Carnegie Mellon University

Academic Year 2024-2025

Mellon College of Science Department of Mathematical Sciences

Doctoral Student Handbook

Degree Programs Covered by This Handbook:

Ph.D. in Mathematical SciencesD.A. in Mathematical SciencesPh.D. in Algorithms, Combinatorics, and OptimizationPh.D. in Pure and Applied Logic

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SECTION 1: Welcome and Introduction

The Department of Mathematical Sciences at Carnegie Mellon University is dedicated to expanding both the reach of mathematical knowledge and the impact this body of knowledge has on the world. The Department pursues this mission through its research and educational programs, both of which remain closely woven into the intellectual fabric of the University. In keeping with the strategy of Carnegie Mellon University, the Department develops and maintains research groups in targeted areas, with an emphasis on areas of mathematics that are natural to application. This research profile positions the Department to contribute to the emergence of new applications of mathematics and naturally generates close links with the many technical disciplines in which Carnegie Mellon University has a significant presence and strong international reputation. The Department currently has research groups in the following areas:

- Algebra and Number theory
- Analysis, Calculus of Variations, Partial Differential Equations, and Applications
- Combinatorics
- Computational Mathematics, Numerical Analysis, and Optimization
- Geometry
- Logic
- Mathematical Finance
- Probability

We have deep collaborations with the Tepper School of Business, the School of Computer Science, College of Engineering, and the Department of Philosophy and the Department of Statistics and Data Science.

At the same time, we utilize our expertise in applicable areas of mathematics and our interdisciplinary connections in the construction of a curriculum that gives excellent support to educational activities across the university and prepares mathematics majors for success in a wide range of careers both in academia and beyond. We offer a traditional undergraduate degree in Mathematics as well as a number of specialized concentrations and minors. Our doctoral programs are focused on training students whose interests are aligned with the research strengths of the faculty. The Department is also a key participant in Carnegie Mellon University's interdisciplinary Master of Science in Data Analytics for Science program.

The recruitment and retention of women and underrepresented minorities is a top priority for the Department. We will continue to analyze and adjust our current recruitment model to reach these student populations.

Prasad Tetali

Alexander M. Knaster Professor and Head of the Department of Mathematical Sciences

SECTION 2: Program Vision, Mission, and Values

CMU's mathematics doctoral programs are organized around the research strengths of the Department, including both longstanding and emerging strengths in areas such as algebra and number theory, combinatorics, geometry, logic, mathematical finance, numerical analysis, probability, pure and applied analysis, and topology. Our faculty and graduate students are not only producing original mathematics but also engaging in interdisciplinary research with a number of partners across the Carnegie Mellon campus.

The primary intent of our graduate program is to attract and train a diverse group of mathematical scientists for a variety of career opportunities. Our graduates pursue research and teaching careers in traditional university settings, conduct research in industrial and government laboratories, and work in the information technology and financial industries.

Our graduate program emphasizes basic mathematical training, with specific applications introduced later. At CMU, we provide the sort of individual attention larger institutions may not offer. The small student/faculty ratio promotes close contact between student and faculty and allows the faculty to assist students in pursuing their career goals.

SECTION 3: Graduate Admission

To be admitted to the Department's graduate program in mathematics, applicants must document competence equivalent to graduation from a recognized U.S. four-year college, university or institute of technology. Students who are finishing a B.S. or B.A. degree in the mathematical sciences (or in a program with a strong mathematics component) are eligible to be considered for admission. Applications should be complete by December 20th for full consideration for admission to begin graduate study in the Fall Semester. There is no application fee. A list of required application materials and the online application itself are available on the Department's <u>website</u>.

The doctoral program is a full-time commitment, and simultaneous enrollment in another academic program is not allowed.

3.1: Contact Information

For further information contact: Christine Gilchrist 412-268-7154 cgilchri@andrew.cmu.edu

The mailing address for the graduate program is:

Department of Mathematical Sciences (c/o Christine Gilchrist) Wean Hall 6113 Carnegie Mellon University Pittsburgh, PA 15213 USA

SECTION 4: Orientation

Students who are admitted to the Graduate Program in Mathematical Sciences are expected to attend certain orientation programs prior to the start of classes. The programs required will depend upon whether the student is an international student, whether the student's native language is English, and whether the student will be a Teaching Assistant during the first year. After accepting admission to Carnegie Mellon, students will be informed about the orientation programs that they will be expected to attend.

New graduate students will be contacted by a member of the Graduate Admissions Committee a couple of months before the start of their first semester at CMU. They will help with the transition to CMU and help with the selection of appropriate courses.

SECTION 5: Degrees Offered

5.1: Doctor of Philosophy in Mathematical Sciences

Students seeking a Ph.D. in Mathematical Sciences are expected to show a broad grasp of mathematics and demonstrate a genuine ability to do mathematical research. The Doctor of Philosophy in Mathematical Sciences is a traditional research degree, and its requirements are representative of all doctoral programs. After being admitted to graduate status by the Department, a student seeking a Ph.D. must be admitted to candidacy for this degree by fulfilling the appropriate program requirements. The most important requirement for the Ph.D. degree is timely completion and public defense of an original Ph.D. dissertation. The Ph.D. dissertation is expected to display depth and originality and be publishable by a refereed journal.

5.2: Doctor of Arts in Mathematical Sciences

The Doctor of Arts degree shares all requirements and standards with the Ph.D., except regarding the dissertation. The D.A. dissertation is not expected to display the sort of original research required for a Ph.D. dissertation, but rather to demonstrate an ability to organize, understand, and present mathematical ideas in a scholarly way, usually with sufficient innovation and worth to produce a publishable work. Whenever practical, the Department provides D.A. candidates with the opportunity to use materials developed to teach a course. While a typical Ph.D. recipient will seek a position that has a substantial research component, the D.A. recipient will usually seek a position where research is not central.

5.3: Doctor of Philosophy in Algorithms, Combinatorics, and Optimization (ACO)

This program is administered jointly by the Department of Mathematical Sciences, the Department of Computer Science, and the Tepper School of Business. It focuses on discrete mathematics and algorithmic issues arising in computer science and operations research, particularly the mathematical analysis of these issues. The participating units evaluate applicants separately. The requirements for this degree and information on participating faculty are available on the ACO <u>website</u>.

5.4: Doctor of Philosophy in Pure and Applied Logic (PAL)

This is an interdisciplinary program with faculty from the Department of Mathematical Sciences, the Department of Philosophy, and the School of Computer Science. The participating units evaluate applicants separately and set their own program requirements. Students who have been admitted to the PAL program, and who complete the requirements for the Ph.D. in Mathematical Sciences with a dissertation in the area of logic, can choose to receive either a Ph.D. in Pure and Applied Logic or a Ph.D. in Mathematical Sciences. The choice of which degree to receive is usually based on the intended career path.

SECTION 6: Doctoral Degree Requirements

The requirements for obtaining a doctoral degree are admission to doctoral candidacy (see Section 6.1), submission of a dissertation, its defense and acceptance by the Department (see Section 6.2) and fulfillment of the teaching requirement (see Section 6.3).

A student entering the doctoral program will be assigned an academic advisor, who will assist the student in meeting the requirements for admission to candidacy. Once the student has found a dissertation advisor, they will assume the role of the academic advisor.

A full-time student must be enrolled for at least 36 units each semester. To remain in the program a student must show sufficient progress. The progress of every student is reviewed by the Graduate Student Retention Committee. Students who are making satisfactory progress towards completion of their doctoral degree, and whose performance in teaching is satisfactory, can expect their support to continue for a total of five years. Support for a sixth year is decided on a case-by-case basis as described in Section 7.1 below.

6.1: Admission to Candidacy

There are three requirements for admission to candidacy:

- Passing a set of basic examinations (see Section 6.1.1)
- Fulfillment of course requirements (see Section 6.1.2)

• Passing the oral qualifying examination (see Section 6.1.3)

6.1.1: Basic Examinations

A student must take and pass four basic examinations from the following list. The set of examinations to be taken should be determined in consultation with the student's pre-advisor. Each examination is based on a corresponding graduate course whose number is given in parentheses.

- Algebra (21-610)
- Differential Equations (21-632)
- Discrete Mathematics (21-701)
- Functional Analysis (21-640)
- General Topology (21-651)
- Measure and Integration (21-720)
- Model Theory (21-603)
- Probabilistic Combinatorics (21-737)
- Probability (21-721)
- Set Theory (21-602)

Examinations are offered at the start of each semester. Each examination is three hours long. Typically a student would take the basic exam soon after taking the corresponding course and pass all four exams at the end of the first year of studies. A student should pass at least two basic examinations by the beginning of the second year of studies (this includes the examinations at the beginning of the second year). A student who has not passed two basic examinations by this time will be placed on academic probation (see Section 7.3). A student who does not pass **two exams by the beginning of their fourth semester** of studies will be supported for the fourth semester, but will generally not be retained in the program beyond that semester.

A student should pass four basic examinations by the beginning of the fourth semester of their studies (this includes the examinations at the beginning of the fourth semester). A student who has not passed four basic examinations by this time will be placed on academic probation (see Section 7.3). A student who does not pass **four exams by the beginning of their fifth semester** of studies will be supported for the fifth semester, but will generally not be retained in the program beyond that semester.

If a student fails a basic examination without having taken the appropriate graduate course which prepares for it, then the student is required to take the course before being allowed to take the basic examination again. The Basic Exam schedule will be posted on the Graduate Program webpage along with instructions for registration.

6.1.2: Course Requirements

Students are required to complete at least six additional courses (72 units) in mathematics, each with a grade of B- or better, beyond those covering their basic examinations. Typically, these are graduate courses in the Department, at level 700 or above. Other choices of courses with

advanced mathematical content may be made, inside or outside the Department, subject in all cases to approval by the Director of Graduate Studies or the Department Head.

If a student gets a grade of C+ or below in any of the courses required for their degree, the student may be placed on academic probation (see Section 7.3)

6.1.3: Qualifying Oral Examination

The primary purpose of this examination is to establish the breadth and depth of the student's knowledge in general areas related to the research area.

The format and content of the Qualifying Oral Examination is decided jointly by the student and the student's Doctoral Advisory Committee which also administers the examination. At least one month before the scheduled date of the examination a document describing its format and content will be submitted to the Department.

Every Doctoral Advisory Committee has at least three faculty members and is chaired by a faculty member chosen by the student. The chair must be chosen by the end of the student's fourth semester of graduate studies.

The format of the Qualifying Oral Examination varies according to subject area. It always contains material related to the area of the proposed dissertation, and it may include one or two minor topics deemed to be of interest or relevance. In exceptional cases the committee may choose to make part of the examination written rather than oral.

The examiners may choose to require the student to repeat all or part of the examination. An unsatisfactory performance on the second examination normally results in the student not being retained in the program.

A student in the Department of Mathematical Sciences is expected to have passed the Qualifying Oral Examination by the end of their fifth semester of graduate studies.

6.2: Dissertation Preparation and Requirements

6.2.1: Selecting a Dissertation Advisor

After admission to doctoral candidacy, a student must select a doctoral dissertation advisor. Acting as a pre-advisor is not a commitment to act as a doctoral dissertation advisor. The advisor/advisee relationship is long-term and not to be entered into casually by either party. It is important to establish a clear understanding of commitment from the start.

Usually, the dissertation advisor is a member of the Department of Mathematical Sciences at Carnegie Mellon. On occasion students are permitted to choose an advisor from outside the Department or even outside the University. However, when the dissertation advisor is not a regular

or research faculty member at Carnegie Mellon, the head of the Mathematical Sciences Department shall appoint, after consulting both the candidate and their dissertation advisor, a faculty member in the Department to serve as the candidate's departmental sponsor. It is the departmental sponsor's responsibility to monitor the candidate's work and to assist the candidate, the dissertation advisor, and the Department in assuring that all work conforms to the candidate's doctoral program.

In most cases, the dissertation advisor is the chair of the Doctoral Advisory Committee that administers the Qualifying Oral Examination.

6.2.2: The Doctoral Dissertation Committee

The Doctoral Dissertation Committee should be appointed no less than two months before the estimated date of the final examination. To permit an orderly performance of the committee's functions, it shall be the responsibility of the candidate to keep the committee informed about the progress of his or her work, from the time the committee is appointed to the time the dissertation is submitted. The committee may specify whether this should be done individually or collectively by formal or informal presentations.

The purpose of a Doctoral Dissertation Committee is to judge the validity, originality, significance, and proper presentation of the candidate's doctoral dissertation. To that end, the committee shall examine the dissertation submitted by the candidate, conduct the public oral final examination on the dissertation, prescribe corrections or revisions to the dissertation before or at the time of the examination, and certify to the dean its finding on the acceptability of the dissertation in its final form.

The Doctoral Dissertation Committee shall consist of no fewer than four members, and shall include the dissertation advisor, as well as the departmental sponsor if there is one.

At least half of the members of the committee shall be regular or research faculty members in the Department of Mathematical Sciences; one of these, who must be a regular faculty member with the rank of assistant professor or higher, shall chair the committee. If qualified under the preceding provision, the dissertation advisor will ordinarily chair the committee; the same is applicable to the departmental sponsor if there is one.

At least one member of the committee shall be a visitor, that is a person not affiliated with the Department nor with any Department participating in the candidate's dissertation research; the dissertation advisor may not serve as visitor. To be eligible to be a visitor, a person should be familiar with academic standards and procedures and be especially qualified to judge some aspect of the dissertation. A visitor may come from another Department at Carnegie Mellon University, from some other university, or from outside academic institutions altogether.

In the usual case that the dissertation advisor is a faculty member of the Department of Mathematical Sciences with the rank of assistant professor or higher, a four-person Doctoral Dissertation Committee comprises:

- Dissertation advisor (chair)
- Mathematical Sciences faculty member
- Visitor
- Faculty member or visitor

A vacancy on the Doctoral Dissertation Committee need only be filled if the remaining members would not constitute a valid committee. When a vacancy is filled, care shall be taken that the new committee member has the time and opportunity to participate effectively in the performance of the committee's functions.

The final examination may proceed only if the committee members present would, by themselves, constitute a valid dissertation committee according to the preceding provisions. A committee member is counted as present if he or she participates via a video-conference connection. A member of the committee who is unable to be present at the final examination may, if he or she wishes, submit a written recommendation.

When the dissertation advisor (and the departmental sponsor if there is one) is satisfied that the dissertation is ready, it shall be submitted to the committee. The final examination shall be scheduled to provide the committee with two weeks to study the dissertation between its submission and the date of the examination.

6.3: Teaching Requirements

All graduate students are required to perform the duties of a teaching assistant (TA) leading a recitation for at least one semester (or two mini courses) before receiving a doctoral degree. Students will benefit from the experience gained by explaining mathematical concepts in an efficient and understandable way and by responding to questions. The classroom performance of TAs is monitored by the departmental TA Supervisor. Students will receive feedback on their teaching performance based on comments received by students and supervising faculty, and on classroom observation by the TA Supervisor.

Students are expected to enroll in the course Teaching Mathematics (21-605) in their first semester of studies as preparation for leading recitations.

Graduate students are required to have a certain level of fluency in English before they can instruct in Pennsylvania, as required by the English Fluency in Higher Education Act of 1990. Through this Act, all institutions of higher education in the state are required to evaluate and certify the English fluency of all instructional personnel, including teaching assistants and interns. The full University policy can be reviewed <u>here</u>.

The fluency of all instructional personnel will be rated by Language Support in the Student Academic Success Center to determine at what level of responsibility the student can TA. In addition to administering the International Teaching Assistant (ITA) Test (a mandatory screening test for any non-native speaker of English), Language Support in the Student Academic Success Center helps teaching assistants who are non-native English speakers develop fluency and cultural understanding to teach successfully at Carnegie Mellon. Visit the <u>Student Academic Success</u> <u>Center</u> website for additional information.

6.4: Residency Requirements

The University requires Ph.D. students to have a minimum of one year in residency on a CMU campus.

6.5: Expected Timeline

In summary, the expected timeline for the Ph.D. Program in Mathematical Sciences is:

- Year 1: At least two Basic Examinations
- Year 2: All four Basic Examinations
- Year 3 (first semester): Qualifying Oral Examination
- Years 3-5: Dissertation research
- Year 5: Dissertation defense

Often, dissertation research begins in the first two years depending upon the preparation of the student and the area of research. Extending the timeline is possible, contingent upon a Research Review discussed in Section 7.2.

6.6: Required Units for Degree Attainment

Per the Course Requirements discussed in 6.1.2 above, Ph.D. students are required to take 72 units of advanced graduate mathematics courses. Typically, students will also take introductory courses in preparation for the Basic Examinations, although these are not always required.

To maintain full-time status, students are required to enroll in 36 units every semester. Many of these units come from Reading and Research (21-900) and Doctoral Thesis Research (21-902) courses, which do not fulfill the Course Requirements.

6.7: Graduate Courses

The Department of Mathematical Sciences maintains a list of graduate courses at: <u>https://www.cmu.edu/math/grad/courses.html</u>

6.8: Department Policy on Double Counting Courses

The Department of Mathematical Sciences permits double counting of courses for degree requirements in one instance: courses may simultaneously satisfy requirements for the Ph.D. in Mathematical Sciences and for the M.S. in Computational Finance / Mathematical Sciences / ACO (as discussed in Section 8). Courses may not be double counted for the Ph.D. and any other degree offered by any other department.

6.9: Department Policy for Courses Outside the Department/College

Courses outside the Department of Mathematical Sciences or even the Mellon College of Sciences may occasionally fulfill Course Requirements provided they contain significant mathematical content. This determination is made by the Director of Graduate Studies or the Department Head.

6.10: Protocol for Evaluation of Transfer Credit

Our program typically does not accept transfer credits for incoming first-year students, unless they are transfer students discussed below in Section 6.10.1.

Students wishing to receive transfer credit should submit the request by email to <u>Christine Gilchrist</u>. Such requests need to contain the following information: name of host institution, course syllabus, course description, semester offered, number of credits/units, CMU course equivalent (if applicable), and modality (in-person or online).

The transfer credit request will be reviewed by the Director of Graduate Studies. When reviewing the request, the following criteria will be considered: the host university's accreditation status, the course content, and the mathematical rigor. If the course is offered online, evidence of proctoring needs to be provided.

Transfer courses will be recorded on this transcript indicating where the course was taken, but without grades. Such courses will not be considered for academic actions, honors or QPA calculations.

Students must receive at least a B- in order to receive credit. Successful course completion is established via an official transcript from the host institution. The Department accepts transcripts via email or mail. Please direct them to:

Christine Gilchrist

Department of Mathematical Sciences Carnegie Mellon University 5000 Forbes Avenue Wean Hall 6119 Pittsburgh, PA 15213

6.10.1: Transfer Students

On occasion, students transfer into a Doctoral Program in the Department of Mathematical Sciences from another graduate program at CMU or from a graduate program at another university. In such cases, the Director of Graduate Studies and Department Head, in consultation with the Grad Admissions Committee and the Graduate Committee will decide what requirements the student must complete to obtain a doctoral degree. The student will receive a letter from the Department Head explaining these requirements

6.10.2: Cross-Registration

Carnegie Mellon University offers students the opportunity to take courses for credit through the Pittsburgh Council on Higher Education (<u>PCHE</u>). The Carnegie Mellon University transcript will include information on courses taken through the cross-registration program, will have grades recorded on the transcript, and will be factored into the QPA.

6.11: Internship/Co-op Requirements and Opportunities

Graduate students may obtain credit for doing an internship, typically in the summer. The internship must be directly related to the student's field of study. The internship must be overseen by a faculty member (typically the pre-advisor). International students must seek employment approval via the Office of International Education, which requires the <u>CPT Recommendation Form</u>.

6.12: Degree Certification

Carnegie Mellon graduate students are expected to complete their degree requirements within the standard length of time for their program of study as outlined in this handbook. Upon completion of the graduate program degree requirements, the degree will be certified by the MCS Dean's Office in the semester in which the student completes the requirements.

SECTION 7: Retention and Readmission

7.1: Graduate Retention Committee and Continuation of Financial Support

The purpose of the Graduate Retention Committee is to ensure that all graduate students are making appropriate progress towards the timely completion of a Doctoral Degree. This committee periodically reviews the progress of each graduate student and makes recommendations to the Department Head concerning readmission and continuation of financial support for each student. The Graduate Retention Committee considers course performance, performance on basic exams and oral qualifying exams, reports from research supervisors, and teaching performance. Students will be informed if the committee recommends for the support not to be continued as soon as possible after the meetings.

Students who are making satisfactory progress towards a doctoral degree and performing their teaching/research duties satisfactorily can expect to receive financial support from the Department for a total of five years of graduate study at CMU. Support for a sixth year is considered on a case-by-case basis.

The Graduate Retention Committee will often require a Research Review for students who have been admitted to candidacy. Research Reviews are mandatory for students who request financial support for a sixth year.

7.2: Research Reviews

As noted above the Graduate Retention Committee can require students to undergo a Research Review. The purpose of a Research Review is to provide the student with an opportunity give a presentation on their work to a committee of experts who can give feedback to the student, including an assessment of where the work stands relative to being sufficient for a dissertation. The committee will make recommendations to the student, the Director of Graduate Studies, and the Department Head. The committee for a Research Review is chosen by the Department Head and Director of Graduate Studies in consultation with the student. Much of the time, the committee for a Research Review will be the student's Doctoral Advisory Committee.

Students seeking financial support for a sixth year should consult their dissertation advisory and the Director of Graduate studies during the first semester of their fifth year to begin planning the required Research Review.

7.3: Academic Probation

If a student does not maintain adequate academic performance, he/she can be put on academic probation. Failure to maintain adequate academic performance can be indicated by poor grades, unsatisfactory performance on basic exams or oral qualifying exams, or unsatisfactory research progress. In this case, the student will meet with the Director of Graduate Studies to discuss the situation and will receive a letter from the Department Head stating a list of steps and a timeline for completion of these steps required to be removed from probation. If the student fails to successfully follow the requirements, the Graduate Retention Committee and Department Head will discuss the case and decide whether the student will be allowed to continue in the program.

SECTION 8: Master's Degrees

8.1: Master of Science in Computational Finance (MSCF)

This professional degree is offered jointly by the Department of Mathematical Sciences, the Tepper School of Business, the Department of Statistics, and the H. John Heinz III College. Admission is obtained through the Tepper School of Business. The program, which begins in August and concludes in December of the following year, includes courses in finance, computing, stochastic calculus, mathematical modeling for finance, and probability and statistics. More detailed information about this program is available on the Master of Science in Computational Finance website.

8.2: Master of Science in Mathematical Sciences

The Department does not offer an M.S. only program. Doctoral students may receive an M.S. degree as a milestone. To obtain an M.S. in Mathematical Sciences a student must successfully complete at least 96 units of graduate courses in Mathematical Sciences (600 level or above), at least which 48 of which are at the 700 level or above with a grade of B- or better in each. The courses must reflect a reasonable level of breadth in Mathematical Sciences. Graduate courses in other departments that have significant mathematical content can be applied towards the M.S. degree in Mathematical Sciences, with permission. The Director of Graduate Studies, in consultation with the Department Head, must approve the choice of courses used to fulfill the requirements for the M.S. degree.

Students who are interested in receiving an M.S. degree should contact <u>Christine Gilchrist</u> to indicate their intention to receive an M.S. degree, before or at the time when the degree requirements have been met. The degree will be certified at the end of the semester during which the degree requirements are met.

8.3: Master of Science in ACO

The Department does not offer an M.S. only program in ACO. Graduate students in the Department of Mathematical Sciences who are in the ACO Program can receive an M.S. degree in ACO by completing 96 units of course work from the 120 units of required courses for the Ph.D. in ACO with an average grade of B- of better.

Students who are interested in receiving an M.S. degree should contact <u>Christine Gilchrist</u> to indicate their intention to receive an M.S. degree, before or at the time when the degree requirements have been met. The degree will be certified at the end of the semester during which the degree requirements are met.

SECTION 9: All But Dissertation

All But Dissertation, ABD, status is intended for students whose only remaining requirements are the completion and defense of their dissertation. Once a student meets the departmental criteria, All But Dissertation status must be approved by the Department by submitting the appropriate form to <u>CMURegistrar@andrew.cmu.edu</u>.

CMU maintains a <u>policy</u> detailing All But Dissertation status for all doctoral students. Students are encouraged to review it for information about the time-to-degree limit, the distinction between *in residence* and *in absentia* status, and the impact on tuition and fees.

SECTION 10: Funding and Financial Support

10.1: Statement of Department Financial Support

Nearly all doctoral students receive financial support in the form of an assistantship (teaching or research) or fellowship. Teaching Assistantships typically involve an average workload of approximately 15 to 20 hours per week including classroom time, preparation, office hours, and grading. Such teaching experience is considered a valuable part of a student's graduate training, and leading recitation is a requirement for the doctoral program.

The hours required for an assistantship are such that the student may pursue a full-time graduate program. Assistantships provide full-tuition remission and a monthly stipend for the nine-month academic year. Ph.D. students serving as TAs or RAs are paid for 20 hours of work per week, which constitutes 100% of their allowed effort, and are thus not permitted to work additional hours.

10.2: Stipend

The monthly stipend for all graduate students in the Mellon College of Science is currently \$3000. This stipend is paid each of the nine months of the academic year.

10.3: Availability of Summer Employment

Additional financial support is usually available during the summer for students wishing to teach or participate in research projects. A few Departmental Fellowships may also be available in the summer. For more information, consult the Department Head or Director of Graduate Studies.

10.4: Departmental Fellowships

The Department of Mathematical Sciences offers fellowship support in various cases. Financially, this support is identical to assistantships as discussed above.

Ph.D. students in good academic standing and in All But Dissertation status receive one semester of fellowship support. Most students use this to assist with dissertation preparation or job applications. Request for this fellowship support should be made to the Director of Graduate studies in the first month of the preceding semester.

10.5: Department Policy on Outside Employment

Students are not allowed to hold outside employment of any type during any semester or summer session in which they receive support from the Department.

For additional clarification, students are encouraged to consult the Department Head

10.6: Health Insurance Requirement

CMU requires students to have medical insurance that meets University requirements each academic year. This can be accomplished either through enrolling in the CMU Student Health Insurance Plan (SHIP) or obtaining a SHIP waiver.

If you elect to enroll in SHIP, the University will cover 100% of the premium cost for your individual coverage under SHIP. Both the fee for SHIP and the departmental credit for SHIP will be applied to your student account in the summer preceding each academic year.

You will have the opportunity to purchase partner, spouse, or dependent coverage under the SHIP plan. But the University's support will be limited to 100% of the individual coverage amount.

Please note that if you wish to elect the required health insurance coverage under an alternate plan, you will not be eligible for the University support referenced here. Please also note that this credit is considered to be taxable income.

The HUB's <u>website</u> also has information specific to health insurance coverage and waivers for doctoral students.

10.7: Department Fees

The Department of Mathematical Sciences has no additional fees.

10.8: Travel and Conference Funding

Carnegie Mellon University, the Mellon College of Science, and the Department of Mathematical Sciences all offer support for graduate students to travel and attend conferences.

The University, through the <u>Office of Graduate and Postdoctoral Affairs</u>, offers <u>Conference Funding</u> and <u>Professional Engagement Funding</u>.

The Mellon College of Science offers MCS Graduate Student Conference Funding Awards.

The Department of Mathematical Sciences also offers support to offset travel and lodging expenses associated with conference attendance. This support is typically capped at \$1000. To apply, contact the Director of Graduate Studies in advance of the travel.

SECTION 11: Departmental Resources

11.1: Personnel

Curtis Meyer, Interim Dean, Mellon College of Science Email: <u>mcsdean@andrew.cmu.edu</u> Office: Mellon Institute 424 Phone: 412-268-8156

Dejan Slepčev, Professor MCS Associate Dean for Faculty and Graduate Affairs Email: <u>slepcev@math.cmu.edu</u> Office: Wean Hall 7123 Phone: 412-268-2562

Prasad Tetali, Alexander M. Knaster Professor Department Head Email: <u>dept.head@math.cmu.edu</u> Office: Wean Hall 6113 Phone: 412-268-2545

Jason Howell, Teaching Professor Associate Department Head Email: <u>howell4@andrew.cmu.edu</u> Office: Wean Hall 6219 Phone: 412-268-2545

Clinton Conley, Associate Professor Director of Graduate Studies Email: <u>clintonc@andrew.cmu.edu</u> Office: Wean Hall 7113 Phone: 412-268-2545

David Offner, Associate Teaching Professor Director of Undergraduate Studies Email: <u>doffner@andrew.cmu.edu</u> Office: Wean Hall 6117 Phone: 412-268-2545

Jeremy Avigad, Professor of Philosophy and Mathematical Sciences Director of the Charles C. Hoskinson Center for Formal Mathematics Email: <u>avigad@cmu.edu</u> Office: Baker Hall 135E Phone: 412-268-8149 Irene Fonseca, Kavčić-Moura University Professor of Mathematics Director of the Center for Nonlinear Analysis Email: <u>fonseca@andrew.cmu.edu</u> Office: Wean Hall 6212 Phone: 412-268-3615

Dmitry Kramkov, Mellon College of Science Professor of Mathematical Finance Director of Center for Computational Finance Email: <u>kramkov@andrew.cmu.edu</u> Office: Wean Hall 6126 Phone: 412-268-5912

David Handron, Associate Teaching Professor Director, BSCF Program (Interim) Email: <u>handron@andrew.cmu.edu</u> Office: Wean Hall 6214 Phone: 412-268-5583

Clive Newstead, Assistant Teaching Professor Teaching Assistant Supervisor Email: <u>cnewstead@cmu.edu</u> Office: Wean Hall 8128 Phone: 412-268-2545

Christine Gilchrist Academic Program Manager Email: <u>cgilchri@andrew.cmu.edu</u> Office: Wean Hall 6119 Phone: 412-268-7154

Jeff Moreci Business Manager Email: <u>morecij@andrew.cmu.edu</u> Office: Wean Hall 6111 Phone: 412-268-3859

Nuno Chagas MCS - Senior Systems Administrator Email: <u>nchagas@cmu.edu</u> Office: Wean Hall 8204 Phone: 412-268-3546 Florin Manolache Director of Scientific Computing for MCS Email: <u>florin@andrew.cmu.edu</u> Office: Wean Hall 6218 Phone: 412-268-8486

Erin Davis Administrative Supervisor Email: <u>eedavis@andrew.cmu.edu</u> Office: Wean Hall 6109 Phone: 412-268-2547

Tabbitha Gordon Administrative Coordinator Email: <u>tabbithg@andrew.cmu.edu</u> Office: Wean Hall 6113 Phone: 412-268-2545

Charles Harper Administrative Coordinator II Email: <u>charper1@andrew.cmu.edu</u> Office: Wean Hall 6101 Phone: 412-268-2545

Rachel Burress Project Coordinator Email: <u>rburress@andrew.cmu.edu</u> Office: Wean Hall 6113 Phone: 412-268-2546

Iulia Dumitriu Web Content Administrator Email: <u>dumitriu@andrew.cmu.edu</u> Office: Wean Hall 6113 Phone: 412-268-2546

A complete directory of faculty and staff is found at: <u>https://www.cmu.edu/math/people/index.html</u>

11.2: Computing Resources

The Mathematical Sciences computing support website can be found <u>here</u>.

There are three layers of computing facilities available to faculty and graduate students:

- 1. The Andrew computing environment maintained by CMU Computing Services offers:
 - Andrew Account
 - University licensed software downloads
 - <u>Network registration</u> of private and lab computers
 - A set of other facilities (e.g. spam filtering, web authoring, licensing). For support of Andrew services, please contact Computing Services at phone 412-268-HELP or email <u>it-help@cmu.edu</u>.
- 2. The <u>departmental computing environment</u> consists of a set of clusters, desktops, and printers maintained by the Department. Departmental support can be obtained by email at <u>help@math.cmu.edu</u>. An account is required to use most of the departmental facilities, and it may be obtained upon request from room 6108. The most important components of the departmental computing facilities are:
 - The cluster in room 6120; the computers qwe1 to qwe8.math.cmu.edu, belong to this cluster and offer easy access to:
 - Most scientific and office applications,
 - Printing and scanning.
 - A departmental email address username@math.cmu.edu which can be filtered and managed locally by the user
 - A personal website http://www.math.cmu.edu/~username/ showing the files in the public directory on the cluster.
 - A separate cluster containing the nodes fp80-fp87.math.cmu.edu that can be used for parallel programming and running scientific simulations. The node fpg1.math.cmu.edu can be used for GPU programming using CUDA. The node fp48.math.cmu.edu can be used for high memory jobs. Access to the parallel cluster is made via ssh using the departmental account.
 - Printing to the printers in the cluster room (code, heavycolor) and lounges at 7th (jet7) and 8th floors (jet8). Every printer is labeled with the printing queues and its network configuration. Typically, a printer is associated with three queues for printing single sided or duplex. These printers can also be used from office computers.
 - Computing education classes. Every spring semester, the Department offers the course <u>21-765</u>: Introduction to Parallel Computing and Scientific Computation.
- 3. Office and lab computers are typically serviced by the departmental support group as well. In certain cases, these computers use a private set of accounts, local to the group owning the computer. Access to these computers and printers is restricted to the group owning them or to the occupants of the office.