

Graduate Handbook for Doctoral Program

Department of Mathematics
Tufts University

Updated by Graduate Committee August 2018



1. OVERVIEW

The Graduate School of Arts and Sciences (GSAS) at Tufts maintains a general graduate student handbook, which you can find online here:

<https://asegrad.tufts.edu/academics/graduate-student-handbook>.

The document you are reading supplements this university handbook by providing specific information about the policies of the mathematics department. In particular, this document describes the **formal requirements** for a *full-time PhD student* to remain in good standing in the Department of Mathematics at Tufts University; it describes other elements of graduate study including **rules and training opportunities**; and it establishes a **suggested timeline** for completion of graduate study in mathematics.

This handbook reflects policy going forward from Fall 2018, some of which may depart from past policies, both formal and informal.

There are several layers of rules and regulations for graduate students, coming from the university, the GSAS, and the department. To make the expectations clear and simple we are writing this document in terms of requirements to remain **in good standing** in the program and we will not distinguish between the sources of the rules. Good standing equals eligibility for department funding, so loss of good standing triggers loss of funding by default, leading to a discussion in the graduate committee of whether to recommend removal from the program. For full details on the procedure for assessing good standing, please see the section on **Progress Reports**.

For a student in good standing, departmental funding (in the form of Teaching Assistantships or Research Assistantships) will normally cover five years, can be extended for a sixth year on a selective basis, and will not be offered after the sixth year. Note however that, just as in most or all graduate mathematics programs, *while the department strives to fund all students, it is not possible to guarantee funding more than a year in advance, even for students in good standing.*

	Department Chair	Misha Kilmer
Current (August 2018) department leadership:	Associate Chair	George McNinch
	Graduate Director	James Adler

2. REQUIREMENTS TO REMAIN IN GOOD STANDING FOR A PH.D. STUDENT

There are seven overall requirements to remain in good standing as a PhD student in the Department of Mathematics. Details can be found in the sections below, and note that for several of these rules an extension might be grantable on a case-by-case basis by the Graduate Committee.

- (1) Maintain status as a **Full-time Student** in good academic standing per the [GSAS handbook](#);
- (2) Complete and submit **Progress Reports** before the end of each semester;
- (3) Take at least one semester of the **Graduate Development Seminar**, Math 291 or Math 292, in the first year;
- (4) Attempt two *different* **Qualifying Exams** by the end of the third semester of study *and* pass three exams by the start of the fifth semester of study;
- (5) Obtain a **Thesis Advisor**, and pass a **Candidacy Exam** within twelve months of passing the last qualifying exam;
- (6) Satisfy the **Teaching Requirement**;
- (7) Write a **Dissertation** and conduct a **Defense**.

Details of these requirements are outlined in the following sections. Entering students are assigned a preliminary advisor to assist in getting to know the system and in choosing courses; there is *no* expectation that this preliminary advisor should later serve as a dissertation advisor.

Note that there are no *course* requirements for the PhD beyond the credits required to remain an active **full-time student**, the [Graduate Research](#) credits required in the last year of study, and the [Graduate Development Seminar](#). However, there are many different courses offered and a brief description of these and how they may affect your standing are given in [Section 3.3](#).

2.1. Full-time status. Status as a a full-time student is not only required for good standing but also for many sources of external funding, for international visas, and for college loan deferments. To maintain this status a student must be enrolled in at least 9 credits each semester, or 6 credits if on TA or RA. Students below that level of coursework must register for a special course called **full-time continuation** (Math 502),

which is described below in [Section 3.3](#). This should only be used in cases where the student is spending a majority of their time working toward their degree/dissertation, but no longer needs to take any courses. First year and most second year students should avoid this option, except under special circumstances.

2.2. Progress Reports. Each semester progress reports are collected from each student in all graduate degree programs in Mathematics. These reports are filled out by the student and checked over by the student's academic advisor. Note that this may be the preliminary advisor assigned if the student has not obtained a Thesis Advisor at this stage. The student's advisor is expected to meet with the student prior to signing this report, and is encouraged to add any confidential remarks to the Graduate Committee about the student. Information on the Progress Reports include: progress made in core courses, including any grades below B- or Withdrawals; progress toward passing qualifying exams (if applicable); progress toward candidacy exam (if applicable); progress toward dissertation and defense (if applicable); and expected graduation date.

These reports are then collected by the Graduate Director, who reviews each one and then calls a meeting with the entire Mathematics Graduate Committee, where these reports are discussed. For each student, it is assessed whether or not they remain in Good Academic Standing, as defined by both the GSAS Student Handbook and by the Department's own academic standing guideline. In addition to these reports, students **must also turn in their unofficial transcripts** along with their progress report before each semester begins to check for I grades, grades below B- or excessive withdrawals, so course/program changes can be made before the semester begins.

2.3. Graduate Development Seminar. The Graduate Development Seminar is a year-long training program for first-year PhD students. Students must sign up for at least one semester of this course, numbered Math 291 (Fall) and Math 292 (Spring). Taking the full year is strongly encouraged. The goal of the seminar is to offer training for teaching and more general public speaking about mathematics along with other professional skills. It is a graduate-student-led teacher training course, which helps students learn about and practice communicating research level mathematics to a broader audience. The course will be graded on an S/U basis only. A grade of U would only be assigned in the rare event that a student failed to attend and/or participate in the seminar. This would also require written documentation from the faculty advisor for the course. The seminar itself will meet for 75 minutes, once a week. In addition, students enrolled in the course are expected to attend either a research seminar or a colloquium each week, when offered.

2.4. Qualifying Exams. The qualifying examinations are *written* exams offered in six possible topic areas:

- (1) Analysis;
- (2) Geometry;
- (3) Algebraic Topology;
- (4) Algebra;
- (5) Partial Differential Equations;
- (6) Numerical Analysis/Linear Algebra.

Students must pass a qualifying examination in **three of these six areas**.

These subject areas correspond to core graduate courses (numbered 211, 217, 219, 215/216, 251/252, 226/228, respectively) that are offered regularly; each of the six will normally be offered at least once every two years. The courses are not required: some students will choose to take qualifying exams immediately upon arrival or after self-study. The material covered in the core courses is a **subset** of the material tested in the exam. Therefore, students should consult the online qual syllabi for the full list of exam topics found on the Department's website. Additional descriptions of qualifying exams from past years are collected on the [OGSM website](#)—these give a good guide to content, but, of course, exams are not guaranteed to remain stable from year to year and across different examiners.

Each qualifying exam is written by two faculty members, one of which is the most recent instructor of the corresponding core course. The associated faculty will issue a grade of PASS or NO PASS within a week of the exam. In the event of a NO PASS grade, students may schedule a repeat examination. Each individual exam may be taken no more than three times.

The qualifying exams are offered twice per year, in either January, May, or August/September, depending on the timing of the associated core course. One exam will be offered at the end of the semester for which the course (or sequence of courses) ends, and one in the following semester (August/September for courses

ending in May). The faculty member writing the exam will fix the date of the exam in advance. Students must register for the exam up to two weeks before that date. They are not allowed to sign up for an exam after this deadline. A student who registers for an exam may decide to withdraw from taking it at any time up to that two-week deadline. If they decide after this deadline and do not show up for the exam, they will automatically receive a NO PASS. In *rare* circumstances, an exam may be requested during an “off cycle time” and will require special approval by the Graduate Committee.

Students are required to have passed their qualifying exams by the start of their fifth semester **and** must have attempted at least two exams by the end of the third semester to remain in good standing.

Qual topics: <http://math.tufts.edu/graduate/qualifyingExams.htm>

OGSM quals archive: <https://sites.google.com/site/tuftsogsm/resources>

2.5. Thesis Advisor and Candidacy Exam. In order to advance to candidacy, each student must find an advisor from among the tenured and tenure-track faculty. This relationship should be formalized soon after the qualifying exams. (This just means the student and professor should agree verbally on the advising relationship. It will then be entered into the record on the student’s next progress report.) Reading courses, independent studies, and PhD credits are all forms of coursework that can be signed up for between student and advisor (see §3.3).

The other formal requirement in the advisor–student relationship is a progress report to be filled out together each semester, detailing the status of exams, dissertation work, and other progress towards the degree. This document certifies the good standing of the student and is used by the graduate committee in making funding allocations and projections and more details are given above (see §2.2). *It is possible to switch advisors if necessary, which will be discussed further below.*

The next requirement is a **candidacy exam**, to be taken within 12 months of passing the last qualifying exam (extensions of this deadline are available by vote of the graduate committee). Before scheduling a candidacy exam, each student must have a chosen advisor who will conduct the exam. The successful completion of this requirement indicates that the student has advanced to candidacy, which is the period of focused work on original research towards a dissertation.

The exam has two required components: a closed-format session for a committee of three members (i.e., with only faculty in the audience) and a public lecture advertised to the whole department.

The advisor will chair the closed session. The content and format of this session may vary considerably from advisor to advisor and even from student to student of the same advisor. It is the student’s responsibility to clarify the format with the advisor before the exam. Many exams will be expository, in which the student creates a high-level presentation on material by other authors assigned by the advisor. Often, a student will present examples or computations that he or she has worked out in the course of learning the material in a particular research area. In some cases, the student may already have original research to present. The public lecture is open to questions from all, and is intended to demonstrate the candidate’s ability to convey mathematics to a broader audience.

The parts may be scheduled in either order. Within a day of the completion of each part, the candidacy committee will issue a grade of PASS (P), CONDITIONAL PASS (CP), or NO PASS (NP). In the event of an NP grade on either part, the exam has been failed; subsequently, the student may attempt a candidacy exam a second and final time. If a second exam is required close to the deadline for advancing to candidacy, the student and advisor should draw up a plan with an appropriate timeline and submit it to the graduate committee to approve a time extension.

A grade of CP suffices for advancing and does not require retaking of the exam, but indicates a concern on the part of the committee about the student’s performance in that part. The student and advisor will come up with a plan to resolve the concerns, such as an informal talk or question session. The resolution of a CP into a P grade is handled between student and advisor and is not a formal requirement.

It is important to note that it is possible to change advisors after the candidacy exam, and a new candidacy exam is *not* required once it has already been passed. However, every student past the candidacy exam must have an advisor to remain in good standing.

2.6. Teaching. One semester of teaching is a requirement for graduation. Typically, this requirement is fulfilled by either teaching a set of recitations for a lower-level course, such as calculus, or being an instructor for an individual section of a course. Some of these courses have a course coordinator who sets the lecture pacing, homework, and exams. Additionally, it is possible to request non-instructional alternatives for the

teaching requirement. These positions, like other TA assignments, are not to exceed 20 hours per week of time commitment. Please consult the graduate director for details on alternative options.

When teaching, it is important that the student get their class thoroughly observed by a faculty member, who can give useful feedback and suggestions. Those applying for academic positions (including postdocs) will need a teaching-focused letter as part of the application file. The student should be on top of making sure an observation happens early enough in the term that they can make use of the feedback. It is also a good idea to schedule an observation by any potential letter-writer whose teaching you admire.

Students, who are interested in learning more about the available teaching assignments, should consult with the [Associate Chair](#), whose job is to oversee teaching-related issues. Finally, there may also be opportunities to teach a course over the summer months. For more information see [Section 3.5](#) below. TA positions are discussed further in [Section 3.2](#) below.

2.7. Dissertation and Defense. The crucial work produced in the course of graduate study is a doctoral dissertation, which contains original research of a quality publishable in respected mathematical journals. There is no length requirement for dissertations. The dissertation is read and approved by a committee of four members put together by the advisor, of which one must be an outside examiner. The outside examiner must be from outside Tufts. The department provides a LaTeX template designed to help students meet the Tufts formatting requirements with basic instructions for setting up the document. This is currently available on the OGSM Resources page: <https://sites.google.com/site/tuftsogsm/resources>.

Most students graduate in the Spring term, in which case the dissertation is due for electronic submission in mid-March. Exact deadlines, including dates for graduating in other terms, can be found in the [GSAS Handbook](#). This also includes instructions on how to file for graduation and where to submit the thesis.

In the last term before graduation, the student and advisor will schedule a doctoral defense, which is announced to and open to the whole department and to visitors invited by the candidate. The standard format is a presentation by the doctoral candidate followed by questions from the audience, who is then asked to leave. This is followed by questions from the committee.

3. OTHER ELEMENTS OF GRADUATE STUDY

3.1. What to expect when you arrive. It is a good idea to plan to arrive in the Medford/Somerville area at least two weeks before the start of school.

The graduate school organizes a small array of orientations in the week before classes start, such as a Matriculation Ceremony, TA Orientation, RA Orientation, International Student Orientation, and Library Orientation. If you are being supported as a TA or an RA, you are **required** to attend the orientation offered by the Graduate School.

Department orientation is much more informal, but always includes introductions and food in the conference room as a chance to meet the new faculty and staff. There is also a brief and relaxed introduction for instructors each Fall.

Academic calendar: <http://students.tufts.edu/registrar/what-we-do/course-registration-and-scheduling/academic-calendars>

3.2. TAship/RAship. The department has a limited number of funded positions available in the form of teaching assistantships, or TA positions. TA duties may include grading for either an undergraduate or a graduate course, running a set of recitations for a lower-level course, or running your own classroom as an instructor of record. Note that the latter two options satisfy the teaching requirement mentioned above. The number of slots per semester for graduate students to teach as an instructor varies from year to year, but you should indicate your interest to the graduate director well in advance of the upcoming semester.

A TA position as a grader or recitation leader should be entered into with strong communication between student and professor about expectations, including time commitment. The department provides forms to be filled out by TA and professor to make the expectations clear. All TA assignments are not to exceed 20 hours per week of time commitment.

A second kind of department support is through research assistantships, or RA positions, often funded by grants held by individual faculty members. In applied math, it is common for the RA position to be tied to a particular project on which the work will support the research program of the faculty member. In pure

math, RA funding during the school year is more rare, but summer stipend is sometimes available from the advisor's grants.

There is a standardized amount of pay for full TA positions; in the 2017–2018 year, the 9-month stipend was about \$21,256. We hope to be able to continue to raise the graduate salaries, but the TA budget is limited and subject to change. RA salaries vary and depend on the source of funding.

3.3. Coursework and Seminars. Graduate students may take undergraduate courses for breadth or to fill in gaps in their undergraduate background; core graduate courses were discussed above. Besides the core courses, the department also offers more advanced classes and topics courses, such as those numbered Math 250. Taking topics courses is strongly encouraged. Additionally, a reading course (see below) can be a great way to get to know a potential advisor, or to start work with a new advisor.

Any two grades below B- in any courses will result in automatic loss of good standing. Additionally, students should **avoid withdrawing** from a core graduate course (associated with a Qualifying exam). Two such withdrawals within the first four semesters automatically triggers loss of good standing.

Our department has a range of active seminars, and the other local schools have an enormous array of seminar options. Besides keeping you acquainted with the frontiers of research, these give you a chance to meet mathematicians from all over the world. When possible, graduate students should always try to attend dinner with the speakers.

Here are special course numbers that all students should be aware of.

- **Full-time continuation:** Any student not meeting the requirements of [full-time status](#) may enroll in this course, numbered **502** for Ph.D. students. There is no grade assigned to this course and its credit is variable; it is automatically set at the level needed to get up to full-time status. There is also a course numbered 501 which is part-time continuation, but this is rarely used in our department.
- **Reading course:** A student and professor can agree to do a one-on-one reading course. The course number is **293** in this case. A one-on-one course form (found in the main office) needs to be filled out for this and a syllabus needs to be written with course objectives as in any other course. A grade is assigned to this course and it will appear on the transcript.
- **Graduate research:** A Ph.D. student should sign up for **297/298** for the last two terms of study while completing the dissertation.
- **TA/RA course:** A student who is supported on TA or RA should be registered for courses Math **405** (TA) or **406** (RA). A student **must** register for these themselves via SIS, so that it appears on the student's list of classes and contributes to their full-time status.

In addition to local classes, Tufts students can benefit from our location in the mathematically rich Boston area to take classes at a range of other local universities, like Brandeis, Boston University, MIT, Harvard, and Boston College. Typically professors at these other places will welcome Tufts students as auditors, and it is an excellent opportunity to get to know other leading mathematicians.

Students can also register for courses officially at Boston College, Boston University, or Brandeis, and their tuition waiver covers the cost. Please be aware that you will need to contact the professor and the host institution itself in a timely fashion in order to meet their deadlines and file any necessary forms.

Cross-registration info: <http://students.tufts.edu/registrar/what-we-do/course-registration-and-scheduling/register-classes/cross-registration>

3.4. Master's degree. The current document is focused on the doctoral program, but doctoral students can also obtain an MS degree en route to the PhD. The MS can provide a good credential for students who leave the program before the completion of the doctorate, but is also available in addition to a PhD. To file for an MS degree, the student must satisfy the master's requirements and file a small amount of paperwork. To find the official deadline and other information, see the [GSAS Handbook](#) and contact the [Graduate Director](#).

3.5. Summers. A limited number of positions are available for summer teaching in Sessions 1–2 of the summer school at Tufts, where the offerings typically range over calculus, discrete math, linear algebra, and differential equations. However, summer can also be an extremely fruitful time for research work and there are many conferences in all specialties all over the world.

To request summer teaching, contact Mary Glaser. In the fall semester—typically in October—she will solicit the mathematics department for interest in summer school instruction. Be sure to discuss summer

options with your advisor before requesting a summer teaching assignment, as some advisors may have access to grant funding to support student research in the summers.

3.6. Other funding sources. There is some precedent for students to supplement or replace TA/RA support with funding from other sources. For instance, there are outside grants like the NSF graduate fellowship, which can be applied for as late as the first year of graduate study.

Sometimes there are also opportunities to get paid positions affiliated with other Tufts initiatives like the Poincaré Institute or the BLAST program.

Some students also seek teaching positions at local schools such as Bunker Hill Community College or Bentley University. (The Boston area has more than 50 colleges and universities!) However, outside teaching is extremely time-consuming and certainly any such plan should be closely discussed with the advisor.

Towards the end of your graduate study, there are a range of grants and fellowships that go by names like *dissertation fellowship* or *write-up grant*. Many of these are targeted to women and members of other groups that are underrepresented in math. Examples include the American Association of University Women and the Ford Foundation. These fellowships are prestigious as well as financially beneficial.

NSF Graduate Fellowship: <http://www.nsfgrfp.org/>

AAUW: <http://www.aauw.org/what-we-do/educational-funding-and-awards/>

Ford Foundation: <http://sites.nationalacademies.org/pga/fordfellowships/index.htm>

3.7. Conferences and travel. Your advisor can keep you in the loop about conferences and workshops in your research area, which are a strongly-recommended way to meet peers and potential future mentors. Many conferences have grants that support graduate students to attend, reimbursing both travel expenses and local expenses. If needed, local funding may be possible for students to attend relevant conferences, either from grants or from department funds. Students can also get travel funding from GSAS through the Graduate Student Travel Fund in the amount of \$400 (if you are giving a talk) or \$200 (if not) once per year. The funding is given out on a first-come first-serve (not merit) basis.

<http://asegrad.tufts.edu/academics/research/funding-opportunities-tufts/graduate-student-travel-fund>

3.8. Visas and immigration. Tufts has an [International Center](#) whose staff can help you learn about your options for visas and immigration. Most international students are here on J visas, but individual circumstances may vary.

Resources for new international students: <http://ase.tufts.edu/icenter/life/resources.asp>

Graduate International Orientation: <http://ase.tufts.edu/icenter/programs/graduateOrientation.asp>

3.9. Medical coverage. The Tufts student benefits include medical coverage, with costs covered by GSAS for funded students in years 1 to 5. Some basic dental coverage, such as injury treatment and wisdom tooth removal, is covered in the basic medical plan. There is also opt-in dental coverage at an additional cost.

Students are only eligible for GSAS subsidies to cover health care costs in the first five years of study. You can still buy student coverage through Tufts after the 5th year, but you are responsible for covering the cost (on the order of \$3000). Note that even if you were to have health fees paid by an external source for part or all of your first five years, you would still be responsible for fees in year six.

There are also many mental health facilities available for students. Student coverage also can pay for an off-campus provider if you get a referral.

Medical (summary): <http://students.tufts.edu/health-wellness>

Details: <https://www.uhcsr.com/uhcsrBrochures/Public/ClientBrochures/2014-202764-1%20Brochure.pdf>

Dental: <http://medicine.tufts.edu/Student-Services-and-Campus-Life/Student-Advisory-and-Health-Office/Dental-Insurance>

Counseling: <http://students.tufts.edu/health-wellness/mental-health/about-counseling-mental-health-services>

3.10. Personal leave. Students may take a personal/medical leave for any reason, and this will not count against the funding clock. In this case, a strong plan for resuming the degree program should be established between student and advisor prior to the start of the leave term. There is a form to be signed by student, advisor, and [Department Chair](#). One difference between these statuses is that students on medical leave are

eligible to remain on Tufts student medical insurance. The first time a student requests a leave, the approval is essentially automatic. Further leaves after the first will receive more scrutiny.

GSAS forms (bottom of page): <http://asegrad.tufts.edu/current-graduate-students>

3.11. Miscellaneous other resources. It is a good idea to cultivate strong relationships with several faculty in the department and to feel comfortable contacting the [Department Chair](#), [Associate Chair](#), and [Graduate Director](#) in cases of need.

The Tufts AMS Chapter, or Organization of Graduate Students in Math ([OGSM](#)), is a venue to get advice and community from other graduate students, and for grads to advocate for information or new policies. For instance, if there is demand for a certain kind of class, OGSM can notify the [Department Chair](#) or [Associate Chair](#) with a request. The department also has chapters of [SIAM](#) (Society for Industrial and Applied Mathematics) and the [AWM](#) (Association for Women in Mathematics).

Outside the department, Tufts has an excellent “Group of Six” cultural centers: the [Africana Center](#), [Asian-American Center](#), [International Center](#), [Latino Center](#), [LGBT Center](#), and [Women’s Center](#). They maintain very strong programming and are open to all.

We also have a [Center for STEM Diversity](#) tackling issues specific to underrepresented minorities in math and science, which runs a wide range of symposia and mentoring events. They welcome graduate student participation and this is highly encouraged!

Finally, the university maintains an [Equal Opportunity Handbook](#) detailing Tufts policy on non-discrimination, disabilities, sexual harassment/misconduct/assault, consensual relationships, and more.

3.12. Violations of Academic Standing. If a particular student is found to be in violation of Good Academic Standing, an initial meeting is made with the student’s advisor to determine if there have been any extenuating circumstances. If not, this is then followed up by a meeting with the student, to explain the reason(s) the student is no longer in Good Academic Standing. Then, a plan is discussed, including timelines, and developed with both the advisor and student in order to help them get back into Good Standing. This plan is then discussed at the next Department Graduate Committee meeting and a vote is made on whether the plan should be carried through.

If this plan is not met and the student remains in violation of Good Academic Standing, the case will be reviewed again, and the student will be referred to the GSAS Executive Committee with a recommendation from the department as to whether the student should be dismissed or further accommodations be made.

4. SUGGESTED TIMELINES

Our program seeks to establish a norm of degree completion in five years, with a sixth year possible if it is deemed advantageous by student and advisor and funding is available. Students who enter with a prior master's degree should finish within five years.

Finishing qualifying exams in the first year is allowed but should not be understood to be specifically encouraged. Taking the core courses is recommended as a way to learn the material more deeply and to get to know the Tufts faculty.

The following lists two **example** timelines for a student to remain in good standing and, ultimately, to obtain the PhD. Specific timings and courses will vary from student to student and the following may be seen as idealized timelines, since it may take a long time to find a precise and approachable problem, the first problem attempted might not work out, or interests may shift over time. Reasons like these can make a sixth year a healthy possibility for certain students.

EXAMPLE 1

First Year:

- ⇒ Takes 3 core courses and one topics course in the first year.
- ⇒ Takes Math 291 and attends various seminars and all colloquia to discover areas of possible interest.
- ⇒ Gets to know faculty within the department and learns about their research areas.
- ⇒ Takes Algebraic Topology [Qualifying Exam](#) in January.
- ⇒ Takes Algebra [Qualifying Exam](#) in May.

Second Year:

- ⇒ Takes 1–2 core courses plus a topics course or independent reading.
- ⇒ Begins reaching out to faculty and learning about different research topics.
- ⇒ Attends seminars on a regular basis as area of interest becomes clearer, in addition to colloquium.
- ⇒ Takes Geometry [Qualifying Exam](#) in January.
- ⇒ By the end of the academic year, the student contacts a faculty member and initiates an [advisor-student relationship](#).

Third Year:

- ⇒ Takes all topics courses in area of interest and attends seminars and colloquium regularly.
- ⇒ Works with [advisor](#), who recommends reading and a small independent research investigation.
- ⇒ Takes [Candidacy Exam](#) in December of the third year, receiving a P and a CP grade. Advisor proposes presentation on a reading project to resolve CP, which is carried out in May, after an extension from the graduate committee.
- ⇒ Attends conferences in the summer between third and fourth year and develops mathematical writing skills.

Fourth Year:

- ⇒ Takes all topics courses in area of interest and attends seminars and colloquium regularly.
- ⇒ Teaches a Calc I recitation in the Fall, satisfying the [Teaching Requirement](#). Teaches Calculus I in Spring.
- ⇒ Begins intensive research and starts building up a body of work on some related problems.
- ⇒ Attends conferences in the summer between fourth and fifth year.

Fifth Year:

- ⇒ Takes all topics courses in area of interest and attends seminars and colloquium regularly.
- ⇒ Enrolls in Math 297 and 298.
- ⇒ Brings a research project to completion, creating one or more polished preprints.
- ⇒ Grades in Fall; teaches Calc I in Spring.
- ⇒ Contacts letter-writers in August and applies for academic jobs in October–November.
- ⇒ Begins intensive [dissertation](#) writing in early Spring.
- ⇒ Gives several talks on research at seminars and conferences suggested by advisor.
- ⇒ [Defends](#) thesis in late Spring.

EXAMPLE 2

First Year:

- ⇒ Takes 4 core courses in the first year.
- ⇒ Takes Math 291/292 and attends various seminars and all colloquia to discover areas of possible interest.
- ⇒ Gets to know faculty within the department and learns about their research areas.
- ⇒ Takes Analysis [Qualifying Exam](#) in May.
- ⇒ Takes PDEs [Qualifying Exam](#) in August/September.

Second Year:

- ⇒ Takes 3 core courses plus a topics course.
- ⇒ Begins reaching out to faculty and learning about different research topics.
- ⇒ Attends several different seminars in addition to colloquium.
- ⇒ Takes Numerical Analysis [Qualifying Exam](#) in May.
- ⇒ By the end of the academic year, the student contacts a faculty member and initiates an [advisor-student relationship](#).
- ⇒ Conducts reading in area of focus over summer between second and third year, writes up small results to develop mathematical writing skills.

Third Year:

- ⇒ Takes all topics courses in area of interest and attends seminars and colloquium regularly.
- ⇒ Works with [advisor](#), who recommends reading and small projects.
- ⇒ Passes [Candidacy Exam](#) in December of the third year.
- ⇒ Teaches Mathematics of Social Choice in the Spring, satisfying the [Teaching Requirement](#).
- ⇒ Attends conferences in the summer between third and fourth year.

Fourth Year:

- ⇒ Takes all topics courses in area of interest and attends seminars and colloquium regularly.
- ⇒ Teaches Calc II in the Fall; supported by advisor's grant in Spring.
- ⇒ Begins intensive research and starts building up a body of work on some related problems.
- ⇒ Attends weekend graduate student conference in the Spring.
- ⇒ Attends conferences in the summer between fourth and fifth year.

Fifth Year:

- ⇒ Brings a research project to completion, creating one or more polished preprints.
- ⇒ Enrolls in Math 297 and 298.
- ⇒ Teaches Social Choice in the Fall; supported by advisor's grant in Spring.
- ⇒ Contacts letter-writers in August and applies for academic jobs in October–November.
- ⇒ Begins intensive [dissertation](#) writing in the second semester.
- ⇒ Takes all topics courses in area of interest and attends seminars and colloquium regularly.
- ⇒ Gives several talks on research at seminars and conferences suggested by advisor.
- ⇒ [Defends](#) thesis in late Spring.

