

FOUR YEAR (2022-2026) HIRING PLAN

DEPARTMENT OF MATHEMATICS
APPROVED BY THE FACULTY ON 19 APRIL 2022

Hiring Plan Committee: Adib Bagh, Christopher Manon, Uwe Nagel, Jack Schmidt, Nathaniel Stapleton, Mihai Tohaneanu, Qiang Ye (Chair), Martha Yip.

Mathematics education and research play a crucial role in UK's education and scholarship missions. The Department of Mathematics pursues excellence in its missions. We (1) provide quality basic mathematics education to undergraduates and maintain two vibrant major programs; (2) sustain a large and highly successful graduate program; (3) conduct funded research in the forefront of mathematical discovery and applications; (4) publish papers in high quality journals and successfully compete at the international level; and (5) provide graduate education support and research collaboration/consultation to various disciplines across UK as well as outreach to the community at large. Mathematics does not require expensive equipment. Our success depends on our strong and stable faculty body.

The Math Department currently has 31 tenure-stream faculty, 10 lecturer faculty, and 2 postdoctoral scholars. We teach more than 35,000 credit hours a year, far more than any other department in the College of Arts and Sciences. The department offers BA and BS degrees in mathematics and is a primary contributor to the Mathematical Economics major program. We have developed a thriving undergraduate research program under the initiative of the Math Lab. This has attracted significant student participation and has enriched students' UK experiences. Several of our recent graduates have received prestigious awards such as Goldwater Scholarship and NSF Graduate Research Fellowship, have gone on to top graduate programs such as Cornell's, Harvard's or Michigan's, and have achieved distinguished careers with companies such as Google and SpaceX. Our graduate program is one of the largest in the College. Our graduate students have received prestigious fellowships in recent years such as Fulbrights, National Science Foundation graduate and postdoctoral fellowships, and others from the Department of Defense and NASA. Our doctoral graduates work in positions throughout academia, industry, business, and government. Tenure-stream faculty conduct vigorous research programs, with 24 out of 31 of them supported by external grants. All tenure-track assistant professors are currently supported by NSF grants. The Department has also recently received a Sloan Fellowship, the first since 1982. Our advanced classes have quite substantial enrollments of graduate students from other programs. Our faculty has lent their expertise by serving on graduate committees and collaborating outside of the department. The department has many outreach activities such as Central Kentucky Mathematics Circles, High School Math Day, and Math Movie of the Month, and indeed led the efforts to improve training of mathematics teachers in the Commonwealth of Kentucky through works such as the Appalachian Mathematical Science Partnership.

The Math Department is presently faced with several significant challenges.

- Our instructors have always had to deal with unevenly prepared students in our service courses but with the aftermath of the Covid-19 disruptions, this challenge has risen to such an unprecedented level that we need to offer remedial works or

redirect students to alternative classes. These demand availability of spaces in our offerings and manpower resources.

- The department has suffered from a skewed demographic distribution in the recent past, that had significantly affected our capacity in services and graduate advising. While this is much alleviated now, the faculty population is still heavily concentrated in the senior full professor and junior associate professor ranks with only 5 in the assistant professor rank and no faculty obtaining a Ph.D. between 1996 and 2006. Without continual hiring, this demographic gap could potentially develop into a crisis situation again.
- There has been significant faculty attrition since the Covid-19 pandemic. We have had two lecturers and one tenure-track faculty leave, two tenured faculty retire, and two more upcoming retirements announced. More retirements are expected in the next few years. These retirements, if not promptly replaced, have the potential to jeopardize much of hard-fought progress that we have made in recent years.

In addition, the department aspires to strengthen our offerings and expand our initiatives in a number of areas.

- Seek more effective ways to deliver our service level classes and improve student experiences by exploring more uses of technology;
- Increase the number of math majors by expanding our course offerings, undergraduate research opportunities, and the Math Lab;
- Strengthen our postdoctoral program by attaining a critical mass that is comparable to our peer institutions;
- Enhance the diversity of our faculty and build a more inclusive community;
- Broaden data science education and research at UK;
- Build faculty capacity that would increase interdisciplinary collaborations and bring research funding from non-traditional sources.

To meet the challenges and reach our goals, investment in faculty is urgently needed.

The Math Department proposes to hire 9 tenure-track assistant professors, 4 lecturers, and 5 postdoctoral researchers in the next 4 years (2022-2026). The department is committed to increasing the diversity in our faculty and will continue in our efforts of making sure to attract, interview, and recruit from a diverse pool of candidates. Our tenure-stream hires will continue to commit a significant amount of their time to teaching large classes from the wide range of service courses offered by the department. We will prioritize the search over the 4 years as follows:

Year 1: one tenure-track assistant professor in Topology, two tenure-track assistant professors in two of the areas of Applied Math, Algebra, or Partial Differential Equations, two lecturers, and one postdoctoral researcher;

Year 2: one tenure-track assistant professor in the area of Applied Math, Algebra, or Partial Differential Equations that is passed over for hiring in Year 1, one tenure-track assistant professor in Partial Differential Equations, one lecturer, and two postdoctoral researchers;

Year 3 and Year 4: four tenure-track assistant professors, one in each of the areas of Applied Math, Algebra, Topology, and Partial Differential Equations, one lecturer, and two postdoctoral researchers. The proposed hiring will be evenly distributed over the two years with the priority to be determined upon potential faculty retirements/departures and the needs at that time.

In Year 1, we propose to conduct a search of two positions in Applied Mathematics, Algebra or Partial Differential Equations. We will search for candidates in all three areas. We expect the applied math candidate to have expertise in data science or machine learning. The reason for looking for candidates in three areas is the difficulty that we anticipate in attracting a high quality pool of candidates in data science/machine learning, due to significant competition with industry. We hope to be able to hire a strong candidate in data science, but if not successful, we expect to have no trouble making two excellent hires in Algebra and Partial Differential Equations.

Below we discuss the rationale for the hiring in each area.

Topology Hire: The Math Department proposes to hire two tenure-track assistant professors in topology in the next four years. There are several reasons to hire in this area. Currently the topology group has five members (Guillou, Ochanine, Ponto, Royster, Stapleton) of which Guillou, Ponto, and Stapleton are research active in topology. Royster has been pursuing research in mathematics education. These faculty are extremely productive across many metrics. Guillou, Ponto, and Stapleton all have active NSF grants and Stapleton also has a US-Israel binational science foundation grant and a Sloan fellowship. They also run an active seminar with many visitors that contributes to the research life of the department and have been active in mentoring undergraduate research in the department's Math Lab. Between them, they have nine graduate students and we expect demand to increase over the next few years. The research group also has two senior members (Ochanine and Royster) who are retiring in the near future. They assist with teaching in topology and have contributed significant service to the department. Hiring in topology would allow the group to broaden its research focus benefiting both faculty and students. There are several directions we are interested in considering. These include differential geometry, manifold topology, symplectic topology, algebraic K-theory, and algebraic topology with an interest in physics applications (field theories and higher category theory). A new course could be designed around each hire's area of expertise. Hiring in topology will allow the department to add members with strong research profiles, who are competitive for external grants, who are experienced and charismatic teachers, and who can contribute broadly to our mission.

Applied Math Hire: The Math Department proposes to hire two tenure-track assistant professors in Applied Math in the next four years. Machine learning and data science are at the forefront of data enabled technological revolutions. Mathematics plays a central role in developments and understanding of algorithms used in learning from data. The math department aspires to become a center of research and education in machine learning and data science at UK. The current Applied and Computational Math group faculty consist of six members and have expertise in machine learning (Nguyen and Ye), data driven applications in economics, biology, drug design, and image science (Bagh, Murrugarra, Nguyen, and Qin), and numerical algorithms (Lu and Ye). In recent years, the group developed an undergraduate course and a graduate topics course in deep learning, MA 421G and MA 721. There has been significant student demand to pursue thesis research in this area that was at times difficult to meet with existing resources. The Applied Math faculty have collaborated with researchers in various disciplines across the campus and have been highly successful in external funding competitions. Five of its six members have external research grants and four of those are NSF grants. The group also runs an active research seminar bringing in outside speakers. We are interested in candidates

who have core expertise in machine learning/data science with connection to areas such as biology, medicine, economics/finance, or other areas of research in the department. New hires will strengthen our existing areas, particularly in data science and related applications, and bring new funding and collaboration opportunities.

Algebra Hire: The Math Department proposes to hire two tenure-track assistant professors in Algebra in the next four years. The Algebra & Number Theory group has seven active members (Corso, Gluesing-Luerssen, Jensen, Leep, Manon, Nagel (Department Chair), Shao), and has repeatedly attracted a postdoc in recent years. We have had three recent retirements (Eakin, Kubota, Sathaye) and more senior members are expecting to retire in the next five years. Additionally, the group has no pre-tenure faculty. The three youngest members of the group (Jensen, Manon, Shao) have NSF research grants. Gluesing-Luerssen and Nagel have Simons collaboration grants. Jensen presently holds the Wimberly and Betty Royster Research Professorship and Gluesing-Luerssen the Ralph and Norma Edwards Research Professorship. The large research output of the group has led to an increase in graduate student interest, with a plurality (15/44) of the recent PhD graduates of the department coming from Algebra & Number Theory. We expect this interest to continue. The group also runs an active research seminar, which typically brings in many outside visitors. The group has also been very active in mentoring undergraduate research in the department's Math Lab. Thanks to the recognition the Algebra & Number theory group has been getting from the broader community, we believe we will be able to make strong hires who, in particular, are competitive for obtaining external funding.

Partial Differential Equations (PDE) Hire: The Math Department proposes to hire three tenure-track assistant professors in Partial Differential Equations in the next four years. The Analysis & Partial Differential Equations group has historically been one of the strengths of the department of mathematics at University of Kentucky. It currently consists of eight members (Brennan, Brown, Chen, Chung, Hislop, Perry, Shen, and Tohaneanu). Six of the eight members have external grants (either NSF or Simons collaboration grants). In the last five years there were two retirements (Lewis and Harris), and there is one announced retirement for the end of 2023 (Brown). The most recent hire (Chen) will also depart at the end of the semester, which will leave the group with no assistant professors starting in the summer of 2022. The group has historically attracted a good number of graduate students, which is expected to continue in the future. The group has also been active in service for the broader community. Chung, Hislop and Tohaneanu, in collaboration with three faculty members from University of Cincinnati, are regularly organizing the Ohio River Analysis Meeting, an NSF-funded annual conference focused on fostering state-of-the-art research activity and developing young mathematics post-docs and graduate students. Given the strength and reputation of the group, we expect to be able to attract very strong candidates in research, teaching, and service.

Lecturer Hire: The Math Department proposes to hire four lecturers in the next four years. Our current group of 10 lecturers provides excellent teaching in some of our most visible courses. Their adoption of open education resources (OERs) including textbooks, in class activities, and homework has lowered costs and improved outcomes, especially in historically underrepresented and underserved populations. They continue to lead in pedagogical improvements that help students navigate first-year courses and develop a more positive attitude towards their courses and UK.

The lecturers work efficiently and collaboratively and have created a positive culture that is well-regarded nationally. This is evidenced by our past and our current search's excellent pools. With the upcoming departures of 2 Full-Time Instructors (Lehmann and Fieldsteel) in June 2022 and the departures of 2 lecturers (Combs and Denomme) over the past two years, our teaching capacity is reduced well below what is expected by the college and other university units. Even sustaining our current efforts will require investment. Despite the strain, our lecturers have produced innovative and research-backed improvements to some of our college's most visible courses. These changes have been necessary responses to the pandemic, but with investment they can become sustainable improvements to outcomes and efficiency within the department and the college as a whole. Our history of successes in co-requisite instruction, high-school dual credit, open educational resources, and online courses is both attractive to new candidates, and a strong base to build on for future hires. Newer programs, such as standards-based grading, graceful handling of quarantine, more efficient exam procedures, early access undergraduate research, calculus late-placement switching to improve undergraduate retention, online courses, and many others rely on the innovation and energy brought about by continued investment in our lecturers.

Postdoctoral Researcher Hire: The Math Department proposes to hire five Postdoctoral Researchers in the next four years. The Department currently has a modest postdoctoral program. Its regular size has been three. The importance of a postdoctoral program has been emphasized in the Department's 2020 External Review. Our postdocs are active and energetic researchers and serve as role models for our graduate students. Postdocs have also organized research seminars, supervised the Math Club, supervised undergraduate Math Lab research groups and taught courses that range from service courses to topics courses. The proposed hiring will be distributed with one in each of Years 1, 3, and 4, and two in Year 2. This will allow us to maintain our post-doctoral program at the level of three researchers in the first two years of the plan and then increase it to four in the last two years.