

Report of the Review Team

Academic Program Review

*Department of Mathematics and Statistics
The University of Nebraska -Lincoln*

Review Committee

External members, participating in discussions and report:

Professor Raúl Curto, University of Iowa
Dr. John Ewing (Chair), American Mathematical Society
Professor Glen Meeden, University of Minnesota
Professor Susan Montgomery, University of Southern California

Internal members, participating in discussions:

Professor Roger Kirby, University of Nebraska (Physics)
Dean Merlin Lawson, University of Nebraska (Graduate Studies)

We are aware that it is common for review committees to recommend increased resources, and we are also aware that the university has struggled through austere financial times recently. The questions from the academic administration make it plain that we should make (at least some of) our recommendations under the assumption of static resources. We would be ignoring our responsibility, however, if we did not point out the single-most important observation about the department: It needs more resources in order to achieve its goals.

This is a department that has consistently responded to the university's mission whenever called upon to do so. It is a model department that should be (and appears to be) held in high esteem by other departments in the university. The data amply support these assertions, as do the observations of the Review Committee. These accomplishments have required substantial effort from virtually *all* faculty within the department, and it is unclear that such efforts can be sustained without additional resources. Providing additional resources will do more than merely relieving stress within a single department — it will encourage similar behavior on the part of other departments and consequently leverage these particular efforts to benefit the entire institution.

The Review Committee was asked to comment on priorities for the department, indicating (again, assuming static resources) which activities the department should consider eliminating in order to relieve stress. While we will address this question indirectly, we observe that in many instances the increased activity of the department is an attempt to carry out the mission of the university and/or college. The university, rather than the department or Review Committee, may want to indicate which parts of its mission should have less emphasis in the future. With that added information, the department will be able to make decisions about which programs should be sustained and which should be cut-back or eliminated.

Although making recommendations is difficult under these circumstances, we can report our factual observations about the overall program, its development since the last review,

and its relationship with the rest of the university. In almost all respects, this is an outstanding program that has improved enormously in the past decade and that well serves the needs of the university. There are a few areas in which the department can make small adjustments, and these are mentioned in the details below. *The single most important change, however, is to strengthen the research component of the department by investing in more faculty.* This requires both additional resources from the university and a commitment by the department to focus on research while sustaining its achievements in service and teaching.

This is a department under stress, but one that has progressed far in recent years. It has done so under energetic and thoughtful leadership, and a major problem in the next few years will be making a possible transition to new leadership that maintains a forward-looking vision.

The Program

The department has undergone substantial change in the past ten years, and the self-study document carefully outlines both the changes and the rationale behind them. The self-study is well-prepared, complete, and thoughtful. It contains ample statistical data to backup the narrative, as well as historical reference material to show how the department has progressed since the previous program review.

Both the self-study and the comments during the visit show that the department has a clear sense of mission, understanding both its role in the university and the university's role in the state. Indeed, one of the most unusual characteristics of this department is its desire to be a "good citizen" within the university, which is not especially common for mathematics departments. The department as a whole seems to take pride in the fact that it serves the needs of the university so well, and faculty take pride in the accomplishments in teaching and outreach. Many faculty also take pride in their personal research programs (sometimes quite active), but they have less of a sense of accomplishment in the research profile of the department as a whole. They were anxious to move forward in that regard. There was also a sense of weariness on the part of many people.

Here are some specific observations about various parts of the program.

Service. This is a department engaged in a remarkable amount of high-quality service and outreach, most of which results in higher visibility for the department and the university, and hence serves as a recruitment tool for both. The self-study document detailed this service, and during the visit its extent and quality became clear to the Review Committee. A sample of this activity includes programs such as:

- Conference for undergraduate women. This annual event, which had taken place just before the visit of the Committee, attracted over 100 young women this year. It has drawn national attention to the department.
- Regional workshop series. These draw regional colleges closer to UNL, and again serve to attract students for graduate work.

- Junior Mathematics Prognosis Test (JUMP). This is aimed at Nebraska high school juniors, to help them develop mathematical skills for undergraduate work.
- American Mathematics Competitions. These exams are administered to almost 500,000 high school students across the country each year, beginning a process that chooses the U.S. Mathematical Olympiad Team each year.
- Math Day. A special day each year aimed at high school students. The latest day attracted more than 1000 students.
- All Girls/All Math. A summer “mathematics camp” for girls in high school, lasting a week and bringing together talented students to interact with professors and each other.

There was much more, including the usual kind of service within every department — reviewing, organizing research conferences. There were also major outreach efforts by particular faculty aimed at educational reform in the schools, especially the work done by Jim Lewis on the systemic initiative.

It would be hard to find many departments of mathematics anywhere in the U.S. that had comparable amounts of outreach.

Instruction. The department does an absolutely outstanding job of instruction, at the undergraduate level. Fifteen faculty have received campus teaching awards, and in 1998 the department as a whole won the university-teaching award. Each year, the department teaches roughly 80% of all freshmen; it teaches more honors students than any other department; it responds to instructional needs whenever they appear, with enthusiasm and innovation. It created new programs to help students who require remediation (EXCEL); it revitalized its basic course for non-majors (Contemporary Mathematics); it restructured its Calculus sequence (along with many other mathematics departments across the country), incorporating “active learning”; it put in place a remarkable course for honors students (Joy of Numbers) that allows students to gain a sense of creating mathematics themselves. The department has done more than create new instruction; it made its current instruction more effective with programs such as the Mathematical Resources Center and online gateway exams.

This department nurtures its undergraduates and has the most impressive collection of majors we have ever seen. This is a remarkable statement to make about a mathematics department in a public institution, and the university should be proud of the accomplishment — the department is proud, with justification. While the achievement is especially connected to a few individuals (Gordon Woodward was mentioned many times), it is clearly the result of the entire faculty, all of whom, young and old, seem to go out of their way to interact with undergraduates.

Many of these same comments can be made about graduate students. Faculty guide them through the program from start to finish. There is a higher percentage of women graduate students than in every other department known to the Review Committee, which is a remarkable achievement, accomplished by hard work over a number of years. Graduate students seem to be satisfied with the system of qualifying and comprehensive exams, and

they find the process of seeking an advisor relatively easy. The single complaint from graduate students concerned the number and breadth of courses offered at the graduate level (an almost-universal complaint in graduate programs). The Committee noted that the graduate examinations had been modified in recent years, reducing stress.

During our visit, curriculum played a minor role in discussions about instruction. That's a healthy sign. Departments often spend all their energy devising new curricula and changing requirements, with little effect on the program. The department appears to be considering changes in the major in keeping with national trends to connect the mathematics major with other programs in the university. Given the care with which other instructional changes have been implemented, this will likely only improve the major. The Review Committee noted an unusually large number of courses listed in both the undergraduate and graduate catalogues, which might be trimmed substantially when revising the curriculum in the future.

For instruction, the department serves as a model for the rest of the university — indeed, for any university in the nation.

Research. This is a department with a research program that is undervalued outside the university (and, we suspect, within the university as well). Its National Research Council (NRC) ranking places it in the third quartile of the 135 ranked doctoral departments of mathematics; it is more likely close to the middle. By taking steps now, the department could easily move well into the top half of ranked PhD departments within the near future. The department already has a very impressive collection of junior faculty in addition to a number of productive and visible senior faculty.

For purposes of the review, the department divided itself into three groups — Algebra/Discrete Mathematics, Pure and Applied Analysis, and Statistics. Those groups normally function to make decisions about instruction, especially about course assignments at the graduate and upper undergraduate levels. Each group works together loosely on research. Each has strengths and limitations, and the faculty appear to be aware of these (although perhaps disagreeing on the details). Statistics is clearly the smallest, with a plan to build in the near future. Algebra and Discrete Mathematics has been singled out as a priority in recent years and has a great deal of potential. Pure and Applied Analysis also has some outstanding mathematicians with good research programs, some of which connect with other departments in the college.

The department has devoted considerable thought to the makeup of its research program. It understands that to increase the external perception of its program it must focus on a few areas, while maintaining sufficient strength across many areas to offer a viable doctoral program. Finding this kind of balance in a relatively small department is not always easy. Understanding the goal, however, is the first, necessary step in the process, and this department seems well aware of the goal. The department aspires to reinforce its already outstanding performance in service and instruction with a higher research profile.

Overall. Finally, this is a cohesive department with strong, energetic leadership. That cohesiveness extends from the faculty to the lecturers to graduate students, majors, and staff. Almost everyone we spoke to believes in this department and what it is doing.

Evaluation and Assessment

Thoughtful departments usually understand the importance of self-inspection, evaluating routine work as well as special projects. This department appears to carry out assessment in most aspects of its work as part of its everyday activities — service, teaching, research. Evaluation is a regular part of most its instruction. There seems to be a good system for evaluating contributions from individual faculty within the department, and the implementation by the Executive Committee appears to work smoothly. In several cases, this has resulted in arrangements for individualized work assignments. This is a healthy development, and we hope it continues to be a viable option for faculty. Individualized assignments become even more important as research takes on greater importance within a department.

There are a few aspects of assessment, however, that the department may want to consider in the future.

- **Outside service.** There was the perception from one or two faculty that **outside service**, as opposed to departmental service, was **undervalued** or even ignored in assessing faculty performance. While the department is spectacularly successful in its outreach programs, **the value of more traditional service** (reviewing, refereeing, organizing research conferences, etc.) remains great — especially if one wants to increase the visibility of research.
- **TA visitation.** While one lecturer *does* visit recitations regularly, it appears that **there is no regular program of faculty visitation of teaching assistants for either recitations or classes**. We suspect that this is due in part to the close interaction of faculty and graduate students (people may already feel that they know the abilities of TAs) and in part to the already heavy burden of faculty responsibilities. Regular evaluation of graduate student teaching, however, sends the right messages to everyone, instructors as well as students.
- **Executive Committee.** The Executive Committee carries out most of the evaluation of faculty each year, and the process is time-consuming. The seven-person committee represents 20% of the faculty, which seems a remarkably large fraction for such a task. **It may be possible to either reduce the size of the Executive Committee or to restructure the evaluation process, placing the responsibility on a smaller group.** The Review Committee also noted that the Graduate Chair should sensibly serve as an *ex-officio* member of the Executive Committee.
- **Graduate Program.** The department is justifiably proud of the large numbers of doctoral degrees awarded in recent years. During the first 60 years of its doctoral program, the department awarded 11 degrees; during the last decade, it awarded 56 (doubling the number awarded in the previous decade). This is a remarkable achievement, which most likely results from careful recruitment, thoughtful restructuring of requirements, and careful nurturing of every student. On the other

hand, it is also important to assess the graduate program not by the number of degrees, but by accomplishments of the recipients. The department already has part of this information, and it can boast of two recent NSF postdoctoral fellowships awarded to recent graduates. There should be an effort to gather even more information in the future, measuring success by outstanding scholarship, fine teaching, and energetic outreach as well as by notable research.

Resources

Instructional resources. This is a department under stress. Faculty, staff, and even students have overextended themselves to accomplish all the positive things described above. Conducting conferences requires time and energy; implementing innovative teaching demands more preparation (and in many cases, more contact hours); earnestly responding to campus initiatives —honors courses, priorities, interdisciplinary programs — consumes large amounts of administrative energy. Almost all of this extra effort comes on the margin, and both faculty and staff appear tired. The present level of activity is barely sustainable.

At the same time, the department aspires to increase its research profile, and doing so in the present circumstances will be difficult. In addition to active outreach programs and innovative instruction, the department has a high student/faculty ratio (over 500) compared to its peers (see page 18 of the self-study). This is even more notable because of two additional factors: The department has less pre-calculus instruction than many similar institutions (which is not faculty taught), and there are no *mass* lecture courses, in the 300 student range. Given these factors, the high student/faculty ratio is clearly worrisome.

The central problem is balance. Roughly 45% of the instruction is done by the faculty, and 55% is done by lecturers, graduate students, or undergraduates. This may be typical in some departments at UNL (we were told), but it is *not* typical of good research departments in mathematics. The balance has shifted to non-faculty instruction over the seven years since the previous review; it needs to shift back. Solving this problem is difficult and needs to be done incrementally.

Leadership resources. There is another, more subtle resource problem. This is a department that has had strong leadership for the past dozen years. Of course, for any department that's good, not bad. But having strong leadership concentrated in one person for a long period of time presents some real dangers as well. When the leadership changes, there is a risk that much of what has been accomplished will dissipate — that the department will be unaware of the enormous effort required to respond attentively to the university's needs, to promote action by the faculty, and to develop a vision for the future.

Jim Lewis carries a great burden for this department and plays a central role in most of its planning and most of its activities. *It is essential that the department begin to plan for a potential transition at sometime in the future.* Other faculty already carry out many essential tasks, but there should be a conscious effort to involve a broader range of faculty

in both day-to-day and visionary leadership, so that those faculty are ready to accept more responsibility ... and the department is ready to accept them.

Looking to the Future

There are two broad goals within the department. First, faculty believe that their accomplishments in outreach and instruction during the past 12 years have served the department (and the university) well. They want to preserve those accomplishments. Second, they aspire to have a higher research profile — one that will complement their high profile for teaching. Both goals appear to be consistent with the general mission of the university and the specific mission set forth in the recent document *Future Nebraska Task Force Report: A 2020 Vision*.

There was a tendency by many faculty to conflate these two aspirations. They implicitly believed that adding faculty will improve research and simultaneously sustain the present level of activity (by sharing the burden). While this may be partially true, it is not self-evident. It is likely that separate steps need to be taken to achieve each goal.

Here are some comments about the likely outcomes of specific actions that were discussed by the Review Committee during our visit. These are grouped into several broad categories, organized around the two goals as well as the general issue of morale.

Increasing research profile

- Because the department's research is undervalued outside, drawing attention to its research program will have a strong positive effect. If the department appoints an Othmer Professor as soon as possible, it has an opportunity to gain rapid visibility in research. The likelihood of increased visibility is improved if the appointment is in an area that is already strong. Building on strength is almost always the best way to improve research in any department, except when there are special needs (for instruction or service).
- Many young mathematicians enter the profession through the mathematical equivalent of a scientific postdoctoral position, often referred to as a "named instructorship". These are usually at the level of assistant professor, require a normal (or slightly reduced) teaching load, and are connected to a particular research group in the department to provide mentoring. The positions last for 2-3 years. If the department had three 3-year postdoctoral positions, this would provide an ideal way to increase visibility and to reinforce the best groups in the department. This is a standard mechanism for departments in the top half of the NRC rankings to ensure the vitality of research programs. It suits such institutions well because it combines instructional needs with research needs. It is consistent with a new program at the National Science Foundation, VIGRE, which attempts to integrate research faculty, postdocs, graduate students, and even undergraduate students in a department. Since these positions are terminal, it also provides flexibility for the administration in case of future financial exigency.
- The department receives additional funds for instruction each year for "temporary instruction" and "replacement of faculty" (as well as several other smaller pools for

honors, SVCAA CEP, etc.). If the department had predictable replacements for faculty, it would increase its research profile in two ways. First, it allows (encourages!) faculty to take advantage of opportunities to go away, which is common in mathematics. Second, it provides a chance for the department to hire a replacement who suits the needs of research as well as instruction. Recruiting visitors in October rather than April or May makes an enormous difference: The department can seek mathematicians (even young ones) who will work with research groups in addition to carrying out instruction.

- Building on strength can also be done by seeking opportunities outside the department. Bioinformatics is of considerable interest throughout the university and the entire scientific community. It appears to be a priority area for many groups. But mathematics underlies all of bioinformatics, which is not just the study of gene sequencing, but far more, involving deep, abstract, new mathematics. If the Algebra/Discrete group in the department aggressively participates in the bioinformatics effort, it will make a big difference. It will need support to do that. Similar comments can be made about other groups in the department, especially modeling which already interacts with geosciences.

Sustaining Past Success

- Much of the outreach and exceptional instruction has been done using faculty, for planning, for organization, and for carrying out the details. If the department had another staff person to coordinate conferences, help with the logistics, help with newsletters, etc., the faculty would have a much smaller burden in carrying out this service. This has the consequence of freeing up some of the most productive faculty, and again increasing the research profile. It also sends a message to those faculty that their activity is valued.
- In addition, there is a widely held perception that computer support is inadequate. This affects all faculty, especially because support for instructional computing comes from within the department itself. If the department had another systems support person for computing, it would make the department more productive and aid those faculty engaged in instructional technology. Which of these two positions (staff or computer support) had greater priority was uncertain in our discussions with faculty.
- The university has taken some steps to address the salary problem noted in the last review, and it made partial progress. On the other hand, the outstanding problem now is in the middle levels, including upper assistant and associate professors. These people represent the future of the department, and as the research profile increases they will be increasingly vulnerable (especially given the visibility of many of them in outreach projects). If the department does not address the salary problem for associates it will have a problem retaining its best young faculty.

General Morale and Infrastructure

- Desktop computing is as essential to a mathematician today as a blackboard was 25 years ago. There is no regular process for replacing either hardware or software in the department. If the department does not address the computer replacement

problem, it will face a crisis in a few years. This cannot be a first-rank research department without solving this problem.

- The department clearly has space problems, but has a clear plan to solve those problems (in a renovated Avery Hall). If the opportunity for new facilities is used wisely, this can dramatically improve morale within department and at the same time make it easier to recruit new faculty. Careful planning involves all aspects of the new facilities — the design of offices, lounges, seminar rooms, computer facilities, even restrooms. This is an opportunity that comes infrequently to departments, and it can have a profound effect on the future. The department already seems to have a good understanding of the importance of careful planning.
- The comments above suggest ways in which the research profile can be improved while the present valuable outreach and instructional activities are sustained. The combination of the two — a department with a high research profile, yet known for its outstanding instruction and outreach — will work together to make this department a model of the way American research universities are supposed to work. On the other hand, there is an important additional step that the department needs to take in order to make this combination work. *The department must stop overextending itself, and in the future it must collectively say No to some requests for new programs or extra courses or additional outreach. It must set priorities for new activities with care.* The advice from the 1993 APR stated that the department simply could not continue to do more without additional resources. That advice was ignored for admirable reasons — demonstrating what *could* be done rather than merely talking about it. If the department continues to ignore the advice, it will not succeed in accomplishing its goals.

General Issues

There were two other general issues that came up repeatedly in discussions of the Review Committee, and while they do not fit neatly into the guidelines for the review report, they are both important for the future of the department.

Statistics. The position of statistics within the department (and the university) has been a topic of discussion for many years. The proposal to expand a statistics group, while maintaining it within the department, is not an ideal solution to the problem. But it is one solution, and it appears to be viable. Such a small, autonomous group is just barely large enough to accomplish the goal of creating a high-quality research group that is focused on a single area (survey sampling). The meaning of “autonomous” should be decided immediately in order to avoid potential bickering later. This is particularly important for matters of tenure and promotion. It may be wise to rethink this solution (or continue to watch for opportunities) in the future. It should be noted that the extra faculty in statistics solve a problem for statistics, but do not solve any of the other problems faced by the rest of the department.

Role of Funding. That this came up repeatedly in our discussions is not surprising: Improved research in many areas of science is often measured by increased external

funding. The connection between funding and research is an issue that almost every mathematics department has to address with the university administration.

Mathematics is different from the hard sciences. A little more than 30% of active research mathematicians receive federal funding; the percentage for the physical sciences is 64% and for biological sciences is 68%. When mathematicians *do* receive grants, they are only a fraction (less than a third!) of those in the experimental sciences. Unlike the hard sciences, most funding in mathematics comes from a single source, the National Science Foundation. Fewer than 15% of active mathematicians have an NSF individual investigator award at any given time.

From this data, it is clear that mathematicians — even mathematicians with active, strong research programs — often do not have grant support. It would be wrong to claim that external support is unrelated to the quality of one's research in mathematics. But it would equally wrong to equate external support with high-quality research. Funding and research are not the same in mathematics.

On the other hand, there *are* opportunities for funding, both inside the Division of Mathematical Sciences and outside, and some groups in the department can and should take advantage of those opportunities. Doing so helps to validate their work and brings recognition (and money) to the university. Actively seeking external funding can also have substantial benefits for the entire department, adding support for graduate students and postdocs, and hence contributing to the overall research environment. Actively seeking external funding is sensible; it's just not essential.

In addition, there are opportunities for instructional funding, and this department has been remarkably successful in taking advantage of those opportunities.

Investing in Mathematics

The report began by noting that almost every departmental review asks for additional resources. The situation for this department is different, however, because the department has excelled in unusual ways since the last review. It has a national reputation for service and teaching. Investing now to strengthen an already fine research program will make effective use of that reputation, will help to sustain the department's accomplishments, and will entice others to emulate the kind of good citizenship that puts the university's interests in the forefront of a department's mission.

At the present time, there is an added incentive to make an investment in the Mathematics department. The National Science Foundation has recommended a major new initiative for dramatically increased support of mathematics throughout the Foundation (which may extend beyond to other agencies). Funding for mathematics, which has been meager in the past, may soon become more like that in the sciences, providing funds for individual investigators, postdoctoral faculty, and graduate students. This is an opportunity for the university to position itself to take advantage of a major increase in external funding, and at the same time to make an exceptionally strong department even stronger.

Additional questions to be considered by the Review Team:

1. The department has three major research groups; each has a number of sub-groups. Algebra and Discrete Mathematics (including bioinformatics, commutative algebra and algebraic geometry, topology, coding theory, combinatorics and discrete mathematics, and geometric group theory/semigroup theory); Pure and Applied Analysis (including functional integration, operator algebras, partial differential equations and control theory, classical harmonic analysis, dynamical systems, mathematical modeling and numerical methods, and ordinary differential and difference equations); and Statistics: (including survey sampling, Bayesian statistics, and biostatistics).

With these areas in mind and assuming more or less static collegiate and campus resources, please address the following questions:

- *Is this an appropriate number of areas given faculty and other resources in the department and on campus?*
- *How do these areas compare with each other in research productivity?*
- *Are these the "right" areas given faculty and other resources and given expectations regarding directions that the discipline will develop over, say, the next decade ?*
- *What is your assessment of the department's strengths and weaknesses in these areas in relationship to other AAU, Research I, and/or land grant universities ? In particular, how do their research output and the quality of that output compare to those at other universities ?*

Review Committee Response

Page 4: "The department has devoted considerable thought to the makeup of its research program. It understands that to increase the external perception of its program it must focus on a few areas, while maintaining sufficient strength across many areas to offer a viable doctoral program. Finding this kind of balance in a relatively small department is not always easy. Understanding the goal, however, is the first, necessary step in the process, and this department seems well aware of the goal."

There are no "right" areas — fashion plays less of a role in mathematics than in some other disciplines. Mathematics has recently made spectacular contributions to biology, however, and biology is in the forefront of the public's attention. For that reason, the Algebra/Discrete Math group is in a position to take advantage of the interest in bioinformatics. The Analysis group, however, is also in a position to contribute to advances in more traditional mathematical biology, as well as many other areas (such as geoscience).

The key to making wise decisions about research focus is to understand one's own strengths and needs, and to have clear goals. This is best done from within rather than from

without, provided a department is able to make thoughtful choices. This is clearly a department that is able.

- 2. How do the department's faculty teaching, research, and service work assignments compare vis a vis other AAU, Research I, and land grant universities? Assess how well the department's workload policy recognizes the strengths and contributions of individual faculty and gives them incentives to focus on what they do best.*

From the report

Page 6: " This is a department under stress. Faculty, staff, and even students have overextended themselves to accomplish all the positive things described above. Conducting conferences requires time and energy; implementing innovative teaching demands more preparation (and in many cases, more contact hours); earnestly responding to campus initiatives —honors courses, priorities, interdisciplinary programs — consumes large amounts of administrative energy. Almost all of this extra effort comes on the margin, and both faculty and staff appear tired. The present level of activity is barely sustainable.

"At the same time, the department aspires to increase its research profile, and doing so in the present circumstances will be difficult. In addition to active outreach programs and innovative instruction, the department has a high student/faculty ratio (over 500) compared to its peers (see page 18 of the self-study). This is even more notable because of two additional factors: The department has less pre-calculus instruction than many similar institutions (which is not faculty taught), and there are no *mass* lecture courses, in the 300 student range. Given these factors, the high student/faculty ratio is clearly worrisome.

"The central problem is balance. Roughly 40% of the instruction is done by the faculty, and 60% is done by lecturers, graduate students, or undergraduates. This may be typical in some departments at UNL (we were told), but it is *not* typical of good research departments in mathematics. The balance has shifted to non-faculty instruction over the seven years since the previous review; it needs to shift back. Solving this problem is difficult and needs to be done incrementally."

Page 5: " There seems to be a good system for evaluating contributions from individual faculty within the department, and the implementation by the Executive Committee appears to work smoothly. In several cases, this has resulted in arrangements for individualized work assignments. This is a healthy development, and we hope it continues to be a viable option for faculty. Individualized assignments become even more important as research takes on greater importance within a department."

- 3. The department is mobilizing faculty to pursue large scale research support in cross-disciplinary collaborations. As best as you can, please assess the options available to organize campus-wide collaborations in the department's three areas? Which area(s) may be the most promising option(s) for collaboration? Are the department's hiring priorities in sync with these areas?*

Review Committee Response

As already mentioned, Algebra/Discrete Mathematics fits nicely with the bioinformatics initiative. Hiring someone in computational algebra and/or combinatorics makes good sense here. The modeling group within Analysis already interacts with other parts of the college, and could do more in the future. Statistics is always able to interact with other groups on campus, provided there is a well-defined mechanism for doing so.

4. What is your sense of how the department overall is viewed nationally? How does the grant activity of its faculty compare with that of individual faculty at other AAU, Research I, land grant universities?

From the report

Page 4: " This is a department with a research program that is undervalued outside the university (and, we suspect, within the university as well). Its National Research Council (NRC) ranking places it in the third quartile of ranked doctoral departments of mathematics; it is more likely close to the middle. By taking steps now, the department could easily move into the top half of all PhD departments within the near future. (There are about 150 ranked doctoral programs in mathematics, and about 180 altogether.) The department already has a very impressive collection of junior faculty in addition to a number of productive and visible senior faculty."

Page 3: " It would be hard to find many departments of mathematics anywhere in the U.S. that had comparable amounts of outreach."

Page 4: " For instruction, the department serves as a model for the rest of the university — indeed, for any university in the nation."

(Because the Chair is highly visible nationally, the department's outreach and instruction are known in the much of the mathematics community.)

Page 10: " Mathematics is different from the hard sciences. A little more than 30% of active research mathematicians receive federal funding; the percentage for the physical sciences is 64% and for biological sciences is 68%. When mathematicians *do* receive grants, they are only a fraction (less than a third!) of those in the experimental sciences. Unlike the hard sciences, most funding in mathematics comes from a single source, the National Science Foundation. Fewer than 15% of active mathematicians have an NSF individual investigator award at any given time.

"From this data, it is clear that mathematicians — even mathematicians with active, strong research programs — often do not have grant support. It would be wrong to claim that external support is unrelated to the quality of one's research in mathematics. But it would equally wrong to equate external support with high-quality research. Funding and research are not the same in mathematics.

"On the other hand, there *are* opportunities for funding, both inside the Division of Mathematical Sciences and outside, and some groups in the department can and should

take advantage of those opportunities. Doing so helps to validate their work and brings recognition (and money) to the university. Seeking external funding is sensible; it's just not essential.

"In addition, there are opportunities for instructional funding, and this department has been remarkably successful in taking advantage of those opportunities."

5. The self-study notes that the department has plans to strengthen the major and to change what are termed "quite traditional" mathematics and statistics requirements. From your perspective, what major changes should be considered?

There should be more of focus in the mathematics curriculum, and a greater emphasis on outside courses supporting the mathematics.

From the report

Page 4: " During our visit, curriculum played a minor role in discussions about instruction. That's a healthy sign. Departments often spend all their energy devising new curricula and changing requirements, with little effect on the program. The department appears to be considering changes in the major in keeping with national trends to connect the mathematics major with other programs in the university. Given the care with which other instructional changes have been implemented, this will likely only improve the major. The Review Committee noted an unusually large number of courses listed in both the undergraduate and graduate catalogues, which might be trimmed substantially when revising the curriculum in the future."

6. The self-study notes several times that the faculty are tired and that the department wants advice from the external review team about what part of the department's mission should have a lower priority. This is a question we would like the team to address too.

From the report

Page 1: " The Review Committee was asked to comment on priorities for the department, indicating (again, assuming static resources) which activities the department should consider eliminating in order to relieve stress. While we will address this question indirectly, we observe that in many instances the increased activity of the department is an attempt to carry out the mission of the university and/or college. The university, rather than the department or Review Committee, may want to indicate which parts of its mission should have less emphasis in the future. With that added information, the department will be able to make decisions about which programs should be sustained and which should be cut-back or eliminated."

Page 9: " The comments above suggest ways in which the research profile can be improved while the present valuable outreach and instructional activities are sustained. The combination of the two — a department with a high research profile, yet known for its outstanding instruction and outreach — will work together to make this department a model of the way American research universities are supposed to work. On the other hand, there is an important additional step that the department needs to take in order to make this combination work. The department must stop overextending itself, and in the future it must

collectively say No to some requests for new programs or extra courses or additional outreach. It must set priorities for new activities with care. The advice from the 1993 APR stated that the department simply could not continue to do more without additional resources. That advice was ignored for admirable reasons — demonstrating what could be done rather than merely talking about it. If the department continues to ignore the advice, it will not succeed in accomplishing its goals."

7. Please assess the department's facilities, space and staff support.

From the report

Page 8: " Much of the outreach and exceptional instruction has been done using faculty, for planning, for organization, and for carrying out the details. If the department had another staff person to coordinate conferences, help with the logistics, help with newsletters, etc., the faculty would have a much smaller burden in carrying out this service. This has the consequence of freeing up some of the most productive faculty, and again increasing the research profile. It also sends a message to those faculty that their activity is valued."

"In addition, there is a widely held perception that computer support is inadequate. This affects all faculty, especially because support for instructional computing comes from within the department itself. If the department had another systems support person for computing, it would make the department more productive and aid those faculty engaged in instructional technology. Which of these two positions (staff or computer support) had greater priority was uncertain in our discussions with faculty."

Page 9: " The department clearly has space problems, but has a clear plan to solve those problems (in a renovated Avery Hall). If the opportunity for new facilities is used wisely, this can dramatically improve morale within department and at the same time make it easier to recruit new faculty. Careful planning involves all aspects of the new facilities — the design of offices, lounges, seminar rooms, computer facilities, even restrooms. This is an opportunity that comes infrequently to departments, and it can have a profound effect on the future. The department already seems to have a good understanding of the importance of careful planning."

*Raúl Curto
John Ewing
Glen Meeden
Susan Montgomery*