

Self-Study Document
Academic Program Review, 2018

Department of Applied Mathematics
College of Arts and Sciences

Degrees offered:

- Applied and Computational Mathematical Sciences (ACMS)
Undergraduate major jointly administered with 3 other departments,
- Applied Mathematics Minor,
- Master of Science in Applied Mathematics,
- Master of Science in Computational Finance and Risk Management (CFRM),
- PhD in Applied Mathematics.

Certificates offered (not included in this review):

- Certificate in Scientific Computing,
- Certificate in Computational Finance,
- Certificate in Quantitative Fundamentals of Computational Finance.

Year of last review: 2006

Chair of Department: Bernard Deconinck

Self-study coordinator: Randall LeVeque (Acting Chair Aut/Win quarters)

Date submitted: March 2, 2018

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1 Overview of Organization

The UW Department of Applied Mathematics (AMath) is one of the premier applied mathematics departments in the world. The department is consistently ranked in the top 5 nationwide, scoring especially high in metrics related to the research quality of the department (citations, grant funding, etc.). The latest (2010) National Research Council (NRC) rankings of applied mathematics PhD programs listed our department and Princeton's as tied for #1. The online Master's degree is ranked as "best online Master's degree in applied mathematics for value" by OnlineCollege.org. The Computational Finance and Risk Management (CFRM) program (started 6 years ago) is now ranked #11 on the [2017 QuantNet list](#), up from #14 three years ago. (See amath.washington.edu/our-awards for more about these and other awards.) While numerical rankings of this sort have limited meaning, they do indicate the high quality of research and educational programs in the department, and the respect that has been achieved. This is also reflected in the stellar quality of PhD students that we attract and the junior faculty who have been hired.

In the decade since the previous program review in 2006, the department has significantly broadened its research scope and impact (around campus and beyond), and introduced several new educational programs. We have moved from the fourth floor of Guggenheim Hall, space that was no longer adequate for the department, to Lewis Hall. This has allowed the department to stay together and provide office space for graduate students, helping us to maintain a vibrant and cohesive unit in spite of the diversity of application areas and mathematical approaches pursued by different groups.

1.1 Mission and organizational structure

1.1.1 Mission and goals

The core mission of the department is to apply, discover, and promote mathematics to model and solve practical problems in many disciplines, ranging from engineering and science to medicine and business. By nature our research is interdisciplinary. By exploiting the common underlying mathematical framework, we initiate the cross-fertilization of ideas and techniques from one discipline to another.

The department provides its PhD students opportunities for significant scholarly activities and original research. Through classes and individual faculty mentoring, our students learn to mathematically model and to develop combined analytical and computational techniques to solve problems. They learn to communicate, using the languages of mathematics and of their application disciplines, and to work with others to advance the frontiers of knowledge. They learn to respond to the mathematical needs of others by teaching, mentoring undergraduates and each other, working in industrial and government settings and on outreach projects in local schools.

Extensive Master's degree programs in both general applied mathematics and in financial mathematics have been developed that serve a variety of traditional and nontraditional students, both on campus and in online programs. Further, we continue to provide a core of undergraduate courses for students in the Applied and Computational Mathematical Sciences (ACMS) program, as well as undergraduate and graduate service courses in applied mathematics to students from many other departments. Our students graduate with the knowledge, the experience,

and the ability to be leaders in a society that has ever increasing demands for competence in communication, computation and mathematics.

The department has always placed an emphasis on applications, and from its inception many of the faculty have been closely aligned with a particular application area. Initially the focus was on fluid dynamics, particularly in the context of aeronautics, oceanography, and atmospheric sciences. Over the years the areas of expertise have greatly broadened, to include biochemistry, ecology, neuroscience, cancer modeling, and financial mathematics, among others. Other faculty focus more on methodologies (e.g. data science, nonlinear waves, numerical analysis, optimization, or stochastics) that have applications to many different fields, while remaining heavily involved in one or more applications. While mathematical rigor and beauty are appreciated by faculty and taught to students, the focus is on using mathematics to solve real problems, and on developing new mathematical models, theory, and methods that are required for applications.

1.1.2 Degree programs

Specifics of the department's degree programs are described in detail in Section 2. Here we give an overview of the evolution of our department into one that participates in a wide range of programs. Historically, the Department started as an inter-departmental graduate program in Applied Mathematics, with faculty having primary appointments in various departments (Aeronautics & Astronautics, Mathematics, Oceanography). When this program became a department in 1985, the initial focus continued to be on the education of PhD students, with a Master's degree program that served some PhD students in other departments. The MS was also a terminal degree for AMath students admitted to the program who did not pass the qualifying exams for PhD candidacy. A few upper division undergraduate courses were offered as service classes for other majors (AMath had no undergraduate major) and also for graduate students (in our department and many others) who lacked some undergraduate background.

Since then, the department has grown substantially and the degree offerings have been broadened in significant ways. Since 1995, more emphasis was placed on developing undergraduate programs, including the development of the ACMS major described below (jointly with three other departments).

Over the past 10 years, the Master's degree program has been clearly delineated from the PhD program. We now admit a very select set of students to the PhD program, who we are confident have the background and ability to pass the qualifying exam and complete a PhD. This past recruitment cycle (2017) 31 were admitted out of 285 applicants, of which 13 accepted our offer. In 2018, 24 were admitted out of 400 applicants and we hope 8–10 will accept. Many more applicants are offered admission to the Master's program and a surprising number of strong students accept in spite of the lack of committed financial support (30 in 2017). Some of these students apply for the PhD program the following year and typically a few are admitted, but the majority go on to PhD programs elsewhere or seek employment.

An online Master's degree program was started in 2007. The department already had significant experience with online teaching through our involvement in the EDGE program, dating back to the 1980s. The online Master's program currently has 75 students enrolled.

Another significant addition to offerings of the department came with the development of the CFRM program. This MS program was started in 2011 and has grown substantially, with both on-campus (32 students currently) and online (47 students) MS degrees. The CFRM program

grew out of a certificate originally developed in the Statistics Department by Prof. Doug Martin, who moved his position to AMath in 2012. Martin has retired but two new faculty have been hired in this area (Lorig in 2014 and Leung in 2016), and this is now a significant research area in AMath with PhD students and postdocs enriching the Master's degree programs.

In addition to these degrees, the department offers three certificates that we do not discuss in detail, in *Scientific Computing*, *Computational Finance*, and *Quantitative Fundamentals of Computational Finance*. These certificates generally require 3 specific courses and are earned by students in other programs or who have graduate nonmatriculated (GNM) status.

AMath faculty participate in a number of inter-departmental graduate programs, including [Computational Molecular Biology \(CMB\)](#), [Quantitative Ecology and Resource Management \(QERM\)](#), a professional [MS in Data Science](#), and [Neural Computation and Engineering](#) (graduate certificate, undergraduate minor, and NIH training program).

1.1.3 Staffing

Appendix A contains a list of faculty and staff, and a summary of the organizational structure, including staff and faculty committees. The webpage amath.washington.edu/people/faculty lists all faculty, including research and teaching associates, adjuncts, and affiliates.

The department currently consists of:

- Faculty: 4 Assistant Professors, 4 Associate Professors, and 8 Full Professors, totaling 14.5 FTEs (Three faculty are 50%, one at each level.)
- Staff: The departmental staff consists of 7 members: an Administrator, a Budget/Fiscal Analyst, an Office Assistant/Receptionist, two Graduate Program Advisors (1 for AMath programs, one for the CFRM program), a CFRM Program Operations Specialist, and a CFRM Career Services Manager.
- Teaching Associates: Dan Hanson is our sole Teaching Associate.
- Research Associates: There are currently 10 Research Associates (postdocs), who are supported to do research with one or more faculty mentors. Six are supported entirely on research grants, while another four are funded by the department to teach CFRM courses (three) or undergraduate AMath courses (one).
- Adjuncts and Affiliates: There are currently 13 adjunct faculty: UW faculty whose primary appointment is in another department but who are heavily involved in our department, e.g. by serving as primary advisor for a PhD student. In addition we have 13 affiliate faculty, who are not UW employees but have close connections to our department.
- Affiliate Instructors: There are currently 8 affiliate instructors, finance professionals who occasionally teach courses in the CFRM program.

1.1.4 Shared governance

The department has an Executive Committee (members listed in Appendix A) which acts as a sounding board for the Chair to discuss issues and decisions that require faculty input

but do not require full faculty discussion. This committee helps decide what issues should be considered more broadly and/or taken to a faculty meeting.

Monthly faculty meetings are held (typically on the first Tuesday) with agenda distributed in advance, with solicitation of additional agenda items welcomed. Major decisions are reached via discussion and voting.

The department usually holds an annual retreat (typically a half day or longer) where a few select topics are discussed in greater detail. For example, the main topic of the AY16-17 retreat was the restructuring of the PhD program requirements in view of a newly developed course sequence on probabilistic and stochastic methodologies. The AY17-18 retreat was used to discuss future directions for the department with respect to undergraduate education.

The PhD students elect a graduate student representative who attends faculty meetings and acts as a liaison between the graduate students and the faculty. A staff member attends the faculty meetings to take notes and provide staff input as needed. As necessary, an executive session of the faculty meeting takes place following the regular meeting, including only faculty of specific rank and higher, depending on the personnel issue under discussion.

1.2 Budget and resources

The department has various sources of funding to support its activities. The table and figures in Appendix B show expenditures broken down according to the source of funds using the following categories. The *General Operating Fund (GOF)* is the primary state budget that supports most tenure-track faculty salaries, and staff and TA positions. The *Designated Operating Funds (DOF)* includes *Research Cost Recovery (RCR)*, a portion of the indirect costs charged by the university on grants and contracts that is returned to the department, as well as startup funds for new faculty that come from the College or Provost. Our *fee-based programs* (the online AMath Master's degree and the CFRM MS degrees) support direct program costs and generate revenue beyond these costs that is used to support departmental expenses, additional staff, TAs, postdocs. *Grants and contracts* obtained by faculty help support grad students and postdocs, and provide some faculty salary as course buy-outs (and in summer). *Gifts and endowments* support endowed chair positions, graduate student fellowships, and various other activities, as specified by the donor agreement.

CFRM funding. All costs associated with offering the CFRM program are entirely covered by the program income. This includes the funding for one faculty position, three staff positions, a teaching associate, and three research associates. Surplus funds, after paying a percentage to the Provost and the College, are returned to the department, together with the surplus funds from the AMath online MS program, see next paragraph. Details are available in the appendices.

Fee-based revenue. Applied Math is doing well financially compared to many UW departments due to the success of our fee-based programs. Following the 2008–09 financial downturn this funding was particularly important in allowing us to continue supporting PhD students in spite of the loss of several TA positions from GOF support. The success of the fee-based programs has also allowed us to build up the research area of financial mathematics through new hiring (currently Leung's tenure line position is funded entirely on fee-based revenue, back-stopped by the College). Fee-based revenue has also been used to support, at least partially, a substantial number of postdoctoral researchers. This has allowed us to bring in many talented young researchers to work with faculty and help mentor graduate students. In addition, we provide them an opportunity to gain teaching experience while we are able to staff more classes

than would be possible otherwise. Thus we have been able to expand and thrive in spite of the fact that state support for the university declined significantly after 2008 and has not fully recovered.

As part of our expansion we outgrew the available space in Guggenheim Hall and in 2012 the department moved into Lewis Hall. This required significant renovation of the building, part of which was paid by the university, but the department also contributed substantially. Since moving we have invested additional funds in the building to address various problems (in particular a new roof) and to reconfigure office space to make it more usable. Capital investments to Lewis Hall paid for by the department have totalled more than \$500,000 over the past three biennia.

A portion of the fee-based revenue is used for faculty-determined research needs. Each faculty member is allocated a portion of the budget to direct towards their highest priorities. This can be used to help support graduate students as RAs, for postdoc support, for faculty or student travel to conferences, to organize workshops, to support visitors, etc. This gives faculty direct research benefit from the additional work they invest in our fee-based programs, allows supporting research assistants beyond what is available from grants, and has increased the number of visitors to the department. Faculty who request departmental funds (e.g. for long-term visitors or new initiatives) are usually asked to commit some of the funds they control to match the departmental contribution, ensuring there is faculty commitment.

TA funding. As class sizes have grown, the number of TAs needed each quarter has been increasing. However, the funds available for TAs provided by the College decreased following the 2008–09 financial crisis and have not recovered. Currently, the GOF funds not allocated to faculty or staff salaries fund no more than 12 TA-quarters per year. An additional 22 quarters of TA support are committed for AMath students by the Mathematics Department through a college agreement, since AMath students serve as TAs for different Mathematics Department service courses, such as its Calculus sequence. In recent years short-term Mathematics Department needs have increased this number to 24 or 25 quarters of TA support. This remains a reduction from the pre-2008 level of 27 quarters.

Additional TAs needed for AMath courses are paid by the department out of fee-based program revenue. Master’s students are often hired on an hourly basis to assist with grading. The tables and plots of Appendix B illustrate the departmental commitment to supporting graduate students and staffing classes.

Grants and contracts. AMath faculty bring in considerable grant funding. The grant expenditures shown in the tables and figures of Appendix B only show the portions of these grants spent directly through the AMath department, which have totalled roughly \$9M over the past 3 biennia. This is a small fraction of the total grant funding, over \$70M, generated in part by AMath faculty over this timeframe, as they are often involved in substantial grants joint with faculty in other departments. Some additional information on this is provided in Appendix B.

Gifts and endowments. The department has several endowments, listed in Appendix B. The endowment portfolio totals about \$1.6M. Different endowments are used for endowed professorships and student fellowships. The department continues to work with the College Development Office to explore new approaches to building up endowments and soliciting donations to the department. The recently redesigned departmental webpages have a prominent “Give now” button leading to a list of giving opportunities. Our endowments have benefited from generous

contributions from former and current faculty. On the other hand, the department suffers from a lack of undergraduate alumni who feel a close connection, due to the lack of a departmental major. We are working with the Development Office to better reach graduate alumni and others with a connection to the department. See also Section 5.3.

Outside funding of PhD students. In addition to TA and RA support coming directly from departmental sources or faculty grants, a number of PhD students are supported by other means. Some students find thesis advisors in other departments who provide funding on their own grants. Others have fellowship support through UW, for example ARCS fellowships. Still others obtain external fellowships. For example among our current PhD students we have 1 Ford Foundation Fellow, 1 DOE Computational Science Graduate Fellow, and 2 NSF fellows. Several others are supported by fellowships internal to UW, e.g., from GO-MAP, the data science IGERT, and computational neuroscience. PhD students are encouraged to apply for outside fellowships. Faculty mentoring and workshops are provided to help them develop proposals.

1.3 Academic unit diversity, recruiting, and outreach

We strive to make the AMath Department welcoming to all faculty, staff, students, and visitors, with welcoming signs posted near the front door and in the reception office. A diversity statement appears on our webpage and diversity resources on our own intranet pages.

Among the Department's 16 full and half-time current faculty members, two are women; three faculty are of Asian and one of Hispanic descent. In our last faculty search (2016), 4 of 8 candidates we interviewed were female. We successfully argued to the dean to allow us to make two offers; in the end both of these were extended to exceptional female candidates. One of these offers was accepted, adding to our ranks an outstanding junior faculty member in stochastic processes and mathematical biology (Bozic). We will continue our outreach efforts to ensure a large and exceptional pool of female and minority candidates in future searches. The staff come from diverse ethnic backgrounds, and currently four out of six are female.

Table 3 shows that our PhD student body has reasonable gender balance relative to programs elsewhere in the mathematical sciences. We pay attention to this in our recruiting and when offers are made. We also work with the Graduate Opportunities and Minority Achievement Program (GO-MAP) and try to identify minority students who are eligible for this scholarship. We have several PhD and CFRM students who were attracted with the help of GO-MAP scholarships. We have also used ARCS Foundation diversity scholarships to help attract high quality URM students. One current PhD student was an undergraduate at a Historically Black College and University (HBCU), and was attracted to UW in part with the help of an ARCS scholarship. We have established a relationship with Spelman and Morehouse Colleges in particular, with both the Chair and the CFRM Program Manager visiting these colleges, and a group of students and faculty coming to UW to meet with faculty and staff.

A recruiting poster is sent to many colleges with large minority enrollment, along with a letter to advisors encouraging them to send students our way. We seek diversity of economic background, and we point out in this letter that UW has an application fee waiver program for students who qualify, and offer additional help from our department for students who might not qualify for this waiver but for whom the application fee is a burden.

We participate in the National Name Exchange, a consortium of universities which annually collect and exchange the names of their talented and underrepresented ethnic minority students who are in their sophomore, junior or senior year of their undergraduate education. Our Master's

degree programs also attract a diverse set of students, as shown in the tables of Appendix D.

Starting in Academic year 2016-17, the Diversity Committee (consisting of 5 graduate students, one staff member and two faculty) has been re-energized and has taken on [new activities](#). The committee has applied for a seed grant to continue our efforts to send faculty and others on recruiting trips to historically black colleges and colleges with diverse student populations. This proposal was not funded but will be resubmitted in the future. The committee submitted a small grant to the NSF WATCH-US program, which was funded; this supports mentoring of undergraduate female mathematicians by our graduate students, and will lead to the establishment of [WAMM](#) (Women in Applied Math Mentorship Program).

Equally important, the committee has organized a range of in-house activities, to discuss racial and gender diversity within the department. Lunch-time discussions have been organized to focus on a number of issues, including women in the workplace, inclusive teaching, and the departmental political climate. A panel discussion of international students has also been organized. Staff members attend quarterly Graduate Diversity Committee (GDC) meetings and participate in training such as a recent UW workshop on undocumented ally training.

The committee and the department as a whole are advancing the position of Applied Mathematics in bridging a large and diverse student population into STEM careers. Our AMath and CFRM advisors often participate in graduate school information fairs, both at UW and at conferences and elsewhere, aimed in particular at recruiting more under-represented minorities and female applicants to our graduate programs.

There is a strong opportunity to use our department's outward looking style of mathematical science to present new, positive, and engaging views of mathematics as immediately applicable to problems of major social interest, from tsunami modeling to neurodegenerative disease. In tandem we can present the human side of the people behind the research. To meet this goal the department has committed at least one funded PhD student position per summer to instruct on applied mathematics topics in the [Math and Science Upward Bound Summer Institute](#) at UW; in 2017 Jacob Price served in this role. He brought in several faculty to give lectures alongside him.

Some other activities: Over the academic years our faculty have partnered with the PNW Louis Stokes Alliance for Minority Participation to bring more advanced students into our department to do research. Several graduate students have been involved in the [Making Connections](#) program on campus, which is a college-readiness program serving low-income high school students. As part of an [oncampus conference](#), Hidden Figures Math Consultant Prof. Rudy Horne (Morehouse College) presented a public lecture "Hidden Figures: Bringing Math, Physics, History and Race to Hollywood" to an enthusiastic audience of over 200 (during Summer Quarter!).

In future years our department will continue its leadership role on campus and beyond to promote diversity and to provide all with access and opportunity in the mathematical sciences. For example, we are considering joining [mathalliance.org](#).

2 Degree Programs, Teaching, and Learning

The following sections describe the AMath degree programs in more detail. Tables of enrollment figures, numbers graduated, and demographics can be found in Appendix D. More description of requirements for each graduate program can be found at [amath.washington.edu/programs-](#)

courses.

2.1 ACMS Major

At the undergraduate level, UW has no separate major in Applied Mathematics. Instead the department participates in the *Applied and Computational Mathematical Sciences (ACMS) Major*, which is administered jointly with the departments of Mathematics, Statistics, and Computer Science & Engineering. This major was established in 1997 and currently has approximately 160 majors enrolled (Winter Quarter 2018). The program graduated 70 students last year. Table 1 in Appendix D shows enrollment and graduation statistics for the past several years.

The major has a set of required courses for the program core (calculus, linear algebra, programming, statistics, modeling, etc.) followed by a set of requirements that vary depending on what program option the student selects. There are currently seven options to choose from: Biological and Life Sciences; Data Sciences and Statistics; Discrete Math and Algorithms; Engineering and Physical Sciences; Mathematical Economics; Scientific Computing and Numerical Analysis; Social and Behavioral Sciences. The requirements for each option and more details about the program can be found on the [ACMS Webpage](#)¹.

Two AMath faculty serve on the ACMS Steering Committee, along with representatives from other departments. Most advising for this degree program is handled by the ACMS / Mathematics Advisors.

The ACMS major has competitive admission and a limit of 200 students that was adopted in 1997. The limit was thought to be reasonable at the time because this program received (and still receives) no funding from the College, beyond some funding of the ACMS advisor (through the Mathematics Department). Release time for the Director is currently provided by the Director's department.

Admissions are decided upon twice a year by a subset of the Steering Committee in conjunction with the advising staff. Applied Math is spearheading the discussion on whether this limit should be increased, and what implications this would have for certain bottleneck courses. In the most recent round of admissions, a number of qualified students were not admitted due to the limit on the total number of majors and/or limits within some of the program Options due to potential bottlenecks. Greater flexibility in requirements for the ACMS major would allow us to serve more students.

Within AMath we have been considering whether to offer a separate major in Applied Mathematics to complement ACMS (the other participating departments all have individual majors). This is discussed further in our first unit-defined question (Section 5.1).

2.2 Applied Mathematics Minor

The department administers an undergraduate minor in Applied Mathematics. Completion of the minor requires at least 27 credits, including 15 credits of calculus and 4 AMath courses at the 300-level or higher. Tung serves as the faculty undergraduate advisor, and is available to discuss the minor with interested students. There are no departmental admission requirements for declaring a minor at UW, so our data on the number students who are minors comes primarily from graduation records, and is shown in Table 2.

¹<https://acms.washington.edu/>

The department recently proposed a new Minor in CFRM, which is currently under review. Undergraduates interested in CFRM can also complete the [Quantitative Fundamentals Certificate](#), which is based on undergraduate level courses.

2.3 On-campus MS in Applied Mathematics

The MS Degree program is designed to be completed in one intensive year of full time study, provided students have the required background coming in. The degree is based on coursework. A minimum of 9 numerically graded courses are required, and a minimum of 24 credit hours from the AMath curriculum. Some MS students choose to stay a second year in order to take more advanced courses, and many of these students are involved with faculty research projects, often writing a thesis. The Master's program includes PhD students from other departments who choose to do a concurrent MS degree in AMath. These students are included in Table 4 of Appendix D. Currently about 50% of these MS students are female, and the fraction is usually between 30–50%.

Most MS students are not funded by the department, but typically one or two very strong students are offered a funded position in the MS program and work as TAs. In addition, the department often hires one or two more each quarter when additional TAs are required, and another four MS students are typically funded each quarter as graders on an hourly basis.

2.4 Online MS in Applied Mathematics

The online program is administered through the UW Program on Continuing Education (PCE), recently renamed Continuum College². There are currently about 75 online MS students, see Table 5. The required courses are taught in special classrooms in Loew Hall where video is captured by PCE professional staff and made available on the web for online students to watch either live or later. The online students are thus taking the same classes with the same instructors as the on-campus students. Some classes (e.g. AMATH 501, 502, 503, AMath 584) are offered online every year, others (e.g. 585, 586) every other year. Most online students have full-time jobs and usually take one course each quarter, so it takes them 2–3 years to complete the degree. We take pride in the fact that the online students are getting an educational experience that matches that of the on-campus MS students as closely as possible. We believe this is one reason that our program has been so successful.

Although some online students live in the Seattle area, the majority of the online students live far from the Puget Sound. Many of these students come to UW for the first time for our departmental graduation ceremony, often bringing their families.

Admission to the online MS program is handled separately from the on-campus program. Similar standards are applied in terms of required background. Because many of these students have been out of college for several years or decades, it is often harder to judge their preparation.

In addition to providing for the department a source of revenue, the online program serves a broad clientele of students who greatly benefit from an MS degree in applied mathematics but are not able to pursue this through a full-time residential program. We have served a variety of very nontraditional students this way. For instance, one student was at a university in Iceland that did not offer applied mathematics (using our MS degree as a springboard, he earned a PhD in Math from the University of Minnesota), many students are active duty military personnel

²<https://www.continuum.uw.edu/>

deployed around the world, including one on a submarine, and one student was a prison inmate.

2.5 On-Campus MS in Computational Finance and Risk Management (CFRM)

The on-campus MS degree in Computational Finance and Risk Management (CFRM) is designed for students interested in pursuing full-time study on campus. The CFRM program offers rigorous and relevant instruction grounded in both theory and practice, and addresses the demand in the financial services industry for advanced quantitative finance competencies and next-generation risk management skills. The [CFRM advisory board](#), consisting of established finance professionals, gives advice on the curriculum and provides perspectives on career development, and helps with networking and job opportunities for our students. There are currently 60 students enrolled in the on-campus CFRM program, see Table 6. The degree requires 42 credits and typically takes students 15-18 months to complete, including a summer internship. The program offers professional development and career services for internships (during the summer) and permanent jobs (upon graduation), to all on-campus CFRM MS students. The on-campus CFRM MS program has maintained a very high job placement rate, with our latest record of 95% in 2017. The program is ranked #11 in the latest QuantNet ranking of all Financial Engineering/Mathematics Master's programs in North America. On top of that, CFRM students also enjoy one of the lowest tuition costs among all similar programs in North America. The on-campus CFRM program is fee-based, so opportunities for funding CFRM students through research or TA appointments are not common or expected. Typically 3–6 students each year are offered scholarships, including one scholarship dedicated to women in finance, to partially offset their fees as a recruiting tool to help increase diversity. The CFRM program also presents a number of awards to outstanding students that have achieved excellent academic performance or shown great potential as finance professionals at the end of the academic year. Similar to the on-campus MS program in Applied Math, the fraction of students who are female typically ranges between 30–60%, with exactly 50% this year.

2.6 Online MS in Computational Finance and Risk Management (CFRM)

The CFRM MS program also can also be attended part-time online. The curriculum and degree requirements for the online program are the same as those for the on-campus program. Like the online AMath program, the online CFRM program is administered through Continuum College. All CFRM core courses and most elective courses are taught in special classrooms in Loew Hall with video capture, while one or two electives are recorded completely off-campus by the instructors, who are typically industry affiliates from other states or countries. All lecture videos are organized and made available on a web portal for online students to watch. In most cases, on-campus students also have access to the same lecture videos. There are currently about 47 enrolled online MS students, see Table 7. Since online students take the online MS-CFRM program part-time, they typically spread out the course loads over 2-4 years to complete the degree. While most on-campus students do not take summer courses due to internships, many online students take CFRM (elective) courses, such as CFRM 580 Energy Markets and CFRM 523 Advanced Trading Systems, over the summer. Most online students have full-time jobs, but students still have access to CFRM career services if needed.

2.7 PhD program

The PhD program remains a core component of the department and all faculty are actively engaged in advising PhD students. These students are involved in joint research with faculty, while serving as the primary source for teaching assistants. There are currently 53 PhD students in the department. Table 3 of Appendix D shows statistics for the number of applicants/admits and for the number enrolled and graduating each year.

Note that over the seven academic years shown in Table 3, the number of enrolled students has grown slowly from 42 to 53 while at least 49 students have graduated. We had low attrition over this period, with only 5 students leaving the PhD program without completing the degree. This is evidence that our admission process is working well. Students are successful in the program and motivated to complete the degree.

The time-to-degree for PhD students is in keeping with other programs in the mathematical sciences. Of the 31 students who graduated between 2013 and 2017, 16 students graduated in 5 years and the remaining were longer, and most completed the degree within 6 years as active students. The mean time-to-degree for these students was 5.85 years, but this is somewhat skewed by some students who took a leave of absence for some period. For students who started the program as a MS student and then moved into the PhD program, this calculation includes their year in the master's program.

Among our PhD students, 24–30% have been female each year, and the number of International students has been 30–45%, although many of these did their undergraduate work at a US institution. Both of these percentages are in line with the demographics of recent doctoral recipients in applied mathematics, according to the AMS Annual Survey of the Mathematical Sciences³. The international students come from a variety of different countries; this academic year we have PhD students from China, India, Korea, Mexico, Romania, Russia, and Taiwan.

The following is required of PhD students:

- Taking 2 of the following 3 sequences within their first year: AMath 561, 562, 563; AMath 567, 568, 569; AMath 581 or 584, and 585, 586.
- Two reading courses with two different faculty, within their first 5 quarters. This exposes them to faculty research areas.
- At least 9 courses from the AMath curriculum.
- A qualifying exam, taken before the autumn of their second year, with one retake possible in December. This consists of three exams of three hours each, spread over several days. The written exams focus respectively on the materials in the sequences 567, 568, 569 (Mathematical Methods), 561, 562, 563 (probability and statistics), and 581/584, 585, 586 (numerical methods). A student chooses to sit for two out of the three exams. The final day is an oral examination with the Examination Committee.
- The general exam, administered by the student's Supervisory Committee. This consists of a written thesis proposal, public oral proposal (30 minute talk) followed by a rigorous oral examination (not open to the public) where the committee verifies that the student is ready to undertake the proposed work.

³<http://www.ams.org/profession/data/annual-survey/phds-awarded>

- Submission of a thesis and an oral thesis defense, consisting of a public talk (45 minutes) and an oral examination with the committee.

2.7.1 Recruiting and support

In Section 1.3 we discuss particular efforts to recruit for diversity. More generally, we take recruiting seriously and strive to identify and attract the students who are the best fit for the department. The Director of Graduate Admissions (currently Professor Emerita Adams) does an initial triage of applicants (400 this year) and sends about 80 files around to other faculty. Each file is seen by at least two other faculty. Discussion with the GPC and Chair result in the selection of 25–35 candidates to whom PhD offers are made. Those who receive offers are assigned to both a faculty member and a current graduate student, who contact the prospective student to answer their questions and encourage them to come. In early April, prospective students attend an open house to explore the department and meet faculty, current students, and their potential colleagues. They have the opportunity to attend a class and go on a Saturday hike.

PhD student admission is not tied to individual faculty. Some students arrive knowing who they want to work with, but many do not. It is also not tied to faculty grant support. All admitted PhD students are guaranteed 5 years of support (including summers) provided they make suitable progress. Most first-year PhD students are supported as TAs, many of them as calculus TAs for the Mathematics Department. Many students are eventually supported by their advisors on grants, at least part of the year. All first year students are expected to apply for fellowships if they do not already have one. Appendix B shows breakdowns of student support within our budgets.

2.7.2 Data Science option

In AY2016-17 AMath started offering the [Advanced Data Science Option](#)⁴ for PhD students. This is part of a campus-wide effort (coordinated by the [eScience Institute](#)) to create a coherent and unified curriculum among the many departments where data science is relevant. Three out of four core courses are required (in data management, machine learning, data visualization, and statistics).

2.8 Student credit hours taught

The number of student credit hours taught has gone up substantially in the past 10 years, nearly tripling from about 6,000 in 2007–08 to almost 18,000 in 2016-17. Figure 1 shows a plot of the trends. Note that over this same period the number of TA positions funded by UW in this department has decreased. Class sizes have significantly increased for some courses, and we have also increasingly used online sections, flipped courses, and other innovative strategies to deal with the growing number of students in our classes. We are proud to say that student evaluations of AMath classes have not gone down over this period and students generally seem pleased with the attention they receive from instructors and TAs.

2.9 Innovative teaching

The AMath Department has always been an early adoptor for innovation in teaching, in a field which is by nature rapidly evolving.

⁴<http://escience.washington.edu/education/phd/advanced-phd-data-science-option>

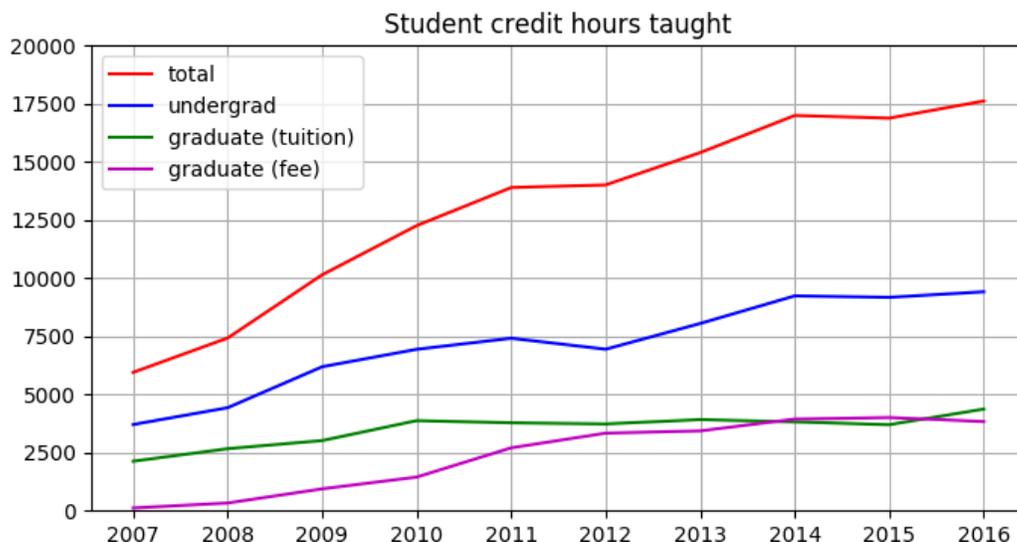


Figure 1: Student credit hours taught by the department.

Curriculum changes. Over the years the curriculum has evolved substantially. It continues to be revised nearly every year. For example, this year a new sequence AMath 561-2-3 was introduced on probability and stochastic processes, addressing the substantial growth in research interest among faculty and students in stochastic (as opposed to deterministic) modeling. This sequence was designed by a committee of faculty and adopted as part of the core set of courses for PhD students, and was accompanied by a revision of the requirements for the PhDs to that stochastic modeling can be part of these.

The mathematical biology curriculum has been revamped and reorganized, leading to an innovative 5-course advanced graduate sequence in mathematical ecology, cell biology, and neuroscience (AMATH 530's), and the new course AMath 536, Mathematical Modeling of Cancer, being introduced this year by Bozic. Teaching in data science and scientific computing has also undergone expansion and innovation, including AMATH 482/582: Computational Methods for Data Science, and AMATH 483/583: High Performance Scientific Computing. The course AMath 574 on Hyperbolic PDEs and Finite Volume Methods will be removed from the course offerings with LeVeque's retirement.

At the undergraduate level, courses have evolved to meet changing needs and we teach far more student credit hours than 10 years ago, as discussed in Section 2.8. Examples include the new interdisciplinary course AMATH 342, Introduction to Neural Coding and Computation, and the success and growth of AMath 383, Continuous Modeling, and AMath 301, Introduction to Scientific Computation, which now enrolls more than 1,000 students annually. The CFRM program has led to the introduction of many new courses on mathematical finance⁵. These range in topic from CFRM 410: Probability and Statistics for Computational Finance, to CFRM 415: Introduction to Financial Markets.

Books and lecture notes. Many of the founding members of the department wrote books that became standard texts in applied mathematics. This tradition has continued, with a large

⁵<http://depts.washington.edu/compfin/courses/>

number of textbooks and advanced reference books produced by our faculty over the years. At least 16 books have been written by current faculty and many more by former faculty⁶. The topics of these books has evolved over the years but a common theme is that they cover hot topics in applied mathematics, and many are developed in the process of teaching new AMath courses for which no good text exists. Many faculty continue to write their own class notes, which are often publicly available and used elsewhere.

Online teaching: Our department has been involved in teaching courses online since the beginning of the EDGE program in the 1980s, when some courses were transmitted to Boeing, broadcast live on cable TV, and/or recorded on video cassette tapes that were couriered to the students. With the advent of high-speed internet and technology, many of our courses are now streamed live, and archived for students to watch at their convenience, after work or on weekends. The videos are available to on-campus students as well. They often use them to review the material or re-watch lectures.

Producing Massive Open Online Courses (MOOCs): In 2013, UW partnered with Coursera, with three AMath courses among the initial offerings — Scientific Computing and Computational Methods for Data Analysis (AMath 581-2) by Kutz and Introduction to High Performance Scientific Computing (AMath 583) by LeVeque. Two additional CFRM courses were also included — Probability and Statistics for Computational Finance taught by former Instructor Kjell Konis, and Introduction to Computational Finance and Financial Econometrics, taught by then Adjunct Professor Eric Zivot, the Robert Richards Professor of Economics.

Flipping classes: In 2014 LeVeque used the 583 course materials produced the previous year to experiment with flipping the class. He was one of the first UW faculty to use the new Active Learning Classrooms in Odegaard Library for this. Bretherton taught AMath 568 as a flipped course in 2016. At the undergraduate level, in Autumn 2013, Kutz and postdoc Steve Brunton (now an Assistant Professor of Mechanical Engineering with adjunct appointment in AMath) pre-recorded a set of lectures for AMath 301, the undergraduate Beginning Scientific Computing course. These lectures continue to be used. The students are asked to watch the video lectures before coming to class. This allows the class time to be devoted to answering questions and providing hands-on coaching of programming. Some of the lecture hours are divided into smaller sections that do not need a large classroom. Flipping this class has also allowed the department to teach considerably more students (over 300 each quarter) than would otherwise be possible. Kutz has converted a storage room in Lewis Hall into a mini studio with lecture capture capabilities for producing new lecture materials. Other faculty use the UW-supported Panopto video capture capabilities on laptops while lecturing.

Automated homework grading: Another innovation that has allowed teaching more students in classes that involve programming assignments is the use of software for automatically grading a portion of the student work. In particular the Scorelator software developed by Kutz and others has been heavily used for many years in AMath 301. Other classes have used scripts (e.g. in Python) to automatically test programs that are submitted.

We continue exploring ways that we can teach better and more efficiently. For example, this Spring one of our Boeing Distinguished Colloquia will be given by Nobel laureate Carl Wieman, aimed at the entire campus science community, to discuss his [Science Education Initiative](#).

⁶<https://amath.washington.edu/research/faculty-books>

2.10 Teaching and mentoring outside the classroom

All faculty are actively involved in advising our 53 PhD students. In addition, many faculty are actively involved in mentoring and/or collaborating with PhD students in other departments.

Many faculty hold weekly group meetings with their undergraduate and graduate research students and postdocs, some of them joint with other faculty in the department or beyond. There are several journal clubs that meet weekly and have faculty/postdoc participation along with graduate students.

All incoming PhD students are required to participate in two reading courses with faculty in the department by Autumn Quarter of their second year. The goal is to introduce new students to some of the research going on in the department and to encourage them to connect with faculty and explore areas of potential interest at the same time that they are taking the required courses and preparing for qualifying exams.

2.11 Graduate student life

Graduate education is a significant component of the department's mission and graduate students play a large role in both the educational and research aspects of the department. We try to create an open and friendly environment where students can thrive as valued members of the community. All 53 PhD students have their own desk (in shared offices). There is insufficient space for all MS students to have a desk, but there is a large open space in Lewis 103 with several tables for these students to work and to congregate. In addition, the lounge/library on the third floor has several tables that are used throughout the day (and evening) by students. There are also several collaborative spaces / conference rooms that students have access to. There is a small computer lab that has some workstations in addition to servers, but most students primarily work on laptops. Each first-year PhD student is awarded a \$1500 stipend for computing equipment or supplies.

The SIAM student chapter [SIAMUW](#) is quite active, with regular [weekly seminars](#) organized by the members, including tutorials on various topics and panel discussions of fellowships, internships, and teaching, and on tools not taught in classes (Matlab, Mathematica, Jupyter notebooks, generating figures, designing a poster, etc.). Several panels and discussions are focused on helping new students adjust to the department and to being a graduate student and on topics such as imposter syndrome. In weeks when there is a [Boeing Distinguished Colloquium](#) speaker in town, they spend an hour meeting with the speaker and have an opportunity to informally discuss research and other topics. Although SIAMUW leadership often consists of PhD students, this group is open to all students and currently the Vice President is an MS student, for example.

In recent years, SIAMUW has organized a poster competition to select a member to send to the SIAM Annual meeting to represent our chapter. This year SIAMUW was chosen by SIAM as one of only 12 students chapters (out of 178) selected to send a representative to participate in Student Days and present a research talk in a special symposium, in addition to representing UW in the *Chapter Meeting with SIAM Leadership breakfast*. SIAMUW organized a separate competition to select this representative, in addition to using their own funds to award travel support to two [winners of the poster session](#). SIAMUW receives some funds from SIAM each year, but has also organized [fund-raising \(half\) marathons](#) to increase their resources, raising more than \$6000 last year.

Among several other activities, SIAMUW organizes a [Math Fair](#) at least once a year at Seattle-area elementary schools, to engage in day-long activities related to applied mathematics. This fair originated more than 15 years ago when the department was involved in NSF GK-12 and VIGRE grants, but the graduate students have kept it going on their own, passed down by now through several generations of students. This year a second fair was organized in connection with local Girl Scout troops, which may also become an annual tradition.

This year SIAMUW also helped to organize the first-ever [BIG Math Networking and Information Session](#), discussed further in Section 5.3.

Beyond SIAMUW, many students actively participate in weekly [journal clubs](#) and often take the leadership role in organizing these meetings and selecting topics of discussion. Graduate students routinely participate in research group meetings and other group activities with postdocs and faculty. Most journal clubs are focused on research areas, such as Mathematical Biology, Mathematical Ecology, Mathematical Finance, Mathematical Methods, and Numerical Analysis. Recently a new reading group was also formed by the students on pedagogy and teaching.

First-year PhD students receive a summer stipend and are encouraged to get involved in research groups, but also spend much of their first summer reviewing material in preparation for the qualifying exam in September, and generally organize group study sessions and review sessions by faculty.

We believe that our current PhD students enjoy being here and as such we have them play a critical role in recruiting new students by writing to applicants who have been admitted in their research area to answer any questions they might have, and by hosting visiting students during our recruitment weekend in April. Further, the student panel discussion has been an integral part of both recruiting weekend and autumn orientation.

At the end of their journey, the department hosts a graduation ceremony on the morning of Commencement (a Saturday in June) for all MS degree students (including CFRM) and PhDs. This is well attended by faculty and many families (around 200 attendees last spring). All graduating students are acknowledged, and new PhDs are hooded by their advisors. A number of awards are also given to continuing students at this ceremony for outstanding achievements (the SIAMUW Award, the Joseph Hammack & Tung Family Endowment Awards, and three separate Boeing Awards for Research, Teaching, and Service). Several awards are also given specifically to CFRM students (the Professional Excellence Award, Academic Achievement Award, Peer Leadership Award, and Outstanding Woman in Finance Award). Since many CFRM students graduate in the fall, an additional CFRM celebration dinner is held then.

3 Scholarly Impact

3.1 Research activities

Our department has always had a strong emphasis on real applications and interdisciplinary research, and on the education of PhD students. This is still reflected in the culture and values of the department today, even as it has evolved substantially to keep up with the changing nature of leading-edge research in applied mathematics and its application areas. Originally the program was heavily focused on classical fluid mechanics, asymptotic analysis, and perturbation theory. More recently the department has developed significant strength in other techniques, including numerical analysis and scientific computing, stochastic methods, optimization, and data science,

for example. Application areas have expanded to include atmospheric sciences, mathematical biology (including ecology, biophysics, neuroscience, and cancer modeling), nonlinear waves, tsunami modeling, and many others.

The department remains highly interdisciplinary and benefits from the collaborative culture at UW. As noted by the Graduate School, Applied Mathematics has been ranked nationally as "in the top five of similar programs for the number of faculty citations in publications and the percentage of interdisciplinary faculty on their staffs".

Three faculty have joint appointments with other departments (Bretherton with Atmospheric Sciences, Todorov with CSE, Shlizerman with EE) and many other faculty have adjunct positions in at least one other department (including Atmospheric Sciences, Bioengineering, Earth and Space Sciences, Electrical Engineering, Mathematics, and Physics). Many faculty are associated with other institutes or centers on campus (including the [eScience Institute](#), the Quantitative Ecology and Resource Management ([QERM](#)) interdisciplinary graduate program, the [Computational Neuroscience Center](#), the [Program on Climate Change](#), the [Northwest Institute for Advanced Computing](#)), and in additional projects with collaborators across campus, often funded by grants with PIs from several departments. We provide some highlights of these interdisciplinary efforts in the paragraphs below. More details about the faculty are included in Appendix C, including 1-page CVs with a brief overview of their research interests, background, and significant awards.

3.2 Faculty research areas

Atmospheric Sciences and Climate. The fluid envelope of our planet consists of the atmosphere and the oceans. Weather affects the inhabitants in the short time scale, climate over the long time scale. Our research includes developing tools for analyzing the high-dimensional weather and climate data and building coupled radiative-microphysical-dynamical models for studying the interaction of atmospheric turbulence and cloud systems. Some current topics of research include studying the effect of chaos on weather prediction, understanding how clouds will respond to and feedback on global warming, and answering why the global warming sometimes slowed for a couple decades and then accelerated, focusing on the role of oceans and its circulation in sequestering the heat from anthropogenic forcing; the phenomenon of El Nino and its newly discovered kin, Modoki, and some of the large-scale climate variability such as the Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation. We actively collaborate with scientists in the Atmospheric Science, Oceanography, and Geophysics department, and train students in the emerging interdisciplinary area of earth system modeling, in addition to providing a traditional education in classical fluid dynamics. Active members are Bretherton, Tung and adjunct Durran.

Computational Neuroscience. Understanding the brain poses extraordinarily challenges for applied mathematics. Our goals are both to define the algorithms that underlie complex, goal-driven natural signal processing and behavior, and to explain mechanistically how these algorithms are implemented through the dynamics of neural circuits. This requires bringing together tools from stochastic processes, optimization, machine learning, and dynamical systems in new ways. Kutz, Shea-Brown, Shlizerman, and Todorov are active at the interfaces of these fields, and the explosion of new types of high-resolution neuroscience data. Our department has been highly active in the formation of the new UW Computational Neuroscience Center to unify and support efforts in this area across campus. Adjuncts and affiliates active in this area

include B. Brunton, Fairhall, Buice, and Mihalas. Research associates include Choi, Gutierrez, and Stern.

Data Driven Modeling and Optimization. The emergence of big data and machine learning methods for the sciences in the last decade has been enabled by the plummeting costs of sensors, computational power, and data storage. Such vast quantities of data afford us new opportunities for data-driven discovery, which has been referred to as the 4th paradigm of science. Data-driven modeling is not at all foreign to applied mathematics; historically two of the greatest achievements in physics were Kepler's law and Wien's displacement law, which inspired Newtonian mechanics and quantum physics. The paradigm shift comes from the quantity of data and its associated computations, and its potential role in the analysis and understanding of dynamical systems in science and engineering. Data are abundant, while precise mechanistic laws in terms of governing equations and realistic parameters remain elusive, as is true for problems in climate science, finance, epidemiology, and neuroscience. Even in classical fields, such as optics and turbulence, where governing systems do exist, researchers are increasingly turning toward statistical descriptions and data-driven analysis. Machine learning methodology fundamentally revolves around optimization. This includes regression and model selection frameworks which aim to provide parsimonious and interpretable models for data. Aravkin, Kutz, Shea-Brown, Shlizerman, Todorov are active at the interface of these fields, bringing state-of-the-art machine learning and optimization to models in the engineering, physical and biological sciences. Adjuncts and affiliates active in this area include S. Brunton, Burke, Dennis, and Proctor. Research associates include Askham, Erichson, and Lusch.

Dynamical Systems Theory and Its Applications. Nonlinear dynamics as a mathematical representation of the Natural World is arguably the oldest branch of applied mathematics, since Isaac Newton first used differential equations in celestial mechanics. Since the 1970s, a qualitative, global, geometric approach to understanding the solution behavior has complemented the more traditional approaches. The department has Deconinck, Kutz, Qian, Shea-Brown, and Shlizerman all working in this area. Dynamics with stochastic components has become the focus of Qian and Shea-Brown. This development couples nicely with the demands on applied probability and statistics from data science. Nonlinear stochastic dynamics as an applied mathematics subject, taught differently from the standard approach in a statistics department, has both stochastic processes and random dynamical systems; these parallel the differential equation dynamical systems approach to classical dynamics.

Financial Mathematics. Financial Mathematics is a multidisciplinary field involving finance, statistics, stochastic modeling, numerical methods, as well as other tools from mathematics and the practice of programming. Among AMath faculty, Leung develops analytical methodologies and numerical methods for derivatives pricing, algorithmic trading and index tracking. Lorig's research focuses on developing computational methods, including efficient polynomial and multiscale expansions, for pricing and hedging under different classes of stochastic models. Aravkin designs machine learning algorithms for financial applications and has taught a CFRM course called Machine Learning for Finance. Martin (Professor Emeritus and former CFRM director) has worked on statistical finance and portfolio optimization. Adjuncts and research associates active in this area include Pal, Angoshtari, Donnelly, and Ugurlu. An additional research associate, Patricia Ning, has recently been hired and will arrive in September.

Mathematical Biology. From single cells to organisms to ecology. In contrast to mechanics, which studies motions of particles, biological systems consist of populations of individuals. The basic equations for biochemical kinetics inside a single cell, cancer cells in tumor tissue, and animals in an ecological niche, are all concerned with population dynamics. Bozic focuses on the dynamics of cancer mutations and their impact on tumor progression; Kot uses integro-difference equations to study ecological dynamics in space and time, and Qian works on intracellular regulations that leads to a wide range of cellular phenomena such as chemotaxis, phenotype switching, and differentiation. Adjuncts and affiliates active in this area include Halloran, Lewis, Leubeck, and Moolgavkar.

Nonlinear Waves. The incorporation of nonlinear effects in wave dynamics allows for the explanation of phenomena in fluids, optics, Bose-Einstein condensation, etc. Deconinck, Kutz, and LeVeque explore different aspects of nonlinear waves using different methods. Deconinck employs both analytical and numerical techniques from soliton theory and dynamical systems to investigate solutions and their stability, mostly in water wave problems. Kutz uses reduced-order modeling and data methods to examine phenomena in optics, neuroscience and other areas. LeVeque works on theoretical and numerical aspects of nonlinear hyperbolic conservation laws, with applications to geophysics, shock-wave therapy and layered media. Adjuncts, affiliates, and research associates active in this area include Brush, Gin, and Riley.

Numerical Analysis and Scientific Computing. Numerical simulation is pervasive in applications areas, from physics and engineering to biology and finance. The faculty who primarily focus on the development and analysis of numerical methods are Greenbaum, Hetmaniuk, and LeVeque. Greenbaum works on numerical linear algebra, a fundamental building block for scientific computing since many mathematical problems (including the solution of nonlinear PDEs, for example) are reduced to large linear systems of equations when discretized. Numerical linear algebra is also essential for many algorithms arising in data science. Hetmaniuk works on finite element methods for PDEs in heterogeneous materials and reduced-order methods and applications. LeVeque develops numerical methods for solving hyperbolic PDEs arising in wave propagation problems. He started the open source [Clawpack software](#) (Conservation Laws Package) in 1994, which is still actively developed today, while being used worldwide to model tsunamis and for other applications. Adams also continues to work in this area as Professor Emerita since 2016. Adjuncts and affiliates active in this area include Dumitriu, Durran, de Boor, Ghate, and Nazareth.

3.3 Faculty impact and excellence

As noted in the introduction, the department is very highly ranked in the latest NRC listings of applied mathematics programs, as well as in other rankings⁷. The current and emeritus faculty includes four fellows of SIAM (and one past president), 2 of the American Mathematical Society, 2 of the American Meteorological Society, and one fellow each of the American Geophysical Union and of the American Physical Society. Faculty have won a number of other awards and fellowships, including 2 presidential Young Investigator Awards, 2 NSF CAREER Awards, 2 Humboldt Foundation Awards, a Sloan Fellowship and a Burroughs Wellcome Career award, and the 2015 SIAM Activity Group on Financial Mathematics and Engineering Early Career Prize. More faculty awards can be found in the 1-page CVs collected in Section C. Fac-

⁷<https://amath.washington.edu/our-awards>

ulty have also played founding roles in new research centers from data science to neuroscience, and have authored more than a dozen books while producing innovations in education and research with global impact, including through new online teaching and open source code and curricula.

3.4 Student research and impact

Our alumni student researchers continue to make us very proud. Many become first-rate researchers already during their graduate career, and often they make significant contributions to advancing science and tackling societal needs long after leaving UW. A list of recent PhD graduates (with advisors and links to theses) is found at amath.washington.edu/alumni-index.

A few examples from the past ten years: **David Ketcheson** (PhD 2009) was supported as a graduate student by a DOE Computational Science Graduate Fellowship. Upon graduation he turned down an NSF postdoctoral fellowship to become an Assistant Professor at the King Abdullah University of Science and Technology (KAUST), where he remains. As one of the first faculty members he was responsible for developing much of the applied and computational mathematics curriculum. **Katie Oliveras** (PhD 2009) wrote her thesis on the stability of surface gravity waves. She moved directly into a teaching position at Seattle University, from where she continues to be actively involved in collaborative research as a faculty member. **Melissa Nivala (née Vellela)** (PhD 2009) wrote her thesis on the stochastic modeling in cellular biochemistry. Her work has since become highly cited in the emergent field. She went on to be a postdoctoral fellow at UCLA School of Medicine and obtained her own fellowship in researching computational cardiology. She is now a professor in the division of Mathematics, Physics, and Computer Science at Evergreen State College (Olympia, WA). **Kirsten Fagnan** (PhD 2010) worked on numerical models for extracorporeal shock wave therapy and then was a postdoc at Lawrence Berkeley National Lab. She is now the Chief Informatics Officer of the DOE Joint Genome Institute. **Kyle Mandli** (PhD 2011) developed new methods for modeling storm surge from tropical storms and was then a postdoctoral fellow at UT-Austin. He is now an Assistant Professor at Columbia. **Joy (Ying) Zhou** (PhD 2013) did her thesis work with Mark Kot on ecological range shifts due to climate change and went on to a postdoc at the NSF-funded Mathematical Biology Institute (MBI). She is now an Assistant Professor at Lafayette. **Tom Trogdon** (PhD 2013) did his thesis work with Deconinck and also collaborated extensively with Sheehan Olver at the University of Sydney. Much of his thesis work went into a book that Trogdon and Olver published with SIAM in 2016. Among other awards, Trogdon won the 2014 Richard C. DiPrima Prize from SIAM. After graduating, he was an NSF Postdoctoral Fellow at the Courant Institute (NYU). He is currently an Assistant Professor at UC-Irvine, where he has just received an NSF CAREER Award. **Yu Hu** (PhD 2014) had his thesis (“Collective Activity in Neural Networks: the Mathematical Structure of Connection Graphs and Population Codes”) selected as the 2014 top-ranked dissertation at UW in Mathematics, Physical Sciences and Engineering. Yu, who was advised by Eric Shea-Brown, produced new results that span all the way from modern network theory to experimental biology. He moved on to be a Fellow at the Harvard Center For Brain Research with Haim Sompolinsky. He is now an Assistant Professor at Hong Kong University of Science and Technology (HKUST). **Natalie Sheils** (PhD 2015) worked on interface problems for partial differential equations. She is currently an IMA postdoc, after being a postdoctoral fellow at Minnesota working with Peter Olver. During her studies she was supported by an NSF Graduate Fellowship. **Jakob Kotas** (PhD 2016) worked

on operations research and Bayesian learning with adjunct professor Archis Ghate and excelled as an instructor in several of our courses. He is now an Assistant Professor at the University of Portland. **Yi-An Ma** (PhD 2017) wrote his dissertation jointly with Qian and Emily Fox in Statistics. Based on his strength in combining stochastic dynamical systems theory with statistical sampling methods, he was offered a Stein Fellowship in the Department of Statistics at Stanford. He turned down this offer for a postdoctoral fellowship with Michael Jordan at UC Berkeley. **Niket Thakkar** (PhD 2017) won the Graduate School Medal for his research and societal awareness (he volunteered as an educator in a prison facility). Niket worked on plasmonics with adjunct faculty member David Masiello in Chemistry, and was supported in part by an NSF Graduate Fellowship. Now he is employed at the Institute for Disease Modeling in Seattle applying his expertise to very different problems than those of his thesis.

PhD students graduating in the past three years have gone to postdoctoral positions at Berkeley, NYU, Columbia, The Mayo Clinic, TU Berlin, University College London, KAUST, and to other departments at UW (Physiology & Biophysics, and APL/eScience). Several others have moved to industry or other research environments.

3.5 Postdoctoral fellows (research associates)

The department has had many more postdoctoral fellows recently than we did 10 years ago. Some fellows come with their own funding (e.g. NSF Postdoctoral Fellowships), while others are supported by a faculty member's grant (often partially supported by the department in exchange for teaching part time). The CFRM postdocs and Pearson Fellow are supported entirely by departmental funds. All postdoctoral fellows are actively involved in research with at least one faculty mentor, and participate in research group meetings and journal clubs, often taking a leadership role. Additionally, every effort is made to give postdocs the chance to present their work at conferences and department seminars, thus giving these young researchers the exposure their work needs at this critical stage of their careers.

The postdoctoral fellows collectively take responsibility for organizing visits by the Boeing Distinguished Colloquium speakers (9 each year), which is a good networking opportunity, and it presents them with the opportunity to interact directly with top researchers in their field.

Recent postdoctoral fellows have gone on to excellent positions elsewhere. Within the past year, NSF postdoctoral fellow Chris Vogl moved to Lawrence Livermore National Lab, and others moved to tenure-track positions: Braden Brinkman at SUNY Stony Brook, King-Fai Li at UC Riverside, Niall Mangan at Northwestern, and Joel Zylberberg at CU Denver.

Postdoctoral fellows have also become an integral part of the CFRM Master's program. In addition to teaching three courses per year in this program, postdocs collaborate on research with faculty who focus on financial mathematics/engineering. While the postdoctoral component of the CFRM program began only in 2016, it has already established a record of success; the first postdoc hired by the CFRM program, Bin Zou, is now in a tenure-track position in the Department of Mathematics at the University of Connecticut.

3.6 Junior faculty

The department has been fortunate in recent years to hire outstanding junior faculty, both as retirement replacements and through opportunities to participate in campus-wide targeted emphasis areas.

Junior faculty typically have a reduced teaching load during their first two years. They have an assigned faculty mentor from among the senior faculty, who help them navigate the university system, make connections with potential collaborators across campus, and provide advice on their teaching, research, and service activities. Junior faculty are mentored on grant writing and department leadership keeps an eye out for funding opportunities and awards that they can be nominated for. Additionally, every effort is made to give junior faculty the opportunity to contribute to the department in a manner that best fits their unique talents. For example, Lorig, whose research involves a great deal of probability theory, has contributed to the development of the new three-quarter course sequence for PhD students on probability, stochastic processes, and model uncertainty. Similarly, Bozic has developed a new graduate course on Mathematical Modeling of Cancer.

4 Future directions

4.1 Research areas, future trends, hiring priorities

We believe the department is on a good trajectory. We have grown in the past few years by taking advantage of opportunity hires and by using income from self-sustaining fee-based programs to hire faculty, instructors, and postdocs. The research areas covered by the department have evolved in response to changes in the field of applied mathematics and its application areas.

Looking forward, beyond hoping to replace retirements (since we now have 5 faculty over the age of 60), we do not anticipate growth of our faculty numbers in the next few years. Potentially, we can grow our postdoctoral and instructor programs further to bring in even more young researchers. This has provided help with the growing class sizes and the number of student credit hours taught by the department, while expanding our research efforts and mentoring for graduate students. In 2017 we introduced the Pearson Fellow position and it is anticipated we will hire an additional Pearson Fellow in AY18-19. As before, faculty are encouraged to support additional postdocs using grant funds.

Numerical analysis and scientific computing. The department has been at the forefront of this research area since the 1980s, as computational modeling became an integral part of scientific and engineering fields. Until recently there were four faculty whose research focused on numerical analysis and scientific computing: Adams, Greenbaum, Hetmaniuk, and LeVeque. Adams retired in 2015 and LeVeque will be retiring in 2018, and Greenbaum is equally senior. The need for strength in this area remains clear across application areas. In addition, many incoming PhD students are interested in this area and there is demand from across campus for both undergraduate and graduate courses. PhD committee members with this expertise are in high demand. If a new hire is granted to replace LeVeque, this research area will likely be a priority.

Data science. The field of data science has exploded in recent years and we believe that Applied Mathematics has a substantial role to play. The department was successful in hiring Aravkin through the Provost's Initiative in Data Science, under which a number of faculty were hired around campus. Shlizerman, who also works in this area, was recently hired (50% AMath). Several other faculty work in closely aligned areas, including Bretherton, Kutz, Shear-Brown, Leung, and LeVeque. Most of these faculty are affiliates or fellows of the [eScience Institute](#), the campus-wide center for data science. They are involved in working groups or educa-

tional efforts coordinated through eScience. Bretherton and Kutz are co-mentoring an eScience postdoctoral fellow, and LeVeque serves on the eScience Executive Committee. Given that data science is continuing to grow in importance and in interest to AMath students, the department must continue to explore additional ways to develop in this direction.

Stochastic analysis and applied probability. The department is positioned well, being ahead of the national trend in recognizing the growing importance of stochastic mathematics in applications, to lead the research and education of this subject in applied mathematics. We are very aware of the need to articulate the development of stochastic dynamics within applied mathematics as a continuation of differential equations, dynamical systems, and mechanics. This is in contrast to the teaching of these areas in a statistics department. In teaching the newly created 561-2-3 sequence, we take advantage of the strong training our students have in partial differential equations (PDEs) and numerical computation versus the typically limited exposure to rigorous measure theory and statistics that is in their background. The research of several of our faculty members is at the forefront of applied stochastic dynamics: Lorig's research combines PDEs with stochastic analysis; Kot's work on integral differential equations has a natural stochastic connection; Shea-Brown is spearheading the integration of stochastic dynamics with information theory and applications to neural science; Qian is developing a unified stochastic dynamics framework that encompasses both stochastic processes and random dynamical systems theory; and Kutz is advancing a measure-theoretical Koopman operator-based approach to PDEs. Both the new educational materials and the research carried out by our faculty defines a new field at the disciplinary boundary between differential equations / dynamical systems and probability / statistics.

4.2 Interdisciplinary activities and collaboration

The department benefits greatly from its interdisciplinary activities and collaborations with other departments. The department will continue to look for opportunities to be involved in interdisciplinary research opportunities and joint grant proposals across campus and with other partners in the Seattle area. As one example, Shea-Brown is a co-PI (with Adrienne Fairhall) in an NRT proposal currently under review by NSF (having been selected by an internal UW committee as one of only two allowed to go forward).

4.3 Online courses and fee-based programs

Our fee-based programs are doing well, but we do not know what the future will bring as more competition arises from other universities introducing similar programs. To ensure their enduring success, the curriculum of these programs is continuously discussed and updated to maintain a competitive edge. The College of Arts & Sciences has indicated that more courses may need to include online overflow sections for on-campus students, due to lack of classroom space, so our efforts at online education may soon expand beyond our fee-based programs.

4.4 Potential capital projects

AMath moved into Lewis Hall in 2013, acquiring more space and the ability to house the entire department together, including the CFRM program and the growing number of postdocs and graduate students. This was accomplished in part because the department was able to contribute nearly \$500,000 toward the necessary remodel using departmental funds originating from the fee-based Master's degree program.

Thinking ahead, with the expectation of limited state funding for capital projects, we are setting aside some of our fee-based program income to fund possible projects. One potential project we have proposed to the College is for the department to contribute to refurbishing several classrooms near Lewis Hall to use for online teaching, something the college would benefit from as well as mentioned above, in return for having priority access for our own classes. Currently all the classrooms used for online teaching are in Loew Hall, and they seat no more than 50 students.

In the long term, we hope that state funding will be found eventually to do a full seismic retrofit of Lewis Hall, since it is an unreinforced masonry building that has been identified as a significant seismic hazard. There are apparently plans to make some upgrades as part of the [2017–19 Capital Project Request](#). If a more extensive reconstruction of Lewis ever takes place, we wish to explore the possibility of turning the currently unusable attic into usable space, including classrooms. This was done to Clark Hall during its seismic retrofit many years ago. (Lewis and Clark were both built in the 1890's with the same floor plan.)

5 Unit-Defined Questions

5.1 Question 1: Are we serving undergraduate students well and are there ways in which the department should be more involved in undergraduate education?

The department's involvement in undergraduate education has increased substantially in recent years, as the number of student credit hours taught has risen (see Figure 1). This has resulted in part from greatly increased enrollment in AMath 301, Introduction to Scientific Computing. Current enrollments are around 500 students per quarter. This growth has been facilitated by flipping the course using the lectures recorded by Kutz and Brunton. Other undergraduate courses have also grown substantially in the past few years, particularly as additional departments have allowed or required our courses for their majors. The increasing number of AMath minors has contributed to the growth as well.

AMath department classes also serve students in the ACMS major. The number of majors has remained fairly constant due to the self-imposed cap of 200 students. This cap is in place because of the presence of some required bottleneck classes that cannot accommodate more students. The ACMS Steering Committee is examining ways to make the major more flexible so that additional qualified students can be admitted.

Introduce an AMath major? Our faculty have renewed discussion of starting an Applied Mathematics major that is distinct from ACMS. AMath developed plans for a major in 1997, which was approved by the College but withdrawn after we decided to join forces on the ACMS major. The other three departments involved in ACMS all have separate majors in addition to their involvement in ACMS. As with the other majors, it is possible that a separate applied mathematics major would serve some students better than ACMS does. In particular, some students who plan to pursue graduate study in applied mathematics might benefit from a more focused program. Students majoring in AMath would feel they are a part of our department and connected to the department's faculty and graduate students, more than ACMS students do, who may not feel they are part of any department. Particularly for students interested in getting involved in research and/or pursuing a graduate degree, this could lead to a much richer

experience with better mentoring. It could also have substantial benefits for the department, by getting more talented undergrads involved in research projects, and by developing a set of alumni with a real connection to the department. A separate AMath major could afford us more flexibility to adapt the requirements to our course offerings, allowing more students to be served than ACMS alone can handle.

We do not think that introducing an AMath major would adversely affect the ACMS program, which is already at the enrollment limit and for which the bulk of the students are enrolled in the program options that are most closely aligned with computer science, data science, and mathematical economics. The ACMS program might still be the best option for students interested in applied mathematics, but who are not focused on research experience or graduate school.

There are potential downsides of starting a separate major. It is not clear that a separate major would be sufficiently different from ACMS to be worth the overhead involved. For example, an additional staff advisor (requiring salary and space) would be needed to advise students. Currently ACMS advising is handled by the Math/ACMS Advising Office in Padelford Hall, and AMath has only a faculty advisor (currently Tung) who primarily advises students who are interested in the AMath minor. Since our graduate advisors are already fully occupied advising PhD, Master's, and CFRM students, supporting a major would require at least a part-time staff person. New courses at a higher level might also need to be introduced, and/or new sections of existing courses opened in additional quarters in order to facilitate students completing the major in a timely manner.

The College of Arts & Sciences is planning to move to a system of direct admission of Freshmen to a division of the college (e.g. Natural Sciences, which includes Mathematics and Statistics as well as AMath), with selection of a major by Sophomore year. Computer Science & Engineering, the other ACMS partner, is also moving to more direct admission to the major. These changes may make significant differences in the number of students interested in mathematical sciences majors, in ways that are not yet clear.

The idea of a separate major is in the exploratory phase and we welcome advice from the review committee regarding the wisdom of starting a new major in the context of already having ACMS in place.

BS/MS program. The department is developing a proposal for a BS/MS degree program, in which ACMS majors (or others) who are doing very well in a specified set of classes would be guaranteed admission to the 1-year MS degree program upon completing the BS degree, with admission decisions made as early as their junior year. This could help attract strong students to the ACMS major, and provide a new stream of students to the MS program. We believe such students will be well prepared to apply to the best PhD programs in applied mathematics, or to secure good jobs. A similar BS/MS program in CFRM is also under consideration.

300-400 level courses. We have been discussing the possibility of introducing a broad undergraduate course in optimization. This could be either at the 300 level, possibly with a modeling focus, or at a more advanced 400 level. We may also add a companion course to the highly successful course AMath 301, Introduction to Data Science, which now enrolls more than 1,000 students. This could be, for example, a new AMath 302, Introduction to Data Science, or an allied topic.

5.2 Question 2: Are we training graduate students well (both Master's and PhD level) for the variety of career paths they pursue, including academics, industry, and government labs?

The department serves a variety of graduate students who sometimes have differing needs and expectations. Some are aiming for academic jobs, others at jobs in a variety of industries.

MS students in CFRM are generally focused on getting a permanent position in the finance industry upon the completion of their degree. The expectation in Master's degree programs of this nature is that the program helps them secure their first job. The department employs a full-time Career Services Manager (Karen Beaudry) and has an excellent record of placing virtually every graduate in a desirable job. Last year we had an impressive 95% job placement rate (within 90 days of graduation), which ranks 3rd among all schools in the QuantNet ranking, behind only Princeton and Columbia. Beaudry teaches career readiness and skills workshops, publishes a Resume Book annually for employers and works with students throughout the year to prepare them for interviews and for their summer internships. Beaudry also spearheads industry relations developing collaborations with employers across the U.S.

Master's degree students in the on-line AMath Master's fee-based program are often employed full-time, while working towards their degree. Many are working in high-tech and engineering industries, others in education. A large group is employed in a branch of the armed forces. Most of these students wish to obtain an MS degree to increase the promotion opportunities available to them. Many working in education need an MS degree simply to keep their current job, as requirements are changing across different states. Yet others are pursuing the degree simply for personal development.

On-campus AMath Master's degree students go in a variety of directions after graduating. Many go on to PhD programs in applied mathematics or other disciplines, and so good preparation for PhD programs is desirable. Most secure industry positions after graduation. Although no placement is offered to these students as part of their degree, many advising opportunities are made available to these students (alumni panels, publicizing job opportunities sent to department leadership by alumni and local business, etc). In general, these graduates are very successful in finding positions that match their interests and take advantage of their talents.

Our PhD students follow many different career paths. Quite a few take the academic route of postdocs and eventually faculty positions, while others choose to enter industry, or to government or private-sector research laboratories.

It is important to maintain a PhD program that works well for the students who intend to pursue careers in the professoriate, and for those who are destined for high-level research careers in other settings. At the same time our limited set of graduate offerings must serve a broad range of students who are not planning on a research career. This causes potential tension in classes that are both core courses in the PhD program and in the Master's program, and are also being taken by graduate students from a variety of other departments. The success of our graduates across their different desired career paths shows that we accomplish our goals for their training well, but we are continuously looking at ways to go beyond this.

Our graduate curriculum is constantly evolving, as discussed in Section 2.9. In particular, we recently added the new sequence AMath 561-2-3 (probability and statistics) and a reworked the qualifying exam system to better address the growing importance of stochastic and statistical modeling in the department. The CFRM advisory board has been active in providing

directions and advice on our curriculum. The practitioners' perspectives are useful for us to ensure our CFRM courses are well aligned to the needs of the finance industry. The core CFRM MS curriculum was modified effective Autumn 2017, and now includes Ethics in the Finance Profession (CFRM 509). CFRM students also benefit from the introduction of new electives, such as Energy Markets Analytics and Derivatives (CFRM 580), Machine Learning for Finance (CFRM 521), and Advanced C++ for Finance (CFRM 524). These additions ensure the program is following trends in the finance industry, so CFRM students will be competitive when entering the job market.

We have added the Advanced Graduate Data Science Option and are discussing adding a data science option for MS students, following the eScience recommendations⁸. We participate in the professional Master's of Science in Data Science program⁹ and we offer three certificates (one in Scientific Computing and two in finance).

5.3 Question 3: Are there ways we can take more advantage of our network of alumni and faculty connections beyond UW to enhance the research, teaching and impact of the department?

The department has a substantial set of PhD alumni¹⁰, many of whom remain actively engaged in joint research with AMath faculty and/or with current students. Those in academics have also proved valuable in encouraging strong undergraduates to apply to our graduate programs. Many of our MS alumni work in the Seattle area and some of these also remain engaged with the department. Unfortunately, ACMS majors generally do not feel a strong attachment to the department and, with exceptions, we have not built up an alumni network from undergraduate students.

We also have connections with faculty and researchers at many other institutions, including of course through many research projects. We have 13 affiliate faculty who have some direct connection to the department. This includes retired faculty from other institutions who now live in the Seattle area, active faculty elsewhere who were once in our department, and researchers in the Seattle area who have strong ties to the department, e.g., at the Allen Brain Institute, the Fred Hutchinson Cancer Research Center, the Institute for Disease Modeling, and the PNNL/UW Northwest Institute for Advanced Computing (NIAC). These researchers are particularly active in joint research and most have advised PhD students in the department. Another 13 faculty in other UW departments are Adjuncts in AMath, and many of these have been advisors or co-advisors of PhD students.

The department publishes a [newsletter](#) on a regular basis to inform alumni and other friends of the department of recent events. In addition, the newsletter contains articles and profiles of faculty and students.

In 2009, the department held its first (and so far, only) Alumni Reunion to mark the 25th anniversary of the department. This 2-day event was well attended and there has been discussion of repeating this in the near future.

A few years ago, the department started the tradition of an annual dinner for faculty, including adjuncts and affiliates, and some local alumni. This has been popular and will continue.

⁸<http://escience.washington.edu/education/phd/data-science-graduate-option/>

⁹<https://www.datasciencemasters.uw.edu/>

¹⁰<https://amath.washington.edu/alumni-index>

This year, the graduate students organized a [BIG Math Networking and Information Session](#), bringing in several researchers from local Business, Industry, and Government (BIG), many of whom were department alumni. The event included two sessions of talks from invited speakers, a poster session showcasing recent work by students in the department, and a networking lunch. This was very well attended and we plan to make it an annual event.

We are looking forward to hear other ideas from the review committee on how to better leverage the contacts and alumni we have outside the department.

5.4 Question 4: How can Applied Math recruit the very best and most diverse set of graduate students for its three different graduate programs?

In Section [2.7.1](#) we discuss our current recruiting strategy. In general we are very happy with the quality of our graduate students. Table [3](#) in Appendix [D](#) shows that we have a very large number of applicants for the PhD program, and all of the applicants we accept have been rated as excellent by the faculty. These students receive offers from many top universities, so we always accept 2–3 times more than we are aiming for. Usually, we come close to the desired number. Further, we have not had problems attracting well-qualified students to the various Master’s degrees. In Section [1.3](#) we discuss many of the efforts we make to attract a diverse student body. We believe that we do reasonably well with respect to gender balance and we have a healthy mix of domestic and international students. However, we are making efforts to do better on gender balance, and especially on attracting more under-represented minorities. We would welcome feedback from the committee on our progress and suggestions on other avenues that we might pursue.

Appendices

A Organizational structure

A.1 Personnel

Listed below are the departmental staff. The figure in the next section shows the organizational structure of the staff and who they report to.

Staff:

Karen Beaudry	CFRM Career Services Manager (professional staff)
Keshanie Dissanayake	Administrator (professional staff)
Laurie Feldman	CFRM Program Operations Specialist (professional staff)
Derek Franz	Fiscal Analyst (classified staff)
Tony Garcia	Office Assistant (classified staff)
Lauren Lederer	AMath Graduate Program Advisor (professional staff)
TBD (currently hiring)	CFRM Graduate Program Advisor (professional staff)

Faculty: See also Appendix C and amath.washington.edu/people/faculty

Alexandr Aravkin	Assistant Professor
Ivana Bozic	Assistant Professor
Matthew Lorig	Assistant Professor
Ulrich Hetmaniuk	Associate Professor
Tim Siu-Tang Leung	Associate Professor
Mark Kot	Associate Professor
Eli Schlizerman	Associate Professor (joint with EE)
Emanuel Todorov	Associate Professor (joint with CSE)
Chris Bretherton	Professor (joint with Atmos)
Bernard Deconinck	Professor and Chair
Anne Greenbaum	Professor
J. Nathan Kutz	Robert Bolles and Yasuko Endo Professor
Randall LeVeque	Boeing Professor
Hong Qian	Olga Jung Wan Professor
Eric Shea-Brown	Boeing Professor
Ka-Kit Tung	Fred and Julia Wan Professor

Postdoctoral fellows and instructors:

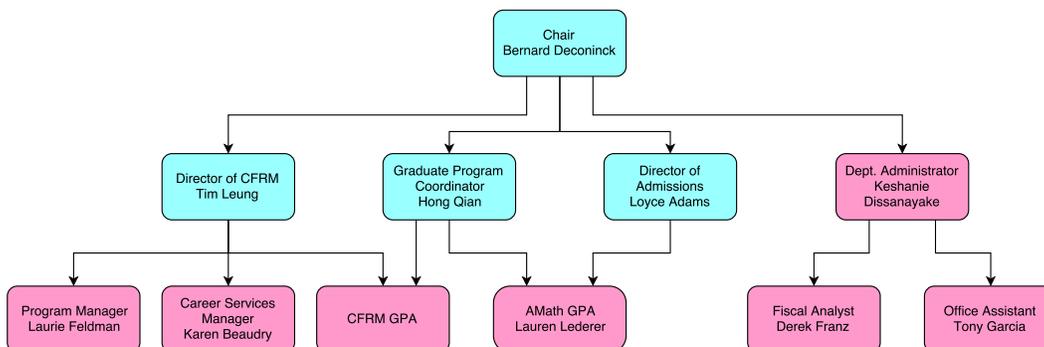
See amath.washington.edu/people/faculty#postdocs

Emeriti, adjunct, and affiliate faculty:

The department has 6 emeriti, 13 adjunct faculty (with primary appointment in a different department) and 13 affiliates. For a list, see amath.washington.edu/people/faculty

A.2 Structure, leadership, and committees

The figure below shows the organizational structure of the AMath staff and their direct supervisors. Staff are shown in red, faculty in blue. The Department Administrator also has administrative authority over all staff.



The tables below show the makeup of various committees and other administrative units within the department. The people listed are faculty unless otherwise indicated.

Faculty leadership:

Chair:	Deconinck
Executive Committee:	Leung, LeVeque, Qian, Tung

Departmental Staff:

Administrator	Keshanie Dissanayake (staff)
Fiscal Analyst	Derek Franz (staff)
Office Assistant	Tony Garcia (staff)

Graduate Program (AMath):

Graduate Program Coordinator:	Qian
Graduate Program Advisor:	Lauren Lederer (staff)
Director of Admissions:	Loyce Adams (emerita)

CFRM:

Director:	Leung
Steering committee:	Deconinck, Leung, Lorig, Tung
Program Operations Specialist:	Laurie Feldman (staff)
Graduate Program Advisor:	TBD; now hiring (staff)
Career Services Manager:	Karen Beaudry (staff)

Student leadership:

Graduate student representative:	Jeremy Upsal (PhD student)
SIAMUW President:	Ryan Creedon (PhD student)
SIAMUW Vice President:	Bethany Sutherland (Master's student)
SIAMUW Secretary:	Ben Liu (PhD student)
SIAMUW Treasurer:	Ke Huang (PhD student)
SIAMUW Webmaster:	Kelsey Maass (PhD student)
SIAMUW Outreach:	Weston Barger (PhD student)

Computing:

Computing Committee:	LeVeque, Hetmaniuk, and WebTAs
WebTAs:	Andreas Freund (PhD student), Nathan Lee (PhD student)

Miscellaneous committees:

Curriculum committee:	Deconinck, Greenbaum, Lorig
Diversity committee:	Bozic, Shea-Brown, Lederer (staff), and 5 PhD students: Kathleen Champion, Brian de Silva, Kelsey Maass, Rose Nguyen, and Jake Price
Departmental Teaching Mentor:	Kot
Undergraduate Advisor:	Tung
Qualifying exam committee (2017):	Greenbaum, Qian, Shea-Brown
Representatives to ACMS steering committee:	Aravkin, Greenbaum
Representative to PCE MS in Data Science:	Kutz, Shlizerman
Representative to NIAC Steering Committee:	LeVeque
Merit review committee:	TBD

B Budget summary and details

See Section 1.2 for an overview. In this appendix we repeat some of the information from that section, with additional details added. The table and figures in this appendix also show revenue and expenditures broken down according to the source of funds, as explained further in the sections below.

Table 1 shows an overview of income and expenditures in each of the past three biennia. Table 2–9 show a breakdown of each line item from Table 1. The income and expenditures for each biennium do not necessarily match, in part because of DOF and fee-based income that has not yet been spent, and also because faculty are involved in many interdisciplinary grants with other departments. Hence the grant revenue through the AMath department does not necessarily match the expenditures on AMath budgets towards AMath faculty and students. This is discussed in more detail in Section B.2 below.

Figures 1–3 show an overview of the composition of faculty, student, and staff salaries by funding source. Unlike many departments, our state budget (GOF and DOF) currently pays less than 40% of student and staff salaries. Moreover only about 70% of salaries for teaching by faculty, postdocs, and instructors is covered by the state budget, with the remainder being supported by our fee-based programs.

Note that in these tables and figures, faculty-level salaries include faculty, postdocs, and instructors, due to difficulties of disentangling these within the various budgets. All tenure track faculty salaries are currently on state budgets with the exception of Leung, who is paid from the CFRM budget.

B.1 GOF and DOF

Table 2 shows the revenue from the General Operating Funds (GOF), the primary state support for tenure-track faculty, and for state-supported TA and staff positions. This includes *recapture funds* that are returned to the department when a faculty member is on unpaid leave or sabbatical, or is partially paid off of a grant or by PCE for teaching fee-based students.

Table 3 shows revenue from the Designated Operating Funds (DOF). This includes *research cost recovery (RCR)*, a portion of indirect cost on grants administered by AMath that is returned to the department (currently 12.5% of the first \$100K, increasing linearly to 25% at \$500K and above). These funds are primarily used to pay replacement instructors, e.g. visiting faculty or graduate students teaching a course. *Startup funds* provided by the College or Provost for new faculty also come into DOF.

Unlike GOF, any positive DOF balance can be carried over from one biennium to the next. We show significant carry over in some biennia in particular because startup funds are often committed over a longer time scale.

B.2 Grants and contracts

Note the following in relation to the budget summary of Table 1, the grant revenue listed in Table 4, and expenditures in other tables:

- Grants & Contracts revenue includes only grants that are administered by the AMath Department.
- The expenditures listed in Table 1 and later tables include all expenditures made through the AMath Department, including to support faculty and students in other departments.

- These tables do not include AMath salaries, benefits, tuition, travel, etc. that were charged to grants administered by other departments.

In addition to the grants whose budgets are included in the tables, faculty have been involved in attracting a number of large inter-disciplinary grants that have brought significant resources (and indirect cost) to the University. The list below includes roughly \$61M in grants that AMath faculty have helped secure over the past 3 biennia, but that do not appear in our budgets:

- *Center for Sensorimotor Neural Engineering*, NSF (ERC), 2011–21, administered by College of Engineering (Shea-Brown is Thrust Leader), \$36,475,600.
- *A Framework of Algorithms & Simulator for Quantum Mechanical Modeling of Nanodevices*, NSF, 2012-2015, administered by EE (Hetmaniuk co-PI) \$340,001.
- *Dynamic intelligence through online optimization*, NSF, 2012–15, administered by CSE (Todorov PI) \$365,527
- *Symbiotic optimization of behavior*, DARPA, 2012–13, administered by CSE (Todorov co-PI) \$374,999.
- *CPT to improve cloud and boundary layer processes in GFS/CFS*, NOAA, 2013–18, administered by Atmos. Sci. (Bretherton PI) \$489,000
- *Dynamic locomotion: From humans to robots via optimal control*, NSF NRI, 2013–17, administered by CSE (Todorov co-PI) \$1,217,695
- *Modeling Social Common Sense for Seamless Human-Machine Interaction*, DARPA, 2015–16, administered by CSE (Todorov PI), \$150,000.
- *Data Science Environments*, Gordon and Betty Moore Foundation, 2014–18, administered by CSE/eScience (LeVeque co-PI), \$10,000,000.
- *Data Science Environments*, Alfred P. Sloan Foundation, 2014–18, administered by CSE/eScience (LeVeque co-PI), \$2,600,000.
- *Evaluating large-eddy simulations of boundary-layer cloud response to climate change using MAGIC observations*, DOE, 2014–18, administered by Atmos. Sci. (Bretherton PI), \$389,567.
- *Collaborative research: Cloud System Evolution in the Trades (CSET)* NSF, 2014–17, administered by Atmos. Sci. (Bretherton co-PI), \$482,163.
- *Expanding the Computational Frontier of Multi-scale Atmospheric Simulation to Advance Understanding of Low Cloud / Climate Feedbacks*, DOE, 2014–18, administered by Atmos. Sci. (Bretherton PI), \$324,265.
- *Collaborative Research: EaSM-3: Understanding the Development of Precipitation Biases in CESM and the Superparameterized CESM on Seasonal to Decadal Timescales*, NSF, 2014–18, administered by Atmos. Sci. (Bretherton PI), \$480,000.

- *Dynamics of non-equilibrium cell state transitions in cell populations*, NIH R01, 2014–19, administered by Institute for Systems Biology (Qian investigator PI), \$1,700,000.
- *A Framework for Probabilistic Tsunami Hazard Assessment of Forces on Coastal Structures*, NSF, 2015–18, administered by Civil & Environmental Engineering (LeVeque co-Pi), \$300,000.
- *Washington Research Foundation Fund for Data Intensive Research*, Washington Research Foundation, 2015–20, administered by EE (Shlizerman PI) \$100,000.
- *An Offshore Geophysical Network Design for Earthquake and Tsunami Early Warning in the Pacific Northwest*, Gordon and Betty Moore Foundation, 2016–17, administered by Earth & Space Sciences (LeVeque co-PI) \$1,000,000.
- *Training Program in Neural Computation and Engineering*, NIH , 2016–21, administered by College of Medicine (Shea-Brown is one of 2 PIs), ~ \$1,000,000.
- *Coupling mechanistically the convective motions and cloud macrophysics in a climate model*, DOE, 2016–19, administered by Atmos. Sci. (Bretherton PI), \$351,000.
- *Bio-inspired volatile detection systems for human scent detection and discrimination*, AFOSR, 2017–21, administered by EE (Shlizerman CoPI), \$750,000.
- *Quality control of and analysis enabling use of MARCUS and MICRE data for scientific applications*, DOE, 2017–19, Subcontract to U. Okla., administered by Atmos. Sci., (Bretherton co-PI), \$263,412.
- *Analysis of G-V aircraft and complementary SOCRATES observations to understand clouds, aerosols and their interactions over the Southern Ocean*, NSF, 2017–20, administered by Atmos. Sci. (Bretherton co-PI), \$1,053,699.
- *Collaborative research: Using SOCRATES datasets to improve simulations of clouds, aerosols and their climate impacts*, NSF, 2017–20, administered by Atmos. Sci. (Bretherton PI), \$240,000.
- *Improving the time discretization of process coupling in ACME*, DOE, 2017–20, Subcontract to LLNL, administered by Atmos. Sci. (Bretherton PI), \$299,191.

B.3 Endowment portfolio

Table 5 gives information about the endowment portfolio. These endowments fund a variety of activities, including several endowed Chair positions in the department (which come with some funds to be used for faculty research needs), a number of student fellowships, and the Boeing Distinguished Colloquium series. Some multi-year commitments to Chairs are carried over from one biennium to the next. Another reason for an apparent surplus many biennia is that these funds are split between many endowments, and a certain amount needs to be accumulated from a single endowment in order to support another student fellowship off that endowment, for example.

B.4 Fee-based programs

Table 6 shows revenues and program costs for the fee-based MS degree in Applied Mathematics. Table 7 shows revenues and program costs for the fee-based MS degree in Computational Finance & Risk Management (CFRM).

Both of these programs are run through PCE/UWCC. Program costs include salary paid to instructors and TAs in direct support of students enrolled in classes through the fee-based program, as well as staff salaries in support of the program and some recruiting scholarships and excellence awards to students. Program costs also include fees paid to UWCC and overhead paid to UW at the Provost level. After subtracting these costs, 10% of the net revenue is contributed to the College of Arts & Sciences, and the remaining 90% is returned to the AMath Department.

B.5 Expenditures from fee-based revenue

The bottom line from Tables 6 and 7 are combined in the top line of Table 8, which shows the total (net) revenues from the fee-based AMath and CFRM MS degree programs.

As discussed in Section 1.2, this revenue is used for many purposes, and is now critical to maintaining the level of educational and research programs that the department now supports. In particular:

- Graduate students are funded as TAs (usually PhD students) and graders (usually MS students) when GOF funds are insufficient to provide the support needed for the growing class sizes.
- Two PhD students are also supported as “Web TAs”, who manage the departmental computing equipment as well as helping administer webpages and mailing lists.
- The department is supporting a Pearson Instructor and three CFRM Research Associates, postdoctoral fellows who are engaged in research in addition to teaching. Funds from the fee-based program have also been used to match research grant funds to bring in additional Research Associates, who in return do some teaching for the department.
- Capital projects: The 2011–12 biennium Operations line in Table 8 includes nearly \$500K towards the renovation of Lewis Hall. Additional investments in later biennia have included renovating offices to better accommodate staff needs.
- A portion of the fee-based revenue is used for faculty-determined research needs. Each faculty member is allocated a portion of the budget to direct towards their highest priorities. This is used to help support graduate students as RAs, for postdoc support, for faculty or student travel to conferences, to organize workshops, to support visitors, etc.
- In two biennia, contributions were made to endowments as matching funds for gifts.
- In the 2015–16 biennium, a contingency fund was initiated in relation to hiring Leung as Associate Professor and Director of CFRM. This tenured position is currently supported entirely by fee-based income from the CFRM program. The fund provides insurance for the College, as it backstops the position.

B.6 Summer quarter

Table 9 gives an overview of revenue and expenses associated with teaching courses during summer quarter. Most of the classes offered in the summer are taught by advanced PhD students who wish to get teaching experience.

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Applied Mathematics Overview

Incoming Funds & Revenue

Biennium	2011-12	2013-14	2015-16
GOF	\$3,883,704	\$4,314,168	\$5,422,661
DOF	\$167,284	\$148,761	\$273,749
Grants & Contracts	\$3,237,577	\$2,386,281	\$3,195,588
Endowment Contrib & Income	\$183,702	\$235,693	\$242,728
Gifts	\$19,257	\$3,340	\$25,349
Fee-Based Programs	\$1,577,611	\$1,875,877	\$2,161,756
Summer Quarter	\$110,583	\$213,214	\$237,066
Total	\$9,179,718	\$9,177,334	\$11,558,897

Expenditures

Salary	Total	\$4,483,351	\$5,335,071	\$6,560,423
	Faculty-level	\$3,441,034	\$3,938,418	\$4,836,156
	Student	\$721,585	\$1,082,700	\$1,334,603
	Staff	\$225,765	\$260,484	\$320,498
	Hourly	\$94,967	\$53,469	\$69,166
Benefits		\$1,123,926	\$1,274,957	\$1,622,155
Tuition & Stipends		\$320,564	\$548,619	\$490,475
Operations		\$1,290,405	\$673,720	\$708,389
	Equipment	\$95,502	\$116,051	\$91,260
	Travel	\$334,803	\$230,953	\$327,098
	Renovation & Building	\$501,141	-\$26,426	\$28,662
Indirect Cost		\$668,058	\$823,487	\$1,090,375
Contingency Fund Contribution				\$200,000
Endowment Contributions		\$100,730		\$200,000
Total		\$7,987,035	\$8,655,853	\$10,871,817

Budget Table 1: Budget Overview. See Section 1.2 and Appendix B for discussion.

General Operating Funds

Biennium		2011-12	2013-14	2015-16
State Allocation		\$3,883,704	\$4,314,168	\$5,422,661
Salary	Total	\$3,044,133	\$3,420,114	\$4,308,575
	Faculty-level	\$2,353,982	\$2,585,412	\$3,288,473
	Graduate Student	\$360,246	\$552,098	\$681,883
	Staff	\$181,287	\$257,362	\$269,606
	Hourly	\$148,618	\$25,243	\$68,612
Benefits		\$776,614	\$802,327	\$1,037,772
Operations		\$59,863	\$91,337	\$33,561
Total Expenditures		\$3,880,611	\$4,313,779	\$5,379,908

Budget Table 2: General Operating Funds (GOF). This is the primary State budget. See Section [B.1](#) for more information.

Designated Operating Funds

Biennium		2011-12	2013-14	2015-16
New Funds		\$167,284	\$148,761	\$273,749
Carryover		\$118,742	\$167,342	\$209,613
Beginning Balance		\$286,026	\$316,103	\$483,362
Salary	Total	\$32,045	\$14,947	\$130,297
	Faculty-level		\$13,750	\$50,138
	Graduate Student	\$28,608		\$71,105
	Hourly	\$3,437	\$1,197	\$9,054
Operations		\$60,670	\$69,651	\$40,624
Benefits		\$5,795	\$18,676	\$28,897
Tuition & Stipends		\$20,174	\$3,216	\$3,023
Total Expenditures		\$118,684	\$106,490	\$202,841

Budget Table 3: Designated Operating Funds (DOF). See Section [B.1](#) for more information.

Grant Portfolio

Biennium		2011-12	2013-14	2015-16
Grant Awards		\$3,237,577	\$2,386,281	\$3,195,588
Salary	Total	\$1,118,311	\$1,341,514	\$1,807,603
	Faculty-level	\$800,494	\$945,334	\$1,344,318
	Graduate Student	\$278,448	\$385,596	\$424,307
	Staff			\$12,413
	Hourly	\$39,369	\$10,584	\$26,565
Benefits		\$265,766	\$298,198	\$414,024
Operations		\$367,237	\$134,456	\$248,179
Tuition & Stipends		\$171,114	\$250,510	\$241,435
Indirect Cost		\$668,058	\$823,487	\$1,090,375
Total Expenditures		\$2,590,486	\$2,848,165	\$3,801,616

Budget Table 4: Grant Portfolio. This includes only the grants administered by the AMath Department. See Section B.2 for a list of other grants with AMath faculty involvement.

Endowment Portfolio

Biennium		2011-12	2013-14	2015-16
Endowment Principals		\$1,038,474	\$1,430,078	\$1,574,952
	Dept Contributions	\$100,730		\$200,000
	Individual Gifts	\$273,532	\$177,410	\$204,525
	Reinvested Earnings	\$17,341	\$18,194	\$19,502
New Contributions		\$391,603	\$195,604	\$424,027
	Investment Income	\$129,702	\$155,693	\$184,483
	College Distributions	\$54,000	\$80,000	\$58,245
Endowment Income		\$183,702	\$235,693	\$242,728
Salary		\$12,970	\$46,730	\$44,794
	Faculty-level		\$32,389	\$26,317
	Graduate Student	\$12,970	\$14,341	\$18,477
Professorship & Boeing Colloq.		\$46,693	\$55,761	\$17,917
Benefits		\$2,079	\$10,678	\$10,758
Tuition & Stipends		\$47,383	\$31,964	\$36,353
Total Expenditures		\$109,125	\$145,133	\$109,822

Budget Table 5: Endowment Portfolio, showing principals, new contributions, and spendable income. The lower part of the table shows expenditures. See Section B.3 for more information.

Applied Math MS Professional Degree (fee-based program)

Biennium		2011-12	2013-14	2015-16
Revenues		\$2,179,596	\$1,921,884	\$2,134,240
Cost Transfers		\$5,425	\$6,848	\$4,610
Total		\$2,185,021	\$1,928,732	\$2,138,850
Salary	Total	\$276,490	\$424,379	\$399,766
	Faculty-level	\$153,138	\$229,641	\$134,838
	Graduate Student	\$82,638	\$126,735	\$144,420
	Staff	\$40,454	\$65,714	\$119,742
	Hourly	\$260	\$2,289	\$767
Benefits		\$67,793	\$98,131	\$96,591
Tuition		\$67,048	\$96,262	\$94,172
Operating Expenses		\$10,623	\$327	\$161
Fees Paid to UWCC		\$368,162	\$314,405	\$322,847
Overhead Paid to UW		\$142,772	\$125,835	\$153,968
Total Program Costs		\$932,888	\$1,059,338	\$1,067,505
Net Revenue		\$1,252,133	\$869,394	\$1,071,345
Contribution to CAS		\$125,213	\$86,939	\$107,135
Contribution to Dept		\$1,126,920	\$782,455	\$964,211

Budget Table 6: AMath MS Professional Degree. See Section B.4 for more information.

CFRM Professional Degree (fee-based program)

Biennium		2011-12	2013-14	2015-16
Revenue (MS Campus)				\$1,346,135
Revenue (MS Online)		\$2,349,558	\$4,021,194	\$3,057,093
Revenue (Certs)		\$529,275	\$766,983	\$655,590
Cost Transfers		\$5,396	\$18,264	\$17,824
Total		\$2,884,229	\$4,806,441	\$5,076,642
Salary	Total	\$1,034,479	\$1,666,960	\$1,779,145
	Faculty-level	\$702,839	\$1,124,163	\$1,049,908
	Graduate Student	\$153,544	\$231,115	\$294,278
	Staff	\$162,723	\$285,948	\$416,089
	Hourly	\$15,373	\$25,734	\$18,870
Benefits		\$267,907	\$398,506	\$445,156
Tuition		\$99,422	\$275,900	\$299,348
Contract Services		\$17,029	\$151,462	\$61,044
Operating Expenses		\$219,338	\$119,673	\$92,877
Supplies & Materials		\$16,832	\$32,670	\$9,055
Travel		\$32,858	\$63,126	\$38,417
Fees Paid to UWCC		\$512,852	\$571,845	\$544,514
Overhead Paid to UW		\$182,743	\$305,964	\$476,480
Total Program Costs		\$2,383,461	\$3,591,527	\$3,746,036
Net Revenue		\$500,768	\$1,214,914	\$1,330,606
Contribution to CAS		\$50,077	\$121,491	\$133,061
Contribution to Dept		\$450,691	\$1,093,423	\$1,197,545

Budget Table 7: CFRM MS Professional Degree. See Section B.4 for more information.

Expenditures from Fee-Based Net Revenue

Biennium		2011-12	2013-14	2015-16
Total Contributions to Dept		\$1,577,611	\$1,875,877	\$2,161,756
Salary	Total	\$275,892	\$511,765	\$269,154
	Faculty-level	\$136,201	\$366,533	\$121,890
	Graduate Student	\$35,414	\$131,730	\$178,897
	Staff	\$44,478	\$6,244	\$76,932
	Hourly	\$26,883	\$16,445	\$33,384
Benefits		\$61,243	\$118,800	\$98,576
Operations		\$755,942	\$293,915	\$368,108
	Building	\$501,141	-\$26,426	\$28,662
Tuition & Stipends		\$61,715	\$238,185	\$177,723
Contingency Fund Contrib				\$200,000
Endowment Contrib		\$100,730		\$200,000
Total Expenditures		\$1,222,606	\$1,171,853	\$1,455,510

Budget Table 8: Expenditures from Fee-Based Net Revenue. The top line comes from combining the net revenue contributions to department from Tables 6 and 7. See Section B.5 for more information.

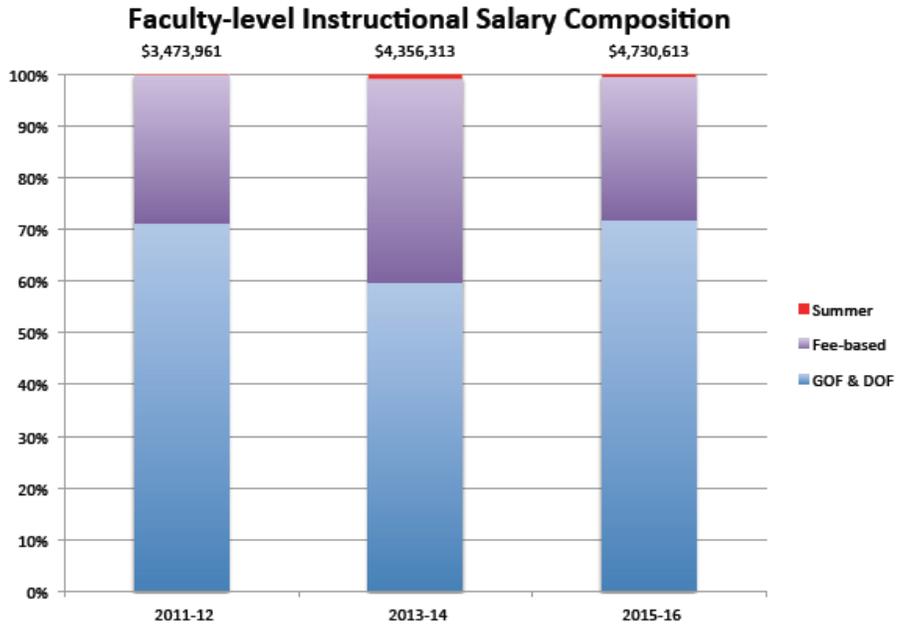
Applied Math Summer Quarter

Biennium		2011-12	2013-14	2015-16
Summer Allocation		\$110,583	\$213,214	\$237,066
Salary	Total	\$77,977	\$133,594	\$172,998
	Faculty-level	\$4,445	\$36,814	\$24,426
	Graduate Student	\$65,585	\$77,615	\$118,351
	Hourly	\$7,947	\$19,165	\$30,222
Benefits		\$12,428	\$26,277	\$32,127
Tuition & Stipends		\$20,178	\$24,743	\$31,941
Operations			\$28,600	
Total		\$110,583	\$213,214	\$237,066

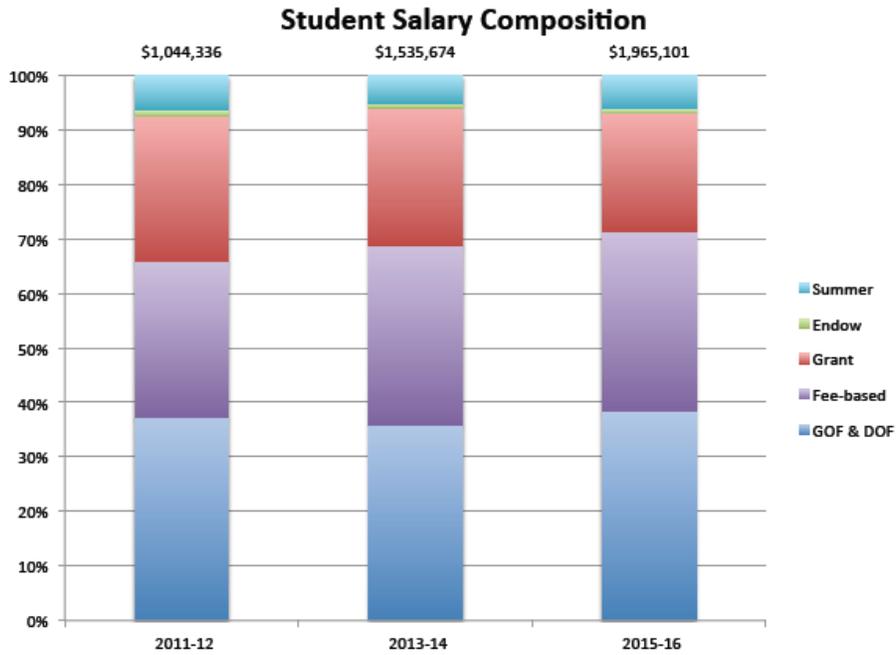
Budget Table 9: Summer Quarter expenditures. See Section B.6 for more information.

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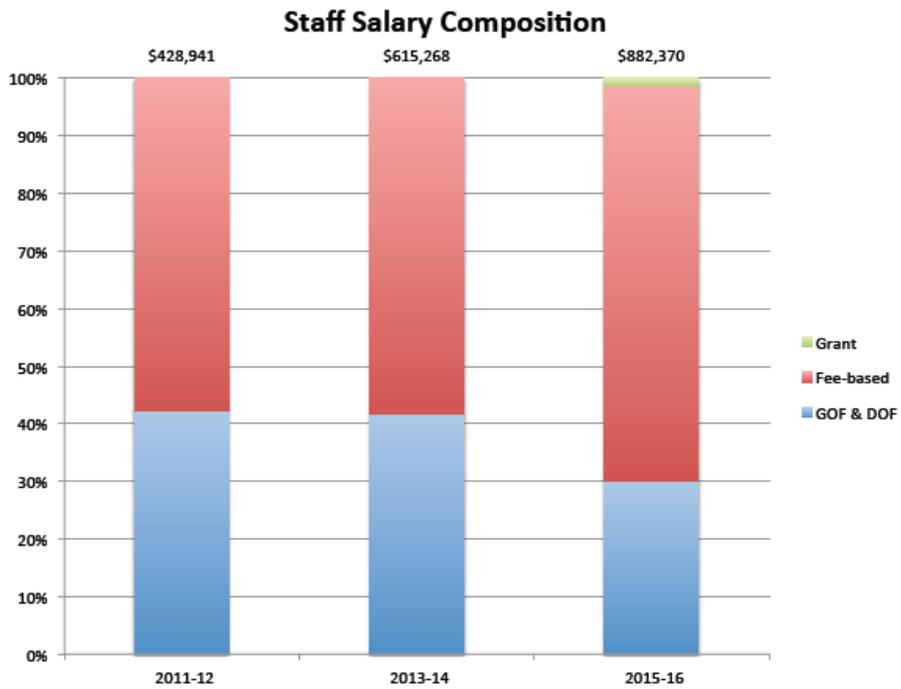
- 1 Faculty-level instructional salary composition 42
- 2 Student salary composition 43
- 3 Staff salary composition 43



Budget Figure 1: Fractional composition of salary expenditures for faculty, postdocs, and instructors for periods of instruction. Does not include salaries paid from grants or other research funds, or for graduate student teaching.



Budget Figure 2: Fractional composition of graduate student salary expenditures. Includes both instructional funding (TA or teaching) and research (RA) funding.



Budget Figure 3: Fractional composition of staff salary expenditures.

C Information about faculty

This section contains a 1-page CV of each faculty member, with links to their full CV online.

C.1 Alexandr Aravkin

Aleksandr Aravkin

Assistant Professor (Applied Math); Washington Research Foundation Data Science Term Professor; Adjunct Professor (Mathematics and Statistics).

Homepage: <https://sites.google.com/site/saravkin/>

Full CV: <https://sites.google.com/site/saravkin/AravkinCV2017a.pdf>

Links to publications: <https://sites.google.com/site/saravkin/publications>

ORCID: <https://orcid.org/0000-0002-1875-1801>

UW history: I joined UW as an Assistant Professor in 2015. I also spent a long time at UW as both an undergraduate student in mathematics and computer science, and a graduate student in mathematics and statistics. I collaborate with multiple groups on and off campus, including faculty in mathematics, statistics, earth and ocean sciences; the Institute of Health and Metrics Evaluation, and the Applied Physics Lab.

Background: I received my PhD in Mathematics (Optimization) from the University of Washington in 2010. From 2010-2012, I was a postdoctoral fellow in Computer Science and Earth and Ocean Sciences at UBC, working on robust approaches for seismic inverse problems. From 2012-2015, I was a Research Staff Member at the IBM TJ Watson Research center, and an adjunct professor at Columbia University in Computer Science and IEOR departments.

Selected Awards and Honors: Data Science Fellow of the eScience Institute (2016); IBM Representative for Singapore Global Young Scientist Summit, 2014.

Interests and Activities: I work on theoretical and practical problems connected to data science, including theoretical work in convex and variational analysis, robust statistical modeling, and algorithm design with applications to high dimensional inference, machine learning, and inverse problems.

C.2 Ivana Bozic

Assistant Professor of Applied Mathematics

Homepage: www.ivanaboasic.com

Full CV: Available on self-study site

Links to publications: <https://ivanaboasic.com/publications/>

Google Scholar profile:

https://scholar.google.com/citations?user=C_IyouIAAAAJ

Mathematical Genealogy Project:

<http://www.genealogy.ams.org/id.php?id=163552>

UW history: Hired as Assistant Professor starting March 2017.

Background: BSc in Mathematics, University of Belgrade, Serbia (2005); MA in Mathematics, University of Belgrade, Serbia (2007); PhD in Mathematics, Harvard University (2012)

Selected Awards and Honors: Foundational Questions in Evolutionary Biology Grant (2012-2014); Keynote at the European Sequencing and Genotyping Infrastructure Symposium (2014); Harvard University Certificate of Distinction in Teaching (2009, 2011); Serbian Ministry of Education Merit Fellowship (1997-2005).

Interests and Activities:

Research areas: Mathematical Biology, Cancer Evolution, Stochastic Processes, Genomics.

Author of twenty published or accepted refereed papers, and two peer-reviewed conference proceedings.

Seventeen invited presentations at conferences and workshops, 27 seminars and colloquia.

Teaching: AMATH 383: Introduction to Continuous Mathematical Modeling (Spring 2017, Winter 2018); developed new course AMATH 536: Mathematical Modeling of Cancer (Spring 2018).

Mentorship: Advisor for independent study for four applied mathematics PhD students (Fall 2017); faculty mentor at the Washington Experimental Mathematics Lab, advising two undergraduate and one graduate mathematics students (Spring 2017).

C.3 Christopher S. Bretherton

Professor of Atmospheric Science and Applied Mathematics

Homepage: www.atmos.washington.edu/~breth

Full CV: www.atmos.washington.edu/~breth/vitae.pdf

Links to publications: www.atmos.washington.edu/~breth/pubs.html

ORCID: orcid.org/0000-0002-6712-8856

Google Scholar profile:

<https://scholar.google.com/citations?user=dGxT7WcAAAAJ>

UW history:

1996-present: Professor of Atmospheric Science and Applied Mathematics

2010-2012: Boeing Endowed Professor of Applied Mathematics

2006-2011: Director, University of Washington Program for Climate Change

1989-1996: Associate Professor of Atmospheric Science and Applied Mathematics

1988-1989: Assistant Professor of Applied Mathematics and Atmospheric Science

1985-1988: Assistant Professor of Applied Mathematics

Background:

1984: Ph. D., Mathematics, Massachusetts Institute of Technology,

1985: Postdoctoral Fellow, Advanced Study Program, Natl. Center for Atmos. Research

Selected Awards and Honors:

1988-1994: NSF Presidential Young Investigator in Atmospheric Science

2004: Elected Fellow of the American Meteorological Society

2012: American Meteorological Society Jule G. Charney Award

2015: Elected Fellow of the American Geophysical Union

2017: American Meteorological Society 2019 Haurwitz Lecturer

Interests and Activities: Chris Bretherton is an atmospheric scientist who studies cloud formation and turbulence and improves how they are simulated in global climate and weather forecast models. His research includes participating in field experiments and observational analyses, three-dimensional modeling of fluid flow in and around fields of clouds, and understanding how clouds will respond to and feed back on climate change. Computer code developed by his research group for simulating cloud formation by atmospheric turbulence is used in the two leading US climate models. He was a lead author of the Intergovernmental Panel on Climate Change Fifth Assessment Report in 2013, Chair of a 2012 National Academy report entitled *A National Strategy for Advancing Climate Modeling*.

C.4 Bernard Deconinck

Professor and Chair of Applied Mathematics

Adjunct Professor of Applied Mathematics

Homepage: <http://depts.washington.edu/bdecon/bernard/>

Full CV: <https://www.dropbox.com/s/zu0sbx2ocl9fogu/cv.pdf?dl=0>

Links to publications: <http://depts.washington.edu/bdecon/allpublications/>

Google Scholar profile:

<https://scholar.google.be/citations?user=XR14ldMAAAAJ&hl=en&oi=ao>

Mathematical Genealogy Project:

<https://www.genealogy.math.ndsu.nodak.edu/id.php?id=140594>

UW history: Research Associate 1999-2001. Hired as Assistant Professor in 2003. Promoted to Associate Professor in 2006 and to Full Professor in 2011. Chair since 2015.

Background: Electrical Engineering Diploma (Option Engineering Physics), University of Ghent, 1993. MS and PhD in Applied Mathematics, University of Colorado at Boulder, 1995 & 1998.

Selected Awards and Honors: VIGRE Postdoctoral Fellow, UW, 1999-2000. NSF Postdoctoral Fellow, UW, 2000-2001. Boeing Endowed Professor of Applied Mathematics, UW, 2012-2015.

Interests and Activities:

Research areas: Nonlinear Waves, Soliton Theory, Fluid Mechanics and Water Waves, Hamiltonian Systems, Stability, Bose-Einstein Condensates, Riemann Surfaces, Symbolical and Numerical Computation, Lie Algebras, Semi-Discrete Systems, Asymptotics, Theta Functions.

Seventy-two refereed papers published, accepted, or submitted. Four refereed proceedings and 4 contributions to books. Eight software packages, most of which are part of the Maple software.

Sixty presentations at conferences and workshops, 68 seminars or colloquia. Presenter of two short courses. Participation in 20 summer schools or workshops. Organizer of 35 mini-symposia, sessions, or conferences.

Recipient or corecipient of 7 federal grants.

Teaching: instructor of 11 different courses at UW. Average course evaluation: 4.85/5, since 2003.

Community Activities: SIAM SIAG on Nonlinear Waves and Coherent Structures, Program Director 2011-2012. Founding President, SIAM Pacific Northwest Section, 2016-2018.

Editorial Activities: Associate Editor, SIAM Journal of Applied Mathematics, since 2016. Associate Editor, [Digital Library of Mathematical Functions](#)

Advisor to 9 PhD students, 8 of whom proceeded to postdoctoral institutions. Mentor to two postdoctoral fellows, both of whom are still in Academia. Undergraduate research mentor for 13 students, all but one of whom proceeded to graduate school.

C.5 Anne Greenbaum

Professor of Applied Mathematics
Adjunct Professor of Mathematics

Homepage: <http://faculty.washington.edu/greenbau/>

Full CV: <http://faculty.washington.edu/greenbau/CV/cv.pdf>

Links to publications:

<http://faculty.washington.edu/greenbau/PREPRINTS/page.html>

ORCID: <https://orcid.org/0000-0002-3783-3466>

Google Scholar profile:

<https://scholar.google.com/citations?user=4-1FimEAAAAJ&hl=en>

Mathematical Genealogy Project:

<https://www.genealogy.math.ndsu.nodak.edu/id.php?id=31589>

UW history: Hired as Full Professor of Mathematics in 1997. Moved to Applied Math Dept. in 2009.

Background: B.S. University of Michigan, 1974 (Mathematics, Philosophy). M.A., University of California, Berkeley, 1978 (Mathematics). Ph.D., University of California, Berkeley, 1981 (Mathematics). Mathematician at Lawrence Livermore National Lab, 1974-1986. Research Professor at Courant Institute of Mathematical Sciences, NYU, 1986-1997.

Selected Awards and Honors: Fellow of the Society of Industrial and Applied Mathematics (SIAM), 2015. B. Bolzano Honorary Medal for Merit in the Mathematical Sciences, 1997. SIAM Activity Group on Linear Algebra Award for Outstanding Paper in Applicable Linear Algebra during 1991-1993.

Interests and Activities:

Research areas: Numerical Analysis, Linear Algebra and Operator Theory. Recent work has been on nonnormal matrices and what to look at instead of eigenvalues to describe the behavior of functions of a matrix. One possibility is the numerical range and I have worked on Crouzeix's conjecture, which is that for any square matrix A and any analytic function f , the 2-norm of $f(A)$ is less than or equal to twice the maximum absolute value of f on the numerical range of A .

Over 50 refereed publications and 3 books. Coauthor of a widely used software package (LAPACK).

Community Activities: Co-organizer (with Mark Embree and Michael Overton) American Institute of Mathematics (AIM) Workshop on Crouzeix's Conjecture, July 31-Aug. 4, 2017. Former Vice-President of SIAM Activity Group on Linear Algebra. Have served on editorial boards of several journals and on organizing committees for several conferences on numerical analysis and applied math.

UW leadership roles: Director of ACMS (Applied and Computational Mathematical Sciences) program, 2010-2013, and interim Director, 2015.

Advisor to six PhD students, four of whom have graduated and have positions in academia or industry. Advisor to several Master's students.

C.6 Ulrich Hetmaniuk

Associate Professor of Applied Mathematics

Homepage: <http://faculty.washington.edu/hetmaniu>

Full CV: <http://faculty.washington.edu/hetmaniu/CV.pdf>

Google Scholar profile:

<https://scholar.google.com/citations?user=qhWkxUAAAAAJ&hl=en>

UW history: Hired as Assistant Professor in 2008. Promoted to Associate Professor in 2014.

Background: Diploma of Engineering, Ecole Polytechnique (1993-1996)

Diploma of Engineering, Ecole Nationale des Ponts et Chaussées (1996-1999)

Ph.D. in Aerospace Engineering Sciences, University of Colorado (2002)

Postdoctoral Researcher, Sandia National Laboratories (2003-2008)

Interests and Activities:

Interests: numerical analysis and scientific computing; domain decomposition methods; finite element methods; reduced-order models.

Research areas:

1. Efficient finite element discretization methods for physical models, governed by partial differential equations and with important features at multiple scales: this work represents the physical variables as a weighted sum of special functions that incorporate knowledge about the physics and/or the partial differential equation; the definition of these functions does not require any user input and combines mathematical results from the theories of domain decomposition, of spectral decomposition, and of finite element methods.
 2. Reduced-order modeling: this work focuses on methods for computing efficiently reduced-order models while preserving certain physical aspects and on a priori and a posteriori error bounds for controlling the accuracy of these models.
- Publicly released MATLAB software to calculate the retarded and less-than Green's function for a two-dimensional quantum device (collaboration with Prof. M. P. Anantram at UW-EE).
https://els.comotion.uw.edu/express_license_technologies/glessuw.
 - PI or co-PI on 2 NSF grants, 2 ONR grants, and 2 sub-contracts (1 from SNL and 1 from PNNL).
 - 34 refereed published papers.
 - Instructor of 7 different courses at UW (AMATH 301, 352, 567, 570, 581, 583, 584).

C.7 Mark Kot

Associate Professor of Applied Mathematics

Homepage: <http://faculty.washington.edu/mkot/>

Full CV: Available on self-study site

Links to publications:

<http://faculty.washington.edu/mkot/tmp/Publications.html>

Google Scholar profile:

<https://scholar.google.com/citations?user=JIzwRnQAAAAJ>

UW history:

Associate Professor, 1994–1996, 2000–2017

Assistant Professor, 1990–1994

Background:

Ph.D. (1987), Ecology and Evolutionary Biology, University of Arizona

M.S. (1987), Ecology and Evolutionary Biology, University of Arizona

M.S. (1984), Applied Mathematics, University of Arizona

M.S. (1979), Theoretical and Applied Mechanics, Cornell University

B.A. (1977), Physics and Applied Mathematics, New College

Interests and Activities:

Most of my research is in ecology and ornithology.

I am the author of two books and the author or coauthor of five book chapters and thirty-nine journal articles.

I was the dissertation advisor for 11 Ph.D.s.

I engage in service.

I have taught many courses.

C.8 J. Nathan Kutz

Robert Bolles and Yasuko Endo Professor of Applied Mathematics
Adjunct Professor of Physics
Adjunct Professor of Electrical Engineering
Senior Data Science Fellow, eScience Institute

Homepage: faculty.washington.edu/kutz/

Full CV: faculty.washington.edu/kutz/page4/

Links to publications: faculty.washington.edu/kutz/page6/

Google Scholar profile:

<https://scholar.google.com/citations?hl=en&user=kfT42KEAAAAJ>

UW history: Hired as Assistant Professor in 1998; Promoted to Associate Professor in 2001; Promoted to Full Professor in 2005.

Background: BS in Physics and Mathematics, University of Washington (1990); PhD in Applied Mathematics, Northwestern University (1994, Advisor: Prof. William Kath); Postdoctoral Fellow, Institute for Mathematics and its Applications (1994-1995); Research Associate, Program in Applied and Computational Mathematics, Princeton University (1995-1997, Advisor: Prof. Phil Holmes); Research Associate, Bell Laboratories, Lucent Technologies (1995-1997).

Selected Awards and Honors: Fellow of the Radcliffe Institute for Advanced Studies, Harvard University (2012-2013); Applied Mathematics Boeing Teaching Award (2007, 2017); National Science Foundation CAREER Award (2001-2006); Woodrow Wilson National Fellowship Foundation: Career Enhancement Fellowship (2001-2002); NSF International Research Fellow Award (1997-1998); NSF-NATO Postdoctoral Fellowship (1997-1998); NSF Mathematical Sciences University-Industry Postdoctoral Fellowship (1995-1997); National Defense Science and Engineering Graduate Fellowship (1991-1994)

Interests and Activities:

Research: My group develops data methods for reduced-order and equation-free modeling, machine learning, and compressive sensing for applications across the engineering, physical and biological sciences. We also leverage traditional applied mathematics expertise in nonlinear waves, scientific computing, perturbation and asymptotic methods, and bifurcation theory. Domain science research includes optics, neuroscience, computer vision, and fluid dynamics. I am author of three textbooks on data science and computational methods (Oxford 2013, SIAM 2017, Cambridge 2018). I am funded from AFOSR, DARPA and DOE.

Group: I am currently mentoring a variety of postdoctoral fellows (6, 3/6 are women), graduate students (10, 5/10 are women) and undergraduate students (3) whose research interests span from neuroscience to fluid dynamics to machine learning. My group routinely produces open-source code and data which is available online for use by the broader community.

Other professional activities: I am Associate Editor for Science Advances and SIAM Journal of Applied Mathematics. I also have organized a number of leading SIAM conferences (SIAM Nonlinear Waves and Coherent Structures in 2006 and 2008) and workshops (e.g. 2017 Rome workshop on Multiscale and Complex Systems).

C.9 Tim Siu-Tang Leung

Tim Siu-Tang Leung

Associate Professor of Applied Mathematics

Homepage: <http://faculty.washington.edu/timleung/>

Full CV: <http://faculty.washington.edu/timleung/CV.pdf>

Links to publications: <http://faculty.washington.edu/timleung/research.html>

ORCID: <http://orcid.org/0000-0002-0023-6289>

Google Scholar profile:

<https://scholar.google.com/citations?user=P40aOHIAAAAJ>

UW history: Hired as tenured Associate Professor in 2016. Director of the Computational Finance & Risk Management Program, affiliate of UW Quantitative Ecology and Resource Management (QERM) Program and eScience Institute.

Background: B.S. in Operations Research and Industrial Engineering, Cornell University (2001-2003); Ph.D. in Operations Research and Financial Engineering, Princeton University (2004-2008); Assistant Professor (tenure-track), Applied Mathematics & Statistics Department (2008-2011); Assistant Professor (tenure-track), Industrial Engineering & Operations Research Department Columbia University (2011-2016)

Selected Awards and Honors: NSF-DMS 8th Western Conference on Math Finance Grant (co-PI, 2017); NSF-DMS Applied Mathematics Research Grant (sole PI, 2009-2012); Columbia University SEAS Summer Research Grants (2014, 2016); Emerald Literati Network Award for Excellence (2016); INFORMS Financial Services Section Best Research Paper Competition (1st runner-up, 2008); Princeton University Charlotte Procter Honorific Fellowship (2007-2008)

Interests and Activities:

Research areas: Financial Mathematics/Engineering and Optimal Stopping/Stochastic Control with applications to derivatives pricing, algorithmic & high-frequency trading, credit risk, executive stock options, exchange-traded funds (ETFs), commodities, and real options.

Books: *Optimal Mean Reversion Trading* published by World Scientific, and *Leveraged Exchange-Traded Funds* published by Springer, both in 2016.

Elected Positions: SIAM Activity Group on Financial Mathematics and Engineering (SIAG-FME) *Vice Chair* (2017-2019), *Program Director* (2014-2016); INFORMS Section on Finance *Chair* (2016-2019), *Treasurer* (2013-2015).

Editorial: Associate Editor of SIAM Journal on Financial Mathematics, Applied Math Finance, Journal of Financial Engineering, High Frequency, Studies in Economics & Finance, Digital Signal Processing. Founding Editor of *Modern Trends in Financial Engineering* (Book Series), published by World Scientific. Book Reviewer of American Mathematical Society, Academic Press, Oxford University Press, SIAM, and Wiley.

Conference Organization: Co-organizer of the 8th Western Conference on Math Finance (2017), co-chair of SIAM Conference on Financial Math & Engineering (2016), organizer of SIAM: 8th International Congress on Industrial and Applied Mathematics (ICIAM) Financial Math Track (2015), minisymposium organizer of the SIAM Conferences on Financial Math & Engineering (2012, 2014), and on Control and Its Applications (2011), Cluster Chair of the INFORMS Annual Meetings (2008, 2010-2014), organizer of the Financial Math Session at the AMS Annual Meeting (2009, 2013).

Teaching: AMATH590: PDE for Finance (2017); CFRM548: Monte Carlo Methods ('17,'18).

C.10 Randall J. LeVeque

Boeing Professor of Applied Mathematics
Adjunct Professor of Mathematics
Adjunct Professor of Earth & Space Sciences
Senior Data Science Fellow, eScience Institute

Homepage: <http://faculty.washington.edu/rjl/>

Full CV: <http://faculty.washington.edu/rjl/vita/LeVequeCV.pdf>

Links to publications: <http://faculty.washington.edu/rjl/pubs/>

ORCID: <http://orcid.org/0000-0003-1384-4504>

Google Scholar profile:

<http://scholar.google.com/citations?user=N66WuY0AAAAJ>

Mathematical Genealogy Project:

<https://www.genealogy.math.ndsu.nodak.edu/id.php?id=44513>

Github: <https://github.com/rjleveque>

UW history: Hired as Assistant Professor in 1985 (100% Mathematics, Adjunct in Applied Mathematics); Promoted to Associate Professor in 1987; Promoted to Full Professor in 1990; Switched to 50% Applied Mathematics in 1991 and 100% AMath in 2001.

Background: BS in Mathematics from UCSD (1977); PhD in Computer Science from Stanford (1982); NSF Postdoc at NYU (1982–83); Hedrick Assistant Professor at UCLA (1983–85); Professor at ETH-Zürich (1990-91).

Selected Awards and Honors: Presidential Young Investigator Award, 1987; Fellow of the Society of Industrial and Applied Mathematics (SIAM), since 2010; Fellow of the American Mathematical Society (AMS), since 2013; Invited Lecture, International Congress of Mathematicians, Madrid, 2006; DiPrima Lecturer, RPI, 2016; Grosswald Lecturer, Temple University, 2016; Clifford Lecturer, Tulane University, 2017.

Interests and Activities:

Primarily focused on numerical analysis, scientific computing, the study and application of numerical methods for hyperbolic PDEs, and their application to practical problems. Core developer of the [Clawpack](#) software project (Conservation Laws Package) since initiating the project in 1994, and recently primarily work on [GeoClaw](#), a variant for modeling geophysical flows, and application of this code to tsunami modeling projects, including for the development of inundation maps and design of vertical evacuation structures for Washington State, for the [Early Warning Offshore Cascadia Project](#), and as part of the NASA Asteroid Threat Assessment Project ([ATAP](#)).

Author of three [textbooks](#) that are widely used, 80 journal publications and more than 40 conference proceedings and other papers.

UW leadership roles: Member of the [M9 Project](#) Steering Committee, Executive Committee of the [eScience Institute](#), [NIAC](#) Steering Committee, and Faculty Council on University Libraries.

Other professional activities: Have served SIAM in various capacities, including two terms each as a member of the SIAM Council (2002–07), Chair of the Journals Committee (2010–15), and currently on the SIAM Board of Trustees (2014–19) and the editorial board of SIAM News. Member of Banff International Research Station Advisory Board.

C.11 Matthew Lorig

Assistant Professor

Homepage: <https://matllorig.yolasite.com/>

Full CV: <https://matllorig.yolasite.com/resources/CV-2017-06-24.pdf>

Links to publications: <https://matllorig.yolasite.com/publications.php>

ORCID: <http://orcid.org/0000-0001-5307-3447>

Google Scholar profile:

<https://scholar.google.com/citations?user=xl7g50MAAAAJ&hl=en>

arXiv author page:

https://arxiv.org/find/q-fin/1/au:+Lorig_M/0/1/0/all/0/1

UW history: Hired as Assistant Professor in 2014.

Background: B.S. in Physics, Summa Cum Laude with Highest Distinction (University of Minnesota – Twin Cities, 2000 – 2004); Ph.D. in Physics (University of California at Santa Barbara, 2005 – 2011); Postdoctoral Researcher and Lecturer, Department of Operations Research and Financial Engineering (Princeton University, 2011 – 2014).

Selected Awards and Honors: SIAM Activity Group on Financial Mathematics and Engineering (SIAG/FME) Early Career Prize (2016); NSF-DMS 8th Western Conference on Math Finance Grant (PI, 2017); National Defense Science and Engineering Graduate Research Fellowship (2005).

Interests and Activities: Financial Mathematics/Engineering, Asymptotics of Partial Differential Equations, Fourier Analysis, and Stochastic Control with applications to derivatives pricing, optimal investment, robust hedging and risk management.

Editorial: Associate Editor, *Applied Mathematical Finance* (Journal), published by Taylor & Francis; Editor Board, *Modern Trends in Financial Engineering* (Book Series), published by World Scientific.

Conference Organization: Co-organizer of the 8th Western Conference on Math Finance (2017); Co-organizer of special session on Financial Engineering and Risk management at the AMS National Meeting (2016); Organizer of a minisymposium on Robust Methods and Model Uncertainty at the 5th SIAM Conference on Financial Mathematics and Engineering (2016).

Teaching: CFRM 504/544: Options and Derivatives ('14, '16, '17); CFRM 550/559: Stochastic Calculus for Derivatives ('15, '16, '17); AMATH 561/572: Introduction to Probability and Stochastic Processes ('16, '17); AMATH 562: Advanced Stochastic Processes ('18); AMATH 569: Advanced Methods for Partial Differential Equations ('17).

Invited Lecturer of Mini-courses: University of Bologna, Bologna, Italy (2013); Ritsumeikan University, Kyoto, Japan (2017).

C.12 Hong Qian

Hong Qian

Olga Jung Wan Endowed Professor of Applied Mathematics
Adjunct Professor of Bioengineering

Homepage: <http://faculty.washington.edu/hqian/>

Full CV: <http://faculty.washington.edu/hqian/CV.pdf>

Links to publications: <http://faculty.washington.edu/hqian/publications.html>

UW history: Assistant Professor 1997-03, Associate Professor 2003-06, Professor 2006-

Background:

Peking University, Beijing, B.A. 1982 Astrophysics

Washington University, St. Louis, Ph.D. 1989 Biomedical Sciences

University of Oregon, Eugene, Postdoctoral 1990-1992 Biophysical Chemistry

California Institute of Technology, Pasadena, Postdoctoral 1992-1994 Mathematical Biology

Selected Awards and Honors:

1992-1994 Fellow, Program in Mathematics and Molecular Biology at the University of California at Berkeley, supported by the National Science Foundation.

2002-2003 Royalty Research Fund, University of Washington.

2007-2008 Boeing Endowed Professorship, University of Washington.

2010 Fellow, American Physical Society, Division of Biological Physics.

Interests and Activities:

Interested in stochastic mathematical representation and statistical physics of complex dynamics, ranging from single biological macromolecules to cells to evolutions of cancer; mathematical biology, nonequilibrium thermodynamics, foundation of information theory.

Taught and teaching undergraduate and graduate *Biophysical Chemistry* (at UCLA); undergraduate, graduate, and specialized *Mathematical Biology*, *Stochastic Mathematics in Biology*, and *Mathematical Genomics*; undergraduate *Mathematical Modeling with Continuous Methods*, undergraduate and graduate level *Dynamical Systems*, *Applied Stochastic Analysis*, graduate *Advanced Methods for Ordinary Differential Equations*.

I was Visiting Professors at Département de Chimie, École Normale Supérieure, Paris (2008), Fudan University, Shanghai (2008,2009), Tang Ao-Qing Visiting Professor of Jilin University, Changchun (2011-2013).

As members of various review panels on *NIH Modeling and Analysis of Biological Systems* (2004,2006), *NSF-NIGMS Mathematical Biology Grant* (2005), *NIH Multiscale Physiome Modeling Study Section* (2008), *NSF New Biomedical Frontiers at the Interface of the Life and Physical Sciences* (2012).

Organized workshops and conferences on *Molecular machines* (IPAM, 2004), *Stochastic modeling in biology* (Soc. Math. Biol. 2004) *Function and dynamics of biomolecules*, *Small system nonequilibrium fluctuations*, *Nonequilibrium processes at the nanoscale* (Kavli Institute for Theoret. Phys. China, 2009, 2013 and 2016); I was the founding Vice Chair for the Gordon Research Conference series on *Stochastic Physics in Biology* (2011) and the Chair (2013).

Served and am serving on editorial boards of journals *Biophysical Chemistry* (2004-2007), *Molecular & Cellular Biomechanics*, (2004-now), *Frontiers in Systems Biology* (2010-2011), *Computers in Biology and Medicine* (2010-2012), *BMC Systems Biology* (2010-now), *Quantitative Biology* (2013-now).

C.13 Eric Shea-Brown

Professor of Applied Mathematics

Homepage: <http://faculty.washington.edu/etsb>

Full CV: http://faculty.washington.edu/etsb/pubs/Shea-Brown_cv.pdf

Links to publications: <http://faculty.washington.edu/etsb/publications.html>

Google Scholar profile:

<https://scholar.google.com/citations?user=GyvbrjcAAAAJ>

UW history: Hired as Assistant Professor starting Jan. 2008. Associate Professor Sept. 2012-Sept. 2016; Professor from Sept. 2016. Adjunct Professor, Department of Physiology and Biophysics; Faculty, Graduate Program in Neuroscience; Affiliate Investigator, Allen Institute for Brain Science.

Background: B.S. in Engineering Physics (with High Honors), University of California at Berkeley (1998). Research fellow, Lawrence Livermore National Laboratory (LLNL), (1996 -1999). Ph.D. (2004) and M.S. (2001) Applied and Computational Mathematics, Princeton University. Advisor: Philip Holmes; Co-Advisor: Jonathan Cohen. Dissertation: Neural oscillators and integrators in the dynamics of decision tasks. Postdoctoral research fellow, Courant Institute for Mathematical Sciences and Center for Neural Science, New York University, (2004- 2007). Mentor: John Rinzel.

Selected Awards and Honors: Boeing Endowed Professor of Applied Mathematics (2015-); Simons Fellowship in Mathematics (2014); National Science Foundation CAREER Award (2011-2016); Burroughs Wellcome Career Award at the Scientific Interface (2006-2013); Council of Graduate Schools / University Microfilms International Distinguished Dissertation Award in the field of Mathematics, Science, and Engineering (2004); Mathematical Sciences Postdoctoral Fellow, National Science Foundation (2004-2007); Porter Ogden Jacobus Fellow, Princeton University (2003-2004); National Science Foundation Graduate Fellowship (1999-2002); UC-Berkeley Departmental Citation in Engineering Science (1999)

Interests and Activities:

Research areas: Theoretical and computational neuroscience; applied dynamical systems.

Mentoring: Current and former postdoctoral fellows (6), PhD students (11), Undergraduates (9). Six former postdocs and PhD students hold tenure-track positions; all others are postdocs at, e.g., NYU and UCL (one just moved to permanent scientific software team position); undergrads have fulfilled goals from PhD to MS to MD to a national lab position.

Teaching: Scientific computing and dynamical systems, and three new courses established: Introduction to Computational Models in Biology, Introduction to Neural Coding and Computation, and Dynamics of Neurons and Networks.

Program Building for Interdisciplinary Mathematics and Science: Co-founder and co-director of UW Computational Neuroscience Center, co-Director of NIH Training Program and UW Graduate Certificate in Neural Computation and Engineering, Thrust leader for Computational Neuroscience for NSF Center for Sensorimotor Neural Engineering (CSNE).

Funding at UW: includes PI for ~ \$2M of research grants, joint PI for ~ \$1.5M training grant and leadership team for another, thrust leader for ~ \$20M NSF research center (CSNE).

C.14 Eli Shlizerman

Eli Shlizerman

Assistant Professor Applied Mathematics and Electrical Engineering
Washington Research Foundation Professor
Research Scientist, Facebook

Homepage: <http://faculty.washington.edu/shlizee/>

Full CV: <http://faculty.washington.edu/shlizee/CV/EliCV.pdf>

Links to publications:

<http://faculty.washington.edu/shlizee/publications.html>

UW history:

2009-2012 Acting Asst. Professor (Postdoctoral), AMATH, UW
2012-2015 Assistant Professor without tenure, AMATH, UW
2015- Assistant Professor tenure track, AMATH and EE, UW
2015- Data Science Fellow, eScience Institute, UW

Background: I combine dynamical systems theory with data analysis to classify, wire and predict high-dimensional time-dependent complex networks. e.g, neurobiological and artificial neural networks, which are extremely challenging to analyze using traditional approaches. Currently, I focus on neurobiological networks underlying insects' sensory systems, neural dynamics of organisms and transfer of concepts from these systems to artificial networks.

Selected Awards and Honors:

2016 Outstanding Teaching Award in Applied Mathematics
2014 NSF/NIGMS Initiative Award
2012 Boeing Award for outstanding research, teaching and service
2011 Society for Industrial and Applied Mathematics Early Career Award

News Coverage:

[Audio to Body Dynamics](#) (CNBC, ...)
[Time-compensated sun compass in the migrating monarch butterfly](#) (BBC, CNC, Cell, ...)
[Eli Shlizerman Appointed UW eScience Institute Data Science Fellow](#) (UW EE News)
[Car exhaust keeps moths from smelling the roses](#) (NY Times, Q13FOX TV, Science, ...)

Interests: Computational Neuroscience, Neural Networks, Machine Learning,
Data Science and Scientific Computing

Research Directions:

Classification of neuronal network dynamics
Wiring and functional connectomics from network dynamics
Modeling nervous systems on various scales
Neuromorphic computing

Activities:

Steering Committee of UW eScience Masters program in Data Science
Steering Committee of UW Computational Neuroscience Center
Facebook Research Scientist in AI
Advising: 4 PhD students, 2 MS students, 3 Undergraduate students
Teaching: Scientific Computing 481/581, EE Entrepreneurial Capstone
Member of 3 PhD Committees
UW EE Graduate Fellowships committee

C.15 Emanuel Todorov

Emanuel Todorov

Associate Professor, Applied Mathematics and Computer Science & Engineering, UW
Founder and CEO, Roboti LLC

University homepage: <http://homes.cs.washington.edu/~todorov/>

Company homepage: <http://www.mujo.org/>

Link to publications: <https://homes.cs.washington.edu/~todorov/papers.html>

UW history

Joined UW as Associate Professor with tenure in 2009, with 50/50 split appointment between Applied Mathematics and Computer Science & Engineering.

Background

PhD in Cognitive Neuroscience, MIT, 1993 - 1998

Postdoctoral training in Computational Neuroscience, UCL, 1999-2001

Research Scientist in Biomedical Engineering, USC, 2001-2002

Assistant Professor in Cognitive Science, UCSD, 2002-2009

Associate Professor in AMATH and CSE, UW, 2009-present

Founder and CEO of Roboti LLC, 2010-present

Selected Awards and Honors

Best Paper Award, International Conference on Robotics and Automation (2016)

Best Paper Award, Uncertainty in Artificial Intelligence (2014)

Sloan Research Fellowship in Neuroscience (2004-2006)

Howard Hughes Predoctoral Fellowship (1994-1998)

International Programming Contest of the ACM - 7th Place (1995)

International Olympiad in Mathematics - Silver Medal (1990)

International Olympiad in Mathematics - Gold Medal (1989)

International Olympiad in Informatics - Gold Medal (1989)

Interests and Activities

We are interested in the control of complex movements in animals, robots and animated characters. Biological movements can be modeled in detail using optimality principles - which is not surprising given that they are shaped by iterative optimization processes such as evolution, learning, adaptation. Similarly, the best way to engineer a complex control system is to specify a high-level performance criterion and leave the details to numerical optimization. In both areas, the main difficulty lies in actually performing the optimization. Thus our focus is on developing more powerful methods for optimal control and applying them to harder problems. A key tool we use is the MuJoCo physics engine developed by Roboti LLC.

C.16 Ka-Kit Tung

Frederic and Julia Wan Endowed Professor of Applied Mathematics
Adjunct Professor of Atmospheric Sciences

Homepage: <https://amath.washington.edu/people/ka-kit-tung>

Full CV:

<https://depts.washington.edu/amath/departmental/fac-cv/tung-cv.html>

Links to publications:

<https://depts.washington.edu/amath/faculty/tung/publications.shtml>

Google Scholar profile:

<https://scholar.google.com/citations?user=uVnpWYoAAAAJ>

UW history: Joined the Department as Professor of Applied Mathematics in 1988 and became the Department Chair in 1993, a position he held until 2007.

Background: Professor Tung received his baccalaureate and master's degrees at the California Institute of Technology, both in 1972, in the field of Aeronautical Engineering. He earned his doctorate degree in Applied Mathematics at Harvard University in 1977, where he also stayed on for two more years as a postdoc before moving on to MIT, first as an Assistant Professor of Applied Mathematics and then as an Associate Professor. He became a John Simon Guggenheim Fellow in 1985. Professor Tung joined the Department as Professor of Applied Mathematics in 1988.

Selected Awards and Honors: Fellow of American Meteorological Society, Royal Meteorological Society; Guggenheim Foundation Fellow; Boeing Professorship, Frederic and Julia Wan Endowed Professorship; Outstanding Service as Chief Editor of Journal of Atmospheric Sciences.

Interests and Activities: Research in climate sciences, atmospheric and oceanic sciences; taught undergraduate mathematical modeling, undergraduate and graduate partial differential equations, complex variables and fluid mechanics.

D Additional data on degree programs

The tables in this section give information on each of the degree programs offered by the department. For a discussion of the programs and this data, see Section 1.1.2.

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ACMS Graduates by Year				
Academic Year	Graduated	Female	International	URM
2016–17	70	29	33	2
2015–16	83	33	54	0
2014–15	71	29	37	0
2013–14	60	19	20	0
2012–13	107	33	30	1
2011–12	116	31	17	1
2010–11	88	25	9	2
2009–10	61	15	6	1
2008–09	49	9	4	0
Total	705			

ACMS Graduates by Program Option									
Academic Year	Graduated	BLS	DMA	EPS	ME	OR	SCNA	SBS	STAT
2016–17	70	5	21	12	20	0	11	0	1
2015–16	83	4	23	6	28	0	18	0	4
2014–15	71	5	16	7	29	3	10	0	1
2013–14	60	2	15	10	23	1	6	0	3
2012–13	107	7	39	18	27	1	10	2	3
2011–12	116	5	34	38	25	2	8	2	2
2010–11	88	5	30	18	24	2	3	0	6
2009–10	61	5	20	12	13	2	4	3	2
2008–09	49	4	17	8	11	0	4	0	5
Total	705	42	215	129	200	11	74	7	27

ACMS Enrollment by Program Option (Winter 2018)									
Academic Year	Enrolled	BLS	DMA	EPS	ME	OR	SCNA	SBS	DSS
2017–18	160	13	59	13	27	0	17	2	30

Student Data Table 1: ACMS Major graduation and enrollment statistics. The Program Options are: **BLS**: Biological and Life Sciences, **DMA**: Discrete Math and Algorithms, **EPS**: Engineering and Physical Sciences, **ME**: Mathematical Economics, **OR**: Operations Research (deprecated), **SCNA**: Scientific Computing and Numerical Analysis, **SBS**: Social and Behavioral Sciences, **STAT**: Statistics (deprecated). **DSS**: Data Science and Statistics. In the top table, **URM** is “under-represented minorities”.

Academic Year	Graduated	Female	International	URM
2016–17	128	41	35	13
2015–16	116	36	51	21
2014–15	74	17	25	3
2013–14	77	20	16	12
2012–13	87	33	9	14
2011–12	81	18	12	15
Total	563			

Student Data Table 2: AMath Minor graduation statistics. Data is not available for current number of minors. **URM** is “under-represented minorities”.

PhD Program Applicants			
Entering Year	Applicants	Admitted	Accepted Offer
AUT 2017	285	31	13
AUT 2016	289	22	7
AUT 2015	230	24	10
AUT 2014	233	31	12
AUT 2013	206	20	8
AUT 2012	257	32	13
AUT 2011	247	21	7
Total			70

PhD Program Graduates and Enrollment					
Academic Year	Graduated	Enrolled	Female	International	URM
2017–18	TBD	53	17	17	5
2016–17	9	50	13	16	4
2015–16	6	49	13	16	4
2014–15	7	49	15	17	4
2013–14	9	44	13	19	2
2012–13	8	46	11	18	4
2011–12	10	42	12	19	3
Total	49+				

Student Data Table 3: PhD program.

On-campus AMath Master's Applicants			
Entering Year	Applicants	Admitted	Accepted Offer
2017-18	89	128	30
2016-17	76	139	25
2015-16	64	69	14
2014-15	74	90	22
2013-14	70	110	27
2012-13	71	98	25
2011-12	70	79	20
Total			153

On-campus AMath Master's Graduates and Enrollment					
Academic Year	Graduated	Enrolled	Female	International	URM
2017-18	TBD	35	18	23	0
2016-17	27	37	12	14	2
2015-16	24	22	7	11	1
2014-15	22	32	16	18	0
2013-14	24	36	16	17	2
2012-13	40	36	12	12	3
2011-12	23	30	9	12	4
Total	160+				

Student Data Table 4: On-campus AMath Master's degree. Note that number admitted may be greater than number who apply since some PhD applicants are instead admitted to Master's program.

Online AMath Master's Applicants			
Entering Year	Applicants	Admitted	Accepted Offer
2016-17	104	82	22
2015-16	128	105	29
2014-15	94	67	19
2013-14	138	102	29
2012-13	120	92	31
2011-12	109	109	29
Total			159

Online AMath Master's Graduates and Enrollment					
Academic Year	Graduated	Enrolled	Female	International	URM
2016-17	21	75	20	5	9
2015-16	17	72	16	4	11
2014-15	26	62	18	6	12
2013-14	31	61	11	12	6
2012-13	23	71	12	7	8
2011-12	21	52	9	5	3
Total	139				

Student Data Table 5: Online AMath Master's degree.

On-campus CFRM Master's Applicants				
Entering Year	Applicants	Admitted	Accepted Offer	Enrolled
2017-18	630	78	37	32
2016-17	703	101	50	30
2015-16	561	123	66	39
2014-15	303	103	38	28
2013-14	277	82	36	34
2012-13	157	47	29	21
2011-12	52	21	21	20
Total			277	204

On-campus CFRM Master's Graduates and Enrollment					
Academic Year	Graduated	Enrolled	Female	International	URM
2017-18	TBD	60	32	41	0
2016-17	39	69	33	60	1
2015-16	31	68	24	61	3
2014-15	28	59	22	49	0
2013-14	18	46	23	41	0
2012-13	17	34	17	31	0
2011-12	1	20	5	16	0
Total	134+				

Student Data Table 6: On-campus CFRM Master's degree.

Online CFRM Master's Applicants				
Entering Year	Applicants	Admitted	Accepted Offer	Enrolled
2017-18	44	23	18	15
2016-17	83	65	27	21
2015-16	49	34	27	22
2014-15	52	42	41	35
2013-14	59	36	22	21
2012-13	53	39	19	16
2011-12	23	15	14	14
Total				144

Online CFRM Master's Graduates and Enrollment					
Academic Year	Graduated	Enrolled	Female	International	URM
2017-18	TBD	47	5	12	6
2016-17	12	59	8	11	5
2015-16	14	57	9	9	4
2014-15	13	60	9	16	4
2013-14	16	39	4	9	9
2012-13	11	29	3	6	3
2011-12	1	14	0	3	1
Total	67				

Student Data Table 7: Online CFRM Master's degree.