

Program Review Report

DEPARTMENT OF MATHEMATICS AND STATISTICS, UMBC

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GENERAL COMMENTS

The Department of Mathematics and Statistics is a rare department where both parts, mathematics and statistics, are strong. The faculty are impressive in their research profiles, external funding, outreach to university, industry and government, organization of meetings and conferences and involvement with professional organizations and journal editorial boards. Both undergraduate and graduate programs are strong overall. The department offers 9% of the total credit hours at UMBC. Consistent with the UMBC emphasis on undergraduate education, the department, under the leadership of the current chair, has launched several student learning initiatives. By and large we found the faculty emotionally invested, even passionate, about the department. While we did confront some problems in the structure and functioning of the department, as well as conflicts of personalities, the underlying collegiality and overall strength was unmistakable and convinced us that the department can continue to fulfil its core mission and excel in exciting new areas. The goal of our report is to help facilitate this advance.

With its strengths in different areas of applied mathematics and statistics, this department is uniquely poised to exploit potential synergies, and one of our recommendations is to explore the creation of an initiative for mathematical biology and biostatistics. On the other hand, the issue of separation of mathematics and statistics came up in our conversations with faculty. We do not recommend separation at this point; however, we do believe a degree of autonomy of the groups, along with establishing formal areas of collaboration, will strengthen the department.

The department currently offers B.A. and B.S. degrees in Mathematics and a B.S. degree in Statistics, and currently has approximated 400 undergraduate majors. The department also offers minors in Biomathematics (since 2014), Mathematics and Statistics.

At the graduate level the department offers M.S. and Ph.D. degrees in Applied Mathematics, M.S. and Ph.D. degrees in Statistics, and an M.S. in Statistics with Environmental Statistics, Biostatistics Tracks. The graduate programs in Applied Mathematics were changed in 2010, including a change in the written comprehensive examination structure. We note that the graduate students made a point to express their appreciation of this change. Recently, the Statistics MS program has eliminated the written comprehensive exam in the non-thesis option. Again, this was viewed as a positive change.

Below we lists the strengths and weaknesses that we observed, followed by our recommendations. (These are listed with no particular order within each category.)

Strengths

1. This is a department where both the mathematics and statistics components are strong. More than a third of the research faculty have externally funded research. The department has been successful in hiring strong candidates to join its faculty.
2. The department has been very successful with federally funded interdisciplinary initiatives, including the NSF-funded Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (UBM), an NSF REU site program and two NSF MRI grants that helped support the UMBC High Performance Computing Facility.
3. Both undergraduate and graduate programs are thriving in the department.
4. Faculty are emotionally invested in the department's future. There was strong faculty turnout in the meeting. This includes the lecturers as well.
5. Strong turnout of the graduate students shows how much they are involved. They are engaged and excited about their future and have definite ideas for improving the graduate program.
6. We met four outstanding undergraduates and were very impressed. They were overwhelmingly complimentary about the program and faculty.
7. The department, particularly the chair, has taken leadership in developing new initiatives aimed at improving undergraduate students' success in mathematics including obtaining internal and external funding.
8. We were impressed by the dedication of the staff and their efforts to ensure that things get done.

9. Despite many concerns that were raised in our meetings with faculty, we found a high degree of overall collegiality.

Weaknesses

1. There is a deficiency of working harmony in the department. Concern was raised by several faculty about a lack of communication between the chair and the faculty, along with transparency. It was not possible for us to explore the full extent of this due to the time we had, as well as the nature of our mission. However, we believe that this is neither long-standing nor systemic, and in view of the inherent collegiality of the faculty we believe this can be overcome.
2. For a university that is so much invested in undergraduate education, we noticed a lack of tenure-line faculty engagement in the department's lower level courses including calculus. The predominant number of students, like most mathematics and statistics departments in the country, is taking general education courses and prerequisites for other STEM majors.
3. Lack of a set of bylaws in the department (we understand they are now being written) is at the root of many of the climate problems in the department.
4. Graduate students are compelled (not merely encouraged) to take regular courses, independent of the relevance to their thesis areas, even after completing all PhD qualifying requirements. It appears this is done to keep graduate classes running.
5. The imminent retirement of an office staff member will put a serious strain on the office workload unless a replacement is found soon.

Recommendations

1. When we explored the issue of separate mathematics and statistics departments the views were mixed. Most faculty recognized the existing and potential synergies if the groups stayed together. Many universities in the country do have separate mathematics and statistics departments. While in many of these instances both programs thrive, it is also true that separation does not always yield the desired results. We recommend all relevant issues be explored fully, including undergraduate and graduate programmatic issues for departments,

long term external funding, internships, placement and collaboration with industry and government, and budget, including undergraduate revenue.

On the other hand as long as the current structure remains in place we recommend:

- (a) The creation of an Associate Chair position from the group that does not include the Chair.
 - (b) Establishing autonomy for the groups in specific areas as well as formal areas of cooperation. Besides graduate and undergraduate programs, areas that may be considered for autonomy may include hiring, promotion and tenure, and annual reviews. Areas of collaboration would include joint programs, as well as general administration of the department. These are a few examples, and we recognize that many other areas need to be considered. We recommend the creation of a departmental task force to develop a full proposal and a department meeting/retreat to arrive at a consensus.
2. Communication and transparency in the department should be improved. Action items from departmental faculty meetings should be addressed in a timely manner. The bylaws should be completed and approved as soon as possible.
 3. One issue of contention is the allocation of teaching assistantships to the two groups. We recommend that this should not be a fixed proportion of faculty size, rather a function of research areas of active faculty, availability of internships, track record of research groups in graduating students, external funding and placement, as well as the quality and interest of the applicant pool. This process should be overseen jointly by the area program directors with faculty input. The success of the students should be equal in importance to the success of faculty research programs.
 4. The courses to be taken by the graduate students that are in addition to the university requirements should be determined by the dissertation advisor. The practice of *compelling* students to take regular courses, independent of the relevance to their thesis areas, even after completing all PhD qualifying requirements, should be discontinued.
 5. The department should explore ways to enhance the course offerings and availability of the top undergraduate majors and minors. The department should make the mentoring of these students a priority.

6. Tenure-line faculty should be involved and engaged in the teaching and oversight of the department's lower level courses.
7. There should be greater consultation with other departments within the university to ensure that the Mathematics and Statistics Department is providing instruction, particularly at the undergraduate level, that is essential and appropriate for success in the "downstream" courses. This is especially true for calculus courses, which are essential for science, engineering, business and so forth, and effort should be made to improve learning outcomes and success rates in calculus.
8. Various department initiatives should undergo complete reviews. Initial data that we were given indicate effectiveness of department's undergraduate initiatives, like Quiz Zero and Math Gym. If the initial conclusions are confirmed, the department, in collaboration with the college, should make plans to ensure their sustainability in a cost-effective manner. The impact of CIRC on graduate student education should also be evaluated.
9. A Mathematical Biology and Biostatistics initiative should be created that generates opportunities for consulting and collaborative research with scientists in the medical school. This will exploit the unique strengths of the department and involve both mathematicians and statisticians in a joint venture. It will also provide opportunities for graduate students to be involved in real-world research problems. The possibility of establishing a professional certificate program in areas related to mathematical biology and biostatistics should be assessed. This initiative has the potential for revenue enhancement. If successful, new external funding could be a basis to turn this initiative into a center.
10. Funding of graduate (PhD) teaching assistants from state funds should be limited to a maximum of X semesters. Our recommendation is $X=10$. This will incentivize students and supervisors to finish the PhD degree in a timely manner.
11. There was a proposal from some faculty in the department to establish a teaching post-doc program. This is a model that is used successfully at other universities to boost teaching as well as research programs. Post-docs are typically fresh PhDs who teach a full load (or slightly reduced load) and are active in the research life of the department. They collaborate with

research groups. A post-doc program with fixed term (three years, for instance) ensures the vibrancy of the program as well as the ability to spread the benefit among various groups. Efforts should be made to find funding for a small number of post-docs in collaboration with the college through salary savings or other means.

12. There are concerns about space. The department should make a concrete proposal, with clear justification, of their space needs and have it ready for any opportunity for discussion with the higher administration.
13. In keeping with the national trend, the department relies critically on a cadre of instructors in the undergraduate program, particularly the lower level courses including calculus. Recent lecturer hires have PhD degrees, and all lecturers who seem to be very dedicated. Some lecturers are the best teachers in the department. Efforts should be made to make sure that they are properly integrated into the department's mission. Lecturers should not be involved in teaching graduate courses, and should only teach upper division graduate courses in special circumstances. Tenure-line faculty should be involved in all of the departmental teaching-related service activities that currently very heavily rely on lecturers, such as advising, curriculum development and review of teaching.
14. The department, in collaboration with the college, should consider a system to reward highly productive research active faculty members (that involves something more than pay raises).

Concluding Remark

This is a strong department that can certainly continue to be effective in teaching and research, and grow in the future, once they resolve some of their internal issues.