# Academic Program Review
# Self-Study

Department of Mathematics and Statistics
University of Nebraska–Lincoln

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# Introduction, Program Goals and Rationale

# Chapter 1

# Introduction

The mission of the Department of Mathematics and Statistics is to promote the creation and dissemination of knowledge in the mathematical sciences. The Department has active research faculty, it has the only doctoral mathematical sciences graduate program in Nebraska, it has large and expanding instructional activities, and it has substantial involvement in outreach programs. All this attests the unique and substantial role the Department plays in the life of the University. This chapter discusses the outcomes of our last APR and the factors that result in the Department of Mathematics and Statistics being a department under stress.

## 1.1 Overview of Self-Study

This report describes the Department of Mathematics and Statistics at the University of Nebraska-Lincoln at the end of the Fall 2000 semester. The Department has 34 members of the instructional faculty on tenured or tenure-leading lines, one research professor on a partial FTE appointment and one tenured faculty member who is fully-funded by grant funds and is no longer a part of the teaching faculty. In Fall 2000 there were six visiting faculty with three additional visitors scheduled for Spring 2001. In addition, eight people have courtesy appointments as members of the Department's graduate faculty. The Department's instructional program is supported by eight lecturers who have partial FTE appointments and by ten people who teach a course in the Department's evening program. Fifty-one graduate students are supported by the Department as either graduate teaching assistants (GTAs) or graduate research assistants (GRAs) and ten undergraduates are appointed as undergraduate teaching assistants. An office staff of four and a computer system administrator provide support services to the faculty and graduate students in the Department. The University Libraries provides a librarian to run the mathematics and statistics branch library, which is located on the 9th floor of Oldfather Hall.

The Department's main offices are housed on the eighth and ninth floors of Oldfather Hall. A graduate student satellite office is located in the 501 Building, several blocks away from Oldfather. The Department also has an undergraduate computer laboratory in Bessey Hall and a Mathematics Resource Center in Burnett Hall. The Department is also home to the American Mathematics Competitions, housed in a building at 1740 Vine Street.

The Department offers undergraduate and graduate degrees from the B.A. to the Ph.D. in mathematics and statistics, with a supporting array of courses. In fact, the Department provides the only doctoral mathematical sciences program in Nebraska, and is one of only four offering masters degrees in the mathematical sciences.

The Department has a substantial instructional responsibility to teach students from all undergraduate colleges. In Fall 2000, approximately 30% of all undergraduates were taking a mathematics or statistics course and the Department's Student Credit Hour (SCH) production was 7.7% of all instruction on campus (14.2% of the College of Arts and Sciences). Despite the demands of the Department's service instruction for the entire campus, the Department also maintains an outstanding program for undergraduates who major in mathematics and statistics as well as a graduate program which has been honored at the White House.

Broadly speaking, faculty in the Department conduct research in mathematics and statistics. The mathematicians tend to fit into two large clusters, *Algebra and Discrete Mathematics* (ADM) and *Pure and Applied Analysis* (PAA). We can further subdivide the Department's primary research interests in mathematics to include four *Areas of Strength* that the Department has emphasized since 1996:

**ADM** Commutative Algebra and Algebraic Geometry
Discrete and Experimental Mathematics

**PAA** Operator Algebras and Functional Integration
Modeling with emphasis on Differential Equations and Partial Differential Equations

Even finer subdivisions are possible as we classify faculty research interests to include subareas such as Coding Theory, Combinatorics, Geometric Group Theory, Semigroup Theory, Classical Analysis, Control Theory, Dynamical Systems, Numerical Analysis, etc. Historically, we have used "Applied Mathematics" to refer to continuous mathematics with an emphasis on differential equations, partial differential equations and numerical analysis. Such language is now viewed as limiting and even incorrect as faculty in semigroup theory work with computer scientists on "information science," and faculty in algebraic coding theory attend research conferences with engineers. Indeed, as was said at a recent presentation to the National Science Board, "Every area of mathematics, as pure as it may appear, has significant applications. The concepts and structures developed by fundamental mathematics often provide just the right framework for the formulation and study of applications in seemingly unrelated areas."

It should be noted that in a department the size of ours, there are many areas of mathematics not covered by the research expertise of the faculty. For example, one might view "Geometry" as an area of comparable size to ADM and we have no faculty who clearly fall into such a category, although we have several who have significant research interests in geometry. Other major areas where we have no faculty concentration include logic, number theory, and mathematical physics.

Similarly, statistics has developed into a very large discipline, independent of mathematics. Until such time as UNL makes a commitment to a much larger statistics program, we believe that the greatest advancement for statistics at UNL can be made by focusing on having a very high quality group of statisticians in the area of survey sampling who make significant contributions to the Gallup Research Center.

This report presents detailed data concerning Departmental activities and productivity. It includes self-assessments of the quality of the Department's activities and it discusses Departmental strengths, weaknesses, and goals, as well as the social, academic and administrative milieu in which the Department functions.

The organization of this report on the whole follows the outline suggested in the Office for Academic Program Review's booklet *Academic Program Review Guidelines*, but at a finer level of detail this report borrows heavily from the report written in 1993 by then APR coordinator Professor Brian Harbourne. Moreover, to keep the main narrative focused, to improve access for information relevant to several sections of this report, and to provide a place for items of independent interest, a number of items are included in appendices.

## 1.2 The 1993 Academic Program Review

The Department's most recent Academic Program Review was in December of 1993. In its Self-Study, the Department identified i) two broad resource issues that face all UNL departments; ii) Department priorities that would require new resources for the Department; and iii) Department priorities that the Department would be able to address with its own resources. We begin this Self-Study with a review of these issues, the review team's report and comments about what has happened since the time of that Academic Program Review.

The review team's report is available as Appendix C to this Self-Study. In the introduction to their report, the review team wrote:

> *The review team was very favorably impressed by the excellent and balanced contributions the Department of Mathematics and Statistics is making to the university and its students. We found a serious and innovative faculty dedicated to advancing the mission of the department and university. We also found a department with severe resource problems whose ability to sustain current activity, let alone respond to new challenges, is threatened by those resource problems. We urge the university to respond immediately to the most pressing needs discussed in this report.*

### 1.2.1 Resource Issues for All UNL Departments

*1. Increasing costs represent a substantial threat to research libraries.*

*2. There is no regular source of funds for computer equipment or for the maintenance and upgrade of computer equipment.*

These two issues remain important issues for UNL seven years later. UNL has made reasonably good efforts to address to deal with the rising prices of journals, both through stop-gap action locally and by participating in joint efforts with other research libraries nationally. The current status of our research library is discussed later in this document.

The department still does not have a permanently budgeted source of funds for the purchase, maintenance or upgrade of computer equipment, but the College of Arts and Sciences has been supportive of including computer funds in start-up packages for new hires, and the university has annually allocated some funds for "instructional equipment". The College has, on occasion, also used end-of-year funds to support computer purchases. In addition, this year the College used funds from the Student Technology Fee to support computer purchases. Thus, in an ad hoc manner we have been able to provide most faculty and graduate students with high quality equipment. Finally, a lab fee which was introduced in Math 221 and Math 314 provides some funds for maintaining and upgrading software and equipment in our Undergraduate Computer Lab.

### 1.2.2 Needs for New Support Identified in 1993 Self-Study

The 1993 Self-Study identified five top priorities for any new resources that would be made available to the department. The review team's report said:

> *We find the department's request and priorities to be sound and well justified...*
> *As one would expect, most of the recommendations will require new funds for the department. We were told that the university does not expect to receive a significant amount of new funding during the next few years; we understand those constraints and that other departments have similar problems. Nevertheless, we want to argue strongly for the modest requests made by the department.*

*1. A computer support position and two new office support/clerical/accounting positions.*

The review team report strongly urged the university to support this request which had been identified as the Department's highest priority.

The A&S Dean's Office and the Office of the Senior Vice Chancellor for Academic Affairs has been very supportive of the Department's need for a computer system administrator. Using soft money, the Department hired Rex Dieter to fill this position early in the fall of 1994. By the start of FY95/96 permanent funds were received for half of this position and by FY96/97 the position was fully funded by state dollars. During the spring of 1999, the Dean's Office supported a significant upgrade of the position to counter an offer that Dieter had received.

Despite the solid support the Department has received for its system administrator, the Department's needs in this area threaten to outstrip our capacity to meet that need. For FY2000/2001, the Department is funding a half-time position to support Dieter and recently reassigned a graduate student to provide additional computer system support. It is reasonable to assume that within a few years we will need a second full-time computer support position to meet the Department's computing needs.

The Department was less successful in getting an increase in office staff support, but here too there has been progress that should be noted. Shortly before the start of the Fall 1996 semester, two members of the office staff resigned. The Dean's Office used this as an occasion to support a significant reclassification of the two positions, enabling the Department to hire two very capable employees. Subsequently, there has been another reclassification of all three office staff positions and now the Department is supported by very talented people.

Our current approach to providing office staff support for faculty and students has been to seek high quality people for the three positions we do have and to back these staff members with several bright student workers.

In Fall 2000 we were also permitted to hire an Administrative Assistant for the Director of our Division of Statistics as part of the University's commitment to build in statistics. (The position is 2/3 supported by permanent state dollars with the balance paid from external grants awarded to statistics faculty.) Thus, while we still have one of the smallest office staffs for a department our size, we are supported by outstanding people and we are no longer in a crisis situation with respect to our office staff.

*2. Increase the operating budget.*

After Brian Foster became Dean of the College of Arts and Sciences in 1994, he worked to increase operating budgets for all Arts & Sciences Departments. In particular, the operating budget for Mathematics and Statistics was raised from $33,354 in FY94/95 to $79,954 in FY95/96. For the current fiscal year our operating budget is $88,421. This change has been quite beneficial and is very much appreciated.

*3. Increase the amount of permanent GTA funds and the number of permanent faculty lines.*

This did not occur. At the time of the Department's 1993 APR the Department had 39 permanently budgeted faculty. The actual FTE on duty was less because of faculty such as Walter Mientka, who had a substantial FTE assigned to the American Mathematics Competitions, and Mark Sapir, who had a .50 FTE in the Center for Communication and Information Science. In addition, Dong Ho Park was on leave without pay.

In contrast, in Fall 2000, the Department had 35 permanently budgeted faculty, including Lynn Erbe who has a .67 FTE appointment. In order to put Erbe on a permanent budget line, the Department used a $40,000 salary pool that had been added to the Department's budget during the 1993/94 Academic Year. The effective strength of the Department was much less as Steve Dunbar was on assignment to the J. D. Edwards Honors Program, Steve Cohn and David Jaffe were on leave without pay, and both Wendy Hines and Earl Kramer had a .50 FTE appointment. Kramer will retire at the end of the Academic Year. The Department has authorization to hire two senior people in statistics this year. If these hires are successful and no other faculty are lost, the Department will start next year with 36 permanently budgeted faculty, but with Jaffe on leave without pay for at least one more year and perhaps longer.

Over the past 7 years the Department's GTA budget has grown at an annual rate of 2.8%, roughly equal to the amount that the university's salaries have increased during that period. No special increase in GTA funds for additional GTAs has been received.

*4. Create a Department of Statistics comprised of faculty currently in the Department of Biometry and in the Division of Statistics of the Department of Mathematics and Statistics.*

During Dean Brian Foster's first year at UNL there was a serious, but unsuccessful, attempt to create a separate Department of Statistics. Instead, agreement was reached to encourage the Department to give courtesy appointments in the Department to faculty interested in graduate education in statistics. This has happened and as a result there is greater interaction between statisticians in the Department and in the Department of Biometry.

Within the past year, the Senior Vice Chancellor for Academic Affairs and the Dean of the College of Arts & Sciences have made a major commitment to statistics which includes a commitment to create a fairly autonomous Division of Statistics within the Department of Mathematics and Statistics. The Department is hopeful that the commitments made this past year will enable the development of a strong statistics program at UNL.

*5. Address the space problem.*

Since 1993, there has been no additional space alloted to Mathematics and Statistics. However, plans are underway for renovation of Avery Hall. The University plans to use Avery Hall to house the Department of Mathematics and Statistics and the Department of Computer Science and Computer Engineering. Architects and a construction management firm have been selected and it is anticipated that the Department will move into a renovated Avery Hall in 2003. If the renovation is completed as planned, the Department will finally have much improved facilities and space should no longer be a problem.

### 1.2.3 1993 Department Goals and Priorities for Current Resources:

The Department identified two broad goals and several strategies that it would follow for each goal, using the resources already available to the Department. We believe that the record, as documented in this Self-Study, will indicate solid achievements in each area. These goals and strategies were:

*1. Continue development of an outstanding research and graduate program.*

Strategies included the support of a postdoctoral program, the reallocation of funds to support visitors, making the support of faculty travel a priority, and the development of a wider range of options at the graduate level. Some progress has been made in implementing each of these strategies. More importantly, the record, as reported in this Self-Study, is that this has been a very good period for both the Department's research program and its graduate program.

*2. Continue development of an outstanding undergraduate program.*

Strategies for the undergraduate program included supporting UNL's retention efforts through a commitment to our 100- and 200-level instruction; further integration of technology into instruction; strengthening advising, including significant improvements to our Math Placement Exam policy; supporting UNL's Comprehensive Education Program; and working with Teachers College to reform the education of future K-12 teachers of mathematics. Once again, the Department is proud of the achievements we have been able to make with the resources available. They are documented in this Self-Study.

### 1.2.4 Highlights from the 1993 Review Team Report:

In 1993 the Review Team was highly complimentary of the work of the department and they cautioned against any effort to do more with current resources. The following are further quotes from the Review Team's report.

- *The University of Nebraska can be justifiably proud that the Department of Mathematics and Statistics is meeting new challenges while continuing to nurture its research program. Many of the faculty maintain a high quality research program that attracts both national and international attention and there is evidence that the total research productivity of the faculty is at an all-time high. The department has a high-quality, student-friendly graduate program. At the same time the faculty is doing an outstanding job in undergraduate education ....*
- *We believe the quality of the graduate program compares favorably with those at the peer institutions.*
- *TA stipends are competitive with those at comparable institutions in neighboring states.*
- *Yes. If anything, they are modest.* (This was in response to the question: Are the department's requests for additional resources reasonable?)
- *The morale of the faculty is quite high.*
- *There is a fantastically positive atmosphere for women students in the department.*
- *We also found that the department is stretched to the limit and we feel strongly that it cannot continue to carry its current load, much less take on additional challenges, without additional resources.*

## 1.3 A Department Under Stress

Since the Department's last APR in 1993, UNL has dealt with a budget deficit known as the "assigned minus" and UNL has also had several major reallocations of resources. Furthermore, there have also been significant changes in the leadership of the institution. Here at UNL, as is perhaps the case for many public universities, there is concern that we face a future in which state support is unlikely to increase. Indeed, in an open letter to all faculty in the University of Nebraska System, President Dennis Smith identified three trends in Nebraska:

- annual decreases in the proportion of the state budget allocated to the university,
- increases in tuition limited approximately to the rate of inflation,
- an ever increasing percentage of the operating budget absorbed by salaries.

As might be expected, University leaders have looked for ways to increase revenues, including attempts to significantly increase external funding, efforts to increase student enrollment, and efforts to increase private giving to the University. In the meantime, administrators find themselves unable to reward departments at levels appropriate to their needs or their achievements. There is an increased reliance on reallocations to fund new programs while the academic

core of the campus (often departments in Arts & Sciences) are called on to focus their programs and essentially, "do more with less".

Since Academic Year 1993/94 the Department of Mathematics and Statistics has done more. Indeed, we believe that the record, as documented in this Self-Study, is one that should make the University justly proud. There are important achievements in every area of the department's mission. The past seven years have seen a marked increase in research productivity of the faculty and the Department has been extremely active in sponsoring research conferences. The graduate program, which was recognized with a Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring, has enjoyed the finest period in the Department's history. Our commitment to undergraduate education is seen both by increases in student credit hour instruction and the 1998 University-wide Departmental Teaching Award.

One might ask whether the Department ignored the advice from our 1993 APR that it "cannot continue to carry its current load, much less take on additional challenges, without additional resources." Perhaps. Our 1993 APR was conducted while the College searched for a new Dean. By Fall 1994, we welcomed new Dean Brian Foster with our very best efforts to achieve on behalf of the College and the University, and we hoped that the Department would be rewarded accordingly. And, as noted in the previous section, the Department did receive real support in the form of a computer system administrator, upgrades for staff positions which permitted hiring more talented staff, and additional funds for our operating budget. In addition, the College has provided significant amounts of temporary funding to help the Department meet its instructional demand.

However, in the one area of greatest importance to the Department, the number of tenure-track faculty, we have been unable to maintain our size, let alone increase in size. Indeed, we have lost faculty despite our achievements on behalf of the University. A faculty of 39 tenure-track faculty has been reduced to a faculty of 34 plus one person on a 3-year, renewable contract. At the same time, demand for instruction in mathematics and statistics has increased. Courses once taught by regular faculty are now taught by part-time lecturers. Further, the Department has lost the one thing most important to maintaining faculty morale—regular, predictable opportunities to hire and renew the Department.

We do not mean to imply that ours is the only department which has faced this kind of stress, nor do we imply that the College has treated our Department poorly in comparison with support given to other departments. Quite the contrary, we believe that the Dean's Office has supported our department as best it could. But we had retirements and faculty losses at a time when the Arts & Sciences College faced serious financial problems and our loss of faculty lines was one consequence.

We do want to emphasize the impact of losing faculty lines at a time when demand for instruction in mathematics and statistics was increasing. At Department meetings in preparation for this self-study, the dominant issue was the feeling of being overworked. While faculty felt the Department accomplishes most parts of its mission extremely well, there was significant frustration at not being able to have the time to do all that we are expected to do. Of particular concern was the opinion that few faculty had sufficient time available to maintain a high quality research program. Such stress would not be as difficult to bear were it not for the perception that it is unlikely that the University or the College will be able to adequately meet the Department's needs in this area.

Unfortunately, ours is a faculty near exhaustion at a time when UNL leaders are calling on faculty to aspire to greatness as a research and graduate education institution. We want to respond to this challenge, but we need either additional resources or advice regarding what part of our mission should have a reduced priority.

In 1999, Senior Vice Chancellor Edwards charged the Future Nebraska Task Force to "...provide a statement of what the nature and scope and quality of UNL's research and graduate programs should be some two decades hence—say in the year 2019, on the 150th anniversary of the University's founding. Call this our Sesquicentennial Vision—what aspirations or dreams or obligations do we have for the future of UNL's research and graduate programs? Our Sesquicentennial Vision should be ambitious, moving UNL beyond our current achievements and status, and recognize our role as one of America's premier research and graduate institutions; it should be hard-headedly realistic, and not necessarily limited by current financial or other constraints; and it should be rooted in our traditions and role as Nebraska's principal state university." The resulting "2020 Vision Report" is available at http://www.unl.edu/svcaa/priorities/future/report.html.

This report, which the current administration takes very seriously and will use heavily when making future decisions on allocation of resources, says that the University should *aspire* to be among the top public research universities in the country (Exhibit 2 in the report). This aspirant group is listed in the table below—note that it consists of many of the finest public universities in the country, including Cal-Berkeley, Michigan and UCLA. It also includes Minnesota, Illinois-UC, and Iowa, three of the best universities in the group of institutions which the Board of Regents currently

uses as UNL's Peer Group.

| | *UNL Aspirant Group* |
|---|---|
| 1. | University of California -Berkeley (stellar) |
| 2. | University of Michigan- Ann Arbor (stellar) |
| 3. | University of Wisconsin - Madison (stellar) |
| 4. | University of Virginia |
| 5. | University of California- Los Angeles |
| 6. | University of North Carolina-Chapel Hill (rising) |
| 7. | University of California-San Diego |
| 8. | University of Illinois-Urbana |
| 9. | Pennsylvania State University |
| 10. | University of Texas-Austin |
| 11. | University of Minnesota |
| 12. | University of Iowa |
| 13. | University of Georgia |
| 14. | University of Maryland - College Park |
| 15. | Texas A&M University (rising) |
| 16. | University of Massachusetts - Amherst (rising) |

If the Department is to move towards the goal of being in the same class as the corresponding departments at these institutions, the instructional demands placed on the Department, relative to the number of faculty, will need to be roughly similar to those at the institutions to which UNL wishes to be compared. Tables 1.1 and 1.2 show the ratios of the number of students to the number of mathematical sciences faculty at the institutions currently used as UNL's Peer Institutions as determined both by the Board of Regents and the Coordinating Commission for Higher Education. Note that Minnesota, Illinois and Iowa, the three Peer Institutions which are part of the aspirant group have a very different student to faculty ratios than our Department. Table 1.1 uses the number of faculty in the "mathematics department." At five institutions, including UNL, statistics faculty are part of the "mathematics department." Table 1.2 reports the combined faculty size of the mathematics department and the statistics department in universities where separate departments exist. Undergraduate enrollments are probably most significant for this comparison, for graduate students tend to take few courses outside their home departments, while undergraduates from all colleges and disciplines enroll in mathematics and statistics courses. We report students per faculty member rather than student credit hours per faculty member because the latter statistic was not readily available.

Because UNL has a Department of Biometry, one might argue that they should be included in the UNL faculty size in Table 1.2. Even if the 7 faculty from Biometry are included in the UNL totals, the only two institutions in the Regents' Peer Group with a higher undergraduate student to mathematical sciences faculty ratio than UNL are Colorado and Kansas, the two other universities in the group without a separate statistics department.

The data provided by these tables offers solid evidence that UNL must deal with the instructional demand placed on its mathematical sciences faculty in order to enable its faculty to increase their contributions in areas such as research, external funding and graduate education.

Given the current environment of tight budgets for the foreseeable future, there is widespread recognition that the College of Arts & Sciences is unlikely to receive sufficient new resources to meet the needs of all its departments and programs. Thus, the College is confronted with the responsibility of deciding whether the Department of Mathematics and Statistics is one of the programs that merit additional resources that do become available. If new resources are not available, the Department is confronted with the question: which, if any, activities should the Department reduce? The review team's recommendations will be very important as the College and the Department deal with these fundamental questions.

| Board of Regents Peer Institution | Coord. Comm. Peer Institution | Enrollments Total | Enrollments Undergrad | Faculty (Math) | Students Per Faculty Total | Students Per Faculty Undergrad |
|---|---|---|---|---|---|---|
| | Louisiana State | 30,870 | 26,130 | 41* | 752.93 | 637.32 |
| | Georgia | 31,288 | 24,209 | 39 | 802.26 | 620.74 |
| | Kansas State | 20,942 | 18,095 | 31 | 675.55 | 583.71 |
| **UNL** | **UNL** | 22,268 | 17,968 | 34* | 654.94 | 528.47 |
| Kansas | Kansas | 27,838 | 18,995 | 38* | 732.57 | 499.86 |
| Colorado | Colorado | 28,912 | 22,344 | 45* | 642.49 | 496.53 |
| Colorado State | | 23,098 | 19,075 | 39 | 592.25 | 489.10 |
| Purdue | Purdue | 37,871 | 30,899 | 65 | 582.63 | 475.36 |
| | Tennessee | 25,474 | 20,009 | 46 | 553.78 | 434.98 |
| Iowa State | Iowa State | 26,110† | 21,503† | 50 | 522.20 | 430.06 |
| Missouri | Missouri | 23,280 | 18,058 | 43 | 541.39 | 419.95 |
| Iowa | | 28,311 | 19,824 | 48 | 589.81 | 413.00 |
| | Oklahoma State | 19,860 | 16,452 | 41 | 484.39 | 401.27 |
| Minnesota | | 45,481 | 26,972 | 69 | 659.14 | 390.89 |
| Illinois - UC | | 36,963 | 27,882 | 80 | 462.03 | 348.52 |
| | Auburn | 21,860 | 18,326 | 57* | 383.51 | 321.51 |
| Ohio State | | 47,952 | 35,749 | 129 | 371.72 | 277.12 |

Notes: $*$ means Math and Stat faculty are in one department, † means 1999 data, and Colorado's faculty size is the total of the math and applied math departments combined.
Source: Institutional Response to Inquiry and Institution Web Site

Figure 1.1: 2000 Enrollment to Faculty Ratios, Math Department Only

| Board of Regents Peer Institution | Coord. Comm. Peer Institution | Enrollments Total | Enrollments Undergrad | Faculty (Math & Stat) | Students Per Faculty Total | Students Per Faculty Undergrad |
|---|---|---|---|---|---|---|
| | Louisiana State | 30,870 | 26,130 | 41 | 752.93 | 637.32 |
| **UNL** | **UNL** | 22,268 | 17,968 | 34 | 654.94 | 528.47 |
| Kansas | Kansas | 27,838 | 18,995 | 38 | 732.57 | 499.86 |
| Colorado | Colorado | 28,912 | 22,344 | 45 | 578.24 | 446.88 |
| | Georgia | 31,288 | 24,209 | 57 | 548.91 | 424.72 |
| Kansas State | | 20,942 | 18,095 | 43 | 487.02 | 420.81 |
| | Tennessee | 25,474 | 20,009 | 58 | 439.21 | 344.98 |
| Purdue | Purdue | 37,871 | 30,899 | 91 | 416.16 | 339.54 |
| | Colorado State | 23,098 | 19,075 | 58 | 398.24 | 328.88 |
| Missouri | Missouri | 23,280 | 18,058 | 57 | 423.27 | 328.32 |
| | Auburn | 21,860 | 18,326 | 57 | 383.51 | 321.51 |
| | Oklahoma State | 19,860 | 16,452 | 53 | 374.72 | 310.42 |
| Illinois - UC | | 36,963 | 27,882 | 93 | 397.45 | 299.80 |
| Minnesota | | 45,481 | 26,972 | 90 | 505.34 | 299.69 |
| Iowa | | 28,311 | 19,824 | 69* | 410.30 | 287.30 |
| Ohio State | | 47,952 | 35,749 | 152 | 315.47 | 235.19 |
| Iowa State | Iowa State | 26,110† | 21,503† | 101 | 258.51 | 212.90 |

Notes: † means 1999 data, $*$ means includes actuarial sciences
Source: Institutional Response to Inquiry and Institution Web Site

Figure 1.2: 2000 Enrollment to Faculty Ratios, Combined Math and Stat Faculty

# Chapter 2

# Rationale and Program Goals

## 2.1 Rationale

The Department of Mathematics and Statistics is a vital component of the University of Nebraska-Lincoln. Through its teaching, research and outreach, the Department plays a central role in UNL's pursuit of excellence. In order to better serve the UNL campus, in the early 1990s the Department adopted the goal of becoming **a model for a department of mathematics in a research university where educational goals are integral to the departmental mission and are supported by broadly based participation in educational programs**. By pursuing this goal the Department stays focused on its responsibility to contribute to UNL's mission and the mission of the College of Arts & Sciences as described in Appendix A.

The importance of mathematics to the University and to the people of Nebraska is not new. When the Nebraska Legislature authorized the establishment of a University in 1869, they authorized six colleges or departments including the College of Ancient and Modern Languages, Mathematics and Natural Sciences. When the University of Nebraska opened its doors on September 7, 1871, a mathematician with the rank of professor was among the faculty who greeted the first students. In 1898, Albert L. Candy was awarded a Ph.D. in mathematics making him the University of Nebraska's third Ph.D. and only the second person awarded a Ph.D. in mathematics in the U. S. west of the Mississippi River.

More than 100 years later, the Department of Mathematics and Statistics is still meeting the needs of the University and the State of Nebraska as it strives for, and achieves, excellence in research, in teaching at both the undergraduate and graduate level, and in service to the people of Nebraska.

Faculty in the Department are engaged in high quality research programs that are centered around the Department's four *Areas of Strength* in Commutative Algebra and Algebraic Geometry, Discrete and Experimental Mathematics, Operator Algebras and Functional Integration, and Modeling with emphasis on Differential Equations and Partial Differential Equations. As described later in this Self-Study, faculty research productivity is at an all-time high.

The past seven years have also been the most outstanding period in the history of the Department's graduate program. Despite having a faculty that is much smaller than its peers, the number of Ph.D.s produced by the Department during this period ranks in the top 15% of all Ph.D.-granting mathematics departments in the U.S. Two graduates during this period have won prestigious NSF Postdoctoral Fellowships. Also, in 1998 the Department was recognized at the White House with a Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring for the Department's success in mentoring women graduate students.

At the undergraduate level the Department offers service instruction for virtually every major on campus, providing the strongest education in mathematics and statistics available in the state. Each year, approximately 80% of all freshman students take at least one course from the Department. In Fall 2000, the Department served 5,564 students and produced 19,279 Student Credit Hours. (Because of the number of 4- and 5-hour courses offered by the Department, the average registration produced 3.46 SCHs.) In 1998, the Department was recognized with the University-wide Departmental Teaching Award for its excellence in undergraduate teaching.

The Department also offers Honors courses to hundreds of students each year and is a place for the very brightest students to major in mathematics and statistics. For example, in 1999 three Department majors received NSF Graduate Fellowships and this year one of our majors won an award that recognizes her as the outstanding undergraduate woman mathematics major in the United States.

The Department also has many high quality outreach programs. Indeed, the Department is the State's leader for promotion of quality education in Nebraska schools. In particular, it provides programs for teacher training, for K-12 students, and is a major contributor towards setting policy for education standards for students and teachers. Evidence of the success of Departmental leadership may be found in the recent "Report Card on Nebraska Schools," available on the web under the heading "Report Card" at www.nde.state.ne.us.

Just as mathematics and statistics is of central importance to the University of Nebraska-Lincoln, mathematics and statistics education and research are increasingly more important to our nation. On October 19, 2000, NSF Director Rita Colwell (a biologist) made a presentation to the National Science Board in which she introduced NSF's "Mathematical Sciences Initiative." In her presentation, Director Colwell stressed that NSF's Mathematical Sciences Initiative was necessary because the mathematical sciences were accelerating progress across the spectrum of science and engineering research at an unprecedented pace but that resources devoted to the mathematical sciences have not kept pace, thus slowing down the nation's scientific enterprise. To remedy this situation, she indicated that new funds would be devoted to three key areas:

- **fundamental mathematical research**
- **interdisciplinary math, science and engineering collaborations**, and
- **mathematics education**.

In November 2000, Director Colwell spoke to the National Research Council's Board on Mathematical Sciences' 2000 Colloquium for Chairs of Departments in the Mathematical Sciences. In her speech she quoted E. O. Wilson as writing "mathematics seems to point arrow-like toward the ultimate goal of objective truth" and then offered the observation "Given the accelerating cross-pollination of mathematics and bioscience, it's not a mere coincidence that Wilson is a biologist. Indeed, mathematics is the ultimate cross-cutting discipline, the springboard for advances across the board."

NSF currently has five major funding initiatives:

- **Information Technology Research**
- **Biocomplexity in the Environment**
- **Nanoscale Science and Engineering**
- **21st Century Workforce**
- **Mathematical Sciences Initiative**

It is interesting to note that only one of these initiatives is clearly centered in a particular discipline and that is the Mathematical Sciences Initiative. Director Colwell went further to say that mathematics is essential to each of the initiatives when she said:

> *"Our mathematics effort really does feed into–and complement–all of the initiatives. It provides the understanding of complexity and uncertainty critical to sorting out biocomplexity. It gives us some of the tools we need to explore new frontiers at the nanoscale. And math plays an indispensable role in educating the scientific and technical workforce our country needs.*"

Just as the education and research in the mathematical sciences is important to our nation, it is important to UNL and Nebraska. UNL needs the commitment of the Department's faculty to high quality instruction at the undergraduate and graduate levels. It needs the Department's commitment to improving K-12 mathematics education in Nebraska. It needs research scholars in the Department to participate in research initiatives such as The Plant Science Initiative and UNL's commitment to nanoscale technology. The Department of Mathematics and Statistics is committed to doing its part by combining excellence in mathematics research and education. The Department is recognized nationally as a model department and has been cited as an example of a department that successfully combines a commitment to mathematics education with a strong research program.[1] Thus, Departmental goals are also commensurate with current national science policy.

[1] See for example, pp 145–147 of *Towards Excellence*, AMS Task Force on Education, J. Ewing, ed., 1999.

Because of its past success, the Department is well positioned to capitalize on the new funds that can be expected for the Mathematical Sciences Initiative at NSF. But if the Department is to respond it must have sufficient faculty strength to make the necessary commitment to fundamental mathematical research, to interdisciplinary research, and to maintaining our commitment to both graduate and to undergraduate education in the mathematical sciences.

## 2.2 Long-Range Goals

The Department of Mathematics and Statistics is one of UNL's larger departments and plays a critical role in providing the foundation upon which any competent education must build. For the past seven years the Department has made extraordinary efforts to serve the University with a high quality, efficient program that has a major impact on the University, the State, and the Nation. To guide its efforts, the Department has adopted three simple, but basic, goals to guide the work of the Department and then has developed strategies for pursuing those goals. The Department's goals are:

- **Continue development of an outstanding research and graduate program**;
- **Continue development of an outstanding undergraduate program**;
- **Continue to be a model program, both on campus and nationally, for a department in the mathematical sciences in a research university where educational goals are integral to the departmental mission and are supported by broadly based participation in educational programs**.

These goals have served the Department and the University well. The Department has been recognized locally for its excellence in undergraduate teaching and nationally for the excellence of its graduate program. Similarly, the Department's majors, both at the undergraduate and graduate levels have been recognized for their excellence. Despite the stress of meeting a significant demand for undergraduate instruction in the mathematical sciences, research productivity of the faculty is at an all-time high and a significant number (more than 75%) of faculty have had some form of external funding during this period. To further stimulate research and the graduate program, the Department has hosted numerous research conferences during this same period. The Department also plays a leadership role in providing outreach activities for K-12 teachers and students in Nebraska, and members of the faculty have had national leadership roles in the profession.

But these achievements have not come without a price. At meetings of the faculty to prepare for the Department's Academic Program Review, it became clear that the faculty are exhausted. Despite enormous pride in their achievements, the faculty do not believe they can sustain the current level of achievement, let alone take on new responsibilities for increasing external funding and making a contribution to the pursuit of the 2020 Vision for the University, given our current faculty size. Support from the University is needed in enlarging the Department to a point compatible with its instructional responsibilities and the University's research and graduate education goals for the Department.

## 2.3 Priorities for New Support

As discussed above, the Department of Mathematics and Statistics is of central importance to the University and it delivers an efficient high-quality program that has a major impact on the University. But it is also a department under stress. The following priorities for new support have been identified.

***1) Increase the number of permanent faculty.*** As discussed in this Self-Study, the achievements of the Department are significant. The Department needs a minimum of 40 faculty on tenure-track lines. In addition to the two lines in statistics that have been authorized for hiring this year and the additional line in statistics that has been authorized for hiring during the 2002/2003 Academic Year, the Department needs to add four additional faculty on tenure-track lines. Most likely this would involve hiring three new faculty in mathematics and one additional faculty member in statistics, bringing the size of the department to 34 faculty in mathematics and 6 in statistics.

***2) Support the hiring of three new Ph.D.s on postdoctoral appointments, each on a 3-year appointment.*** There is a strong tradition in the mathematical sciences for hiring new Ph.D.s on 3-year temporary appointments that combine teaching and mentored research. Indeed, virtually every quality research mathematics department hires some new faculty on postdoctoral appointments. This has the benefit of helping develop the research talent in the discipline at a time when federal funding for research postdocs in the mathematical sciences is far less than in the other sciences.

At the same time, it provides universities with doctoral-level instruction and research stimulation for the permanent faculty without the financial commitment of tenure-track hires. Over the past seven years, the Department has made an effort to hire one, and sometimes two, such postdoctoral faculty but there is no regular source of funds to hire such temporary faculty. A permanent budget of $120,000 per year would fund the three positions described in this priority. Should such permanent funds become available, the Department envisions a named postdoctoral position, similar to the Hedrick Postdoc at UCLA. A permanent named postdoc program would significantly enhance the prestige of the Department.

***3) Make Replacement Funds Predictable.*** Currently if a faculty member is given another assignment in the University (as with Professor Dunbar's service as Founding Director of the J. D. Edwards Honors Program), the Department is not guaranteed any return of financial resources to replace the lost instruction, research, etc. The situation is similar if a faculty member goes on leave without pay, has grant funds available to "buy-out" a portion of their time, or simply retires or resigns. Current policy consumes an inordinate amount of the Chair's (and Dean's) time which could more profitably be spent on other matters and, furthermore, is inconsistent with a desire to increase external funding and to encourage entrepreneurial behavior among faculty. In addition, current policy handicaps a department's ability to plan, and it holds the research and graduate education program of a large department like Mathematics and Statistics hostage to the more basic question of "What is the cheapest form of replacement instruction you can purchase?" A far better policy would be to guarantee some level of return, e.g. 70%, of available dollars that the Department could count on and use for the Department's highest priority.

In identifying these priorities for new support, the Department does not want to imply that it has no other resource issues. But it does want to state that other issues pale in comparison with the need for sufficient faculty to enable the Department to continue, and indeed to increase its achievements on behalf of the University.

There are other resource issues that bear monitoring. As reported in the Department's 1993 APR, our University Libraries face significant problems in maintaining journal collections as journal prices rise faster than university budgets can respond. Also, as departments become more computer intensive, the need for a predictable source of money for equipment maintenance and replacement increases. Because our faculty size has shrunk, our need for temporary instruction funds has increased to the point where it is pointless to refer to the need as "temporary." The University should recognize that the need in departments such as English, Modern Languages and Mathematics and Statistics is so predictable that the GTA budget of each department should be increased.

Even with the addition of a new Administrative Assistant for the Division of Statistics, the Department has one of the smallest staffs for a department the size of the Department of Mathematics and Statistics. Additional staff is already sorely needed, and will become even more critical in the next five years. Even more likely to become a priority is the potential need for a second system administrator for our computer system. The Department is a computer-intensive department and our need for specialized support is great. Currently we are fortunate to have a mathematics major as our system administrator and a graduate student who was a system administrator for the Gateway Computer Company as a half-time system administrator. Our needs in this area are growing rapidly. Similarly, our operating budget is adequate now but has not been increasing with inflation during the past three years. This too bears watching.

But these issues are issues for the entire College of Arts & Sciences, if not for the entire University. As reported earlier, the College has done its best to meet our needs in these areas and we ask only our fair share of available resources in these areas.

## 2.4 Important Changes Currently Underway

This section discusses two changes that are currently underway and which are of great importance to the Department. The continuing support of the Dean's Office is needed to ensure that these changes are brought to a successful conclusion.

**Avery Hall.** At the time of the Department's 1993 APR, the Department's space problem was described as a crisis. The Department was using space spread across six buildings, the Department Library needed space to expand and graduate students in Oldfather Hall were squeezed three to an office.

By 1996, space for the Department had been identified in Avery Hall and a Program Statement was developed as the first step in renovating Avery for the Department and for the Department of Computer Science and Computer Engineering. It took until 1998 to obtain resources for the renovation (approximately $10.7 million) from the State Legislature as part of a plan to renovate several campus buildings.

Plans now call for the renovation of the north half of Avery to begin in the summer of 2001, with renovation of the south half to begin in 2002 following completion of a new building for the Department of Chemical Engineering. Because the Department would primarily occupy the north half of Avery, it is believed that the Department will move into its new facilities no later than the summer of 2003 and possibly as early as January 2003. An architectural firm and a construction management firm have been selected, and the architectural plans for the building will be developed in spring 2001.

It thus appears that the Department will finally have outstanding facilities that meet the needs of the Department. On this issue, the Department simply needs the continuing support of the Dean's Office to make these new facilities a reality.

**Division of Statistics.** In the spring of 2000, the Dean of the College of Arts and Sciences and the Senior Vice Chancellor for Academic Affairs made a significant commitment to the rebuilding of the Department's statistics program as part of a counter offer to Professor Lahiri. This commitment has the potential to significantly strengthen statistics at UNL and to enable it to make a major contribution to the profession in one targeted area of statistics research, survey sampling. It is important that the University stay the course on this commitment.

The key details of the plan to strengthen statistics at UNL are as follows:

- Statistics hiring will focus on statisticians who can make a significant contribution to research in survey sampling. It is assumed that each scholar will have a research program broad enough to make contributions to other areas of statistics research. In particular, as the number of statisticians in the Department increases, the statistics faculty will make an increased commitment to collaborative research with faculty at the University of Nebraska Medical Center and with research scholars in the biological sciences at UNL.
- The Division of Statistics, which was first created in 1988, will be developed into essentially an autonomous unit within the Department.
- An administrative assistant position for the Division of Statistics was authorized and filled.
- Two senior statisticians will be hired during the 2000/2001 Academic Year and an additional statistician will be hired no later than the 2002/2003 Academic Year. This will bring the minimum size of the statistics faculty to five no later than the start of the Fall 2003 semester. Four outstanding scholars have been interviewed for positions in the Department and negotiations for the first hire are currently under way.
- The Division of Statistics will work closely with UNL's Gallup Research Center and the Survey Research and Methodology Masters program.
- UNL will enter into good faith negotiations to join the Joint Program in Survey Methodology (JPSM), a consortium that currently includes faculty at the University of Maryland and the University of Michigan and statisticians at the Westat Corporation.

In addition to these major steps in building a strong statistics program at UNL, Professor Allan McCutcheon, Donald O. Clifton Distinguished Professor of Survey Research has asked that his tenure home be changed to the Department of Mathematics and Statistics and a significant portion of his FTE moved into the Department. Similarly, Professor Linda Young, who currently has a Courtesy Appointment, in the Department has indicated a desire to move all or a portion of her FTE into the Department. Thus, there is reason for optimism that after many years of failed efforts to build statistics at UNL, the current effort will be successful.

## 2.5 Strategies for Strengthening the Department over the Next Five Years

Because of the success that the Department has enjoyed over the past seven years in all phases of the its work, the Department's first responsibility is to work to sustain outstanding programs, to retain outstanding faculty, and to carefully plan new hires who can strengthen the Department and contribute to Department priorities. The Department needs the advice of the APR Review Team as to how the Department should make choices between competing priorities, should UNL's resource problems make it impossible to increase the size of the Department. However, this section of our Self-Study focuses on strategies for strengthening the Department under the assumption that the University will find a way to add faculty to the Department over the next five years. Indeed, the entire University of Nebraska System

is currently participating in a planning exercise to identify the University's most outstanding programs that it wants to strengthen. Several priorities put forth by the Dean of Arts & Sciences have important roles for faculty from the Department of Mathematics and Statistics. Given the opportunity to hire, the Department's hiring will support College priorities.

**Hiring:** The College has proposed an Institute for Statistics and Survey Methodology. This is consistent with the College plan for strengthening statistics with a focus on survey sampling. Our opportunities to hire in statistics will support this plan. Two Arts & Sciences priorities presented to the UNL Chancellor are: Algebra & Discrete Mathematics and Bioinformatics & Biological Modeling. The top priorities for hiring in mathematics will be supportive of these two priorities. To support the Algebra and Discrete Mathematics College Initiative the Department would hire one faculty member in discrete mathematics who can also contribute to the bioinformatics initiative, and the Department would hire one person in computational algebra. To support the College's efforts in biological modeling, the Department would propose to hire a faculty member in biomathematics who will be able to conduct interdisciplinary research with faculty in the biological sciences.

While the description above gives priorities for hiring for particular disciplinary reasons, it is important to recognize that other factors could significantly change Department priorities. For example, the loss of a faculty member in an area important to our graduate program could immediately change our highest priority for a new hire. Another opportunity we hope to have will definitely influence hiring decisions. We have been advised by staff at the University of Nebraska Foundation that the Department will receive one, and possibly two, Othmer Professorships. These are one million dollar endowed chairs designed to significantly increase the quality of the research faculty at UNL. When an Othmer Professorship becomes a reality, the Department will want to hire the most outstanding scholar who can be attracted to UNL, regardless of area. Of course, it is assumed that a hire of this stature will be someone who will add to one of the Department's existing strengths. When this opportunity arises, the Department will need the support of the College in making the hire as quickly as possible in order that the new faculty member's hiring can be a new Department strength prior to the next NRC rankings. (The next NRC rankings are expected to be conducted within the next few years.)

**Fund Raising:** The Department is in the early stages of a major fund-raising effort designed to increase Foundation support for Department priorities. At the top of the list will be funds to create a named professorship that might be awarded to a current faculty member and a named postdoctoral position that would make UNL a more attractive option for an outstanding new Ph.D. just beginning her or his research program. Thus, we hope that this fund-raising effort will assist in faculty retention and in creating a regular funded postdoctoral position. Other priorities for the fund drive are graduate student fellowships and outreach programs for Nebraska youth.

**Research and External Funding:** The Department believes that several current and future efforts will lead to an increase in faculty research and external funding. In 1997, the Department initiated a small program to provide 1-2 faculty per year with release time to focus on their research program in response to internal proposals. Starting in 1999, the Department provided each untenured faculty member with a one-course reduction in teaching to focus on their research program during the year of their "Fourth Year Review." Both programs have contributed to an increase in the research productivity of the participating faculty and to the number of grant proposals submitted by faculty. For Spring 2001, three senior faculty have received a teaching reduction to enable them to work on major grant proposals. Two will work on a VIGRE proposal (VIGRE is an NSF program called Vertical Integration of Research and Education in the Mathematical Sciences) and the other will work on strengthening research experiences for undergraduate majors and a possible REU proposal to NSF. Additionally, faculty with interests in interdisciplinary research in the biological sciences participated in a meeting with faculty from the biological sciences to pursue collaborative projects that may eventually lead to a proposal under NSF's QEIB (Quantitative Environmental and Integrative Biology) announcement. Finally, Professor David Jaffe has taken a leave of absence without pay to spend at least two years at the MIT Whitehead Institute as part of his switch from research in coding theory and algebraic geometry to research in bioinformatics. While all of these efforts are expected to pay positive dividends in the form of both increased research and external funding, faculty recognize that further improvements in this area are tied to our ability to meet our instructional responsibilities and, at the same time, protect more faculty time for research.

**Graduate Education:** As reported elsewhere in this Self-Study, the past seven years have been a particularly good period for graduate education in the Department. At the same time, a drop in the number of new graduate students accepting GTA appointments in the Department places at risk our ability to continue the achievements of the late 1990s. To respond to an increased difficulty in recruiting graduate students, the department now supports two annual research conferences, the Regional Workshop in the Mathematical Sciences in the fall and the Nebraska Conference for Undergraduate Women in Mathematics in the winter. These two conferences, together with the new Othmer Graduate Fellowships the Graduate College has created and the Graduate Chair's work on the Department's graduate web site, offer promise to improve graduate recruiting and protect the quality of the graduate program.

**Undergraduate Education:** The faculty believe that the Department has done a good job in offering service instruction at the 100 and 200 level including our honors offerings—note that less than 10% of the students in honors courses major in mathematics and statistics. The greatest concern is that a shortage of Ph.D. faculty will force larger classes, a reduction in honors offerings, and a further shift from faculty-taught courses to "instruction by the course" taught by lecturers. There is a desire to focus greater attention on the undergraduate major, and in Spring 2001 a Department committee will work on ways to strengthen the major, to recruit more students to the major, and to assess the quality of our graduates. Another major effort at the undergraduate level will be to work with faculty in Teachers College to strengthen the preparation of K-12 mathematics teachers. Currently UNL's *Math Matters* grant from NSF is aimed at improving the preparation of elementary school teachers. The next major step is to work to improve the education of middle school and high school mathematics teachers.

**Outreach:** Currently the Department houses the American Mathematics Competitions and negotiations are underway with the Mathematical Association of America to commit a faculty member to leading an effort to expand MAA outreach to talented youth through the AMC. In addition, the Department has played a significant role in the creation of the Center for Science, Mathematics and Computer Education and the College of Arts & Sciences Math/Science Education Area of Strength. Other major Department efforts include UNL Math Day, All Girls/All Math, and Power Math, three outreach programs for high school and middle school students. Finally, the Department has sponsored two-week workshops for Lincoln Public School teachers the past two summers and has three workshops planned for the summer of 2001. Thus, our primary goal in this area is to maintain as many of these programs as it is possible to support in a quality manner. The one new effort we anticipate over the next five years is to work with Professor Fowler in Teachers College to provide further professional development and graduate degree opportunities for Nebraska high school mathematics teachers.

## 2.6 Promotion of Diversity

Currently the Department's tenure-track faculty consists of 30 males and 4 females. Three males are of Indo-Asian ethnicity and one male is of Hispanic ethnicity. Our current Ph.D. visitors include two females, one African-American male and two males who are natives of India. The Department is fortunate to have had clear support from the College and the Office of the Senior Vice Chancellor for Academic Affairs as we dealt with dual career issues that impacted our ability to retain the two women faculty who have been recommended for promotion and tenure this year, and as we sought permission for an "opportunity hire" to hire the Hispanic male. As new opportunities to hire faculty become available, the Department will continue to be supportive of UNL efforts to diversify our faculty.

The Department has taken a number of activities that are supportive of UNL's diversity goals for students. At the graduate level, the Department has put a special emphasis on making the Department a supportive environment for women graduate students. For most of the past 7 years the percentage of women graduate students has been between 42% and 48%, extremely high for a department in the mathematical sciences. Because of our success in mentoring women students to the Ph.D., in 1998 the Department received an NSF sponsored Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. This is a program that honors people and programs that have distinguished themselves with respect to mentoring women or minority students. The Department is the only department of mathematics to have been so honored in the history of the mentoring award.

More recently the Department has been successful in attracting one African-American male, one black male from Cameroon and two black females from the Bahamas to our graduate program. We have also learned that a former student, a black woman from Trinidad and Tobago, who earned her masters in our department, has obtained her Ph.D.

in mathematics from Georgia Tech. These examples are modest by comparison with our success with women graduate students, and it is a Department goal to increase the ethnic diversity of our graduate program over the next five years.

At the undergraduate level, the Department has been a participating department in UNL's SIPS Program, a bridging program for minority freshmen. Two years ago the Department initiated a Math Excel program modeled after one at the University of Kentucky. Unfortunately, because of the low numbers of minority undergraduates recruited to UNL who start college mathematics in calculus, this program has not yet had an impact on opportunities for undergraduate minorities at UNL.

# Part II

# Program Activities

## Part II Overview

The Department has a substantial record of scholarly activity. Major areas of research emphasis are algebra and discrete mathematics, pure and applied analysis, and statistics. The Department offers the Bachelors, Masters, Special Masters for Teachers of Mathematics, and the Ph.D. degrees.

Since the 1993 APR, there has been increases both in faculty publication rates and in the amount of external support the faculty has engendered for the Department. At the undergraduate level, the Department has restructured its calculus and precalculus sequences. increasing success rates substantially. It has expanded its course offerings at the 200 level, and it has expanded its Honors course offerings. At the graduate level, one sees an expansion in the number of Ph.D. degrees awarded, in the flexibility of the graduate exam structure, and in the number of graduate degrees. In addition, there has been an expansion in the outreach and service work carried on by the Department.

# Chapter 3

# Degree Structure and Curricular Offerings

## 3.1 Degrees Offered

The undergraduate degrees offered by the Department are the Bachelor of Arts (B.A.) and Bachelor of Science (B.S.). The graduate degrees offered are the Master of Arts (M.A.), Master of Sciences (M.S.), Master of Arts for Teachers (M.A.T.), Master of Sciences for Teachers (M.Sc.T.) and Doctor of Philosophy (Ph.D.).

In addition to the degrees listed above, in response to a College of Arts and Sciences initiative, the Department has created a masters degree program in interdisciplinary applied mathematics. This special program leads to a Masters Degree in Applied Mathematics with an interdisciplinary component consistent with the research interests of the faculty. Students in the program take courses both in mathematics and in an allied area of science and engineering such as geoscience, chemistry, chemical engineering, electrical engineering, industrial engineering, computer science, or applied mechanics. The goals of the program are to prepare students for employment in industry and to provide a strong mathematical foundation for students who want to pursue further study in science or engineering. Students entering the program are not required to have an undergraduate major in mathematics. Students with science or engineering degrees are strongly encouraged to apply.

## 3.2 Undergraduate Program

### 3.2.1 Requirements for the B.A. and B.S. Degrees

The BA and BS degrees in the Arts and Sciences College require 125 hours if the student has had two years of one foreign language in high school and 130 hours if not. BS majors in Mathematics and Statistics must take at least 28 hours of liberal arts courses (or "Essential Studies") , must complete the fourth semester of a foreign language (unless the student had four years of the same language in high school), must complete the three semester calculus sequence, differential equations (Math 221), matrix theory (Math 314), and three 400-level and three 300 or 400-level mathematics and statistics courses. Thus, students must have at least 8 advanced mathematics and statistics courses beyond calculus. The BA major has the same major and language requirements, but instead of 22 hours of science, must complete a distributed 10 hours of science and take an additional 6 hours of liberal arts courses. Both degrees require at least 30 hours of courses above 299 and 10 courses from the Integrative Studies list (no more than three from the same department). Integrative Studies courses are part of the University's Comprehensive Education Program and are described later in this chapter. Precise details of degree requirements may be found in the Undergraduate Bulletin.

The mathematics and statistics major requirements are quite traditional and in need of changes. The core courses are three semesters of calculus, differential equations, and matrix theory. At present the Chief Undergraduate Advisor directs students into one of three general tracks once the student has determined a direction: pure mathematics, industrial mathematics, or statistics. Each has various subdivisions depending on whether the student is planning on entering a career after the Bachelors degree or going on for a masters or Ph.D. degree. All majors are strongly encouraged to take either elementary abstract algebra (Math 310) or elementary analysis (Math 325) - preferably both - for proof theory and problem solving skills that are unique to mathematics and statistics 380. Those planning on ending with the Bachelors degree are then encouraged to take additional statistics and operations research courses and

to choose among the courses listed in the College's business minor and or the computer science major for outside supporting courses. Those planning to continue for a masters degree in mathematics, industrial mathematics, financial engineering, or statistics are encouraged to take more serious statistics and optimization courses. Those interested in Ph.D. programs in mathematics are encouraged to take serious senior level proof theory courses from the major areas of analysis and algebra.

Beginning in the AY 97-98, the Department separated its undergraduate/graduate combined sections in analysis (Math 425/825), algebra (Math 417/817), and applied math (Math 442/842) into undergraduate and graduate only sections. For the instructor of the undergraduate section this really freed up the constraint of covering the material necessary for the graduate exams and allowed a course more reasonably paced for undergraduates who are typically taking 15 hours of course work.

### 3.2.2 Honors Program

The University's honors program depends on the departments to offer honors sections of courses. The Department of Mathematics and Statistics offers honors courses to more students than any other department on campus with the possible exception of the Department of English. In the Fall 2000 semester, the Department offered 9 honors sections: Math 106H, 4 sections of Math 107H, 2 sections of Math 189H, Math 221H, and Math 310H. In the current semester (Spring 2001) the Department offers 4 honors courses: Math 107H, 2 sections of Math 208H, and Math 314H. The honors courses are taught by faculty interested in the challenge and the students. An undergraduate honors TA is assigned to each of the honors calculus courses partly as a role model to the students and partly to offer some relief to the instructor (honors calculus courses add one or two additional class hours per week to the normal faculty assignment). The Department's emphasis on honors instruction is not simply motivated by a desire to be a good citizen of the University. The Department believes that honors instruction provides an outstanding vehicle to promote mathematics among top students and attract high quality majors.

### 3.2.3 Comprehensive Education Program

The Comprehensive Education Program, which is required of all undergraduate students who entered UNL in fall 1995 or later, encompasses four components, of which two are particularly relevant to Mathematics and Statistics: Essential Studies (ES) and Integrative Studies (IS). See Appendix B for further details on the Comprehensive Education Program.

**Essential Studies:** The Essential Studies requirement consists of courses intended to give students a context for understanding the breadth of human endeavor. Students are generally required to have 27 credit hours of ES courses in a broad range of subjects. Courses approved for the ES designation must meet the criteria listed in the Essential Studies section of Appendix B. A careful review is made at the college and university levels before a course is given ES status. Many of the 100 and 200 level courses offered by the Department of Mathematics and Statistics are designated as ES courses. Such courses are marked in the course catalog with the symbol (ES).

**Integrative Studies:** Integrative Studies is a UNL experience requirement intended to engage students in actively developing their ability and desire to analyze, evaluate and communicate complex material and positions. Courses approved for the IS designation must meet the criteria listed in the Integrative Studies section of Appendix B. A careful review is made at the college and university levels before a course is given IS status.

Most of the undergraduate Math/Stat courses with no graduate counterpart at the level of calculus and beyond satisfy the IS requirements.

## 3.3 Graduate Program

### 3.3.1 Degree Requirements

**Requirements for the Masters Degree**

**M.A. and M.S.** While other departments may distinguish between the M.A. and the M.S. degrees, the Department of Mathematics and Statistics does not, and students are free to pick which name they prefer on their degree. Students

may pursue a program of study under any of the three options specified by the Graduate College: Option I (36 semester hours of credit, of which at least 8 are graduate-only coursework, including a thesis — until 1998, this option had not been exercised in the Department for many years), Option II (36 semester hours, of which 12 are graduate-only courses, and at least one minor) or Option III (36 semester hours, of which 18 are graduate-only courses, and no minor). Under any option the student must pass a written comprehensive examination. Students are required to specialize in either Applied Mathematics, Pure Mathematics or Statistics. Under Option II a candidate may select a minor consisting of courses taken in Mathematics, Applied Mathematics, Statistics or, with approval from the Departmental Graduate Committee, in other departments which offer a masters degree. However, a Pure Mathematics major cannot minor in Applied Mathematics, or vice versa. A copy of the graduate program pamphlet, which is given to all graduate students in the Department, is contained in Appendix E.3. A detailed description of the M.A./M.S. requirements is given there.

Students in the interdisciplinary masters program in applied mathematics are required to select option I, and nine hours of their coursework must be from courses outside the Department of Mathematics and Statistics. The thesis is designed to be the final report of a project that develops the student's interdisciplinary skills.

**M.A.T. and M.Sc.T.** These are degrees in mathematics, not the pedagogy of mathematics. The program provides training in mathematics of a nature which is especially appropriate to teachers' needs. Special courses or sections of courses bearing a "T" designation are offered specifically for persons in the program. The possession of a valid teaching certificate for mathematics at the secondary level is a prerequisite to the award of the degree. See Appendix E.3 for complete details.

#### Requirements for the Ph.D. Degree

Doctoral candidates may specialize in algebra, analysis, applied mathematics/differential equations, combinatorics or statistics. A student may be admitted to the Ph.D. program either initially, as for the masters program, or after completion of a masters degree. To be fully admitted to the Ph.D. program the student must pass a qualifying examination. Generally, the Masters Comprehensive Examination also plays the role of this Ph.D. Qualifying Examination. In order to become a Candidate for the Ph.D. degree, the student must pass a comprehensive examination (although ultimate authority lies with the student's supervisory committee); students in the mathematics program must also pass a language examination. In place of a language requirement, students in statistics must demonstrate competency with a computerized research tool; the specific requirements are determined by each student's Ph.D. supervisory committee. After the Ph.D. thesis is completed a student takes a final oral examination. Specific details for the requirements and a more complete description of the program are given in the graduate program pamphlet in Appendix E.3.

### 3.3.2 Teaching Assistant Training

Each fall since 1993, the Department has provided training for teaching assistants in mathematics and statistics. This has become particularly important since the change in the calculus curriculum because new graduate teaching assistants are assigned to teach the calculus recitation sections.

## 3.4 Courses Offered

Department course offerings from the Undergraduate and Graduate Bulletins are listed below.

### 3.4.1 Undergraduate Courses

Undergraduate courses as listed in the Undergraduate Bulletin, 2000-01 are below.

**Introductory Mathematics Courses**

**100A [100x]. Intermediate Algebra** (3 cr) Prereq: One year high school algebra and appropriate score on the Math Placement Exam. Credit earned in MATH 100A will not count toward degree requirements. *A review of the topics in a second-year high school algebra course taught at the college level. Topics include: real numbers, 1st and 2nd degree equations and inequalities, linear systems, polynomials and rational expressions, exponents and radicals. There is a heavy emphasis on problem solving strategies and techniques throughout the course.*

**101 [101x]. College Algebra** (3 cr) Prereq: Appropriate placement exam score and either two years of high school algebra or a grade of P, C, or better in MATH 100A. Real numbers, exponents, factoring, linear and quadratic equations, absolute value, inequalities, functions, graphing, polynomial and rational functions, exponential and logarithmic functions, systems of equations.

**102 [102x]. Trigonometry** (2 cr) Prereq: One year high school geometry and either two years high school algebra, one semester high school precalculus, and a qualifying score on the Math Placement Exam; or a grade of C, P, or better in MATH 101. Credit towards the degree may be earned in only one of MATH 102 or 103. Trigonometric functions, identities, trigonometric equations, solution of triangles, inverse trigonometric functions, and graphs.

**103. College Algebra and Trigonometry** (5 cr) Prereq: Appropriate placement exam score, one year high school geometry, and two years high school algebra. For students with previous college math courses, permission is also required. First and second degree equations and inequalities, absolute value, functions, polynomial and rational functions, exponential and logarithmic functions, trigonometric functions and identities, laws of sines and cosines, applications, polar coordinates, systems of equations, graphing, conic sections.

**104. Calculus for Managerial and Social Sciences** (3 cr) [ES] Prereq: Appropriate placement exam score or a grade of P (pass), or C or better in MATH 101. Credit for both MATH 104 and 106 is not allowed. Rudiments of differential and integral calculus with applications to problems from business, economics, and social sciences. **NOTE:** Students with adequate high school preparation (equivalent to MATH 101 and 102) should begin with MATH 106, which is the first course in a three-semester calculus sequence. Students who have had some calculus in high school may be eligible for advanced placement and should contact the Department of Mathematics and Statistics for further information. MATH 104 is recommended for students in managerial and social sciences.

**106 [106x]. Analytic Geometry and Calculus I** (5 cr) [ES][IS] Prereq: One year high school geometry; two years algebra and one year precalculus-trig in high school, or MATH 102 or 103 or equivalent. Math Placement Policy applies. Credit for both MATH 104 and 106 is not allowed. Functions of one variable, limits, differentiation, exponential, trigonometric and inverse trigonometric functions, maximum-minimum, and basic integration theory (Riemann sums) with some applications.

**106H. Honors Calculus I** (5-7 cr) [ES][IS] *Prereq: By invitation only.* This is an accelerated calculus course that covers MATH 106 and approximately half of MATH 107.

**107 [107x]. Analytic Geometry and Calculus II** (5 cr) [ES][IS] *Prereq: A grade of P (pass), C or better in MATH 106.* Integration theory; techniques of integration; applications of definite integrals; basics of ordinary differential equations; series, Taylor series.

**107H. Honors Calculus II** (5-7 cr) [ES][IS] *Prereq: By invitation only.* This is an accelerated calculus course that covers approximately half of MATH 107 and all of MATH 208.

**198H. Freshman Seminar** (1-3 cr) Prereq: Open only to students in the Honors Program or by invitation.

**200/800. Mathematics for Elementary School Teachers** (3 cr) Prereq: Undergraduates must be admitted to Teachers College or the child development program of HRFS; successful completion of the PPST; and removal of any mathematics entrance deficiencies. Graduate students are admitted by permission. All mathematics entrance deficiencies must be removed before taking this course. Fundamental mathematical concepts basic to the understanding of arithmetic.

**201/801. Geometry for Elementary School Teachers** (3 cr) Prereq: Completion of MATH 200 with a grade of C, P or better. Undergraduates must be admitted to Teachers College or the child development program of HRFS. Graduate students are admitted by permission. Fundamental mathematical concepts basic to the understanding of elementary geometry will be presented in this course.

**203. Contemporary Mathematics** (3 cr) [ES][IS] Prereq: Sophomore standing and removal of all entrance deficiencies in mathematics. Not open to students with credit or concurrent enrollment in MATH 104, 105, 106, or STAT 180. Applications of quantitative reasoning and methods to problems and decision making in the areas of management, statistics, and social choice. Topics include networks, critical paths, linear programming, sampling, central tendency, inference, voting methods, power index, game theory, and fair division problems.

**208 [208x]. Analytic Geometry and Calculus III** (4 cr) [ES][IS] *Prereq: A grade of P, C or better in MATH 107.* Vectors and surfaces, parametric equations and motion, functions of several variables, partial differentiation, maximum-minimum, Lagrange multipliers, multiple integration, vector fields, path integrals, Green's Theorem, and applications.

**208H. Analytic Geometry and Calculus III** (4 cr) [ES][IS] *Prereq: Admission to the University Honors Program or by invitation.* Vectors and surfaces, parametric equations and motion, functions of several variables, partial differentiation, maximum-minimum, Lagrange multipliers, multiple integration, vector fields, path integrals, Green's

Theorem, and applications.

**260. Introduction to the Foundations of Mathematics** (3 cr) [IS] *Prereq: MATH 106. Not open to mathematics majors except for dual matriculants in Teachers College.* Elementary logic, inductive and deductive reasoning, methods of proof.

**350. Concepts in Geometry** (3 cr) *Prereq: MATH 260. Not open to mathematics majors except those with dual matriculation in Teachers College.* Modern elementary geometry, plane transformations and applications, the axiomatic approach, Euclidean constructions. Additional topics will vary.

**Advanced Mathematics Courses**

**221/821. Differential Equations** (3 cr) [IS] *Prereq: A grade of "P"' or "C" or better in MATH 208. Not open to MA or MS students in mathematics or statistics.* First- and second-order methods for ordinary differential equations including: separable, linear, Laplace transforms, linear systems, and some applications.

**221H. Differential Equations** (3 cr) [IS] *Prereq: Admission to the University Honors Program or by invitation.* First- and second-order methods for ordinary differential equations including: separable, linear, Laplace transforms, linear systems, and some applications.

**310. Introduction to Modern Algebra** (3 cr) [IS] Introduction to groups, rings, and fields as a natural extension of elementary number theory and the theory of equations. Particular emphasis is placed on the study of polynomials with coefficients in the rationals, reals, or complex numbers.

**310H. Introduction to Modern Algebra** (3 cr) [IS] *Prereq: Admission to the University Honors Program or by invitation.* Introduction to groups, rings, and fields as a natural extension of elementary number theory and the theory of equations. Particular emphasis is placed on the study of polynomials with coefficients in the rationals, reals, or complex numbers.

**314/814. Applied Linear Algebra (Matrix Theory)** (3 cr) Not open to MA or MS students in mathematics or statistics. Fundamental concepts of linear algebra from the point of view of matrix manipulation with emphasis on concepts that are most important in applications. Topics include solving systems of linear equations, vector spaces, inner products, determinants, eigenvalues, similarity of matrices, and Jordan Canonical Form.

**314H. Applied Linear Algebra (Matrix Theory)** (3 cr) [IS] *Prereq: Admission to the University Honors Program or by invitation.* Fundamental concepts of linear algebra from the point of view of matrix manipulation with emphasis on concepts that are most important in applications. Topics include solving systems of linear equations, vector spaces, inner products, determinants, eigenvalues, similarity of matrices, and Jordan Canonical Form.

**322/822. Advanced Calculus** (3 cr) *Not open to MA or MS students in mathematics or statistics.* Uniform convergence of sequences and series of functions, Green's theorem, Stoke's theorem, divergence theorem, line integrals, implicit and inverse function theorems, and general coordinate transformations.

**324/824. Introduction to Partial Differential Equations** (3 cr) *Prereq: MATH 221. Not open to MA or MS students in mathematics or statistics.* Derivation of the heat, wave, and potential equations; separation of variables method of solution; solutions of boundary value problems by use of Fourier series, Fourier transforms, eigenfunction expansions with emphasis on the Bessel and Legendre functions; interpretations of solutions in various physical settings.

**325. Elementary Analysis** (3 cr) [IS] An introductory course emphasizing mastery of basic calculus concepts and the development of skill in constructing proofs. Topics include mathematical induction, completeness of the real numbers, sequences and series, limits and continuity, derivatives, uniform convergence, Taylor's theorem, integration and the fundamental theorem of calculus.

**340/840. Numerical Analysis I** (Computer Science 340/840) (3 cr) Prereq: CSCE 150 or 155. Credit cannot be given for both MATH 340 and ENGM 480. Not open to MA or MS students in mathematics or statistics. Algorithm formulation for the practical solution of problems such as interpolation, roots of equations, differentiation and integration. Includes analysis of effects of finite precision.

**405/805. Discrete and Finite Mathematics** (3 cr) [IS] Prereq: MATH 314 is desirable but not required. Credit is not allowed for both MATH 105 and MATH 405, or for both CSCE 235 and MATH 405. Not open to math majors except for dual matriculants in Teachers College. Not open to MA or MS students in mathematics or statistics. Graphs and networks, map coloring, finite differences, Pascal's triangle, the Pigeonhole Principle, Markov chains, linear programming, Game Theory.

**417/817 [817T**]. Introduction to Modern Algebra I (3 cr) [IS] *Prereq: MATH 310 is advisable for most students.* Topics from elementary group theory and ring theory, including fundamental isomorphism theorems, ideals, quotient

rings, domains, Euclidean or principal ideal rings, unique factorization, modules and vector spaces, including direct sum decompositions, bases, and dual spaces.

**418/818. Introduction to Modern Algebra II** (3 cr) *Prereq: MATH 417/817.* Topics from field theory including Galois theory and finite fields and from linear transformations including characteristic roots, trace and transpose, and determinants.

**423/823. Introduction to Complex Variable Theory (**3 cr) Complex numbers, functions of complex variables, analytic functions, complex integration, Cauchy's integral formulas, Taylor and Laurant series, calculus of residues and contour integration, conformal mappings, harmonic functions, and some applications. This is an advanced introductory course for engineering, physical sciences, and mathematics majors.

**425/825 [825T]. Mathematical Analysis I** (3 cr) [IS] Real number system, topology of Euclidean space and metric spaces, compactness, sequences, series, convergence and uniform convergence, and continuity and uniform continuity.

**426/826. Mathematical Analysis II** (3 cr) *Prereq: MATH 425/825.* Differentiation, the mean value theorem, Riemann and Riemann-Stieltjes integrals, functions of bounded variation, equicontinuity, function algebras, and the Weierstrass and Stone-Weierstrass theorems.

**427/827. Mathematical Methods in the Physical Sciences** (3 cr) *Prereq: MATH 221. Not open to mathematics majors. Not open to MA or MS students in mathematics.* Matrix operations, transformations, inverses, orthogonal matrices, rotations in space. Eigenvalues and eigenvectors, diagonalization, applications of diagonalization. Curvilinear coordinate systems, differential operations in curvilinear coordinate systems, Jacobians, changes of variables in multiple integration. Scalar, vector and tensor fields, tensor operations, applications or tensors. Complex function theory, integration by residues, conformal mappings.

**428/828. Principles of Operations Research** (3 cr) [IS] *Prereq: MATH 314 and either STAT 380 or IMSE 321 or equivalent.* An introduction to the techniques and applications of operations research. The topics will include linear programming, queueing theory, decision analysis, network analysis, and simulation.

**430/830. Ordinary Differential Equations I** (3 cr) [IS] *Prereq: MATH 221 and 322.* The Picard existence theorem, linear equations and linear systems, Sturm separation theorems, boundary value problems, phase plane analysis, stability theory, limit cycles and periodic solutions.

**431/831. Ordinary Differential Equations II** (3 cr) *Prereq: MATH 430.* A continuation of MATH 430.

**432/832. Linear Optimization** (3 cr) [IS] *Prereq: MATH 314/814.* Mathematical theory of linear optimization, convex sets, simplex algorithm, duality, multiple objective linear programs, formulation of mathematical models.

**433/833. Nonlinear Optimization** (3 cr) *Prereq: MATH 314/814.* Mathematical theory of constrained and unconstrained optimization, conjugate direction and quasi-Newton methods, convex functions, Lagrange multiplier theory, constraint qualifications.

**441/841. Approximation of Functions** (Computer Science 441/841) (3 cr) *Prereq: A programming language, MATH 221 and 314.* Polynomial interpolation, uniform approximation, orthogonal polynomials, least-first-power approximation, polynomial and spline interpolation, approximation and interpolation by rational functions.

**442/842. Methods of Applied Mathematics I** (3 cr) *Prereq: MATH 221 and 314, or their equivalents.* Derivation, analysis, and interpretation of mathematical models for problems in the physical and applied sciences. Scaling and dimensional analysis. Asymptotics, including regular and singular perturbation methods and asymptotic expansion of integrals. The calculus of variations.

**443/843. Methods of Applied Mathematics II** (3 cr) *Prereq: MATH 442 or permission.* Application of partial differential equation models to problems in the physical and applied sciences.. Topics include derivation of partial differential equations, the theory of continuous media, linear and nonlinear wave propagation, diffusion, transform methods, and potential theory.

**445/845. Introduction to the Theory of Numbers I** (3 cr) Arithmetic functions, congruences, reciprocity theorem, primitive roots, diophantine equations and continued fractions.

**447/847. Numerical Analysis II** (Computer Science 447/847) (3 cr) *Prereq: CSCE 340, MATH 221 and 314.* Numerical matrix methods and numerical solutions of ordinary differential equations.

**450/850. Combinatorics** (3 cr) *Prereq: MATH 310 or 314* .Theory of enumeration and/or existence of arrangements of objects: Pigeonhole principle, inclusion-exclusion, recurrence relations, generating functions, systems of distinct representatives, combinatorial designs and other applications.

**452/852. Graph Theory** (3 cr) *Prereq: MATH 310 or 314.* Theory of directed and undirected graphs, including trees, circuits, subgraphs, matrix representations, coloring problems, and planar graphs. Emphasis on methods which can be implemented by computer algorithms. Selected applications.

**456/856. Differential Geometry I** (3 cr) *Prereq: MATH 221, 314, and 322.* Introduction to a selection of topics in modern differential manifolds, vector bundles, vector fields, tensors, differential forms, Stoke's theorem, Riemannian and semi-Riemannian metrics, Lie Groups, connections, singularities. Applications include gauge field theory, catastrophe theory, general relativity, fluid flow.

**457/857. Differential Geometry II** (3 cr) *Prereq: MATH 456.* A continuation of MATH 456.

**465/865 [865T]. Introduction to Mathematical Logic I** (Computer Science 465/865) (3 cr) Semantical and syntactical developments of propositional logic, discussion of several propositional calculi, applications to Boolean algebra and related topics, semantics and syntax of first-order predicate logic including Godel's completeness theorem, the compactness theorem.

**Statistics and Probability**

**180. Elements of Statistics** (3 cr) [ES][IS] Prereq: Removal of all entrance deficiencies in mathematics. Credit not allowed for both STAT 180 and ECON 215 or both STAT 180 and EDPS 459/859. Not open mathematics majors in the College of Arts and Sciences or secondary mathematics majors in Teachers College**. NOTE**: Persons with previous credit in any statistics course may not register for or earn credit in STAT 180 without first receiving special written permission from the Director of the Division of Statistics. Topics include finite probability, random variables, probability distributions, statistical inference, estimation and testing of hypotheses.

**380/880. Statistics and Applications** (3 cr) *Prereq: MATH 208 or 107H. Not open to MA or MS students in mathematics or statistics.* Probability calculus; random variables, their probability distributions and expected values; t,F and chi-square sampling distributions; estimation, testing of hypothesis and regression analysis with applications.

**481/881 [881T] Theory of Probability** (3 cr) *Prereq: MATH 208 or 107H.* Combinatorial probability, conditional probability and independence, random variables and expectations, generating functions, law of large numbers and central limit theorem, introduction to Markov chains.

**482/882. Mathematical Statistics I Distribution Theory** (3 cr) *Prereq: MATH 208 or 107H; STAT 380 or equivalent is strongly recommended.* Sample space, random variable, expectation, conditional probability and independence, moment generating function, special distributions, sampling distributions, order statistics, limiting distributions, and central limit theorem.

**483/883. Mathematical Statistics II Statistical Inference** (3 cr) *Prereq: STAT 482/882.* Interval estimation; point estimation, sufficiency, and completeness; Bayesian procedures; uniformly most powerful tests, sequential probability ratio test, likelihood ratio test, goodness of fit tests; elements of analysis of variance and nonparametric tests.

**484/884. Applied Stochastic Models** (3 cr) *Prereq: STAT 380/880 or IMSE 321 or equivalent.* Introduction to stochastic modeling in operations research. Topics include the exponential distribution and the Poisson process, discrete-time and continuous-time Markov chains, renewal processes, queueing models, stochastic inventory models, stochastic models in reliability theory.

**485/885. Applied Statistics I** (3 cr) *Prereq: STAT 380/880 or IMSE 321, and knowledge of matrix algebra.* General linear models for estimation and testing problems, analysis, and interpretation for various experimental designs.

**486/886. Applied Statistics II** (3 cr) *Prereq: STAT 380/880 or IMSE 321, and knowledge of matrix algebra.* Time Series: Introduction to model building and forecasting. Multivariate Analysis Methods: Multivariate distributions, inference on correlations, regression, mean vectors and covariance matrices; tests of independence; canonical correlation; classification and discriminant analysis, principal component analysis.

**487/887. Applied Statistics III** (3 cr) *Prereq: STAT 380/880 or IMSE 321 or permission.* Sampling Techniques: simple random sampling, sampling proportions, estimation of sample size, stratified random sampling, ratio and regression estimates. Nonparametric Methods: order statistics, tests for goodness of fit, linear rank tests, asymptotic relative efficiency, means of association.

**488/988. Topics in Statistics and Probability** (3 cr per sem) *Prereq: Permission.* Special topics in either statistics or the theory of probability.

**Seminars, Independent Study, Topics and Reading Courses**

398. Special Topics in Mathematics (cr arr) *Prereq: Permission.*

**399. Independent Study in Mathematics** (cr arr) Prereq: Prior arrangement with and permission of individual faculty member.

**399H. Honors Course** (I -4 cr) Prereq: For candidates for degrees with distinction, with high distinction, or with highest distinction in the College of Arts and Sciences.

**495 /895. Honors Seminar** (1-3 per sem, max 6) Prereq: MATH 208 and permission.

**496/896. Seminar in Mathematics** (1-3 cr per sem, max 6) *Prereq: Permission.*

**497/897. Reading Course** (1-4 cr) Prereq: Open to graduate students and, with permission, to seniors and especially qualified juniors.

### 3.4.2 Graduate Courses

Graduate Courses, as Listed in the Graduate Bulletin 2000-02, appear below.

**Algebra (MATH)**

**800. Mathematics for Elementary School Teachers** (3 cr) Prereq: Permission. Fundamental mathematical concepts basic to the understanding of arithmetic.

**814. Applied Linear Algebra (Matrix Theory)** (3 cr) Prereq: MATH 208 or 107H. A term paper and/or special project is required for graduate credit. *Not open to MA or MS students in mathematics. For computer science, statistics, engineering, physics, chemistry, and mathematics students.* Similarity of matrices, diagonalization of symmetric matrices, canonical forms, eigenvalues, quadratic forms, vectors, and applications to linear systems.

**815. Modern Algebra with Applications** (3 cr) Prereq: MATH 310 or CSCE 235 or permission. *Credit for both MATH 815 and 817 is not allowed.* Boolean algebra, binary functions, groups and semigroups, homomorphisms, congruencies, quotient structures, isomorphism, theorems for groups, Jordan-Holder theorem, finite-state machines, electronic realization, Winograd's theorem, Krohn-Rhodes algebraic decomposition theory.

**817 [817T]. Introduction to Modern Algebra I** (3 cr) Prereq: MATH 310 is advisable for most students.

Topics from elementary group theory and ring theory, including fundamental isomorphism theorems, ideals, quotient rings, domains. Euclidean or principal ideal rings, unique factorization, modules and vector spaces including direct sum decompositions, bases, and dual spaces.

**818. Introduction to Modern Algebra II** (3 cr) Prereq: MATH 817. Topics from field theory including Galois theory and finite fields and from linear transformations including characteristic roots, matrices, canonical forms, trace and transpose, and determinants.

**901. Algebra I** (3 cr) Prereq: MATH 818 or permission. In-depth treatment of groups, rings, modules, algebraic field extensions, Galois theory, multilinear products, categories.

**902. Algebra II** (3 cr) Prereq: MATH 818 or permission. In-depth treatment of groups, rings, modules, algebraic field extensions, Galois theory, multilinear products, categories.

**905. Commutative Algebra** (3 cr) Prereq: MATH 818 or permission. Selected topics from classical ideal theory, Dedekind rings, completions, local rings, valuation theory.

**907. Theory of Fields** (3 cr) Prereq: MATH 818 or permission. Selected topics from algebraic closure, finite fields, transcendental extensions, transcendence bases, extensions of fields, Galois theory, cyclotomic extensions, Kummer theory, valuation theory.

**909. Theory of Semigroups** (3 cr) Prereq: MATH 818 or permission. Selected topics from semigroups of transformations, ideal structure and homomorphisms, free semigroups, inverse semi-groups, matrix representation, decompositions and extensions.

**911. Theory of Groups** (3 cr) Prereq: MATH 818 or permission. Selected topics from isomorphism theorems, direct sums, abelian and p-groups, solvable, nilpotent and free groups, group extensions, permutation groups, representation and classification theory.

**913. Introduction to the Theory of Rings** (3 cr) Prereq: MATH 818. Elementary ring theory and examples of rings, the Jacobson radical and the structure of semi-simple rings, rings with minimum condition, Wedderburn's theorem, structure of modules.

**915. Homological Algebra** (3 cr) Prereq: MATH 902 or permission. Basic topics in homological algebra, including homology of complexes, extensions, tensor and torsion products and homological dimension, with application to rings and algebras.

**918. Topics in Algebra** (3-6 cr per sem, max 6)

**953. Algebraic Geometry** (3 cr) Prereq: MATH 901-902. Affine geometry, coordinate rings, the Zariski topology, function fields and birational geometry, the Nullstellensatz, Krull dimension and transcendence degree, smoothness, projective geometry, divisors, curves.

**Analysis and Applied Mathematics (MATH)**

**805. Discrete and Finite Mathematics** (3 cr) Prereq: MATH 814 is desirable but not required. *Credit in MATH 805 will not count towards the MA or MS degree in mathematics. Not open to math majors except for dual matriculants*

*in Teachers College. Credit is not allowed for both MATH 105 and 805, or for both CSCE 235 and MATH 805.* Graphs and networks. Map coloring. Finite differences. Pascal's triangle. The Pigeonhole Principle. Markov chains. Linear programming Game Theory.

**821. Differential Equations** (3 cr) Prereq: A grade of "P" or "C" or better in MATH 208. *Not open to MA or MS students in mathematics or statistics.* First- and second-order methods for ordinary differential equations including: separable, linear, Laplace transforms, linear systems, and some applications.

**822. Advanced Calculus** (3 cr) Prereq: MATH 208 or 107H. A term paper and/or special project is required for graduate credit. *Credit in MATH 822 will not count towards the MA or MS degree in mathematics.* Green's theorem, Stokes' theorem, the divergence theorem, and applications from differential and integral vector calculus, line integrals, general coordinate transformations, inverse function theorem, and uniform convergence of sequences and series of functions.

**823. Introduction to Complex Variable Theory** (3 cr) Prereq: MATH 208 or 107H. *Introductory course for engineering, physical sciences, and mathematics majors.* Complex numbers, functions of complex variables, complex integration, calculus of residues, infinite series, conformal mapping, Schwarz-Christoffel transformation, Poisson's integral formula, and applications of the above.

**824. Introduction to Partial Differential Equations** (3 cr) Prereq: MATH 821. *Credit in MATH 824 will not count towards the MA or MS degree in mathematics.* Derivation of the heat, wave, and potential equations; separation of variables method of solution; solutions of boundary value problems by use of Fourier series, Fourier transforms, eigenfunction expansions with emphasis on the Bessel and Legendre functions; interpretations of solutions in various physical settings.

**825 [825T]. Mathematical Analysis I** (3 cr) Prereq: MATH 208 and evidence of adequate preparation.

Real number system, topology of Euclidean space and metric spaces, continuous functions, derivatives and the mean value theorem, the Riemann and Riemann-Stieltjes integral, convergence, the uniformity concept, implicit functions, line and surface integrals.

**826. Mathematical Analysis II** (3 cr) Prereq: MATH 208 and evidence of adequate preparation. Real number system, topology of Euclidean space and metric spaces, continuous functions, derivatives and the mean value theorem, the Riemann and Riemann-Stieltjes integral, convergence, the uniformity concept, implicit functions, line and surface integrals.

**827. Mathematical Methods in the Physical Sciences** (3 cr) Prereq: MATH 821. *Credit in MATH 827 will not count towards the MA or MS degree in mathematics.* Matrix operations, transformations, inverses, orthogonal matrices, rotations in space. Eigenvalues and eigenvectors, diagonalization, applications of diagonalization. Curvilinear coordinate systems, Jacobians, changes of variables in multiple integration. Scalar, vector and tensor fields, tensor operations, applications of tensors. Complex function theory, integration by residues, conformal mappings.

**828. Principles of Operations Research** (3 cr) Prereq: MATH 814 or permission and STAT 880 or IMSE 321 or
equivalent. Introduction to techniques and applications of operations research. Includes linear programming, queueing theory, decision analysis, network analysis, and simulation.

**830. Ordinary Differential Equations I** (3 cr) Prereq: MATH 821 and 822. The Picard existence theorem, linear equations and linear systems, Sturm separation theorems, boundary value problems, phase plane analysis, stability theory, limit cycles and periodic solutions.

**831. Ordinary Differential Equations II** (3 cr) Prereq: MATH 821 and 822. The Picard existence theorem, linear equations and linear systems, Sturm separation theorems, boundary value problems, phase plane analysis, stability theory, limit cycles and periodic solutions.

**832. Linear Optimization** (3 cr) Prereq: MATH 814. Mathematical theory of linear optimization, convex sets, simplex algorithm, duality, multiple objection linear programs, formulation of mathematical models.

**833. Nonlinear Optimization** (3 cr) Prereq: MATH 814. Mathematical theory of constrained and unconstrained optimization, conjugate direction and quasi-Newton methods, convex functions, Lagrange multiplier theory, constraint qualifications.

**840. Numerical Analysis I** (CSCE 840) (3 cr) Lec 3. Prereq: CSCE 150 or 156 and MATH 208. *Credit in CSCE/*

*MATH 840 will not count towards the MA or MS degree program in mathematics and statistics. Credit towards the degree may be earned in only one of: CSCE/MATH 840 or ENGM 880.* For course description, see CSCE 840.

**841. Approximation of Functions** (CSCE 841) (3 cr) Prereq: A programming language, MATH 821 and 814.

For course description, see CSCE 841.

**842. Methods of Applied Mathematics I** (3 cr) Prereq: MATH 821 and 814, or their equivalents.

Interdependence between mathematics and the physical and applied sciences. Includes the calculus of variations, scaling and dimensional analysis, regular and singular perturbation methods.

**843. Methods of Applied Mathematics II** (3 cr) Prereq: MATH 842 or permission. Application of partial differential equation models to problems in the physical and applied sciences. Includes derivation of partial differential equations, the theory of continuous media, linear and nonlinear wave propagation, diffusion, transform methods, and potential theory.

**847. Numerical Analysis II** (CSCE 847) (3 cr) Prereq: CSCE 340, MATH 821 and 814. For course description, see CSCE 847.

**921. Real Analysis I** (3 cr) Prereq: MATH 818, 826, and 871 or permission. Semicontinuity, equicontinuity, absolute continuity, metric spaces, compact spaces, Ascoli's theorem, Stone Weierstrass theorem, Borel and Lebesque measures, measurable functions, Lebesque integration, convergence theorems, Lp spaces, general measure and integration theory, Radon-Nikodyn theorem, Fubini theorem, Lebesque-Stieltjes integration.

**922. Real Analysis II** (3 cr) Prereq: MATH 818, 826, and 871 or permission. Semicontinuity, equicontinuity, absolute continuity, metric spaces, compact spaces, Ascoli's theorem, Stone Weierstrass theorem, Borel and Lebesque measures, measurable functions, Lebesque integration, convergence theorems, Lp spaces, general measure and integration theory, Radon-Nikodyn theorem, Fubini theorem, Lebesque-Stieltjes integration.

**923. Advanced Topics in Analysis** (3 cr)

**924. Theory of Analytic Functions I** (3 cr each) Prereq: MATH 826 or permission. Complex number field, elementary functions, analytic functions, conformal mapping, integration and calculus of residues, entire and meromorphic functions, higher transcendental functions, Riemann surfaces.

**925. Theory of Analytic Functions II** (3 cr each) Prereq: MATH 826 or permission. Complex number field, elementary functions, analytic functions, conformal mapping, integration and calculus of residues, entire and meromorphic functions, higher transcendental functions, Riemann surfaces.

**927. Asymptotic Methods in Applied Mathematics** (3 cr) Methods for approximating the solutions of differential equations, including local analysis near singular points, singular perturbation methods, boundary layer theory, WKB Theory, and multiple-scale methods. Asymptotic expansion of Laplace and Fourier integrals. Illustration of the use of asymptotics from journals in mathematics, science, and engineering.

**928. Functional Analysis I** (3 cr) Prereq: MATH 818 and 921, or permission. Banach and Hilbert Spaces, linear operators and functionals, completely continuous operators, spectral theory, integral equations.

**929. Functional Analysis II** (3 cr) Prereq: MATH 818 and 921, or permission. Banach and Hilbert Spaces, linear operators and functionals, completely continuous operators, spectral theory, integral equations.

**930. Advanced Topics in Functional Analysis I** (3 cr, max 9) Prereq: MATH 929 and permission. Selected topics in functional analysis.

**932. Advanced Ordinary Differential Equations I** (3 cr) Prereq: MATH 826 or permission. Cauchy-Peano existence theorems, continuity and differentiability of solutions with respect to initial conditions, differential inequalities, uniqueness theorem, oscillation theory, Poincare-Bendixson theory, stability theory, almost periodic solutions.

**933. Advanced Ordinary Differential Equations II** (3 cr) Prereq: MATH 826 or permission. Cauchy-Peano existence theorems, continuity and differentiability of solutions with respect to initial conditions, differential inequalities, uniqueness theorem, oscillation theory, Poincare-Bendixson theory, stability theory, almost periodic solutions.

**934. Advanced Topics in Differential Equations** (3 cr) Prereq: Permission. Existence theorems in ordinary and partial differential equations.

**935. Advanced Methods in Applied Mathematics I** (3 cr) Prereq: MATH 821 and 826. Banach and Hilbert spaces, operator theory with application to differential and integral equations; spectral theory for compact, self-adjoint operators.

**936. Advanced Methods in Applied Mathematics II (**3 cr) Prereq: MATH 935 or permission. Distributions, Green's functions and boundary value problems; integral transforms and spectral representations.

**937. Nonlinear Partial Differential Equations** (3 cr) Prereq: MATH 843 or 941 or permission. Nonlinear wave propagation and shock structure with applications, dispersive waves, hyperbolic systems, group velocity and the method of stationary phase. WKB approximation and perturbation methods.

**938. Mathematical Modeling** (3 cr) Prereq: MATH 842, 843 and permission. Advanced course in mathematical modeling for students who desire experience in formulating and analyzing open-ended, real-world problems in the natural and applied sciences. Participation in a few group projects that require conceptualization and analytical, numerical, and graphical analysis with formal oral and written presentation of the results.

**941. Partial Differential Equations** (3 cr) Prereq: MATH 826. Theory of hyperbolic, elliptic, and parabolic equations. Classification, existence and uniqueness result, solution representations.

**942. Numerical Analysis III** (CSCE 942) (3 cr) Prereq: CSCE 840 (MATH 840) or CSCE 841 (MATH 841) or CSCE 847 (MATH 847) or permission. For course description, see CSCE 942.

**Combinatorics and Geometry (MATH)**

**801. Geometry for Elementary School Teachers** (3 cr) Prereq: Permission. Properties of congruence and similarity, lines and rays, angles, parallels and perpendiculars, bisectors, notion of area.

**850. Combinatorics** (3 cr) Prereq: MATH 310 or 814. Theory of enumeration of arrangements of objects, recursion
relations, generating functions, applications to enumeration of combinatorial structures.

**852. Graph Theory** (3 cr) Prereq: MATH 310 or 814. Theory of networks of points and connecting paths, structure
and existence theorems for graphs and subgraphs, graph characteristics, special graphs and applications.

**856. Differential Geometry I** (3 cr) Prereq: MATH 814, 821, and 822. Theory of space curves and surfaces, Gaussian curvature, differential parameters, geodesics, etc.

***858 [*858T]. Topics in Geometry** (3 cr) Prereq: MATH 208. Selected topics in some branch of geometry.

**951. Finite Geometries and Designs** (3 cr) Prereq: MATH 818 or equivalent, or permission. Combinatorial properties, construction methods, existence theorems for structures such as finite geometries, Latin squares, block designs, and strongly regular graphs.

**958. Topics in Combinatorial Mathematics** (3 cr) Prereq: Permission. Selected topics in combinatorics.

**Logic and Foundations of Mathematics (MATH)**

**865. Introduction to Mathematical Logic I** (CSCE 865) (3 cr) Semantical and syntactical developments of prepositional logic, discussion of several propositional calculi, applications to Boolean algebra and related topics, semantics and syntax of first-order predicate logic including Godel's completeness theorem, the compactness theorem.

**866. Introduction to Mathematical Logic II** (3 cr) Prereq: MATH 865. Semantics and syntax of first-order predicate logic including Godel's completeness theorem, decision problems, formalization of deductive theories, the structure of applied predicate calculi, the calculus of classes, introduction to higher order predicate logic.

**Number Theory (MATH)**

**845. Introduction to the Theory of Numbers I** (3 cr) Prereq: MATH 208. Arithmetic functions, congruencies, reciprocity theorem, primitive roots, diophantine equations, and continued fractions.

**846. Introduction to the Theory of Numbers II** (3 cr) Prereq: MATH 845. Diophantine approximations, irrationality and transcendence, applications of the Euler-Maclaurin sum formula, Selberg's proof of the prime number theorem, order of magnitude of some arithmetic functions, the lattice point problem.

**909. Theory of Semigroup** (3 cr) Prereq: MATH 818 or permission.

**Topology (MATH)**

**871 [871T]. General Topology I** (3 cr) Prereq: 6 hrs mathematics beyond MATH 208. Set theory, topological spaces, continuity, connectedness, coverings, separation axioms, product and quotient spaces, and sequences, nets, and filter bases.

**872. General Topology II** (3 cr) Prereq: 6 hrs mathematics beyond MATH 208. Set theory, topological spaces, continuity, connectedness, coverings, separation axioms, product and quotient spaces, and sequences, nets, and filter bases.

**970. General Topology** (3 cr) Prereq: MATH 826 or permission. *Credit for both MATH 871-872 and 970 not allowed.* Topological spaces, product and quotient spaces, compactification, metrizability, uniformities, functions spaces.

**971. Algebraic Topology** (3 cr) Prereq: MATH 817 or 871 or equivalent. Categories and functors, fundamental groups, free groups and free products, Van Kampen theorem, covering space theory and polyhedra.

**978. Topics in Topology** (3-6 cr) Prereq: Permission. Topics from topological groups, rings of continuous functions, fiber spaces, differential topology, etc.

**Statistics and Probability (STAT)**

**880. Statistics and Applications** (3 cr) Prereq: MATH 208 or 107H. A term paper and/or special project is required for graduate credit. *MATH 880 is not open to MA or MS students in mathematics or statistics.* Probability calculus; random variables, their probability distributions and expected values; t,F and chi-square sampling distributions; estimation, testing of hypothesis and regression analysis with applications.

**881 [881T]. Theory of Probability** (3 cr) Prereq: MATH 208 or 107H. Combinatorial probability, conditional probability and independence, random variables and expectations, generating functions, law of large numbers and central limit theorem, introduction to Markov chains.

**882. Mathematical Statistics I-Distribution Theory** (3 cr) Prereq: MATH 208 or 107H. Sample space, random variable, expectation, conditional probability and independence, moment generating function, special distributions, sampling distributions, order statistics, limiting distributions and central limit theorem.

**883. Mathematical Statistics II-Statistical Inference** (3 cr) Prereq: STAT 882. Interval estimation; point estimation, sufficiency and completeness; Bayesian procedures; uniformly most powerful tests, sequential probability ratio test, likelihood ratio test, goodness of fit tests; elements of analysis of variance and
nonparametric tests.

**884. Applied Stochastic Models** (3 cr) Prereq: STAT 880 or IMSE 321 or equivalent. Introduction to stochastic modeling in operations research. Includes the exponential distribution and the Poisson process, discrete-time and continuous-time Markov chains, renewal processes, queueing models, stochastic inventory models, stochastic models in reliability theory.

**885. Applied Statistics I** (3 cr) Prereq: STAT 880 or IMSE 321, and knowledge of matrix algebra. General linear models for estimation and testing problems analysis and interpretation for various experimental designs.

**886. Applied Statistics II** (3 cr) Prereq: STAT 880 or IMSE 321, and knowledge of matrix algebra.

Time series: introduction to model building and forecasting. Multivariate analysis methods: multivariate distributions, inference on correlations, regression, mean vectors and covariance matrices; tests of independence; canonical correlation; classification and discriminant analysis, principal component analysis.

**887. Applied Statistics III** (3 cr) Prereq: STAT 880 or IMSE 321 or permission. Sampling techniques: simple random sampling, sampling proportions, estimation of sample size, stratified random sampling, ratio and regression estimates. Nonparametic methods: order statistics, tests for goodness of fit, linear rank tests, asymptotic relative efficiency, means of association.

**888. Topics in Statistics and Probability** (3 cr per sem) Prereq: Permission. Special topics in either statistics or the theory of probability.

**980. Advanced Probability Theory** (3 cr) Prereq: MATH 826. Probability spaces and random variables, expectations and fundamental inequalities, characteristic functions, four types of convergence, central limit theorem, introduction to stochastic processes.

**983. Statistics Theory I** (3 cr) Prereq: MATH 826 and STAT 883. General decision problems, admissibility, mini-max and Bayes rules, invariance and unbiasedness, families of distributions problems in estimation theory.

**984. Statistics Theory II** (3 cr) Prereq: STAT 983. UMP tests, likelihood ratio tests, confidence ellipsoid multiple
decision and multiple comparisons, sequential decision problems.

**985. Theory of General Linear Model and Experimental Designs** (3 cr) Prereq: Permission. Distribution of quadratic forms in normal random variables, general linear hypothesis, estimability and testability criteria,
analysis of variance and the analysis of various design models, variance component analysis.

**986. Multivariate Analysis** (3 cr) Prereq: STAT 886 or equivalent. Statistical inference concerning parameters of multivariate normal distributions with applications to multiple decision problems.

**988. Advanced Topics in Probability and Statistics** (3 cr per sem) Prereq: Permission. Selected topics in either statistics or probability.

**Seminars and Independent Study Courses (MATH) (STAT)**

**895. Honors Seminar** (1-3 cr per sem, max 6) Prereq: MATH 208 and permission.

**896. Seminar in Mathematics** (1-3 cr per sem, max 6) Prereq: Permission.

**897. Reading Course** (1-4 cr) Prereq: Permission.
**919. Seminar in Algebra** (1-3 cr per sem, max 6)
**943. Seminar in Applied Mathematics** (1-3 cr per sem, max 6)
**944. Seminar in Analysis** (1-3 cr, max 3)
**949. Seminar in Number Theory** (1-3 cr per sem, max 6)
**957. Seminar in Numerical Analysis** (1-3 cr per sem, max 6)
**979. Seminar in Topology** (1-3 cr per sem, max 6)
**989. Seminar in Statistics and Probability** (1-3 cr per sem, max 6)
**996. Seminar** (1-3 cr per sem, max 6)
Advanced topics in one or more branches of mathematics.
**997. Reading course** (1-24 cr)
**999. Doctoral Dissertation** (1-24 cr)

# Chapter 4

# Basic Program and Curricular Data

Figures 4.1, 4.2 and 4.3 provide basic information on course sizes, and registrations, etc. in several forms for both Fall 1993 and Fall 2000.

Notice that total enrollment, as measured by student credit hour production went up during this period. Most of the increase was in the service courses, and is at least partially a result of changes in undergraduate course requirements beginning in 1995 due to UNL's adoption of the Comprehensive Education Program.

Another important observation is that due to higher admission standards and the success of its outreach programs, particularly the JUMP and Math Placement Exam programs, the Department, (and hence the University as a whole), has fewer entering students requiring remedial algebra or precalculus (Math 100, 101, 102, 103). Student credit hour production in these courses has dropped from 6751 in F1993 to 5315 in F2000, a drop of approximately 21%.

Corresponding to this is an increase in students who are ready for calculus. Indeed, student credit hour production in first and second semester calculus courses (Math 104, 106, 107) went up from 6023 in F1993 to 7451 in F2000, an increase of approximately 24%. The Department views these as positive trends, for students spend less time filling gaps in their backgrounds and more time studying subjects closer to their fields.

Mathematics departments nationwide saw a drop in graduate enrollments in the mid 1990s and the Department saw its graduate enrollments parallel national trends. The Department responded to the drop in graduate enrollments by aggressively recruiting new graduate students. Note that the success of these efforts can be seen by the recent rebound in 800 level enrollments.

Next, Figure 4.4 gives student enrollments by College. The centrality of the Department's courses to the University's mission is evident by the number of colleges from across the campus whose students take courses in the Department. The percentages of student enrollments by College is displayed in Figure 4.5. The final column of Figure 4.5 gives the three year averages of numbers of students in each college who enroll in a Department course. Note that it shows that in fall semesters, nearly 30% of all UNL undergraduates enroll in a Math/Stat course, and nearly 25% of all UNL students enroll in a Math/Stat course. The data illustrates once again, the centrality of the mathematical sciences.

Table 5
Department of Mathematics & Statistics
Number of Course Sections, Registrations,
Average Class Size, and Student Credit Hours
Fall Semesters 1993-94 and 1994-1995

| | 1993-94 | | | | 2000-2001 | | | |
|---|---|---|---|---|---|---|---|---|
| Course Number | No. of Sections | Regis-trations | Avg. Class Size | Student Credit Hrs. | No. of Sections | Regis-trations | Avg. Class Size | Student Credit Hrs. |
| Math 100A | 21 | 630 | 30 | 1,890 | 13 | 435 | 33 | 1,305 |
| 100C | 2 | 28 | 14 | 84 | 1 | 27 | 27 | 81 |
| 101 | 26 | 902 | 35 | 2,706 | 23 | 765 | 33 | 2,295 |
| 101C | 1 | 35 | 35 | 105 | 1 | 35 | 35 | 105 |
| 102 | 6 | 224 | 37 | 448 | 6 | 216 | 36 | 432 |
| 102C | 1 | 39 | 39 | 78 | 1 | 36 | 36 | 72 |
| 103 | 8 | 270 | 34 | 1,350 | 5 | 180 | 36 | 900 |
| 103C | 1 | 18 | 18 | 90 | 1 | 25 | 25 | 125 |
| 104 | 4 | 444 | 111 | 1,332 | 4 | 510 | 128 | 1,530 |
| 104C | 1 | 17 | 17 | 51 | 1 | 32 | 32 | 96 |
| 106 | 6 | 595 | 99 | 2,975 | 6 | 723 | 121 | 3,615 |
| 106C | 1 | 30 | 30 | 150 | 1 | 35 | 35 | 175 |
| 106H | 1 | 15 | 15 | 75 | 1 | 20 | 20 | 100 |
| 107 | 2 | 231 | 116 | 1,155 | 2 | 258 | 129 | 1,290 |
| 107C | 1 | 30 | 30 | 150 | 1 | 35 | 35 | 175 |
| 107H | 1 | 27 | 27 | 135 | 4 | 94 | 24 | 470 |
| 189H | -- | -- | -- | -- | 1 | 16 | 16 | 48 |
| 198 | -- | -- | -- | -- | 2 | 37 | 19 | 37 |
| 198A | -- | -- | -- | -- | 2 | 53 | 27 | 53 |
| 200 | 4 | 131 | 33 | 393 | 3 | 85 | 28 | 255 |
| 201 | 1 | 36 | 36 | 108 | 2 | 40 | 20 | 120 |
| 203 | 3 | 97 | 32 | 291 | 10 | 343 | 34 | 1,029 |
| 203C | -- | -- | -- | -- | 1 | 30 | 30 | 90 |
| 208 | 8 | 235 | 29 | 940 | 6 | 218 | 36 | 872 |
| 208C | 1 | 20 | 20 | 80 | 1 | 28 | 28 | 112 |
| 208H | 1 | 2 | 2 | 8 | 1 | 38 | 38 | 152 |
| 221 | 5 | 184 | 37 | 552 | 4 | 133 | 33 | 399 |
| 221H | 1 | 32 | 32 | 96 | 2 | 57 | 29 | 171 |
| Subtotal | 107 | 4,272 | 40 | 15,242 | 106 | 4,504 | 42 | 16,104 |
| 310 | 1 | 32 | 32 | 96 | 1 | 19 | 19 | 57 |
| 310H | 1 | 18 | 18 | 54 | 1 | 7 | 7 | 21 |
| 314 | -- | -- | -- | -- | 1 | 31 | 31 | 93 |
| 314/814 | 4 | 101 | 25 | 303 | 2 | 63 | 32 | 189 |
| 324/824 | 1 | 31 | 31 | 93 | 1 | 21 | 21 | 63 |
| 340 | -- | -- | -- | -- | 1 | 1 | 1 | 3 |
| 350 | 1 | 30 | 30 | 90 | -- | -- | -- | -- |
| 398 | -- | -- | -- | -- | 1 | 6 | 6 | 6 |
| 417/817 | 1 | 31 | 31 | 93 | -- | -- | -- | -- |
| 425/825 | 1 | 37 | 37 | 111 | -- | -- | -- | -- |
| 430/830 | 1 | 28 | 28 | 84 | -- | -- | -- | -- |
| 432/832 | -- | -- | -- | -- | 1 | 21 | 21 | 63 |
| 441/841 | 1 | 5 | 5 | 15 | 1 | 13 | 13 | 39 |
| 442/842 | 1 | 35 | 35 | 105 | -- | -- | -- | -- |
| 445 | -- | -- | -- | -- | 1 | 22 | 22 | 66 |
| 450/850 | 1 | 28 | 28 | 84 | -- | -- | -- | -- |
| 465/865 | -- | -- | -- | -- | 1 | 18 | 18 | 54 |
| Subtotal | 14 | 376 | 27 | 1,128 | 12 | 222 | 19 | 654 |

Table 5 (continued)

| Course Number | No. of Sections | Regis-trations | Avg. Class Size | Student Credit Hrs. | No. of Sections | Regis-trations | Avg. Class Size | Student Credit Hrs. |
|---|---|---|---|---|---|---|---|---|
| 800 | 1 | 1 | 1 | 3 | - | - | - | - |
| 801F | 1 | 162 | 162 | 486 | - | - | - | - |
| 817 | - | - | - | - | 1 | 16 | 16 | 48 |
| 821 | 1 | 3 | 3 | 9 | - | - | - | - |
| 825 | - | - | - | - | 1 | 22 | 22 | 66 |
| 842 | - | - | - | - | 1 | 19 | 19 | 57 |
| 872 | 1 | 6 | 6 | 18 | - | - | - | - |
| 901 | 1 | 4 | 4 | 12 | 1 | 7 | 7 | 21 |
| 905 | 1 | 8 | 8 | 24 | - | - | - | - |
| 907 | - | - | - | - | 1 | 8 | 8 | 24 |
| 911 | - | - | - | - | 1 | 8 | 8 | 24 |
| 918 | 1 | 8 | 8 | 24 | - | - | - | - |
| 919 | 1 | 9 | 9 | 25 | 1 | 2 | 2 | 4 |
| 921 | 1 | 22 | 22 | 66 | 1 | 10 | 10 | 30 |
| 924 | - | - | - | - | 1 | 6 | 6 | 18 |
| 928 | 1 | 8 | 8 | 24 | - | - | - | - |
| 932 | - | - | - | - | 1 | 8 | 8 | 24 |
| 935 | 1 | 11 | 11 | 33 | - | - | - | - |
| 939 | 1 | 17 | 17 | 51 | - | - | - | - |
| 943 | 1 | 13 | 13 | 14 | 1 | 14 | 14 | 14 |
| 944 | 1 | 6 | 6 | 15 | 1 | 3 | 3 | 3 |
| 957 | 1 | 2 | 2 | 4 | - | - | - | - |
| 958 | 1 | 9 | 9 | 27 | 1 | 7 | 7 | 21 |
| 996 | - | - | - | - | 1 | 1 | 1 | 1 |
| Subtotal | 16 | 289 | 18 | 835 | 14 | 131 | 9 | 355 |
| Independent Study | | | | | | | | |
| 399 | - | - | - | - | 1 | 1 | 1 | 3 |
| 399H | 1 | 3 | 3 | 9 | - | - | - | - |
| 897 | 1 | 1 | 1 | 3 | 1 | 4 | 4 | 9 |
| 899 | - | - | - | - | 1 | 1 | 1 | 3 |
| 996 | 1 | 1 | 1 | 3 | - | - | - | - |
| 997 | 1 | 4 | 4 | 12 | 1 | 3 | 3 | 9 |
| 999 | 1 | 15 | 15 | 59 | 1 | 15 | 15 | 99 |
| Subtotal | 5 | 24 | 5 | 86 | 5 | 24 | 5 | 123 |
| Math Total | 142 | 4,961 | 35 | 17,291 | 137 | 4,881 | 36 | 17,236 |
| | | | | | | | | |
| Stat 180 | 6 | 222 | 37 | 666 | 15 | 498 | 33 | 1,494 |
| Subtotal | 6 | 222 | 37 | 666 | 15 | 498 | 33 | 1,494 |
| 380/880 | 3 | 103 | 34 | 309 | 3 | 111 | 37 | 333 |
| 482 | 2 | 67 | 34 | 201 | - | - | - | - |
| 482/882 | - | - | - | - | 1 | 37 | 37 | 111 |
| 485 | 2 | 35 | 18 | 105 | - | - | - | - |
| 485/885 | | | - | - | 1 | 28 | 28 | 84 |
| Subtotal | 7 | 205 | 29 | 615 | 5 | 176 | 35 | 528 |
| 882 | 1 | 37 | 37 | 111 | - | - | - | - |
| 885 | 1 | 20 | 20 | 60 | - | - | - | - |
| 985 | - | - | - | - | 1 | 6 | 6 | 18 |
| 986 | 1 | 6 | 6 | 18 | - | - | - | - |
| 988 | 1 | 5 | 5 | 15 | - | - | - | - |
| 989 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |
| Subtotal | 5 | 69 | 14 | 205 | 2 | 9 | 5 | 21 |
| Stat Total | 18 | 496 | 28 | 1,486 | 22 | 683 | 31 | 2,043 |
| | | | | | | | | |
| Dept Total | 160 | 5,457 | 34 | 18,777 | 159 | 5,564 | 35 | 19,279 |

Figure 4.1: Course Sections, Registrations, Ave. Class Size, and Credit Hours, F’93 and F’00

Table 4
Academic Program Review
Department of Mathematics & Statistics
Number of Class Registrations, Student Credit Hours, and Student Contact Hours By Level
Fall Semesters 1993-94 to 2000-2001

| Year | Total | | | Lower Level | | | Upper Level | | | Graduate & Professional | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of Regis. | Credit Hours | Contact Hours | No. of Regis. | Credit Hours | Contact Hours | No. of Regis. | Credit Hours | Contact Hours | No. of Regis. | Credit Hours | Contact Hours |
| 1993-1994 | 5,457 | 18,777 | 18,813 | 4,494 | 15,908 | 15,988 | 463 | 1,389 | 1,383 | 500 | 1,480 | 1,442 |
| excluding 801F * | 5,295 | 18,291 | 18,327 | 4,494 | 15,908 | 15,988 | 463 | 1,389 | 1,383 | 338 | 994 | 956 |
| 1994-1995 | 5,221 | 17,979 | 18,005 | 4,466 | 15,730 | 15,788 | 426 | 1,278 | 1,272 | 329 | 971 | 945 |
| 1995-1996 | 5,494 | 19,029 | 19,066 | 4,821 | 16,991 | 17,021 | 398 | 1,194 | 1,194 | 275 | 844 | 851 |
| 1996-1997 | 5,336 | 18,755 | 18,806 | 4,774 | 17,045 | 17,094 | 346 | 1,035 | 1,035 | 216 | 675 | 677 |
| 1997-1998 | 5,188 | 18,098 | 18,151 | 4,583 | 16,294 | 16,314 | 428 | 1,264 | 1,268 | 177 | 540 | 569 |
| 1998-1999 | 5,222 | 18,411 | 18,456 | 4,668 | 16,742 | 16,788 | 385 | 1,125 | 1,130 | 169 | 544 | 539 |
| 1999-2000 | 5,689 | 19,705 | 19,901 | 5,113 | 17,939 | 18,133 | 399 | 1,185 | 1,187 | 177 | 581 | 581 |
| 2000-2001 | 5,564 | 19,279 | 19,484 | 5,003 | 17,598 | 17,782 | 320 | 951 | 963 | 241 | 730 | 739 |
| % Change from 1993-94 to 2000-2001 | 2.0 | 2.7 | 3.6 | 11.3 | 10.6 | 11.2 | (30.9) | (31.5) | (30.4) | (51.8) | (50.7) | (48.8) |
| % Change excluding 801F | 5.1 | 5.4 | 6.3 | 11.3 | 10.6 | 11.2 | (30.9) | (31.5) | (30.4) | (28.7) | (26.6) | (22.7) |
| % Change from 1999-2000 to 2000-2001 | (2.2) | (2.2) | (2.1) | (2.2) | (1.9) | (1.9) | (19.8) | (19.7) | (18.9) | 36.2 | 25.6 | 27.2 |

Source: Office of Institutional Research and Planning. Fall 2000 data from Census Class Schedule Report.

* 801F was an NSF-funded course taught by Mel Thornton, supported for 1 year, and transmitted to 14 different satellite downlink locations.

IRP, 6/30/00

Figure 4.2: Class Registrations, Student Credit and Contact Hours by Level

Table 6
Academic Program Review
for the Department of Mathematics
Student Credit Hours by Course Level
and Department of the Instructional Staff Teaching the Courses
Fall Semesters 1993-94 through 1999-2000

| Fall Semester | Course Level | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | Total |
| 1993-94 | 12,933 | 2,388 | 837 | 570 | 0 | 0 | 0 | 1,056 | 427 | 18,211 |
| 1994-95 | 12,326 | 2,695 | 873 | 333 | 0 | 0 | 0 | 531 | 404 | 17,162 |
| 1995-96 | 13,153 | 2,888 | 789 | 312 | 0 | 0 | 0 | 441 | 403 | 17,986 |
| 1996-97 | 12,752 | 3,044 | 764 | 268 | 0 | 0 | 0 | 305 | 378 | 17,511 |
| 1997-98 | 12,497 | 2,869 | 874 | 399 | 0 | 0 | 0 | 246 | 291 | 17,176 |
| 1998-99 | 12,987 * | 2,922 | 843 | 249 | 0 | 0 | 0 | 247 | 270 | 17,518 |
| 1999-00 | 14,111 * | 3,015 | 789 | 303 | 0 | 0 | 0 | 312 | 254 | 18,784 |
| Percent Change from 1993-94 to 1999-2000 | 9.11 | 26.26 | (5.73) | (46.84) | | | | (70.45) | (40.52) | 3.15 |
| Percent Change from 1998-99 to 1999-2000 | 8.65 | 3.18 | (6.41) | 21.69 | | | | 26.32 | (5.93) | 7.23 |

Note: Credit is assigned according to the home department of the instructional staff who teach the courses.

Source: Profile Table 140
* Figures corrected for incorrect classification of Buren Thomas as Division of Continuing Studies.
IRP, 6/1/00

Figure 4.3: Student Credit Hours by Level

Table 9
Department of Mathematics & Statistics
Student Registrations in the Department by College
Fall Semesters 1993-94 to 2000-2001

| College | 1993-94 | 1994-95 | 1995-96 | 1996-97 | 1997-98 | 1998-99 | 1999-2000 | 2000-2001 |
|---|---|---|---|---|---|---|---|---|
| Agricultural Sciences & Nat. Resources | 407 | 316 | 316 | 324 | 285 | 282 | 327 | 302 |
| Architecture | 96 | 83 | 104 | 80 | 101 | 102 | 91 | 76 |
| Arts & Sciences | 1381 | 1372 | 1506 | 1480 | 1494 | 1423 | 1483 | 1473 |
| Business Administration | 746 | 693 | 838 | 767 | 714 | 757 | 775 | 783 |
| Engineering & Technology | 701 | 708 | 694 | 780 | 818 | 846 | 849 | 787 |
| Fine & Performing Arts | 0 | 0 | 34 | 40 | 72 | 70 | 101 | 121 |
| Graduate | 407 | 404 | 325 | 280 | 219 | 195 | 214 | 273 |
| Human Resources & Family Sciences | 68 | 62 | 103 | 81 | 80 | 56 | 68 | 69 |
| Journalism & Mass Communications | 0 | 0 | 38 | 73 | 125 | 139 | 212 | 176 |
| Teachers | 328 | 457 | 438 | 402 | 352 | 358 | 419 | 435 |
| General Studies | 0 | 0 | 984 | 922 | 845 | 914 | 1056 | 970 |
| Criminal Justice | 0 | 0 | 72 | 88 | 62 | 58 | 66 | 69 |
| Other, Visiting, and Undeclared | 1323 | 1126 | 42 | 19 | 21 | 22 | 28 | 30 |
| TOTAL | 5457 | 5221 | 5452 | 5336 | 5188 | 5222 | 5689 | 5564 |

Source: Statistics registration tape as of the sixth day of enrollment for above years.

IRP, 11/13/00

Figure 4.4: Student Registrations in Department by College, F93–F00

Figure 4.5: Enrollment Trends: Students in Other Colleges enrolled in Math/Stat Courses

Percentage of students from each college taking a course from the Department of Mathematics and Statistics

| | Fall 1998 | | | Fall 1999 | | | Fall 2000 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| College | Math | Total | Percent M/S | Math | Total | Percent M/S | Math | Total | Percent M/S | 3Yr Ave |
| Agricultural Sci. & Nat. Res. | 282 | 1480 | 19.1% | 327 | 1459 | 22.4% | 302 | 1408 | 21.4% | 21.0% |
| Architecture | 102 | 489 | 20.9% | 91 | 463 | 19.7% | 76 | 470 | 16.2% | 18.9% |
| Arts & Sciences | 1423 | 4379 | 32.5% | 1483 | 4240 | 35.0% | 1473 | 4221 | 34.9% | 34.1% |
| Business Administration | 757 | 2832 | 26.7% | 775 | 2804 | 27.6% | 783 | 2881 | 27.2% | 27.2% |
| Engineering & Technology | 846 | 2285 | 37.0% | 849 | 2386 | 35.6% | 787 | 2499 | 31.5% | 34.6% |
| Fine & Performing Arts | 70 | 619 | 11.3% | 101 | 622 | 16.2% | 121 | 671 | 18.0% | 15.3% |
| Human Resources & Family Sci. | 56 | 858 | 6.5% | 68 | 750 | 9.1% | 69 | 721 | 9.6% | 8.3% |
| Journalism & Mass Comm. | 139 | 891 | 15.6% | 212 | 968 | 21.9% | 176 | 973 | 18.1% | 18.6% |
| Teachers | 358 | 1580 | 22.7% | 419 | 1600 | 26.2% | 435 | 1659 | 26.2% | 25.0% |
| General Studies | 914 | 2350 | 38.9% | 1056 | 2283 | 46.3% | 970 | 2266 | 42.8% | 42.6% |
| Others* | 80 | 217 | 36.9% | 94 | 229 | 41.0% | 99 | 199 | 49.7% | 42.3% |
| Graduate, Law & Prof Arch | 195 | 4428 | 4.4% | 214 | 4338 | 4.9% | 273 | 4300 | 6.3% | 5.2% |
| Undergraduate Total | 5027 | 17980 | 28.0% | 5475 | 17804 | 30.8% | 5291 | 17968 | 29.4% | 29.4% |
| Total | 5222 | 22408 | 23.3% | 5689 | 22142 | 25.7% | 5564 | 22268 | 25.0% | 24.7% |

*Others Includes Cont. Studies, Criminal Justice, Intercampus & Visiting Students

Note: Data is taken from reports provided by Institutional Research.

# Chapter 5

# Curricular Change (Program Content Change)

## 5.1 Undergraduate Program

### 5.1.1 Calculus Reform

Because of the large number of students who take calculus and because of its central importance in educating students in mathematically based disciplines, how calculus is taught is the most important mathematics curriculum issue on a university campus. At UNL, Math 106 (first semester calculus) is taught to approximately 1250 students each academic year. Substantial numbers of these students go on to take Math 107 (second semester calculus) and Math 208 (multivariate calculus). In the last half of the 1980's, the National Science Foundation funded a number of very large curriculum projects whose purpose was to revitalize how calculus is taught. Over the last decade, virtually every mathematics department in America has focused time, energy and money on rethinking how they teach calculus on their campus. Collectively, efforts to change how calculus is taught became known as the calculus reform movement. *Calculus reform is the Department's most important curriculum project in over 30 years, and this section is devoted to describing the changes.*

**From Graphing Calculators to a New Textbook and Curriculum** UNL's involvement in "calculus reform" began modestly in Fall 1993 with the experimental use of graphing calculators in calculus while retaining use of a standard calculus book. Faculty using graphing calculators in calculus became dissatisfied with the traditional text, because it became apparent that the material could be made more conceptual, particularly in regards to the understanding of integration and to the ways in which the calculus is applied in other disciplines. The traditional text did not do a good job with illustrating connections with other fields, nor was the theory it contained written in a way the students could readily understand. Thus, in the Spring of 1994, the Department sought a calculus text written with the assumption that students have access to graphing calculators. A selection process ensued, resulting in the choice of the Hughes-Hallett text.

The Hughes–Hallett text is part of a widely used calculus curriculum developed by the Harvard Calculus Consortium. This program builds on the expectation that students will become active learners and participants in the classroom, rather than passive recipients of information obtained via lectures. The philosophy of the consortium is to present each topic of calculus geometrically, numerically and algebraically, and to show whenever possible how formal definitions and procedures evolve from the investigation of practical problems. These materials represent a significant shift from the traditional method of calculus instruction. The Department is still using this text.

With the adoption of the new text in Fall 1994, the Department made a total commitment to changing how we teach calculus. The commitment included:

- the use of technology in teaching calculus;
- the use of extended writing projects;
- the introduction of cooperative learning techniques;

- a shift to active learning in the classroom;
- the use of a "reform" textbook; and
- the effort to connect mathematics to other disciplines.

**Implementation** Some of the issues involved with implementing the new curriculum were: the selection of five faculty to lead the implementation; sending each of the lead faculty to workshops to learn how to use the new materials; the acquisition of enough calculators and overhead projection units so that there would be enough for all the calculus instructional staff; training of teaching assistants and others in using the new materials; hiring a lead TA to co-ordinate the activities of all the teaching assistants; the creation of a drop-in Calculus Lab for students; informing other UNL departments, area high schools and regional colleges of the changes taking place; and organizing an evaluation effort to assess the impact of the changes.

Implementation of the changes in calculus required additional resources, and support was received from two sources: i) a grant from the NU Foundation to support our work; and ii) funds from the Dean of Arts & Sciences and the Senior Vice Chancellor for Academic Affairs provided five members of the faculty release time to work on this curriculum project.

The NU Foundation grant provided funding to reduce recitation class size, to support faculty travel to workshops to learn how best to use the new materials, a calculus laboratory, and equipment. The administrative support was a strong signal that UNL administrators understood both the importance of the effort and the time it would take. As a result, five faculty with NSF research grants (Professors Hines, Marley, Orr, Pitts and Radcliffe) agreed to provide the leadership for the Department's calculus curriculum reform effort.

The calculus lab was staffed by undergraduates, TAs and faculty during the three semesters the Harvard materials were being implemented. Due to its success, the calculus lab has been permanently funded and is now called the Mathematics Resource Center.

**The Mathematics Resource Center** The Mathematics Resource Center (MRC) is a place where students may go to obtain informal help from teaching assistants and undergraduate math counselors, meet other students to work on projects, or to study. Until fall of 1999, it was also the place students went to take a computerized exam (a gateway exam), but there is now a separate facility for this. The MRC is open Monday–Thursday from 12:30–8:30 pm. and Fridays 12:30-2:30 pm.. In the fall of 1999, approximately 3064 students made use of the MRC.

**Extended Writing Projects and Group Projects** Starting around 1993, the Department began implementing group writing projects in lower level courses. Initial efforts were fairly modest, but showed that it was possible to introduce group projects into large lecture calculus courses. Knowing that group projects are feasible in large lecture courses was important when the Department selected the Harvard curriculum in 1994. Indeed, one of the features of the Harvard curriculum is an increased emphasis on student writing. There were fewer projects used in Math 106 during the fall of 1994 than in 1993, but the newer projects asked the students to exhibit a deeper understanding and write more clearly. Group projects have been a standard part of the calculus curriculum since 1994.

There are several motivations for the use of group projects. The central one is the belief that student understanding of, and enthusiasm for, calculus is enhanced by working on problems which show the utility of calculus. Furthermore, such problems provide an opportunity for in-depth writing. The use of groups was initially chosen to reduce the workload in grading the assignments in large lecture sections, but it does have benefits for the students. For example, students learn how to work with others and develop communities which reduce the sense of isolation experienced by many students in a large lecture class at a large university. Further, students often accomplish more and solve harder problems by working as a team than they do working individually.

Currently, the typical group project produced by a student group ranges from 3–8 pages in length, and incorporates graphs and formulas into text describing the solution of the problem. Students are encouraged to write with care, and to be careful to present their material in an attractive way.

Projects are now used throughout the core freshman and sophomore mathematics sequences (Math 106-107-208, Math 221, and Math 314). Appendix E.4 gives several sample projects.

Shortly after our introduction of group projects, UNL implemented the Integrative Studies and Essential Studies graduation requirement for undergraduates. The new requirements dovetailed very well with the changes we had made

in calculus instruction and it was natural to have the calculus sequence included as IS/ES courses. (See Appendix B for more information on IS/ES requirements.)

**Active Learning** The portability of calculators enables them to be used by students for numerical experiments in the classroom. For example, students might calculate and tabulate numerical approximations to the derivative of an exponential function. Using the table, they are able to see that the derivative is again an exponential function prompting a discussion about why that should be. Calculators have also been used in a creative way to collect and analyze data. Such activities enable students to engage the material, and to claim ownership of ideas and information in ways which were impossible before graphing calculators were available. The new text is well suited to this style of teaching, since there are so many deep exercises in it.

### 5.1.2 Technology

#### Calculator Use

Prior to undertaking calculus reform, creative efforts to use computer algebra systems in 300 and 400 level mathematics courses by Professors Dunbar and Shores led to the creation of a computer laboratory, which in turn led to further expansion of technology in upper level undergraduate courses. These efforts and the widespread availability of graphing calculators paved the way for the Department's decision to use graphing calculators throughout the calculus sequence. One of the advantages of using calculators over computers in the calculus sequence is the fact that calculators are affordable and portable. Hence, they can be used easily in any classroom or virtually anywhere a student chooses to study.

Graphing calculators are powerful tools which enable students to visualize calculus. Therefore, the Department recognized the need to rethink the goals and objectives for calculus. Accordingly, during the summer of 1993, an ad-hoc committee was charged with preparing a document outlining what current departmental thinking on the goals and objectives of calculus were.

*Calculator Use in Calculus*

The philosophy of the Department regarding calculators is two-pronged. First, calculators should be used as a tool to help students visualize the material. Second, the focus must be on teaching *calculus*, not calculators.

The initial use of calculators in calculus began with their use in a small class during the 1993 Summer Session, and then expanded in the Fall of 1993 to two of the five large lecture-recitation sections taught that semester. Since the Fall 1994 semester, graphing calculators have been required of all students in the 106-107 calculus sequence. Students taking Math 208 (third semester calculus) already have a graphing calculator from Math 107, so calculators are not explicitly required in Math 208.

Finally, students are allowed to use calculators on exams in Math 104, but their use is not required in that course.

*Calculator Use in PreCalculus*

With the introduction of calculators into the calculus sequence, the Department believed that it would be useful to incorporate calculators into the precalculus courses. Thus, calculators are now used in Math 101, Math 102, and Math 103.

*Calculator Use in Other Courses* Calculators are used at the discretion of the instructor in a variety of other courses in the department, including Math 221 (differential equations) and 314 (matrix theory).

#### Use of Computer Algebra Systems

We train students in the writing of technical documents and use of high level computational tools in numerical and symbolic mathematical calculations. The lab is the foundation for our technology-based innovations in Math 221 and Math 314, where we now require a lab component. Students are expected to develop some expertise in the computer algebra system Maple and use it to write up project reports, done individually or in teams. The lab supports high end use of computer algebra software (Maple, Mathematica, Matlab, etc.) in all post-calculus courses. Lab facilities are used in other more advanced courses as well, such as Math 417 (abstract algebra), Math 433 (nonlinear optimization) and Math 442 (applied mathematics), to name a few. The availability of high powered computing software has influenced how we teach these courses. The common thread in all of these courses is that we can now routinely expect students to perform mathematical experiments in diverse areas ranging from algebra to analysis to statistics. This adds an entirely new dimension to our teaching.

About a decade ago, experience in teaching introductory differential equations and linear algebra courses convinced some faculty in the Department that these courses were in serious need of revitalization and reform. In the spring of 1990, with the assistance of an Instrumentation and Laboratory Initiative grant from the National Science Foundation the Department began our computer laboratory. The laboratory opened with 7 NeXT workstation computers, and has grown (and changed) steadily over the past decade. Along the way, the Department hired a full time computer lab manager to service the growing computer needs. The Math Computer Lab now has over 700 accounts for undergraduate students, graduate students, and faculty. The original computer lab, which is staffed by attendants, consists of 20 workstations in Bessey 105. In addition, the Department has an unstaffed computer lab consisting of 8 workstations in Oldfather 838, which is used primarily by graduate students and some math majors, and 6 workstations in the Math Resource Center (Burnett 126), used principally by undergraduates and staffed by graduate students.

The availability of the computer lab has allowed the Department of Mathematics and Statistics to integrate computer algebra systems and the computer lab into the curriculum of Math 221 and Math 314. Math 221, *Differential Equations for Engineers,* and Math 314, *Matrix Algebra,* follow Math 208, *Calculus and Analytic Geometry III*. These courses serve math majors, actuarial science majors, computer science majors, physical science majors, and most engineering majors. The computer lab is used for in-class demonstrations and homework projects or papers requiring extensive use of the lab and the software. Prof. Tom Marley has used computer algebra software and the Mathematics Computer Lab in Math 310, *Introduction to Abstract Algebra,* since 1992. Mathematics majors and computer science majors, as well as secondary education majors with a mathematics emphasis, take Math 310. The use is for in-class demonstrations, and homework projects requiring extensive use of the lab and the software. Prof. Tom Shores and Prof. Steve Dunbar have integrated the computer lab and software into the numerical analysis sequence Math 441, *Approximation of Functions*, Math 447, *Numerical Analysis*, and Math 942, *Numerical Analysis*. Advanced students in mathematics and statistics, computer science, engineering and physical sciences take these courses. Math 442-443, *Methods of Applied Mathematics*, and Math 427, *Mathematical Methods in the Physical Sciences* have used the computer lab and computer algebra software. In Fall, 2000, Prof. Judy Walker taught Math 445, *Number Theory,* in the computer lab and did very little lecturing—students in her class made conjectures based upon numerical evidence, proved their conjectures, and finally presented their proofs to the entire class.

An explicit goal of all the uses of the computer technology and written homework projects in these upper-level mathematics courses is to prepare students to:

- Use mathematics to structure their understanding of and investigate questions in the world about them.
- Use mathematics to formulate and solve problems and to communicate those solutions to others.
- Use technology as an integral part of the problem solving process.

**Web Activities**

Several of our faculty are developing high visibility Web courses which depend on the lab as a vehicle for dissemination as well as a source of development tools. For example, John Orr has done pioneering work in the area of web testing and grading. See, for example, the URL http://calculus.unl.edu. In addition, he and Mark Sapir have put courses on the web. Recognition of faculty-developed web technology and lab components in various courses has given UNL increased national visibility. The departmental home page on the web is becoming increasingly important to our recruiting efforts for graduate students. Finally, the web is used by most faculty as the preferred information vehicle for their courses. Most faculty have developed their own home course pages and some of our faculty are using the Blackboard program (supported by UNL) for presentation of class materials, notes, etc, on the web.

**Web Testing**

### 5.1.3 Gateway Exams in Math

The concept of gateway exams grew out of the redesign of the core calculus sequence (Math 106-107-208) described in Section 5.1.1. The redesigned sequence of courses placed an increased emphasis on understanding applications and concepts of calculus, and required extensive classroom time for group work, classroom discussion and open-ended problem-solving. While there was overall satisfaction with the goals of the reform, the concern heard most from

within the Department and from client departments was that these new activities and the time they demanded would squeeze out the time students need to learn how to do basic computations of integrals and derivatives.

These concerns led the Department in Fall 1996 to introduce Gateway Exams in calculus. Following a model inspired by the University of Michigan, the term Gateway Exam means a competency test which students are required to pass at some specified level of proficiency in order to pass the course and proceed to subsequent courses. The Calculus Gateway Exams at UNL test basic computational skills in each of the courses they are given in, and count for 5%–10% of the course credit. There is no partial credit, so that students must attain the passing level (typically 80%) in order to receive any credit for the test. Because the Gateway Exams require a very high standard of proficiency, students are offered extensive retakes, together with unlimited opportunity to practice sample questions over the web. In each retake and practice session, students are given a fresh set of questions covering the same base topics. Although passing the Gateway Exam is not an absolute requirement for passing the course, we have found essentially no student passes these courses with a C or better without also passing the Gateway Exam.

In Fall 1996, John Orr developed the software to give the first on-line Gateway Exams, coordinated creation of the first test bank of questions, and oversaw administration of the exams. The computer system developed is now called eGrade. Computer grading and on-line delivery proved to be an essential component of successful Gateway Exams. Earlier in Fall 1996, we had run our first Gateway Exam using hand-generated and hand-graded tests. While the results with students were encouraging, the exam placed an immense load on faculty and the GTAs in the Math Resources Center. Currently, using degrade, we give Gateway Exams to roughly 3,000 students a year, but the on-line delivery means that this translates to an almost negligible increase in the workload of an individual instructor of one of these courses.

The Gateway Exams provide a certification to the Department and to our client departments that students graduating from our core courses have mastered a set of basic computational skills in these courses. They are a complement to the reform methods adopted in our calculus and precalculus classes, and serve to allay fears that reform has led to a computational weakening of these courses. Because they do not increase the work-load of faculty or require extensive new resources, the exams have become firmly established as part of the teaching culture of the department.

It is also worth mentioning that Math 203, *Contemporary Mathematics*, now uses web testing as well.

## 5.2 Graduate Program

There have been several changes in the graduate program since 1993. The main changes are the following:

- the deletion of courses from the course catalog which were virtually never offered or run;
- an addition of a course in asymptotic methods (math 927);
- the retitling of math 941 from ‘Stochastic Control Systems’ to ‘Partial Differential Equations;’
- a change to graduate-student only enrollment in the basic graduate course sequences (Math 817-18 (algebra), Math 825-8 (analysis), and Math 842-3 (applied math));
- changes in requirements for the graduate exams; and
- a content change in the basic algebra sequence (Math 817-818).

The courses dropped from the course catalog are: 813, 816, 820, 844, 926, 931, 939, 940, 946, 947, 855, 857, 860, 966, 945, 948, 972, 981, 982, 987, 969. These changes in the course listings are principally cosmetic and have resulted in virtually no curricular changes, because the courses dropped had not been offered for many years.

Changing the basic graduate sequences in algebra, analysis and applied math to graduate-only enrollment was concurrent with an effort to offer corresponding undergraduate enrollment only courses. This change was designed to encourage undergraduates to take courses in these fundamental topics without the added intimidation factor of taking a class geared towards graduate students. Particularly able undergraduates may still enroll in the graduate sequences.

The basic graduate algebra sequence, Math 817-818 now contains much more linear algebra and less finite group theory. The course now contains more emphasis on orthogonal groups and geometry.

The structural changes in exams have resulted in some curricular change because they affect student course selection somewhat.

**CHANGES IN MASTERS EXAM** Listed below are the requirements for the masters exam in 1993 and in 2000.

**Exams in Mathematics**

*1993 Mathematics Requirements:* Three three-hour exams were required.

Part I: Analysis (material from Rudin's Principles of Mathematical Analysis).

Part II: This part of the exam gave students a choice of an exam in Algebra (material from Dummit and Foote, Abstract Algebra) or an exam in Applied Mathematics (material from Logan, Applied Mathematics).

Part III: An exam depending on the individual student's program.

*Current Mathematics Requirements:* Two three-hour exams are currently required. One of the exams must be in either algebra or analysis (analysis topics are the same as in 1993, algebra topics cover more linear algebra than previously) and the other exam must be over a two-course (year-long) sequence offered by the Department or two courses approved by the Graduate Advisory Committee.

**Exams in Statistics**

*1993 Statistics Requirements:* There were three three-hour exams required in 1993.

Part I: Mathematical statistics (material from Mood, Graybill, and Boes, Introduction to the Theory of Statistics)

Part II: Applied Statistics (material from Netter, Wasserman, and Kunter, Applied Linear Statistical Models)

Part III: An exam depending on the individual student's program.

*Present Statistics Requirements:* Two three-hour exams, one in mathematical statistics and one in applied statistics. Material on the exams is roughly the same as in 1993.

**CHANGES IN PHD QUALIFYING AND COMPREHENSIVE EXAM:** The Ph.D. qualifying exam is basically unchanged from 1993. There are two principal changes in the comprehensive exam. One change in the comprehensive exam is that the second part may now be either written or oral, as opposed to written in 1993. The other change is more of a change in faculty attitudes towards the comprehensive exam. Graduate College rules state that the Ph.D. supervisory committee is responsible for the comprehensive exam. Traditionally, however, supervisory committees in the Department relied on the Department's Graduate Committee to prepare comprehensive examinations and allowed the Graduate Committee as a whole to decide whether a student passed or failed. Now, however, the Department has returned more responsibility for the comprehensive exam to the student's Ph.D. supervisory committee, thus bringing the Department more into line with the usual practices of Ph.D. committees throughout UNL.

## 5.3 Evidence of Need

The Department's instructional program is central to the University and to the State of Nebraska. What follows is a brief outline of the demand and need for the Department's courses.

In Fall 2000, the Department produced 19,279 SCHs. This is 7.2% more than in Fall 1994 despite both a drop in the number of students attending UNL and in the size of our permanent faculty. In Fall 1994, 87% of our instruction was at the 100 and 200 level but because of efforts to focus the graduate curriculum and drops in graduate SCHs, this figure has increased to 91% in Fall 2000. In order to meet this demand with reduced resources, the number of 400/800/900 level courses offered dropped from 23 in Fall 1994 to 19 in AY 98/99.

Averaging the data for the last three Fall semesters, we find that 80% of freshmen take at least one math class and during any one semester, 34.1% of A&S students, 42.6% of General Studies students, 34.6% of Engineering students, 25% of Teachers College students, 27.2% of CBA students, 19% of Architecture students, and 21% of Agriculture students are taking a math/stat class. Almost all registrations in math/stat are to satisfy a major requirement, a Comprehensive Education Program requirement or to make up a deficiency. If Mathematics and Statistics does not do a good job, every program suffers. Indeed, in terms of the retention of freshmen and sophomores, UNL suffers the most.

This is not to say that we do not have a substantial and successful program at both the undergraduate and graduate levels. Using the most recent data available, the Department ranks 8th in the college in terms of undergraduate degrees awarded. If we were to get credit for the math majors in teachers college, we believe that ranking would jump to 5th. At the Masters level, we are 3rd in degrees conferred over the past four years, and at the Ph.D. level we are 5th in the college.

There is ample evidence that the quality of the department's instructional program is high. Fifteen of our faculty have won College or University Distinguished Teaching Awards and in 1998 the department won the University-wide Department Teaching Award. In addition, the Department was one of four departments to represent UNL in the AAHE Peer Review of Teaching project and one of 12 math departments to be part of the national Mathematicians and Education Reform Department Network. (Michigan, Washington, Arizona, Maryland and Rutgers are among other departments in this prestigious group.) In the fall of 1998, the the Department was recognized with a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. The Department was recognized for its achievements in mentoring women graduate students.

When we look at the Department from the point of view of how students who major in Math/Stat are served or at the quality of our graduate program, we get further evidence of the quality of the department. The median GPA for our majors is 3.64 and 73% have a GPA above 3.0. Over the past decade, 12 of our majors have won prestigious Goldwater Scholarships, and 7 of the approximately 100 students nationwide admitted to Penn State's intensive semester in mathematics for undergraduates have been UNL students. At the graduate level, while we have increased the number of Ph.D.s awarded, our graduates are obtaining outstanding positions. Indeed, we have produced two NSF postdoctoral fellows in the past three years.

In terms of the effectiveness and efficiency of the department, note that we have increased our SCH production while losing tenure-track faculty lines. This combined with the evidence of our success indicates that we have offered an effective program with remarkable efficiency. During a planning exercise in Spring, 1999, the Department compared itself with the top 10 NRC-rated public departments in our discipline. We also compared our instructional program with the top 48 departments and discovered that we would need 55-58 faculty based on the size of our instructional program. In another exercise, we took our total SCH production for the year (32,788) and our total faculty and D-line budget + (temporary funds) - (funds removed from faculty lines) and discovered that our cost is $82.62/SCH. That's a remarkable total on a campus where the in-state undergraduate tuition is $92. In a manner of speaking, tuition raised by the courses we teach exceeds the cost of our instructional program and our research program. Even if you add in staff salaries and our operating budget, the cost per SCH is only $88.37.

Turning now to the issue of demand, the SCH data offer clear evidence that there is high demand for instruction in mathematics and statistics. There is also demand for research partners from the mathematical sciences. And there is a growing demand for mathematics faculty to take a greater role in the production of teachers and the improvements of mathematics education in our K-12 schools. Our success can be UNL's success.

Perhaps our most impressive increase since 1994/1995 is our commitment to honors courses. In Fall 2000 we offered 10 honors courses serving 230 students for a total of 954 SCHs of honors instruction. [Note: this averages 4.15 hours per student because of the large number of students in an honors calculus class.] Of these 306 students, 69% are freshmen and only 8% of them indicate that they are math majors. Hence the Department's commitment to superb honors instruction for UNL's brightest freshmen amounts to teaching students from other disciplines and the Department feels the need for recognition and rewards for its contributions in this area.

# Chapter 6

# Faculty Responsibilities

## 6.1 Policies Related to Faculty

The mission of the Department as accepted by the College of Arts & Sciences is described as 45% Research, 45% Teaching and 10% Service. As part of the Department's annual evaluation process there is a further refinement of this mission to 36% Research Productivity/Activity, 9% as a Reward for External Funding, 36% Classroom Teaching, 9% Advising/Non-classroom Teaching and 10% Service.

Historically, both the expectations of faculty and the reward system implied that each faculty member should aspire to the same model where their individual contributions matched the Department's mission. However, over the past 10–15 years, the culture of the Department has changed to a point where there is a more flexible view as to how the faculty can combine their individual efforts to meet the Department's total mission. This change was institutionalized in 1998 with the adoption of the Performance Expectations Document. (The Performance Expectations Document is attached as Appendix D.1.1.)

Currently, the prevailing view of the faculty is that each faculty member is responsible, in consultation with the Chair, for determining how he or she will best contribute to meeting the Department's mission. Each faculty member should, of course, contribute significantly to the Department's instructional mission and should be involved in some form of research or creative activity. At the same time, it is recognized that faculty have different strengths and at different points in their careers may be motivated to contribute to the department in different ways. By adopting a broader view as to how faculty can make valuable contributions, the Department has been able to encourage some faculty to make significant contributions through outreach activities (e.g., NMSI, JUMP), curriculum development, advising, or other service activities (e.g., the placement exam or WebTesting). At the same time, faculty contributions to traditional research in the mathematical sciences have increased both in quality and quantity.

Departmental policies concerning assignments for untenured faculty should be stressed. New assistant professors are hired based on an assessment of their potential for excellence as a research scientist and as a classroom teacher. Also important is an assessment as to whether the new faculty member can be expected to become a good Departmental citizen, eventually assuming their share of service or outreach responsibilities. A Department goal, formerly achieved on a regular basis, is to protect untenured faculty from heavy service responsibilities, and instead urge them to focus on the development of their own research program and on developing their skills as a teacher. Only after they develop in these areas are they asked to become more heavily involved in service activities or instructional activities outside the classroom. Regrettably, the stresses on the Department are so great that such protection of new faculty is frequently impossible.

### 6.1.1 Teaching Loads

The standard teaching load for faculty in the Department is two courses per semester. Most courses are 3-hour courses, but M208 is a four-hour course and M106H and M107H are five-hour courses. The Departmental Chair, Graduate Chair, and Vice-Chair each receive a one course reduction per semester. Teaching assignments are made by the Vice-Chair, under the authority of the Chair.

Large lecture classes typically run close to 125 students, and sometimes as much as 150, and most other undergraduate classes taught by faculty have an average of about 35 students. Even senior level undergraduate classes and

800 level graduate classes often run in sections with more than 25 students, placing substantial time demands on faculty as a result of grading duties and the need for individual consultation with students. Trends toward incorporating lab assignments and projects in undergraduate classes have added to the time demands of a typical course. Because the Department has no permanent source of funds for graders and qualified graders for high level courses are difficult to find, some requests for graders are denied. This has been cited by faculty as an important factor increasing time demands on faculty and limiting their effectiveness as teachers.

Certain courses can require more work than might be expected for a standard assignment. As mentioned earlier, M106H, M107H and M208 can result in a 7 or even 8 hour assignment. Regular sections of M106 and M107 are taught in large lecture sections and include the responsibility to coordinate the work of five graduate teaching assistants who meet smaller recitation sections twice a week. Moreover, the recent changes in calculus instruction have resulted in a substantial increase in the workload for teaching those courses.

Graduate classes can require substantially greater preparation time than most undergraduate classes. On the average, each semester each faculty member is assigned one class that meets one of these special descriptions plus one standard undergraduate class.

The graduate program involves significant informal instructional responsibilities. Many faculty shoulder a substantial role as Ph.D. thesis advisor to one or more graduate students. In addition, there are about ten regularly scheduled seminars in a range of areas: algebraic geometry, applied mathematics, commutative algebra, combinatorics, difference equations, partial differential equations and control theory, numerical analysis, operator algebras, optimization, semigroups, and statistics. These seminars are attended by both faculty and graduate students and are very important to the Department's research and graduate programs.

The Department realizes its responsibility to maximize the productivity of its faculty. A review of the records of the 35 faculty on permanent lines indicates that 30 faculty fit one of the following descriptions: an untenured assistant professor; a recently tenured associate professor whose research was judged superior or excellent at the time of promotion; a full-professor actively involved in research and the graduate program; or a tenured faculty member with substantial involvement in outreach activities that have attracted external funding to UNL. Of the remaining five faculty members, four are heavily involved with major service or outreach responsibilities. Thus, it is the view of the Department that any substantial increase in the instructional responsibilities for current faculty can have only three possible consequences, all of them bad: a lowered quality of instruction as a result of increased demands on an already overextended faculty; the elimination or serious reduction in the Department's involvement in outreach activities; or serious harm to the Department's research and graduate education mission. This last consequence would have the most lasting impact by seriously harming the Department's ability to attract or retain high quality teacher-scholars and would, over time, represent a retreat from UNL's mission as a comprehensive, land grant university.

**Teaching Reductions** In an effort to increase the research productivity, the Department in 1997 instituted a "Release Time for Research" program. This is a competitive program in which faculty members may request a course reduction for a given semester in order to have more time to devote to research. At most two faculty members receive this type of course reduction in a given academic year. The Research Advisory Committee reviews faculty applications for release time under this program and makes a recommendation on the merits of the application to the Chair.

Untenured faculty in their fourth year of service to the University are automatically given a one course teaching reduction in order to ensure maximum opportunity to establish an independent research program prior to the tenure decision.

Occasionally for special reasons a faculty member may receive a one course reduction. Usually such reductions are to allow sufficient time for a faculty member to perform a substantial service or teaching activity on behalf of the Department. For example, the APR coordinator was granted such a reduction this semester.

**Teaching Increases** Despite general faculty opposition for increasing teaching loads on a widespread basis, at times some individual faculty have felt that teaching additional courses might be their best way to contribute to the Department. Indeed, during the past seven years, a few faculty members have on occasion taught three courses per semester. Currently, in accordance with the performance expectations document, one faculty member negotiated an individual performance expectation document which results in a three course teaching assignment for him. It is important to note that these increases in teaching load are not punitive; rather, they are due to the recognition that an increase in teaching load is the best way for the individual faculty member to contribute to the overall mission of the Department.

### 6.1.2 Faculty Evaluation

Faculty members are evaluated each spring for their contributions the previous calendar year in teaching, research, and service. The evaluation is made by the Chair and the Departmental Executive Committee, acting in concert. Generally, rankings are given in equivalence classes rather than in linear ordering. Each faculty member receives a written evaluation and is invited to discuss the evaluation with the Chair. This meeting can result in adjustments to the evaluation.

The evaluation categories and their weights in the evaluation process are described in detail in Appendix D.1.2. Briefly, research is evaluated according to: papers published or accepted for publication; external support held, with some but less weight given to submissions of proposals for support; and other research activities such as journal submissions, talks given, and graduate students directed.

To evaluate classroom teaching, the Executive Committee examines student teaching evaluations, and in particular, Question 8 on the Departmental teaching evaluation form, which asks "What is the overall quality of instruction in this course?" (The complete teaching evaluation form can be found in Appendix D.5). Other factors considered on an ad hoc basis include teaching awards received, or student compliments or complaints made to the Chair or Vice-Chair. Non-classroom teaching and advising is also evaluated for quality and quantity. This category includes advising duties, of course, as well as course development and outreach activities.

Service is evaluated by both its quantity and quality. Traditionally, service includes efforts to benefit the Department, University and the larger mathematical and academic community. Thus service includes the administrative work done by the Vice-Chair and graduate program chair, the student advising carried on by the undergraduate student advisor and others, committee assignments at all levels, editorial work and reviewing, and other participation in the international mathematical community. More recently, outreach efforts expended on programs such as Math Day, All Girls/All Math, JUMP and NMSI has increased greatly and has been evaluated under this category. A list of the current Departmental committees is contained in Appendix D.3.

#### Performance Expectation Statement

In 1997 the University required all departments on campus to adopt a performance expectation statement tailored to the needs of the individual department. The Department's Performance Expectation Statement was adopted following significant faculty input and discussion. It appears in this self-study as Appendix D.1.1.

### 6.1.3 Reward Structure

Faculty raises in the Department are merit based, subject to constraints handed down from higher administration. The amount of a merit increase correlates with a faculty member's evaluation. It is determined by the Chair in consultation with the Executive Committee.

Each year, the University administration allows each college to increase its salary base by a percentage amount based upon appropriation by the State Legislature. The College in turn allows each department a (smaller) percent increase in department salary base. This results in a fixed number of dollars to be distributed among the Department faculty. The Executive Committee of the Department divides the money using both percentage amounts and fixed amounts. Younger faculty typically benefit most from fixed amounts, while senior faculty, who have higher salaries, benefit more from percentage raises. Some more senior faculty object to this system.

Certain jobs within the Department are very demanding: Chair, Vice Chair, Graduate Chair, Chief Undergraduate Advisor, and Director of the Division of Statistics are among the most notable examples. Appropriately, the greatest rewards are given to faculty who are most active in research. With active research programs and increasing demands for service, faculty find it difficult to undertake the types of demanding tasks listed above. Indeed faculty feel that undertaking such a task is likely to harm their research program and hence potentially reduce the rewards received. Thus the Department needs methods to more effectively reward those who take such jobs.

it becomes more difficult to find faculty willing to undertake

### 6.1.4 Promotion Policies

**Full Professor.** Each fall, one third of all associate professors are asked to update their vitae for the purpose of assessing the progress of each associate professor towards promotion to full professor. This is done on a rotating basis, so that at least every third year, each associate professor receives information about progress towards promotion. These

vitae are then circulated to the Committee of Full Professors (CFP) who, in a later meeting, can vote to request that an associate professor complete a promotion file.

During the fall semester, every associate professor also has the right to request consideration for promotion to full professor. Should this occur, the associate professor prepares a promotion file for review.

In either case, completion of a file involves the Chair soliciting external letters from (usually ten to twelve) peer reviewers regarding the quality of the candidate's research, and the candidate in conjunction with the Chair preparing other materials which will be helpful in the promotion decision. Typically, such additional materials include a teaching portfolio and a service portfolio.

The CFP meets in December for a final vote. The main criterion for promotion to full professor is the accumulation of a substantial body of work (usually research work, but also possibly scholarly work on educational issues).

**Associate Professor and Tenure.** Promotion to Associate Professor is usually considered at the time a tenure decision is made – i.e., during the sixth year of service to the University. The primary criteria are the establishment of an independent, visible research program and very good teaching, with service work carrying much less weight in the tenure decision. Indeed, young faculty are encouraged to concentrate on developing their research and teaching. In 1999 the Department introduced a policy of providing a course reduction for untenured faculty during their 4th year of service. This reduction has been a great benefit to untenured faculty in establishing independent research programs.

At the Departmental level, decisions regarding promotion to associate professor and tenure are made by a committee consisting of all associate and full professors.

### 6.1.5 Recruitment and Retention

When hiring has been authorized, the Department has generally had very good success in recruiting quality faculty since 1994. In most cases, new hires are at the Assistant Professor level. However, in 2000, the Department was able to hire George Avalos as an Associate Professor with tenure. Indeed, the Department is particularly pleased with the quality of the faculty hired in the last five years. Currently the Department has a search in statistics which will hopefully result in two new hires at the level of Professor with tenure.

From 1994 to 2000 the Department hired 9 faculty, listed here by division, name, level and date of hire.
Mathematics: Judy L. Walker (Asst. Prof., 1996); Mark E. Walker (Asst. Prof., 1998); Allan P. Donsig (Asst. Prof., 1997); Susan Hermiller (Asst. Prof., 1998); George Avalos (Assoc. Prof., 2000); Mark Brittenham (Asst. Prof., 2000).
Statistics: Daniel S. Nettleton (Asst. Prof., 1996); Trent D. Buskirk (Asst. Prof., 1999); Tapabrata Maiti (Asst. Prof., 1999).

The Department has also seen the loss of 14 faculty from 1994–2000. The faculty lost are:
Mathematics: Joan R. Leitzel (resigned 1996); James R. C. Leitzel (resigned 1996); Gary H. Meisters (retired 1997); Mark Sapir (resigned 1997); Rao Chivukula (retired 1998); Paul Krajkiewicz (died, 1998); Albert W. Zechman (retired 1998); and Melvin C. Thornton (retired 2000).
Statistics: Chris Rodgers (not reappointed 1995); Dong Ho Park (resigned 1995); Kun-Liang Lu (not reappointed 1997); Jian-Jian Ren (resigned 1997); K. Lal Saxena (retired 1997); and Daniel S. Nettleton (resigned 2000).

Both Leitzels resigned when Joan Leitzel was appointed provost at the University of New Hampshire. During her time at UNL, Joan Leitzel was Senior Vice Chancellor of Academic Affairs and later Interim Chancellor and hence was not directly active in departmental affairs; however, James Leitzel was quite active in the Department. Sapir resigned to accept a very attractive unsolicited offer at Vanderbilt University.

In addition to the faculty who have officially retired, about the time that Walter Mientka became the Executive Director of the IMO 2001, he formally gave up his tenure in order that Mark Walker could be hired on Mientka's tenure-track line. Thus, the Department no longer has access to Mientka as part of the teaching faculty although he remains active in the profession.

Jian-Jian Ren left to take a position at Tulane University; a significant factor in her leaving was a desire to live in a location closer to her husband. Dong Ho Park resigned to take a position in his native Korea. Chris Rodgers was not reappointed following his second-year review and Kun-Liang Lu did not receive tenure. Finally, Daniel Nettleton accepted a position in the Statistics Department at Iowa State University.

The Department faces serious pressures in retaining faculty, due to a number of causes.

*Retirement:* Earl Kramer expects to retire in June 2001. Ten current faculty were born in 1945 or before, including seven who were born in 1943 or earlier. It is reasonable to expect that some of this group of ten faculty will retire within the next 5–7 years.

*Salary Pressures:* The data from Figures 9.5 and 9.6 show that current Departmental salaries are lagging behind other UNL departments and UNL's peers. The loss of both Sapir and Nettleton was due, in part, to the outstanding salary offers they received from other institutions. Moreover, in the Spring of 2000 the Department faced the likely loss of Partha Lahiri due to a significant outside offer. Fortunately, in this case the Department received strong support from the Dean's Office and the Office of the Senior Vice Chancellor for Academic Affairs which enabled the Department to make a strong counter-offer that included a significant salary increase and a major University-wide commitment to statistics.

Ideally, the University's current efforts to increase faculty salaries will include substantial assistance in improving salaries within the Department. Without such support, the Department will face increased risk of loss of faculty able to command higher salaries at other institutions. Naturally, the highest performing faculty will be the most mobile, so an inability to raise salaries may lead to the departure of those faculty most difficult to replace.

*Faculty Morale:* Currently Department faculty have reasonably high morale despite a concern that the University continues to ask faculty to do more with less support. The common belief is that budgetary pressures and lack of hiring have resulted in significant increases in faculty workloads. In addition, faculty strongly believe that the Department is exemplary and undertakes activities which bring positive attention to the University. However, there is a growing perception among the faculty that the Department has not been rewarded with additional resources (especially faculty lines) at a level commensurate with its performance. Should workloads continue to increase and rewards remain at their current levels, faculty burnout is likely. Such a scenario makes it difficult to retain faculty.

In the late 1980s the Chair indicated that the department would attempt to build strong groups in applied mathematics, with an emphasis on ODEs and PDEs, and in commutative algebra and algebraic geometry. The Department would, however, also support outstanding faculty in other areas, with hires based on the achievement of the most outstanding faculty. In 1996 the Chair appointed a Hiring Directions Committee under the direction of Professor John Meakin and charged the committee with preparing a hiring plan. The resulting hiring plan (see Appendix D.4) added focused research groups in statistics and two other areas of mathematics in addition to the ones identified above. The plan served the department well as long as there was an expectation of regular hiring opportunities. Unfortunately, recent budget constraints have made it more difficult for the College to authorize additional hires in mathematics and this has added to the stress felt by the faculty. Regular support for new hires and salary increases is essential to maintain faculty workloads at reasonable levels, and to replace faculty losses due to resignations and retirements.

## 6.2 Faculty Responsibilities

### 6.2.1 Research

The National Research Council ranks mathematics departments on a 0-5 point scale (with 5 high) and using this ranking, the American Mathematical Society groups Ph.D. granting mathematics departments into three groups: Group I consists of departments with ranking in the 3.00–5.00 range (there are presently 48 Group I departments), Group II consists of departments in the 2.00–2.99 range (Group II has 56 departments) and Group III contains the remaining 73 departments. The Department of Mathematics and Statistics currently belongs to Group II.

#### Research Groups and Research Productivity

**Research Groups** The Department is organized into three large research groups: Algebra and Discrete Mathematics, Pure and Applied Analysis, and Statistics. Within these groups are the following subgroups.

*Algebra and Discrete Mathematics:* Bioinformatics, Commutative Algebra & Algebraic Geometry, Topology, Coding Theory, Combinatorics & Discrete Mathematics, and Geometric Group Theory/Semigroup Theory.

*Pure and Applied Analysis:* Functional Integration, Operator Algebras, Partial Differential Equations & Control Theory, Classical Harmonic Analysis, Dynamical Systems, Mathematical Modeling & Numerical Methods, and Ordinary Differential & Difference Equations.

*Statistics:* Survey Sampling, Bayesian Statistics, Biostatistics.

**Research Productivity** Research activity is expected from all faculty members of the Department and is a major consideration in promotion, tenure, and salary decisions. The Department maintains a strong program of weekly seminars in several research fields, and most of the faculty are actively involved in at least one of these seminar activities. Also, most faculty members have significant research activity in other areas, such as giving lectures at conferences or other mathematics departments, and sponsoring research visitors.

However, the most important research responsibility is to publish; Figure 6.2 shows, for each of the years 1994 through 2000, the number of current (i.e., Fall 2000) faculty members who were on staff in each of those years, the number of these with a publication each of those years, the total number of publications which appeared each of those years, and the ratio of papers per person. For each year, it includes publications of all current faculty, whether they were on our faculty at that time or not, because this is the best way to assess the current faculty. Of course, it does not include faculty who were on our faculty previously but have left. The last row gives data on papers that are currently accepted for publication but have not yet been published.

Figure 6.2, while as accurate as possible, does not include all papers which will be published officially in 2000. In order to give data through 2000, the partial data available for the year 2000 was included. A computation of the Departmental publications per faculty member per year, using the six-year period 1994–2000 appears in Figure 6.1 and shows that the Department's rate is up dramatically from the rates reported in previous APRs.

| APR Year | 83–87 | 88–92 | 94–00 |
|---|---|---|---|
| Pubs./fac./yr. | 0.75 | 1.25 | 1.74 |

*Note:* The 2000 rate uses the seven year period 1994–2000.

Figure 6.1: Changes in Reported Publications/faculty/year, 1983–2000 APRs

Figure 6.3 provides a different measure of the research productivity of current Departmental faculty. The first table in Figure 6.3 separates faculty members into categories based on the number of papers which have either appeared *or* been accepted in the period 1994–2000. The second table gives the corresponding data for the period 1998–2000. Note that only 2 faculty members (just 5.7% of all faculty) have had fewer than 4 papers either appear or be accepted since 1994. In the past 3 years, 19 faculty members (over 54%) have had at least 7 papers appear or be accepted for publication. Four faculty members have had a remarkable total of over 15 such papers in the last three years.

For purposes of comparison, Figure 6.4 compares the research production per faculty member over the period 1994–2000 of the Department with other mathematics departments at peer institutions. The following methodology was used to construct this table. A list of faculty in the Department of Mathematics was obtained from the department's web site or from other sources. MathSciNet was used to determine the number of publications for that faculty member which appeared in print between 1994 and 2000. There would be an obvious undercount for publications not reviewed by Math Reviews. This undercount would occur most frequently for statisticians, applied mathematicians or faculty who publish pedagogical articles. Other undercounts occurred for faculty whose articles appear in a proceedings publication or for some 1999 or 2000 articles not yet listed in MathSciNet. JASA was a notable example of the latter. The undercount is apparent when one compares the 7 year average of 12.15 (total publications for entire faculty divided by 35 faculty) for UNL arising from Table 6.2 with the UNL 7 year average of 9.7 appearing in Table 6.4.

On a publication per faculty member per year basis, the highest publication rate (Iowa) is 1.79=12.5/7yrs publications per year, compared with UNL's rate of 1.38=9.7/7yrs. All but 2 of 17 institutions have a rate above 1.00 publications per year.

Figure 6.4 indicates clearly that UNL compares favorably with its peer institutions in terms of faculty publication rate. A publication rate of 9.7 publications per faculty during this period places UNL much closer to the top (12.4) than to the bottom (3.4) of this list. Indeed, all of the schools ahead of UNL in this list, except for Iowa, Missouri and Auburn, are Group I Institutions.

*Lectures Given:* Department faculty are active in giving lectures on research at conferences and other institutions. An examination of faculty vita shows that during the period 1994-2000, departmental faculty gave approximately 676 such talks, which averages about 21 talks per faculty member during that time.

*Ph.D. Production:* Another measure of research productivity is the number of Ph.D. degrees awarded by the Department since and including 1994. The Department has awarded 57 Ph.D. degrees in the calendar years 1994–2000.

| Year | Number of Faculty | Number Published | Number of Publications | Per Capita |
|---|---|---|---|---|
| 1994 | 30 | 23 | 58 | 1.93 |
| 1995 | 31 | 27 | 66 | 2.13 |
| 1996 | 34 | 24 | 57 | 1.68 |
| 1997 | 34 | 27 | 56 | 1.65 |
| 1998 | 34 | 24 | 62 | 1.82 |
| 1999 | 35 | 27 | 54 | 1.54 |
| 2000 | 35 | 20 | 49 | 1.40 |
| Accepted | 35 | 27 | 86 | 2.46 |

Figure 6.2: Publication Data for Current Faculty, (1994–2000)
*Source:* Departmental records from annual evaluations.
*Note*: A current faculty member is included in the data for a given year (whether or not the faculty member was on the UNL faculty at the time) if and only if the faculty member had their Ph.D. for at least part of that year.

| Number of Papers | Number of Faculty |
|---|---|
| 0–3 | 2 |
| 4–6 | 4 |
| 7–9 | 6 |
| 10–14 | 11 |
| $\geq 15$ | 12 |

1994–2000

| Number of Papers | Number of Faculty |
|---|---|
| 0–3 | 9 |
| 4–6 | 7 |
| 7–9 | 11 |
| 10–14 | 4 |
| $\geq 15$ | 4 |

1998–2000

Figure 6.3: Numbers of Papers Which Have Either Appeared or Been Accepted for Publication of Current Faculty

| *Board of Regents Peer Institution* | *Publication Rate* | *Approx. 2000 Faculty Size* | *Coord. Comm. Peer Institution* |
|---|---|---|---|
| Iowa | 12.5 | 48 | |
| Illinois | 12.4 | 80 | |
| Missouri | 11.8 | 43 | Missouri |
| Purdue | 10.9 | 69 | Purdue |
| Minnesota | 10.8 | 69 | |
| Ohio State | 10.4 | 129 | |
| | 10.1 | 57 | Auburn |
| **UNL** | **9.7** | **35** | **UNL** |
| | 9.5 | 31 | Kansas State |
| Iowa State | 8.9 | 50 | Iowa State |
| | 8.5 | 46 | Tennessee |
| | 8.2 | 39 | Georgia |
| Colorado | 7.9 | 45 | Colorado |
| Kansas | 7.6 | 38 | Kansas |
| | 7.4 | 41 | Louisiana State |
| | 4.8 | 41 | Oklahoma State |
| Colorado State | 3.4 | 39 | Colorado State |

*Note:* Data for Colorado includes both Math and Applied Math; other data is for Math Departments only.

Figure 6.4: Number of Publications per Regular Faculty for 1994–2000, peer group.
Source: MathSciNet data base

| *Calendar Year* | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|
| *Ph.D.s Awarded* | 7 | 7 | 7 | 13 | 4 | 8 | 8 |

Figure 6.5: Ph.D.s Awarded by Calendar Year, 1994–2000

Table 10.10 gives a listing of all Ph.D.s awarded during this time, together with placement, advisor and thesis title. Figure 6.5 provides summary data. (Note that the figures differ somewhat from those in Figure 10.1 below because there the data is fiscal year data.)

During the period AY1994/5–AY1999/00, the Department awarded 51 Ph.D. degrees. Here the Department compares extremely favorably with other institutions. According to data collected by the American Mathematical Society, during this time period the Department ranks second in average annual Ph.D. production among all Group II institutions, and if the Department was a Group I institution, would rank 26th of 49 in Group I. Overall Ph.D. granting institutions, UNL ranks 27 of 177 in average number of Ph.D. degrees awarded annually. As noted above, the Department is smaller than many of its peers, so on a ranking of Ph.D.s per faculty member per year, the Department would rank even higher.

Figure 6.6 shows a summary of the Ph.D. production of various institutions.

**PH.D. PRODUCTION SINCE 1994, SORTED BY GROUP**

| | | 94-95 | 95-96 | 96-97 | 97-98 | 98-99 | 99-00 | Avg |
|---|---|---|---|---|---|---|---|---|
| | U Cal-Berkeley | 40 | 31 | 26 | 22 | 27 | 25 | 28.5 |
| | U Wisc-Madison | 29 | 21 | 21 | 26 | 21 | 10 | 21.3 |
| | U Cal-LA | 24 | 29 | 16 | 21 | 17 | 18 | 20.8 |
| | U Maryland-CP | 18 | 19 | 18 | 27 | 25 | 17 | 20.7 |
| | Mass Inst Tech | 22 | 23 | 21 | 23 | 15 | 16 | 20.0 |
| | **U Illinois-Urbana** | 19 | 19 | 17 | 16 | 17 | 19 | 17.8 |
| **TOP** | U Mich | 21 | 13 | 15 | 19 | 17 | 16 | 16.8 |
| **25** | **Ohio St U** | 9 | 25 | 20 | 13 | 16 | 12 | 15.8 |
| **IN** | NYU - Courant Inst | 19 | 14 | 14 | 14 | 12 | 21 | 15.7 |
| **GROUP** | U Chicago | 14 | 12 | 10 | 18 | 14 | 20 | 14.7 |
| **1** | **U Minn** | 16 | 16 | 11 | 14 | 11 | 16 | 14.0 |
| | **Purdue U** | 11 | 21 | 15 | 11 | 14 | 8 | 13.3 |
| | Rutgers U-NB | 21 | 12 | 14 | 11 | 9 | 11 | 13.0 |
| | U Illinois-Chicago | 11 | 12 | 14 | 11 | 12 | 12 | 12.0 |
| | Harvard U | 10 | 7 | 13 | 14 | 15 | 9 | 11.3 |
| | Princeton U | 9 | | 21 | 6 | | 9 | 11.3 |
| | U Texas-Austin | 10 | 10 | 15 | 13 | 9 | 7 | 10.7 |
| | Mich St U | 7 | 16 | 10 | 11 | 12 | 5 | 10.2 |
| | U Cal-San Diego | 10 | 8 | 7 | 10 | 11 | 13 | 9.8 |
| | Stanford U | 16 | 9 | 11 | 8 | 4 | | 9.6 |
| | SUNY-Stony Brk | 10 | 10 | 10 | 13 | 8 | 5 | 9.3 |
| | Penn St U | 12 | 13 | 9 | 5 | 6 | 10 | 9.2 |
| | CUNY-Grad Ctr | 9 | 7 | 10 | 9 | 5 | 12 | 8.7 |
| | Indiana U-Bloom | 5 | 4 | 8 | 12 | 9 | 11 | 8.2 |
| | Cornell U | 7 | 6 | 5 | 10 | 12 | 8 | 8.0 |
| **AVERAGE OF TOP 25 (GROUP 1)** | | 15.2 | 14.9 | 14.0 | 14.3 | 13.3 | 12.9 | 14.0 |
| **AVERAGE OF NEXT 23 (GROUP 1)** | | 5.8 | 6.2 | 5.8 | 5.4 | 5.5 | 4.5 | 5.5 |
| **TOP** | **U Iowa** | 15 | 10 | 8 | 12 | 8 | 6 | 9.8 |
| **5** | **U Nebraska-Linc** | 8 | 7 | 8 | 11 | 5 | 8 | 7.8 |
| **IN** | Virg Poly Inst & St U | 13 | 4 | 8 | 7 | 4 | 9 | 7.5 |
| **GROUP** | U Kentucky | 2 | 4 | 10 | 14 | 6 | 9 | 7.5 |
| **2** | Texas A&M U | 7 | 6 | 4 | 13 | 5 | 8 | 7.2 |
| **AVERAGE OF GROUP 2** | | 4.5 | 4.1 | 4.5 | 4.9 | 4.4 | 4.1 | 4.4 |
| **PEERS** | **U Missouri-Columbia** | 0 | 6 | 10 | 5 | 7 | 5 | 5.5 |
| **NOT** | **U Colo-Boulder** | 5 | 3 | 3 | 5 | 9 | 4 | 4.8 |
| **APPEARING** | **Iowa St U** | 5 | 5 | 2 | 4 | 2 | 5 | 3.8 |
| **ABOVE** | **Colo St U** | 2 | 2 | 3 | 2 | 5 | 3 | 2.8 |
| | **U Kansas** | 1 | 2 | 3 | 0 | 1 | 4 | 1.8 |
| **AVERAGE OF GROUP 3** | | 2.0 | 2.0 | 2.1 | 2.1 | 2.0 | 2.6 | 2.0 |

Figure 6.6: Ph.D. Production by Group

**Funding**

Since 1994, 29 faculty members (well over $3/4$ of Departmental faculty) have been supported by externally funded grants or contracts. Figure 6.7 gives a yearly accounting of total external funding credited to the Department since the 1993/94 academic year. Much of the totals in the early years is a result of the Nebraska Math and Science Initiative (NMSI) funding and so a drop in funding occurred when the NMSI grant ended.

| *Year* | *Amount* |
|---|---|
| 93/94 | $2,318,616 |
| 94/95 | $1,340,258 |
| 95/96 | $1,344,935 |
| 96/97 | $1,851,861 |
| 97/98 | $ 698,431 |
| 98/99 | $ 410,644 |
| 99/00 | $ 608,050 |

Figure 6.7: Total External Funding Credited to Department by Year

**Recipient and Source of External Funds:** The details of grant activity for the period 1994–2000 are given below.

*Group Grants:* These grants are for travel, conferences, infrastructure, etc., but not for supplementing summer salary. They are shared by at least 3 members of the faculty.

NSF: Topics in commutative algebra and algebraic geometry
B. Harbourne, T. Marley, R. Wiegand, S. Wiegand
$25,000, 93–96

NSF: Topics in commutative algebra and algebraic geometry
B. Harbourne, D. Jaffe, T. Marley, M. Walker, R. Wiegand, S. Wiegand
$30,010, 96–99

NSF: Topics in commutative algebra and algebraic geometry
B. Harbourne, T. Marley, J. Walker, M. Walker, R. Wiegand, S. Wiegand
$45,936, 00–03

NSF: Nebraska Conference for Undergraduate Women in Mathematics
A. Donsig, S. Hermiller, L. Orlandi-Korner, R. Rebarber, J. Walker
$45,000, 01–04

NSA: Nebraska Conference for Undergraduate Women in Mathematics
A. Donsig, S. Hermiller, L. Orlandi-Korner, R. Rebarber, J. Walker
$25,000, 01

NSF: Conference on Geometric and Combinatorial Methods in Group Theory and Semigroup Theory
S. Hermiller, J. Meakin and M. Sapir
$10,000, 00

AMS: Epsilon Grant for All Girls/All Math Summer Camp
G. Hines and J. Walker
$5,000, 00

MAA: Tensor Grant for Women In Mathematics In Nebraska
G. Hines and J. Walker
$10,000, 97–00

NSF: Conference on Algorithmic Problems in Groups and Semigroups
J. Meakin and others
$10,000, 98

NSF: CBMS Grant for Research Conference on Mathematical Control Theory of Coupled Systems of PDEs
R. Rebarber

$27,708, 99
NSF: Presidential Award for Excellence in Science, Mathematics,
and Engineering Mentoring
J. Walker (and the Department)
$10,000, 98–00

*Individual Grants:*

G. Avalos NSF: $83,000, 99-02
NSF: $18,00, 97–98 (Texas Tech)
NATO: $5,500, 97(with Weiss)(Texas Tech)
NSF: $25,00, 93–95(Texas Tech)

M. Brittenham NSF: $34,400, 92–94 (U. Texas as Austin)
NSF: $53,800, 94–97 (U. Texas as Austin)
NSF: $66,123, 97–00 (U. North Texas)

S. Cohn NSF/EPSCOR: $98,299, 93–98
NSF: $75,000, 97–99(with J.D. Logan)

B. Deng NSF: $67,000, 94–97

S. Dunbar NSF-DUE: $946,394, 96–01 (with B. Fuller et al.)
NSF-DUE: $50,000, 94–95 (with B. Fuller et al.)
EG&G Idaho, INEL: $14,498, 93–94

L. Erbe NSF: $116,000, 00–03(with A. Peterson)
NSERC(Canada): $132,000, 93–98

S. Hermiller NSF: $74,680, 00–03
NSF, NSA, MSRI: $108,516, 93–00 (MSRI, U.Melbourne)

G. Hines NSF: $18,000, 94–95

D. Jaffe NSF: $30,000, 96–98
NSF: $55,669, 98–01

E. Kramer NSA: $104,998, 93–95 (with S.S. Magliveras and D.R. Stinson)
NSA: $56,078, 95–96 (with S.S. Magliveras and D.R. Stinson)
NSA: $40,009, 96–97 (with S.S. Magliveras and D.R. Stinson)

P. Lahiri NSF: $75,310, 99–01
NSF: $65,114, 97–00
NSF: $63,779, 95–98
NSF: $12,700, 95–97
NSF: $55,043, 92–95
NSF: $6,250, 93–95
NCHS: $24,933, 98–99
NDHHS: $701,408, 97–00 (with D. Johnson)
USPS,NCHS,Gallup: $27,000, 99
Gallup, et al: $40,000, 97
USBLS: $19,842,92–94

| | |
|---|---|
| G. Ledder | NWRI: $57,040, 94–96 (with Geology and Civil Engineering) |
| W.J. Lewis | NSF: $199,911, 00–02 (with R. Heaton and P. Fisher)<br>USDE: $228,689, 97–00<br>Eisenhower Program: $50,884, 95<br>Howard Hughes Medical Institute: $1,000,000, 94–97(with T.J. Morris, et al)<br>NSF: $10,000,000, 91–98 (with D.Miller, M.Thornton, et al) |
| J.D. Logan | NSF: $75,000, 97–00 (with S. Cohn) |
| T. Maiti | Gallup: $5,000, 99–00<br>ASA/NSF/Census Bureau: $104,248, 01<br>NSF: $30,000, 00<br>NSF: $44,062, 00-03 |
| J. Meakin | NSF: $73,440, 99–02 (with Birget, Margolis and Sapir)<br>NSF: $116,619, 96–98 (with S.W. Margolis, M.V. Sapir, J.C. Birget)<br>GEOMETRY CENTER: $22,152, 94–95(with S.W. Margolis, M.V. Sapir, J.C. Birget)<br>NSF: $218,500, 92–94(with S.W. Margolis, M.V. Sapir, J.C. Birget) |
| W. Mientka | ONR: $431,521, 94–01<br>ARO: $84,309, 94–98<br>USDE: $379,856, 98–01<br>NSA: $250,000, 97–01<br>NSF: $450,000, 99–01<br>Wolfram Research: $270,000<br>Texas Inst.: $250,000, 99–01<br>Matilda Wilson Foundation: $25,000, 96–98 |
| J. Orr | John Wiley & Sons: $171,100, 97–00<br>NSF: 120,000, 95–98(with D. Pitts)<br>NSF: 106,260, 92–95(with D. Pitts) |
| A. Peterson | NSF: $116,000, 00–03 (with Lynn Erbe) |
| D. Pitts | NSF: 120,000, 95–98(with J. Orr)<br>NSF: 106,260, 92–95(with J. Orr) |
| A.J. Radcliffe | NSF: $48,618, 94–97 |
| R. Rebarber | NSF: $78,249, 92–95<br>NSF: $50,193, 96–98<br>NATO: $12,354, 95–98 (with Townley et al.) |
| J. Walker | NSF: $77,736, 00–03<br>NSF: $18,000, 97–00<br>AMS (Travel): $1,000, 00<br>AWM (Travel): $750, 00 |
| M. Walker | NSA: $26,000, 00–01<br>NSF (Postdoctoral): $66,000, 96–99<br>AMS (Travel): $1,000, 00 |
| R. Wiegand | NSF: $42,000, 94–97 |

NSF: $59,084, 98–00

S. Wiegand NSA: $25,654, 96–98

*National Science Foundation Investment from 1990–2000:* UNL ranks 77th out of all 104 Group I and II institutions in terms of total NSF/DMS investment dollars. When comparing with Group II institutions only, UNL is ranked 29th out of all 56 Group II institutions in terms of total NSF/DMS dollars received.

For comparison purposes, Figure 6.8 shows NSF/DMS annual funding rates for each of the Board of Regents Peer institution and the Nebraska Coordinating Commission for Postsecondary Education Peer institutions for the period 1994–2000. This information was obtained from a database kept at the NSF Division of Mathematical Sciences. The dollars given in column one represent all grants from DMS to the entire institution. Thus, included in the totals may be grants to faculty in other departments such as Statistics or Computer Science. For this reason, we have included both mathematics and statistics faculty in this table in computing faculty size.

In terms of funding, the table shows that UNL ranks near the median in its combined peer group. Clearly, however, UNL ranks close to the bottom in terms of total funding.

| *Board of Regents Peer Institution* | *Avg. Annual Funding* | *Faculty Size (incl. Stats.)* | *Avg. Funding per Faculty* | *Coord. Comm. Peer Institution* |
|---|---|---|---|---|
| Minnesota | 2245.5 | 90 | 24.9 | |
| Illinois | 1876 | 93 | 20.2 | |
| Colorado | 746.9 | 45 | 16.6 | Colorado |
| Purdue | 1394.3 | 91 | 15.3 | Purdue |
| | 490.3 | 57 | 8.6 | Georgia |
| Kansas | 319.8 | 38 | 8.4 | Kansas |
| Iowa | 568.2 | 69 | 8.2 | |
| Missouri | 440.2 | 55 | 8.0 | Missouri |
| **UNL** | **227.3** | **35** | **6.5** | **UNL** |
| Ohio State | 854.6 | 152 | 5.6 | |
| | 287.3 | 53 | 5.4 | Oklahoma State |
| | 288.1 | 58 | 5.0 | Tennessee |
| | 197.3 | 43 | 4.6 | Kansas State |
| Colorado State | 261 | 58 | 4.5 | Colorado State |
| | 169.6 | 57 | 3.0 | Auburn |
| Iowa State | 159.1 | 101 | 1.6 | Iowa State |
| | 42.3 | 41 | 1.0 | Louisiana State |

Figure 6.8: 1994–2000 NSF-DMS Institutional Investment Per Faculty Per Year (In thousands of dollars, peer group)
Note: Data for Colorado includes Applied Math.
Source: Bernie McDonald, National Science Foundation

**Internal Research Support**

A number of sources of internal funds are available.

**The UNL Research Council:** Until 1999, the most comprehensive was the Research Council, which provides money for which all UNL faculty members may compete. Presently, due to a changes in the Office of Vice Chancellor for Research, the Research Council is undergoing significant changes, and it is unclear what form the Research Council will have once the situation stabilizes. Figure 6.9 shows changes in the Research Council budget in the years 1994–2000 for the various programs described below.

The Research Council currently has a single deadline (this year the deadline was October 31, 2000) for applications for most Research Council programs. An active program of visiting scholars who give colloquia, seminars and

| Fiscal Year | Budget Available as per OSP | Fellowship/Seed Grants | Grants-In-Aid/Grants | Visiting Scholar | Symposium/ Dist. Lect. | Travel to Funding |
|---|---|---|---|---|---|---|
| 1996-1997 | $328,819 | $130,000 | $139,237 | $37,043 | $4,935 | $711 |
| 1997-1998 | $313,503 | $130,000 | $129,365 | $32,363 | $10,500 | $2,650 |
| 1998-1999 | $475,129 | $195,000 | $196,735 | $42,159 | $5,995 | $13,710 |
| 1999-2000 | $198,490 | $114,837 | $67,519 | $7,317 | $10,005 | $1,101 |
| 2000-2001 | $235,515 | $126,300 | $84,928 | $12,081 | $11,675 | $0 |

Figure 6.9: Research Council Budget, 1996–2000

discuss current research with Department faculty is essential to sustain Departmental research. Although many visitors have been funded through the Council, some faculty members feel that the applications are too much trouble. In particular, the Research Council now has a single deadline in October for visiting scholar applications, so that one must apply up to 12 months in advance for visitors. Visits are often difficult to arrange a year in advance. Furthermore, this policy means that Council funds cannot be used for sudden opportunities for visitors, such as when a faculty member would like to bring to Nebraska a distinguished lecturer from the Far East or from Europe who happens to be in the US on other business.

Several years ago, the Department started to take advantage of the Research Council Grant-in-Aid program. Several requests for microcomputers (funded at approximately $2500 each) have been funded. Other requests, including at least one for ancillary equipment (at about $300), have also been funded. It must be noted that in almost every case the Department has had to supplement the Research Council grant, usually by hundreds of dollars. Nonetheless, the Research Council Grant-in-Aid program has been invaluable in obtaining individual faculty computer equipment. The current policy is to fund computer equipment via other means.

The Research Council funds applications for the following programs.

*Visiting Research Scholar:* This program supports visiting scholars who are recognized for excellence in their fields and whose research and scholarly activities are closely related to the research interests of the faculty and graduate students at UNL. Each visitor is to give at least one lecture that is open free-of-charge and advertised to the entire University community.

*Symposia/Distinguished Lecturer:* The Research Council annually supports outstanding invited scholars who will give symposia or colloquia that should be of interest to a large interdisciplinary segment of the university community.

*Travel to Funding Agencies* This program is for the purpose of supporting travel requests from potential principal investigators who are seeking research awards from federal funding agencies, primarily those located in Washington, D.C. (The budgetary information indicates that program is in the process of being discontinued.)

*Faculty Seed Grants* Awards will be for projects that promote a faculty member's research program or scholarship and enhance the prospects of obtaining outside, competitive support.

*Grants-In-Aid* Awards will be for projects that promote a faculty member's research program or scholarship which may or may not enhance the prospects for obtaining outside support.

Departmental faculty regularly apply to the Research Council for funds for visiting scholars and the Department typically meets with reasonable success. Usually the Department has five or six requests per funding period. The Department has been able, through returned overhead funds or from its Foundation account, to fund other requests for visiting scholars. Other Research Council programs which the Department has utilized are: the Symposia/Distinguished Lecturer program (which is often used to help defray costs associated with the Rowlee lecture), the grant-in-aid program, and summer fellowships (a discontinued program).

**Funds for Travel:** The Arts and Sciences Dean's office makes available up to $800 annually to each tenure-track faculty member for travel in order to present a lecture at a scholarly meeting or to participate in a meeting the faculty member helped organize. At most $400 may be used for any one trip. A significant source of research support for the Department, this College travel money is straightforward to obtain.

A faculty member who exhausts the Arts & Sciences travel money for a given year may apply to the Department for additional funding for a research trip. This money comes from a variety of sources, but principally indirect costs from grants held by faculty in the Department.

**Leaves:** The University also has a self-funded leave program; leaves funded under this program are called Faculty Development Leaves. Faculty may compete for such leaves following six years of service or six years since a previous FDL. The number of leaves awarded to a department annually depends on the size of the department; the Department currently is authorized to provide 2 or 3 leaves per year, which can be either for full pay for one semester or for half-pay for the academic year. The Department is responsible for making up for the loss in staffing, although the College may return to the Department a portion of the salary of a faculty member on leave.

**New areas of research**

There are now faculty in two areas of research, bioinformatics and topology, not previously represented in the department.

*Bioinformatics:* In October of 1999, one faculty member, David Jaffe, began a complete switch of his research focus from coding theory to bioinformatics. During the Spring 2000 semester, he taught a course in bioinformatics to a wide audience, including computer scientists, engineers, and biologists. He is currently conducting research at the Whitehead Institute at MIT, one of the most prestigious centers for genomics and bioinformatics. Moreover, he expects to receive a 5-year retraining grant from the National Institute of Health. The Department enthusiastically supports Jaffe's efforts in bioinformatics, for upon Jaffe's return, the Department expects to have a major presence in the area.

*Topology:* In 1999, the Department hired Mark Brittenham, a topologist interested in the topology of manifolds. With the addition of Brittenham, the Department fills a long-standing gap in its research program and is better able to meet the needs of its graduate students.

**Nature and Extent of Secondary Support for Research**

The Department has one of the smallest office staffs for a Department its size on the UNL campus, but fortunately, the staff members are very talented and flexible enough to provide reasonable support. Basic needs for research support, such as mailing, duplication, and office supplies are adequate.

The Department's computer technician, Rex Dieter, and his assistants have been most helpful in supporting faculty working with the technical issues surrounding submission of grants using NSF's FastLane system.

Administering grants is ably done by the Department's office supervisor, Mavis Hettenbaugh, in co-ordination with the Research Grants and Contracts Office.

Individual faculty have expressed serious frustration with the lack of assistance in preparing grant proposals. At present, Norm Braaten of UNL's Research Grants and Contracts office provides most of the assistance with grant preparation. More could be done to support Department efforts in this area. In particular, having one of the Departmental administrative assistants prepare budgets "in house" would be extremely helpful in meeting funding agency deadlines.

Recently, the University has encouraged faculty and departments to seek large grants. One promising area for Departmental involvement in a large grant is NSF's Grants for Vertical Integration and Research in the Mathematical Sciences (VIGRE) program. Presently, the Department does not have the infrastructure support to administer and manage such a large grant. Nevertheless, the Department plans to prepare a proposal for a VIGRE grant; however, there is concern that the lack of support staff may make the Department's application less competitive.

Support for grants in education is now available from the Center for Science, Math, and Computer Education. Initially, financing for this support came from the grant which initiated the Center; however, its success led to permanent financing.

### 6.2.2 Teaching

The Department regards its teaching responsibilities seriously—so much so that demonstrated good teaching is essential for an untenured faculty member to obtain tenure. Indeed, in the past decade, at least two untenured faculty members were not reappointed, in large part because their teaching did not meet Departmental expectations for teaching quality.

| *Year* | *Faculty Member* | *Award* |
|---|---|---|
| 1964 | Lloyd Jackson | College Distinguished Teaching Award |
| | Walter Mientka | College Distinguished Teaching Award |
| 1974 | Dave Skoug | Chancellor's Distinguished Teaching Award |
| 1979 | Jerry Johnson | College Distinguished Teaching Award |
| | Jim Lewis | College Distinguished Teaching Award |
| 1980 | Robert Krueger | College Distinguished Teaching Award |
| 1981 | Tom Shores | College Distinguished Teaching Award |
| 1983 | Allan Peterson | College Distinguished Teaching Award |
| 1984 | Spyros Magliveras | College Distinguished Teaching Award |
| | Mel Thornton | AMACO University Distinguished Teaching Award |
| 1988 | John Meakin | Burlington-Northern Outstanding Teacher-Scholar |
| | Don Miller | College Distinguished Teaching Award |
| 1991 | Steve Dunbar | College Distinguished Teaching Award |
| | Jim Lewis | UNL Teachers College Award for Leadership and Service to Education |
| | David Logan | College Distinguished Teaching Award |
| 1992 | Brian Harbourne | College Distinguished Teaching Award |
| 1993 | Tom Marley | College Distinguished Teaching Award |
| | Mel Thornton | MAA Sectional Distinguished Teaching Award |
| 1994 | Jim Lewis | MAA Sectional Distinguished Teaching Award |
| | John Orr | College Distinguished Teaching Award |
| | Mel Thornton | Outstanding Teacher and Instructional Creativity |
| | Richard Rebarber | College Distinguished Teaching Award |
| | Mel Thornton | Charter Member of Academy of Distinguished Teachers |
| | Jamie Radcliffe | College Distinguished Teaching Award |
| | Tom Shores | MAA Sectional Distinguished Teaching Award |
| 1997 | Steve Dunbar | MAA Sectional Distinguished Teaching Award |
| | David Skoug | MAA Sectional Distinguished Teaching Award |
| | *The Department* | University-wide Departmental Teaching Award |
| 1999 | Dan Nettleton | College Distinguished Teaching Award |
| 2000 | Judy Walker | College Distinguished Teaching Award |
| | Judy Walker | Scholarly Teacher Award |

Figure 6.10: Mathematics & Statistics Faculty Teaching Awards

*Teaching and Mentoring Awards:* The Department's strong commitment to outstanding teaching is visible in the number of awards given to the Department and individual faculty members for outstanding teaching. Table 6.10 gives a list of teaching awards by the Department.

Of the 22 faculty members listed in the table, all but 15 are current Departmental faculty.

Also, note that in 1998, the Department received a University-wide award honoring the entire Department for its outstanding teaching.

Also in 1998, the Department received the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring in recognition of its success in mentoring female graduate students. This was one of only 8 such mentoring awards given nationwide that year, and represents the only time this award has been given to a mathematics department ever. Judy Walker and Jim Lewis traveled to Washington D.C. to receive the award from President Clinton.

*Course Size:* Precalculus courses are taught by GTA's in small sections of about 35 students. The Business Calculus course (Math 104) is taught by faculty in large lecture classes averaging 105 students, but sometimes in addition by a GTA in a small section of about 35, which meet three days per week. Calculus I and II (Math 106 and 107) also meet three days per week in faculty-taught large lectures (averaging about 113 students) with twice-weekly recitation sections (of about 26 students) taught by GTA's. On occasion, Calculus I and II are taught by GTAs in small sections. All courses beyond Calculus II are taught in small classes with a targeted maximum of thirty-five.

| Course | Number of Responses | Excellent (%) | Very Good (%) | Good (%) | Fair (%) | Poor (%) | NR (%) | Avg. |
|---|---|---|---|---|---|---|---|---|
| Precalculus($\leq$ 103) | 651 | 43 | 33 | 16 | 6 | 1 | 0 | 3.12 |
| Service: CBA (Math 104) | 182 | 35 | 35 | 15 | 9 | 4 | 1 | 2.88 |
| Service: Nontech., not CBA | 641 | 34 | 31 | 20 | 9 | 7 | 0 | 2.77 |
| Math 106–107 (Large lecture) | 327 | 25 | 37 | 24 | 9 | 4 | 0 | 2.71 |
| Math 208, 221 and small 106-107 | 152 | 47 | 34 | 13 | 5 | 1 | 1 | 3.21 |
| 300–400 level (math) | 234 | 37 | 38 | 17 | 6 | 2 | 0 | 3.03 |
| 300–400 level (stat) | 116 | 40 | 30 | 22 | 6 | 2 | 1 | 3.01 |
| Honors classes | 112 | 56 | 34 | 7 | 1 | 2 | 0 | 3.42 |
| Graduate classes | 92 | 57 | 35 | 7 | 2 | 0 | 0 | 3.46 |
| All Stat classes | 481 | 33 | 33 | 21 | 9 | 5 | 0 | 2.80 |
| All classes | 2681 | 39 | 34 | 17 | 7 | 3 | 0 | 2.99 |

Figure 6.11: Student Evaluation Form Question 8 Responses, Spring 2000

While the Department generally feels that smaller classes are better for the students and more satisfying to teach, limited resources make large lectures unavoidable, and there is agreement that large lectures in M106 and M107 are being handled fairly successfully. The move to greater utilization of graphing calculators in these courses shows the Department's continuing efforts on behalf of these courses. There is less agreement in the Department about the success of M104 (Business Calculus) under the large lecture format: on the one hand, M104 has large lectures and no recitations, but, on the other, students in M104 tend to be less self-sufficient and less motivated than students in M106. This combination makes M104 much trickier to teach well than M106. Prior to 1986–1987, M104 was, in fact, taught in small sections, but budget cuts forced a move to large lectures. However, M104 would be more challenging to teach than M106 under any circumstances (for the same reasons mentioned above), and the College of Business, for whose benefit mainly the course is run, seems to be satisfied with Departmental handling of M104.

Perhaps the best measure of the Department's success at optimizing its teaching performance under the constraint of its limited resources is student opinion of that performance. Students in Departmental courses seem generally pleased with the instruction they receive. Every semester students are asked to evaluate their instructors by filling out a Departmental teaching evaluation form. On Question 8, "What is your overall impression of the quality of instruction in this course?", the responses for Spring Semester 2000 are summarized in Figure 6.11. The column denoted "Average" is the weighted average of the categories "Excellent" (which counts as 4) down to "Poor" (which counts as 0).

Overall, 73% of the Department's students rate their instruction as very good or excellent, only 3% as poor, and only 10% as less than good. As a whole, Departmental staff are committed to excellent teaching and do a good job in the classroom; there are only two or three who at times perform below expectations.

Responses are also analyzed for various comparison groups. The comparison group "Graduate classes" consists of all responses from students in graduate classes with no undergraduate section. The comparison group "Service: CBA (104)" consists of all responses from students in Math 104 which is primarily a course taught for the College of Business Administration (CBA). The comparison group "Service: Nontech., not CBA" consists of all responses from students in courses for nontechnical majors outside CBA; i.e., M180, M200, M201 and M203.

Based on this, the Department feels that it has an outstanding teaching faculty and, for the most part, that students have a quality experience in mathematics and statistics courses. If greater resources were available, this experience could be even better, and those areas where student satisfaction is least (e.g., large lectures) could be significantly improved.

Of course, the ideal situation would be to have small classes at all levels and forego the large lecture/recitation format. This is clearly impossible, but whereas the Department's use of recitation instructors in M106 and M107 and graders in M104 partially offsets large calculus class sizes, resources to provide graders for upper level classes with sizable enrollments are often not available but would be very desirable. Having graders would increase interaction between students and the instructional staff and thereby increase the quality of instruction, as has been the experience

at other universities. Not only would graders allow much more homework to be collected and thus more feedback to be provided, but it would foster implementing larger writing components in mathematics courses.

### 6.2.3 College Initiatives

The College of Arts and Sciences has supported several initiatives in which the Department has participated.

**Discrete, Experimental and Applied Mathematics** The Discrete, Experimental and Applied Mathematics focus area in the College had its genesis in a proposal submitted in response to Dean Foster's call for proposals for "Areas of Strength" in the fall semester 1995. The area (originally known as DEM - Discrete and Experimental Mathematics) received seed funding during the 1996-97 academic year ($12,000 from the College of Arts and Sciences, and additional seed funding from CCIS, the Department of Mathematics and Statistics and the Department of Computer Science and Engineering). DEM also received seed funding in the 1997-98 academic year ($18,000 from the College, some additional match from Math-Stat and CSE). The group expanded its focus by adding a strong interdisciplinary group of research workers in mathematical modeling during the 1997-98 year and submitted a proposal for designation as an "Area of Strength" in Discrete, Experimental and Applied Mathematics (DEAM) for the 1998-99 academic year. DEAM was provided with $42,500 in college funding during the 1998-99 year and an additional $45,000 in college funds during the current year (1999-2000).

DEAM consists of a quite diverse group of faculty from Math-Stat (the bulk of the membership), CSCE, Chemistry, Geosciences, Chemical Engineering, and Mechanical Engineering, together with five external affiliates from a variety of institutions around the world. The membership changes from year to year and will continue to change if the area continues to receive support. Each year, DEAM has provided broad support for research activities and graduate student recruitment across the spectrum of interests represented by the membership. In addition, DEAM has focussed resources each year on a major activity in one of the areas of interest to the membership. This has resulted in a series of high profile conferences, workshops and focus years/semesters in a variety of different areas. The main activities of DEAM during the past four years, are the following:

*Focus Years/Major Conferences and Workshops* DEAM has sponsored at least four very successful workshops and conferences and has sponsored a focus semester in mathematical modeling. The focus semester served to cement relationships between researchers interested in mathematical modeling in various departments in UNL and to cultivate new professional relationships with key members of this scientific area.

*Visiting Scholars Program* DEAM has sponsored an extremely successful visiting scholar program during the past four years. In addition to the scholars who visited UNL in connection with the conferences and workshops mentioned above, DEAM has supported visits of around 40 or 50 very prominent scholars to this campus.

*External affiliates and links with other institutions:* DEAM has a number of external affiliates who work closely with UNL faculty, serve to facilitate national and international connections between DEAM and similar groups at other institutions, and collaborate directly with UNL faculty in the organization of some of DEAM's activities.

*Graduate Program Support* DEAM has devoted considerable effort (in the form of faculty time and financial resources) to the development of the graduate program at UNL. In particular DEAM has been involved with the *Interdisciplinary IAM master's degree*, and led the effort to organize the *Regional Workshops in the Mathematical Sciences*.

*Other DEAM activities* DEAM has supported many other research activities that have had a significant impact on the national visibility and intellectual climate of our programs at UNL. In particular, DEAM provided partial support for the development of two large software packages here at UNL (the Pythia package and the Clifford package), partially supported conferences and Rowlee lectures.

**Math/Science Education Area of Strength:** One of the first two interdisciplinary areas to be designated as a College of Arts & Sciences Area of Strength was the Math/Science Education Area of Strength (M/S AoS). While there were several excellent education projects in other science disciplines within the College of Arts and Sciences, it is reasonable to say that the designation of this area of strength was due in large part to the work of the Department of Physics and Astronomy in physics education and the work of the Department of Mathematics and Statistics in mathematics education.

The goal of the M/S AoS is to encourage and support the education activities of faculty in the sciences within the College. In order to participate actively as part of the M/S AoS, a department must provide $5,000 in matching funds to support the Area of Strength funds provided by the College. The Chairs of participating Departments then serve on the Steering Committee of the Area of Strength in order that they might work to integrate the work of the M/S AoS with the instructional and outreach efforts of their departments. During most of the M/S AoS's existence, the Chair of the Department has also served as Chair of of the Steering Committee of the M/S AoS.

The College of Arts & Sciences is also a sponsor (along with Teachers College) of the **Center for Science, Mathematics and Computer Education (CSMCE)**. The CSMCE grew out of the Nebraska Math and Science Initiative (NMSI), Nebraska's NSF-funded Statewide Systemic Initiative. The NMSI was active from 1991 to 1998 and attracted $10,000,000 from NSF to support efforts to improve math and science education in Nebraska. In addition, the NMSI received $500,000 from the Nebraska Energy Office, $532,000 from the State's lottery money, and several million dollars in matching funds from school districts in the state which worked together with the NMSI on professional development for teachers. Near the end of the funding for the NMSI, then Chancellor Moeser initiated a campus-wide reallocation. Based on the recommendations of the Deans of A&S and Teachers College, funds were reallocated to fund the CSMCE, providing a permanent infrastructure to support faculty efforts in the important work of improving math and science education in the state. The CSMCE is under the direction of Sandy Scofield, a former State Legislator and Chief of Staff to the Governor, who also served as Director of the NMSI from late 1993 until 1998.

From the beginning, the M/S AoS and the CSMCE have pooled their funds and their efforts to improve mathematics and science education in Nebraska, both at the collegiate level and the K-12 level. Activities that have involved significant numbers of faculty from the Department include a conference on graduate education, a conference on NSF-funded K-12 curriculum projects, an NSF-funded Shaping the Future Conference, a conference to honor Mel Thornton on the occasion of his retirement, All Girls/All Math, Power Math, and UNL-LPS Professional Development Workshops. The M/S AoS annually sponsors a workshop for new TAs in the sciences and funds prominent speakers on education subjects. For example, the M/S AoS funded a joint visit to UNL by Deborah Ball and Hyman Bass. In addition, the CSMCE office has organized the Department's JUnior Mathematics Prognosis (JUMP) Test in recent years and the M/S AoS sponsored a workshop for A&S science faculty who wanted to learn to use John Orr's eGrade software in their own courses.

### 6.2.4 Service and Outreach

The University as a whole, and the Department in particular, have taken on many new worthwhile projects in the past decade in an effort to meet the educational and outreach needs of the State. For example, Math Day, and the Nebraska Mathematics and Science Initiative, were created during this period; moreover, assessment issues have also become more prominent during this time.

The need for faculty to participate in service activities has risen accordingly, but additional resources have not kept pace with demand for outreach and service activities. Thus the service and outreach activities have increased the burden on faculty.

The Department is heavily involved with service and outreach activities. Faculty take pride in the positive regional, national and international attention that these activities bring to the Department and the University. Moreover, faculty willingly undertake service and outreach activities that are seen as providing valuable support for Departmental and University missions.

The faculty service activities described below indicate considerable involvement at all levels within the University and at all levels within the regional and the national communities. With this involvement has come a commitment to the advancement of the profession and a commitment to providing quality efforts to help the Department and University function more effectively.

There is another aspect of Departmental service, however, that is often overlooked. The Department of Mathematics and Statistics serves as a basic resource for the whole university community, both in teaching, in such related programs as the Math Resource Center and the placement exam program, and in consultation in research. Mathematical sciences play a central role in the sciences, business, and engineering, and therefore the Department does an exceptionally large amount of service teaching. Many science and engineering students take more credit hours of mathematics and statistics during their first two years than in any other single area. Further, many Departmental faculty are involved regularly in discussions with faculty in other departments about their research problems, and often find themselves members of masters and Ph.D. committees in the sciences and engineering.

It should be noted, however, that faculty have become increasingly annoyed by the numerous and repetitive

planning exercises mandated by the College and University. The Department feels it does a good job in planning and would like the ability to follow its established plans. As one faculty member put it, "I wish we could be in the 3rd year of a five-year plan, rather than always creating a new five year plan."

Because a large percentage of the Department's undergraduate teaching mission consists of courses taught for students in other disciplines, a case can be made that much of the Department's undergraduate teaching is service to the campus. However, such teaching is described elsewhere; the following paragraphs focus on the major non-teaching service and outreach activities of the Department.

**Conferences Hosted by Department:** The Department has hosted at least 22 conferences (see Figure 6.2.4) on research or teaching since 1994. Notable among these for their combination of outreach and research are the following events.

*Regional Workshop Series:* This series, begun in 1998, is designed to highlight links between four-year colleges in the region and UNL. It spotlights common areas of research and allows for interaction between advanced undergraduates and research faculty. Initially, the conference had approximately 100 participants, it has grown steadily—the Fall 2000 conference had 176 registrants. Much funding for the series has come from the Discrete, Experimental and Applied Mathematics (DEAM) Initiative.

*Annual Conference for Undergraduate Women in Mathematics:* Inaugurated in 1999, this conference series is designed to give outstanding undergraduate women the opportunity to discuss their own research and to meet other women who share their interest in the mathematical sciences. The conference represents a significant national outreach effort, and is now partially supported by NSF and NSA grants. The 1999 conference had 50 outside participants and grew to 75 outside participants in 2000. The 2001 conference has over 100 registrants so far, with the registration deadline still several weeks away.

*Centennial Celebration:* The first mathematics Ph.D. awarded by the University of Nebraska was to Albert Candy in 1898. Upon becoming aware of this fact early in the Fall of 1997, the Department recognized a significant opportunity to have a reunion and symposium in 1998 celebrating the accomplishments of the Department during the past century. The Department had several goals for the Celebration. Among them were: to connect to alumni, former faculty, visitors and other friends; to share with the University and local community Departmental strengths and accomplishments; to learn more about the history of the Department through memories and photographs; and to have a symposium focusing on current areas of strength in the Department.

The Centennial Celebration was attended by more than 200 people, ranging from alumni, faculty, members of the UNL administration, former faculty and staff, local business leaders, high school teachers, and scholars from other colleges and universities.

The Centennial Celebration had a number of components worthy of mention here.

PROGRAM BOOKLET: In addition to a listing of the program, this booklet contains a detailed history of the Department, lists of all current and former faculty, a list of all Ph.D. recipients, descriptions of department awards, photographs and reminiscences. It took a significant effort on the part of many people in the Department to produce this book. A copy of the booklet is available as supplementary materials and is strongly commended to the reader's attention.

PRESENTATIONS: There were 5 featured lectures, 10 special sessions devoted to research talks, teaching issues, and how alumni had used mathematics in their careers, and two panel discussions. In all, there were more than 70 talks.

BANQUET AND OPENING RECEPTION: There was an opening reception at the Sheldon Art Gallery and a banquet at the Cornhusker Hotel the following night. These events were very successful and were instrumental in achieving several of the goals we had for the Centennial Celebration.

DISPLAY AREA: A display area was set up in Burnett Hall to allow participants to view photographs, mathematical displays, obtain refreshments and interact with one another.

The Centennial Celebration was extremely successful event which involved the entire Department in its creation and success.

| | |
|---|---|
| 2001 February | The Third Annual Conference for Undergraduate Women in Mathematics |
| 2000 October | The Third Annual Regional Workshop |
| 2000 June | Conference in Honor of the Retirement of Melvin Thornton |
| 2000 May | International Conference on Geometric Methods in Group Theory and Semigroup Theory |
| 2000 April | Centennial Celebration of Commutative Algebra |
| 2000 February | The Second Annual Conference for Undergraduate Women in Mathematics |
| 1999 November | The Second Annual Regional Workshop |
| 1999 August | NSF-CBMS Regional Research Conference (Control Theory) |
| 1999 March | Symposium on Model Selection, Empirical Bayes and Related Topics |
| 1999 March | Workshop on Mathematical Methods in the Geosciences and Related Areas |
| 1999 March | Nebraska Conference for Undergraduate Women in Mathematics |
| 1999 February | Regional Workshop in Mathematics |
| 1998 June/July | Mathematical Olympiad Training Program |
| 1998 May | Centennial Celebration |
| 1998 May | International Conference in Algorithmic Problems in Groups and Semigroups. |
| 1997 October | Current Topics in Survey Sampling |
| 1997 June/July | Mathematical Olympiad Training Program |
| 1997 June | First Lincoln Workshop in Cryptology and Coding Theory |
| 1997 May | Conference Honoring the Mathematical Work of Gary H. Meisters |
| 1997 April | Workshop on Geometric Group Theory |
| 1997 February | UNL Celebration of Teaching |
| 1996 June/July | Mathematical Olympiad Training Program |
| 1996 March | Nebraska Association of Teachers of Mathematics |
| 1995 October | $24^{\text{th}}$ Midwest Differential Equations Conference |
| 1994 May | Great Plains Operator Theory Symposium |

Figure 6.12: Conferences Hosted by Department, 1994–2000

An average of more than three conferences a year is an unusually high level of activity for a department of this size and places a significant burden on faculty and the Department support staff. Nevertheless, there is strong support for undertaking these activities because of the attention they bring to UNL.

During faculty meetings in preparation for the present self-study, there was broad faculty support for a request for an additional staff person whose duties in part would be an events coordinator. Such duties would include assistance with securing funding for the event, helping with registration, arranging lecture halls, participant lodging, publicity etc. While the Dean's office staff provides some of this kind of support, additional support would be extremely helpful in relieving stress on faculty when planning these activities.

**Howard Rowlee Lecture Series:** In 1996, Howard Rowlee, a Lincoln resident and friend of the Department, made a generous donation to the University of Nebraska Foundation to establish a fund to support research in mathematics. The Department responded by creating the Howard Rowlee Lectures, an annual series that seeks to bring internationally acclaimed scholars in the mathematical sciences to UNL, and by doing so, stimulate mathematical research and bring attention to the Department's research activities.

The lectures are intended for a wide and general audience, including graduate students and faculty from other disciplines, and are to be given by a prominent mathematical scientist for the purpose of highlighting the relevance, challenges and beauty of current mathematical or statistical research. The Rowlee Lecturers and their titles are:

1997: Efim Zelmanov, Yale, "What makes a group infinite?"
1998: Avner Friedman, U. Minnesota, "What is industrial mathematics?"
1999: Bradley Efron, Stanford, "Shakespeare and the case of the suspicious statistician"
2000: Melvin Hochster, U. Michigan, "Why prime numbers are useful."
2001: Vaughan F. R. Jones, Berkeley, "TBA"

Further information on the lecture series, including abstracts of previous lectures, may be found at http://www.math.unl.edu/?area=Rowlee.

Traditionally associated to the Rowlee Lecture is a small workshop or mini-conference, organized around the

general area of the Rowlee Lecturer's research interests.

Support for the Rowlee lectures has come from a variety of sources, including Mr. Rowlee, the Discrete, Experimental and Applied Mathematics program, the UNL Research Council, and the Department.

**American Mathematics Competitions:** This is among the oldest and most widely known of the Department's outreach activities. It sponsors the high school mathematics competition that leads to the selection of the U.S. Math Olympiad Team. More information is available at http://www.unl.edu/amc/.

**Math Day:** Math Day is a large scale annual outreach effort to Nebraska high schools and their students. The first Math Day was held in 1990 with 562 students from 68 schools and was essentially a copy of a similar competition at Colorado State. It has evolved and grown considerably since then. This fall, 1340 students from 99 schools participated. The total number of registered participants in all Math Days is 11,747 students, which corresponds to approximately 5,000 distinct students. Twenty-nine schools have attended all 11 Math Days, almost 200 distinct schools have attended at least one Math Day, and each year new schools participate. The winners of the individual competition are Nebraska's best. Among the previous 10 first place finishers who have now graduated from high school, 2 went to MIT, 1 each to Cal. Tech., Brown, Princeton, and University of Dallas, and 3 came to UNL (one later transferred to MIT). The 1997 winner was Jaclyn (Kohles) Anderson, who is currently an undergraduate math major at UNL and the recipient of this year's Alice T. Shafer prize from the Association for Women in Mathematics for excellence in mathematics by a U.S. woman undergraduate.

The purpose of Math Day is to stimulate interest in Mathematics among Nebraska high school students, to encourage them to pursue mathematics or mathematics based science as a career, to recognize mathematical ability by awarding scholarships, certificates, and trophies. Math Day consists of one individual and two team mathematics competitions, information about majors and departments, career information, and recreational mathematical activities. All students participate in a multiple choice, preliminary exam called PROBE I (Problems Requiring Original and Brilliant Effort). The top 3 males and females on this exam will receive plaques. The top 50 students move on to take the now famous essay exam PROBE II. The top 10 Nebraska high school students on PROBE II are awarded a total of $34,000 in 4-year scholarships to UNL.

The first team competition is based on the scores from PROBE I. It is determined by summing the top 3-5 scores from each school on PROBE I, depending on the school's class. The second team competition is the Math Bowl. It is a double elimination tournament pitting three-member teams against each other. The team competitions are divided into classes (smallest, small, medium, and large schools) with trophies given to the top two teams in each. All the questions assume only two years high school algebra and one year geometry. However the answers to PROBE II questions require the creativity and originality that we expect from only the very best students.

As the day progresses, students have opportunities to participate in mathematical games, puzzles, etc. The UNL Office of Admissions offers campus tours to groups of students and parents. The Department provides the students free lunch in residence hall cafeterias which gives them an opportunity to sample a bit of campus life. While the students are writing the PROBE I exam, there is a presentation or group discussion of interest to the teachers. Thus Math Day provides an excellent opportunity for outreach to high school students and teachers.

Support for Math Day initially came from Department and College funds; recently, the Gallup Organization has also provided support.

Math Day requires the effort of the entire Department (faculty, graduate students, and staff) to make it a success. Approximately 100 people are necessary on the day itself, and about 10 people contribute their time during the month preceding Math Day.

**JUnior Mathematics Prognosis Test (JUMP):** The JUMP Program endeavors to help high school students develop mathematical skills necessary for the successful pursuit of educational and career goals. This outreach program is offered free to Nebraska high school juniors. Last year, 127 schools and 6941 students participated in the JUMP program. Schools initiating a JUMP program find senior level math enrollments increase significantly.

The program conducts the JUMP test, a 45-minute mathematics exam for Nebraska high school students. JUMP offers the test in two versions: TEST A, covering first year algebra and geometry, and TEST B, covering second year algebra, trigonometry, and pre-calculus. Each student who completes the test receives a computer generated letter which reports the student's test score and advises the student toward removing any indicated mathematical

deficiencies. Studies demonstrate that students who participate in the JUMP Test are less likely to require remedial mathematics courses as college freshmen, saving the student time and tuition. Sample exams are available at http://www.math.unl.edu/~jump.

Mathematics instructors may administer the JUMP Test at any time of the year. Completed tests are scored at UNL and returned to the mathematics teacher within a week. JUMP Test scores are strictly confidential, only known to the student and instructor. Participating institutions receive statewide statistics regarding performance on the exam. Such figures are also available at the website listed above.

In the Summer of 1999, JUMP published the third edition of Mathematical Requirements Associated with Academic Programs at Nebraska Post-Secondary Institutions. This book details the mathematics requirements for degree programs at 37 Nebraska universities, colleges, and technical schools. JUMP mailed a copy of the publication to every high school in the state.

Teachers directing the JUMP Program at Nebraska high schools, referred to as JUMP Coordinators, receive support to attend the Nebraska Association of Teachers of Mathematics conferences. JUMP Coordinators are also eligible for scholarships to attend the National Council of Teachers of Mathematics Conference.

**All Girls/All Math:** This Summer Mathematics Camp for High School Girls provides a stimulating and supportive environment for girls to develop their mathematical ability and interest. The program began in 1997 when, with the encouragement of the Nebraska Math and Science Initiative, Wendy Hines and Judy Walker organized the first camp.

Camp participants, girls grades 9-12, attend courses on Chaos and Codes. The girls have the opportunity to work with women mathematics professors and graduate students, and they interact with peers who share an interest in mathematics. They stay in a UNL residence hall and are chaperoned by a female mathematics graduate student.

A typical day at camp includes:

- Challenging mathematics classes each morning and afternoon;
- Problem sessions following each class facilitated by the instructors and a UNL graduate student;
- Evening activities

At the end of the week, a prominent woman mathematician gives a special presentation about Women in Mathematics. Following the presentation, the girls have the opportunity to meet the speaker personally.

All girls attending high school in Nebraska are invited to apply for the camp. Special consideration is given to those entering their sophomore or junior year in the fall and who have successfully completed high school geometry.

Further information is available at http://www.math.unl.edu/ sumcamp/

*It's a Math Thing. . . :* In this related program, high school girls are invited to attend a two-day workshop. At the workshop, girls meet new people from across the state who share an interest in mathematics, learn about new areas in mathematics not encountered in high school and develop problem-solving skills.

The two-day program consists of:

*Subject Area Sessions:* Participants are divided into small groups for 90-minute hands-on sessions. Each will focus on a different topic in mathematics. All participants will have an opportunity to attend each area session.

*Problem Sessions:* Participants are again divided into small groups to work with other students on challenging, yet solvable problems. The girls work towards solving problems, developing written solutions and then finally presenting their solutions.

*Speakers:* Invited speakers address interesting topics within mathematics and participate in a panel discussion on career opportunities in mathematics. Panelists are representatives from Lincoln businesses.

**Power Math:** This is a one week Summer Mathematics Camp for male and female students who have just graduated from the 7th or 8th grades. Thirty students live in the dorms and participate in discovery activities in mathematics during the day. Potential students are targeted by their performance on the American Junior High School Mathematics Exam which is administered by the American Math Competition. It is given to approximately 9,000 Nebraska 7th and 8th graders. Invitations are sent to the top 400 scorers via their math teachers (home addresses are not available). The teachers are also asked to encourage other qualified students to apply. A fairly even mixture of males and females are then selected. The Chief Advisor is the director of the camp. There are two head counselors, one female and one

male senior graduate student. They live with the students and run much of the daily activities. This camp began in the summer of 1999.

Daytime activities are centered around three themes: Problem Solving and Critical Thinking, Statistical Analysis, and Mathematical Modeling and Codes. The director and the head mentors are each responsible for planning and presenting one theme. The presentations are carried out in segments during the week. To help create a comfortable workgroup setting, the students are usually separated according to gender. The evening activities consist mostly of games.

The students pay $55 for room, board, and camp activities. This covers about one-third of the total cost. The remaining support comes from the Departments Mathematics/Science Education Area of Strength fund and the Center for Science, Mathematics, and Computer Education.

**Service to the Profession:** *Refereeing and Reviewing Activities:* As is expected in a research department, most Departmental faculty are active in reviewing grant proposals for external funding agencies and in refereeing research papers for journals devoted to mathematical research. Please see faculty vita for activity in this area.

*Roles in Professional Societies:* Several Department faculty are heavily involved with service to professional societies, such as the MAA or AMS.

**Service within Department:** At the Department level every faculty member serves in some capacity to aid its operation. There is an abundance of day-to-day work, such as course convening and text selection for multiple section courses, to pass around. The faculty is very cooperative in shouldering these tasks. In addition, the Department maintains a heavy service role on things such as the Newsletter (available in the supplementary materials.), conference organization and other outreach activities, each which involves a substantial effort from a number of faculty.

# Chapter 7

# Administration of the Program

The chief administrative officer of the Department is the Chair. The Dean of the College of Arts & Sciences appoints the Chair to a term, typically five years, agreed upon by the Chair and the Dean. The Chair appoints a Vice-Chair and an Undergraduate Advisor. The primary duties of the Vice-Chair deal with the Department's instructional program, including responsibility for creating the Schedule of Classes and determining teaching assignments. The Vice-Chair also serves as Summer Chair and represents the Department in the absence of the Chair. The Undergraduate Advisor has the lead responsibility for the major, including organizing and conducting most of the advising of majors as well as having the lead responsibility for the Department's assessment of the major. The Graduate Chair is appointed by the Dean of the Graduate College upon the recommendation of the Chair of the Department and is responsible for the graduate program.

Prior to this year, the Chair also appointed the Director of the Division of Statistics but in the future, the Director will be appointed by and evaluated by the Dean of the College of Arts and Sciences. The Director of the Division of Statistics is the chief administrative officer for the Division of Statistics. The Dean and the Department's Executive Committee have given their support to the creation of a Division of Statistics that is virtually autonomous with most major decisions effecting statistics being made by faculty in the Division. Details of the relationship between the Division and the Department as a whole will be worked out in Spring 2001.

The Departmental Executive Committee serves as an advisory committee to the Chair. The Committee meets weekly to discuss current issues; it plays an active role in hiring decisions, faculty evaluations, and salary increase recommendations. Its makeup and mission are described in the following guidelines:

> The committee will work in close association with the Chair of the Department in an advisory capacity. The Chair of the Department will be its chair. The responsibilities of the committee will be established not so much by official action as by continued practice. They may include consultation on Departmental policies and personnel, and review of the Departmental budget. Any member of the committee may request the Chair to call a meeting of the committee at any time.
>
> The Executive Committee shall consist of the Chair and the Vice-Chair of the Department, the Director of the Division of Statistics (or designee), and four members to be elected by the professorial faculty of the Department. The Executive Committee shall have at most two elected members from each professorial rank. Eligible for election shall be any member of the professorial faculty of the Department who has been with the Department for at least two years. Terms for elected membership on the executive committee shall be for no more than two consecutive years. Two new members shall be elected each year as early as possible in the fall semester.

Appendix D.3 gives an organizational chart listing the department committees and other major service responsibilities assigned to faculty.

Students are not directly involved in any Departmental program administration or policy making. There is an active Graduate Student Advisory Committee which selects its own members and which serves to communicate issues of importance to graduate students to the Graduate Chair, the Department Chair and the faculty of the Department. At the undergraduate level, the student officers of the Pi Mu Epsilon administer this honorary society.

For over a decade, every search committee in the department has had a graduate student member and interviews with graduate students are a part of every on-campus interview. Graduate students have also served on committees that involve teaching courses involving TA's. For example, graduate students Stephanie Fitchett, Cheryl Olson and Sandeep Holay have had a major role in the effort to revise M103 and M106 (Calculus I) to include graphing calculators.

Three additional faculty committees have significant authority with respect to graduate exams and the reappointment, tenure and promotion of faculty. The Graduate Committee (consisting of all Members and Fellows of the graduate faculty) meet to make decisions as to which students have passed graduate exams and to determine policies for the graduate program. The Tenured and Promoted Faculty meet to discuss the reappointment of untenured faculty and to vote on recommendations for tenure and promotion to Associate Professor. The Committee of Full Professors meets to assess the progress of Associate Professors towards being fully promoted and to vote on promotions to the rank of (Full) Professor.

# Chapter 8

# Continuing Education & Distance Learning

Historically the Department has cooperated with the Division of Continuing Education to offer an evening program of courses, both non-credit and credit bearing. The non-credit bearing courses are courses in plane geometry and intermediate algebra and assist students in removing entrance deficiencies in mathematics. The credit bearing courses are in intermediate algebra, college algebra, trigonometry, precalculus, business calculus, the three-semester calculus sequence and a noncalculus-based statistics course. Enrollment in these courses is often quite heavy with the clientele being a mix of true "evening students" and regular students who have been unable to obtain a section of the corresponding course during the daytime. Students in these courses take the same final exam and students in the corresponding day sections and thus there is evidence that the quality of the instruction is comparable to our regular offerings. A list of the instructors for our evening program is provided in Volume 2 of this Self-Study.

The Department has not offered many courses using distance education techniques but that situation is beginning to change. In Fall 1993, Professor Melvin Thornton did offer a course in Geometry for Elementary School Teachers via two-way audio, one-way video. This course, which was financially supported by the NSF funded Nebraska Math and Science Initiative, served 162 Nebraska teachers at 14 different satellite down-link locations. A semester later Professor David Pitts taught Math 322 using the CORPNET system. Only 2 students took the course from a remote location and no effort was made to repeat the offering.

More recently, in Fall 2000, Professor Partha Lahiri taught a statistics course originating at The Gallup Organization and also serving students in the Joint Program in Survey Methodology at the University of Maryland. Offering this course was connected with our efforts to negotiate to join the JPSM partnership. In Spring 2001, Professor Lahiri will teach a second JPSM course originating from a campus site. If we are successful in joining the Joint Program, Professor Lahiri will move to the College Park headquarters of JPSM and regularly teach distance education courses as part of this program. In addition, UNL students in statistics or survey methodology will have access to a wide range of courses offered by the JPSM program.

Starting in Summer 1999, the Department has been offering two-week workshops for K-12 mathematics teachers on site at a Lincoln Public Schools building. In 1999 there was one workshop, there were two in Summer 2000, and three will be offered in Summer 2001.

In the mid 1990s the College of Arts and Sciences provided financial assistance to Professors John Orr and Mark Sapir to develop courses that could be offered over the web. Sapir developed a matrix theory course that could be taught on the web and used the materials as part of an on campus offering of Math 314H. Orr developed a web version of Math 425-426, a senior/beginning graduate level course in analysis. Sapir accepted an offer from Vanderbilt and has continued to experiment with the use of the web in teaching at Vanderbilt. Orr has never taught a course using his materials but he reports significant "hits" on his web site indicating that persons around the world have found the materials useful.

Professor Orr has also developed a very successful system for using the web to provide student tutorial help, to complete homework assignments, to give practice tests and to give proctored examinations. The system, called eGrade, is currently being marketed by the Wiley Publishing Company as a supplementary resource for their textbooks in calculus and precalculus mathematics. Another company is negotiating to purchase the software from Orr. At UNL our department uses the eGrade system to give "Gateway Exams" in calculus and precalculus (mastery exams over basic computational skills) and to give two exams in Math 203, Contemporary Mathematics.

The Department believes that the eGrade system has enormous potential both to supplement on campus in-

struction and as a tool that supports distance education. Orr and the Department have worked with faculty in other disciplines to adapt eGrade for their use and Orr took the lead in an A& S proposal to the U. N. Foundation which led to the creation of the A& S Testing Center in Burnett Hall. Currently, we estimate that 10,000 undergraduate students will use eGrade in at least one course they take this academic year.

# Part III

# Program Resources

## Part III Overview

The Department has an industrious faculty and support staff, and talented and enthusiastic majors and graduate students. The Department also has a high quality computing environment and an excellent research library located in Oldfather Hall. Much has been achieved by the Department in the past seven years: the Department achieves a high level of research, teaching, outreach, and service activity.

Space is a serious problem as Department facilities are spread across five buildings, some faculty share an office, graduate students in Oldfather are three to an office and other graduate students are housed several blocks from Oldfather. Also, free shelf space in the Department's library has fallen to unworkable levels. Fortunately, a solution for the Department's space problems is at hand, as renovation will begin soon on Avery Hall. Avery will become the Department's new home by the summer of 2003 at the latest.

The Department's most serious problem is that program resources are not adequate to permit the Department to continue to meet the expectations that the University has for the Department. Decreasing faculty size and increased demand for instruction in the mathematical sciences has resulted in the need to hire lecturers to teach courses on a per-course basis. When instructors are hired "by the course" to teach, they cannot be asked to perform service work, hence the service responsibilities of the Department fall on a reduced number of faculty. This has a negative impact on the ability of the faculty to conduct research, and threatens to reduce or eliminate recent gains in research productivity.

The demands on the Department's staff are equally high. Greater utilization of technology has made additional technical support necessary. Clerical demands are greater than current office staff can provide, and the demands on staff increase as the Department becomes more involved with sponsoring research conferences or outreach programs. Far too often the result is that faculty end up performing clerical functions that might normally be done by staff.

# Chapter 9

# Description of Faculty

## 9.1 Faculty Demographics

Figures 9.1, 9.2 and 9.3 present listings by professorial rank of the current faculty of the Department, showing each professor's area of specialization, place and year of Ph.D., full time equivalence (FTE), and graduate faculty status, the latter under the heading 'GFS'. In explanation, faculty at the University of Nebraska who teach graduate classes are expected to be 'members' of the graduate faculty, while those who also direct theses are expected to be 'fellows' of the graduate faculty. To become a member (or fellow, respectively), one first must be nominated by a member (fellow) of the graduate faculty. The candidate's curriculum vita and scholarly writings are circulated among the Departmental members of the graduate faculty, who then vote on the issue, the criterion being scholarly work beyond the candidate's doctoral degree (a somewhat higher level of scholarly work being required for fellow status).

Also, Figure 9.4 contains a table of long-term visitors to the Department.

**Age, Race and Gender Summary** The Department currently has 4 women faculty members, of whom one is a full professor, and three are assistant professors. It should be noted that two of the assistant professors were recommended for promotion in Fall 2000 to associate professor by the Department and the College. In addition, the Department has: one male Hispanic faculty member, one male native of China, and two male natives of India.

## 9.2 Faculty Salaries

UNL has a faculty salary problem and as a consequence, the Department of Mathematics and Statistics has a faculty salary problem. As long-time faculty at UNL recall, faculty salaries were disasterous in 1987. A significant campaign during 1987/88 to convince the State Legislature to increase faculty salaries resulted in a 3-year salary plan that increased UNL's salary base by about 34% from 1987/88 to 1990/91. Unfortunately, salary increases were modest during the next few years and so by 1993/94 faculty salaries in the Department averaged $1,483 per faculty member below that of faculty at the institutions chosen by the Board of Regents as our Peer Institutions, according to the data provided in Figure 9.6. This figure was determined by computing the dollars faculty in each rank were ahead or behind salaries for their peers and then dividing the total by the number of faculty. Basically, this put total faculty salaries $57,850 behind salaries at peer institutions. A similar computation puts faculty in the Department $2,080 behind salaries of all UNL faculty during the same year, 1993/94.

There is no evidence that the UNL administration has treated faculty in the Department poorly. Indeed, according to Figure 9.5, salary increases for faculty in the Department from FY 1993/94 to FY 1999/2000 closely mirrors salary increases for faculty in the University as a whole. For example, the average salary in the Department increased 26.6% during this period. Using campuswide salary averages, one computes a 26.8% increase for all faculty at UNL. Further, it is important to note that the Dean's Office was very supportive of the need for special salary increases in the Department this past year. It should also be pointed out that average salaries by rank for the Department can be impacted as much by a retirement or the loss of a faculty member whose salary was high or low compared with other faculty in the same rank. This is particularly significant in understanding salaries in the Department at the Associate Professor rank from 1998/99 to 1999/2000. One faculty member who was the lowest paid faculty at that rank died

| Name | Area | Ph. D. (year) | FTE | GFS |
|---|---|---|---|---|
| Steven R. Dunbar | Applied Mathematics | Minnesota (1981) | 1 | Fellow |
| Lynn H. Erbe* | Differential Equations | UNL (1968) | 1 | Fellow |
| Brian Harbourne | Algebraic Geometry | M. I. T. (1982) | 1 | Fellow |
| Gerald W. Johnson | Analysis | Minnesota(1968) | 1 | Fellow |
| Earl S. Kramer | Combinatorics | Michigan (1969) | .5 | Fellow |
| Partha Lahiri | Statistics | Florida (1986) | 1 | Fellow |
| W. James Lewis | Commutative Algebra | Louisiana State (1971) | 1 | Fellow |
| J. David Logan | Applied Mathematics | Ohio State (1970) | 1 | Fellow |
| John C. Meakin | Semigroups | Monash (1969) | 1 | Fellow |
| Walter E. Mientka | Number Theory | Colorado (1955) | 1 | Fellow |
| Allan C. Peterson | Difference Equations | Tennessee (1968) | 1 | Fellow |
| David R. Pitts | Operator Theory | U C Berkeley (1986) | 1 | Fellow |
| Richard Rebarber | Control theory | Wisconsin (1984) | 1 | Fellow |
| Thomas S. Shores | Numerical Analysis | Kansas (1968) | 1 | Fellow |
| David L. Skoug | Analysis | Minnesota (1966) | 1 | Fellow |
| Roger A. Wiegand | Commutative Algebra | Washington (1967) | 1 | Fellow |
| Sylvia M. Wiegand | Commutative Algebra | Wisconsin (1972) | 1 | Fellow |

*Note: Lynn Erbe is a Research Professor on a renewable three-year contract. Funds for his position are permanent state dollars.

Figure 9.1: Full Professors, Fall 2000

during the Fall of 1998. Removing that faculty member's salary from the pool creates an artificial "bump" for both faculty at the Associate Professor level and for the overall faculty salary average.

The salary problem faced by faculty in the Department is a reflection of UNL's faculty salary problem combined with the fact that outside UNL, salaries in mathematics and in statistics have risen faster than overall faculty salaries during the past seven years. The tendency for raises in each department to be similar to the overall increase in the UNL salary pool, has a particularly serious impact on departments where salaries are increasing rapidly.

The methodology required by the University's Board of Regents obligates the Office of Institutional Research and Planning to compute salaries based on faculty who were on duty, full-time on October 1 of each year. Thus, if a faculty member has a reduced FTE appointment or is on leave without pay, they would not be counted in the salary study. Note, for example, that only 29 people are counted in the Mathematics and Statistics salary base for 1999/2000. While this approach may not have a significant impact on faculty salaries for the entire university, it can have a very significant impact on the computation of average salaries within a department. Imagine, for example, the effect on a group of 7-15 faculty if one takes out of the pool the highest or lowest paid faculty member. Thus, information provided by Figure 9.5 or Figure 9.6 is not as reliable as might be desired.

The Department believes that better information can be obtained using the approach of the AMS/IMS/MAA Data Committee whose report is published annually by the American Mathematical Society in their *Notices*. The approach of the Data Committee is to include the salary of any tenure-track faculty member whether they are on leave, or not, and not to include visiting faculty. Figure 9.7 provides information from that report together with special reports that the AMS has produced for the Department the past three years. Because this includes 2000/2001 salary information, this information is especially useful for reviewing the current status of faculty salaries.

To understand all the information provided by Figure 9.7, it is necessary to understand the Group I, II and III classification used by the AMS in its Data Survey. The AMS uses the National Research Council ratings of Ph.D. departments of mathematics and groups them according to those for whom the rating of the research faculty is above 3.0 for Group I, between 2.0 and 3.0 for Group II, and below 2.0 for Group III. Currently there are 25 public Group I institutions, 56 public and private Group II institutions and 73 Group III institutions. Note that in 1993/94 there were 39 Group I departments and 43 Group II departments. After the 1995 NRC rankings were published, Group I was expanded to 48 departments (25 public and 23 private). Because of evidence that salaries were significantly higher at the highest rated private universities, the Data Committee began to provide salary information for Group I public and

| Name | Area | Ph. D. (year) | FTE | GFS |
|---|---|---|---|---|
| George Avalos | Control Theory | Virginia (1995) | 1 | Fellow |
| Leo G. Chouinard, II | Algebra | Princeton (1975) | 1 | Fellow |
| Steve D. Cohn | Applied Math | Courant (1990) | 1 | Fellow |
| Bo Deng | Dynamical Systems | Michigan State (1986) | 1 | Fellow |
| David B. Jaffe | Genomics | U C Berkeley (1987) | 1 | Fellow |
| Glenn W. Ledder | Applied Math | RPI (1990) | 1 | Fellow |
| Thomas J. Marley | Commutative Algebra | Purdue (1989) | 1 | Fellow |
| John L. Orr | Operator Theory | King's College (1989) | 1 | Fellow |
| Andrew J.(Jamie) Radcliffe | Combinatorics | Cambridge (1989) | 1 | Fellow |
| Mohammed Rammaha | Partial Diff. Equ. | Indiana (1985) | 1 | Fellow |
| Gordon S. Woodward | Analysis | Maryland (1971) | 1 | Fellow |

Figure 9.2: Associate Professors, Fall 2000

| Name | Area | Ph. D. (year) | FTE | GFS |
|---|---|---|---|---|
| Mark Brittenham | Low dimensional topology | Cornell(1990) | 1 | Fellow |
| Trent D. Buskirk | Statistics | Arizona State University (1999) | 1 | Nonmember |
| Allan P. Donsig | Operator Algebras | Texas A & M (1993) | 1 | Fellow |
| Susan Hermiller | Geometric Group Theory | Cornell (1992) | 1 | Fellow |
| Gwendolen Hines | Dynamical Systems | Georgia Tech. (1993) | .5 | Member |
| Tapabrata Maiti | Statistics | Kalyani University (1996) | 1 | Fellow |
| Judy L. Walker | Algebraic Coding Theory | University of Illinois (1996) | 1 | Fellow |
| Mark E. Walker | Algebraic $K$-theory | University of Illinois (1996) | 1 | Fellow |

Figure 9.3: Assistant Professors, Fall 2000

| | | | |
|---|---|---|---|
| 1993–1994 | Desiree Beck | 1997–1999 | May Nilsen |
| 1993–1994 | Gaetano Zampieri | 1997–1998 | Agnes Novak |
| 1994–1995 | Victor Guba | 1997–1998 | Kunitaka Shoji |
| 1994–1995 | Bao-Ping Jia | 1997–1998 | Joe Skopp |
| 1994–1996 | Susan Loepp | Spring 1998 | Jiming Jiang |
| 1994–1995 | Michael Neubauer | 1998–present | Lisa Orlandi-Korner |
| 1995–1996 | Alexandre Carvalho | 1998–1999 | Tathagata Banerjee |
| 1995–1996 | Shuba Das | 1998–1999 | Vijay Kodiyalam |
| 1995–1996 | Fengchun Peng | 1998–1999 | John Ritz |
| Spring 1996 | Arijit Chaudhuri | Spring 1999 | Jerry Beckman |
| Fall 1996 | Gauri Datta | Spring 1999 | Ron Mathsen |
| 1996–1997 | Alemdar Hasanov | 1999–2000 | Mark Brittenham |
| 1996–1997 | Jung Won Ko | 2000–present | Saibel Chattopadyay |
| 1996–1997 | Florin Pop | 2000–present | Mark Johnson |
| 1996–1998 | Mark E. Walker | 2000–present | Byoung Soo Kim |
| 1997–1998 | Richard Evans | 2000–present | Sugata Sen Roy |
| 1997–1998 | Jeong Gyoo Kim | 2000–present | Maria Tjani |
| 1997–1998 | Jung-Ho Lim | | |
| 1997–1998 | Tapabrata Maiti | | |

Figure 9.4: Long Term Visitors (Semester or Longer) 1993–2000

private departments separately. The increase in the number of departments falling into Group I or Group II (from 82 to 104) can be expected to have dampened salaries at both the Group I and Group II institutions.

Careful study of Figure 9.7 allows the reader to study how salaries have increased at Group I, II and III departments from 1993/94 to the past three years, how salaries have changed for UNL's Peer Departments the past three years, how salaries in the UNL Department of Mathematics and Statistics have increased over this period and to compare UNL salaries with these other groups. For each year reported, we use the Department's distribution of faculty to compute an average salary for each group reported. We can then tell both the dollars and the percent that UNL salaries (by rank or overall) are ahead or behind those of the comparator group.

The comparison with Group II institutions shows that in 1993/94 salaries in the Department were very close to the Group II average, that by 1998/99 the salaries in the Department had slipped to 5.5% behind the Group II average but over the past two years Department salaries have caught up and the average salary is virtually identical with the Group II average. One might conclude then that salaries are quite reasonable, if the goal is for the Department to be an average, Group II department.

If instead the goal is to have salaries within the Department be at the midpoint of UNL's peers, we see that a significant problem has developed. We can use the data provided by Figure 9.6 because 38 of 39 faculty were included in the salary pool that year. Using this as a reference point, salaries were, as reported above, $1,483 per faculty member behind the peer group. By 1998/99, salaries in the Department had fallen to a shocking $7,821 (13.39%) per faculty member behind salaries at the Peer Institutions. The past two years have been the first two years of what is hoped to be a four year effort to increase UNL salaries to the midpoint of UNL's peers. There is no doubt but that this salary initiative and the support of the Dean's Office has made a difference as the gap in salaries has fallen to $4,951 (7.54%) per faculty member. But spread across 34 tenure-track faculty this is a $168,334 salary problem for the Department. Thus there still exists a clear need for the continuing support of the Dean's Office in addressing the salary problem in the Department. Without this support, UNL could find that it has reached its goal of having salaries at the midpoint of UNL's peers but salaries in the Department could still be far behind our mathematics peers.

## 9.3 Adequacy of Faculty

The Department has an excellent faculty, active in research and service, superb in the classroom, deeply involved in outreach programs, and congenial in their interactions with each other. The faculty feel in fact that they are doing quite a lot with very little. Many clerical duties that in other departments are handled by non-academic staff are here

Table 1
Academic Program Review
Department of Mathematics & Statistics
Average Faculty Salaries and Average Years in Rank
By Rank, 1993-94 and 1999-2000

| Rank | 1993-94 | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics & Statistics | | | Overall UNL - Excludes Library | | |
| | 9 Month | | | 9 Month | | |
| | No. | Ave. Yrs. in Rank | Ave. Salary | No. | Ave. Yrs. in Rank | Ave. Salary |
| Prof. | 12 | 13.5 | $67,096 | 273 | 12.1 | $66,907 |
| Assoc. | 14 | 7.2 | 44,442 | 222 | 7.4 | 47,162 |
| Assist. | 12 | 4.1 | 38,586 | 236 | 4.2 | 42,189 |

| Rank | 1999-2000 | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics & Statistics | | | Overall UNL - Excludes Library | | |
| | 9 Month | | | 9 Month | | |
| | No. | Ave. Yrs. in Rank | Ave. Salary | No. | Ave. Yrs. in Rank | Ave. Salary |
| Prof. | 14 | 12.5 | $77,455 | 272 | 12.5 | $79,218 |
| Assoc. | 8 | 8.5 | 50,599 | 257 | 7.2 | 56,782 |
| Assist. | 7 | 1.4 | 48,151 | 161 | 3.0 | 48,933 |

| | % Increase 199-94 to 1999-2000 | |
|---|---|---|
| | Mathematics & Statistics | Overall UNL - Excludes Library |
| Prof. | 15.4 | 18.4 |
| Assoc. | 13.9 | 20.4 |
| Assist. | 24.8 | 16.0 |

Source: UNL Faculty Salary Study Committee file for above years.

The 1993-94 and 1999-2000 Faculty Salary Study files exclude Deans and other administrative salaries and include chairpersons.
Faculty with 1.00 or greater FTE who are active on October 1 and ranked as instructor and above are included. Named Professorship stipends are included.

Library staff work on 12 month salaries.

IRP, 5/30/00

Figure 9.5: Departmental Salary Averages, F93 and F99

Table 2
Academic Program Review
Department of Mathematics & Statistics
Percent Faculty Salaries are Above (+) or Below (-) the Peer Average
1993-1994 and 1999-2000

| Percent Above (+) or Below (-) the Peer Average | Professor | Associate | Assistant | Instructor |
|---|---|---|---|---|
| 1993-1994 | +0.9 | -6.2 | -5.9 | -- |
| 1999-2000 | -7.0 | -15.3 | +1.5 | -- |

The Faculty Salary Study file includes those having a 1.00 FTE, ranked as instructor and above. Deans and other academic administrative salaries are excluded, departmental chairpersons are included. Regents Professorship stipends are included. All personnel and salaries are taken from the October 1 personnel data tape. Twelve-month salaries are converted to nine-month salaries by using a factor of 9/11. The salaries were derived using a faculty salary comparison model that conforms with Central Administration computation requirements. These requirements include using a 9/11th's factor to convert 12-month salaries to their 9-month equivalents. This factor was used forboth the Regents Peer Group and UNL.

Note: The ten comparator institutions are: University of Minnesota, Purdue University, University of Missouri, Ohio State University, University of Illinois, Iowa State University, University of Iowa, Colorado State University, University of Colorado, and University of Kansas.

Actual 1999-2000 salary data from the University of Minnesota have not been received. Preliminary calculations have been made by inflating 1998-99 Minnesota data by 5.0%.

Source: AAU Data Exchange, 1999-2000, and UNL September, 1999 Personnel Data Tape.

IRP, 8/15/00

Figure 9.6: Peer Group Salary Comparison, F93 and F99

Comparison of UNL Math/Stat Salaries with Comparator Groups

| **AY 93/94** | Prof (13) | UNL$+/- | UNL%+/- | Asso (14) | UNL$+/- | UNL%+/- | Asst (12) | UNL$+/- | UNL%+/- | Total (39) | UNL$+/- |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Group I | 74200 | | | 50275 | | | 41983 | | | 55699 | |
| Group II | 64737 | 2484 | 3.70% | 46202 | -1760 | -3.96% | 40268 | -1682 | -4.36% | 50554 | -321 |
| Group III | 60341 | | | 44066 | | | 38332 | | | 47727 | |
| Peers Math | N/A | | | N/A | | | N/A | | | | |
| UNL Math/Stat | 67221 | | | 44442 | | | 38586 | | | 50233 | |
| **AY 98/99** | Prof (16) | UNL$+/- | UNL%+/- | Asso (12) | UNL$+/- | UNL%+/- | Asst (6) | UNL$+/- | UNL%+/- | Total (34) | UNL$+/- |
| Group I Pub | 85571 | | | 58166 | | | 50424 | | | 69696 | |
| Group II | 73775 | -981 | -1.35% | 53499 | -7448 | -16.17% | 46418 | -1685 | -3.77% | 61791 | -3388 |
| Group III | 69269 | | | 51638 | | | 44771 | | | 58723 | |
| Peers Math | 80025 | -7231 | -9.93% | 56130 | -10079 | -21.89% | 49613 | -4880 | -10.91% | 66225 | -7821.294 |
| UNL Math/Stat | 72794 | | | 46051 | | | 44733 | | | 58403 | |
| UNL Math/Stat % Inc 93/94-98/99 | 8.29% | | | 3.62% | | | 15.93% | | | 16.26% | |
| **AY 99/00** | Prof (16) | UNL$+/- | UNL%+/- | Asso (10) | UNL$+/- | UNL%+/- | Asst (8) | UNL$+/- | UNL%+/- | Total (34) | UNL$+/- |
| Group I Pub | 88274 | | | 61081 | | | 52379 | | | 71830 | |
| Group II | 77005 | -730 | -0.96% | 55507 | -4962 | -9.82% | 48200 | -542 | -1.14% | 63904 | -1930 |
| Group III | 70792 | | | 53174 | | | 47068 | | | 60028 | |
| Peers Math | 83811 | -7536 | -9.88% | 58754 | -8209 | -16.24% | 51851 | -4193 | -8.80% | 68921 | -6947.353 |
| UNL Math/Stat | 76275 | | | 50545 | | | 47658 | | | 61974 | |
| UNL Math/Stat % Inc 98/99-99/00 | 4.78% | | | 9.76% | | | 6.54% | | | 6.11% | |
| **AY 00/01** | Prof (15) | UNL$+/- | UNL%+/- | Asso (11) | UNL$+/- | UNL%+/- | Asst (8) | UNL$+/- | UNL%+/- | Total (34) | UNL$+/- |
| Group I Pub | 94256 | | | 63638 | | | 54746 | | | 75054 | |
| Group II | 79545 | 3284 | 3.96% | 57314 | -4004 | -7.51% | 50263 | 156 | 0.31% | 65463 | 190 |
| Group III | 73927 | | | 55818 | | | 48222 | | | 62020 | |
| Peers Math | 86242 | -3413 | -4.12% | 61449 | -8139 | -15.27% | 53869 | -3450 | -6.84% | 70604 | -4950.706 |
| UNL Math/Stat | 82829 | | | 53310 | | | 50419 | | | 65653 | |
| UNL Math/Stat % Inc 99/00-00/01 | 8.59% | | | 5.47% | | | 5.79% | | | 5.94% | |
| UNL Math/Stat % Inc 93/94-00/01 | 23.22% | | | 19.95% | | | 30.67% | | | 30.70% | |

Note: Data on average salaries for Group I, II and III departments comes from the Data Report published by the AMS.
Data on salaries of UNL peers provided by the American Mathematical Society.
Data on salaries for UNL Department of Mathematics and Statistics faculty is based on department records.

Figure 9.7: Comparisons of UNL Math/Stat Salaries with Comparator Groups

handled by the professors themselves; this is unavoidable, given the low ratio of support staff to academic staff, half or one third that of other departments on campus and of other math departments nationally.

Departmental professors mostly type their own papers and they spend much time on routing forms and budget pages of grant proposals. Indeed, some faculty members express the concern that they spend as much time with these issues as on the scientific content of the proposal itself. Much committee work is clerical, but a substantial amount is done by professors. Starving the support staffing budgets saves money, but the savings are bought with expensive faculty time and lost opportunities.

Moreover, the job the Department is being asked to do is expanding. At the time of the last Academic Program Review, revisions in the way calculus is taught, use of technology in teaching, many of conference and workshop activities (the regional workshop, Rowlee lectures), many outreach activities (All Girls, All Math), assessment exercises, and increased emphasis on obtaining large grants etc. were still in the future.

Increasing instructional demands intensify the stress on the program. Figure 9.8 provides some documentation of how instructional demand has increased for the Department. Notice that for the period 1993–2000, total student credit hour production has remained relatively flat, with a modest increase of 3.1% during that period. However, in the same period, the data shows that FTE instructional faculty strength has decreased by 9.5%, resulting in an *increase* of 14% in SCH/FTE.

Moreover, during the seven-year period from calendar year 1994–2000, the Department awarded 54 PhDs, exactly *triple* the 18 PhDs awarded during the previous seven-year period, calendar years 1987–1993. This provides evidence that the increased emphasis on graduate education has paid off, but also provides another measure of the increased stress on the Department.

Table 7
Academic Program Review
Department of Mathematics & Statistics
Student Credit Hours Per FTE Instructional Faculty By Level
Fall Semesters 1993-94 to 1999-2000

| | Total | | | Lower Level | | | Upper Level | | | Graduate & Professional | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | FTE Instr. Faculty | SCH | SCH/FTE | FTE Instr. Faculty | SCH | SCH/FTE | FTE Instr. Faculty | SCH | SCH/FTE | FTE Instr. Faculty | SCH | SCH/FTE |
| 1993-94 | 53.35 | 18,211 | 341.3 | 36.00 | 15,321 | 425.6 | 8.36 | 1,407 | 168.3 | 8.99 | 1,483 | 165.0 |
| 1994-95 | 53.54 | 17,162 | 320.5 | 36.91 | 15,021 | 407.0 | 7.89 | 1,206 | 152.9 | 8.74 | 935 | 107.0 |
| 1995-96 | 48.94 | 17,986 | 367.5 | 35.20 | 16,041 | 455.7 | 6.54 | 1,101 | 168.3 | 7.20 | 844 | 117.2 |
| 1996-97 | 49.60 | 17,511 | 353.0 | 37.76 | 15,796 | 418.3 | 6.71 | 1,032 | 153.8 | 5.13 | 683 | 133.1 |
| 1997-98 | 48.73 | 17,176 | 352.5 | 37.62 | 15,366 | 408.5 | 5.79 | 1,273 | 219.9 | 5.32 | 537 | 100.9 |
| 1998-99 | 47.60 | 17,518 | 368.0 | 35.69 | 15,909 | 445.8 | 6.84 | 1,092 | 159.6 | 5.07 | 517 | 102.0 |
| 1999-2000 | 48.26 | 18,784 | 389.2 | 37.50 | 17,126 | 456.7 | 5.87 | 1,092 | 186.0 | 4.89 | 566 | 115.7 |
| % Change from 1993-94 to 1999-2000 | (9.5) | 3.1 | 14.0 | 4.2 | 11.8 | 7.3 | (29.8) | (22.4) | 10.5 | (45.6) | (61.8) | (29.8) |
| % Change from 1998-99 to 1999-2000 | 1.4 | 7.2 | 5.8 | 5.1 | 7.6 | 2.5 | (14.2) | 0.0 | 16.5 | (3.6) | 9.5 | 13.5 |

Note: FTE and Student Credit Hours for this table were calculated using only course sections taught by faculty in this department. Course sections taught by faculty in this department are included, regardless of what department the course section is offered in. Conversely, course sections offered by this department, but taught by faculty from another department, are not included.

Source: Institutional Research and Planning
1998 and 1999 data corrected for incorrect classification of Buren Thomas as DCS.
IRP, 5/31/00

Figure 9.8: Student Credit Hours by Level

**Summary** The Department's faculty is well motivated, highly productive and well qualified to meet Departmental and University missions. However, the number of faculty need to increase in order to continue its mission and to

continue to meet the increasing needs of the University.

Should additional faculty lines not be allocated to the Department, the Department will have to undertake the difficult and painful process of deciding which of its activities to cut or scale back. Such a process is unlikely to improve the Department.

# Chapter 10

# Students

This chapter begins with a display of data regarding students. Figure 10.1 shows the number of degrees awarded by the Department in each of the *fiscal years* 1993-94 through 1999-00. Note that the figures for PhD production differ from those in Figure 6.5 in Part II because Figure 6.5 is based on degrees awarded in *calendar years*. Figure 10.2 shows the number of endorsements (certificates given to education majors) in mathematics given in each year.

Data on undergraduate majors by class rank is not readily available from the Office of Institutional Research and Planning. Instead such data was compiled by Professor Gordon Woodward who is the Chief Undergraduate Advisor for the Department. The data is contained in Figure 10.4.

Detailed data on the number of non-majors served by the Department is shown in Figure 4.5.

## 10.1 Undergraduate Students

The Department has a Chief Undergraduate Advisor who is assisted by one support staff member. Students are expected and asked to visit with this advisor for information about our program, academic rules, course selection, career preparation, scholarships, summer programs, and graduate schools. Students are also encouraged to visit with other faculty in the department about discipline subject matter, graduate schools, and any others areas of interest. Faculty are quite aware that the students should definitely come to the Chief Advisor for interpretation of academic rules and requirements. The chief advisor has an open door policy, but after the initial few contacts, much of the routine advising is done via email conversations with the Chief Advisor. The Chief Advisor has a variety of other departmental oversight responsibilities such as student employment, scholarships, and Math Day, which keep him in close contact with our majors.

Admission and GPA standards are the same as that of UNL. For graduation we require a 2.5 GPA in the advanced major courses (all math degree courses above calculus). One can get either a BA or a BS degree in mathematics and statistics. The differences amount to three or four science courses.

The Institutional Research and Planning Office has supplied some data (see Table 10.3), but it does not include students who have math/stat as their 2nd major. Usually the students' listed first major is simply which of their current majors they had first. Figure 10.4 gives the official math/stat major count taken in September of each year. This includes both 1st and 2nd majors. The graduation count included in Figure 10.4 also differs from the IRRP reports since it is based on the academic year calendar, December, May, August, instead of the fiscal year.

Fall 94 (term 951) was the lowest count in over 15 years of records. It is not clear why, but compared to the previous year there was a significant drop in double majors with math/stat and either computer science or actuarial science. This may reflect the growing trend in both of these areas to concentrate on supporting courses in business. The column headed "1st" counts those that listed math/stat as their major. The oscillating nature of this column seems to suggest an artificial influence that may be coming from our department. It needs further study.

Next is an academic profile summary of our students from two independent sources: UNL GPA and ACT Composite. This information suggests that as a group our majors are among the most academically talented on campus.

**UNL GPA:** Mean 3.41, Median 3.64, and 57% of our majors have a GPA of 3.5 or better. (Using a 4.0 system. Based on the 134 majors that are not 1st semester freshmen).

**ACT Composite:** Mean 29.4, Median 30. (Based on 115 students for which this data is available.)

Table 8(a)
Academic Program Review
Department of Mathematics & Statistics
Degrees in Mathematics (Undergrad) and Mathematics & Statistics (Grad)
Number of Degrees Awarded By Level
1993-94 Through 1999-2000

| Year | Bachelor's Degree | Master's Degree | Doctor's Degree | Total |
|---|---|---|---|---|
| 1993-94 | 46 | 22 | 3 | 71 |
| 1994-95 | 41 | 16 | 8 | 65 |
| 1995-96 | 45 | 23 | 7 | 75 |
| 1996-97 | 31 | 9 | 8 | 48 |
| 1997-98 | 31 | 11 | 11 | 53 |
| 1998-99 | 33 | 11 | 5 | 49 |
| 1999-2000 | 26 | 3 | 8 | 37 |
| Percent Change from 1993-94 to 1999-2000 | (43.5) | (86.4) | 166.7 | (47.9) |
| Percent Change from 1998-99 to 1999-2000 | (21.2) | (72.7) | 60.0 | (24.5) |

Source: Office of Institutional Research and Planning

Note: Degrees are for each year starting July 1 and ending June 30.

IRP, 7/10/00

Figure 10.1: Mathematics and Statistics Degrees Awarded by Level

Table 8(b)
Academic Program Review
Center for Curriculum & Instruction
Endorsements in Mathematics
Number of Degrees Awarded By Level
1993-94 Through 1999-2000

| Year | Bachelor's Degree | Master's Degree | Doctor's Degree | Total |
|---|---|---|---|---|
| 1993-94 | 17 | -- | -- | 17 |
| 1994-1995 | 19 | -- | -- | 19 |
| 1995-96 | 28 | -- | -- | 28 |
| 1996-97 | 13 | -- | -- | 13 |
| 1997-98 | 11 | -- | -- | 11 |
| 1998-99 | 21 | -- | -- | 21 |
| 1999-2000 | 9 | -- | -- | 9 |
| Percent Change from 1993-94 to 1999-2000 | (47.1) | -- | -- | (47.1) |
| Percent Change from 1998-99 to 1999-2000 | (57.1) | -- | -- | (57.1) |

Source: Office of Institutional Research and Planning

Note: Degrees are for each year starting July 1 and ending June 30.

IRP, 8/15/00

Figure 10.2: Endorsements in Mathematics (for Teachers)

Table 3(a)
Academic Program Review
Department of Mathematics & Statistics
Majors by Full and Part Time, Gender, and Age
Fall Semester 1999-2000

1993-1994

| Major and Gender | Age of Students: Full-Time <18 | 18-19 | 20-21 | 22-24 | 25-29 | 30-34 | 35-39 | 40-64 | 65 &> | Unkn | Total FT | Part-Time <18 | 18-19 | 20-21 | 22-24 | 25-29 | 30-34 | 35-39 | 40-64 | 65 &> | Unkn | Total PT | Total Full & Part |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mathematics** | | | | | | | | | | | | | | | | | | | | | | | |
| **Undergraduate** | | | | | | | | | | | | | | | | | | | | | | | |
| Men | 1 | 13 | 27 | 24 | 5 | | | 1 | | | 71 | | | | 3 | 4 | 2 | 1 | 2 | | | 12 | 83 |
| Women | 1 | 13 | 30 | 10 | 2 | | | | | | 56 | | | | 3 | 2 | 1 | | 1 | | | 7 | 63 |
| Total | 2 | 26 | 57 | 34 | 7 | | | 1 | | | 127 | | | | 6 | 6 | 3 | 1 | 3 | | | 19 | 146 |
| **Mathematics & Statistics** | | | | | | | | | | | | | | | | | | | | | | | |
| **Graduate** | | | | | | | | | | | | | | | | | | | | | | | |
| Men | | | | 9 | 21 | 8 | 3 | 2 | | | 43 | | | | 1 | 2 | 3 | 1 | 1 | | | 8 | 51 |
| Women | | | | 7 | 18 | 2 | 2 | 1 | | | 30 | | | | 1 | | 1 | | 1 | 1 | | 4 | 34 |
| Total | | | | 16 | 39 | 10 | 5 | 3 | | | 73 | | | | 2 | 2 | 4 | 1 | 2 | 1 | | 12 | 85 |

**Summary**

| | | | |
|---|---|---|---|
| For the UG majors: | 87% are full time | 57% are men | 86% are traditional age college students* |
| | 13% are part time | 43% are women | 14% are non-traditional age college students |
| For the Grad majors: | 86% are full time | 60% are men | |
| | 14% are part time | 40% are women | |

1999-2000

| Major and Gender | Age of Students: Full-Time <18 | 18-19 | 20-21 | 22-24 | 25-29 | 30-34 | 35-39 | 40-64 | 65 &> | Unkn | Total FT | Part-Time <18 | 18-19 | 20-21 | 22-24 | 25-29 | 30-34 | 35-39 | 40-64 | 65 &> | Unkn | Total PT | Total Full & Part |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mathematics BA/BS** | | | | | | | | | | | | | | | | | | | | | | | |
| **Undergraduate** | | | | | | | | | | | | | | | | | | | | | | | |
| Men | | 15 | 23 | 10 | 5 | 1 | | | | | 54 | | | | 2 | 4 | | 1 | | | | 7 | 61 |
| Women | | 27 | 14 | 6 | 1 | 0 | | | | | 48 | | | 1 | 3 | 0 | | 1 | | | | 5 | 53 |
| Total | | 42 | 37 | 16 | 6 | 1 | | | | | 102 | | | 1 | 5 | 4 | | 2 | | | | 12 | 114 |
| **Mathematics & Statistics** | | | | | | | | | | | | | | | | | | | | | | | |
| **Graduate MA/MAT/MS** | | | | | | | | | | | | | | | | | | | | | | | |
| Men | | | | 6 | 1 | | | 1 | | | 8 | | | | | | | | | | | | 8 |
| Women | | | 2 | 2 | 4 | 1 | | | | | 9 | | | | 2 | 2 | | | | | | 4 | 13 |
| Total | | | 2 | 8 | 5 | 1 | | 1 | | | 17 | | | | 2 | 2 | | | | | | 4 | 21 |
| **Mathematics & Statistics** | | | | | | | | | | | | | | | | | | | | | | | |
| **Graduate (PhD)** | | | | | | | | | | | | | | | | | | | | | | | |
| Men | | | | 3 | 6 | 5 | 2 | | | | 16 | | | | | | 2 | 1 | 1 | | | 4 | 20 |
| Women | | | 1 | | 6 | 4 | 1 | 1 | | | 13 | | | | | 1 | | 1 | | | | 2 | 15 |
| Total | | | 1 | 3 | 12 | 9 | 3 | 1 | | | 29 | | | | | 1 | 2 | 2 | 1 | | | 6 | 35 |

**Summary**

| | | | |
|---|---|---|---|
| For the UG majors: | 89% are full time | 54% are men | 89% are traditional age college students* |
| | 11% are part time | 46% are women | 11% are non-traditional age college students |
| For the Grad majors: | 82% are full time | 50% are men | |
| | 18% are part time | 50% are women | |

* Traditional age college students are those age 18 to 24. (The students under 18 are also included.)
Source: Fall Semester 1993-94 and 1999-00 Profiles, Office of Institutional Research and Planning
IRP, 5/15/00, IRP, 8/30/00

Figure 10.3: Demographics of Mathematics and Statistics Majors

| Year | FR | SO | JR | SR | Total | 1st | AY | # Graduates |
|---|---|---|---|---|---|---|---|---|
| 1995 | 18 | 15 | 26 | 61 | 120 | 104 | 95-96 | 38 |
| 1996 | 21 | 20 | 25 | 56 | 122 | 121 | 96-97 | 48 |
| 1997 | 15 | 22 | 34 | 53 | 124 | 98 | 97-98 | 27 |
| 1998 | 21 | 21 | 38 | 65 | 145 | 118 | 98-99 | 35 |
| 1999 | 28 | 26 | 28 | 60 | 142 | 109 | 99-00 | 29 |
| 2000 | 24 | 26 | 49 | 56 | 155 | 122 | 00-01 | 27 |
| 2001 | 17 | 30 | 36 | 66 | 149 | 115 | | |

Figure 10.4: Math & Stat Majors by Class (includes Double Majors), Fall Semesters, 1994–2000

| | Eastman | Stebbins | Harkson | Dubinsky | Winchester | Schneider | Matzke | Gallup |
|---|---|---|---|---|---|---|---|---|
| Available | 151492 | 1822 | 4458 | 2689 | 1756 | 391 | 752 | 9500 |
| Budgeted | 136790 | 1822 | 3958 | 2689 | 1756 | 391 | 752 | 1000 |

Total awarded: $ 149,158.00 to 75 students. So, about 50% of our majors have a Math/Stat scholarship. Their median GPA is 3.896 with a mean of 3.802.

Figure 10.5: Scholarship Awards, 2000-2001

Fortunately the Department is able to recognize the talents of its majors through scholarships and discipline related jobs such as paper grading in calculus and above, Math Resource Center counselor, Computer Lab attendant, and undergraduate TA, to name a few.

The largest source of support is the Department's scholarship fund. The Dean H. and Floreen G. Eastman scholarship fund was initiated in late 1989 with a 1.5 million dollar gift to the Department. It is restricted to graduates of a Nebraska high school. Since the AY 1990-1991, the Department has offered at least five 4-year $12,000 Eastman Scholarships and up to eleven 1-year Eastman $1000 (renewable) scholarships to potential incoming freshmen math/stat majors. We have two other more recently acquired scholarship funds, the Drusilla Winchester fund and the Ruby Matkze Wittemore fund that we can use to recruit qualified incoming freshmen students who have not graduated from a Nebraska high school. Our upper class majors are also considered for Eastman and other scholarships in various amounts. (All our offers must be approved by the Office of Scholarships and Financial Aids.)

Figure 10.5 gives scholarship award totals for AY 2000-2001. (The fund names listed are shortened version of the full names.)

For comparison purposes, Figure 10.6 gives similar data for AY 1992-1993.

In addition to scholarships, the Department is strongly committed to employing its majors in ways that enhance and support their mathematics. Undergraduate TAs are hired based on the criteria of teaching skill, knowledge, responsibility, interest in graduate school and departmental need. For the past several years, there have been 4 honors TAs and at least 2 calculus recitation TAs. They are paid $1800 per semester with the commitment for the full AY, subject to satisfactory performance. For the last two years the Department has also hired two undergraduate mentors to work with the calculus Math Excel workshops at this same salary. This fall we had 11 undergraduate students as either TA's or mentors. The Math Resource Room is a walk-in tutorial for entry level mathematics courses up through calculus II. It is open 12:30 to 8:30 Monday through Thursday and 12:30-2:30 on Friday. TA's are required to put in one two hour shift each week one semester each year as part of their regular commitment. Undergraduate counselors are required to work 3 2-hour shifts each week for $850 per semester. Two of these counselors spend 4 hours of their shift as mentors for our Reach workshops in intermediate algebra (Math 100A). These teaching, tutoring, and mentoring jobs offer an excellent way for our majors to hone their mathematical understanding and to experience some aspects of teaching. The seven undergraduate computer lab attendants are paid the same amount to work 8 hours per week in the computer lab keeping an eye on the equipment, helping students with our operating system, and proctoring our Gateway exams. Grading sophomore and above level courses offers the chance for our students to deepen their understanding of sophisticated mathematics. The Department hires graders at $6 per hour to grade for calculus III (Math 208), differential equations (Math 221), matrix theory (Math 314), elementary abstract algebra (Math 310), elementary analysis (Math 325), and introductory statistics (Stat 380). A strong effort is made to find graders for our more advanced 400-level courses when they have more than 15 students. However this is quite often difficult, since

| | Eastman | Stebbins | Harkson | Dubinsky | Winchester | Schneider | Matzke | Gallup |
|---|---|---|---|---|---|---|---|---|
| Available | 95188 | 1350 | 2456 | 1188 | 43 | 246 | NA | NA |
| Budgeted | 95300 | 1350 | 2450 | 1188 | 43 | 246 | NA | NA |

Total awarded: $ 100,527.00 to 92 students. (NA indicates the scholarship did not exist at that time. GPA data is not readily available for this period.)

Figure 10.6: Scholarship Awards, 2000-2001

the very undergraduates qualified to grade at this level are quite often undergraduate TA's and too busy. In addition to these jobs the Department also hires Math Placement Exam proctors, web page developers, and math summer camp counselors. Approximately 40 students in the fall and 38 in the spring are hired as either TA's, counselors, attendants, or graders. An added benefit to this undergraduate employment is that it instills a sense of family and commitment between the students and the Department.

The Department aggressively recruits majors to apply to a variety of national programs. Some of these include: Summer REU's (Research Experience for Undergraduates, sponsored by the National Science Foundation), MASS at Penn. St. (fall semester concentrated on junior-senior level mathematics courses), Budapest Semesters in Mathematics (spring semester concentrated on advanced mathematics courses), study abroad, semester or summer internships, and McNair scholarships (to prepare minority students for Ph.D. programs). In addition the Department encourages students to apply for national scholarships and awards as well as local awards and honors. Participating in these programs and opportunities stimulates the student's interests in mathematics and helps to focus the student's career objectives, which has a multiplying effect in the Department. Following is a brief summary of the student activity in these programs.

In Summer 2000 ten students participated in a summer research program, eight of them funded by NSF. Before that the Department averaged 5 students per summer in such programs.

In the period 1996-1999 the Department has had 7 students attend the MASS program at Penn. State. No one applied last fall, but at least one student is preparing an application for fall 2001.

One student attended the Budapest program in the spring of 1999. Another is going this spring and another is preparing an application for spring 2002.

There have been twelve Goldwater Scholars since its beginning 12 years ago in 1989.

Jaclyn (Kohles) Anderson received Honorable Mention in the Alice T. Shafer award for undergraduate women in mathematics from the Association of Women in Mathematics in 2000 and then was the winner of the award in 2001 (announced last month, but will be presented this month). This award recognizes the top undergraduate women in mathematics in the nation.

In 1999 two majors and a recent graduate won NSF graduate student fellowships, and one additional major received honorable mention.

Each year since its inception about 8 years ago, one male and one female major has received a Student Leader Award jointly sponsored by the College and the Alumni Association.

This past spring the Department honored 15 undergraduate women at the annual Graduate Women in Science local chapter's award dinner. Each of these honorees received a certificate of achievement and a lot of attention. The Department has been very active in this program. In the 7 years before last spring we average 8 honorees each year.

In September of each year the Department hosts its Mathematics and Statistics Scholars Reception. All students and their families who have received a scholarship from the Department are invited. About half of the faculty also attend. The purpose is to formally honor the recipients and to offer the opportunity for the families and faculty to visit. Typically between 80 and 100 people attend.

In the past 5 years the Department has had 4 McNair scholars.

The Department sees the University's Honors Program as an excellent educational process and supports it fully. The final requirement of the Program is to write an honors thesis. Only about half of all students who begin the program actually complete it. The Department encourages its Honors Programs majors to take the time to write a thesis. The Chief Advisor explains to the student how to pick a thesis advisor and counsels the student as to who might best fit his/her interests. Unfortunately, the Honors Program records thesis by author, not by major. So a reliable count on the number of honors thesis written is not available. This is different if the thesis is also to be presented to the College for a Degree with Distinction, High Distinction, or Highest Distinction. In these cases the thesis must be

| Employment | # Students |
|---|---|
| Actuarial Science | 8 |
| Business | 10 |
| Computer Science | 8 |
| Military | 6 |
| Statistics | 4 |
| Teaching | 4 |
| Graduate Sch (Math area) | 24 |
| Professional Sch | 6 |
| Unknown | 8 |
| Total | 78 |

Figure 10.7: Career Choices of Bachelors Graduates

approved by a Departmental committee which is chaired by the Chief Advisor. A count of these theses, year (number) is: 2001 (6 have filed an intent); 2000 (2); 1999 (3); 1998 (2); 1997 (1). Since over 70 of our majors are in the Honors Program, it is reasonable to expect many more theses are being written.

There are a variety of other departmentally sponsored activities for its majors. The William Lowell Putnam exam practice group meets once each week for six to eight weeks each fall to practice for this nationally competitive exam. For the past several years over 30 students have signed up and attended many of the practice sessions, at least 20 have taken the exam. The Department's team ranked in the top 12% out of over 400 schools for the past two years. (Fall 2000 results are not yet known.) The Department also offers cash prizes of $150 and $100 to its top two Putnam scorers. The UNL chapter of the mathematics honorary fraternity, Pi Mu Epsilon, is Nebraska's Alpha Chapter, the first in the state. The members typically organize a local calculus competition, and invite guests to speak on careers, mathematics, graduate schools, and other topics of interest. The fraternity also provides an opportunity for socializing. Two years ago a new and very active group, the Women's Undergraduate Math Network, started at the urging of some of our undergraduate women majors. They offer a support group organized also around mathematical or career related talks. In the fall all majors (indeed, all staff) are asked to volunteer to help with Math Day.

The Department endeavors to have each of its prospective graduates take an exit exam and stop by for an exit interview the month before graduation. Actually there are two exit interviews, one with the Chief Undergraduate Advisor concerning program structure and curricular issues and another with the Chair concerning personnel and departmental climate issues as well as curricular issues. The interview questions are located in the AppendixF. The reality is that about 47% of the graduates beginning with the AY 95-96 have been interviewed. It appears to be a fairly representative group of students. The students overwhelmingly approved of the Department's program, but suggested matrix theory (Math 314) be taken before differential equations (Math 221), did not remember much about content they only saw in one course (not surprising), did not get much out of our introductory statistics (Stat 380), and found the theory courses difficult (again not surprising). They had high praise for most of the Department's regular instruction, but complaints about visiting instructors, and they liked the general sequencing of our courses (other than the already mentioned 314-221). Their career choices are quite interesting. Figure 10.7 indicates general career areas of their first employment after graduation. Only the "unknowns" had not yet received acceptable offers.

There were twenty-six exit exams for the period 1995–1998. The exams from 1999 and 2000 have not yet been graded. Again there seems to be a fair representation. The exam is in Appendix F. The graded results appear in Figure 10.8, first over all four years, then by year.

The exam covers only the courses listed. While majors are not required to take all these courses, they are considered core for various concentrations. Students only answer questions over courses they have had. Here Calculus refers to Math 106-107-208. A score of 50% is considered good (40% if the student's concentration is in other aspects of math/stat). This exam needs some improvement. There are at least three problems: In an attempt to protect the student's identity the student is not asked for his/her GPA. This is a mistake. Second, additional courses need to be added to the topics. Finally, the exam should include a section for the student to make anonymous comments about the Department. The exam indicates that, with the tremendous improvement in Math 221, students' retention is strong except in Stat 380. This is another indication that we need to work on our delivery of statistics to our undergraduates. This is something the Department is working on. In the past the statistics demand far exceeded the permanent statistics staffing.

| Semester | Calculus | M221 | M314 | M310 | S380 |
|---|---|---|---|---|---|
| ALL | 70.9 | 33.5 | 49.6 | 46.1 | 27.5 |

| Semester | Calculus | M221 | M314 | M310 | S380 |
|---|---|---|---|---|---|
| 952 | 70.8 | 32.1 | 44.4 | 36.7 | 28.6 |
| 962 | 95.5 | 100.0 | 100.0 | 66.7 | 90.0 |
| 972 | 69.2 | 12.5 | 44.4 | 53.3 | 23.8 |
| 982 | 69.9 | 50.0 | 53.5 | 44.4 | 22.5 |

Figure 10.8: Exit Exam Results, Spring Semesters

In the fall 2000 semester, the Department initiated the policy of paying for interested students to take the GRE subject exam in mathematics or if not that then the General GRE exam providing the student list the Department as one of the schools to receive the results. This will offer an additional evaluation student learning.

## 10.2 Graduate Students

This section provides an in-depth look at the aspects of the Department concerning graduate students and resources concerning graduate students.

**Graduate Student Advising and Graduate Programs** Incoming students are assigned an (often temporary) advisor who provides advice regarding course selection, appropriate timing of Qualifying or Comprehensive exams, etc. Generally, Masters students find no need to change advisors. However, Ph.D. students frequently change advisors once the student's research interests are more precisely known. The change to the new advisor requires (usually pro formal) approval of Graduate Chair and the new advisor.

The advisor and student design a program around the Department's requirements and the student's interests and career goals. Each student is given a copy of the Department's information handbook for graduate students, (see Appendix E.3). Students not having a Masters degree are advised to follow one of the Masters level programs before proceeding to the Ph.D. program.

At the Masters level, students may choose among three options in any of the areas Applied Mathematics, Pure Mathematics, and Statistics. The advisor and student then select courses to move the student efficiently toward a successful completion of the Masters Comprehensive Exams, which students have five semesters to complete.

The Department offers two specialized Masters degrees, Master of Arts for Teachers and Master of Sciences for Teachers (MAT and MScT), the requirements of which are quite different from the M.A./M.S. degree. Two permanent advisors are assigned to work with students in these programs. A requirement for acceptance into this program is that the student be an active school mathematics teacher. However, only 6 MAT and MScT degrees have been awarded in the past 7 years.

In order to better serve secondary math teachers in the State, the Department has done the following.

a) In partnership with the Lincoln Public Schools, the Department offers credit-bearing summer workshops for teachers on site at a Lincoln School. This program has been in place for the past two years.

b) The Department offers an MAT course in the second summer session for teachers working on a degree.

c) The Department gave Assoc. Prof. David Fowler of Curriculum and Instruction a courtesy appointment and membership on the Department's graduate faculty and has charged him with leading the revitalization of course offerings for secondary mathematics teachers.

At the Ph.D. level, a student may select Pure Mathematics, Applied Mathematics,Statistics, or the Computer Science option (offered in cooperation with the Computer Science Department). The advisor and student then select courses to move the student efficiently toward successful completion of the Ph.D. Qualifying exam. During this period the student is really operating under Option 3 (see Appendix E.3) of the Masters program. The Qualifying exam

doubles as a Masters Comprehensive exam. The Qualifying student automatically satisfies the Masters requirements (assuming, as is most common, that the 36-hour course requirement is met). The student who attempts to qualify and fails may still pass at the Masters level, and thus obtain a Masters degree. After successfully completing the Qualifying exam, the student chooses a dissertation advisor who also becomes the student's general advisor.

At both levels every effort is made to monitor the student's progress. If the Graduate Committee feels that a student is not progressing satisfactorily, the student is so advised and is given specific goals with deadlines. Failure to meet these deadlines generally means the student will not not receive continued financial support and may be dropped from the program.

**Graduate Student Admission and Retention** The Department follows the admission and retention regulations of the Graduate College. In addition, the Department requires that the student have a good undergraduate record which includes at least 18 hours beyond calculus (15 hours if the student's record is very strong). This amounts to essentially 32 hours (29) of undergraduate mathematics courses. These courses must form what the Departmental Graduate Chair assesses to be a solid foundation for advanced degree work. Students whose official Graduate School status is Unclassified or Provisional must satisfy admission and retention standards which are individually tailored to their goals.

The Department does not require an admission test score and, since many applicants are foreign students, the undergraduate GPA is not interpretable in many cases. Most successful international students have a combined general GRE score of over 2100. For domestic students, strong letters of recommendation are a far better indicator of success than GRE scores or GPAs.

Foreign students must pass the Test of English as a Foreign Language (TOEFL) with a score of at least 550, and at least 600 in order to be considered for a GTA.

All graduate students are expected to pass their Masters Comprehensive or Ph.D. Qualifying exams sometime during their first two years. Depending on the progress they have made, some students are supported for a third year prior to passing the Qualifying Exam. The Ph.D. student is expected to pass the Ph.D. Comprehensive exam sometime during the first four years.

The number of students dropped from the Masters and Ph.D. program for each of the past seven years is difficult to determine, since students may come to graduate school hoping to complete a Ph.D. but discontinue studies after receiving an M.A. and failing to qualify for the Ph.D. degree. Students who seek a Ph.D. are admitted to the M.A. program if they do not possess an M.A., and are only admitted to the Ph.D. program after passing the Qualifying exams (which are concurrent with the M.A. exams but require a higher grade).

**Graduate Student Demographics** Data concerning gender is available and can be found in Figure 10.3 above. A key point to note here is that the Department has been extremely successful at providing an environment supportive of women graduate students and this success led to the Presidential Mentoring Award mentioned earlier. The Department is the only mathematical sciences department in the nation ever to have received such an award, and the Department is justifiably proud of its accomplishments in recruiting and mentoring women students.

With minority students, the Department has been less successful. Presently the Department has 4 black graduate students, two of whom are female. One of the black male students is on the faculty at Metro Community College in Omaha.

The Department also had two minorities receive Masters degrees in the past seven years: one was a Hispanic woman who returned to California for family reasons after receiving her Masters, and the other was a black woman from Trinidad/Tobago who recently received her Ph.D. from Georgia Tech.

**Graduate Degrees Awarded** Information on degrees granted is given in Figure 10.1 and also in Figure 6.5.

As discussed earlier, the past seven years have been the most productive period for Ph.D. production in Department history. Also see the discussion concerning Figure 6.6 in section 6.2.1 for a comparison of the Department's production of Ph.D.s with other institutions

**Financial Support for Graduate Students** Approximately 80% of Departmental graduate students are teaching assistants funded by the Department. Many of the remaining 20% are funded by family, friends, their home governments (foreign), and private organizations. Some Departmental students supplement their local funding with federally backed student loans. Except for money from external grants, the Department has no funds available for Research

| FTE | Typical Contact Hrs/year | New GTAs | 2nd Yr GTAs | Pass Qual | Pass Comp |
|---|---|---|---|---|---|
| 0.33 | 8 | 12,000 | 12,000 | 12,500 | 13,000 |
| 0.37 | 9 (or 10) | NA | 12,200 | 12,700 | 13,300 |
| 0.40 | 10 | 13,600 | 13,800 | 14,300 | 14,900 |
| 0.49 | 12 | 15,200 | 15,400 | 15,900 | 16,500 |

**Notes on Table:** 1) The salaries above assume that the graduate student has permission to be a "teaching assistant." If English is not the GTA's native language, the GTA must attend the International Teaching Assistant Workshop for three weeks. At the end of the workshop, they make a presentation before a panel and the panel decides whether the TA can be given teaching duties. Those who do not gain this "ITA approval" are assigned grading duties and (this year) are paid $11,000 per year.
2) All GTAs who have a .33 FTE appointment (Full Time Equivalent) or more receive a tuition waiver (up to 12 hours) each semester and then a 12 hour tuition waiver in the summer, even if they don't have teaching duties in the summer.
3) After the first year, GTA salaries are tied to whether the GTA has passed the Department's Qualifying Exam and/or the Comprehensive Exam.

Figure 10.9: GTA Salary Structure for 2000/2001

Assistantships or other fellowships which provide purely research support for graduate students. Unlike the situation in many of the other sciences, external funds for graduate student support in mathematics and statistics are extremely limited. Nonetheless, some advanced students have received summer research assistantships under faculty NSF grants.

There are four categories of University-administered support for graduate students.

*Teaching Assistantships:* Students known to be proficient in the English language and having full graduate standing are generally allowed to teach two 2-credit courses each semester. As the Department gains confidence in their teaching performance, they may be allowed to teach up to two courses each semester totaling 6 hours. See Figure 10.9 for stipend salaries.

*Loans:* Two of the loans described in the section for undergraduate students are also available to graduate students. These are the National Direct Student Loan Program and the Guaranteed Student Loan Program. Neither is available for most foreign students.

*Fellowships for Currently Enrolled UNL Students:* These are: Presidential Fellowships; Mildred Francis Thomson Fellowship; Maud Hammond Fling Fellowship; J. J. and Eleanor Ogle Fellowship; and the Franklin E. and Orinda M. Johnson Fellowship. Smaller awards are the Gerald L. Philippe Memorial Awards. Also available are travel awards to support dissertation research through the Warren F. and Edith R. Day Student Aid Fund.

For details on these fellowships and awards, see pages 12–13 of the 2000-2002 Graduate Studies Bulletin.

*Fellowships for New UNL Graduate Students:* These are: Othmer Graduate Fellowships; Chancellor's Doctoral Fellowships; Richard H. Larson Minority Graduate Fellowships; Graduate Nonresident Fellowships; and Regents Tuition Fellowships. Further details on these fellowships may be found on page 12 of the 2000-2002 Graduate Bulletin.

The Department has found these fellowships, particularly the Othmer Fellowships, useful in recruiting outstanding new graduate students. There are 66 Othmer Fellowships available, each of which is worth $7500 per year. They are awarded competitively campus-wide to new students as a part of recruitment. Fall 2000 was the first year of the program, and 22 three-year, 22 two-year, and 22 one-year fellowships were awarded to students starting in Fall 2000. The department was especially successful gaining permission to make offers of 7 Othmer fellowships, which resulted in attracting 4 Othmer Fellows this year.

When combined with a GTA award of $12,000–$15,200 per AY plus summer support of $3400, tuition waiver, and health benefits, Othmer Fellowships enable the Department to make especially attractive offers to new graduate students.

In addition to the fellowships listed above, the Department has several awards and fellowships. A complete listing of these awards and awardees can be found in Appendix E.2.

Approximately 12% of Departmental students are not listed with any particular funding support. Very few of these are locally employed. Their source of funds seems to be family, friends, private organizations, foreign government scholarships and in one case, the US Air Force.

**Professional Preparation** Proficiency in explaining mathematics is vitally important to almost any career goal for Departmental graduate students. It is important that they refine this art quickly, since most will be teaching assistants during much of their tenure here. All new TA's are required to attend a Departmental Fall Orientation Meeting in which they receive, inter alia, initial training on how to conduct their classes; these training sessions are conducted by the Department's best teachers. More information on TA training is given in the discussion on page 33. Until the Department is confident in a TA's teaching abilities, the TA is assigned to assist one of the regular faculty in a large lecture course.

Foreign (international) students who have been awarded assistantships cannot have a classroom teaching assignment until they have attended the International Teaching Assistant Institute, a three-week program on language and American culture sponsored by the University's Teaching and Learning Center (TLC). The workshop ends with an examination in spoken English. The student is graded pass or fail by a panel consisting of: TLC members; an English Department specialist on English as a Foreign Language; a Departmental faculty member; and a Departmental undergraduate. A student who fails is assigned to grade papers for advanced courses or sections of Business Calculus (Math 104), at a substantially reduced stipend.

TA's who are recitation lecturers meet with groups of 25–30 students twice each week, to explain problem solutions. The lecturer monitors the TA's performance, offers suggestions, and collects a summary of the student evaluations of the TA for the TA's and the Department's use. Those TA's who receive good marks on their evaluation forms are allowed to teach a greater variety of courses and their stipend is increased, thereby emphasizing the Department's very serious attitude toward teaching responsibilities.

Most of the Department's Ph.D. graduates accept academic jobs. For them, teaching and dissertation research comprise the necessary job training. For those who plan to enter non-academic careers and for all students in the Masters program, the Department heavily emphasizes the need for applied courses. This usually consists of courses in applied mathematics or statistics, and in computer science, as suggested by various non-academic employers of Departmental graduates.

The Department also participates in a University program, "Preparing Future Faculty" which is designed to provide students understanding of the challenges and responsibilities of academic positions.

In order to receive a Ph.D., students are required to participate in seminars, which give them valuable practice in presenting advanced technical material.

Students graduating from the Department have thus had numerous opportunities for professional preparation: teaching experience, curricular planning and development, experience giving seminars, research experience, experience with organizing workshops, etc.

**Evidence of Student Learning** Evidence of student learning is obtained from the Qualifying and Comprehensive examinations, and from dissertations.

**Placement of Graduate Students** The following table gives the placement of graduate students since 1994.

The placement column gives the list of all known positions held since receipt of degree, listed in ascending chronological order.

Ph.D. Placement since 1994

| Year | Student | Advisor | Placement |
|---|---|---|---|
| 1994 | Arora, Vipin Kumar | Partha Lahiri | Statistical Team Leader, Eli Lilly and Company. |
| | Cimen, Nuri | Roger Wiegand | Assistant Professor, Hacettepe University. |
| | Holay, Sandeep H. | Brian Harbourne | Instructor, Southeast Community College – Lincoln. |
| | Huffman, Timothy J. | David Skoug | Assistant Professor, Northwestern College (Iowa). |
| | Li, Aihua | Sylvia Wiegand | Visiting Assistant Professor, North Dakota State; Assistant Professor, Loyola University of New Orleans. |
| | Lim, Jae-Hak | Dong Ho Park | Assistant Professor, Taejun National Uinversity of Technology |
| | Kilibarda, Vesna | John Meakin | Assistant Professor, University of Alaska–Southeast; Assistant Professor, Indiana University Northwest. |
| 1995 | Atici, Ferhan | Allan Peterson | University of Ege (Turkey). |
| | Campbell, Nancy L. | K.M. Saxena | Assistant Professor, John Carroll University. |
| | Harmsen, Betty Jean | Allan Peterson | Instructor, University of Nebraska – Omaha; Assistant Professor, N.W. Missouri State; Assistant Professor, Dana College. |
| | Jajcay, Robert | Spyros Magliveras (C.S.) | Assistant Professor, Indiana State University. |
| | Nam, Kyung Hyun | Dong Ho Park | Assistant Professor, Kyonggi Uinversity |
| | Pfabe, Kristin A. | Thomas Shores | Assistant Professor, Univsersity of Northern Kentucky; Assistant Professor, Nebraska Wesleyan University. |
| | Reyes, Jose Tristan Fua | Gerald Johnson | Chair of the Mathematics Department at De La Salle University, Manila, Phillipines. |
| 1996 | Al-Khaled, Kamel | Thomas Shores | Assistant Professor, Jordan University of Science and Technology. |
| | Herzinger, Kurt D. | Roger Wiegand | Assistant Professor, West Texas A & M; Assistant Professor, US Air Force Academy. |
| | Jorgensen, David A. | Roger Wiegand | Postdoctoral position at University of Texas–Austin; Assistant Professor; University of Texas–Arlington. |
| | Morelli, Michael | Allan Peterson | Central Michigan University; University of Wisconsin-Stout; Lockheed-Martin. |
| | Szaniszlo, Zsuzsanna | A. Jamie Radcliffe | Assistant Professor, University of South Dakota. |
| | Wang, Kaicheng | John Meakin | National Indemnity, Omaha. |
| | Yamamura, Akihiro | John Meakin | Visiting Researcher, Telecommunications Advancement Organization of Japan. |
| 1997 | Anderson, Douglas R. | Allan Peterson | Assistant Professor, Concordia College (MN). |
| | Avery, Richard Irvin | Allan Peterson | Utah State University; Dakota State University. |
| | Butar Butar, Ferry | Partha Lahiri | Assistant Professor, Sam Houston State University. |
| | Dawkins, Paul | Steve Dunbar | Assitant Professor, Lamar University (Beaumont, TX). |
| | Fitchett, Stephanie | Brian Harbourne | Lecturing Fellow, Duke University; Assistant Professor, Florida Atlantic University. |
| | Holley, Darren J. | Roger Wiegand | Omaha North High School. |
| | Homp, Michelle Reeb | David Logan | Assistant Professor, Concordia University (NE). |
| | Jajcayova, Tatiana | John Meakin | Assistant Professor, Cornelius University, Bratislava, Slovakia. |
| | Mueller, Jennifer L. | Thomas Shores | NSF Postdoctoral Fellow, Rensselaer Polytechnic Institute; Assistant Professor, Colorado State University. |
| | Olsen, Cheryl L. | Earl Kramer | Assistant Professor, Shippensberg Univisity (PA). |
| | Ruyle, Robert L. | John Meakin | Visiting Assistant Professor at Nebraska Wesleyan University; Assistant Professor, University of Alaska–Southeast. |
| | Sapir, Olga B. | John Meakin | Visiting Assistant Professor, Vanderbilt University. |
| | Van Peursem, Dan | Glenn Ledder | Assistant Professor, University of South Dakota. |

Ph.D. Placement since 1994

| Year | Student | Advisor | Placement |
|---|---|---|---|
| 1998 | Krueger, Robert | Allan Peterson | Assistant Professor, Coe College. |
| | Saydam, Serpil | Sylvia Wiegand | Assistant Professor, University of Louisiana-Monroe. |
| | Wei, Ruizhong | Earl Kramer (M&S) and Doug Stinson (C.S.) | Postdoctoral Fellow, University of Waterloo; Assistant Professor, Lakehead University (Thunder Bay, Canada). |
| | Wu, Chien-Hua | Partha Lahiri | Statistical Reviewer at the Center for Drug Evaluation, Taiwan. |
| 1999 | Bell, Darryl | Bo Deng | Research Assistant Professor, Department of Electrical Engineering and Center for Electro-Optics, University of Nebraska-Lincoln. |
| | Deis, Tim | John Meakin | Assistant Professor, University of Wisconsin-Platteville. |
| | Nielsen, Lance | Gerald W. Johnson | Assistant Professor, Creighton University. |
| | Pollis, Tim | Jamie Radcliffe | Actuarial Analyst, Tillinghast-Towers Perrin. |
| | Taylor, Krista Jean | Bo Deng | Assistant Professor, Shawnee State University. |
| | Wagstrom, Rikki | Steve Cohn | Assistant Professor, Calvin College. |
| | Wan, Shu-Mei | Partha Lahiri | Assistant Professor, Lunghwa Institute of Technology, Taiwan. |
| | Gierke, Paul | Tom Shores | Visiting Assistant Professor of Computer Science, Nebraska Wesleyan University; Senior Analyst, ALPHATECH, Inc. |
| 2000 | Abu-Jeib, Iyad | Tom Shores | Instructor, Computer Science Department, UNL. |
| | Agre, Keith | Mohammad Rammaha | Visiting Assistant Professor, Nebraska Wesleyan. |
| | Akin, Elvan | Alan Peterson | Kocaeli University in Izmit, Turkey. |
| | Ira, Michael | Earl Kramer | Assistant Professor, University of Wisconsin-Platteville. |
| | Johnson, Lisa | Gerald Johnson | Assistant Professor, University of St. Thomas. |
| | Leuschke, Graham | Roger Wiegand | NSF Postdoctoral Fellow, University of Kansas. |
| | Meza, Jane | Partha Lahiri | Assistant Professor, Department of Preventative and Societal Medicine, University of Nebraska Medical Center. |
| | Strei, Theresa | Mohammad Rammaha | National Security Agency. |

Figure 10.10: Ph.D. Placement since 1994

**Student Opinion of the Graduate Program** This Fall the Department surveyed its 179 graduates with graduate degree dates (115 Masters and 64 Doctorates ) since May 1990. A copy of the survey with tabulations of the responses can be found in Appendix E.1.

Below is a summary of the responses. Appendix E.1.1 contains a complete analysis of the responses. Graduate students seemed pleased with the program.

The graduate survey had a somewhat different format from that of the undergraduate survey discussed earlier, although the multiple choice questions stuck to the same basic format. Of the 36 replies, 22 were from women. Also, 13 respondents had received a Ph.D., 25 had received a M.A. or M.S., including 6 who received both. Four received MAT or MScT degrees.

In the overall rating of the graduate program, the average was 3.19 (on the same 4 to 0 scale used in the undergraduate survey), with no rating of less than ‘good’.

We asked ‘how well the [Department] performed in providing you with a supportive environment for your graduate studies’. The average was 3.39 (out of 4), splitting as 3.56 for Ph.D. recipients and 3.25 for Masters. The average for women was 3.57; for men, 3.27. There were relatively few written comments, none of them negative.

Computer facilities received a respectable rating of 2.47. There were a number of suggestions, notably more machines, more workshops on the use of technology, and the incorporation of computer work into courses. Respondents

were glad to have learned to use graphing calculators in teaching and to have learned LaTeX(particularly popular in writing dissertations) and computer algebra packages. Several people on the statistics side mentioned SAS.

The library drew a 'very good' rating (3.03) but relatively little comment. One person suggested longer hours and another commented that having it in the department was 'a luxury I didn't know I should appreciate'.

The Qualifying and Comprehensive Exams drew considerable comment. About half the respondents offered some variation on 'about right', with most commenting that the exams were fair. Some said they were quite difficult while one suggested that 'Certainly don't need to be watered down'.

We asked respondents to rate 'advising for graduate students'. The average overall was 2.77; for women, it was 3.07, for men, 2.59. The average rating for Ph.D. recipients was 2.69 while for Masters recipients, it was 2.88.

There was a range of responses to 'what advice do you wish you had received'. Eight respondents wished they had been told to take a greater variety of courses, both inside and outside the department; a number mentioned taking more statistics courses. The second most popular topic was career advice, in particular, knowing about and preparing for a variety of careers. One respondent specifically mentioned industry "internships/fellowships". A few people commented that they wished they had a better sense of the time-line and requirements for completing a Ph.D. Finally, several wished for more advice on doing research, either writing grant proposals, searching the literature, or just 'how to survive as a researcher'.

Asked to rate instruction out of the same 5 choices (excellent(4) to poor (0)), all responses were in the top three (excellent to good), with an average of 3.25 overall.

# Chapter 11

# Budgetary Data for Program

## 11.1 Budgetary Data for the Department

To understand the financial resources available to the Department, one must understand the permanent state budget, how the department obtains temporary instructional funds, UNL policies on returned overhead, funds for instructional equipment, start-up funds, foundation funds, programs allied with the department, and other occasional opportunities for special funds.

### 11.1.1 Permanent State Budget

Figure 11.1 provides a 20 year history of the Department's permanent state budget. This should be viewed as a snapshot of the budget on July 1 of each new fiscal year. The benefits portion of the state budget is not included because these funds are controlled centrally and the Department does not get access to these funds if there is a balance at the end of the year, nor does the department suffer a loss if the benefits line runs a deficit.

If a faculty member goes on leave without pay, is on assignment to another part of the university, or has grant funds to "buy out" a portion of his or her salary, the Department does not automatically get any portion of the faculty member's salary either for hiring visitors or meeting other Departmental needs. Similarly, if a faculty member resigns or retires, the corresponding salary dollars are removed from the Department's budget and placed in a salary pool in the Dean's budget. The Dean's Office gives the Department the opportunity to recover some or all of the former faculty member's salary by arguing that the Department has a need for "replacement funds." However, the decision to grant the Department replacement funds is based primarily on whether the Department needs the funds to meet necessary instructional responsibilities and there is no guarantee of any return of dollars to the Department's budget.

Starting with FY94/95, the Department has received $40,000 annually in permanent funds from a College allocation of instructional funds to "stressed departments." These funds effectively add one Ph.D. level faculty member to the Department and have been used each year to hire a new PhD on a postdoctoral appointment. Unfortunately, University policy does not add salary increase funds to this kind of salary pool and so the "buying power" of the money has eroded each year. During FY 1999/2000, the funds were combined with some GTA funds to provide permanent funds to support a .67 FTE appointment for Lynn Erbe.

GTA funds are available to the department to hire GTAs, undergraduate TAs or undergraduate employees in the Math Resource Center. Over the past seven years GTA funds have grown 21%, approximately 2.78% per year. Increases have been used to increase GTA stipends. The significant growth in funds for support staff results from the permanent funding of our computer system administrator and from the upgrades of the positions of our office staff. Not reflected in this budget is the salary of our newest staff member who was hired as the administrative assistant to the Director of the Division of Statistics.

The 20-year history of the Department's operating budget shows one significant increase for FY 1987/88 and then stagnation through FY 1994/95. These funds were significantly increased in FY 1995/96 and the following year but now they have again begun to stagnate.

In the early 1990s the Department instituted a $15 "lab fee" to support the Department's undergraduate computer lab. This fee is charged primarily in Math 221 and Math 314 and provides about $13,000-14,000 per year to support software upgrades and maintenance of the lab.

Department of Mathematics and Statistics Permanent State Budget - 1981/82 - Present

| Academic Year | Faculty Salaries | Temporary Salary Pool | GTA Stipends | Total Instruction | Support Staff | Student Workers | Operating | Budget Total |
|---|---|---|---|---|---|---|---|---|
| 1981/82 | 989827 | | 249747 | 1239574 | 33137 | 809 | 20746 | 1294266 |
| 1982/83 | 1014462 | | 223191 | 1237653 | 34064 | 809 | 21519 | 1294045 |
| 1983/84 | 1040997 | | 228638 | 1269635 | 28484 | 809 | 21519 | 1320447 |
| 1984/85 | 1152344 | | 265241 | 1417585 | 30794 | 809 | 21519 | 1470707 |
| 1985/86 | 1218082 | | 254362 | 1472444 | 33391 | 809 | 21519 | 1528163 |
| 1986/87 | 1212109 | | 279589 | 1491698 | 32471 | 809 | 21519 | 1546497 |
| 1987/88 | 1254113 | | 283069 | 1537182 | 34392 | 833 | 31372 | 1603779 |
| 1988/89 | 1354176 | | 321671 | 1675847 | 34111 | 911 | 31385 | 1742254 |
| 1989/90 | 1470184 | | 349174 | 1819358 | 39021 | 1006 | 32248 | 1891633 |
| 1990/91 | 1660543 | | 385279 | 2045822 | 40811 | 1110 | 32732 | 2120475 |
| 1991/92 | 1826658 | | 385279 | 2211937 | 43226 | 1154 | 32732 | 2289049 |
| 1992/93 | 1812164 | | 493215 | 2305379 | 45161 | 1204 | 32732 | 2384476 |
| 1993/94 | 1844614 | | 521890 | 2366504 | 46184 | 1212 | 32372 | 2446272 |
| 1994/95 | 1889660 | 40000 | 536764 | 2466424 | 48387 | 1248 | 33354 | 2549413 |
| 1995/96 | 2004100 | 40000 | 558234 | 2602334 | 62730 | 1298 | 79954 | 2746316 |
| 1996/97 | 2003823 | 40000 | 574981 | 2618804 | 65668 | 1337 | 84687 | 2770496 |
| 1997/98 | 1983957 | 40000 | 592230 | 2616187 | 91364 | 6527 | 84687 | 2798765 |
| 1998/99 | 1854068 | 40000 | 609996 | 2504064 | 95022 | 6723 | 86687 | 2692496 |
| 1999/2000 | 2004799 | 40000 | 607988 | 2652787 | 117200 | 5995 | 88421 | 2864403 |
| 2000/01 | 2157707 | | 631883 | 2789590 | 127045 | 6280 | 88421 | 3011336 |

Figure 11.1: Permanent State Budget

**JUMP** Officially, the Department has control over the Junior Mathematical Prognosis Exam budget, but that program is administered by the Center for Science, Mathematics, and Computer Education. Occasionally, the CSMCE Director has made end-of-year funds available to the Department. For example, this was done two years ago to purchase a new copy machine for the department.

### 11.1.2 Temporary Funds

Temporary funds are needed each year to maintain student access to courses in mathematics and statistics. Figure 11.2 gives a nine-year history of the Department's "soft-money" instructional budget. Funds are reported in the 'Replacement Funds' column if the funds were made available to the Department with a direct connection to the faculty member being replaced. Funds are placed in the 'Grant Buyout' column if directly connected to a grant received by a faculty member.

#### Temporary Instruction Funds

These funds include a large, annual allocation to the Department, funds specifically allocated to support honors instruction or funds to offer Comprehensive Education Program courses. Funds in the Special Projects column are connected with dual career support, diversity funds, support for Math Reach, or offering a section of Math 189H.

Math Excel funds are not included in this Temporary Funds report because Math Excel funds do not increase the number of courses offered or students served. For example, the department would normally assign one first-year GTA to teach two recitation sections of calculus. Math Excel sections meet twice as long and use experienced GTAs. Thus, it would take two experienced GTAs to offer two Math Excel recitation sections. The Department's regular budget would provide the resources needed to hire one new GTA and Math Excel funds would provide the additional funds necessary to hire a second person and to hire experienced GTAs.

Department of Mathematics and Statistics
Temporary Instruction Budget - 1992/93 - Present

| Academic Year | Temporary Instruction | Replacement Funds | Grant Buyout | Special Projects | Total Temporary Instruction |
|---|---|---|---|---|---|
| 1992/93 | 25000 | 44399 | 82986 | | 152385 |
| 1993/94 | 42900 | 39342 | 21547 | 15000 | 118789 |
| 1994/95 | 33255 | 82352 | 21915 | 85500 | 223022 |
| 1995/96 | 44000 | 84000 | 36600 | | 164600 |
| 1996/97 | 40000 | 61000 | 20000 | 36500 | 157500 |
| 1997/98 | 114800 | 104000 | | 13800 | 232600 |
| 1998/99 | 176000 | 136579 | | 27000 | 339579 |
| 1999/2000 | 216500 | 55500 | | 25450 | 297450 |
| 2000/01 | 250500 | 138200 | | 25000 | 413700 |

Figure 11.2: Temporary Instruction Budget

**Special Funds**

Special Funds are available to the Department from sources such as returned overhead, instructional equipment funds, start-up funds, and funds from the Department's main account at the UN Foundation. These funds are reported in Figure 11.3.

*Returned Overhead* In the early 1980s the University began returning to individual departments a portion of the indirect cost funds collected from grants generated by faculty in that department. This Returned Overhead became an important source of funds to the Department, especially after Nebraska's Statewide Systemic Initiative grant increased the amount of returned overhead to more than $20,000 in the 1992/93 fiscal year. The Department has used these funds to support enhanced start-up packages for new faculty, to support computer purchases, and to support travel by faculty and graduate students. Although a number of factors go into determining how much money is returned to individual departments, in recent years the amount has been close to 27% of the amount collected. This source of funds for the Department is now threatened by a planned change to a policy which would give the Department 11% and the individual PI 11% and also to keep a larger share of funds in the Dean's Office. What will actually happen is uncertain and at the end of 2000 we still do not know how much the department will receive this year in returned overhead.

*Instructional Equipment:* Each fall, since at least FY 1988/89, the University has had an annual allocation of Instructional Equipment money. The source of this money is not exactly clear and the amount available varies each year. Occasionally, there has been a special allocation of Instructional Equipment money in the spring. As indicated by the funds reported in Figure 11.3, this has become an important source of money for the Department.

*Startup Funds:* Starting with hires made during the 1989/90 Academic Year, the Department has been able to get support from the Dean's Office (and sometimes from the Office of the Vice Chancellor for Research) for start-up offers to new hires. Typically, the Department must pay a percentage of the offer and the Dean's Office and VCR pay a percentage of the total offer. This has been an important source of money to provide new hires with good computer equipment and, in the last few years, with an offer of some summer salary.

*End-of-Year and Other Temporary Funds:* In addition to the funds reported in Figure 11.2 and Figure 11.3, there have been occasions when the College of Arts & Sciences made available end-of-year funds to departments. Also, for a few years the College asked departments to request temporary funds for each quarter. For example, several years ago, the Department received $10,000 from the College to help with a renovation of the Department's Main Office and the Department received $10,000 from the College to support its Centennial Celebration. Another regular source of funding is a travel fund that allows each faculty member to spend up to $800 per year for travel as long as the faculty member is giving a talk or otherwise has a significant role at a meeting. Other occasional requests to the A&S Dean's Office provide small amounts of money to support items such as graduate student recruiting.

Department of Mathematics and Statistics
Temporary Budget - 1985/86 - Present

| | Returned Overhead | Instructional Equipment | Start-up Funds | Foundation Fund #2477 |
|---|---|---|---|---|
| 1985/86 | 5064 | * | 0 | 2461 |
| 1986/87 | 6624 | * | 0 | 193 |
| 1987/88 | 9667 | * | 0 | 4776 |
| 1988/89 | 14341 | 16000 | 0 | 2946 |
| 1989/90 | 9304 | 30000 | 0 | 9667 |
| 1990/91 | 3191 | 15720 | 14000 | * |
| 1991/92 | 2592 | 52864 | 0 | * |
| 1992/93 | 22592 | 30723 | 0 | 3562 |
| 1993/94 | 56990 | 52461 | 15000 | 4840 |
| 1994/95 | 30878 | 30008 | 0 | 1728 |
| 1995/96 | 42953 | 31833 | 9843 | 11669 |
| 1996/97 | 37523 | 50046 | 17038 | 1115 |
| 1997/98 | 53015 | 31501 | 8707 | 2934 |
| 1998/99 | 37538 | 21562 | 21951 | 4400 |
| 1999/2000 | 35075 | 19336 | 31677 | 2608 |
| 2000/01 | ?? | 44035 | # | 1502 |

Notes: * = Records Incomplete
# = Funds received to date = $11,529

Figure 11.3: Special Temporary Funds Budget

Department of Mathematics and Statistics
Funds held at the U. N. Foundation
As reported by the Foundation on 11/30/00

| Fund | Endowment Book Value | Endowment Market Value | Cash |
|---|---|---|---|
| Math Department | | | 47,131 |
| Eastman | 1,574,749 | 3,911,964 | 201,310 |
| Emeritus | 60,749 | 92,124 | 7,947 |
| Gallup-Math Day | 64,509 | 64,463 | 19,595 |
| Jim & Doris Lewis | 28,604 | 27,849 | 962 |
| Don Miller | 189,952 | 221,989 | 36,404 |
| Rennemann/Luebbers | 19,978 | 21,762 | 888 |
| Ruby Matzke Whittemore | 9,999 | 12,192 | 744 |
| GC & WH Young | 13,329 | 22,636 | 2,106 |

Figure 11.4: UN Foundation Funds

### 11.1.3 UN Foundation

The Department has a growing number of special funds at the UN Foundation. The *Math/Stat Fund* is the primary fund to which alumni make small donations. The recent history of using this fund is reported in Figure 11.3. Also, Figure 11.4 gives the current value of this fund ($47,131) and several other funds that support the Department.

*Eastman Fund:* By far the Department's largest fund at the UN Foundation is the Dean and Floreen Eastman Fund which supports scholarships for undergraduate students. As of Fall 2000, the Fund has provided over $1,000,000 in scholarship support for undergraduate mathematics majors and another $68,000 will be allocated in the spring. Two other funds for undergraduate scholarships (Whittemore, Rennemann/Luebbers) are reasonably new and will begin awarding scholarships next year. There are also several scholarship funds that are administered by the Scholarships and Financial Aids Office but which set aside a portion of their funds for mathematics majors.

*Emeritus Faculty and Young Funds:* The Emeritus Faculty Fellowship Fund and the GC & WH Young Fund are two funds that provide small, supplementary fellowships for graduate students. Both funds have primarily been created and sustained by faculty donations although one alumni has made substantial donations to the Emeritus Fund in recent years. Since establishing the Emeritus Fund in 1989 and the Young Fund in 1996, the department has awarded $22,400 in fellowships and will soon award another $4,000.

*Rowlee Fund:* The Howard Rowlee Fund was set up five years ago by Mr. Rowlee who wanted to create a fund to support research in the department. Although the amount of money currently in the fund is small, Mr. Rowlee has purchased a $100,000 life insurance policy with this fund as his beneficiary. To thank Mr. Rowlee and allow him to see the results of his donation during his life time, the Department created the Howard Rowlee Lectures which will eventually be funded by the Howard Rowlee Fund.

*Gallup Math Day Fund:* The Gallup-Math Day Fund was started three years ago and results from a decision by The Gallup Organization to become the official sponsor of the Department's UNL Math Day. This Fund now supports scholarships won by students at UNL Math Day.

*Miller Fund:* The Miller fund was set up in 1993 and honors the mathematics education work of the late Donald W. Miller, a long time professor in the department. It has seldom been used and has grown in value to over $250,000. The *Lewis Fund* was created in 2000 and has yet to be used. Together, these two funds represent new resources that can support the work of faculty in the department.

*Other Funds:* During the planning for this Academic Program Review, the faculty identified additional named professorships and a named postdoctoral position as priorities for the department. The Department is currently in the early stages of a special fund drive and has raised over $45,000 to support department priorities. These funds are not yet reported in Figure 11.4.

# Chapter 12

# Adequacy of Support Services, Physical Plant and Resources

### 12.0.4 Library

The Department has a branch library located within the Department. The library is a key resource for research activity in the Department. The presence of a branch library of mathematical holdings is definitely an asset for the Department whose value is keenly appreciated by the faculty. A very useful tool made available to all faculty in the mid 1990s is MathSciNet. This is a modern computerized abstracting service which allows access to Mathematical Reviews and greatly facilitates literature searches.

There are real difficulties looming over the library's future. One problem is that of space; currently, only 6% of shelf space remains free in the Math Library, well below the 13% level considered full by national standards for a circulating library. More and more Math Library materials have been relocated to a central campus location away from the Department because of space problems. Figure 12.1 shows trends in shelf space since 1993. However, the Department expects that library space pressures will be mitigated when the Department moves to Avery Hall in several years' time.

An ongoing budgetary problem for the library is that costs of library materials have for some time outstripped increases in the library budget. Several expensive subscriptions have been replaced by one or more serials of lesser costs. Also, any new subscriptions must be balanced by canceling current ones; a number have been lost in recent years. Journal price increases resulting in subscription cancellation represent a particularly serious threat to the Department's ability to conduct research. Indeed, the library and its journals may properly be viewed as the most important research tool in the mathematical sciences.

### 12.0.5 Computing

Every faculty member in the Department and most graduate students have a computer in their office which is linked to the Department's computer network.

The Department has no permanent budget for computer maintenance. This represents a potentially serious problem. Indeed, maintenance for computers presently is done via replacement—as computer equipment fails, it is replaced using funds from new equipment requests. Thus, should such funds become more difficult to obtain, the Department may find itself with a reduction in computing power.

The computing needs of the Department have increased dramatically in the past seven years, and the Department has generally been able to obtain the necessary software and equipment. Along with the increase in computing needs comes a corresponding increase in the need for computer technicians. Currently, the Department has one permanent computer technician, Rex Dieter, and a graduate student was hired (using temporary funds) to assist him.

The College has established a testing center for administering on-line exams. Technical administration of the testing center falls primarily upon Rex Dieter, and consumes an ever increasing amount of his time. Thus, while the Department's computer technicians are extremely good, the Department is lacking in adequate computing support personnel.

**SUMMARY OF SHELF SPACE IN MATH LIBRARY PROPER, 1993 - 2000**
(Annual Measurements in meters (m) for all materials)

| YEAR | TOTAL SPACE (m) | OPEN SPACE (m) | % OPEN | APPROX. GROWTH (m) | NOTES |
|---|---|---|---|---|---|
| 1993 | 792 | 110 | 14% | 26 | |
| 1994 | 816 | 103 | 13% | 30 | Began use of original East Wall built-ins |
| 1995 | 816 | 77 | 9% | 26 | |
| 1996 | 863 | 96 | 11% | 28 | East Wall shelf construction |
| 1997 | 863 | 72 | 8% | 24 | Move 11 titles to LOVE & ENGR |
| 1998 | 863 | 44 | 5% | 29 | |
| 1999 | 863 | 77 | 9% | 17 (?) | Move titles to LNB |
| 2000 | 863 | 48 | 6% | 29 | |

Note: MATH library has never routinely measured all serials holdings. We measure empty shelf space remaining annually in May-June. We measure specific sets, usually those that are candidates for transfer or storage. We also measure recent years of active sets to obtain estimates of growth needs. In future, particularly in preparation for the move to Avery, we probably will measure the entire shelf space occupied by journals, but that specific information is not currently available.

Figure 12.1: Math/Stat Library Shelf Space, 1993–2000

### 12.0.6 Office Support

The 1993 APR made a strong case that the Department was seriously under-staffed in office support. The College upgraded the job classification for three office personnel to Administrative Assistant and recently permitted the hiring of an Administrative Assistant to provide support for the Statistics Division. An increase in funds has enabled the Department to hire more student workers to handle some of the routine office tasks. These improvements have been extremely beneficial, but the Department remains under-staffed.

Faculty would be particularly appreciative of additional office support to help with such activities as coordinating events and administering or preparing grants.

## 12.1 Adequacy of Physical Plant

The Department looks forward to moving to more spacious quarters in Avery Hall. The Department expects that most of the serious space issues described below will be resolved once the Department is relocated. It is very important, however, that renovation plans for Avery Hall allow sufficient room for the Department to grow should the Department be allowed to hire desperately needed faculty.

*Instructional Facilities and Seminar Rooms:* The Department's instructional facilities are generally sufficient to meet its instructional needs and little further comment is required here.

The Department has a single seminar room, which holds approximately 10 people and is used for both conferences and seminars. It is in such high demand that it is often difficult to schedule seminars. A larger seminar room and separate conference room would be desirable.

*Offices:* Faculty offices are adequate, though somewhat small. The recent renovation of offices in Oldfather Hall has been an improvement, for most faculty now have wall mounted bookcases which somewhat mitigates the small office size.

However the total number of offices is inadequate for the Department. There is little space for emeritus faculty,

Oldfather offices used by graduate students are occupied by three or more graduate students, and there is not enough space to house visitors.

All first-year and many second-year graduate students must use cubicles in the 501 Building located several blocks away from Oldfather Hall. It would be desirable to have the entire Department housed in one building.

*Maintenance and Operation:* Generally faculty feel maintenance and operation are good, with two rather minor exceptions. Transparency projectors in some classrooms are sometimes poorly maintained. Indeed, it can be embarrassing to UNL when a high-profile colloquium speaker must scrub the lens with a cloth or deliver a lecture using a blotted lens. Also, some faculty expressed frustration with the recent reduction in custodial services.

## 12.2 Adequacy of Resources

The principal resource issue for Departmental faculty is lack of time resulting from too few faculty members. This has been well documented elsewhere in this self-study, however it has a negative impact on all facets of the Department's mission.

Research in mathematics requires long periods of uninterrupted study, which, in the current environment, is increasingly rare.

# Part IV

# Program Evaluation and Development

# Chapter 13

# Student Assessment

## 13.1 Undergraduate Assessment

The Department developed an Undergraduate Assessment Plan in a deliberative process over two semesters that involved the entire faculty in discussions and, eventually, approval. The original plan was presented to the College in April 1996 and approved at that time. A slightly revised plan was submitted and approved a year later. The College just recently approved our fall 2000 report. The fall 2000 report and the revised plan are in Appendix F, but a brief summary follows.

The Plan has a set of 3 goals and then a series of 10 objectives that the Department feels are measurable and indicative of how well we are meeting our goals. The goals are to develop students who:

- understand and are able to use the processes and procedures of mathematics;
- are mathematically literate, with the ability to learn independently, reason effectively and express themselves articulately both orally and in writing; and
- understand the role mathematics plays in a broad range of disciplines and in modern society.

The 10 objectives are:

(a) to think and write with clarity and precision, adducing conclusions from hypotheses in a logical and rigorous way(EX);

(b) to understand and critique arguments for rigor and logical content(LA);

(c) to understand the meaning and significance of mathematical terminology and concepts (e.g., what is the meaning and significance of a derivative, or of the variance, or of a ring, etc.)(AM);

(d) to compute efficiently and accurately (e.g., to simplify algebraically, to integrate and differentiate symbolically, and to perform matrix operations)(CM);

(e) to understand the statement and significance of important theorems (e.g., the fundamental theorem of calculus, the fundamental theorem of arithmetic, the invertibility of square matrices with nonzero determinants, the central limit theorem, etc.)(AM);

(f) to translate situations proficiently into mathematical language and analyze the results mathematically (e.g., mathematical modeling)(CM, AM);

(g) to communicate mathematical ideas proficiently(EX);

(h) to understand mathematically oriented writing (e.g., proofs, articles)(AM);

(i) to generate mathematical ideas and proofs(LA);

(j) to understand practical and career related uses of mathematics.

The "titles" CM, AM, LA, EX stand for Concrete Math, Abstract Math, Logical Arguments, Exposition. These titles match headings on the evaluation forms that our instructors use to evaluate the students in their class. So if an instructor gives a student the highest rating in the AM column, then that translates to the student being ranked high (relative to the particular course) on the objectives that are tagged by AM. Rating students in 4 simple categories is just a whole lot simpler and the Department felt far more consistent than using the full set of 9 objectives. Objective (j), the 10th objective, is the responsibility of the Chief Advisor to relay to the students and is evaluated during the exit interview.

The actual evaluation process works as follows. Fourteen courses have been identified as important major courses in which the above objectives can be measured on an individual basis. For these courses, the instructors are asked to rate each mathematics and statistics major and each Teachers College mathematics major on the Student Assessment Form. Seven courses have been identified as important to all students with a major in the mathematical sciences. For these courses, the instructors are asked to rate the middle group of the class on a collective basis on the Course Assessment Form. These forms are attached to the Assessment Plan in the appendix. The Assessment Report that was recently accepted by the College contains the results of these various assessments. What is left is to present the reports to the faculty for discussion.

## 13.2 Graduate Assessment

At the Graduate Level, the main features of the Department's assessment plan are (1) keeping track of graduate students' performance on graduate exams (Masters Comprehensive, Ph.D. Qualifying and Ph.D. Comprehensive); and (2) tracking the success of our graduates, both Masters and Ph.D.

In order to implement (2), we have recently instituted an "exit form", which gives the position the graduate holds after leaving UNL, contact information, and so on. This information will be updated if the person transfers to another job or college. For those with academic employment, we keep track of their promotion and tenure status. We have a database of email addresses for all graduates since 1995 and are working backwards with a goal of having a quick way of contacting each of our graduates since 1980. (We have found the Alumni Association records to be rather unreliable, and we share our information with them in order to help them update their records as well.) We also have a database of all publications from our graduates who received Ph.D.'s in the period 1995–1999. Next spring we will add our 2000 graduates and will periodically update the database as more publications are forthcoming. (Our initial data on publications came from email contact, since we wanted to include preprint information as well. In the future we will use the MathSciNet.)

## 13.3 Peer Review of Teaching Project

In the 1998-99 academic year, the Department participated in UNL's Peer Review of Teaching Project directed by Professor Daniel Bernstein of the Department of Psychology. This project is part of a national program by the American Association for Higher Education aimed at improving teaching through critical self-examination and peer feedback. (For more information on the Peer Review of Teaching Project, consult the project's home page at *http://www.unl.edu/peerrev*.)

The department's peer review team consisted of Professors Glenn Ledder, Jim Lewis, Mel Thornton, Judy Walker and Tom Marley. The project was focused on Math 106 and 107 (Calculus I and II), Math 208 and Math 221 (Calculus III and Differential Equations), and Math 203 (Contemporary Mathematics). It was decided that as part of our review of these courses, we would produce a body of materials (i.e., an instructor's manual) which would help other instructors teach these courses. Marley took on this task for Math 106 and 107, Ledder was responsible for Math 208 and 221, while J. Walker took on Math 203.

In addition to the people above, all Math 106 and 107 instructors in the Fall and Spring semesters of 1998-99 were involved. These people were: Professors Steve Cohn, May Nilsen, David Pitts, Jamie Radcliffe, Lecturer Skip Thomas, and graduate students Mike Ira and Karl Kattchee. Over the course of the year the group had many lively discussions relating to instruction at UNL.

## 13.4 Instruction

The Department evaluates instruction through the use of student teaching evaluations, and peer review of teaching.

Each semester, students in each course are asked to complete a teaching evaluation for the course, a copy of which may be found in Appendix D.5.

The results of the teaching evaluations are used by the Executive Committee and the Chair when preparing each faculty member's annual evaluation letter. They form the primary basis for determining the performance group into which the faculty member will be placed (see Appendix D.1.2). Moreover, a teaching performance of poor quality for two consecutive years may trigger a post-tenure review (see Appendix D.1.1).

When a faculty member is considered for promotion, a more senior faculty member is asked to write a review of the candidate's teaching, which is then placed in the candidate's promotion file. Serious discussion of the review takes place at a meeting attended by the senior faculty. This review is based on conversations with the candidate and may also be based on classroom visits.

# Chapter 14

# Program Development

## 14.1 Areas of Excellence

As documented throughout this self-study, the Department excels at all areas of its mission, in research, teaching, and outreach/service. In fact, in every facet of its mission, the Department has never performed at such high levels as it is now.

The Department has a strong faculty, active in several areas of research: applied mathematics, combinatorics, commutative algebra and algebraic geometry, differential equations and dynamical systems, function space integration, operator theory, control theory, semigroups and statistics. Publication rates are at an all time high and compare favorably with other institutions. These areas have active seminars and are producing doctoral students who are themselves being hired at academic institutions. In most cases, external funding is being obtained for these areas. There are also many examples of interdisciplinary work, involving Departmental faculty and faculty from departments such as Chemistry, Biological Sciences, Geology and Computer Science. Adding to this, the Department has hired many promising new faculty.

Teaching is outstanding at all levels, supported by a faculty committed to good teaching and high academic standards. This is documented by the number of teaching awards, by student evaluations, by the long term support of such programs as the Math Resource Center, and the large numbers of Ph.D. graduates. The Department is also deeply involved in issues of educational outreach and reform, through such programs as the American Mathematics Competition, JUMP, Math Day, ALL GIRLS/ALL MATH, Power Math, NMSI and the Math/Science Education Area of Strength, and through the introduction of technology into the classroom, as exemplified by its computer lab, its technology demonstration classroom in Bessey, its efforts in calculus reform, and by its innovations in the use of the web (eGrade and WebNotes).

The Department has vigorous undergraduate and graduate programs, conducive to substantial interaction between students and faculty. From before matriculation at UNL (via such programs as Math Day and JUMP), through entry level courses (via such programs as the placement exam, the math counselors, the Math Resource Center and the system of Honors courses), and continuing on to upper level undergraduate courses (via such activities as the Putnam Exam, Pi Mu Epsilon, and facilitating access to financial aid and research opportunities), the Department takes a hand to make students' UNL experience rewarding. A similar pattern of care is found at the graduate level. Graduate students have been included in issues of educational reform, traveling with faculty to national meetings on such issues and helping to formulate and try out new educational approaches. On the research side, faculty help students establish themselves in research both by the traditional large measure of attention graduate students receive in the Department and by such means as arranging for students to attend research conferences. Also, the Department is well known for providing a supportive environment for its students.

The Departmental library is a good facility with an excellent librarian, Margaret Tyler. Its intramural location and after-hours accessibility to faculty are particularly valuable features of the faculty.

The faculty as a whole promote an environment of cordial professionalism. Factionalism is low and faculty members are given ample opportunities to develop their own profile of professional activity in research, teaching, outreach and service.

## 14.2 Areas Needing Improvement

Departmental capacity to carry out its mission is stretched beyond its limit, and, without relief, it is unlikely the Department will be able to continue to perform at such a high level. Above all, relief is needed in the form of additional faculty lines, see Section 2.3. Secondary relief is needed in the areas of additional staff support, and computer staff and maintenance support. Physical crowding has reached crisis proportions, but will be mitigated upon moving to Avery Hall. University administrative constraints limit Departmental flexibility and autonomy in managing money for leaves, visits, travel money and positions. As described throughout this document, the Department is stretched beyond its capacity.

## 14.3 Program Development Strategies

As noted earlier, the Department is performing at the highest level in its history. Department leadership, particularly Chair Jim Lewis, has been instrumental in bringing the Department to its present level of performance and success. Since Jim Lewis has been Chair since 1988, the Department needs to prepare for a transition to a new Chair sometime relatively soon, certainly within the next 30 months. Lewis shoulders an enormous workload, and his experience, knowledge and leadership as Chair will be difficult to replace. Thus the Department welcomes suggestions on preparing for the transition from the review team and the administration.

# Part V

# Appendicies

# Appendix A

# Mission Statements

## A.1 Mission Statement, University of Nebraska, Lincoln

**The Role of the University of Nebraska-Lincoln** The University of Nebraska-Lincoln, chartered by the Legislature in 1869, is that part of the University of Nebraska system which serves as both the land-grant and the comprehensive public University for the State of Nebraska. Those responsible for its origins recognized the value of combining the breadth of a comprehensive University with the professional and outreach orientation of the land grant University, thus establishing a campus which has evolved to become the flagship campus of the University of Nebraska. UNL works cooperatively with the other three campuses and Central Administration to provide for its student body and all Nebraskans the widest array of disciplines, areas of expertise, and specialized facilities of any institution within the state.

Through its three primary missions of teaching, research, and service, UNL is the state's primary intellectual center providing leadership throughout the state through quality education and the generation of new knowledge. UNL's graduates and its faculty and staff are major contributors to the economic and cultural development of the state. UNL attracts a high percentage of the most academically talented Nebraskans, and the graduates of the University form a significant portion of the business, cultural, and professional resources of the State. The quality of primary, secondary, and other post-secondary educational programs in the state depends in part on the resources of UNL for curricular development, teacher training, professional advancement, and enrichment activities involving the University's faculty, museums, galleries, libraries, and other facilities. UNL provides for the people of the state unique opportunities to fulfill their highest ambitions and aspirations, thereby helping the state retain its most talented youth, attract talented young people from elsewhere, and address the educational needs of the non-traditional learner.

The University of Nebraska-Lincoln has been recognized by the Legislature as the primary research and doctoral degree granting institution in the state for fields outside the health professions. UNL is one of a select group of research universities which hold membership in the American Association of Universities (AAU). Through its service and outreach efforts the University extends its educational responsibilities directly to the people of Nebraska on a state-wide basis. Many of UNL's teaching, research and service activities have an international dimension in order to provide its students and the state a significant global perspective.

**The Missions of the University of Nebraska-Lincoln** The role of the University of Nebraska-Lincoln as the primary intellectual and cultural resource for the State is fulfilled through the three missions of the University: teaching, research, and service. UNL pursues its missions through the Colleges of Architecture, Arts and Sciences, Business Administration, Engineering and Technology, Fine and Performing Arts, Human Resources and Family Sciences, Journalism and Mass Communications, Law, Teachers College, the university-wide Graduate College, and the Institute of Agriculture and Natural Resources which includes the College of Agricultural Sciences and Natural Resources, the Agricultural Research Division, the Cooperative Extension Division, International Programs Division, and the Conservation and Survey Division. Special units with distinct missions include the University Libraries, the Division of Continuing Studies, International Affairs, the Lied Center for Performing Arts, the Bureau of Business Research, the Nebraska Educational Television System, the Sheldon Memorial Art Gallery, the University of Nebraska State Museum, the University Press, the Water Center, the Nebraska Forest Service, the Nebraska Statewide Arboretum, and Intercollegiate Athletics.

To capitalize on the breadth of programs and the multidisciplinary resources available at UNL, a number of Centers exist to marshall faculty from a variety of disciplines to focus teaching and research on specific societal issues and to provide technical assistance for business and industry in order to enhance their ability to compete in world markets. Additionally, interdisciplinary programs promote integration of new perspectives and insights into the instructional research and service activities.

The University of Nebraska-Lincoln promotes respect for and understanding of cultural diversity in all aspects of society. It strives for a culturally diverse student body, faculty, and staff reflecting the multicultural nature of Nebraska and the nation. UNL brings international and multicultural dimensions to its programs through the involvement of its faculty in international activities, a student body that includes students from throughout the world, exchange agreements with other universities abroad involving both students and faculty, and the incorporation of international components in a variety of courses and curricula.

Teaching, research, and service take on a distinctive character at the University of Nebraska-Lincoln because of its status as a comprehensive land-grant university. These traits provide opportunities for the integration of multiple disciplines permitting students more complete and sophisticated programs of study. Its land-grant tradition ensures a commitment to the special character of the State and its people.

The faculty is responsible for the curricular content of the various programs, and pursues new knowledge and truths within a structure that assures academic freedom in its intellectual endeavors. The curricula are designed to foster critical thinking, the re-examination of accepted truths, a respect for different perspectives including an appreciation of the multiethnic character of the nation, and a curiosity that leads to life-long learning. Additionally, an environment exists whereby students can develop aesthetic values and human relationships including tolerance for differing viewpoints.

**Teaching** The people of Nebraska created UNL to provide its citizens with the highest quality of post-secondary education. Therefore, a fundamental mission of the University of Nebraska-Lincoln is teaching. The distinctiveness of the teaching mission at the University of Nebraska-Lincoln lies in its range of undergraduate majors, the character and quality of the faculty, and the extracurricular environment. The University provides students with a wide choice of courses and career options which often expands the scope of their dreams and ambitions. The size and diversity of the University permits students to mature and to develop their own sense of self-confidence and individual responsibility. The course work is enriched by a faculty that is engaged in active research and creative activity and whose frame of reference is the national and international community of scholars.

Having created the first graduate college west of the Mississippi River, the University of Nebraska-Lincoln has historically recognized graduate education to be a central and unique component of its mission. Thus, UNL has primary responsibility in the State for graduate education, especially at the doctoral and professional levels. UNL is unique in possessing the scope of programs necessary for multidisciplinary instruction at the graduate level, a faculty involved in research necessary to support graduate education, and the libraries, laboratories, computer facilities, museums, galleries, and other ancillary resources required for graduate instruction.

**Research** Basic and applied research and creative activity represent a major component of UNL's mission, a component that is recognized in Nebraska legislative statutes, and in its status as both a land-grant and an AAU research university. The quest for new knowledge is an essential part of a research university; it helps define and attract the type of faculty necessary to provide a university education; it distinguishes the quality of the undergraduate students' classroom experience; and it is the necessary component of graduate instruction.

As part of its research mission, UNL is dedicated to the pursuit of an active research agenda producing both direct and indirect benefits to the State. The special importance of agriculture, environment, and natural resources is addressed in its research priorities. In addition, UNL conducts a high level of research and creative activities that address in specific ways the issues and problems that confront Nebraska. Through their research and creative activities, faculty at UNL interact with colleagues around the world and are part of the network of knowledge and information that so influences our society. As a consequence, the University serves as the gateway through which Nebraska participates in and shares the gains from technological and cultural developments.

**Service** The land-grant tradition creates for the University of Nebraska-Lincoln a special statewide responsibility to serve the needs of Nebraska and its citizens. In addition, many of its service aspects extend to regional, national, and international clientele. Special units such as the Division of Continuing Studies, and the Cooperative Extension

Division have specific responsibilities to bring the teaching and research resources of the University to a wider clientele. Through Cooperative Extension's partnership with federal, state, and county agencies, UNL has an outreach program in each county in the state. Moreover, all units of the University have a service and outreach mission. To help accomplish this mission, UNL delivers educational services through diverse ways including telecommunications methods and as a participant in the development of regional educational centers especially in those areas where it has statewide responsibilities. The University recognizes its obligation to extend the resources of the University beyond the campus and throughout the State. Serving the needs of Nebraska requires more than responding to the felt needs of the time. UNL must be visionary in its planning and must help the citizens of the state prepare for the future as well as deal with the present.

*Approved by the Board of Regents May 10, 1991.*

## A.2 Mission Statement, College of Arts and Sciences

The College's mission is:

- To educate undergraduate students of the College of Arts and Sciences to a high level of competence in their major fields through instruction that integrates formal course work with experience in research and creative activity.
- To advance knowledge through research and creative activity that are national and international in stature.
- To provide all undergraduate students with a range of knowledge and a broad intellectual experience that can form the basis for critical and imaginative thinking, thereby enabling them to become tolerant and responsible members of a global society.
- To provide undergraduate and graduate students across the campus with courses in the arts, humanities, social sciences, and sciences to meet their academic needs in their major programs.
- To serve the university and community-at-large and provide educational leadership for the state and region."

The University of Nebraska started instruction in 1871 as the College of Ancient and Modern Literature, Mathematics and Natural Sciences, later to become the College of Arts and Sciences.

Now, as in the past, the College occupies the central position at the University of Nebraska-Lincoln and in the University of Nebraska system of higher education. It is the oldest, largest, and most diverse college in the University and state. The College, encompassing a comprehensive range of academic disciplines, comprises more that seventeen departments, schools, institutes, and centers with approximately 370 permanent faculty, 4,500 undergraduate majors and 1,200 graduate students. Virtually all UNL undergraduates take courses in the College. The College offers two undergraduate degrees (BA and BS) involving more than 50 major and minor programs in individual departments, interdisciplinary areas of the humanities, social sciences, and sciences, and 16 pre-professional programs (like pre-medicine, pre-law, and pre-dentistry).

Essential to the mission of the College of Arts and Sciences is the role of its faculty as scholar-teachers. The quality of their research and creative activities and their commitment to teaching enable them to expose their students to a wide range of knowledge and to the processes by which new knowledge is acquired.

# Appendix B

# UNL Comprehensive Education Program

*The following material is from the 1997-1998 Undergraduate Bulletin.*

Program Overview
UNL, as a research university, provides for a student's educational experience through its faculty, curriculum, libraries, laboratories, museums, performing art centers, athletic activities, public lectures and living community. To assist a student in logically connecting these pieces, the UNL faculty designed the Comprehensive Education Program. Unlike the specific study in a major field, which students often envision as their purpose for being at a university, the Comprehensive Education Program requires students to lay a foundation for their continued intellectual growth by developing (1) their ability and desire to analyze, evaluate and communicate complex material and positions and (2) a context for understanding the breadth of human endeavor. Without this foundation, students may be unable to engage the complex issues which either an in-depth study in a major area requires or our society faces. The Comprehensive Education Program, which is required of all undergraduate students entering UNL in fall 1995 and subsequently, encompasses four components: Information Discovery and Retrieval, Essential Studies, Integrative Studies, and Co-Curricular Experience. Each of these components are discussed in the paragraphs which follow.

**Information Discovery and Retrieval** The University of Nebraska-Lincoln's Love Library faculty is making available to all incoming students a 1-credit-hour course which will teach not only how to use the library system on campus but also how to do research with emerging electronic databases. Students in several UNL colleges will be required to take this course in their first year.

**110.** Introduction to Library Research (1 cr) A seven-week independent learning course designed to provide a practical understanding of libraries, their organization, tools and services. The course emphasizes effective strategies for accessing information and performing library-based research.

**Essential Studies** To provide students a context for understanding the breadth of human endeavor, Essential Studies maps out a minimum experience for an undergraduate student in a broad range of university offerings. While recognizing that one or two courses in any area cannot result in mastering the knowledge of that area, a single course can familiarize a student with the representative issues in an area and a foundation for understanding the perspective that area offers. To meet the Essential Studies requirement, a student will take nine courses across the following areas of knowledge:

**Area A, Communication:** Knowledge of and experience with writing and speaking appropriate to a broadly educated college graduate, not limited only to the technical or pragmatic demands of the student's major. (1 course)

**Area B, Mathematics and Statistics:** Knowledge of essential mathematical concepts and of the nature of mathematical reasoning and language, or, when appropriate, of methods of statistical analysis. (1 course)

**Area C, Human Behavior, Culture and Social Organization:** Knowledge of individual and group behavior, the nature and origins of culture, the structure and governance of societies, the characteristics of economic practices and systems, and the interplay of human activity (urban, agricultural, and industrial) and the natural environment. (2 courses)

**Area D, Science and Technology:** Knowledge of the natural world and its interrelationship with human existence, of the aims and methods of scientific exploration, and the creation and social impact of technology. (1 course)

**Area E, Historical Studies:** Knowledge of the natural world and its interrelationship with human existence, of the aims and methods of scientific exploration, and the creation and social impact of technology. (1 course) Area F, The Humanities: Knowledge of literary, philosophical, or religious efforts to interpret and illuminate human existence. (1 course)

**Area G, The Arts:** Knowledge of the history and creation of music, art, design, architecture, drama, dance, photography, or the communication media. (1 course)

**Area H, Race, Ethnicity and Gender:** Knowledge and analysis of theoretical concerns, social experiences, or creative works arising from human diversity in the United States and the world community to which it belongs. (1 course)

While a single Essential Studies course may encompass more than a single area of knowledge, it cannot simultaneously fulfill the Essential Studies requirement for two areas. A single course may be applied to only one area.

While Essential Studies is a requirement of the Comprehensive Education Program, colleges often extend a student's Essential Studies experience and require additional courses beyond the minimum experience required within the Comprehensive Education Program. Recognizing this, students should consult with their college adviser when planning their academic program and their Essential Studies courses. A list of Essential Studies courses are identified in the Bulletin course descriptions by the ES symbol.

**Integrative Studies** Integrative Studies is a UNL experience requirement intended to engage students in actively developing their ability and desire to analyze, evaluate and communicate complex material and positions. A student will take ten courses which are taught as Integrative Studies to enhance the following skills:

a) Critical Thinking (objective and subjective), through a variety of approaches in which students investigate arguments, engage in research, gather data, perform qualitative and quantitative analysis, and assess conclusions.

b) Writing (formal and informal), on which the instructor comments, used to explore substantial problems in the subject area and report the results of critical and creative thinking.

c) Oral Expression in the classroom through discussion, group and individual reports, and other activities that provide students opportunities to share creative work, describe research, or explore important issues.

d) Analysis of Controversies concerning the subject matter of the course in which students investigate concepts and hypotheses open to question.

e) Exploration of Assumptions underlying beliefs and concepts relevant to course content and of processes for examining those assumptions, so that students understand and establish control over those ideas they bring to their study of the subject matter.

f) Inquiry Through Course Content Into The Origins, Bases and Consequences of Intellectual Bias through which students will understand the particular perspective on the world employed in the academic discipline of the course.

g) Consideration of Human Diversity appropriate to the subject matter of the course so that students can explore the way in which cultural differences shape conceptions about the subject matter and discern the intellectual and pragmatic effects on human groups of the subject matter and ideas related to it.

To encourage students to develop their intellectual abilities throughout their academic program, at least one course in Integrative Studies must be taken at the 200-level, one at the 300-level and one at the 400-level and no more than three courses are to be taken within a single department.

Many courses which meet Essential Studies or other college requirements are taught as Integrative Studies. While the variety of courses available as Integrative Studies allows students to choose how to meet their Integrative Studies requirement, students benefit from consulting with their college adviser so that choices which enrich their academic program can be made. A list of Integrative Studies courses are identified in the Bulletin course descriptions by the IS symbol.

**Co-Curricular Experience** At the center of the university experience are the classes students take in pursuit of their undergraduate degrees. However, a student who only takes courses even if he or she works hard and learns a great deal has missed a substantial part of what it means to be a university student. Any experienced student or graduate will say that a vital aspect of his or her education involved experience outside the classroom which contributed to his or her growth as an active, knowledgeable, self-aware, open-minded, and healthy individual. A university such as UNL provides students with a wealth of opportunities to grow and develop.

The co-curricular component involves opportunities for growth in these areas: personal development, health and wellness, intellectual development, cultural understanding, arts appreciation, career development, values and ethics, and social responsibility.

All entering students will receive information and assistance that will enable them to create a plan to reach established goals in each of these areas and to record their achievements for recognition.

# Appendix C

# The 1993 APR Review Team Report

THE UNIVERSITY OF NEBRASKA, DEPARTMENT OF MATHEMATICS AND STATISTICS
ACADEMIC PROGRAM REVIEW REPORT

**Review Team:** *External Members:*

Jack Hale, Georgia Institute of Technology;
Ronald Randles, Department of Statistics, University of Florida;
Judy Roitman, Department of Mathematics, University of Kansas
Spud (John S.) Bradley (Chair), American Mathematical Society

*Internal Members:*

David Brooks, Stuart Margolis, Kurt Hertzinger, and Joyce Yen.

**INTRODUCTION** The review team visited the university on December 5, 6, and 7, 1993. This report is based on conversations with faculty, students, the department chair, and members of the university administration and on information contained in the department's self-study.

The review team was very favorably impressed by the excellent and balanced contributions the Department of Mathematics and Statistics is making to the university and its students. We found a serious and innovative faculty dedicated to advancing the mission of the department and university. We also found a department with severe resource problems whose ability to sustain current activity, let alone respond to new challenges, is threatened by those resource problems. We urge the university to respond immediately to the most pressing needs discussed in this report.

This is a difficult time for mathematical sciences departments at research institutions. Departments are being challenged to adopt a broader mission with special emphasis on instructional and outreach issues that recently have not had a prominent role in research departments. Serious research faculty approach these issues with a legitimate concern over whether an increased commitment to instruction and outreach will result in a reduced commitment to research and graduate education. The most resourceful departments are finding that they can meet theses new demands without harming their research program.

The University of Nebraska can be justifiably proud that the Department of Mathematics and Statistics is meeting new challenges while continuing to nurture its research program. Many of the faculty maintain a high quality research program that attracts both national and international attention and there is evidence that the total research productivity of the faculty is at an all-time high. The department has a high-quality, student-friendly graduate program. At the same time the faculty is doing an outstanding job in undergraduate education, including the modification of its approach to teaching based on a forward looking vision of the future.

We also found well-conceived, highly visible outreach programs aimed at improving the K-12 education system. Particularly impressive is the department's leadership role in the Statewide Systemic Initiative (SSI) program funded

by the National Science Foundation. Although the NSF has now funded 26 SSI's, very few are based in a university and only one other (Montana) has its origin in a mathematics department.

It is clear that the current Chair, Jim Lewis, deserves a large measure of the credit for the state of affairs we describe. He has been extraordinarily successful in motivating the faculty to be creative in revising the undergraduate curriculum and in providing a nurturing environment for graduate and undergraduate students, while at the same time maintaining a strong commitment to enhancing an already active research program. It is also significant that there is strong support among the faculty for the departments many activities and we found no resentment about the state of the department among the faculty.

**RECOMMENDATIONS** The remainder of this report will consist of recommendations, mostly in response to a set of thirteen questions presented to the review team the first evening of the review.

**1.** What should be the priorities of the College of Arts and Sciences for improving the quality of the Department of Mathematics and Statistics?

We find the department's request and priorities to be sound and well justified. We discussed in the introduction the excellent contributions being made by the faculty to the mission of the university. We also found that the department is stretched to the limit and we feel strongly that it cannot continue to carry its current load, much less take on additional challenges, without additional resources.

As one would expect, most of the recommendations will require new funds for the department. We were told that the university does not expect to receive a significant amount of new funding during the next few years; we understand those constraints and that the other departments have similar problems. Nonetheless, we want to argue strongly for the modest request made by the department.

Much has appeared in the popular press and in professional publications about the sorry state of undergraduate education in the nation's institutions of higher education, especially in "research universities". The University of Nebraska is fortunate to have a department of mathematics - a department that is crucial to retention issues for all students pursuing technical programs - that is clearly doing an outstanding job in meeting its obligations to provide a quality undergraduate program that is accessible to most students and that is engaged in high quality, high visibility outreach programs. Therefore, we suggest that the university not wait until it can meet the needs of other departments before providing this department the means to continue its contributions to the fundamental academic program of the university.

We first recommend in the strongest possible terms that the department's first request be met. Specifically, it is urgent that funds be made available to hire a staff person to handle the departments computational needs and that at least two additional secretarial positions be authorized and funded. These additions are needed to free faculty from routine chores that can be done less expensively and just as competently by less well-trained individuals. Aside from the potential moral problem of continuing to ask highly trained faculty to perform routine tasks, it is a mis-allocation of resources that decreases the research and other intellectual contribution of members of the faculty.

The second recommendation is that additional teaching power be provided. The department asks that this be in the form of additional GTA funds, money for paper graders, and postdoctoral positions. This appears to the most efficient way of meeting the existing needs and the review team concurs in this request.

The third recommendation, which will not require money, is to simplify the process for requesting travel funds and funds to support visitors. Obviously, additional funds are welcome, even needed, but much can be accomplished by simply making it easier, and requiring less lead time, for faculty to request travel funds and funds for visitors from the Dean's office and from the Research Council.

The fourth recommendation is to provide additional space contiguous to the department's space in Oldfather Hall. Assigning three graduate students to each of the small student offices in Oldfather and the separation of the students housed in the 501 Building are serious detractions from the teaching and graduate programs of the students.

The fifth recommendation is that the applied mathematics faculty in the department, study the course offerings at the graduate level with the goal of designing a set of basic courses that would provide a common body of mathematics to the graduate students interested in applied mathematics. We believe this would allow for a more cohesive

environment for these students and would improve the graduate program in this area, encourage more interaction among these students, and enhance their job prospects. Particular attention should be given to the level and content of courses in ordinary and partial differential equations at the 900 level.

**2.** Evaluate the plan to establish a separate Department of Statistics. Should it be implemented? If so, when?

The review team recommends that a department of statistics be created by combining the statistics faculty currently in the Department of Mathematics and Statistics with those in the Biometry Department of the Institute of Agriculture and Natural Resources (IANR). This would provide the statistics faculty on campus with the recognition and visibility they need and would also strengthen the research and instructional programs in this important discipline. An immediate effect would be a broadening of the undergraduate and graduate programs to include both theoretical and applied components. This is especially important to the masters and doctoral students. It will not only enrich their learning experience, it will made them more competitive for jobs as professional statisticians. A longer term effect we would expect is a broadening and enriching of the research of the faculty from both groups of statisticians.

The review team discussed the proposed merger with the statisticians in both departments and with the mathematicians. There are some potential losses to the mathematics program, particularly to the graduate applied mathematics program. Probability theory is important in many parts of applied mathematics and the courses in the is area are taught primarily by statisticians. Those faculty indicated they would continue to offer the graduate probability course and would continue to welcome mathematics students to take the course, which we believe mitigates this potential loss.

It is apparent that over the past several yeas a number of very good statisticians have come into the department and have left after only a few years. Many of the individuals have left to go to universities that offer the recognition and identity of a separate statistics department. Thus, creating a separate department would work toward strengthening statistics at the university and would counterbalance any potential loss to the mathematicians resulting from their being detached from the statistics program.

From a programmatic point of view, it seems clear that creating a separate department of statistics is in the best interest of the university, its students and the statisticians and that the potential loss to mathematics is counterbalances by the potential for a stronger statistics program. Moreover, the two groups of statisticians seemed determined to work cooperatively and to made compromises in order to make the union of the two groups function appropriately. The IANR statisticians are looking forward to new teaching responsibilities and the Mathematics and Statistics Department statisticians are looking forward to new involvement in the real problems of their IANR colleagues. There remain, of course, a number of administrative problems associated with such a move. The most obvious and important of these are the problem of deciding on a location for the new department and providing departmental leadership.

**3.** Appraise the quality and quantity of the department's research productivity. How could it be enhanced? Should the department undertake activity in other research areas? Should and could the department become more active in seeking external funding? If so, how can this be encouraged and accomplished?

The quantity is well documented in the faculty vitae and a useful summary was prepared by Professor Harbourne. The research output as measured by papers published in referred journals seems comparable to that of Nebraska's peer institutions.

Assessing quality and making comparisons with other mathematical sciences departments is more difficult; however, it is quite evident that this department has some very strong research groups in important areas of mathematics with active seminars and bright, interested students. Of course, the key to each of these groups is the presence of a few excellent faculty who are known nationally, and in some cases internationally, for their research. Additionally, we believe that hiring the tenuring have been done wisely in the past several yeas and that has strengthened the department.

We do not think it is meaningful to try to make comparisons with entire departments because different departments have different sizes and strengths. Neither do we thing it is meaningful to attempt to place this department in one of the three groups of doctoral granting departments defined by the American Mathematical Society; the study on which that grouping was based is approximately fourteen years old and most of the faculty in this department have been hired since then.

It is our considered opinion that the distinct research groups to which we referred above and the leaders of these groups are comparable in research productivity and excellence to groups in the peer institutions such as Colorado, Iowa, Iowa State, and Kansas; further, we are not aware that Colorado State and Missouri have groups of comparable strength. Finally, we believe that Illinois, Minnesota, and Ohio State and Purdue are in a distinctly different situation. The mathematics departments at theses institutions are much larger, have broader and more nearly complete representation of the active areas in mathematics, have larger and more noted research groups led, in many cases, by internationally known ”stars”. It is important to note that these ”stars” have academic-year salaries well into six figures.

We caution that the assessment offered in the proceedings paragraphs necessarily relies on some subjective judgments; however, it also takes into account certain objective considerations, such as personal knowledge of the research of some of the faculty by some members of the team, the reputation of the journals in which the faculty publish, the number of faculty receiving federal funding, and the number of faculty receiving invitations to speak at other comparable institutions and at national and international conferences.

The concentration of faculty into identifiable groups of faculty who work in the same or similar areas serves the department well. We feel this policy strengthens the research program, provides a rich environment for graduate students, and should be continued. One negative side effect is that there are important areas of contemporary mathematics, such as differential geometry and topology, not represented in the department and this could cause serious gaps in the mathematical education of graduate students. The faculty is, of course, aware of this and prevents the most serious gaps by offering courses in the missing areas. This is an additional burden on the faculty, but this solution is preferable, we believe, to expanding into the missing areas.

The total amount of outside funding obtained by this department is unusually high for a mathematics department of this size. While a large amount of this is for support of educational activities, the amount of research funding and the number of faculty supported is quite high when one considers the current state of affairs at federal granting agencies, especially at NSF. We find particularly innovative the approach taken by the algebra group and believe this may become a model for modes of support at NSF.

The department has been aggressive in seeking outside research support and it should continue its efforts. Care should continue to be exercised not to equate success at obtaining grants with faculty research. While one can safely assume that obtaining outside support for research implies that the faculty member’s research is of high quality, one cannot, and should not, assume that a grant proposal being declined by a federal agency implies the member’s research is of inferior quality. The large number of high quality mathematics proposals and the small NSF budget ensure that excellent proposals clearly worthy of funding are turned down each year.

We recommend that the department not seek to undertake activity in other research areas, unless the department were to be enlarged significantly. The department has wisely concentrated its hiring to a few areas of strength and this has provided a critical mass in each of these areas that is useful for the faculty and graduate students.

**4.** Is the structure of graduate faculty membership at UNL conducive to insuring quality graduate education? Is faculty mentoring enhanced or inhibited by graduate faculty categories of Member and Fellow? Has the mentoring of graduate faculty in the department been successful?

The structure of the faculty was addressed in our response to Question 3 and we believe it is indeed conducive to insuring quality graduate education.

We did not explore with the faculty the question of the usefulness of the categories of Member and Fellow, but this strikes us as a bureaucratic classification with little meaning. We urge that it be discarded.

**5.** Is the balance between the teaching, research, and service activities of the department and its faculty appropriate?

Yes, we believe the balance is appropriate. We also applaud the prevalent attitude that the departmental mission is the collective responsibility of the faculty and that the expectation is that each member will contribute in a way that most nearly fits her or his talents and interests. The Chair has done an outstanding job in allocating responsibilities and finding ways for faculty to use their talents in positive ways. The faculty have responded positively and seem pleased with the direction in which the department is moving.

**6.** Are the goals of the department realistic? What other education and research challenges (if any) should the department be preparing to address to insure that it and its programs will be viable into the next century? Is the vision for future programmatic and curricular improvement in each of the areas of emphasis focused, realistic, and well planned? What should be the highest priority of the department?

Yes, we feel that the goals of the department are realistic and we do not recommend that the department undertake any additional educational or research challenges. We believe the department is on the right track, that its vision of the curriculum is forward looking, and that it is well positioned to educate students for the next century.

**7.** Appraise the quality and effectiveness of the department's undergraduate program. How does it rank in comparison to others at similar universities?

We have a very positive impression of the undergraduate program. The common core of course requirements are well conceived and the students feel they are provided a very supportive learning environment. We were especially impressed with the accessibility the students feel they have to the faculty and even to some of the graduate students. This undoubtedly helps maintain the number of undergraduate majors, which is somewhat large compared to other research universities of comparable size.

Our opinion, based on conversations with students and faculty, is that the best of the undergraduate majors can go just about anywhere and compete successfully. However, some faculty expressed frustration that there are too many majors who are ill prepared and unmotivated and who are just "passed along" and graduated without having learned very much mathematics. These kinds of frustrations are not unusual in young faculty, especially those trained at some of the elite institutions where the undergraduate they have taught are better prepared and motivated. Nevertheless, the department should be cognizant of this issue and maintain a dialogue with its younger faculty on such matters.

**8.** Appraise the effectiveness of the department's honors program. Should it be expanded?

Based on our conversations with students who had experiences in the honors program, we believe the program is very effective. We do not recommend that it be expanded because it is already quite substantial and because there are not enough faculty resources to do so.

**9.** Appraise the quality and effectiveness of the outreach activities of the department. Should they be increased?

As we mentioned in the introduction, we believe these activities are of excellent quality, are effective, are highly visible, and should be continued. We do not recommend any expansion of these programs, primarily because of the fact that the faculty is fully extended.

**10.** Appraise the quality of the graduate program and indicate how it ranks in comparison to others at similar universities. Appraise the quality of the graduate students. Is the department nationally competitive for truly outstanding graduate students? Are TA stipends competitive? Are TA's being used effectively?

The faculty clearly feels that the quality of the graduate students is quite high and after discussions with the faculty and the students we agree with this assessment.

We believe the quality of the graduate program compares favorably with those at the peer institutes. There is faculty research leadership in several important areas of mathematics and these leaders are well recognized nationally for the quality of their research. The organization of the department into cohesive research groups serves the graduate program well. Indeed, we give the department very high marks for its mentoring of its graduate students and for creating nurturing research communities for the students and for creating nurturing research communities for the students.

We feel that the department is not competitive nationally for truly outstanding students and that, given its geographic location, it would be unrealistic for the department o have those kinds of expectations. This opinion should not be taken as a criticism of the department; no university in the great plains is competitive for the very best graduate students. In the entire Midwest, from the Mississippi o the Rockies, only Minneapolis and Austin can said to be

competitive for the very best students. From the students we talked to we formed the view that most of the best graduate students are graduates of this department.

TA stipends are competitive with those at comparable institutions in neighboring states. This assertion is based on a comparison of TA stipends listed in the 1993-94 issue of Assistantships and Graduate Fellowships in the Mathematical Sciences published by the American Mathematical Society. Comparisons were made with the Universities of Colorado, Kansas, Missouri, and Oklahoma and with Iowa State University and Oklahoma State University. When required student fees are subtracted from the stipends, only Kansas at $9500 and Colorado at $8,948 exceed the net of $8,600 offered by Nebraska. Oklahoma is the lowest at $7,000 and Missouri is next with $8,000. Iowa State is almost identical to Nebraska at $8,498.

**11.** Are the department's requests for additional resources reasonable?

Yes. If anything, they are modest. The department is performing at its capacity, is meeting the needs of its students and the university, and we feel strongly that its requests are justified and should be met in order that it can continue on its present path.

**12.** Appraise the quantity and quality of the department's computer resources and facilities.

The NeXT laboratory is a modern, state of the art, facility for teaching mathematics and it is being used imaginatively. The faculty and the students that use this lab are excited about what is being done and about the possibilities not yet realized. One faculty member who designed and is teaching an upper level course in approximation theory said he now sees the course in an entirely different light and will never teach the course without the use of computers again.

The primary use of the lab is for lower division courses and it will some be oversubscribed. Plans should begin now to provide additional facilities of this kind.

Computing facilities available to faculty seem to be adequate; all faculty have a computer on their desk. These range from PCs to Sun workstations and appear to be appropriate to their needs.

Computing facilities for graduate students, in general, are not adequate. The common computing facility in Oldfather Hall is not adequate to meet the demands of the graduate students. Also, statistics students found access to appropriate statistical software to be lacking. Moreover there is only one PC in the 501 building for more than 30 students. Both facilities need considerable upgrading.

Of course, the most serious problem with the department's computing facilities is the lack of a staff person to maintain the hardware and software and to provide assistance to the faculty and students. This issue is addressed elsewhere in this report.

**13.** Evaluate the morale of the faculty. How could it be improved?

The morale of the faculty is quite high. This became apparent at the first discussions with faculty and we were at first surprised, given the ambitious undertakings of the department. Our initial assessment of faculty morale was confirmed by later conversations and we believe the attitude is indeed universal. We wondered if there might be individual faculty members with grievances who did not feel comfortable airing them in public. Since there were no scheduled conferences with individual faculty we made an offer to each group to meet privately with anyone who wanted to speak to the entire team or to one of us. No one took us up on the offer.

We believe the good feeling the department has about itself is genuine, but also recognize such feelings are very fragile. This is another reason we strongly recommend that the department's most serious needs, for a computer support person, additional clerical staff, and additional funds to augment the teaching staff, be met.

This answers the 13 questions presented to us; however, we now want to address three additional issues we encountered during our visit.

**14.** In discussions with untenured faculty one of them reported that the practice of making initial offers for only one year created a sense of unease and uncertainty. Other members of the group countered that the first year appointments were always renewed and should not be a source of concern.

Of course, potential faculty considering such offers are not aware, and may not believe it when told, that renewal is automatic.

We recommend that the university consider a policy of making initial appointments for two years.

**15.** The issue of teaching evaluations came up in several discussions with faculty. There seemed to be uniform dissatisfaction with what most faculty believe is total reliance on question #8 on the student questionnaire for evaluation of teaching. Our recommendation is to seek broader measures of teaching effectiveness, such as peer evaluation, exit interviews of graduating students, periodic surveys of alumni, etc.

**16.** Judy Roitman was asked at the beginning of the visit to seek out women students and faculty to determine whether there are serious barriers to the success of women and under-represented groups. She spoke to women in groups and individually and reports that there is a fantastically positive atmosphere for women students in the department. She gives the faculty especially high marks for creating this environment. She found that the barriers that exist are primarily due to the fact that women faculty, including GTAs, are perceived differently by students than their male counterparts. She found a consensus among both women TAs and faculty that student expectations, from seemingly trivial matters such as appearance to obviously major issues such as how much authority the instructor should exercise, are different for women instructors than for men. This was partly born out by an informal comparison by one woman faculty member of TA evaluations - women were either rated high or low, with very few in the middle, whereas most male TAs were rated in the middle. This differential raises troubling issues for promotion, tenure, and general recognition of teaching, issues of which the chair and several other faculty are well aware.

Evidence was also found that student attitudes about African Americans could become a barrier to persisting in mathematics. One African American student reported noticing a lack of eye contact on the part of some faculty and noticing that some undergraduate students believed the African American students was ”out of place” in advanced mathematics classes.

The faculty has generally dealt well with equity issues, and is to be commended both for maintaining a supportive atmosphere for all students, and for recognizing potential problem areas. Any negative atmosphere for women and minorities seems to come largely from student attitudes, and seems to effect women faculty (including TAs) and minority students. Improving the atmosphere on this level is the job of higher administration in university-wide programs.

# Appendix D

# Materials Relating to Faculty

## D.1 Faculty Evaluation Materials

### D.1.1 Department Performance Expectations Document

Performance Expectations for Tenured Faculty
Department of Mathematics and Statistics
October 12, 1998

This document discusses the expectations that the department has for all tenured faculty and establishes standards for satisfactory performance. It is expected that most tenured faculty members will substantially exceed these standards.

Each faculty member is expected to make contributions to the department, the university and their discipline through their combined achievements in research, teaching and service. Core activities that clearly contribute to the department's scholarly mission include the publication of scholarly work, presentations at professional meetings and other talks. Teaching contributions can be made through traditional classroom instruction that merits being judged "satisfactory" (but preferably higher) and out of classroom teaching activities including advising, curriculum work, reading courses, etc. Service can take the form of traditional service to the department, the university or the profession or it can constitute "outreach" activities such as working with K-12 teachers or students. The preparation of grant proposals and the securing of external funds, while not required of any one individual, are viewed as valuable means of contributing to the department.

As a part of the annual evaluation process in the Department of Mathematics and Statistics, each faculty member is rated in six different categories and placed in one of four performance groups. The six categories and the corresponding performance groups are listed below. The percentages listed after each category reflect the weight that the department currently assigns to each category in its overall mission. These percentages may be modified in the future.

| | **Performance Groups** | | | |
|---|---|---|---|---|
| | **First** | **Second** | **Third** | **Fourth** |
| **RESEARCH (45%)** | | | | |
| Published Work (27%) | Very Productive | Productive | Modest | None |
| Documented Activity (9%) | Substantial | Productive | Modest | None |
| Funding (9%) | Outstanding | Good | Modest/Efforts | None |
| **TEACHING (45%)** | | | | |
| Classroom (36%) | Outstanding | Very Good | Satisfactory | Poor |
| Nonclassroom/Advising (9%) | Significant | Above Average | Modest | None |
| **SERVICE (10%)** (Dept., Campus, Discipline) | Significant | Above Average | Modest | None |

The document “Areas of Faculty Responsibility and Typical Activities Evaluated in Each Area,” which annually is given to faculty as part of the annual evaluation process, provides a more detailed list of activities which contribute to the department’s mission. It describes a not necessarily exhaustive list of activities recognized in each area.

Because of the importance attached to “Published Work” and to “Classroom Teaching”, these categories are designated as major categories (and the others as minor categories) for most faculty in the department. In a typical year a member of the faculty should strive to achieve the following performance expectation based on the faculty member’s annual evaluation.

**Performance Expectation**
Either

**(a)** The faculty member should rate in one of the top three performance groups in four categories, including both major categories, and in one of the top two performance groups in at least one of these four categories.

or

**(b)** The faculty member should rate in one of the top two performance groups in two categories, one of which must be a major category, and in one of the top three performance groups in one other category.

The department believes that faculty are usually the best judge of how to allocate their time and energy toward filling departmental needs, subject only to the expectation that faculty will teach their assigned courses and accept a reasonable share of service activities they are assigned.

Faculty members who believe that they can contribute more to the overall mission of the department by negotiating a differentiated workload are encouraged to discuss this with the department chair. Part of the negotiation might, for example, permit the designation of one of the minor areas above as being major for the particular work assignment of the individual faculty member. If a faculty member has negotiated a differentiated workload for any particular year, then the details of this arrangement, together with performance expectation for the faculty member based on this work load, must be specified in writing by the department chair, approved by the executive committee and accepted by the faculty member.

Any faculty member who receives a rating of “Poor” in the “Classroom Teaching” category for two consecutive years should develop a written plan for improving his/her classroom teaching. Any faculty member who receives a rating of “None” in the “Published Work” category for two consecutive years should either develop a written plan for improving his/her research productivity or should request a differentiated work assignment which would decrease the importance of this category in the annual evaluation and correspondingly increase what is expected in other categories.

In order to comply with the requirement that the department specify the performance expectations of faculty while retaining an approach that permits faculty flexibility in determining how best to allocate their time and energy, the department has adopted the policy described below.

Each year, as part of the annual evaluation process, the department chair must provide the department executive committee with a written report that includes the following:

a) A list of all faculty who do not meet the performance expectation specified above: the report should indicate their performance ratings for the previous three years.

b) A list of all faculty who may meet the performance expectation requirements but whose work is judged by the chair to be at a level that warrants concern about the faculty member’s performance.

c) A recommendation to the executive committee as to which faculty, if any, should be judged to have a deficiency that is substantial, chronic or both substantial and chronic.

As a general guideline, it is understood that a classification of substantial deficiency in a faculty member’s performance should be made only if the faculty member’s performance in a particular year falls substantially below

the performance expectation specified above, in the judgement of the department chair and executive committee. A deficiency in a faculty member's performance would be regarded as chronic if this deficiency were apparent in previous years. In making a recommendation to the executive committee, the chair should pay special attention to each faculty member's rankings in the Published Work and Classroom Teaching categories. It is recognized, however, that no evaluation system is perfect and, in fact, a low rating for a faculty member whose work is deemed satisfactory by the executive committee may indicate a need to modify the individual's work assignment in order to properly reflect the individual faculty member's contributions.

After receiving the chair's report, the executive committee must decide (by majority vote) whether any faculty member's performance should be judged to have a substantial or chronic deficiency or both. The annual letter of evaluation must then inform the faculty member that their work has been judged to have a substantial or chronic deficiency (or both). Faculty whose performance is judged by the executive committee to have both substantial and chronic deficiency could be candidates for post-tenure review.

## D.1.2 Annual Evaluation Letter

May 24, 2000
**To:** Faculty

**From:** Jim Lewis

**Subject:** Annual Evaluations

This letter, which is sent to all tenure-track faculty, is a part of your annual evaluation. In addition, the following items are considered to be a part of your annual evaluation:

1) The departments Performance Expectations Statement for Tenured Faculty or, where appropriate, an individualized performance expectations statement;

2) Your Annual Update, which is your description of your accomplishments during the period evaluated, and

3) An individual letter of evaluation that assesses your accomplishments during the period evaluated. This letter indicates how you were evaluated in each of the six areas which, taken together, represent the traditional categories of faculty work.[1]

Let me emphasize this is intended to be an evaluation of contributions during 1999, not an evaluation of faculty worth nor of career achievements. For a limited number of faculty, this evaluation covers a two-year period.

Earlier this spring, the Executive Committee spent many hours discharging their duties in the evaluation process. The Executive Committee based their assessment of each faculty member on the faculty members vita, the Annual Update, any additional information provided by the faculty member, material that is available in the public faculty files in the department office, and my analysis of the student evaluations of teaching that we collect each year. I would like to thank each member of the committee for their hard work and for the seriousness with which they completed their part in the evaluations.

UNL Guidelines for the Evaluation of Faculty require an annual written evaluation of each faculty member by the Chair. Copies are given to the faculty member and the Dean and a copy is placed in the faculty member's permanent file. Mandatory procedures require that "prior to the preparation of the final written evaluation, the affected faculty member will be given an opportunity to meet with the supervising administrator to discuss the faculty member's performance." Also, "The written evaluation must be shared with the faculty member and it shall be signed by the faculty member which indicates that the person has seen the document. The faculty member's signature does not imply concurrence with the contents."

Please sign and return one copy of your evaluation. Mavis will contact you to set up a meeting to discuss your individual evaluation. In addition, I will seek your opinions regarding departmental priorities as well as your own goals and objectives for the next couple of years. Finally, should any faculty member wish to dispute their evaluation, this will provide an opportunity.

Attached to this letter is the document **Areas of Faculty Responsibility and Typical Activities Evaluated in Each Area.** This document describes the relative weight assigned to different parts of our total mission and a not necessarily exhaustive list of activities recognized in that area. The percentages are not meant to reflect the percentage of one's time spent in research, teaching or service. Rather, they reflect what we as a department believe we are, or should be, as well as how we want to divide up salary increase dollars available to us. Individual faculty should direct their energy toward filling a departmental need that will be recognized in our reward system.

As part of the evaluation process, the Executive Committee reviewed faculty achievements for the past year (or two years where appropriate), and then worked with me to develop the numerical assessment of each faculty member required by the A&S "Merit Matrix." We then took evaluations from previous years and combined them to come up with the final "Merit Matrix" sent to the Dean. This has the effect of counting 1999 as 50% of the evaluation and the three years previous to that as 50%.

[1] If the Chair and Executive Committee determine that a 'substantial and chronic defficiency' has been identified and unless corrected, will result in a post-tenure review, hten a statement to that effect will be attached to the individual letter of evaluation.

I want to stress a distinction between the Annual Evaluation and the "Merit Matrix" information sent to the Dean. The Annual Evaluation letter is an evaluation of contributions during 1999. The "Merit Matrix" information, which is used in determining salary increases, combines the evaluations of the previous four years.

The Executive Committee believes individual faculty evaluations should use equivalence classes in each area with individual comments added to convey the proper tone of the evaluation. The chart below gives titles for the equivalence classes and the number in each category. With the exception of Classroom Teaching, the evaluation combines a quality and quantity assessment. For Classroom Teaching, the assessment is a quality rating while quantity was also used in the merit matrix. For most faculty that quantity is 6. Faculty who teach an unusually large share of the large lecture, honors, and/or 400/800[2] level classes had their quantity rating increased to a 7. If your quantity rating is not 6, this is indicated on your evaluation.

In the Advising and Service areas, faculty should not assume it a criticism if their evaluation is modest or none. Rather, it may simply be a reflection of duties assigned to them or the fact that they have put their energy into other areas. On the other hand, since research is a very important part of the mission of our department, faculty whose research is judged modest or none should either increase their efforts in this area or be certain they are making major contributions to the department in other areas.

**RESEARCH**

| Published Work: | | Documented Activity: | | Funding: | |
|---|---|---|---|---|---|
| Very Productive | 16 | Substantial | 18 | Outstanding | 12 |
| Productive | 9 | Satisfactory | 8 | Good | 3 |
| Modest | 4 | Moderate | 4 | Modest/Efforts | 11 |
| None | 2 | None | 1 | None | 5 |

**TEACHING** **SERVICE**

| Classroom: | | Nonclassroom/Advising: | | | |
|---|---|---|---|---|---|
| Outstanding | 17 | Significant | 4 | Significant | 9 |
| Very Good | 6 | Above Average | 8 | Above Average | 13 |
| Satisfactory | 8 | Modest | 16 | Modest | 7 |
| Poor | 0 | None | 3 | None | 2 |

[2] 900 level Stat classes are also included in this category.

**4) Areas of Faculty Responsibility and Typical Activities Evaluated in Each Area**

**RESEARCH**(45%)
- Published Work and Other Documented Research Activity (36%)
  - Published Work (27%)
    - Refereed research papers that have appeared in print
    - Refereed research papers accepted for publication
    - Expository articles published or accepted
    - Graduate or research level books authored
  - Documented Research Activity (9%)
    - Papers submitted for publication
    - Seminar participation
    - Travel for scholarly purposes
    - Invited and contributed talks
    - Editorships of research journals
    - Ph.D. students (current & recently graduated)
    - Activity as a reviewer/referee
- Funding (9%)
  - Federally supported grants
  - Foundation grants
  - Efforts to obtain grants
  - Contracts with industry
  - Major UNL funded research grants

**TEACHING** (45%)
- Classroom Teaching (36%)
  - Number of courses taught per semester
  - Teaching evaluations
  - Student retention
  - Recognition of those carrying significant roles at the graduate level or with large lecture classes
- Advising & Non-Classroom Teaching (9%)
  - Chief Adviser
  - Graduate Chair
  - Math Placement Exam
  - Advising work at both undergraduate & graduate level
  - Special teaching projects (eg: Nebraska Scholars)
  - Course development (eg: Math 203)
  - Nebraska Math and Science Initiative
  - Math Day
  - Foreign GTA Adviser
  - Graduate Exams Creation and Grading
  - Reading courses

**SERVICE**(10%)
- Vice Chair, Director of the Division of Statistics, Former Chair
- Other major administrative tasks
- Department, College & University committee service work
- Service to professional organizations
- Community service work that benefits UNL
- Major outreach projects (e.g. JUMP)

## D.2 Release Time for Research Policy

**RELEASE TIME FOR RESEARCH**

**DISCUSSION** One goal of the department's budget reallocation proposal is to consider individualized work assignments in such a way that the department can respond to all of its responsibilities. In particular, a stated goal is to make it possible to give a few faculty release time for research. The intent is to give faculty who are conducting research at a very high level an occasional one-course teaching reduction. It is expected that each year three to four faculty would be selected for this one-course reduction.

This program is different from the Faculty Development Fellowship program, in which between 2/3 and 3/4 of our faculty participate. It is targeted at those whose scholarly work can contribute the most toward enhancing the department's scholarly reputation and who can offer evidence that the additional time made available by a one-course release from teaching duties can be expected to result in substantially greater research accomplishments.

**THE SELECTION PROCESS** Each spring, by March 15, a faculty member who believes (s)he could make a significant contribution to departmental research productivity by having a one-course teaching reduction during the next academic year should submit an application (one or two pages only) to the department chair. The chair will turn these applications over to the RAC, which will review each application along with the applicant's vita and/or annual update, and make recommendations to the chair within two weeks. If an RAC member has applied for release time (s)he will not be involved in the selection process; the chair will appoint another faculty member (not an applicant) to serve on the selection committee.

**GUIDELINES** 1. The most important attribute of a strong applicant is an outstanding research record showing strong evidence of national or international recognition. The following are examples of things that the applicant might use to document evidence of peer recognition and commitment to a strong research program:

   (a) Particular research projects that have had a major impact.
   (b) Publications in prestigious journals.
   (c) Success (and efforts) at obtaining external funding.
   (d) Awards and honors.
   (e) Invited lectures at major conferences.
   (f) Colloquia at other institutions.
   (g) Successful placement of PhD students.
   (h) Funding from other institutions for professional leaves.

2. Other factors that may be considered:

   (a) Timing: If release time during the next academic year would be particularly beneficial, the applicant should explain the circumstances.
   (b) Length of time since previously receiving release time for research.
   (c) Payoff in research productivity from previous release time, faculty development fellowships, etc.
   (d) Strong commitment to research, as indicated, for example, by use of summers for research even when external funding is not available.
   (e) Other professional commitments (teaching, advising, service and outreach) that are important to the department but limit the scholar's research time to a degree that may be detrimental.

3. The standards applied to younger faculty should take into account the number of years since the PhD.

4. While there is no fixed waiting period before a successful applicant for release time may again apply, it is not intended that this program be a means for a de-facto permanent teaching reduction for any faculty member. Thus, when considering a second (or subsequent) teaching reduction for one faculty member, the selection committee should apply a particularly high standard of excellence to the faculty member if there are other applicants who broadly meet the standard of being among the department's outstanding research scholars.

5. This program is designed to enhance the overall productivity of our department. There should be other mechanisms whereby faculty who take on significant administrative or service roles can receive release time from teaching (or research) in order to carry out these additional duties.

**COMMENTS** Faculty contribute to the department's total mission in many different ways. The purpose of this document is to describe one means of helping a limited number of faculty make a special contribution to our research mission. At the same time, it is important that recognition (and reward) go to those faculty whose contributions to other parts of the department's mission help make possible this extra commitment to departmental research.

## D.3 Faculty Committee Assignments, Spring 2001

**Chair** Jim Lewis
**Vice Chair** Tom Marley
**Graduate Chair** Roger Wiegand
**Director, Division of Statistics** Partha Lahiri
**Undergraduate Advisor** Gordon Woodward

**Math Computer Lab Director** Tom Shores
**Math Placement Director** Leo Chouinard
**Library Chair** Mark Brittenham
**Colloquium Chair** Brian Harbourne

**Executive Committee:** Jim Lewis (Chair), Tom Marley, Partha Lahiri, David Pitts, Jamie Radcliffe, Judy Walker, Roger Wiegand

**Graduate Advisory Committee:** Roger Wiegand (Chair), Steve Cohn, Brian Harbourne, Jerry Johnson, Partha Lahiri, Al Peterson, Jamie Radcliffe

**Research Advisory Committee:** David Pitts (Chair), George Avalos, Steve Cohn, Susan Hermiller, John Meakin, Roger Wiegand

**Undergraduate Advisory and Curriculum Committee:** Gordon Woodward (Chair), Glenn Ledder, Tom Marley, Mohammad Rammaha, Richard Rebarber, Judy Walker

**Degrees with Distinction Comm:** Gordon Woodward (Chair), Jamie Radcliffe, Tom Shores

**Technology Advisory Comm:** Tom Shores (Chair), Leo Chouinard, Steve Dunbar, John Orr, Gordon Woodward

**Alumni Relations and Newsletter Committee:** Tom Marley (Chair), Lynn Erbe, Brian Harbourne, Wendy Hines, Al Peterson, Dave Skoug, Mark Walker

**Math Day Committee:** Gordon Woodward (Chair), Earl Kramer, Jamie Radcliffe

**Pi Mu Epsilon:** Allan Donsig (Chair), John Orr

**Putnam Exam Committee:** Mark Walker (Chair), Tom Marley

**MAT Committee:** David Fowler (Chair), Jim Lewis

**Recognition Dinner Committee:** Mark Walker, Allan Donsig (co-Chairs)

## D.4 The Departmental Planning Report

The following document was submitted to Interim Dean Linda Pratt by Jim Lewis in response to a College planning exercise regarding hiring. The document contains information about Departmental areas of research, planning and hiring priorities.

**DEPARTMENT OF MATHEMATICS AND STATISTICS**
**2000 PLANNING DOCUMENT**

**1. Identify two or three areas of program priority that are most crucial to maintain or expand in the next five years**

A. Algebra and Discrete Mathematics (ADM)
    1. Discrete Mathematics
    2. Computational Algebra
B. Pure and Applied Analysis (P&AA)
    1. Biomathematics
    2. Operator Algebras
C. Statistics
    1. Survey Sampling

To help you understand the department's priorities, let me describe the make-up of the department from the point of view of faculty research interests and then discuss how these priorities fit with past planning efforts, as well as how they give evidence of directions the department is prepared to move.

Broadly speaking, the department hires both mathematicians and statisticians. The mathematicians tend to fit into two large clusters, "Algebra and Discrete Mathematics" and "Pure and Applied Analysis". You might think of this as a distinction between discrete and continuous mathematics although almost any classification of this type has counterexamples as faculty pursue problems they find intellectually interesting rather than hold to fixed descriptions of the area in which they work. Once inside the ADM or P&AA group, we can further subdivide the department's primary research interests in mathematics to include the four *Areas of Strength* that the department has emphasized since 1996:

ADM

Commutative Algebra and Algebraic Geometry
Discrete and Experimental Mathematics

P&AA

Operator Algebras and Functional Integration
Modeling with emphasis on Differential Equations and Partial Differential Equations

Even finer subdivisions are possible as we classify faculty research interests to include subareas such as Coding Theory, Combinatorics, Geometric Group Theory, Semigroup Theory, Classical Analysis, Control Theory, Dynamical Systems, Numerical Analysis, etc. Historically, we have used "Applied Mathematics" to refer to continuous mathematics with an emphasis on differential equations, partial differential equations and numerical analysis. Such language is now viewed as limiting and even incorrect as faculty in semigroup theory work with computer scientists on "information science", and faculty in algebraic coding theory attend research conferences with engineers. Indeed, as was said at a recent presentation to the National Science Board, "Every area of mathematics, as pure as it may appear, has significant applications. The concepts and structures developed by fundamental mathematics often provide just the right framework for the formulation and study of applications in seemingly unrelated areas."

Even as I sort the research interests of the faculty into these groupings, I want to stress that in a department the size of ours, there are many areas of mathematics not covered by the research expertise of the faculty. For example, one might view "Geometry" as an area of comparable size to ADM and we have no faculty who clearly fall into such a category, although we have several who have significant research interests in geometry. Other major areas where we have no faculty concentration include logic, number theory, and mathematical physics.

Similarly, statistics has developed into a very large discipline, independent of mathematics. Until such time as UNL makes a commitment to a much larger statistics program, we believe that the greatest advancement for statistics

at UNL can be made by focusing on having a very high quality group of statisticians in the area of survey sampling who make a big contribution to the Gallup Research Center.

Qualifying the Department's Priorities:

We have put forth these priorities with the assumption that the charge is to determine how our hiring would proceed based on current information available to the department and assuming that the hiring will be primarily at a junior level. Listed below are conditions that could lead to a major change in hiring priorities:

i) Significant unanticipated loss of faculty in an area important to our graduate program, as a result of retirements, departures or reassignments.

ii) An opportunity to hire an Othmer Professor. We have been repeatedly advised by the UN Foundation that one and possibly two Othmer Professorships are anticipated for our department. Should an Othmer become a reality, our belief is that we should pursue hiring the most outstanding scholar we can attract to our department regardless of area. Quite possibly, this would result in hiring in an area different from the areas identified above.

iii) Department involvement in a campus initiative. We recognize that sometime over the next five years the department may get an opportunity to participate in a campus research initiative which would force us to change our hiring priorities.

iv) Diversity hiring. It is possible that the Department could advance the UNL goal of increasing the number of minority (or women) faculty on campus by attracting a strong faculty member whose research area may fit the department but who would not be in an area identified above.

v) Dual career hiring. We recognize that we have been able to hire some very strong faculty because of our openness to supporting couples. Should such an opportunity occur, we would want to consider the benefit of the hire weighed against the change it might require in our hiring priorities.

**2. Why are these areas important to your success and/or national reputation? If this is a new area without a history of academic strength and national reputation, what are the reasons your unit wants to move in this direction?**

It is important to stress that the Department wants to contribute to UNL's commitment to research in the life sciences. Thus, each of the major areas of mathematics within the department has identified a priority that can draw the department closer to joint research projects with faculty in the life sciences.

ADM's most pressing need, for a hire in discrete mathematics, is precipitated by Earl Kramer's expected retirement this year and to a certain extent by David Jaffe's move from coding theory into bioinformatics. At the same time, a person trained in the methods of discrete mathematics would be well positioned to contribute to the University's bioinformatics initiative through both research and graduate education. We believe that the reputations of Jamie Radcliffe and Judy Walker should make it possible to attract an outstanding researcher in this area to UNL and that the new faculty member would find a supportive climate here, both within and outside the Department. Our ability to recruit top students to our graduate program is at risk if we fail to build our strength in discrete mathematics. (Kramer has had three Ph.D. students graduate in the past six years.) There has been a huge national upswing in the number of undergraduates doing research projects, and the most ambitious projects tend to be in discrete mathematics. We need to enlarge our nucleus of discrete mathematicians if we hope to attract these outstanding students.

The need for a second hire, in computational algebra, stems from the dramatic increases in computational power that have changed the way we think about teaching and research in algebra. Many faculty in ADM work on problems where there is a need for symbolic computation, and some, notably Susan Hermiller, are doing research on computational algebra *per se*. Virtually everyone in the ADM research group would benefit from a person skilled in computer algebra. Such a person would almost certainly be able to contribute as well to the University's bioinformatics initiative through large-scale symbolic computation.

I should note that currently the department has a faculty member (Jaffe) who is at the Whitehead Institute at MIT as part of his long range plan to shift his research focus from algebraic geometry and coding theory to bioinformatics. There are two other faculty in the ADM area who participated in Jaffe's bioinformatics course last year and who have expressed some interest in moving their research program in the direction of bioinformatics. Thus, a hire that supports the priorities described above will make a contribution to our graduate program, will provide

strengths in bioinformatics, will support the other faculty considering a shift in this research direction, and will help us attract Jaffe back to UNL after his time at the Whitehead Institute.

Hiring in discrete mathematics and computational algebra also offer our best chance for rebuilding our ties with Computer Science and Engineering. These ties, which were so fruitful for two decades, have been virtually severed by the departure from UNL of several outstanding theoretical computer scientists. There are indications, however, that CSE may be trying to replace some of these major losses, and both departments have everything to gain by finding areas of mutual research interest.

The top P&AA priority is to hire in biomathematics. We would pursue such a hire with an emphasis on the potential of the candidate to conduct interdisciplinary research with UNL faculty in the biological sciences. At present, five of the faculty in P&AA have at some point in their career been involved in mathematical applications to biology (modeling chemical processes in pancreatic function, cartilage strength and biomechanics, ecology and population modeling, and microorganism transport in aquifers). Moreover, members of the group have conducted a year-long seminar in mathematical biology, and a course in this area is currently being planned. Six members of the P&AA group have responded positively to Dean Starace's inquiry regarding the recent NSF initiative in Quantitative Environmental and Integrative Biology (QEIB). Whether or not we are able to respond immediately to this RFP, we do hope to initiate discussions between faculty in our department and faculty in the life sciences as we explore mathematical questions in biology where our faculties could work together effectively.

It is important to stress that "bioinformatics" is not the only way that mathematics at UNL can contribute to an initiative in the biological sciences. The October 2000 issue of *Nature* has an article titled "Systems biology's multiple maths" which describes "post-genomics" and "proteomics" as "phrases that mean little that is specific but herald an encyclopedic era of information about the way biological cells and their genes and proteins behave." The article says "It is, at last, possible to anticipate mathematics becoming useful in the modeling of the systems." One effort they describe is creating a "virtual cell" which is represented by a series of differential equations, as protein-protein interactions are characterized in a linear fashion. Later they comment "they should achieve a long-awaited development when mathematics does what it has so often done in other disciplines: provide a basis for prediction and thereby lead rather than lag behind the experiments." It is this kind of mathematical biology that our P&AA faculty hope to support.

A second priority for the P&AA group is to hire an analyst who can contribute to our department's strength in operator algebras, an area where the department has been strong for nearly 30 years. Such a hire would be essential for graduate instruction in analysis (which is common to all doctoral study in the department) if we were to lose another faculty member in operator algebras or functional integration. Even without a loss of faculty in the area, we are interested in building this area over time to a position of national prominence.

In statistics, the department has committed itself to establishing an (essentially) autonomous Division of Statistics within our department. We believe that with a limited number of statisticians it is best for us to focus on one area of statistics, survey sampling, and aspire to be one of the very best programs in the nation in this area. Such a focus will enable the statistics program to make major contributions to UNL's Gallup Research Center, the graduate program in survey methodology, and (we hope) join the Joint Program in Survey Methodology (JPSM) at Maryland and Michigan. If we are successful in achieving these steps, we will be part of the most outstanding program of its type in the world and we will be well positioned for obtaining external funding from a wide variety of government agencies.

We are pleased to note the commitment of the College of Arts and Sciences and the Office of the SVCAA to support the growth of our statistics program in this direction. This commitment includes searches for two senior positions that are currently underway and to an additional hire in the area in 2002/2003. It should be noted that even with this focus on survey sampling, our statisticians will be eager to participate in other major initiatives at the University. Currently Professor Partha Lahiri is leading efforts to write a proposal aimed at bringing faculty from UNL and UNMC into stronger collaborations on health statistics. We already have research interaction between our statisticians and faculty in the Department of Preventive and Societal Medicine and the Department of Geriatrics at UNMC. There is also interest in contributing to UNL's research initiatives in the biological sciences. Next spring, we will host a workshop on statistical genetics featuring Professor Robert Elston, a world-renowned expert in the area. Despite our interest, we must indicate that our ability to make greater contributions in this area may be limited by the number of faculty in the Division of Statistics.

**2 (continued). In a climate of limited resources, why would investment in these areas be of value to UNL as a whole?**

Simply put, the Department of Mathematics and Statistics is an extremely good bargain and it is an important

area for investment if UNL wishes to increase its national reputation and its external funding.

We believe that the Department has established a reputation for excellence that UNL should make every effort to maintain or enhance if we hope to improve our NRC Department Rankings the next time an evaluation of academic disciplines takes place. During the last NRC Department Rankings which were conducted in 1993 and published in 1995, our department was essentially in a tie for 7th place among all UNL disciplines which were rated in the main category of Quality of the Research Faculty. The areas rated above ours included Chemistry and two areas of the Biological Sciences where UNL had invested far more resources than in Mathematics and Statistics. The other top areas with a higher rating than our discipline were, not surprisingly, Psychology, Physics and English, all strengths of the College of Arts and Sciences. Our rating at the time reflected a significant improvement for the department and this is reflected in how the department "scored" in the the category which measured how much programs had improved over the previous five years. Our department's improvement was ranked in a tie for 14th out of 139 programs rated. Because we had quite a few junior faculty at that time and we have had some very successful hires since that time, we believe that the department's ranking will improve, especially if we achieve additional hires before the next rankings.

It is important to note that any hiring in the Department of Mathematics and Statistics brings a faculty member into a culture that greatly values undergraduate teaching. Our department is one of the major contributors to UNL's General Education effort and we are one of the largest providers of honors instruction. Indeed, honors instruction in mathematics is especially important to students in the sciences and engineering. Thus, there is a clear instructional benefit derived from a research hire in mathematics or statistics.

The undergraduate program in mathematics and statistics also attracts some of UNL's most outstanding undergraduate students. In 1999, three of four undergraduates at UNL who were awarded prestigious NSF Graduate Fellowships were majors in mathematics. The only other universities to have three or more in mathematics that year were Harvard, Princeton and MIT. The fourth student to win an NSF Graduate Fellowship was in engineering but was taking several advanced 400/800 level mathematics classes. More recently, Jaclyn Kohles Anderson won an award from the Association for Women in Mathematics that recognizes her as the outstanding woman math major in America. In the best spirit of integrating undergraduate instruction with UNL's research mission, Jaclyn is participating in an undergraduate research project under the direction of Professor Roger Wiegand, one of our most outstanding faculty in ADM.

At the graduate level, there is even more to point to in terms of our national reputation in mathematics. At the time of the last NRC Department Rankings, our rating in the "Educating Doctoral Scholars" category was significantly higher than the rating of the quality of our faculty. We rated 64th out of 139 mathematics departments, placing the Department in the second quartile of mathematics departments. A comparison with other UNL programs reveals the fact that only the interdisciplinary program in Biochemistry / Molecular Biology and the Department of Chemistry rated higher. The ranking for Psychology was virtually identical to that in Mathematics.

Since the time of that ranking, the Department has significantly improved its doctoral program. We won a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring for our success in mentoring women graduate students. Note that we are the only mathematics department to ever win one of these awards. Our Nebraska Conference for Undergraduate Women in Mathematics, which was created to continue the work that led to the Presidential Award, has brought outstanding publicity to both our commitment to research for undergraduates and to our graduate program. This publicity has helped us recruit four Othmer Graduate Fellows. We have received new funding from both NSA and NSF which guarantees that this conference will continue for another four years and thus provide an outstanding opportunity to strengthen our graduate recruiting. Another program designed to support graduate recruitment, our Regional Workshop in the Mathematical Sciences, attracted over 170 people this year, up from about 100 last year. In addition, we have welcomed Computer Science and Computer Engineering as a cosponsor of this conference in a joint effort to improve the quality of graduate students in the mathematical and computing sciences.

A report provided by the AMS-IMS-MAA Data Committee indicated that for the five year period 1994/95 to 1998/99, the Department awarded 39 Ph.D.s. This places the department in 26th place among 177 Ph.D. granting departments in mathematics. Most departments that awarded more Ph.D.s during this period are the obvious "top" programs such as UC-Berkeley, UCLA, Michigan, Wisconsin, Maryland, Stanford, MIT, Harvard, etc., with far larger faculties and a greater commitment to graduate education. Indeed, of the 18 public universities who awarded more Ph.D.s in this period, the average size of the tenure-track faculty is 59 as compared with our 34. If one looks at the ratio of Ph.D.s awarded in five years to the number of tenure-track faculty, only 14 programs have a higher average than our department.

In the slightly more than one year since the Data Committee report, the department has awarded another 11 Ph.D.s bringing our total to 50 in just over 6 years. Of those 50, 19 (38%) have been awarded to women, a fact that brings our department significant national publicity. I want to stress that the quality of our Ph.D.s has been high. Since 1997, two have received prestigious NSF Postdoctoral Fellowships. Because only about 30 such fellowships are awarded each year in the mathematical sciences, it is quite significant that we have had two in the last four years. Indeed, we believe our graduate program should be viewed as a University "star" and every effort made to assist us in keeping it strong. [Further evidence that the graduate program in Mathematics and Statistics is successful can be obtained from the 2000 A&S Graduate Alumni Assessment report which indicated that on 25 of 26 questions, Department alumni rated the department better than the average rating given by alumni in the College.]

Mathematics and Statistics is a particularly good area in which to invest in new faculty because the cost is far less than hiring in engineering or the lab sciences, because the discipline is becoming increasingly important to successful research in the life sciences, and because the discipline is about to gain a significant infusion of new funds at the national level. On October 19, 2000, NSF Director Rita Colwell (a biologist) made a presentation to the National Science Board in which she introduced NSF's "Mathematical Sciences Initiative" which called for increasing the NSF budget in the Division of Mathematical Sciences from its current FY2000 $106 million to $250 million by FY2003 and $500 million by FY 2006. In her presentation, Director Colwell stressed that NSF's Mathematical Sciences Initiative was necessary because the mathematical sciences were accelerating progress across the spectrum of science and engineering research at an unprecedented pace but that resources devoted to the mathematical sciences have not kept pace, thus slowing down the nation's scientific enterprise. To remedy this situation, she indicated that new funds would be devoted to three key areas:

- fundamental mathematical research,
- interdisciplinary math, science and engineering collaborations, and
- mathematics education.

Because our department has often been cited as an example of a department that successfully combines a commitment to mathematics education with a strong research program, we believe we are well positioned to capitalize on these new funds that are expected for the mathematical sciences at NSF. Of course, in order to respond we need sufficient faculty strength to make both the necessary commitment to fundamental mathematical research and to interdisciplinary research while maintaining our commitment to graduate education and to undergraduate instruction.

**3. Analyze (a) the number of faculty and their expertise that you now have in these areas, (b) the number of faculty and their expertise you reasonably expect to lose in the next few years in these areas, and (c) the number and expertise of the faculty you will need in these areas in order either to continue the program's strength or expand the program's national reputation**

Algebra and Discrete Mathematics

a) Currently we have 12 tenure-track faculty in ADM plus one visitor and one posdoc. Two (Earl Kramer and Jamie Radcliffe) are currently in combinatorics (discrete mathematics) and David Jaffe has changed his research area to bioinformatics, a related form of discrete mathematics. John Meakin's work is related to discrete mathematics as is the work being done by Judy Walker, Mark Brittenham and Susan Hermiller. Hermiller's work can also be described as computational algebra.

b) The visitor and postdoc will likely be gone after this year and we have no apparent capacity to replace them. More importantly, Professor Earl Kramer will retire this year. If we focus specifically on the area of discrete mathematics, after Kramer retires we will have only one faculty member, Associate Professor Radcliffe. Thus, it is especially important to be able to replace Kramer. In the related area of bioinformatics, we have one faculty member now conducting research in this area (Jaffe) and two ( Radcliffe and Brian Harbourne) who are exploring a research shift in this direction. It should be noted that Jaffe's shift to bioinformatics results in a loss of a faculty member in algebraic geometry. Harbourne is also in algebraic geometry. Should he shift in the direction of bioinformatics it will mean a loss of a second person in what has long been our strongest area. This will place even greater responsibilities on the shoulders of Roger Wiegand and Sylvia Wiegand, the two senior faculty in the area.

c) We believe that two hires, one in discrete mathematics and one in computational algebra can help the department make a contribution to bioinformatics while continuing to make contributions to ADM, traditionally the strongest area in our department. If there is a major UNL initiative in this area, it may be appropriate to consider additional hires.

Pure and Applied Analysis

a) Currently we have 17 faculty in P&AA including one (Erbe) who is on a three-year position. We also have one visitor in the area. Five faculty have done previous work in biomathematics although none have that as their primary research interest.

b) We have no faculty that we expect to lose soon although at least one faculty member has discussed the possibility of leaving academia for a position with a private company and one faculty member indicated that he anticipates at least a partial retirement within five years. These losses, if they occur, would most likely be in pure analysis and would be a blow to our ability to offer core courses in analysis at the graduate level. The visitor is not expected to be here after this year.

c) Given the assumption of very limited hiring over the next five years, we would be pleased to be able to hire one new faculty member in biomathematics and (possibly) replace one in pure analysis with a faculty member in operator algebras.

Statistics (Survey Sampling)

a) Currently we have 3 faculty in statistics and two visitors. All three faculty have research strengths in survey sampling. b) We do not anticipate losing any faculty in this area. c) The two hires that have already been authorized for this year and the hire that has been authorized for 2002/2003 represent the minimum necessary faculty strength if we are to pursue our goal of true national prominence in survey sampling. We are hopeful that after a reasonable period of demonstrating the potential of our statistics strategy, consideration will be given to additional hires in statistics.

**4. Timetable for each area for investment from 2001/2002 until 2005/2006:**

- 2000/2001 - Hiring conducted for two senior faculty in statistics. Faculty arrive by Fall 2001.
- 2001/2002 - Hiring search in discrete mathematics and biomathematics. Faculty arrive in Fall 2002. Note that if there is a campus initiative in bioinformatics, functional geonomics or proteomics, there may be grant support for one or both of these hires for a limited period of time.
- 2002/2003 - Hiring searches in statistics and computational algebra. Faculty arrive in Fall 2003
- 2003/2004 - Hiring in operator algebras - Faculty arrives in Fall 2004. This hire should be timed to replace possible faculty loss in pure analysis.

**5. How will this priority ... help instructional needs?**

Each new faculty member will help the department respond to the significant responsibility of providing access of freshmen and sophomores to mathematics and statistics courses while also adding to the department's strengths in graduate education. The department has an outstanding track record of providing access to its courses to students who need instruction in mathematics or statistics.

**5. (continued) During the next five years, what areas within your unit will you not expect to strengthen or continue because of giving priorities to the two or three areas you have selected?**

Algebra and Discrete Mathematics

The two most important keys to our department's reputation are John Meakin and Roger Wiegand. Thus we would like to be able to hire directly in their own areas, and if our only criteria for our priorities was to increase our national reputation, our highest priority would be to hire to support the Commutative Algebra and Algebraic Geometry program built by Roger (and Sylvia) Wiegand or to hire in Semigroups, Algorithmic Systems or Geometric Group Theory to support the group built by Meakin. However, both Wiegand and Meakin place a higher priority on a hiring choice that fills key needs at this time, namely discrete mathematics and computational algebra. They do this both to be supportive of our graduate program and to enable the department to make a contribution to UNL's commitment to research in the biological sciences. I do want to stress that should one of our hiring opportunities be for an Othmer Chair, we would change our priority to hiring the strongest mathematician we can attract to our department. It is likely that we would need to use the reputation of Meakin and the Wiegands to attract a scholar worthy of an Othmer Chair and thus the hire might be in an area very close mathematically to one of them.

Pure and Applied Analysis

In Applied Analysis, our modeling group (David Logan, Steve Cohn, Glenn Ledder, Steve Dunbar, Tom Shores) is strong and under normal circumstances we would be interested in hiring to make this group stronger. However, we have chosen to put this area (and all other areas in applied analysis) "on hold" while we attempt to hire in

biomathematics because of its potential to contribute to UNL's priorities. It should be noted, of course, that the successful hire might end up having strengths in modeling just as the person may be strong in partial differential equations, control theory or some other subarea of applied analysis where the department already has strong faculty. In pure analysis, our identification of operator algebras as a priority for hiring means that we will not be proposing any hiring in functional integration.

Mathematics Education

The Department is quite proud of its outreach efforts and its achievements in the area of mathematics education, and we have been a strong supporter of the A&S Math/Science Education *Area of Strength*. Given limited hiring opportunities, however, we cannot consider hiring anyone who focuses their creative work in this area. Instead, we hope to continue a model where faculty become involved in mathematics education activities while maintaining a strong research program in one of the Department's main research areas.

**6. What three measures will you use in five years to assess the academic strength and national reputation of the areas identified?**

**Grants:** External funding, long the *sine qua non* of research in the hard sciences, has gained importance in the mathematical sciences and is clearly a major issue here at UNL. This is the first area in which our research achievements should be judged.

**Publications:** Pressure to publish is severe, and faculty must sometimes make the decision as to whether to submit a paper to a top journal or to a slightly less prestigious one with a quicker turnaround time. While we will track the number of publications by our faculty, we will also pay particular attention to the quality of the journals. Special attention will be paid to any publications in a journal the quality of the *American Journal of Mathematics* or *Inventiones Mathematicae*.

**Graduate Recruitment:** Our goals include an increase in the quality and the number of graduate students we recruit. We will pay particular attention to our success in obtaining Othmer Graduate Fellowships, the success of these students in the job market, and our ability to have graduates who receive postdoctoral research appointments. If we are successful with the three categories above, we should also see improvement the next time that the NRC provides department rankings.

## D.5 Student Teaching Evaluation Form

## D.6 Faculty Salary List with Biographical Data

# Appendix E

# Materials Relating to Students

## E.1 Surveys of Department Graduates

### E.1.1 Summary of Undergraduate and Graduate Surveys

As part of the Academic Program Review, the department sent out two surveys, one to all who completed an undergraduate degree with first major in mathematics and statistics since 1990 and a different survey to all who completed a graduate degree in that time. These surveys, together with the more easily tabulated responses, are included as an appendix to this summary.

Of the 318 undergraduate surveys sent out, 64 were returned. There were 179 graduate surveys sent out, with 36 responses. The response rates where just over 20% for each. There is possibly some selection bias in favor of positive responses (those who have successes to report or feel strongly that the department did a good job are more likely to reply) but the response rates seem large enough to give a reasonable assessment of the undergraduate and graduate programs, or rather, an assessment of the programs as they were when the respondents graduated. On the previous APR, similar surveys were sent out, with response rates of about 10% and 20%, respectively.

The results of both surveys suggest that graduates, overall, are happy with the preparation their program provides for them and with the organization of the programs themselves. This is not to say that the programs are perfect and some graduates suggest possible (sometimes incompatible) improvements. Also, the department has already moved to address some of the concerns raised by respondents.

## Undergraduate Survey

The first opinion question on the survey asked about ‘the preparation our undergraduate program provided for your future graduate study and or employment’; there were five possible responses, from ‘Excellent’ to ‘Poor’; Weighting these as 4 through 0, the average was 2.82 on this question. For those who went on to graduate school, the average was 2.86; for those who took jobs, 2.73; for those six students do did ‘other’ after graduation, the average was 3.00.

Another question asked explicitly about the quality of ‘the program offered’ by the department and offered the same 5 choices. Using the same weighting, the average on this question was 3.06. For those who went on to graduate school, the average was 3.15; for those who took jobs, 3.00. These numbers suggest that the department program provides reasonable preparation for academic and non-academic careers.

We specifically asked about the significance of the analytical/critical thinking skills developed in the program, as such skills form a crucial part of the program. The majority of students said such skills were very significant (42 out of 63). Of the 26 who went to graduate school, 20 rated the skills as very significant; of the 31 who took jobs, 18 rated them as very significant.

A number commented that although their work was not directly mathematical, their undergraduate preparation, and these analytical skills in particular, were vital to it. Among the comments offered are the following:

> My math degree provided me with the problem solving skills needed to excel in my career as a systems analyst.

> Problem solving skills are a key component to my job, and many of those techniques I credit to my undergraduate preparation
>
> Because I have entered the medical field, I am not actively using the information I learned in my math classes. However, and more importantly, I am using the problem solving and theoretical skills I gained in my math classes every day.
>
> Technical skills and analytical thinking are critical to my work in the financial services industry.
>
> Although I am not really "doing" math in my current position, the skills I learned are invaluable. I'm doing automation and development for my company. I use the analytical and critical thinking skills I learned in college everyday.
>
> Problem solving is used in many ways. Both as an officer in the Air Force and as an actuary, I've needed to work through complex problems.

We also asked about specific parts of the undergraduate program: advising, technology, specific courses that were or weren't useful, instruction in general and specific instructors who stood out, and finally if the department provided a supportive environment.

There was a striking response to the question: Overall, do you believe the [department] provided you with a supportive environment for your undergraduate education? There was one blank, 6 variations on no, 4 variations on somewhat, and 52 positive responses. Several students who have gone on graduate school elsewhere favorably compared the department's concern for undergraduates to their current institutions. A number mentioned the accessibility of professors.

> Yes, I wouldn't be able to do what I do without having teachers who cared.

Some of the negative comments were:

> No. Some of my individual teachers provided a very supportive environment but I was not comfortable in the department as a whole.
>
> Despite having an Eastman Scholarship, I never really felt "into" the program.
>
> In the early 90's, I didn't sense much of a "community" or togetherness in the math department. I felt like I was going it alone.

Some of the issues raised in these responses have already been addressed; for example, the department has a fall reception for scholarship winners, in part to help them integrate into the department.

We asked students to rate advising using the same five possible responses. Ignoring the 3 blanks, the average is 2.83. This is a considerable improvement on the rating from the previous APR survey, where the same question with 5 choices (very good, good, satisfactory, fair, and poor) obtained an average of 2.22. Interestingly, the average for students who went to graduate school is 3.00, compared to 2.69 for those when directly to jobs.

The chief undergraduate advisor, Gordon Woodward, is particularly praised. One student wrote: 'I miss him; there is surely no Dr. Woodward in med school'.

A number of students suggested providing more information about non-academic careers. This was probably the single most common suggestion in the undergraduate survey. This is something Professor Woodward has been working on and so this concern may already be partly addressed.

It is perhaps not surprising that math majors prefer their math and stat instructors to those in other departments. Nonetheless, there is a significant difference: the average rating for math-stat instructors is 3.19 compared to 2.46 for other UNL instructors. Comparing averages for different groups; the average rating from women graduates is 3.23 compared to 3.16 from men graduates. ¿From those who went to graduate school, the average is 3.25; for those who took jobs, the average is 3.10.

One student even wrote 'I never had a bad math instructor!". Here are a number of other quotations, starting with the more positive ones:

> I think the Math/Stat professors take their jobs as instructors very seriously. I had many professors in other areas that didn't seem to care or were lazy. Math professors really made an effort to teach all students willing to learn.

> I really had no instructor in the department that I thought was a poor instructor. They all cared and were quite approachable.
>
> I still remember a lot of professors I had at UNL fondly...not because I knew them personally but because they were central in helping me decide what to "do next".
>
> My experience was excellent. However, I am not shy and willing to ask for the help that I needed. UNL is very big and I could easily see where some people may be too intimidated to ask.
>
> All my instructors did a good job teaching the material. My biggest complaint has always been how much time professors take away from students with research. It's a necessary evil, but one I really was disappointed with.
>
> I found the Math-Stat instructors to be less variable in quality than UNL instructors as a whole. It's very hard to rate all UNL instructors because some were excellent while others were very poor.

Turning to individual instructors, an impressive range of instructors are praised. The most commonly mentioned are Dunbar, Woodward, Shores, and Lewis.

We asked respondents which courses they thought would be valuable to all undergraduate students, which were personally valuable, and which were not valuable. Although some respondents put matrix theory, abstract algebra, and real analysis in the latter category, others singled out these courses as being particularly valuable. The calculus sequence was also often mentioned as important, along with the statistics courses, particularly Stats 380. Combinatorics and graph theory were mentioned as being personally valuable.

Finally, many respondents stressed the need for adequate computing facilities. Although graduates from the early 90's report limited use of technology, more recent graduates say that they used technology heavily. Interestingly, quite a number of respondents, while urging us to use technology, also express concern that we don't go overboard. One person suggests 'crossover' courses between mathematics and computer science/information technology, presumably beyond the existing joint teaching of numerical analysis courses.

To conclude, here is a sample of responses to the issue of technology, together with the year of graduation:

> Students need to know how to use the various forms of technology available (i.e., graphing calculators, computer programs). They should be given problems which require their use. ('90)
>
> At the time there wasn't much technology used—I would imagine that this has changed considerably in the past 10 years. Technology use should be practical application—not everyone goes on to graduate degrees so students need to be ready to begin their careers with the knowledge/skills gained in the undergraduate program. ('92)
>
> The computer lab was invaluable to me. I learned a great deal using Mathematica and now I use Matlab all the time. These kinds of software should be available to students. ('94)
>
> I learned Maple and Mathematica for projects in Calculus, differential equations and linear algebra. That experience was very helpful. I think incorporating such packages as projects for classes is very appropriate—encourage students to experiment and learn to "teach themselves" this technology. My ability to independently learn software packages and programming really distinguishes me as an employee. ('96)
>
> I still believe it is important to understand the fundamentals, but I use Math software to solve integrals and algebraic equations. I still want to see both incorporated in classes. ('97)

## Graduate Survey

The graduate survey had a somewhat different format, although the multiple choice questions stuck to the same basic format. Of the 36 replies, 22 were from women. Also, 13 respondents had received a Ph.D., 25 had received a M.A. or M.S., including 6 who received both. Four received MAT or MScT degrees.

Again, respondents were asked about the preparation provided by by our graduate program 'for further graduate study and/or employment'. The average (on the same 4 to 0 scale used in the undergraduate survey) was 3.08, with 3.14 for women and 3.04 for men. For those who received a masters degree, the average was 2.90; for those with a Ph.D., it was 3.31. In the overall rating of the graduate program, the average was 3.19, with no rating of less than

'good'. Interestingly, the masters/Ph.D. split is much less pronounced here; the averages are 3.21 for masters recipients compared to 3.27 for Ph.D. recipients. Comparing men to women, the averages are 3.29 to 3.13, respectively.

22 reported that the program was very relevant to their current activities, while 13 said somewhat relevant and one said not much related. While 19 said that performing research was part of their current position, 15 said it was not.

Besides questions about advising, technology, instruction and the department environment, we asked about the library, the graduate exams, and department weaknesses. There were also two questions directed specifically to doctoral scholars, which we return to at the end of the summary.

We asked 'how well the [department] performed in providing you with a supportive environment for your graduate studies'. The average was 3.39 (out of 4), splitting as 3.56 for Ph.D. recipients and 3.25 for Masters. The average for women was 3.57; for men, 3.27. There was relatively few written comments, none of them negative, so all of them are included:

> The record here speaks for itself: mentoring awards, etc.
>
> The dep't was extremely supportive and caring—I doubt there is another like it. Also, the faculty liked each other, which made for a more secure and relaxed atmosphere.
>
> The Department of Mathematics and Statistics is very supportive and friendly.
>
> Professors were very helpful with coursework and are open to working with students outside of class.
>
> Better every year.
>
> It improved generally over the years—the increasing secretarial support was great.
>
> It was a very friendly place. You hear horror stories from some people about other programs—Math/Stats is very supportive of the students.

Computer facilities received a respectable rating of 2.47. There were a number of suggestions, notably more machines, more workshops on the use of technology, and the incorporation of computer work into courses. Respondents were glad to have learned to use graphing calculators in teaching and to have learned LaTeX (particularly popular in writing dissertations) and computer algebra packages. Several people on the statistics side mentioned SAS.

The library drew a 'very good' rating (3.03) but relatively little comment. One person suggested longer hours and another commented that having it in the department was 'a luxury I didn't know I should appreciate'.

The qualifying and comprehensive exams drew considerable comment. About half the respondents offered some variation on 'about right', with most commenting that the exams were fair. Some said they were quite difficult while one suggested that 'Certainly don't need to be watered down'.

What follows is all of the even partially negative comments and three positive comments.

> Quals and comps at times seem rather inconsistent and contrived.
>
> [quals and comps are] too tied to the actual courses in the given year. Taking the tests even a year after completing the courses is a huge disadvantage.
>
> It is not pleasant to take exams and exams don't really measure skills, but they are one way of separating students.
>
> Too many. When I talk to colleagues at conferences they can't believe we took five exams. I appreciated the leniency in choice and number of exams taken at a time.
>
> Fair if I could take one at a time.
>
> Actual exams were adequate representations of course material but grading procedure could be clearer.
>
> I thought both sets of exams were reasonable and appropriate. I know there's been some discussion of eliminating the second tier exams, but I think they are very valuable. Although I had been successful in the corresponding courses, I learned a great deal (both old material in greater depth and recognizing new connections in old material) in preparing for the exams. They're a valuable educational tool, even if they are questionable as an assessment tool.
>
> Intense, very stressful—however, a great learning process for real life situations when a ton of material needs to be absorbed in a short time frame.
>
> Your exam structure should be commended; I believe it works just the way it should.

We asked respondents to rate 'advising for graduate students'. The average overall was 2.77; for women, it was 3.07, for men, 2.59. The average rating for Ph.D. recipients was 2.69 while for masters recipients, it was 2.88. In spite of the latter numbers, several students said advising was inadequate/uninvolved until one selected a Ph.D. advisor. One person asked for better advice about non-academic careers and another, who rated advising as poor, commented that "I wanted a Ph.D. in math but I was never sure what branch of math to look into". There were relatively few written comments on advising though.

There was a range of responses to 'what advice do you wish you had received'. Eight respondents wished they had been told to take a greater variety of courses, both inside and outside the department; a number mentioned taking more statistics courses. The second most popular topic was career advice, in particular, knowing about and preparing for a variety of careers. One respondent specifically mentioned industry 'internships/fellowships'. A few people commented that they wished they had a better sense of the timeline and requirements for completing a Ph.D. Finally, several wished for more advice on doing research, either writing grant proposals, searching the literature, or just 'how to survive as a researcher'.

Finally, here are a few direct quotations:

> Stay and finish your Ph.D.!
>
> Get through exams (qualifying and comprehensive) as soon as possible!
>
> How not to be in my mid-20's and immature while trying to succeed in graduate school!

Asked to rate instruction out of the same 5 choices (excellent to poor), all responses were in the top three (excellent to good), with an average of 3.25 overall; 3.43 for women, 3.14 for men. For Ph.D. recipients, the average was 3.44; for masters recipients, 3.15. Five respondents offered a blanket endorsement of the department instruction, usually some variation on 'My instructors were consistently outstanding'. There were also some negative comments, which are listed below.

> I could have used more help than I got.
>
> In certain cases I know communication was more an issue as opposed to their technical knowledge.
>
> I would rate my mathematics instructors as excellent, but my experience in a couple [of] undergrad stat courses was less than favorable.
>
> At the time I (personally) felt like I really didn't know any of the Stat professors outside the classroom, which I personally found less than desirable.
>
> A majority of the instructors I encountered had very little interest in promoting learning in students. Drs Saxena, Park, and Lahiri <u>all</u> were fine teachers who cared about student learning.

Again, a wide range of instructors (tabulated on the survey form in the appendix) drew specific praise. Professors Peterson, R. Wiegand, Harbourne, Meakin, S. Wiegand, and Lewis were the most frequently mentioned.

We asked all respondent about department weaknesses and any 'complements, criticisms, suggestions, or comments' that they might have. Although several responded to the question 'does the [department] have weaknesses?' with a flat no, a number offered suggestions. These covered quite a range: computer system support, faculty specializing in interdisciplinary research and computation mathematics, a better link with statistics and more focus on applied math/numerical analysis, exchange programs to other schools, more visiting scholars. Several people suggested that the statistics program needs a greater variety of courses and more faculty. One comment perhaps deserves quoting in full:

> Advising early on needs to be addressed as well as choosing the top teaching faculty for intro graduate courses (especially 825 and 817).

We specifically asked doctoral respondents what departmental strengths were important to them and what advice they had. A supportive faculty was most frequently mentioned strength, although a wide range of other topics appeared: most subject areas, computer facilities, support of graduate student travel, faculty that could find great research problems for graduate students, seminar participation, and emphasis on teaching methods. In advice, career information was again mentioned, along with a few others:

Don’t let any slip by on minimalist course requirements.

Perhaps a common core of prerequisite course, including physics and 800-level DEs.

Require more of the applied math and statistics.

### E.1.2 The Undergraduate Survey

### E.1.3 The Graduate Survey

# E.2 Graduate Student Awards

## E.2.1 Emeritus Faculty Fellowships

| Year | Scholar | Graduate School Status |
|---|---|---|
| 90/91 | Sandeep Holay | Ph.D. 1994 |
| 91/92 | Robert Jajcay | Ph.D. 1994 |
| | David Jorgensen | Ph.D. 1996 |
| | Vesna Kilibarda | Ph.D. 1994 |
| | Jeff Rushall | M.A. 1992 (Trans. to Texas) |
| | Tim Huffman | Ph.D. 1994 |
| | Sui-Mei Wan | Ph.D. 1999 |
| 92/93 | Regina Bade | M.S. 1993 |
| | Nancy Campbell | Ph.D. 1995 |
| | Stephanie Fitchett | Ph.D. 1997 |
| | Kaicheng Wang | Ph.D. 1996 |
| | Akihiro Yamamura | Ph.D. 1996 |
| 93/94 | Paul Dawkins | Ph.D. 1997 |
| | Kurt Herzinger | Ph.D. 1996 |
| | Jaeyong Lee | M.S. 1994 (Trans. to Purdue) |
| | Susan Szaniszlo | Ph.D. 1996 |
| | Quiling Zhang | M.S. 1993 (Trans. to Michigan) |
| 94/95 | Doug Anderson | Ph.D. 1997 |
| | Daryl Bell | Ph.D. 1999 |
| | Lisa McShine | M.S. 1995 (Trans. to Georgia Tech) |
| | Ferhan Atica | Ph.D. 1995 |
| | Akihiro Yamamura | Ph.D. 1996 |
| 95/96 | Meral Arnavut | Active |
| | Tim Deis | Ph.D. 1999 |
| | Michelle Homp | Ph.D. 1997 |
| | Ryan Karr | Active |
| | Jennifer Raschko-Mueller | Ph.D. 1997 |
| 96/97 | Richard Avery | Ph.D. 1997 |
| | Iyad Abu Jeib | Ph.D. 2000 |
| | Karl Kattchee | Active |
| | Patricia Nelson | Active |
| | Vera Rayevskaya | M.S. 1995 (Trans. to Vanderbilt) |
| 97/98 | Keith Agre | Ph.D. 2000 |
| | Graham Leuschke | Ph.D. 2000 |
| | Victoria Sapko | Active |
| | Theresa Strei | Ph.D. 2000 |
| | Chien-Hua Wu | Ph.D. 1998 |
| 98/99 | Keith Agre | Ph.D. 2000 |
| | Iyad Jeib Ph.D. 2000 | |
| | Karl Kattchee | Active |
| | Jane Meza | Ph.D. 2000 |
| | Patricia Nelson | Active |
| 99/00 | Elvan Akin | Ph. D. 2000 |
| | Justin James | Active |
| | Bill Wolesensky | Active |
| 00/01 | Shijie Chen | Active |
| | Lois Goss | Active |
| | Matt Koetz | Active |
| | Benmei Liu | Active |

### E.2.2 Outstanding First Year Student Award

| Year of Award | Scholar | Graduate School Status |
|---|---|---|
| 89/90 | Darren Holley | Ph.D. 1997 |
| 90/91 | David Jorgensen | Ph.D. 1996 |
| 91/92 | Kurt Herzinger | Ph.D. 1996 |
| 92/93 | Stephanie Fitchett | Ph.D. 1997 |
| 93/94 | Quiling Zhang | M.S. 1993 (Trans. to Michigan) |
| 94/95 | Michael Morelli | Ph.D. 1996 |
| 95/96 | Richard Avery | Ph.D. 1997 |
| | Victoria Sapko | Active |
| 96/97 | Graham Leuschke | Ph.D. 2000 |
| 97/98 | Steve Lindblad | Active |
| 98/99 | Joe Scherer | M.S. 1999 (Trans. to Oregon) |
| 99/00 | Lois Goss | Active |
| 00/01 | Jayeon Jeong | Active |

### E.2.3 Outstanding Qualifying Exam Awards

| Year of Award | Scholar | Graduate School Status |
|---|---|---|
| 89/90 | Troy Riggs | Ph.D. 1993 |
| 90/91 | David Jorgensen | Ph.D. 1996 |
| 91/92 | Nancy Campbell | Ph.D. 1995 |
| | Kristin Pfabe | Ph.D. 1995 |
| 92/93 | Stephanie Fitchett | Ph.D. 1997 |
| | Kaicheng Wang | Ph.D. 1996 |
| 93/94 | Jaeyong Lee | M.S. 1994 (Trans. to Purdue) |
| 94/95 | Doug Anderson | Ph.D. 1997 |
| 95/96 | Victoria Sapko | Active |
| 96/97 | Nikolay Silkin | M.S. 1999 (Trans. to Vanderbilt) |
| 97/98 | (no award given) | |
| 98/99 | Jane Meza | Ph.D. 2000 |
| 99/00 | Bill Wolesensky | Active |
| 00/01 | Shijie Chen | Active |

### E.2.4 Outstanding Graduate Student Teacher Award

| Year of Award | Scholar | Graduate School Status |
|---|---|---|
| 91/92 | John Schneider | Ph.D. 1992 |
| 92/93 | Lori Higby | M.S. 1993 |
| 93/94 | Nancy Campbell | Ph.D. 1995 |
| | Cheryl Olsen | Ph.D. 1997 |
| 94/95 | Stephanie Fitchett | Ph.D. 1997 |
| | Kurt Herzinger | Ph.D. 1996 |
| 95/96 | Tim Deis | Ph.D. 1999 |
| | Michelle Homp | Ph.D. 1997 |
| 96/97 | Robert Krueger | Ph.D. 1998 |
| 97/98 | Mike Ira | Ph.D. 2000 |
| 98/99 | Tim Pollis | Ph.D. 1999 |
| 99/00 | Lisa Johnson | Ph.D. 2000 |
| | Theresa Strei | Ph.D. 2000 |
| 00/01 | Keith Agre | Ph.D. 2000 |

### E.2.5 Grace Chisholm Young & William Henry Young

| Year of Award | Scholar | Graduate School Status |
|---|---|---|
| 96/97 | Theresa Strei | Ph.D. 2000 |
| 97/98 | Rikki Wagstrom | Ph.D. 1999 |
| 98/99 | Graham Leuschke | Ph.D. 2000 |
| 99/00 | Patricia Nelson | Active |
| 00/01 | Justin James | Active |

### E.2.6 Graduate Research Assistant Award, UNL College of Arts and Sciences

| Year | Scholar | Graduate School Status |
|---|---|---|
| 1999 | Graham Leuschke | Ph.D. 2000 |

### E.2.7 Alumni Association Graduate Research Assistant Award

| Year | Scholar | Graduate School Status |
|---|---|---|
| 2000 | Graham Leuschke | Ph.D. 2000 |

### E.2.8 Alumni Association Graduate Teaching Assistant Award

| Year | Scholar | Graduate School Status |
|---|---|---|
| 1989 | Margaret Kaiser-Woodward | M.A.T. 1989 |
| 1994 | Cheryl Olsen | Ph.D. 1997 |
| 1996 | Stephanie Fitchett | Ph.D. 1997 |
| 1999 | Mike Ira | Ph.D. 2000 |
| 2000 | Lisa Johnson | Ph.D. 2000 |

### E.2.9 National Science Foundation Postdoctoral Fellowships

| Starting Year | Scholar | Fellowship Location |
|---|---|---|
| 1997 | Jennifer Raschko-Mueller | Rensselaer Polytechnic Institute |
| 2000 | Graham Leuschke | University of Kansas |

### E.2.10 National Physical Sciences Consortium Fellowship

| Years | Scholar | Fellowship Location |
|---|---|---|
| 1995-2000 | Theresa Strei | National Security Agency |

## E.3 General Information On Graduate Programs

**(Revised December, 1998)**

*This information applies only to students entering the program after 1999. Students entering before 1999 should see the Degree Requirements dated April 1998.*

The general requirements for advanced degrees are in the Graduate Studies Bulletin (pages 19–20 for the Masters Degree and pages 21–23 for the PhD). This pamphlet describes some (but not all) of these general requirements, but the main focus is on additional requirements imposed by the Department of Mathematics and Statistics (hereafter called "the Department"). Inquiries may be directed to the Chair of the Graduate Committee (Roger Wiegand, rwiegandmath.unl.edu). Specific inquiries regarding the Statistics program should be made to the Director of Statistics (Partha Lahiri, plahiriunlinfo.unl.edu).

All new graduate students are initially assigned a faculty advisor from the Graduate Committee. Students may change advisors at any time during their program, and if they do so they should notify the Graduate Committee Chair of the change. The advisor assigned initially need not be the student's PhD advisor.

Requirements for a degree in the graduate program in Mathematics and Statistics include both coursework and exams, described in detail below. Graduate exams are given during two examination periods per year—in January during the first three weeks of Spring Semester, and during the period between the Memorial Day Holiday and the beginning of First Summer Session. Specific dates are announced by the Graduate (GAC) Committee. Coursework requirements are described in the Graduate Studies Bulletin, with some specific information in this document.

**Graduate Committee:** *Professors:* Chivukula, Dunbar, Halfar (emeritus), Harbourne, Jackson (emeritus), Johnson, Kramer, Lahiri (Director, Division of Statistics), Leavitt (emeritus), Lewis (Department Chair), Logan, Meakin (Acting Department Chair, Fall 98), Meisters (emeritus), Mesner (emeritus), Mientka, Rebarber, Peterson, Saxena (emeritus), Shores, Skoug, Thornton (Acting Department Vice-Chair, Fall 1998), R. Wiegand (Graduate Chair), S. Wiegand

*Associate Professors:* Chouinard, Cohn, Deng, Jaffe, Krajkiewicz, Ledder, Marley, Orr, Pitts, Radcliffe, Rammaha, Woodward; Assistant Professors: Donsig, Hermiller, Hines, Nettleton, J. Walker, M. Walker, Zechmann (emeritus)

*Adjunct Professors / Courtesy Appointments:* Eskridge, Magliveras, McCutcheon, Parkhurst, Tortora, Young.

**MASTERS DEGREE**

**Master of Science and Master of Arts:** The Department offers Masters Degrees (MS or MA) in Mathematics and in Statistics. The requirements for the two degrees are identical.

**Master of Science (Arts) for Teachers:** The MScT and MAT programs are designed for persons who are or will be teaching secondary mathematics. The possession of a valid secondary mathematics teaching certificate is a prerequisite to the award of the degree. For details on the program contact the Chair of the MAT-MScT Committee (Mel Thornton, mthorntounlinfo.unl.edu).

**Master of Science in Interdisciplinary Applied Mathematics:** The IAM Masters program is for those who are interested primarily in the application of mathematics to problems in science, engineering and industry. The program emphasizes modeling, computation and problem solving in an interdisciplinary environment. For details contact the IAM Coordinator (Steve Cohn, scohn@math.unl.edu).

**Degree Options** There are three options for the Masters Degree. Each option requires 36 hours of coursework. Some of this coursework must be in graduate-only courses, which are defined to be 900-level courses or 800-level courses without a 400-level counterpart. All three options allow a minor, and Option 2 requires a minor. The choice of minor area must be approved by the student's advisor.

- Option 1 requires a thesis. The program must include 6–10 hours of Math 899 and at least 8 hours of graduate-only coursework. A member of the Graduate Faculty must act as thesis advisor.
- Option 2 requires a minor. Mathematics majors may take a minor in Statistics or some area offering the Masters Degree outside the Department. Statistics majors may take a minor in Mathematics or some area

offering the Masters Degree outside the Department. The program must include at least 12 hours of graduate-only coursework. Option 2 is not intended for students who expect to pursue a PhD.

- Option 3 may be taken with an area of specialization in Pure Mathematics, Applied Mathematics or Statistics. The program must include at least 18 hours of graduate-only coursework.

**The Masters Exam** The Masters Exam (called the "Masters Comprehensive Exam" in the Graduate Studies Bulletin) is taken in either Mathematics or Statistics. The exam consists of two three-hour parts. In addition, students with an outside minor may be required by the minor department to take a Masters Exam in the minor area, but in practice this third exam is often waived. Description of the Masters Exam:

**I. Mathematics:** Two three-hour exams are required, one of which must be either the algebra or analysis exam (described below). Each exam must be over a two-course sequence offered by the Department or over two related Department courses approved by the GAC. The algebra exam is over the material usually covered in Math 817-818. Recent text: D. Dummit and R. Foote, Abstract Algebra. Additional references: I. N. Herstein, Topics in Algebra; Chapters 1, 4 and 7 of M. Artin, Algebra. The analysis exam is over the material usually covered in Math 825-826. Recent text: W. Rudin, Principles of Mathematical Analysis. Additional reference: T. Apostol, Mathematical Analysis.

**II. Statistics:** Two three-hour exams are required: *Part 1.* An exam in mathematical statistics over the material usually covered in Stat 882-883. Recent text: Mood, Graybill, and Boes, Introduction to the Theory of Statistics. Additional reference: Hogg and Craig, Introduction to Mathematical Statistics. *Part 2.* An exam in applied statistics over the material usually covered in Stat 885-886 or Stat 885-887. Recent texts: Netter, Wasserman and Kunter, Applied Linear Statistical Models; Johnson and Wichern, Applied Multivariate Analysis; Conover, Practical Nonparametric Statistics.

General Policies for the Masters Exam

(a) During any examination period a student may take one or both parts of the Masters Exam. While there is no limit to the number of times a student may take (parts of) the Masters Exam, scores are valid for only two years (five examination periods). A student need not retake a part of the Exam on which he or she has obtained a passing (P) score, subject to the time limitation above. (b) The Graduate Advisory Committee (GAC) will determine passing and failing scores on the Masters Exam.

**Administrative Procedures** 1. The Memorandum of Courses must be filed in the Graduate College before completion of eighteen hours of graduate credit. The form is required for candidacy and should be completed in consultation with the student's advisor. 2.Application for a Masters Degree must be filed at the Office of Registration and Records (107 Adm, Window 1) at the outset of the semester or session in which graduation is planned. 3.The Masters Exam cannot be completed more than 10 months prior to receipt of the degree. The student and the advisor should jointly determine the appropriate time to take the written exam. 4.The Final Exam Report must be filed in the Graduate Office four weeks prior to the deadline for filing the final report for the degree.

**Course Requirements** There are no specific course requirements for the Masters Degree.

**THE PHD DEGREE** The Department offers PhD degree programs in Mathematics and in Statistics. The PhD program requires a Qualifying Exam, a PhD Comprehensive Exam and a Final Oral Exam. In addition there are Course Requirements and a Language Requirement.

**The PhD Qualifying Exam** Entrance into the Department's PhD program is determined by the PhD Qualifying Exam. The exam has three three-hour parts. The same exams serve as parts of both the Masters Exam and the PhD Qualifying exam, though qualifying for the PhD program requires a higher level of performance than passing at the Masters level. The Exam may be taken in either Mathematics or Statistics.

**I. Mathematics:** Students must take the algebra exam and the analysis exam (described earlier in the section on the Masters Exam) and a third exam over two Math-Stat Department courses in the same area and approved by the GAC.

**II. Statistics:** Students must take the mathematical statistics exam and the applied statistics exam (described earlier in the section on the Masters Exam) and a third exam over two Math-Stat Department courses in the same area and approved by the GAC.

**General Policies for the PhD Qualifying Exam**

(a) During any examination period the student may take one or more parts of the PhD Qualifying Exam.

(b) Scores on parts of the PhD Qualifying Exam are valid for two years; a student need not retake a part of the Exam on which he or she earned a qualifying (Q) score, subject to the two-year limitation.

(c) A student is expected to complete the PhD Qualifying Exam during at most five consecutive exam periods (a span of two years). Exceptions may occasionally be granted by approval of the GAC.

(d) Students taking the Masters Exam may subsequently fulfill the requirements of the PhD Qualifying Exam by taking the appropriate third exam, subject to the time limitations (b) and (c).

(e) The GAC will determine the level of performance on each part of the Masters/Qualifying Exam—Q (qualify for the PhD program), P (pass at the Masters level), or F (fail). The decision as to whether a student has qualified for the PhD program ultimately resides with the Graduate Faculty. (This final decision is made early in the Fall semester for June exams and early in the Spring semester for January exams.) The GAC shall make recommendation to the Graduate Faculty according to the following guidelines: i) If a student has earned a "Q" on all three parts of the exam, then the GAC shall recommend that the student shall qualify for the PhD program. ii) In other cases the GAC is empowered to review both the total examination performance and the student's overall performance as a graduate student, and may, at its discretion, forward a recommendation to the Graduate Faculty to qualify the candidate. iii) The GAC is to inform the candidate, within a period of three weeks from the last day of the exam, of its recommendation to the Graduate Faculty.

**PHD COMPREHENSIVE EXAM** The student's PhD Supervisory Committee will determine the timing and the content of the PhD Comprehensive Exam. By common agreement of the Graduate Faculty, the PhD Comprehensive Exam will at least consist of the following:

**I. Mathematics:** The PhD Comprehensive Exam in Mathematics consists of two parts: *Part 1:* One of the following: (a) A four-hour written exam in algebra over the material usually covered in Math 901-902. Recent text: Lang, Algebra. Additional References: Hungerford, Algebra; Kaplansky, Fields and Rings. (b) A four-hour written exam in analysis based on the material usually covered in Math 921-922. Recent text: Royden, Real Analysis. Additional Reference: Rudin, Real and Complex Analysis. *Part 2:* A four-hour written exam or a two-hour oral exam administered by the Supervisory Committee, to test the student's breadth of understanding of the field of knowledge of which his/her special subject is a part. Note: A student may fulfill both Part 1 and Part 2 by completing BOTH (a) and (b) under Part 1.

**II. Statistics:** The PhD Comprehensive Exam in Statistics will consist of written exam(s) in one or more areas to test the student's breadth of understanding of the field of knowledge of which his/her special subject is a part.

General Policies for the PhD Comprehensive Exam

(a) The decision as to whether or not the student has passed the Comprehensive Exam, and if not, which part(s) of the exam must be repeated, rests with the Supervisory Committee.

(b) Standard exams (e.g., the four-hour written exams in algebra and analysis) will be offered in January and June. In some cases, specialized exams may be administered by the Supervisory Committee, and the scheduling of these specialized exams might be more flexible.

(c) A student should pass all components of the Comprehensive Exam within a single seven-month period. Exceptions may be granted by the Supevisory Committee. In cases where the student takes the Comprehensive Exam, but has not yet formed a PhD Supervisory Committee, the Graduate Faculty will act as the student's Supervisory Committee until the actual committee is formed.

**Additional Requirements–Course Requirements for the PhD Degree:**

**I. Mathematics** Each student in Mathematics must include either a topology course or a numerical analysis course on his or her Program of Study. (These course requirements may be transferred from other programs upon recommendation by the PhD Supervisory Committee. Note that Math 840 cannot be used for credit toward a degree in the Department of Mathematics and Statistics.)

Each PhD student in Mathematics must take two of the following three sequences, earning an average grade of at least a B+ in each sequence: Math 901–902; Math 921–922; Math 932–933

If a student completes the required sequences with an average grade below B+ on any sequence, his or her Supervisory Committee shall require the student either to repeat certain courses, to take additional courses, or to administer extra written exam(s) in area(s) where weakness is felt. Note: Students who expect to pursue a college or university teaching career should plan to take all three of the sequences listed above, as well as both topology and numerical analysis.

**II. Statistics** Each PhD student in Statistics must include Math 823, 825, 826, 921 and Stat 980 in his or her program of study. (These course requirements may be transferred from other programs upon recommendation by the PhD Supervisory Committee.) Each student must complete Stat 983, 984, 985, and 986 with an average grade of at least B+. If a student completes these courses with an average grade below B+, his/her Supervisory Committee shall either require the student to repeat certain courses or administer extra written exam(s) in area(s) where weakness is felt.

**Language Requirement for PhD** I. The language requirement for students in Mathematics is reading ability of one foreign language, selected from French, German, or Russian. Competence may be demonstrated in one of the following ways: A. Passing an exam in the language administered by the Foreign Language Committee of the Mathematics and Statistics Department. B. Completion of at least one advanced course in the language with a grade of B or above. (See the section "Language Research Tool Requirement" in the Graduate Studies Bulletin.) C. Passing the Educational Testing Service exam as administered at the University of Nebraska or as administered at another university (with a grade of 500 or more).

II. The language requirement for students in Statistics consists of a research tool in Computer Science. The specific requirement is determined by the student's PhD Supervisory Committee.

**Seminar Participation:** Seminars and colloquia are a valuable part of a student's training. Regular participation in all departmental colloquia and seminars in the student's area of interest is expected of all PhD candidates. The student's advisor will help direct the seminar participation.

**Final Oral Exam:** After a student completes a PhD dissertation there is a final oral exam. This exam, often called a "thesis defense", is open to the public. Complete details of the final examination procedure are in the Graduate Studies Bulletin.

**Administrative Procedures**

1. After a student has passed the Department's PhD Qualifying Exam, but before he or she has earned 45 credit hours, the student forms a PhD Supervisory Committee. The student must choose an Advisor, who will chair the Supervisory Committee and direct the dissertation. A form listing the PhD Supervisory Committee must be filed with the Graduate Studies Office.

2. A Program of Studies form must be filed with the Graduate Studies Office before the student has earned 45 credit hours; this form is completed with the advice and consent of the student's Supervisory Committee.

3. Once a student has passed the PhD Comprehensive Exam and satisfied the language requirement, the student must file the Admission to Candidacy form with the Graduate Studies OfficeStudies Office. This form must be filed no later than seven months prior to graduation.

## E.4 A Sample Calculus Project in Math 106

Senator Foghorn
United States Senate
Washington DC 20510

October 1997

Dear Staffers:

On September 17, 1997, Senator Robert Kerrey (D-NE) gave a speech to the National Press Club in which he outlined some new proposals to reform the Social Security system. As you know the Social Security system is predicted to go bankrupt by 2030, leaving many Americans to face an uncertain future. Sen. Kerrey called his proposal "a two-part plan to use our federal laws to help all Americans to own a part of their country." I would like you to analyze his ideas and figures to help me clarify my position. Could you give me a clear analysis together with some graphs to show when I speak on the topic.

- In the first part of the proposal, Sen. Kerrey proposes taking a 2% payroll tax (diverting it from the present FICA/Social Security payroll tax) and putting it in medium-risk investments. Sen. Kerrey says that for a family earning the median income of $35,000 per year his plan would enable the family to build a retirement value of more than $400,000. I want you to determine if this is really possible, and under what conditions.
- In the second part of his proposal Sen. Kerrey proposes opening a $1000 investment account for each newborn American citizen and investing it. He assumes that these investments can be made at an average return of $8.5\%$ He says that by age 65, the child's investment account would be worth $250,000. I did a swift calculation and got a different answer: $1000(1.085)^{65} \simeq \$200,900$. Can you figure out for me what Sen. Kerrey was thinking?
- I would like to get a better handle on Sen. Kerrey's figures in the first part of his plan. If we assume that median family income will increase exponentially at some continuously compunded percentage $b$ over the period of the investment, what will the final value of their investment savings be?
- How much would a family accumulate in investment savings if their household income was increasing linearly at some rate $a$ over the period of investment?

I spoke briefly to one of my constituents (a mathematician at the university) when I was back home last week. The mathematician noted that for a family being paid every two weeks over a 40-year period, the salary could be reasonably considered as being paid continuously. She also said that to figure out the total value of a continuous stream of investment like this we'd have to use an integral (whatever that is!). Can you make sense of her notes?

> If $r$ is the interest rate (and so $e^{rt}$ is the continuous compounding factor) then the future value $\Delta F$ of a small investment $\Delta I$ made $t$ years beforehand is $\Delta F = (\Delta I)e^{rt}$, and the total future value is simply the sum of these contributions. Since $\Delta I$ is proportional to $\Delta t$ this sum is a Riemann sum approximating an integral.

I need a report (with tables and graphs) quickly – I have to respond in committee pretty soon.

Good luck!

P. Q. Foghorn
United States Senator

## E.5 The Mathematics Placement Examination Program

**History and statement of policy** In the summer of 1990, UNL adopted a mathematics placement policy that put limitations on the courses students could enroll in when beginning mathematics. This was phased in over the following academic year, applying to entering freshmen only in the fall of 1990, to all freshmen in the spring of 1991, and to all students starting in the summer of 1991. Most students participating in New Student Enrollment (NSE), and others desiring to start with a math course in the main precalculus or calculus sequences, are given a Math Placement Exam developed here and geared to Departmental course offerings. Math advisors are present at NSE both to give the placement exam and to discuss with students options available to them. If a student's record indicates a good likelihood of success, the mathematics advisor has the option at that point to sign a waiver granting the student permission to take the course even if the student's performance on the placement exam was below the qualifying level. Alternatively, the advisor may recommend that the student start in a lower course, or review the mathematics in their background and attempt the placement exam again. (The Department has three to four current versions of the placement exam active at any time, and a student always has the option to retest using any version the student has not yet taken.) The precise placement policy has changed in some ways in its treatment of students from other branches of the University of Nebraska system and with regard to students who have a lapse of over a year in their mathematics track at UNL, but the central policy with regard to students beginning their college mathematics has not changed. The policy at this point can be stated as follows:

• A student wishing to take a mathematics course in the Math 100A-106 range at UNL must meet a prerequisite requirement and a readiness requirement.

• The prerequisite requirement states that the student should have completed the prerequisites for the course, in high school or in college, with a C or better (or equivalent). The most recent course at or below the level of the prerequisite is the one considered in assessing this requirement, if such courses have been taken more than once.

• The readiness requirement can be met in one of two ways: If the prerequisite requirement was completed in a class taken at the University of Nebraska, the requirement is considered met. If the prerequisite requirement was completed in a course taken elsewhere, the student should have a current qualifying score on the Math Placement Exam. Scores on the exam are current for one summer, one fall, and one spring.

• A student who does not meet the above requirements may have their enrollment canceled, unless the requirements are waived by an authorized representative of the Department.

In the spring of 1998, with the support of college and university administrators, and with additional funding provided by the Nebraska Math and Science Initiative, we began offering the math placement exam on site in Nebraska high schools on a fixed date once per year to any of their seniors. Over the three years of this program, we have gone from 2925 exams processed to 3725 exams in the spring of 2000. Also, the University of Nebraska at Omaha and the University of Nebraska at Kearney have started to use the results of the high school exam for placing students into their math courses. This past year UNO started to use UNL's exam for their math placement testing, though they apply it with somewhat different policies and standards.

Over the past two years, we have also worked on developing an online version of the exam, using *eGrade*, the web-based testing software developed under the leadership of John Orr. We expect to begin giving the exam officially in this manner in the spring of 2001.

# Appendix F

# Assessment Items

## F.1 Undergraduate Assessment

### F.1.1 Assessment Report

September 27, 2000

To: Mike Steinman, Chair of College Assessment Committee
Cc: Jim Lewis, Chair Math/Stat

From: Gordon Woodward, Chair Math/Stat Assessment Committee

Subject: Undergraduate Assessment

There are two sections to this report. Section I is a response to the College Assessment Committee's Review (CCR) dated November 18, 1998 of our May 25, 1998 Progress Report (PR) (Attachments #1 and #2). Section II is a report of our assessment progress to date.

I. The CCR evaluation of our Assessment Program claimed that the items in our PR did not match the Learning Objectives in our Plan. I think there is some miscommunication here. It may be that the committee was not using our approved Revised Assessment Plan titled "Department of Mathematics and Statistics Assessment Document" submitted and dated May 30, 1997 but instead an earlier version or it may be that our PR did not clearly state its relationship to our assessment plan. Let me explain.

The Department's original plan was submitted in April 1996. Revisions together with copies of the revised assessment tools were submitted in a document dated May 30, 1997 (Attachment #3). This Revised Assessment Plan (RAP) was approved. The approved revised assessment instruments consist of Course Portfolios, Course Assessment, Student Assessment, Research Experience Assessment, Exit Interviews, Exit Exam, and Alumni Surveys. The RAP indicated that our Learning Objectives (a) through (i) would be assessed with these tools. Thus it was appropriate to discuss the implementation of the Course Assessment, Student Assessment, Research Experience, Exit Interviews, and Exit Exams in the PR. It may be that the PR failed to clearly point out its connection to the approved RAP together with the assessment tools presented in that plan.

At this time we are not interested in trying to sort out what might have transpired two year ago. Section II is our current Assessment Report. Please let us know if additional material is needed.

II. Assessment Progress: Our Assessment Committee recently met to go over the implications of the data presented here. Their comments have been incorporated into this report. The Committee will be presenting this report and to the full Department for discussion later this semester as part of our APR analysis.

In our Assessment Plan we list 10 Objectives of our undergraduate program and a variety of assessment instruments. These instruments, as revised in our Revised Assessment Plan are: Course Portfolios, Course Assessment and Student Assessment to help assess writing as well as other objectives, Undergraduate Research Seminars, Honors Thesis, Advising, Exit Exams, Exit Interviews, and Alumni Surveys.

**Course Portfolios**: The department carried out an extensive review of our largest support courses, Math 106, 107, 208, 221, and 203 as part of the Peer Review Process that Prof. Dan Bernstein directed. Our study was a year long process conducted during the 98-99 AY. Objectives and expectations were set; the relation between the exams and the objectives was analyzed; and an analysis of the final exam results and expectations was carried out. All this together with sample exams, projects, and course philosophy are now part of the portfolios for those courses. We are creating summary portfolios for our other regularly offered courses. These will consist of objectives, previous syllabus and policy statements, samples of hour exams, all projects (that instructors feel worth using again), and comments collected from instructors on our Course and Student Assessment forms. The purpose of these portfolios is to offer a resource to instructors as they prepare to teach the course. In our department GTA's teach the courses 100A-103, and faculty cycle through a variety of our offerings at the level of 104 and above. Thus quite often someone is teaching a course for the first time or the first time in several semesters. These portfolios will help maintain the consistency in our courses, offer resources to the instructor, and provide the instructor with valuable insights on student preparation. All together we plan to have portfolios on 26 of our courses, 20 of them are covered by our Course or Student Assessment forms.

**Course and Student Assessment**: As indicated in our Revised Assessment Plan, we have Course Assessment forms for our main service courses (Math 106, 208, 260, 314, and Stat 380, 428, 482) and Student Assessment forms for our major core courses (Math 107H, 221, 310, 325, 350, 405, 417, 423, 425, 432, 442, and Stat 486, 487). Here "student" means math/stat major or math education major. We've collected the forms for the semesters: 981, 982, 992, 001. That data is summarized below as average scores over all these semesters. It is divided into levels and within levels into math, statistics, and math education courses. The two bottom courses are strictly math education courses.

| Courses | PM | CM | AM | LA | EX | #Majors |
|---|---|---|---|---|---|---|
| 107H | 3.92 | 3.67 | 3.58 | 3.33 | 3.50 | 12 |
| 221 | 2.84 | 3 | 2.69 | 2.83 | 2.46 | 37 |
| 310,325 | 2.51 | 3.09 | 2.73 | 2.61 | 2.56 | 81 |
| 405 | 2.84 | 3.06 | 2.82 | 2.49 | 3.04 | 26 |
| 417,423,442 | 2.30 | 2.67 | 2.32 | 2.21 | 2.01 | 70 |
| 486,487 | 2.22 | 2.44 | 1.72 | 1.78 | 2.28 | 10 |
| | | | | | | |
| 350 | 1.92 | 1.92 | 1.92 | 1.92 | 1.71 | 24 |

| Courses | PM | CM | AM | LA | EX | #Sections |
|---|---|---|---|---|---|---|
| 106 | 1.88 | 2.30 | 2.00 | 2.08 | 2.06 | 16 |
| 208 | 1.57 | 2.12 | 2.30 | 2.15 | 2.20 | 22 |
| 314 | 2.75 | 2.40 | 2.25 | 2.35 | 2.69 | 9 |
| 380 | 2.00 | 2.00 | 1.50 | 1.75 | 2.00 | 5 |
| | | | | | | |
| 260 | 1.50 | 2.50 | 2.00 | 2.50 | 2.00 | 2 |

Students are scored numerically 0, 1, 2, 3, 4 with 4 the best, 2 means sufficient for success, 3 means handles most of the material quite well. So the scores are subjective both to the instructor and to the course (i.e. a student who earns a 3 in 221 but does not mature significantly in mathematics, would be expected to receive a 1-2 in 423 and a 1 in 417). The abbreviations PM, CM, AM, LA, EX, stand for understanding and use of Prerequisite Material, new

Concrete Material, new Abstract Material, Logical Arguments, and student Exposition (writing). For example the 417, 423, 442 row in the AM column gives the average score given to 70 math/stat majors over the 4 semesters. (The instructors are also asked to rate the middle student on his/her understanding of specific prerequisite material and course objectives. These ratings will be placed in the course portfolios. They are not listed in this report.) The semester by semester data is quite variable, no doubt due to the variability in the instructors' expectations, but the averages above do give a collective assessment of the students. Moreover there is only a small amount of variability among the students within a given section. So one can expect most of their students to be roughly of the same abilities. There are some weaknesses: prerequisites in 106, 208, 260, 350, ability to handle abstract material in most of our statistics courses, and all categories in 350. In most cases the data indicates that the students' growth rate in mathematical sophistication about matches that of the courses, albeit not easy for them (2 is just "sufficient") at every level.

The first 9 objective categories (a)-(i) in our Assessment Plan are addressed by the 5 column categories in the tables.

**Undergraduate Research Seminars**: The department's Assessment Committee suggests that his assessment tool may have to be changed. This will be discussed with the full department. It was envisioned that we would require our majors to take a "capstone" course in which they worked in groups of two or three on problems of relevant interest. There are two problems with this. First our majors have interest in quite diverse areas: economics, computer science, actuarial science, physics, operations research, sociology, etc. So in many cases a senior simply can't find another senior with similar interest as a project partner. Second many of our seniors have a heavy minor concentration or are preparing for graduate school either of which would benefit from getting more breadth by taking more courses. So we are still struggling with the research seminar. In the meantime, we have created three "capstone" style courses that also add to breadth by separating 417/817, 425/825, and 442/842 into undergraduate and graduate only sections starting with the fall of 97. These new undergraduate courses now have flexible syllabi and function as capstone courses in the separate areas of algebra, analysis, and applied math. In 97-98 and 98-99 we had over 30 of our junior/senior majors participate in these courses each year. Fewer participated last year, but this seems to be partly due to some changes in our offerings, which we are addressing. In addition to these courses, we do serious recruiting for summer Research Experience for Undergraduates (an NSF funded program), other summer research programs (such as UCARE), internships in math/stat areas, and special semester programs that concentrate on math/stat (such as MASS program at Penn. St. and the Budapest Semesters program in Hungary). These off-campus programs are nationally competitive. Getting one is quite prestigious. Eight of our students were selected last summer. This is an increase over previous years. We also run a one credit undergraduate seminar in which the students select a topic of the semester and prepare a couple of presentations. The latter is not a capstone experience, but the presentations often use material from several courses. With these alternate research experiences, we have considerable success.

**Honors Thesis**: It is difficult getting a count of students writing a thesis for the Honors Program. But we do have well-defined process for the thesis for distinctions within the College. In that regard, the number of honors thesis for A&S distinction degrees, including the number in progress by year are:

| Year | # Students |
|---|---|
| 1997 | 1 |
| 1998 | 2 |
| 1999 | 3 |
| 2000 | 2 |
| 2001 | 6 |

Currently, 70 of our majors are in the Honors Program; 32 of them are seniors.

**Advising**: The undergraduate advisor is busy in all aspects of advising from recruiting high school students to selecting courses to helping direct graduating seniors to graduate schools or professional schools or careers. Indeed in May 1999, our chief undergraduate advisor was awarded the UNL Student Association/Builders Award for Excellence in Undergraduate Advising. Here is some demographic information on our majors. The left table is self-explanatory; the right is number of graduations for the indicated academic year.

| Term | FR | SO | JR | SR | Total | | AY | # Graduates |
|---|---|---|---|---|---|---|---|---|
| 951 | 18 | 15 | 26 | 61 | 120 | | 951-3 | 38 |
| 961 | 21 | 20 | 25 | 56 | 122 | | 961-3 | 48 |
| 971 | 15 | 22 | 34 | 53 | 124 | | 971-3 | 27 |
| 981 | 21 | 21 | 38 | 65 | 145 | | 981-3 | 35 |
| 991 | 28 | 26 | 28 | 60 | 142 | | 991-3 | 29 |
| 001 | 24 | 26 | 49 | 56 | 155 | | 001-3 | 27 |
| 011 | 17 | 30 | 36 | 66 | 149 | | | |

With the exception of the first two years listed, our graduation numbers are about 50% of our listed senior class size.

38% of our majors have GPA at least 3.75, 55% at least 3.5, and 71% at least 3.0. 59 % of our seniors have a GPA at least 3.5.

**Exit Exam**: Each of our graduating seniors is asked to take an anonymous exit exam. In the past, not all took the exam, but many did. Now it is part of our published requirements. So most will be taking it. For the years 1995 to 1998, we have 26 exams from a good representation of majors. The graded results are below, first over all four years, then by year. We have not yet recorded the results for years 1999 and 2000.

| Semester | Calculus | M221 | M314 | M310 | S380 |
|---|---|---|---|---|---|
| ALL | 70.9 | 33.5 | 49.6 | 46.1 | 27.5 |
| | | | | | |
| | | | | | |
| | | | | | |
| Semester | Calculus | M221 | M314 | M310 | S380 |
| 952 | 70.8 | 32.1 | 44.4 | 36.7 | 28.6 |
| 962 | 95.5 | 100.0 | 100.0 | 66.7 | 90.0 |
| 972 | 69.2 | 12.5 | 44.4 | 53.3 | 23.8 |
| 982 | 69.9 | 50.0 | 53.5 | 44.4 | 22.5 |

The exam covers only the courses listed. While our majors are not required to take all these courses, they are considered core for various concentrations. Students only answer questions over courses they have had. Here Calculus refers to Math 106-107-208. A score of 50% is considered pretty good (40% if the student's concentration is in other aspects of math/stat). This exam needs some work: first, we were overzealous in protecting the student's identity to the extent that we didn't ask for the students GPA. This was a mistake. Second, we need to add other courses to the topics. Finally, we plan to ask the student to comment on the quality of our courses, instruction and in general our program We ask this in the exit interviews, but here the student can respond anonymously. The exam indicates that, with the tremendous improvement in Math 221, students' retention is strong except in Stat 380. Another indication that we need to work on our delivery of statistics to our undergraduates. This is something that we are working on. In the past we have been plagued with a statistics demand that far exceeded our permanent staffing. With the new positions approved for next fall, we can make serious improvements in the delivery of our statistics courses.

**Exit Interviews**: Our department started exit interviews in the fall of 1995. The exit interview and exit exam requirement $1^{st}$ appeared in the 1999-2000 Bulletin. Both the Chair and the Chief Advisor have separate interviews with the students. The Chief Advisor's interview is concerned with the undergraduate program relative to, course structure and sequence, course content and expectations, offerings, career choices. It is quite difficult getting together with all our seniors. We have interviewed 78 students. The students overwhelmingly approved of our program, but suggested Math 314 before Math 221, did not remember much about content they only saw in one course (not surprising), did not get much out of our Stat 380, and found the theory courses difficult (again not surprising). They had high praise for most of our instruction and the general sequencing of our courses. Their career choices are quite interesting.

The table below indicates general career areas of their $1^{st}$ employment after graduation. Only the "unknowns" had not yet received acceptable offers. (These interviews do not include students in math education who are in Teachers College. They are important to us which is why we count them in our Student Assessment, but we cannot require them to come to an interview.)

| Employment | # Students |
|---|---|
| Actuarial Science | 8 |
| Business | 10 |
| Computer Science | 8 |
| Military | 6 |
| Statistics | 4 |
| Teaching | 4 |
| Graduate Sch (Math area) | 24 |
| Professional Sch | 6 |
| Unknown | 8 |
| Total | 78 |

**Alumni Surveys**: We will be doing a survey this year as part of our APR for both our graduate and undergraduate programs. An abbreviated form of this survey will then be used every two years.

## F.1.2 Assessment Plan

**I. Goal:**

The goal of the Department is to develop students who:

• understand and are able to use the processes and procedures of mathematics;
• are mathematically literate, with the ability to learn independently, reason effectively, and express themselves articulately both orally and in writing;
• understand the role mathematics plays in a broad range of disciplines and in modern society.

The Department recognizes that its students come to study mathematics for a variety of reasons. These differences stratify our majors into the following four rough categories:

(1) those (typically headed to graduate school) whose interest in mathematics extends beyond the uses to which it can be put, to include an interest in developing new mathematics;
(2) those (such as future teachers) not primarily interested in developing new mathematics, but who wish to be able to explain known mathematics, and its significance, to others;
(3) those with mathematically oriented professional (such as statistical or actuarial) aspirations;
(4) and others (such as those in pre-professional programs) with an intellectual curiosity in mathematics as an important component of both a liberal arts and technical education.

**II. Objectives:**

We have ten fundamental learning objectives for our majors. Our expectations for each objective differ for the different categories of students. We may eventually need to modify our list of objectives. Suggesting such modifications will be one of the responsibilities of the Assessment Committee (as discussed below). The objectives are:

(a) to think and write with clarity and precision, adducing conclusions from hypotheses in a logical and rigorous way

(b) to understand and critique arguments for rigor and logical content

(c) to understand the meaning and significance of mathematical terminology and concepts (e.g., what is the meaning and significance of a derivative, or of the variance, or of a ring, etc.)

(d) to compute efficiently and accurately (e.g., to simplify algebraically, to integrate and differentiate symbolically, and to perform matrix operations)

(e) to understand the statement and significance of important theorems (e.g., the fundamental theorem of calculus, the fundamental theorem of arithmetic, the invertibility of square matrices with nonzero determinants, the central limit theorem, etc.)

(f) to translate situations proficiently into mathematical language and analyze the results mathematically (e.g., mathematical modeling)

(g) to communicate mathematical ideas proficiently

(h) to understand mathematically oriented writing (e.g., proofs, articles)

(i) to generate mathematical ideas and proofs

(j) to understand practical and career related uses of mathematics

**III. Assessment Instruments:**

The Department will utilize a variety of assessment instruments. They will include both objective and subjective measures as well as anecdotal information. Taken together and properly analyzed, the information should help the faculty understand what we do well and what we do not. Although the first item is more precisely a curricular matter, it is essential to our efforts to coordinate our goals with our curriculum.

(i) Course portfolios: The Department will develop a course portfolio for each course deemed to be a core part of the major. Each faculty member who teaches one of these courses will add to the course portfolio material they have developed for the course. Included in the course portfolio will be a list of the explicit objectives for that course. The Department will survey a selection of students to collect their perceptions as to how well these courses met the stated objectives. Their responses will be added to the course portfolio. We will begin this effort with the Fall 1996 semester.

(ii) Student writing: Most of our curriculum now includes student writing (e.g., in-depth projects in M106, M107, M208, M221, M314, and proof based writing assignments in Math 325, Math 417 and M425). An assessment checklist will be developed to permit faculty to assess the progress of our majors in meeting objectives (a)-(g) at various stages in the curriculum. The Department will implement a trial version of this checklist during the Fall 1996 semester. It should be fully implemented by the Fall of 1997.

(iii) Undergraduate research seminars: The Department will develop a seminar for our majors in order to offer a summative disciplinary experience that involves substantial independent research and writing on the part of the student. (It should be noted that some majors currently get such an experience by writing an honors thesis, by participating in a summer Research Experience for Undergraduates, or through some similar experience.) For a period of two years (Fall 1996 to Spring 1998) students will be strongly encouraged to participate in such a seminar, with honors theses and REU's remaining available as alternatives to this seminar. Initially, it will be our goal to get at least 60% of our graduating seniors to participate in such a summative disciplinary experience. This seminar will provide us with assessment information covering objectives (a)-(i). We will gather this information with a checklist similar to the one to be used with our core courses. At the end of the trial period, the research seminar (or alternatives) will be adopted as a requirement for the major if it is determined by the faculty to add sufficiently to the quality of the major. If it is not adopted, alternative assessment techniques will be developed to provide the information previously obtained from the research seminar.

(iv) Honors theses: The number and quality of honors theses provides another measure of Departmental success for objectives (a)-(i), probably most meaningfully bearing upon category 1 students. To promote objective (g) on the part of our majors and better understanding of our majors' quality on the part of the faculty, we also will institute the expectation that students present their work publicly and that faculty attend these presentations.

(v) Advising: The Department will assess objective (j) as part of its advising process. In general, insights gained by our undergraduate advisor can be important in our understanding how well the Department's undergraduate program is doing. Our undergraduate advisor will share these insights with the rest of the faculty via periodic reports. With time we will refine our understanding of what explicit information to include in these reports and how often they should be made.

(vi) Student testing: The Department is using a draft version of an exit exam (see attachment). The purpose of the exit exam is to assess the progress our students are making toward the learning objectives, especially (a)-(g). For the next two years, the Department will continue to improve the effectiveness of the exam at assessing student achievement. By the Spring of 1998, the Department will determine whether the exit exam should be required for all graduating seniors. The Department will also compile records of the scores of its majors on national exams such as the GRE subject or the Putnam exam.

(vii) Exit interviews: The Department began interviewing all of its graduating seniors in the spring of 95. We will continue to use these exit interviews to gather feedback from our graduating majors.

(viii) Alumni surveys, the Departmental Newsletter and the WWW: To measure changes in student perception after graduation, we will continue to disseminate alumni surveys periodically and to encourage continued feedback via contacts with alumni through our annual Newsletter. We will also set up a WWW page to solicit and accept comments on the Department.

**IV. Evaluation of Assessment Data:**

The Department Chair will appoint an Assessment Committee which will be responsible for collecting and evaluating our assessment information. The Committee will submit to the Chair an annual report on its findings and recommendations concerning the following questions:

(a) How successful is the Department in meeting the goals and objectives for our majors?

(b) What changes should be made in our undergraduate program in order to better meet these goals and objectives?

(c) What changes should be made in the Department's Assessment Plan (taking in consideration goals, objectives and assessment instruments) in order to improve the Assessment Plan?

### F.1.3 Student Assessment Form

STUDENT ASSESSMENT FORM

(107H, 221, 310, 325, 350, 405, 417, 423, 425, 432, 442, ¡445¿, 486, 487)

To help us maintain a quality undergraduate program, you are asked to assess each of your students who is a math/stat major in either Arts and Sciences or Teachers College. Attached is a table that lists all of these students that are on your grade roster. Use the definitions below to rate each one in each category listed. Then in the Prerequisite Comments column, list any major prerequisite deficiencies that have caused that particular student difficulties in your course. Following the table, you are asked to list the prerequisites and objectives of your course and rate your majors collectively as to how well they met these requirements.

PM. Understanding and use of prerequisite material.

1 = Major weaknesses that posed significant problems and usually result in D or F grade.
2 = Preparation adequate for success.
3 = Preparation stronger than typical.
4 = Preparation excellent.

CM. Ability to understand and use new material of a concrete nature.

0 = Not relevant to this course.
1 = Able to understand some new material, but usually not sufficient to expect success in course.
2 = Able to understand enough of the new material to be successful.
3 = Easily understands much of the new material and, with effort, capable of understanding most all of it.
4 = Easily understands and uses all the new material.

AM. Ability to understand and use abstract material.

0 = Not relevant to this course.
1 = Able to understand some new material, but usually not sufficient to expect success in course.
2 = Able to understand enough of the new material to be successful.
3 = Easily understands much of the new material and, with effort, capable of understanding most all of it.
4 = Easily understands and uses all the new material.

LA. Ability to understand and create logical arguments.

0 = Not relevant to this course.
1 = Requires considerable assistance to understand or use theorems and definitions.
2 = Understands and applies most theorems and definitions with little assistance.
3 = Understands logical arguments and creates the simpler required logical arguments.
4 = Understands, uses and writes sophisticated proofs; very competent with all required material.

EX. Exposition. (Include the following items: clarity, coherence, use of technical language, mechanics, interesting.)

0 = Not relevant to this course.

1 = Exposition is irrelevant or very difficult to understand (poorly organized, avoids using or incorrectly uses many of the terms, etc.).

2 = Can understand exposition, accurate use of many terms, reasonably well organized.

3 = Easy to read, accurate use of terms, well organized.

4 = Interesting, insightful, appropriate and accurate use of terms, extremely well written.

| Student | PM | CM | AM | LA | EX | Prerequisite Deficiencies |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | | | | | |

List here the prerequisite material you consider necessary that you are using as a basis for this assessment. Then rate how well the students above collectively were prepared in this material by using the letters u (unsatisfactory), s (satisfactory), w (well).

Course Objectives: List the major objectives of your course. Try to limit it to 5-10 specific objectives that are most important. Then rate how well the students above collectively met each objective using the letters u (unsatisfactory), s (satisfactory), w (well).

### F.1.4 Class Assessment Form

COURSE ASSESSMENT FORM

(106, 208, 260, 314, 380, 428, 482)

To help us maintain a quality undergraduate program, you are asked to assess your class as indicated below. For this evaluation, focus on the middle group in your class (roughly within one standard deviation of the mean) and use your professional judgement to describe that group. Comments are encouraged. Return to Lori Mueller.

Check the sentence that best describes your class in each category.

A. Ability to understand and use new material of a concrete nature.

___ Not relevant to this course.
___ Able to understand some new material, but not quick enough for the demands of the course.
___ Able to understand enough of the new material to keep up with the course and be successful.
___ Easily understands much of the new material and, with effort, capable of understanding most all of it.
___ Easily understands and uses all the new material.

Comments:

B. Ability to understand and use abstract material.

___ Not relevant to this course.
___ Able to understand some new material, but not quick enough for the demands of the course.
___ Able to understand enough of the new material keep up with the course and be successful.
___ Easily understands much of the new material and, with effort, capable of understanding most all of it.
___ Easily understands and uses all the new material.

Comments:

C. Ability to understand and create logical arguments.

___ Not relevant to this course.
___ Requires considerable assistance to understand or use theorems and definitions.
___ Understands and applies most theorems and definitions with little assistance.
___ Understands logical arguments and creates the simpler required logical arguments.
___ Understands, uses and writes sophisticated proofs; very competent with all required material.

Comments:

D. Exposition. (Include the following items: clarity, coherence, use of technical language, mechanics, interesting.)

___ Not relevant to this course.
___ Exposition is irrelevant or very difficult to understand (poorly organized, avoids using or incorrectly uses many of the terms, etc.).
___ Can understand exposition, accurate use of many terms, reasonably well organized.
___ Easy to read, accurate use of terms, well organized.
___ Interesting, insightful, appropriate and accurate use of terms, extremely well written.

Comments:

E. Understanding and use of prerequisite material.

___ Major weaknesses that posed significant barriers to meeting course goals.
___ Preparation adequate for success.
___ Preparation stronger than typical.
___ Preparation excellent.

List here the prerequisite material you are using as a basis for this assessment. Then rate how well your class was prepared in each by using the letters u (unsatisfactory), s (satisfactory), w (well).

F. Course Objectives: List the major objectives of your course. Try to limit it to 5-10 specific objectives that are most important. Then rate how well your class met each objective using the letters u (unsatisfactory), s (satisfactory), w (well).

### F.1.5 Exit Interview

Date:

Name:

Majors: Math/Stat;

Minors:

1. What are some of your most memorable mat/stat learning experiences? (relative to content learning)

2. Do you feel confident about your abilities and knowledge in 106-107, 208, 221, 314, 310, 380, or xxx? Did you fell confident in this material shortly after completing the course?

3. Which of your courses did you feel least confident in shortly after completing? Do you still feel this way?

4. What topics, skills, or content material did you find most useful in later courses? (Taught in which course, if not clear.)

5. What topics, skills, or content material do you expect to find most useful in the future?

6. Which courses seemed useless and uninteresting to at the time? In retrospect?

7. What courses or topics do you think we need to offer that are not currently offered?

8. What do you think of the use of computer lab and projects in your classes?

### F.1.6 Exit Exam

Please do not use notes or texts. We want to know what lasting knowledge we are communicating to our students. If you use a calculator, please indicate when and how it helped. Use scratch paper when needed, but just return this exam. Only work on questions from courses you had. Once again, we thank you for your efforts.

Calculus

1. At time t = 0 a bottle of orange juice is taken out of a 40 degree F refrigerator and left in a room with temperature 65 degree F. If T(t) is the temperature of the orange juice at time t, draw what you think the graph of T(t) would look like. (Please put appropriate units on the axes.)

2. Find the Taylor expansion of f(x) = x2 + 3x + 4 about x = 1.

3. A straight wire is on the x-axis from x = a to x = b. Assume $\delta$(x) is the mass density of the wire measured in grams per unit length. What does (())represent?

4. If f(x) is an increasing function which increases at a slower and slower rate, what can you say about f'(x) and f"(x)?

5. Does the series 1+1/2+1/4+1/8... converge? If so to what?

What about 1+1/2+1/3+1/4+...?

6. If G(t) = (()), then G′(t) = _____ .

7. Express the area between the xaxis and the indicated graph of f(x) over the interval [2,8] in terms of the definite integral.

8. Evaluate the following:

a) ()=

b) ($\infty$)=

c) ($\partial\partial$)sin(t x + t2) =

Math 221.

1. Find y(t) so that y′ = y + 1 and y = 2 when t = 1.

2. Graph the slope field for y′ = x + y. Without solving this differential equation, use this slope field to graph the solution of this differential equation that passes though the point (0,0).

3. Dead leaves accumulate in the ground in a forest at a rate of 3 grams per square centimeter per year. At the same time the leaves decompose at a rate which is .75 times the amount of dead leaves (per square centimeter) at time t. Write down a differential equation for the amount A(t) of grams of dead leaves per square centimeter at time t.

4. The population of a certain community is known to increase at a rate proportional to the number of people present at any time. If the population has doubled in 5 years, how long will it take the population to triple?

Math 314.

1. What are the possibilities for the number of solutions that a 3x3 linear system of equations can have?

2. If A, B and C are square matrices of the same size, does AB = AC imply that B = C?

3. Can you give an example of a 2 by 2 matrix for which every non-zero vector is an eigenvector? If yes, give one.

Can you find a 2 by 2 matrix for which every real number is an eigenvalue?

4. Do the vectors (1,1,1), (1,0,1), (2,0,2) form a basis for R3?

5. What is the dimension of the subspace of R4 consisting of all solutions to the equation x+y+z+w=0?

6. Let A = $\begin{pmatrix} 2 & 7 & -2 \\ 0 & 0 & 1 \\ 0 & 0 & 3 \end{pmatrix}$.

(a) The eigenvalues of A are:

(b) det(A) =

(c) Is A invertible?

Math 310. I took this course Yes, NO. (circle one)

1. Can 2x5-x3+6x-5 be factored in the rational numbers?

Can x3 + 4x2 + 2x - 4?

2. Give an example of a finite field.

3. What is the multiplicative inverse of 3 in the integers modulo 8?

Stat 380. I took this course Yes, NO. (circle one)

1. The Powerball Lottery is drawn twice every week on Wednesday and Saturday. The odds of winning the Jackpot are essentially 1 in 55 million. Suppose every adult in our state, say the number is 1,000,000 plays the game every Tuesday and Friday for each of the 52 weeks in a year. What is the chance that at least one would hit the jackpot during one year?

2. Suppose in a fund drive for a symphony orchestra, a ”contact” (may be by mail or letter or in person) can produce the following result:

no contribution with probability 15/32
$100 contribution with probability 10/32
$250 contribution with probability 4/32
$500 contribution with probability 2/32
$1000 contribution with probability 1/32

(a) Suppose you contact 100 randomly selected people.

(a1) What is the expected value of the total of their contributions?

(a2) What is the probability that your within 10% of this expected value?

(b) How many contacts should be made (the effort should be to find the smallest number) so that there is a chance of at least .95 of getting pledges for at least $150,000?

3. A chain of grocery stores wishes to open a store in a community which already has a few grocery stores. So, the chain would first want to do some market analysis. It would like to know what proportion of the community would visit the new store. For that purpose it wants to know how many people in the community should be sampled? You as a statistician are to provide the answer. How would you proceed to give the answer?

Math 430. I took this course Yes, NO. (circle one)

1. Classify the critical point at the origin for the given system by considering an appropriate linearization.

x′ = y
y′ = x - y + x ( x - 2y )

2. Draw the phase diagram for the following system of differential equations.

x′ = -x - 3y
y′ = -3x - y

3. Given A = $\begin{pmatrix} 2 & 1 \\ 0 & 2 \end{pmatrix}$, find eAt.

4. Find a fundamental matrix for the vector equation: x′ = $\begin{pmatrix} 0 & 1 \\ -2 & -3 \end{pmatrix}$x.

COMMENTS:

# Appendix G

# Historical Materials

## G.1 Historical Faculty Listing, 1871–2000

**NOTE:** After 1949, only people in a tenure-line position are listed.

| | |
|---|---|
| 1871-1893 | Henry E. Hitchcock |
| 1880-1884 | Charles N. Little |
| 1882-1884 | Margueritte Hitchcock |
| 1884-1902 | T. Morey Hodgman |
| 1884-1886 | Ellen Smith |
| 1891-1893 | Oscar V.P. Stout |
| 1893-1917 | Ellery W. Davis |
| 1893-1896 | Juergen Albers |
| 1893-1934 | Albert L. Candy |
| 1893-1894 | Alta Johnson |
| 1893-1894 | Derrick N. Lehmer |
| 1894-1897 | William E. Brook |
| 1894-1904 | George R. Chatburn |
| 1894-1895 | John M. Howe |
| 1894-1897 | Lon C. Walker |
| 1895-1896 | James W. Crabtree |
| 1895-1896 | Derrick N. Lehmer |
| 1896-1929 | Carl C. Engberg |
| 1897-1898 | Albert W. Whitney |
| 1898-1904 | Robert Moritz |
| 1900-1903 | Ellen H. Frankish |
| 1902-1908 | Laura D. Puffer |
| 1904-1906 | Charles F. Hagenow |
| 1904-1907 | Mary E. Sinclair |
| 1907-1915 | Henry T. Johnson |
| 1907-1908 | Jacob M. Kinney |
| 1907-1915 | Julia E. Loughbridge |
| 1907-1928 | Mary Zimmer |
| 1908-1944 | William C. Brenke |
| 1908-1909 | Allen Carpenter |
| 1909-1953 | Lulu Runge |
| 1910-1916 | Elizabeth A. Bennett |
| 1911-1913 | Solomon Lefschetz |
| 1913-1918 | Henry Blumberg |
| 1915-1916 | Oliver Holmes Gish |
| 1916-1920 | Albert Babbitt |
| 1916-1917 | Mary Alice Colpitts |
| 1918-1949 | Meyer G. Gaba |
| 1918-1929 | Charles R. Sherer |
| 1919-1940 | Allen Ray Congdon |
| 1919-1920 | William M. Bond |
| 1919-1957 | Oliver Collins |
| 1919-1944 | Tracy Pierce |
| 1920-1922 | James Henry Taylor |
| 1920-1921 | Constance Rummons |
| 1922-1947 | Floyd Harper |
| 1922-1928 | William J. Hiller |
| 1926-1968 | Howard P. Doole |
| 1927-1927 | Alexander Maslow |
| 1928-1929 | Magnus R. Hestenes |
| 1929-1931 | Merrill M. Flood |
| 1930-1959 | Chester C. Camp |
| 1930-1970 | Miguel Basoco |
| 1935-1937 | Anna A. Stafford |
| 1935-1938 | Merritt S. Webster |
| 1935-1938 | Joseph D. Novak |
| 1938-1943 | Daniel M. Dribin |
| 1938-1939 | David L. Netzorg |
| 1939-1942 | Donald H. Rock |
| 1943-1944 | Albert Neuhaus |
| 1944-1947 | Ralph Hull |
| 1944-1950 | Lucy K. Pierce |
| 1945-1949 | Margaret Ehlers |
| 1946-1947 | James Francis Heyda |
| 1946-1951 | Maurice Lamoree |
| 1946-1948 | Everett J. Lowry |
| 1946-1951 | William T. Lenser |
| 1946-1962 | Florence E. Pool |
| 1946-1950 | Mary K. Smith |
| 1947-1986 | Edwin Halfar |

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|---|---|
| 1947-1986 | William G. Leavitt |
| 1947-1949 | F. Robert Poole |
| 1948-1952 | F. Marion Clarke |
| 1949-1951 | Frances Buell |
| 1949-1951 | Barbara Isaacson |
| 1950-1961 | Hugo Ribeiro |
| 1950-1955 | George Seifert |
| 1950-1984 | Lloyd K. Jackson |
| 1953-1957 | R. M. Kozelka |
| 1954-1959 | Arne Magnus |
| 1954-1957 | Fred C. Andrews |
| 1954-1959 | Frank W. Anderson |
| 1954-1956 | T. A. Newton |
| 1955-1992 | Donald W. Miller |
| 1957-1962 | William R. Abel |
| 1957-1962 | Douglas L. Guy |
| 1957-present | Walter E. Mientka |
| 1957-1980 | Hubert H. Schneider |
| 1958-1961 | Jack M. Anderson |
| 1958-1964 | Bernard Harris |
| 1958-1962 | Hubert L. Hunzecker |
| 1958-1964 | John E. Kimber, Jr. |
| 1959-1963 | Gary H. Meisters |
| 1960-1963 | John Christopher, Director of Computing Center |
| 1960-1964 | John J. Birch |
| 1961-1998 | Albert W. Zechmann |
| 1962-1967 | Arlington M. Fink |
| 1963-1967 | Spencer E. Dickson |
| 1963-1998 | Rao Chivukula |
| 1963-1966 | Jagdish N. Srivastava |
| 1963-1965 | Elliot Tanis |
| 1964-1989 | John Eidswick |
| 1964-1966 | Bruce G. Secrest |
| 1965-1998 | Paul M. Krajkiewicz |
| 1965-1969 | John P. Maloney |
| 1965-1997 | K. Lal Saxena |
| 1966-1984 | Max Larsen, Dean 1975-1981 |
| 1966-1992 | Dale M. Mesner |
| 1966-present | David L. Skoug |
| 1967-1972 | Harvey Lee Baker, Jr. |
| 1967-1970 | Ahmed Mirbagheri |
| 1967-1971 | Chong Jin Park |
| 1967-1985 | Yung Liang Tong |
| 1967-1971 | Paul Wilson |
| 1968-present | Gerald W. Johnson |
| 1968-1973 | Gerhard Knutson |
| 1968-present | Allan C. Peterson |
| 1968-present | Thomas S. Shores |
| 1969-1970 | Kenneth D. Shere |
| 1969-2000 | Melvin C. Thornton |
| 1970-1974 | Loren N. Argabright |
| 1970-1988 | Jerald P. Dauer |
| 1970-1974 | Melvin D. George, Dean of Arts & Sciences |
| 1970-present | Earl S. Kramer |
| 1970-1973 | Robert J. Lopez |
| 1970-present | John C. Meakin |
| 1971-1974 | John J. Kinney |
| 1971-present | W. James Lewis |
| 1971-1973 | Gary M. Thomas |
| 1971-present | Gordon S. Woodward |
| 1972-1997 | Gary H. Meisters |
| 1972-1973 | Gordon W. Pledger |
| 1972-present | Roger A. Wiegand |
| 1972-present | Sylvia M. Wiegand |
| 1972-1974 | Peter B. Worland |
| 1973-1988 | Frank L. Gilfeather |
| 1973-1985 | Robert J. Krueger |
| 1974-1978 | George F. Corliss |
| 1974-1976 | Jeffrey L. Dawson |
| 1974-1986 | Leon M. Hall, Jr. |
| 1974-1975 | Ralph L. Kodell |
| 1974-1977 | James D. Lynch |
| 1974-1978 | Edward S. Nevius |
| 1974-1976 | Janina Spears |
| 1975-1978 | Cecil D. Bykerk, Actuarial Science |
| 1975-1979 | Douglas W. Mallenby |
| 1976-present | Leo G. Chouinard, II |
| 1976-1987 | David R. Larson |
| 1976-1978 | Ira H. Shavel |
| 1977-1978 | Thomas S. Fischer |
| 1977-1981 | Gregory A. Kriegsmann |
| 1977-1984 | Daniel P. Mihalko |
| 1978-1984 | Ross P. Kindermann |
| 1978-1984 | Spyros S. Magliveras |
| 1979-1982 | Vincent N. La Riccia |
| 1979-1982 | Suan-Boon Tan |
| 1981-present | J. David Logan |
| 1982-1985 | Martin Levy |
| 1983-1995 | Dong Ho Park |
| 1984-present | Richard Rebarber |
| 1985-present | Steven R. Dunbar |
| 1985-present | Brian Harbourne |
| 1985-present | Mohammed Rammaha |
| 1985-1987 | Daniel J. Weiner |
| 1986-present | Partha Lahiri |
| 1986-1989 | S. Das Paddada |
| 1986-present | David R. Pitts |
| 1986-1992 | Chris A. Tiahrt |
| 1987-present | Bo Deng |
| 1987-1992 | Marek Slaby |
| 1988-1989 | Richard Baker |
| 1988-1989 | Altha Blanchet |
| 1988-1992 | Jean M. Rynes |
| 1989-present | Steve D. Cohn |

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|---|---|
| 1989-present | David B. Jaffe |
| 1989-present | Glenn W. Ledder |
| 1989-present | Thomas J. Marley |
| 1990-1996 | Kun-Liang Lu |
| 1990-1997 | Jian-Jian Ren |
| 1991-present | John L. Orr |
| 1991-1997 | Mark Sapir |
| 1992-1996 | Joan R. Leitzel, SVCAA and Interim Chancellor |
| 1993-present | Gwendolen Hines |
| 1993-1996 | James R. C. Leitzel |
| 1993-present | Andrew J.(Jamie) Radcliffe |
| 1993-1995 | Chris Rogers |
| 1996-2000 | Daniel S. Nettleton |
| 1996-present | Judy L. Walker |
| 1996-present | Mark E. Walker |
| 1997-present | Allan P. Donsig |
| 1998-present | Susan Hermiller |
| 1999-present | Trent D. Buskirk |
| 1999-present | Tapabrata Maiti |
| 2000-present | George Avalos |
| 2000-present | Mark Brittenham |

## G.2 PhD Degrees Conferred, 1898–2000

| Year | Student | Thesis Title | Advisor |
|---|---|---|---|
| 1898 | Candy, Albert L. | *A general theorem relating to transversals, and its consequences* | Ellery Davis |
| 1899 | Engberg, Carl C. | *The cartesian ovals* | Ellery Davis |
| 1900 | Moritz, Robert E. | *Generalization of the differentiation process* | Ellery Davis |
| 1929 | Doole, Howard Pollock | *A certain multiple-parameter expansion* | Chester Camp |
| 1934 | Cowgill, Allen Parker | *On the summability of a certain class of series of Jacobi polynomials* | William Brenke |
| 1935 | Nichols, Guerdon David | *The explicit arithmetized Fourier series developments for certain doubly periodic functions of the second kind* | Miguel Basoco |
| 1937 | Dwyer, Wendell Arthur | *On certain fundamental identities due to Uspensky* | Miguel Basoco |
| 1941 | Daum, John Andrew | *Basic hypergeometric series* | Miguel Basoco |
| 1947 | Mundhjeld, Sigurd | *Certain doubly periodic functions of the third kind* | Miguel Basoco |
| 1953 | Gass, Clinton Burke | *Eigenfunction expansions associated with certain irreducible partial differential equations* | Chester Camp |
| 1957 | Keedy, Mervin Laverne | *Some properties of basic order relations in the arithmetic of relation algebras* | Hugo Ribeiro |
| 1960 | Fountain, Leonard DuBois | *The boundary value problem for an ordinary nonlinear differential equation of second order* | Lloyd Jackson |
| 1961 | Bohn, Sherman Elwood | *A sub-function study of the Dirichlet problem for a quasi-linear differential equation* | Lloyd Jackson |
| | Suprunowicz, Konrad | *Diagram normal forms and their applications to the theory of models* | Hugo Ribeiro |
| 1962 | Bebernes, Jerrold | *Subfunctions and their application to the boundary value problem for ordinary nonlinear second-order differential equations* | Lloyd Jackson |
| 1963 | Gross, Mildred Lucile | *Sieve methods and some applications* | Walter Mientka |
| | Herzog, John Orlando | *Phragmen-Lindelof theorems for second order quasi-linear elliptic partial differential equations* | (Lloyd Jackson |
| | Heuer, Charles Vernon | *An extension problem for cancellative semigroups* | Donald Miller |
| | Peinado, Rolando Enrique | *The generalized module type of a ring* | William Leavitt |
| 1964 | Frederickson, Paul Oliver | *Series solution of an almost periodic differential equation* | Arlington Fink |
| 1965 | Cobb, Ernest Benton | *The characterization of the solution sets for generalized reduced moment problems and applications* | Bernard Harris |
| | Heimes, Kenneth | *Boundary value problems for ordinary second order systems* | Lloyd Jackson |
| | Jenkins, Terry Lloyd | *The theory of radicals and radical rings* | William Leavitt |
| | Mathsen, Ronald Melvin | *Subfunctions for third order ordinary differential equations* | Lloyd Jackson |
| | Schwabauer, Robert Jacob | *The lattice of closed sets of commutative semigroup equations* | Hubert Schneider |
| 1966 | Armendariz, Efraim | *The hereditary property in semisimple and radical classes* | William Leavitt |
| | Brown, Joseph Gary | *A calculus of natural deduction for predicate logic with functional variables and identity* | Hubert Schneider |
| | Church, James Denton | *Asymptotic properties of a non-homogeneous generalization of the Galton-Watson branching process* | John Birch |
| | Dussere, Paul Louis | *Automorphism groups of semigroups* | Donald Miller |

| Year | Student | Thesis Title | Advisor |
|---|---|---|---|
| | Gilbert, Gary G. | *The multiplicative semigroup of a ring* | Donald Miller |
| | Hoffman, Anthony | *The constructions of the general theory of radicals* | William Leavitt |
| | Jensen, Bruce Ansgar | *Infinite semigroups having only finite proper homomorphs* | Donald Miller |
| | Schrader, Keith William | *Boundary value problems for second-order ordinary differential equations on infinite intervals* | Lloyd Jackson |
| 1967 | Alin, John Suemper | *Structure of torsion modules* | Spencer Dickson |
| | Eliason, Stanley Bruce | *The integral* $T\int_{T/2}^{T/2} p(t)\,dt$*, and the boundary value problem* $x'' + p(t)x = 0, x(-T/2) = x(T/2) = 0$ | Arlington Fink |
| | Pfeifer, Glenn Lee | *Mappings of irreducibly connected spaces* | Edwin Halfar |
| | Schmitt, Klaus | *Solutions to boundary value problems and periodic solutions of second-order nonlinear differential equations* | Lloyd Jackson |
| | Shreve, Warren Eugene | *The equation* $y'' = f(x, y, \lambda)$ *on* $[a, \infty)$ *with boundary conditions involving* $\lambda$ | Arlington Fink |
| 1968 | Anderson, Donald Alfred | *On the construction and analysis of multi-factorial experimental designs* | J. Srivastava |
| | Chopra, Dharam Vir | *Investigations on the construction and existence of balanced fractional designs of* $2^m$ *series* | J. Srivastava |
| | Erbe, Lynn Harry | *Nonlinear boundary value problems and second order differential equations* | Lloyd Jackson |
| | Fox, David Franklin | *Natural deduction and universal validity* | Hubert Schneider |
| | Klaasen, Gene Allen | *Boundary value problems for second order ordinary differential equations* | Lloyd Jackson |
| | St Mary, Donald Frank | *Oscillation and comparison theorems for second order linear differential equations* | Arlington Fink |
| | Tangeman, Richard Louis | *Rings which are radical extensions of subrings* | William Leavitt |
| | Teply, Mark Lawrence | *Torsion free injective modules* | Spencer Dickson |
| | Tolo, Kenneth William | *Factorizable semigroups* | Donald Miller |
| 1969 | Bruning, Linda Mae Frank | *The classification of rings by the characteristic free modules admitted* | William Leavitt |
| | Fuelberth, John Douglas | *On commutative splitting rings* | Spencer Dickson |
| 1970 | Bosch, William W. | *Polyanalytic functions* | Paul Krajkiewicz |
| | Boisen, Monte B. | *Prufer and valuation rings with zero divisors* | Max Larsen |
| | Kelly, Patrick Henry | *Valuation pairs and maximal partial homomorphisms* | Max Larsen |
| | Leech, Robert Bruce | *A characterization of HB spaces* | Jack Eidswick |
| | Mosbo, Edward Paul | *Reduction of matrices to a triangular form under similarity* | William Leavitt |
| | Woodward, Walter | *Operator semigroups and invariant linear functionals* | Rao Chivukula |
| 1971 | Brown, David Eugene | *Separation of nonassociates in a commutative ring by valuations* | Max Larsen |
| | Heckman, Randall Kirk | *Convolutions and factorization theorems* | Rao Chivukula |
| | May, William Donley | *Order properties of* $L(E, F)$ | Rao Chivukula |
| | Massagli, Robert Albert | *On the structure of the Wright radical in topological rings and groups* | Melvin Thornton |
| 1972 | Enersen, Paul Oliver | *Class functions in the general radical theory of rings and algebras* | William Leavitt |
| | Masat, Francis E. | *Right simple congruences on a semigroup* | Donald Miller |
| | Shipley, Charles Thomas | *A semantical theory and several deductive systems for universally free logic* | Hubert Schneider |

| Year | Student | Thesis Title | Advisor |
|---|---|---|---|
| | Thomas, Kenneth Edwin | *Conjectures regarding compact connected 2-dimensional topological lattices* | Harvey Baker, Jr. |
| 1973 | Ewan, Robert Allan | *The Cameron-Storvick operator-valued function space integrals for a class of finite-dimensional functionals* | David Skoug |
| | Maik, Russell Louis | *Applications of order statistics to multivariate exponential distribution models* | J. Srivastava & Lloyd Jackson |
| | Peterson, Dale Edward | *Uniqueness, existence, and comparison theorems for ordinary differential equations* | Lloyd Jackson |
| | Salmon, Ronald Dale | *Perfect mappings and singular sets* | Edwin Halfar |
| | Smith, Neil Graham | *On a set-theoretic offshoot of the normal Moore space question* | Harvey Baker, Jr. |
| | Spencer, James David | *Boundary value functions for nonlinear differential equations* | Allan Peterson |
| 1974 | Innes, Joan | *Existence and uniqueness of solutions of boundary value problems for a third order differential equation* | Lloyd Jackson |
| | Onstad, Joseph Allen | *A study of certain classes of regular semigroups* | Donald Miller |
| | Sukup, Dwight | *Boundary value problems for nonlinear differential equations* | Allan Peterson |
| 1976 | Gahl, Robert Daniel | *Controllability of nonlinear systems* | Jerald Dauer |
| 1977 | Byleen, Karl E. | *The structure of regular and inverse semigroups* | John Meakin |
| | Hardy, Bonnie Rae | *Arithmetical semigroup rings* | Thomas Shores |
| | Franke, William Tadd | *Fractional derivatives and orders of distributions* | Gary Meisters |
| | Petersen, Edith Kregelius | *On distributions of compact support* | Gary Meisters |
| | Petersen, Loren Verne | *On Banach function spaces and p-sums of Banach spaces* | Gerald Johnson |
| | Ivatury, Ramabhadrasarma | *Means with values in a banach lattice and some results on tensor products* | Rao Chivukula |
| 1978 | Fischer, Thomas S. | *The prime spectrum of a Bezout ring* | Roger Wiegand |
| | Meyer, Robert A. | *The number of solutions to a system of divisibility conditions* | Walter Mientka |
| | Call, Frederick W. | *Torsion theories with the bounded splitting property* | Thomas Shores |
| | Chang, Kun Soo | *Scale-invariant measurability in function spaces* | Gerald Johnson |
| | Midgarden, Bette Gene | *Rings of bounded module type* | Roger Wiegand |
| | Wetzell, David E. | *Allocation of observations in ranking and selection problems via majorization and other related inequalities* | Yung Tong |
| 1980 | Carroll, John L. | *A study of closed queueing networks with population size constraints* | Lester Lipsky C.S |
| | Pakala, Jagannadham V. | *Commutative torsion theories* | Thomas Shores |
| | Smith, Norman L. | *Inequalities for functions of order statistics under an additive and a multiplicative model* | Yung Tong |
| 1981 | Grow, David E. | *A class of $I_0$-sets* | Gordon Woodward |
| | Henderson, Johnny L. | *Right focal boundary value problems for ordinary differential equations* | Lloyd Jackson |
| | Krauter, William W. | *Combinatorial properties of algebraic sets* | Roger Wiegand |
| | Sivasankara, Sastry A. | *Vector integrals and products of vector measures* | Rao Chivukula |
| | Sebo, Donald E. | *Multiple objective linear programming in objective space* | Jerald Dauer |
| 1982 | Liefvoort, Albertus H.A. | *An algebraic approach to the steady state solution of G/G/1//N type loops* | Lester Lipsky (C.S.) |

| Year | Student | Thesis Title | Advisor |
|---|---|---|---|
| 1984 | Kreher, Donald L. | *Algebraic methods in the theory of combinatorial designs* | Spyros Magliveras (C.S.) |
| 1985 | Beezley, Randall S. | *Electromagnetic direct and inverse problems for absorbing media* | Robert Krueger |
| | From, Steven G. | *Optimal linear combinations of consistent, asymptotically normal estimators* | K.M. Saxena |
| 1986 | El-Abyad, Abdelwahab | *Geometric approach to multiple objective optimization with application to multiple criteria decision making* | Jerald Dauer |
| | Hankerson, Darrel R. | *Boundary value problems for n-th order difference equations* | Allan Peterson |
| | Liu, Yi-Hsin | *Analysis of objective space in multiple objective optimization* | Jerald Dauer |
| 1987 | Saleh, Ossama A. | *A characterization of proper minimal points as solutions of sublinear optimization problems* | Jerald Dauer |
| | Stephen, Joseph B. | *Applications of automata theory to presentations of monoids and inverse monoids* | John Meakin |
| 1988 | Coomes, Brian A. | *Polynomial flows, symmetry groups and conditions sufficient for injectivity of maps* | Gary Meisters |
| | Gallagher, Richard J. | *Scalarization of vector optimization problems and properties of the positive cone in normed vector lattices* | Jerald Dauer |
| | Kulasekera, Karunarathna | *Estimation of change points in failure rate models* | K.M. Saxena |
| | Weil, Pascal | *Inverse monoids and the dot-depth hierarchy* | John Meakin |
| 1989 | Diaz, Gerald | *Applications of cone theory to boundary value problems* | Allan Peterson |
| | Goddard, Bartley E. | *A finite dirichlet series related to Newman polynomials* | Walter Mientka |
| 1990 | Jia, Bao-Ping | *Splitting of prime ideals and valuations* | Roger Wiegand |
| | Li, Yuanzhang | *Robust Bayesian analysis* | K.M. Saxena |
| | Peil, Timothy | *Criteria for disconjugacy and disfocality for an nth order linear difference equation* | Allan Peterson |
| | Woerner, Edwin L. | *Self-similar solutions to the detonation equations in non-homogeneous media* | David Logan |
| 1991 | Dobson Fosnaugh, Linda | *Tilings with the neighborhood property and tiling lattice points with blocks* | Earl Kramer |
| | Wu, Qiu-rong | *On properties and constructions of t-designs, $\lambda$-designs and perpendicular arrays* | Earl Kramer |
| 1992 | Ahn, Byung Moo | *Path integrals, Fourier transforms and Feynman's operational calculus* | Gerald Johnson |
| | Schneider, John Martin | *Green's functions, Cauchy functions and cone theoretic eigenvalue results for difference equations* | Allan Peterson |
| 1993 | Fosnaugh, Timothy A. | *Optimization over and connectedness of the efficient set(s)* | Jerald Dauer & Gerald Johnson |
| | Riggs, Troy D. | *A Feynman-Kac formula with a Lebesgue-Stieltjes measure for the one-dimensional Dirac equation, associated Dyson series and Feynman's operational calculus* | Gerald Johnson |
| 1994 | Arora, Vipin Kumar | *Empirical Bayes and hierarchical Bayes estimation of small area characteristics* | Partha Lahiri |
| | Cimen, Nuri | *One-dimensional rings of finite Cohen-Macaulay type* | Roger Wiegand |
| | Holay, Sandeep H. | *Generators and resolutions of ideals defining certain surfaces in projective space* | Brian Harbourne |

| Year | Student | Thesis Title | Advisor |
|---|---|---|---|
| | Huffman, Timothy J. | *An analytic Yeh-Feynman-Fourier transform and convolution* | David Skoug |
| | Li, Aihua | *Partially ordered sets of prime ideals and prime filtrations of finitely generated modules* | Sylvia Wiegand |
| | Lim, Jae-Hak | *Stochastic comparisons of maintenance policies and Bayesian Imperfect Repair Model* | Dong Ho Park |
| | Kilibarda, Vesna | *On the algebra of semigroup diagrams* | John Meakin |
| 1995 | Atici, Ferhan | *Fixed point techniques in cone theory with applications to difference equations* | Allan Peterson |
| | Campbell, Nancy L. | *Bayesian models for a change-point in failure rate* | K.M. Saxena |
| | Harmsen, Betty Jean | *The discrete calculus of variations* | Allan Peterson |
| | Jajcay, Robert | *Vertex-transitive graphs and maps and their automorphism groups* | Spyros Magliveras (C.S.) |
| | Nam, Kyung Hyun | *Trend changes in failure rate and mean residual life its relations and applications* | Dong Ho Park |
| | Pfabe, Kristin A. | *A problem in nonlinear ion transport* | Thomas Shores |
| | Reyes, Jose Tristan Fua | *Exponentials of noncommuting operators via Feynman's operational calculus, and associated evolution equations* | Gerald Johnson |
| 1996 | Al-Khaled, Kamel | *Theory and computation in hyperbolic model problems* | Thomas Shores |
| | Herzinger, Kurt D. | *Minimal generating sets of ideals and torsion in* $I \otimes_R I^{-1}$ | Roger Wiegand |
| | Jorgensen, David A. | *Vanishing of Tor on a complete intersection* | Roger Wiegand |
| | Morelli, Michael | *Disconjugacy of a third-order linear difference equation* | Allan Peterson |
| | Szaniszlo, Zsuzsanna | *On the Bollobas inequality* | A. Jamie Radcliffe |
| | Wang, Kaicheng | *Rewriting reduction and pruning reduction on Munn trees* | John Meakin |
| | Yamamura, Akihiro | *HNN extensions of inverse semigroups* | John Meakin |
| 1997 | Anderson, Douglas R. | *Discrete Hamiltonian systems* | Allan Peterson |
| | Avery, Richard Irvin | *Multiple positive solutions to boundary value problems* | Allan Peterson |
| | Butar Butar, Ferry | *Empirical Bayes methods in survey sampling* | Partha Lahiri |
| | Dawkins, Paul | *Spurious eigenvalues in the spectral tau method* | Steve Dunbar |
| | Fitchett, Stephanie | *Generators of fat point ideals on the projective plane* | Brian Harbourne |
| | Holley, Darren J. | *Quotients of the multiplicative group of a field* | Roger Wiegand |
| | Homp, Michelle Reeb | *A transport equation in porous media with an oblique, evolutionary boundary condition* | David Logan |
| | Jajcayova, Tatiana | *HNN extensions of inverse semigroups* | John Meakin |
| | Mueller, Jennifer L. | *Inverse problems for singular differential equations* | Thomas Shores |
| | Olsen, Cheryl L. | *On graphical designs* | Earl Kramer |
| | Ruyle, Robert L. | *Pseudovarieties of inverse monoids* | John Meakin |
| | Sapir, Olga B. | *Identities of finite semigroups and related questions* | John Meakin |
| | Van Peursem, Dan | *Analytical modeling of groundwater flow* | Glenn Ledder |
| 1998 | Krueger, Robert | *Disconjugacy of* $n$*th order linear difference equations* | Allan Peterson |
| | Saydam, Serpil | *Prime ideals in birational extensions* | Sylvia Wiegand |
| | Wei, Ruizhong | *Traceability schemes, frameproof codes, key distribution patterns and related topics – a combinatorial approach* | Earl Kramer (M&S) and Doug Stinson (C.S.) |
| | Wu, Chien-Hua | *On a test for multivariate normality and on certain statistical procedures for complex surveys* | Partha Lahiri |
| 1999 | Bell, Darryl | *The uniform bifurcation of n'front traveling waves in the singularly perturbed FitzHugh-Nagumo equations* | Bo Deng |

| Year | Student | Thesis Title | Advisor |
|---|---|---|---|
| | Deis, Tim | *Equations in Free Inverse Monoids* | John Meakin |
| | Nielsen, Lance | *Stability properties of Feynman's operational calculus* | Gerald W. Johnson |
| | Pollis, Tim | *Notes on Hamilton Paths and 2-Factors in Self-Complementary Graphs* | Jamie Radcliffe |
| | Taylor, Krista Jean | *Chaotic attractors in one-dimension generated by a singular Sil'nikov orbit* | Bo Deng |
| | Wagstrom, Rikki | *Well-Posedness of a Nonlinear, Nonlocal Problem Arising in Ion Transport* | Steve Cohn |
| | Wan, Shu-Mei | *Jackknife method in small area estimation and related problems* | Partha Lahiri |
| | Gierke, Paul | *Discrete Approximations of Differential Operators By Sinc Method* | Tom Shores |
| 2000 | Abu-Jeib, Iyad | *Frames in Hilbert Space and Matrices of Special Structure* | Tom Shores |
| | Agre, Keith | *Initial–Boundary Value Problems for Non-linear Wave Equations* | Mohammad Rammaha |
| | Akin, Elvan | *Boundary Value Problems, Oscillation Theory and Cauchy Functions for Dynamic Equations on a Measure Chain* | Alan Peterson |
| | Ira, Michael | *Steiner Trigraphical Designs and Block-Size Bounds* | Earl Kramer |
| | Johnson, Lisa | *The effect of time changes on Feynman's operational calculus as made rigorous by Wiener and Feynman integrals* | Gerald Johnson |
| | Leuschke, Graham | *Finite Cohen-Macaulay Type* | Roger Wiegand |
| | Meza, Jane | *Resampling Methods in Small Area Estimation* | Partha Lahiri |
| | Strei, Theresa | *Global regularity for nonlinear wave equations* | Mohammad Rammaha |

## G.3 Department History

The following history (written by several people) was created for the Spring 1998 Centennial Celebration. As a substitute to doing a history revision that includes information on people and events since Spring 1998, we refer the reader to the most recent Mathematics and Statistics Newsletters.