DEPARTMENT OF MATHEMATICS AND STATISTICS
PROGRAM REVIEW COMMITTEE REPORT

The Department of Mathematics and Statistics prepared a self study following program review guidelines. A two-person external review team visited the campus; reviewed the self study; interviewed unit personnel, university administrators, undergraduate students, and graduate students; and submitted an external report. The Program Review Committee studied all written materials. The Committee liaison for the Department discussed the self study with the department chair and faculty. The Committee discussed its preliminary findings with the Dean of the College of Arts & Sciences. This document reflects the Committee’s findings and recommendations.

SUMMARY OF THE SELF STUDY

Introduction

Mission. The Department’s mission is to “sustain a curriculum and program that meets the intellectual and vocation needs of our students, to foster a sound teaching environment, and to provide a setting for professional research in mathematics and in statistics.”

History. The Department is one of the oldest at the University. The Ph.D. program was launched in 1971. The self study highlights two major shifts in the faculty since then, in the late 1980s and in the mid-1990s, largely as a result of numerous retirements.

Description of the Unit

Programmatic and curricular offerings. The Department offers B.S. and B.A. degrees in Mathematics and in Statistics, and specializations in Actuarial Science and in Applied Mathematics are available for the mathematics degrees. The Department offers minors in Mathematics and in Statistics. Education majors who specialize in mathematics are effectively mathematics majors or minors as well. At the graduate level, the Department offers an M.A. with tracks in Mathematics, Statistics, or Applied Mathematics; an M.A.T. in Mathematics; an M.S. in Applied Statistics (jointly with Applied Statistics and Operations Research); and a Ph.D. in Mathematics, with a specialization available in Statistics. A separate Ph.D. program in Statistics is awaiting approval by the Ohio Board of Regents.

Faculty resources. The total number of faculty has risen from about 29 in 1998 to about 39 in 2004, although all of the increase has been in non-tenure track positions. The number of faculty with only a master’s degree has increased sharply, from one to thirteen over the same time. The self study states that the faculty is reasonably diverse in gender and ethnicity compared to national averages. The standard allocation of effort is 40% teaching, 40% research, and 20% service for tenured and tenure-track faculty, and they
carry a standard teaching load of four courses per year. The norm for non-tenure track faculty is 90% teaching and 10% service (or 60:40 for course coordinators) and a teaching load of six to eight courses per year.

Graduate assistant resources. Since 1998, the number of graduate students has risen from about 60 to about 70, with the fraction of Ph.D. students rising from about a third to about half (i.e. roughly from 20 to 35 students). The primary GA responsibility is teaching one section of a five-hour course or two sections of a three-hour course, always with a faculty course coordinator.

Staff resources. The Department has maintained the same number of classified staff, three secretaries, for at least 20 years.

Students in the program. The number of “pure” Mathematics, Applied Mathematics, and Statistics majors has remained constant since 1998 at about 25-30, while the number of students specializing in Actuarial Science has grown from less than 10 to over 30. The number of minors has decreased from about 20 to about 12. The self study considers students majoring in Integrated Mathematics secondary education as mathematics majors, given that they take the same number of mathematics courses and that the Department provides advising for them. The number of these students has risen steadily from about 110 to over 180. Likewise, Mathematics specialization Middle Childhood Education students are regarded as mathematics minors, and their numbers have risen even more, from about 60 to over 200.

Student credit hour production. The undergraduate student credit hours taught by the Department averages almost 28,000 per year, and has remained roughly constant over the period of the self study. The self study does not estimate the number of SCH per FTE. It does, however, indicate that class sizes in lower division courses have dropped from roughly 30 to roughly 24 since 1998 because of the deliberate choice to keep class sizes small in MATH 112 and 122 when they were created.

Recruitment and retention efforts. At the undergraduate level, the Department participates in University efforts and has revised its curriculum guides, especially to emphasize job opportunities. Actuarial Science is promoted through flyers sent to high schools, word of mouth, and a listing with the Society of Actuaries. At the graduate level, the Department advertises and responds promptly to inquiries. Viable domestic applicants are contacted by phone to discuss their goals and to further assess their strengths. Viable candidates are also invited to visit campus. Finally, the Department assists incoming students in completing university procedures and in making the transition to graduate studies and Bowling Green. Retention is not a serious problem for majors who make it through the first few calculus courses or for master’s students. The Department is concerned about the retention of doctoral students, especially because of the difficulty of obtaining funding beyond the fourth year. Several international students have left the program recently over their concern about continued funding.
Facilities and equipment. The self study notes that storage space and seminar/meeting space are very limited and that all available office space is in use and will probably not be adequate for the Department’s needs next fall. There is a very serious need for better computers for graduate students. The current desktop computers are typically shared among three to four students and are too old even to run most basic software, including web browsers, much less high-end software used in undergraduate classes.

Information resources and services. Library resources are especially important, and have been diminished by the cancellation of some journal subscriptions and a significant number of books being moved to the book depository. Library reductions are affecting the ability of faculty and students to do research and may negatively impact faculty retention and recruitment.¹

Financial resources. The Department’s operating budget increased for several years, but it then decreased for several years, due in part to reduced enrollments in MATH 095 and the resulting reduction in lab fees. Nevertheless, the Department has operated within its budget for a number of years.

Self Evaluation

Faculty quality and productivity. The 24 tenured and tenure-track faculty have published about 42 articles per year in refereed publications and almost two books per year. Three faculty members are Fellows of the American Statistical Society. The faculty submitted 77 proposals for external funding since 1998, with 33 funded for a total of about $2.5 million. The number of proposals submitted and the number funded have risen more or less steadily since 1998, and the total funding awarded has increased by nearly four times.

Student entry attributes. As a group, mathematics, statistics, and mathematics education majors have higher high school GPAs than the university average. About 70% of these majors have ACT scores of 21 or above and about 30% score 26 or above. Among graduate students, the average GPA of domestic students has varied somewhat around an average of about 3.7. The average quantitative GRE score has risen somewhat from roughly 710 in 1998-2000 to roughly 740 in 2001-2005. The average TOEFL on international students has risen from about 600 in 1998 to over 620 in 2005.

Assessment of student learning outcomes. In recent years the Department has focused on assessment of its service courses, including issues such as placement, retention, and tracking. The self study argues that the Department’s activities have been the result of ongoing critical assessment of student success in its service courses. The faculty feels they have not had the wherewithal or the personnel to undertake significant systematic assessment of its major or graduate programs at the same time.

¹ At the time the self study was written, the University was pursuing plans to close the Ogg Science Library. However, it now seems likely that the Science Library will remain open, mitigating concerns about availability of research materials for mathematicians.
Demand. Demand for graduate and upper-level courses has been very stable, and has even risen slightly in recent years. The self study states that demand for lower-level service courses has skyrocketed, although the SCH data reported show a slight decline since 1998. The self study states that demand for well-trained mathematicians and statisticians is very high. The placement for master’s and Ph.D. graduates has been at 100% for well over ten years.

Connection to the mission. The academic theme of Leadership in Learning pervades the Department’s operations. The Department’s innovative approach to service teaching and commitment to teacher education illustrate its dedication to quality instruction, as do its participation in and support for programs such as COSMOS, PRISM, and PMET. The study of mathematics is also integral to critical thinking about values and to inquiry.

Financial considerations and adequacy of resources. The Department does not have adequate data to evaluate its cost effectiveness, although the high enrollments, relatively small number of tenured and tenure-track faculty, and modest equipment needs suggest it does well for the University.

The Department’s resources are generally adequate, with two notable exceptions. One is the loss to retirement of senior faculty, including two Distinguished University Professors, and the increase of non-tenure track faculty, now 43% of the total faculty. The second exception is space. There is no available office space for three pending faculty hires, nor is there dedicated research space.

Doctoral programs. The guidelines for preparing the self-study document call for a section devoted to doctoral programs, to include information on the doctoral program’s faculty, graduates, vitality, demand, interactions with other institutions and organizations, access, student outcomes assessment at the doctoral level, and program revisions from previous reviews. This information is to be subsequently reported to the Regents Advisory Committee on Graduate Study (RACGS). However, the Department’s self study only provides information on faculty (quality and productivity), graduations, and job placement. As mentioned above, the Department has not undertaken detailed assessment of graduate student outcomes. The development of a new Ph.D. program in statistics is mentioned below as part of the Department’s response to the previous program review. However, the other items listed are not directly addressed in the self study.

Unit planning (next seven years)

The planning process. The Department held small-group discussions for the major research groups over two years, as well as regular large-group discussions.

Goals and strategies. The self study describes seven goals, which are briefly summarized as follows:
a. Continue to support the research area of Probability and Statistics;
b. Continue to support the research area of Mathematics Education;
c. Continue to support the research area of Core Mathematics;
d. Continue to expand and improve the Department’s service role;
e. Revise the Department’s infrastructure to better incorporate its full-time instructors;
f. Continue to refine the major curriculum; and
g. Continue to refine the graduate program.

Timetable and implementation plan. The self study lists specific itemized agenda items for the next three years.

RESULTS OF PREVIOUS REVIEWS

The last departmental program review was conducted in 1998-99. The final report of the Program Review Committee included eight recommendations, which are quoted (in part) below along with a description of actions taken on each item.

1. Provided there is satisfactory progress on all aspects of recommendations 2-8, we recommend that the Dean of Arts and Sciences provide additional FTE to the department, returning it to at least 32 FTE, including instructors/lecturers, by August, 2003.

The number of full-time faculty rose to over 32 in Fall 1999 and has remained so since then.

2. We recommend that the department redouble its efforts to obtain external funding both from governmental and corporate sources.

The Department has improved its record of external funding. Compared to 1998, the number of proposal submissions per year in 1999-2003 was consistently higher, and in 1999-2003 both the number of proposals funded and the total funds awarded were greater as well.

3. We recommend that by January 2000 the department show the Dean of Arts and Sciences that it has thoroughly reconsidered its hiring plan.

The Department revised its hiring priorities toward areas with excellent prospects for external funding and toward hiring more women. The fraction of women faculty members has risen from 7% in 1998 to 17% of tenured/tenure-track faculty and 72% of instructors. The Department continues to collaborate with the College of Education and Human Development regarding hiring in mathematics education.

4. We recommend that the department develop a written, multifaceted plan to staff its service classes in mathematics and statistics and to increase the quality of instruction in those classes.
In consultation with the Dean of the College of Arts & Sciences, the Department critically reexamined the content and delivery of its service courses. To address these courses the Department increased its funding support of the Math Lab and the Supplemental Instruction Program, and expanded the Supplemental Instruction Program to two additional courses; hired a Director of Service Mathematics; split the five-hour course MATH 120 into two three-hour courses; redesigned the mathematics placement exams, including an on-line format; worked on utilizing all available information to improve advising and course placement for students; and developed a new course-evaluation form. The Department provides a teaching seminar and classroom observation and feedback to strengthen the teaching skills of its graduate assistants.

5. **The PRC’s recommendations concerning the relationship between Mathematics/Statistics and ASOR** … will be included in the Final Report for ASOR.

The Department is not aware of specific recommendations regarding its relationship with ASOR.

6. **We recommend that the Department of Mathematics and Statistics form a program area in Statistics and one or more in Mathematics. As part of this reorganization, we urge the faculty to adopt strategies for maintaining the cohesion of the department.**

In consultation with the Graduate College, the Department submitted a proposal for a new Ph.D. program in statistics, which is expected to receive final approval soon. A new M.A. in statistics is planned. The Department has tried to participate more fully in the Statistical Consulting Center, but without success. Dual-listing MATH and STAT courses was attempted but proved to be problematic. As a result of additional strategic planning, the pure mathematics group is now much less territorial and much more cohesive, aided by the more cross-disciplinary approach of many of the younger faculty.

7. **We recommend that the department continue to institute new/additional methods of student outcomes assessment that focus on both undergraduate and graduate major programs.**

The Department’s efforts have focused more heavily on global issues of student success related to its service courses rather than on individual learning outcomes or its majors. The faculty analyzed student performance on the Praxis II for secondary mathematics education majors and coursework that covers the relevant material. They are instituting advising changes to help students prepare better for the exam.

8. **We recommend that the department develop a plan for updating all faculty in the appropriate technologies for classroom instruction.**
The Department embraces the use of technology where appropriate, and many faculty use it in their teaching. However, several problems make the use of technology difficult and/or less effective for student learning. Faculty release time for professional development is impractical on a sufficient scale. The Department is focusing discussion of technology use on key courses.

**SUMMARY OF THE EXTERNAL REPORT**

The external reviewers, Professors Allan Sampson (University of Pittsburgh) and Warren Wogen (University of North Carolina at Chapel Hill), praised the Department on several counts. They cited the Department’s strong commitment to high-quality teaching, the impressive breadth of its undergraduate program, its efforts to refine and expand its degree programs and service courses, and the strong research profiles of the faculty. Their chief concern was that the Department is severely understaffed with respect to tenured and tenure-track faculty to support the Department’s research agenda. The reviewers made the following recommendations:

1. Three to five new tenure-stream faculty members need to be hired. They consider this issue critical, noting that the large number of instructors can cover classes, but are not in a position to develop or revise courses, supervise TA instruction, or contribute to the research environment. The tenure-stream faculty members teach almost no courses below the junior level. They are stretched too thin, because their service load has increased, and their research may soon suffer. The stress has them “in the danger zone.”

2. Visiting faculty positions need to be increased. They suggest that some instructor positions be converted to fixed-term postdoctoral and visiting research positions, as existed in the Department until recently.

3. Some instructor positions need to be converted into lecturer positions (with fixed term rolling contracts), with teaching and substantial service tasks, but no expectation of research.

4. Class sizes could be increased. The reviewers cite larger class sizes at their home institutions and guess that the national average is also larger. They suggest that smaller sizes of 25 could be maintained for inexperienced TA’s, but instructors’ class sizes could be increased to 35-40, which would help pay for their first three recommendations.

5. Decrease the TA teaching load. The current load of four courses per year is heavy and could be reduced by having experienced TAs teach two to three larger sections per year instead.

6. Address concerns about the 5th year of TA support. Graduate students and faculty are concerned, and anecdotal evidence indicates some graduate students have left the program because of fear they would not finish in four years. They urge the Department and the University to produce a compromise to alleviate this concern.

7. They recommend that an acceptable solution be reached regarding the future of the science library, that computers be made more available to graduate students, and that national standards be considered when setting salaries for new hires in order to stay competitive.
The Department has a strong record of achievement, and responded positively and with great success to the recommendations resulting from the previous program review. We commend the faculty on their “strong commitment to teaching at both the graduate and undergraduate levels” (in the words of the external reviewers). The Department carries an extremely heavy service teaching load while at the same time serving a diverse set of its own majors, plus mathematics education majors. The Department has made very significant strides in improving their service courses, student support mechanisms, student placement, and preparation of teaching assistants. We also concur with the external reviewers regarding the research strength of the faculty, evidenced in part by their strong publication record of both refereed articles and books, and by a nearly four-fold increase in external funding in the past seven years.

1. Tenure-Track Staffing

**Findings.** The self study and the external reviewers both list the hiring of additional tenure-track faculty as the greatest need for the Department. It is vital to strengthen the tenured and tenure-track faculty in order to assure high quality instruction in service courses, assure that majors have all of their courses from tenure-stream faculty, moderate the increased service load on the tenure-stream faculty, and maintain the healthy and growing research productivity.

**Recommendation.** The Department and the Dean of Arts and Sciences should discuss the appropriate tenured/tenure-track and non-tenure track staffing levels for the Department in order to assure its continued success in teaching (both graduate and undergraduate), research, and service missions. The Department should prepare a hiring plan with clear priorities for additions in the various research areas. The plan should be created with input from the Dean, and approved by him by the end of the 2006-07 academic year.

2. Non-Tenure-Track Staffing

**Findings.** As mentioned by the external reviewers and discussed by the faculty with the PRC liaison, the Department benefited greatly in the past from having Ph.D. faculty in visiting positions. These visitors were typically postdoctoral fellows. They helped to stimulate the research environment but also carried a significant teaching load. Salaries slightly above that of typical instructors would be needed, but with only modest reduction in teaching capacity, and the benefit to the research program could be substantial. Converting one or more instructor positions to lecturers might help recruit and retain well-qualified Ph.D. faculty who could contribute more fully outside the classroom, e.g. to curriculum development, service, or even to research. The external reviewers also recommended increasing class sizes somewhat in order to reduce the number of instructors needed to cover the service courses. The faculty expressed concern
to the PRC liaison about the capacity of available classrooms and about a negative impact on the quality of instruction and on student success.

Recommendation. In consultation with the Dean, the Department should consider various options for changing the types of positions included among the non-tenure-track faculty (postdocs, visiting faculty, lecturers, and instructors), along with teaching loads and class sizes. Based on this consultation, the Department should present a specific proposal to the Dean, by the end of the 2006-07 academic year.

3. Integration of Instructors

Findings. In response to the substantial increase in the number of instructors, the Department has faced some new challenges. The self study describes two important steps needed in order to better integrate instructors into the life of the Department. One is to revise governance documents to include instructors more fully, especially in terms of workload expectations, annual evaluations, and merit. The second step is to devise appropriate training for instructors, particularly as they move into teaching higher-level courses. More broadly, instructors will benefit greatly from guidance, formative evaluation, and professional development no matter what courses they teach, and the need will be ongoing due to the inevitable turnover among the instructors. We applaud the faculty for recognizing these issues and for the very significant progress they have already made in addressing them. The recommendation that follows simply anticipates the natural completion of what the Department has already undertaken.

Recommendation. The Department should complete the revision of its governance documents to address such issues as workload, evaluation, and merit for instructors. The governance documents should be revised by the end of fall semester, 2006. The Department should also complete the development of mechanisms to provide training, formative evaluation, and professional development opportunities for instructors. To some extent, this effort should be on going, but an initial plan should be in place by the end of the 2006-07 academic year.

4. Assessment of Majors and Graduate Students

Findings. The Department has done excellent work assessing and revising its services courses. Building on that success, the Department should now turn to similar assessment and revision of its major or graduate programs. The self study describes several changes being developed for both programs. It is important to make such changes in light of authentic assessment of the stated learning outcomes.

Recommendation. We recommend that the Department continue to institute new/additional methods of student outcomes assessment that focus on both undergraduate and graduate major programs. During the 2006-07 academic year, the Department should set a goal of implementing an assessment procedure for majors. The following year, the Department should add an assessment program for graduate programs. Progress on these efforts should be reported annually in the Department’s report to the Student
Achievement Assessment Committee. Future revisions to the curriculum should be informed by the results of assessment of student outcomes.

5. Service Courses

Findings. Many other departments, with a variety of needs and expectations, rely on the Department to teach service courses, resulting in a heavy and diverse teaching load. The Department has taken a number of positive steps to improve its service courses, and the self study describes plans for additional changes.

Recommendation. In ongoing consultation with the other units it serves, the Department should continue its strong efforts to assess and revise as needed its service courses in order to better meet the needs of the students.

6. Statistical Consulting Center

Findings. The Department desires and the opportunity exists to expand the mission of the Statistical Consulting Center to include off-campus consulting and engagement with the external community. A large pool of expertise in statistics could be tapped from the Department of Mathematics and Statistics, the Department of Applied Statistics and Operations Research, and a number of other units across campus. There are barriers, however, to consulting and engagement, such as the need to develop and coordinate external clients and to make sure that the amount of the “indirect costs” charged are not a disincentive to external clients, which must be removed for the Center to engage successfully with external clients. Other centers on campus and off (e.g., the Center for Regional Development) could be used as a model for external functions of the Statistical Consulting Center.

Recommendation. The Department should solicit the involvement of the Graduate Dean, the deans of Arts & Sciences and Business Administration, the Department of Applied Statistics and Operations Research, and other relevant stakeholders to put together a plan for the future of the Statistical Consulting Center. This plan should reconsider the mission of the Center, consider consulting and engagement opportunities for students and faculty, and address the need for help in developing relations with the external community. A similar recommendation has been made in the Committee’s report to the Department of Applied Statistics and Operations Research, which has historically taken the lead in running the Center.

7. Graduate Student Stipend Levels

Findings. Stipend levels are not high enough to allow the University to attract the highly qualified students it seeks for its graduate programs. This is a recurring theme across departments and programs. The normal process of annual increases will not provide adequate resources to provide a system-wide solution. Further complicating the problem is the fact that programs and disciplines differ greatly in their ability to secure grant-funded assistantships. In the case of doctoral students in the Department, there is an
additional problem arising from the limit of four years of doctoral funding, which may be causing us to lose well-qualified students to other institutions that offer five years of doctoral funding.

Recommendation. As a university community, it will be essential to address the competitiveness of stipend levels. However, the solution cannot be solely to rely on internal funding of graduate stipends. Neither can individual departments take on the whole burden. Therefore, any efforts to increase stipend levels must involve collaboration among the faculty, the departments, the colleges, and the Graduate College. The Committee urges the Department and the Graduate Dean to develop a plan, by the end of the fall semester of 2006, to address the fifth year of funding for highly-qualified doctoral students.

8. Doctoral Program Report

Findings: The section of the self study on the doctoral program did not follow the outline specified in the Program Review Report outline. Information about Program Faculty and Program Graduates was present, and other parts of the report addressed Assessment and Program Revisions to some extent. However, other required items were not directly addressed. The Program Review Committee needs this information in order to adequately understand and evaluate the Department. Furthermore, the Graduate College needs this information, and in this format, to present to RACGS.

Recommendations: The Department should rewrite the Doctoral Program section of the self study in the form specified and submit it to the Graduate Dean by June 15, 2006.

The Department of Mathematics and Statistics should report annually to the Dean of the College of Arts and Sciences, with a copy to the Provost, on the implementation of these recommendations.