6. Faculty scholarship: Strengths and Challenges

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During the last twenty years, the department has created two major research foci, one in operator and matrix theory, and another in operations research. Smaller and newer research groups exist in biomathematics, combinatorics, computational mathematics, mathematical physics, and statistics. In addition, several department members are involved in mathematics curricular activities, both K-12 and undergraduate, and the department views publications and NSF grants in this area as consistent with its scholarly mission. The departmental procedures document identifies refereed publication, outside grantsmanship, invitations to speak at national meetings and other universities, and the award of national research prizes as being the primary criteria that it uses to judge scholarship of its members.

The research foci: Today the department's primary research groups are as follows. Primary members of each group are listed and secondary members, i.e., those with secondary interests in the given research area, are in parentheses. Many faculty belong to several groups.

- the matrix and operator theory group: Bolotnikov, Johnson, Li, Rodman, and Spitkovsky;
- the operations research group: Kincaid, Leemis, and Phillips (Lewis);
- the biomathematics group: Shi, and Tian (Day and Li, plus Dey and Iaci who apply statistics in biological and biomedical contexts);
- the computational group: Day and Lewis (Dey, Iaci, Li, Leemis, Phillips, and Shi)
- the stochastic group: Dey and Iaci in statistics (Leemis in stochastic operations research)
- the mathematical physics group: Zobin and Hassler;
- the combinatorics group: Vinroot, and Yu (Johnson, Kincaid, and Li)
- the mathematics education and mathematics curriculum group: Rublein and Lutzer (plus Day, Li, Lewis, Phillips, Shi, and Tian through membership in the NSF-UBM or the NSF-CSUMS group)

The extensive overlap between membership in these research groups is important, and reflects the level of scholarly collaboration that occurs within the department. For example, while Li's research focus continues to be in matrix analysis, he writes articles in biomathematics and quantum computing, and is the PI of the department's CSUMS grant. Also important is the fact that members of the applied science, biology, and physics departments are external members of the mathematical biology, computational, and mathematical physics groups respectively. In addition, members of the mathematical education group are co-PIs with members of the School of Education on grants now totaling more that $1 million per year to improve middle-school mathematics teaching.

Major research strengths: Built up over the last twenty years, the matrix and operator theory group is the strongest research group in the department. This group is, without a doubt, of international caliber. Its five members published thirty-six refereed articles in 2007, the most recent year for which complete data exists. Members of this group have wide-ranging research interests: their publications make use of, and have applications in, many parts of mathematics, e.g., biomathematics, combinatorics, graph theory, mathematical physics, and quantum computing. In 2007-08, four were PIs on NSF grants. Four are editors or associate editors of the leading professional journals in their discipline. Members of the matrix and operator theory group gave dozens of invited talks at conferences and universities in the U.S. and abroad during 2007. In summer 2008, members of the matrix and operator theory group organized the NSF-sponsored IWOTA conference at William and Mary.

Research Challenges: We mention three current challenges in research, and one other that is on the horizon.

Integrating a large cohort of new tenure-track faculty into our research/teaching mission will be a major challenge during the next five years. The last three years have seen extensive rebuilding of the department's tenure-track faculty. Inside of two months in the spring of 2006, our nineteen member department lost five members who were recruited by other universities (Indiana University, University of South Carolina, University of California at Davis, Virginia Tech, University of Massachusetts at Boston). Two were statisticians, one was in combinatorics, and two were biomathematicians. Two other senior department members retired, one in May 2005 and one in May 2008. Replacing so large a fraction of our department was not completed until the spring of 2008. Many of our new faculty are just starting their professional careers, and integrating them into the department's particular mix of research and teaching will be a challenge for the near future.

Keeping our most productive researchers will be another challenge for the future. Three issues were cited by faculty who left the department in recent years for positions elsewhere: salary, teaching assignments, and the ability to supervise Ph.D. students. (These same issues arose in our hiring efforts over the last two years.) In each case, the administration agreed to match outside salary offers. Reduced teaching assignments offered elsewhere were a major problem for us: while the department agreed to use its private money to reduce teaching assignments from four to three courses per year for a couple of years, we could not afford to make the reductions permanent. Finally, the non-existence of a traditional Ph.D. program in the department was insurmountable. Even though our faculty may participate in doctoral supervision through our research apprentice doctoral program in the applied science department, there is no guaranteed stream of graduate students, and no guaranteed level of graduate support.

Overcoming a certain psychological challenge deserves to be mentioned in this section. Over the last five years, many of our tenured faculty members have become concerned that the administration does not sufficiently value existing research in the department. Our two oldest research groups, as noted above, are in matrix and operator theory and in operations research. We often sense that the administration would prefer to shift our departmental focus to a group of other special research topics, and away from the topics that have grown into our strengths over the last twenty years. It is true that, over the last six years, we have received three net-new faculty positions because of our departmental interest in new areas such as biomathematics, statistics, and computational mathematics, and the addition of these positions has enhanced the department. But that does not mean that we want such directions to be our only growth areas[1]. It is disappointing that our record of building strength and grantsmanship in existing research areas does not seem important to the university and it is confusing that our operations research group is not viewed as an applied and computational mathematics group. Perhaps the administration's attitude will be changed by a 2007 memo to us from the chair of the physics department in which he listed mathematical research areas that physics would like to see included in our department. Their list included a broad spectrum of pure mathematics, namely representation theory for groups and algebras, differential geometry, algebraic geometry, and partial differential equations, as well as more specifically mathematical physics topics such as geometrical and topological methods for quantum field theory and string theory[2].

There is another researh (and teaching) challenge on the horizon for which we need university help. Some years ago, we received an NSF grant (PI = Lewis) to create a computational cluster in the mathematics department, and to a large degree the combination of this cluster and high performance desktop computers have met most of our computing needs. But not all. Our recent hirings have included several faculty in computational and applied mathematics. These faculty conduct computationally intensive research and supervise computationally intensive undergraduate research. Today they and their students have access to the College's Cyclone system when the departmental system is not adequate, and that is almost always good enough. But faculty and student needs will soon outstrip local computing power. For example, in 2008-09 we have a one-year visitor who does computational mathematical biology and he has found it necessary to use the computing facilities at Vanderbilt (where he was a post-doc) because College computers do not meet his needs.

[1] For example, the administration's original proposal to replace one biomathematician and two pure mathematicians was to authorize a search in 2007-08 for three tenure track applied mathematics positions. Our arguments convinced the dean to modify the decision, allowing a search for "at least two tenure track positions in any part of pure or applied mathematics plus a third position provided it is arguably applied."

[2] In our hiring in 2007-08, we appointed one new mathematician in group representation theory and another in mathematical physics.