent on achieving certain benchmarks by specific dates.
3. No departmental support, but student may continue to enroll as a graduate student in Mathematics.
4. May not continue as a graduate student in Mathematics.
5. Defer decision until further information.

Students will learn of the Graduate Review Committee's determination within a week of the decision being made.

4. Graduate TAs, RAs and Fellowships

Three forms of graduate appointment are available in this department, namely Teaching Assistantships, Research Assistantships, and Fellowships. Teaching Assistantships are the principal form of graduate support. Research Assistantships are available through the Campus Research Board or through individual faculty research grants from outside funding agencies. Fellowships come from a variety of sources including national programs, university-wide programs and departmental sources.

The Mathematics Department does not normally offer teaching assistantships or other forms of financial aid to masters degree students.

Teaching Assistantships

Most teaching assistantships in the Department are at the 50% level, meaning a nominal workload of 20 hours per week during the semester. Appointments at less than 50% can be made in combination with research assistantships and/or fellowships.

Teaching duties fall into four categories:

Discussion Sections. In discussion sections, the principal responsibility of the TA is to answer student questions and provide guidance on homework assignments and in-class worksheets. In addition the TA is responsible for office hours (or tutoring room hours), and the grading of quizzes and exams designed by the main lecturer.

Standalone Classes. Standalone classes give the TA full responsibility (subject to the approval of a supervisor) over all aspects of a class, from lecture preparation and delivery to the creation and grading of assignments and exams and the assignment of grades. Only experienced TAs are assigned to such classes. Most standalone classes meet three times a week for one hour at a time.

Grading Papers. Many of our courses have TA graders assigned to assist the lecturer in grading homework and exams.

Tutoring Service. The department offers a free tutoring service for its calculus sequence and some other courses. TAs are typically used to staff the tutoring rooms.

A 50% teaching assistantship can take a variety of forms in terms of the four categories above. Some examples are:
- a standalone three hour per week class
- a standalone two hour per week class (37.5%) and a grading assignment (12.5%)
- two discussion sections in the calculus sequence (25% each)
- tutoring room duties (25%) and two grading assignments (12.5% each)
- four grading assignments (12.5% each)

New graduate students are not permitted to teach standalone classes in their first year. As students gain more experience in teaching and receive positive evaluations from students and supervisors, teaching opportunities and responsibilities will increase.

The day-to-day management of the teaching assistantship program in the Department is in the hands of the Associate Chair, and all questions and problems relating to teaching duties should be directed to the Associate Chair.

Assistants and fellowship holders with appointments ranging from 25% to 67% are exempt from paying tuition and service fees, but not the insurance and health center fees. For students holding such appointments in the Spring semester, the exemption extends through the summer session. Recipients of assistantships must be registered full-time during the term of employment.

Students receiving a summer assistantship are not required to register for classes during the summer term.

International TA issues

Teaching assistants who have not passed the EPI test or met the minimal TA English proficiency requirement are not allowed to perform duties that involve contact with students and therefore are assigned only grading duties.

International students dependent on departmental or campus support who fail to meet the campus English proficiency requirements to be a TA by February of their third year will not be allowed further support as a TA from the Mathematics Department. Students are encouraged to apply to other institutions to continue their graduate studies if they have failed to meet the campus English proficiency requirements by October of their third year.

For international students who hold external fellowships, requests for TA support either in conjunction with or upon the termination of their fellowship will only be considered if the student has already met the campus English proficiency requirement to be a TA or if departmental need exists.

Note concerning TA workload

Teaching Assistantships at the 50% level entail a maximum average workload of 20 hours per week over the course of a semester. It is to be expected that a TA's workload may be higher than the average at certain times in a semester as a result of exam grading and similar activities. Faculty and instructional staff supervisors are reminded that TAs have a primary responsibility to the completion of their degree programs, and thus such supervisors should exercise discretion in requiring temporarily-above-average teaching work of TAs. TAs are reminded that good teaching sometimes requires short-term time commitments substantially greater than the average time commitment, and that proper professional development includes developing the capacity to manage such variations in workload. Faculty and instructional staff should notify their TAs of temporarily-above-average time requirements as far in advance as possible.

A 12.5% grading appointment is to be interpreted as a maximum average of 4 hours per week of active grading work and one hour of preparation. This is to be adjusted proportionally for other levels of appointment (for example, a 50% appointment involves a maximum average 16 hours of active work and four hours of preparation). Faculty and instructional staff teaching supervisors bear substantial responsibility for ensuring that these maximums are not exceeded. Supervisors should be aware that their 25% and 12.5% TAs will likely have other TA and RA duties.

TAs who are having or expect difficulty meeting the expectations of their assignments should approach their teaching supervisors to explain issues and start working out appropriate solutions. A student who feels his/her concerns are not being appropriately addressed may ask the Director of Graduate Studies to help with resolving issues.

Satisfactory performance of TA duties

The Associate Chair coordinates the performance evaluations of TAs each semester. A necessary condition for reappointment as a Teaching Assistant is satisfactory performance of TA duties during the previous appointment.

Graduate Teacher Certificates

All Illinois graduate students who are (or have been) teaching assistants for at least two semesters on this campus are eligible to apply for the Graduate Teacher Certificate (GTC). This certificate program helps students improve and document their teaching. The Graduate Teacher Certificate is a program of the Center for Innovation in Teaching & Learning (CITL) and is supported by campus academic units and the Graduate College. More information is available on the web at http://citl.illinois.edu/professional-development/teaching-certificate-program/graduate-teacher-certificate. To apply, contact CITL by calling 333-3370 or by stopping by 249 Armory Building.

Research Assistantships

Graduate Research Assistantships are funded by the Campus Research Board or by external granting agencies. Such appointments are generally available only to advanced students working with a faculty member. The application for a research assistantship is made by the faculty member.

Fellowships

For information on fellowships awarded by the Department of Mathematics, the Graduate College and external organizations, please see https://math.illinois.edu/academics/graduate-program/funding/graduate-awards-and-fellowships.

Tax Status of Salaries

The income tax liability of students is determined by the Internal Revenue Service (IRS) and the State of Illinois Department of Revenue (IDR) and not by the University. The information provided in the remainder of this subsection is based on the present understanding of the tax code. However, some rules may be interpreted differently in the future by the IRS or IDR. The University may also change the policies stated below regarding the reporting of income and withholding of taxes.

Teaching Assistantship salaries are taxable income to the recipient. The value of any tuition and fee waiver associated with the assistantship is not taxable income. The University withholds taxes on assistantship salaries and reports the taxable income (and the tax withheld) to the IRS and IDR. For most assistants, the amount of tax withheld satisfies the statutory requirements.

Fellowship stipends are taxable income to the recipient. The value of any tuition and fee waivers associated with the fellowship is not taxable income. At this time, the University does not withhold income taxes on fellowship stipends unless the University Payroll Office is explicitly requested to do so. Also, it does not report fellowship stipends as income to the IRS or IDR. It is the fellow's responsibility to declare the fellowship stipend as taxable income on the appropriate income tax returns, and to make arrangements for paying any taxes due on this income.

Student assistants on non-immigrant visas are taxed as non-residents (and thus taxed somewhat differently from U.S. residents). The U.S. also has tax treaties with many countries, and these treaties affect the tax liabilities of fellows or assistants who are citizens of these countries. In such cases, the assistant may arrange with the Payroll Office for increased or reduced withholding that will more closely approximate the estimated tax liability.

5. Masters Degree Programs

The Masters degree programs in Mathematics can be completed in one to two years. There are no language requirements, and a Masters thesis is optional. No comprehensive examinations are required. Students are advised to consult the Associate Director of Graduate Studies to plan their programs.

General Regulations

A Masters degree in the Department of Mathematics requires at least 32 credit hours of work in 400- and 500-level courses. The following courses do not count towards these required hours: Math 405, Math 415, Math 444, Math 499.

At least 12 credit hours must be in 500-level courses, and, depending on the program, at least 8 or 12 of these credit hours must be in Mathematics. A Masters thesis may be added to some of the degrees in addition to the required 32 credit hours. The final GPA must be at least 3.0 (out of 4.0), and no course with a grade of D and at most one course with a grade below B- (B minus) may be applied to the degree. The credit/noncredit option may not be used for courses counting towards the degree. The student's course of study is subject to approval by the Associate Director of Graduate Studies or the Director of the Actuarial Science Program.

There are three Masters degree programs, one of them having four options, as discussed below:

- Master of Science in Mathematics
- Master of Science in Applied Mathematics:
    1. Actuarial Science
    2. Optimization and Algorithms
    3. Applications to the Sciences
    4. Computational Science and Engineering (CSE)
- Master of Science in the Teaching of Mathematics

Thesis Option

A thesis option is available for all Masters degrees in Mathematics, with the exception of Actuarial Science and the Teaching of Mathematics. Students wishing to pursue this option should register for 4 credit hours of Math 599 for one semester. The thesis may consist of one of the following:

1. A paper (20+ pages) describing and synthesizing material from one or several papers on a topic in mathematics or applied mathematics.
2. A historical account of the development of some branch of mathematics, applied mathematics, or the philosophy of mathematics.
3. A paper concerning some mathematical procedure, one component of which is a computer program implementing the procedure.
4. A paper representing original research.

The student should find a thesis adviser who, together with a second reader appointed by the Associate Director of Graduate Studies, will be responsible for the suitability of the material chosen and the approval of the thesis. For a Masters thesis, there is no oral thesis defense.

Master of Science in Mathematics

This program is appropriate for students who want a flexible general education in mathematics, including students pursuing the PhD degree.

Degree Requirements

A student may earn the degree by completing 32 credit hours of graduate study, with at least 24 credit hours in Mathematics (Math 405, 406, 415, 444, 499 cannot be counted). At least 12 credit hours must be in 500-level courses in Mathematics. In addition, the courses submitted for the degree must include:

>A course in algebra at least at the level of one of the following (substitutions are sometimes allowed with the approval of the Associate Director of Graduate Studies):
>>Math 418 - Intro to Abstract Algebra II
>>Math 500 - Abstract Algebra I
>>Math 501 - Abstract Algebra II

>A course in analysis at least at the level of one of the following:
>>Math 448 - Complex Variables
>>Math 542 - Complex Variables I
>>Math 540 - Real Analysis

Students are advised to take at least one course in real analysis and at least one course in complex analysis if these were not covered in their undergraduate preparation.

At most 8 credit hours in courses from other departments that are not cross-listed with Mathematics can be counted toward the required 32 credit hours of course work. These courses should have significant mathematical content and are subject to approval by the Associate Director of Graduate Studies.

Master of Science in Applied Mathematics: Actuarial Science

This option is appropriate for students preparing for actuarial science careers; it provides background for much of the material on the basic professional actuarial examinations. Admission to this program does not require an undergraduate degree in actuarial science, but students who have not already passed the first actuarial exam (probability theory) should be prepared to sit for it during their first semester. A student who enters with a significant actuarial background will have the opportunity to do more advanced work in mathematics, statistics, finance, and / or economics, including possibly independent study under the direction of a faculty member.

A student successfully finishing the program will typically have mastered the material covered on most or all of the basic actuarial exams (Exams P, FM, MLC, MFE, and C), and will have had an opportunity to study some finance, economics, or other areas of potential application to actuarial work. However, the program is designed to be flexible, and to appeal to people with varied experiences. Since students' backgrounds are different, each student is assigned a faculty adviser to help develop a plan of study most relevant and effective for the student's needs. Note the Masters thesis option is not available for this program.

Degree Requirements

A student may earn the degree by completing 32 credit hours of graduate study. At least 24 credit hours must be in Mathematics. Only courses at the 400- and 500-level courses can be counted toward a graduate degree (however, Math 405, 406, 408, 415, 444, 461, 463, and 499 cannot be counted toward the actuarial science Masters degree). At least 12 credit hours must be in approved 500-level courses courses (however, FIN 521 cannot be counted toward this requirement), and 8 of these credit hours must be chosen from:

>   Math 565 - Actuarial Models for Life Contingencies
>   Math 567 - Actuarial Models for Financial Economics
>   Math 568 - Actuarial Loss Models
>   Math 569 - Casualty Actuarial Science

The remaining 24 credit hours (or more) are chosen through consultation with the faculty advisers. They are subject to approval by the Director of Actuarial Science.

The following courses (or their equivalents) are strongly recommended. If a student has passed an actuarial exam covering the subject matter of a course, that course need not be taken. However, there is no Graduate College credit for passing actuarial examinations.

>   Math 409 - Actuarial Statistics II or Math 464 - Statistics and Probability II
>   Math 469 - Methods of Applied Statistics
>   Math 472 - Life Contingencies II
>   Math 563 - Risk Modeling and Analysis

Additional course possibilities include relevant 400- and 500-level courses in, for example, Mathematics, Statistics, Finance, or Economics, including Math 563 Risk Modeling and Analysis.

Master of Science in Applied Mathematics: Optimization and Algorithms

This option is appropriate for students interested in acquiring a background in mathematics applicable to computer science or operations research, including students pursuing a PhD degree.

Degree Requirements

A student may earn the degree by completing 32 credit hours of graduate study, with at least 24 credit hours in Mathematics (Math 405, 406, 415, 444, 499 cannot be counted). At least 12 credit hours must be in 500-level courses, and at least 8 credit hours of these must be in Mathematics. In addition, the following requirements must be satisfied:

> Four of the following seven core courses (or their equivalent) must be among the courses submitted for the degree or taken earlier. More advanced courses may be substituted for these.
>
> > Math 412 - Graph Theory
> > Math 413 - Intro to Combinatorics
> > Math/CS 450 - Numerical Analysis
> > Math/CS 473 - Fundamental Algorithms (currently offered as CS498 DL1 Theory II)
> > Math 469/Stat 420 - Methods of Applied Statistics
> > Math 482 - Linear Programming
> > Math 484 - Nonlinear Programming
>
> At least 20 credit hours must be in the following areas, with at least three areas represented. Core courses count toward these area requirements when taken for the degree. The list of courses used to satisfy this requirement is subject to approval by the Associate Director of Graduate Studies. A number of courses appropriate for these areas are taught in other departments.
>
> > Area 1. Optimization
> > Area 2. Control Theory and Coding Theory
> > Area 3. Combinatorics and Graph Theory
> > Area 4. Algorithms and Theory of Computation
> > Area 5. Statistics

Master of Science in Applied Mathematics: Applications to the Sciences

This option is appropriate for students interested in advanced training in differential equations and classical methods of applied mathematics, including students pursuing a PhD degree.

Degree Requirements

A student may earn the degree by completing 32 credit hours of graduate study, with at least 20 credit hours in Mathematics (Math 405, 406, 415, 444, 499 cannot be counted). At least 12 credit hours must be in 500-level courses. At least 8 credit hours must be in a department other than Mathematics. In addition, the following requirements must be satisfied:

> Three of the following four core courses (or their equivalent) must be among the courses submitted for the degree or taken earlier. More advanced courses may be substituted for these.
>
> > Math 489 - Dynamics & Differential Equations
> > Math 550 - Dynamical Systems I
> > Math 553 - Partial Differential Equations
> > Math 558 - Methods of Applied Mathematics
>
> A course in complex analysis at least at the level of one of the following must also be submitted for the degree or taken earlier.
>
> > Math 446 - Applied Complex Variables
> > Math 448 - Complex Variables
> > Math 542 - Complex Variables I

The 8 credit hours in departments other than Mathematics should provide substantive applications of applied mathematics and are subject to approval by the Associate Director of Graduate Studies. These credit hours may come from a broad range of fields, including but not restricted to material science, mathematical physics, engineering, economics, and the biological sciences.

Master of Science in Applied Mathematics: Computational Science and Engineering (CSE)

This option is appropriate for students interested in areas of mathematics involving computational applications to science and engineering, including numerical methods for differential equations, simulations, symbolic algebra, computational geometry, and mathematical graphics. The program emphasizes both the underlying mathematics and the use of computers in exploring and solving applied problems.

Degree Requirements

A student may earn the degree by completing 32 credit hours of graduate study, with at least 20 credit hours in Mathematics (Math 405, 406, 415, 444, 499 cannot be counted). At least 12 credit hours must be in 500-level courses, and at least 8 credit hours must be in Mathematics. In addition, courses submitted for the degree must include:

> An advanced course in differential equations, such as
>> Math 550 - Dynamical Systems I
>> Math 553 - Partial Differential Equations

> An advanced course in algebra or analysis, such as
>> Math 418 - Intro to Abstract Algebra II
>> Math 448 - Complex Variables
>> Math 542 - Complex Variables I
>> Math 540 - Real Analysis

> 12 credit hours from CSE courses. Of these, at least 4 credit hours must be from courses cross-listed in both Mathematics and CSE, and at least 4 credit hours must be from CSE courses not cross-listed in Mathematics.

More information about the CSE program and its participating departments can be found at http://www.cse.illinois.edu/.

Master of Science in the Teaching of Mathematics

This program is appropriate for students who want a broad background in mathematics as a preparation for teaching in a community college or in the first two years of a college program. It is also aimed at high-school teachers who would like to expand their mathematics background and improve their credentials. This program does not confer any state certification as a teacher. Students who want to be certified as a high school teacher should consult the College of Education about the requirements for certification.

Degree Requirements

A student may earn the degree by completing 32 credit hours of graduate study, with at least 24 credit hours in Mathematics (Math 405, 415, 444, 499 cannot be counted). At least 12 credit hours must be in 500-level courses, and at least 8 of these credit hours must be in Mathematics. The Masters thesis option is not available for this program. In addition, the courses submitted for the degree must include:

A course in algebra such as:
Math 417 - Intro to Abstract Algebra
Math 418 - Intro to Abstract Algebra II
Math 453 - Elementary Theory of Numbers
Math 500 - Abstract Algebra I

A course in analysis such as:
Math 447 - Real Variables
Math 448 - Complex Variables
Math 542 - Complex Variables I
Math 540 - Real Analysis

At least seven hours of course work from the College of Education in courses related to the teaching of mathematics at the secondary or college level, subject to approval of the Associate Director of Graduate Studies.

Students are strongly recommended to complete at least one course from four of the following six areas:

Area 1. Algebra
Area 2. Analysis
Area 3. Computer Science/Combinatorics/Logic
Area 4. Geometry/Topology
Area 5. Probability/Statistics
Area 6. Applied Math/Optimization/Differential Equations

In addition, this program requires two semesters of teaching. This requirement may be waived or reduced by the Associate Director of Graduate Studies based on sufficient previous teaching experience. Students should teach in two different formats if possible:

Discussion class instructor
Regular classroom instructor
Small group learning instructor
Merit workshop instructor
Lab instructor

The student will be compensated as a teaching assistant while satisfying this requirement.

For each of the two semesters students are expected to write a summary paper about their teaching experience and are encouraged to fulfill the requirements for the *Graduate Teacher Certificate* (note that this does not provide state certification as a teacher.)

6. General Information

Degree Codes

- PhD in Mathematics (Code: 10KS0439PHD)
- Master of Science (Code:10KS0439MS)
- Master of Science in Applied Mathematics (Code: 10KS0327MS; for Actuarial Science option: 10KS0328MS)
- Master of Science in the Teaching of Mathematics (Code: 10KS0290MS)

Degree choice is made the last time a student registers, before the degree is to be conferred. At that time candidates must indicate on their program request form the degree or certificate for which they are a candidate (PhD or MS) and the curriculum in which they will graduate.

Appeal and Grievance Procedures

Petitions are used to request exceptions (for good cause) from the rules and regulations stated in this *Guide* or in the *Graduate College Handbook*. Petitions must include a justification for the request, and must be endorsed by the student's adviser and the Director of Graduate Studies. A petition involving Departmental rules may be submitted in the form of a letter addressed to the Graduate Affairs Committee. Petitions involving Graduate College regulations must be prepared on standard Graduate College petition forms which are available at the Graduate College website.

Appeal and grievance procedures are used in problems involving academic or research work, assistantship duties, discrimination, and sexual harassment. Appeals may be lodged by graduate students about any departmental decision concerning them.

Informal Procedure

(Must be attempted before the formal procedure described below.) If the student's appeal or grievance relates to the student's responsibilities as a teaching assistant, then the student should begin by consulting with the Associate Chair. If the student's appeal or grievance relates to an academic matter, the student should begin by consulting with the Director of Graduate Studies. If the appeal is a request for an exception to the examination or progress requirements, then the Director of Graduate Studies may decide in an emergency. Otherwise he or she will refer the matter to the Graduate Affairs Committee or Graduate Review Committee for a decision, as appropriate.

Formal Procedure

A student dissatisfied with a departmental decision may appeal it by following the Graduate College Grievance Policy as set forth in the *Graduate College Handbook*. The student may also seek advice from the dean in the Graduate College who handles grievances.

Counseling Center

The campus Counseling Center provides a range of services to help students address emotional, interpersonal and academic concerns. The services include individual, couples and group counseling, and all are paid for through the Health Services Fee. The Counseling Center offers primarily short-term counseling, but also provides referrals to the community when students will benefit from longer term services. For an initial appointment with a counselor call (217) 333-3704 More information can be found at counselingcenter.illinois.edu/.

Room and Desk Assignments

PhD students who have not passed their comprehensive exams are provided with keys to the basement of Coble Hall. Here you will find a large number of desks and computers, available on a first-come, first-served basis.

Students assigned to Coble Basement are responsible for establishing a professional environment there:

- behavior and noise levels must be respectful towards other students, and permit them to carry out their work;
- alcoholic beverages may not be brought onto university property, as doing so violates the Student Code;
- meeting with one or two undergraduate students in Coble Hall is acceptable, but mass office hours, study sessions or review sessions must be held elsewhere – please book a room through Aaron Brewer in the main department office;
- in fairness to other students, do not leave books or belongings at the desks or computers when you leave the building; unattended belongings may be removed and discarded.

If you need a place to store items, you may get a locker in Coble Hall by stopping by the main office (273 Altgeld Hall). You may also rent a locker ($5.00) in the basement of Altgeld Hall by asking at the Business Office (221 Altgeld Hall).

After a PhD student passes his/her comprehensive exams, he/she is eligible for a desk. Graduate student offices are located in Coble Hall, Altgeld Hall, Illini Hall, and other buildings as necessary. Room assignments are made late summer, and are based on seniority and whether you are changing offices or not, and the needs of the department. Details will be emailed to you in July. If you become eligible for an office off-cycle, then please go to the Business Office in 221 Altgeld Hall to see whether space is available.

Keys

Keys for the outside door of your office building and for the office and desk to which you are assigned are available from the staff in 273 Altgeld Hall.

Photos

You are required to have your photograph taken at orientation for use in the private database of students maintained by the department. If for some reason you are unable to have it taken during orientation, you must make arrangements with the Graduate Office to have it taken as soon as possible. Photographs of graduate students are also posted outside 259 Altgeld Hall. Students are

strongly encouraged to have their photo posted there, but FERPA regulations require that students sign a permission form allowing the photo to be posted. Photo permission forms will be available when you have your photo taken.

Departmental Computer Facilities

The department maintains a computer lab in Room 123 Altgeld Hall for use by graduate students and faculty. There are also shared workstations in many of the graduate student offices.

Information about the Mathematics computer systems is available on the web at https://math.illinois.edu/resources/it-services. If you have questions or need assistance with a computer problem, please send a help request via email to math-it@illinois.edu, or see the consultants in 102 Altgeld Hall.

University student computer accounts and Active Directory passwords are managed by Technology Services at Illinois. For further information visit the Technology Services at Illinois website techservices.illinois.edu.

Email and Homepages

Please read your university email regularly. If you are not receiving departmental email notices, please notify the Graduate Office.

Students are encouraged to maintain a professional homepage on our website. Please send the url of your webpage to the webmaster at www@math.uiuc.edu.

Mailboxes, Photocopying and Scanning

Graduate student mailboxes are located in the mail room, 250 Altgeld Hall. Please check your mailbox regularly. Note that the mail room is only open during office hours, 8:30 a.m.–5:00 p.m. Monday-Friday.

The department's photocopiers are located in the mail room and in 325 Illini Hall. If you need to make copies early or late in the day, please use the copier in 325 Illini Hall. Note that Illini Hall is open 7:00 am-10:00 pm Monday-Friday, and the copier room is not locked.

The cost for personal copying is 12 cents/page. Misuse of the photocopiers (for example, by making personal copies at the department's expense) can lead to disciplinary action.

The copiers are also equipped with a scanning function. If you need assistance copying or using the scanning function, or if the copier malfunctions, please ask for assistance from the mailroom student worker or the staff in 273 Altgeld Hall.

Office Supplies and Services

Teaching assistants may obtain supplies for the course they are teaching in 273 Altgeld Hall. These supplies are for use in teaching, not for personal use and not for use in your studies.

Common Room (coffee and cookies)

The departmental common room is located in 321 Altgeld Hall. Coffee and tea are available daily on a self-service basis. All faculty and students are invited to join in conversation and cookies. Cookies are served on Tuesday and Wednesday at 3:30 p.m. On Thursdays, either donuts (colloquium days) or cookies (non-colloquium days) are served at 3:30 p.m. The refreshments are provided to stimulate social interaction. Please choose modest portions, and do not take food out of the room in which it is provided.

Security

Please be security conscious. Do not leave personal valuables in your office or desk. Do not share your keys or invite others to the graduate student offices or other department facilities. The last person leaving an office should lock the door. Do not reveal your computer password to anyone. If you suspect that it is compromised, change it immediately.

Tornado Sirens

The city tornado sirens are tested on the first Tuesday of each month at 10 a.m. If they sound at any other time, then go immediately to the basement and stay away from windows.

Emergency Operations Plan

The department has an established emergency operations plan for evacuating the building in case of emergency. [View complete emergency operation plan](#).