

***Academic Program Review University  
of New Mexico***

***Department of Mathematics and Statistics  
Self-Study***

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## Executive Summary

**Department Overview:** The Department of Mathematics and Statistics at the University of New Mexico fulfills the mission of teaching service courses in the two disciplines that go beyond the department's own programs in remarkable fashion despite the limited amount of human resources, financial resources and facilities. Currently we have 29.3 tenured or tenure track faculty: 22.5 in Pure and Applied Mathematics, 5.3 in Statistics, 1.5 in Mathematics Education. In addition, the Department has 7 Lecturers. Of these numbers, one faculty has been working for several years full time in the UNM Office of Research and 2 are on leave without pay (LWOP). These numbers reflect a net loss of total faculty and an even greater loss of tenured stream faculty compared to what we had in our last review (1995) when a growth in tenure stream faculty was recommended. As one of the largest departments in the College of Arts and Sciences, we currently generate over 45,000 student credit hours per year at the undergraduate and graduate level and rely heavily on a devoted and professional Part-time Instructor pool as well as highly trained graduate teaching assistants.

Despite challenges in funding, staffing, and faculty turnover, the department prides itself on maintaining its high integrity as one of the flagship departments at UNM. Long known for our service to students, the department continues to provide unstintingly to the University. Our faculty continues to receive grant funding, including; for example, active grants between 7/1/06 and 6/30/07 totaled \$6.2. Beginning this summer, we will have a program funded by the NSF at 750K dollars entitled: "EMSW21-MCTP Attracting, Motivating and Preparing Mathematics students in the Southwest by building an energetic community" which amongst other things will help in attracting students to our graduate programs. We continue to thrive in interdisciplinary collaborations; examples include Statistics and Mathematics faculty collaborations with the federal Laboratories in the state, collaborations with the School of Engineering and the Health Sciences Center and no less important, collaborations (with funding) with scientists from other Institutions (UT Austin, Purdue, UC San Francisco). Faculty serve on critical committees representing the department with dedicated service; included committees are the provost search committee, Title V steering committee, the building committee, undergraduate curriculum committee, assessment and outreach committees, and many more. Our staff serve on several committees on a regular basis and are often the first sought to serve. Some of those committees include the Banner evaluations committees, faculty hiring committee, purchasing committee within the college, building committee, advisor training committee, advisement committees, represent the College of Arts and Sciences as IT agent, Arts and Sciences staff development committee, and much more.

The department is always responsive to calls for assistance from the University and the College of Arts and Sciences. There have been partnerships formed across the UNM community, the Albuquerque community, and Central New Mexico Community College to support students and programs at UNM. Recently, the department was called upon to develop a math course for the new BA/MD program and to provide faculty for that class. We now have a section of Calculus for the Life Sciences which could open the gates for an increase of Math majors with emphasis in the Life Sciences. To our benefit, the department shares a faculty member with Biology. Our graduation rates and retention at the graduate level are far above average. The number of majors in our department is astounding considering that this is after all, Mathematics and Statistics. Their graduation rates continue to rise under our excellent advisement program. Our reputation for collaboration is far above par and the department and its service to UNM is often pointed to as an excellent example of the collaborative spirit.

The programs in our department continue to depend on a hit and miss opportunity mode in terms of our Applicant pool. We try to “sell” our program as best as we can, including personal contacts. The challenges are, from the Undergraduate program, to identify through our service courses students with talent and who have appreciation for our disciplines and who have not committed to another degree. This ideally should start with our Calculus courses; the fact that we do not have research faculty teaching such courses is a clear handicap. In terms of our Graduate programs, it all starts with the compensation packages (TAs) we offer, which are not competitive. This does not mean we can't provide success stories; the honors program grows steadily each year, helping undergraduate students learn the value of working on research with dedicated faculty. Two faculty members has a small (REU) grant added to a regular NSF grant to pay undergraduate students for their research.

Where does the department want to be in five years? Since the last Academic Program Review (APR), we experienced many changes in the upper Administration which hindered any possible long term plan. For the first time in many years it appears there will be some stability, in particular with a new (since 08/07) Dean and University President and next year a new Provost. This could make a big difference in addressing this question. If there is going to be serious commitment to our Programs and if there was a department wish list, it would include the ability to provide the number of faculty needed to support growing undergraduate and graduate programs. It would include the ability to hire additional staff to handle the ever growing list of administrative duties the department must do each year. This wish list would include the ability to attract and retain our best faculty and staff and provide competitive stipends to our top student applicants. The wish list would be for a university-wide system that works well and is beneficial for finance, student services, and human resources. With the upcoming new Sciences and Mathematics Learning Center; a building to be in place by 2011, we have a unique opportunity to strengthen our programs. As we embark into fundraising and creating endowments (and we are ahead of the curve as UNM has already raised 250K dollars in support of a visualization room) a parallel effort needs to be in place based on the APR recommendations so altogether we have programs in Pure and Applied Mathematics, Mathematics Education and Statistics we can all be proud of.

**Concerns:** To provide some perspective, we teach and administer about 15% of the total course load for a University of 28+ thousand students. To do so, we rely on a large number of Part time Instructors (PTI), Teaching Assistants (TAs) and a small core of Lecturers, and tenured stream Faculty. The demands and public pressure to demonstrate evidence of success in the classroom in the Algebra, pre-Calculus and Calculus courses taken by majors in Science, Business, pre-Med, Pharmacy, Health Sciences, and Engineering are all important and are taken seriously by our Department. In particular, the past few years we (UNM and the Department) have hosted annual summit meetings with High School Mathematics teachers to find ways to improve success in the classroom. An unintended consequence of the visibility of this issue is that historically there has been a lack of attention to our own degree programs. In recent years, the number of research faculty declined and we suffered a serious problem with retention of our outstanding faculty.

In the past 5 years, 8 faculty left and accepted offers from Institutions such as Georgia Tech, Minnesota State, Colorado State, Rice, UT Dallas, Southern Methodist University, and Ohio State. Two more have accepted outside offers and will leave in Fall 08. While we have been successful in hiring a few excellent faculty during the same period, we cannot stay even. Our new faculty view these losses with great concern in terms of the stability of the department and the overall morale among the faculty is quite low. The Statistics group has suffered the most

and they are at a point where their programs are in jeopardy since they cannot teach required courses or mentor the number of students currently enrolled in M.S. and Ph.D. programs.

Nationwide, many institutions are responding to the need to increase the number of scientists in STEM disciplines and to improve the quality and number of Mathematics teachers to supply the ever increasing demand for these professionals. Its importance is well stated in the "America Competes Act" (2007) signed by Congress and the President and this Act should be viewed as a mandate to boost Math and Science at all levels. Today, we see no evidence of UNM responding to this in a significant manner. This self-study will show efforts by our outstanding faculty; for the most part all coming from within the department, rather than from a consolidated effort led by the administration to meet the needs of STEM professionals. Any successful initiative in our department, for the most part, has to be self-sustained. Just to give an example, our department was recently awarded a National Science Foundation Grant (3-years, \$750,000) under the Enhancing the Mathematical Sciences Workforce in the 21<sup>st</sup> Century-Mentoring through Critical Transition Points (EMSW21-MCTP) program. The grant is for a proposal to transition from undergraduate to graduate education in mathematics. As those who apply for National Science Foundation (NSF) grants we know how competitive this program is and what it does to enhance visibility to our program. That we were awarded this grant validates the quality of our faculty. That we got it despite the fact that at the time we could not get institutional support (eg: a letter from the then Interim Dean or the Provost) is extraordinary. Those of us that participate in NSF panels know the positive (negative) impact institutional (lack thereof) support has in the decision making. The lack of institutional support is a great concern to our department.

On the research front, in the past two years we have generated the largest amount of research dollars ever seen in the department—this year alone the department received \$6.2 million in grants. Given the obstacles presented by a dysfunctional Office of Research Administration, these successes produced a heavy burden in our outstanding staff. The department remains concerned that our staff will eventually burn out and leave us for other positions.

Our department has majors and minors in both Mathematics and Statistics, at the graduate and undergraduate level. At this point in time, there are 225 majors at the undergraduate level as identified in the majors lists supplied from the Registrar's Office (some of these students consider themselves majors, however until they become part of the College of Arts and Sciences we do not officially count them as our official majors). There are 122 graduate students in Pure Mathematics, Applied Mathematics, and in Statistics. As a major department at UNM, we are very concerned about our ability to fully meet the educational needs of our undergraduate and graduate majors with the 13 to 1 ratio of students to FTE. This is becoming particularly problematic as we lose senior faculty and continue to recruit and admit graduate students to the Ph.D. programs. Although we offer a master's examination for the M.S., we need more senior faculty to chair dissertation committees as our Ph.D. enrollment continues to remain steady. The only alternative the department has as a response to these low faculty positions, is to limit the number of Ph.D. students we admit each year. This move will not benefit our department nor will it benefit UNM as a whole.

Mathematics concentrations and Statistics offers a large (N=122) competitive graduate program with three distinct tracts. We offer funding for 43 .50 FTE graduate students in the form of Teaching Assistantships and through creative use of funding we are able to offer 13 .25 FTE Graduate Assistantships. In this manner we are able to offer funding to more students; however it is difficult for students to subsist on the .25 FTE alone. This lack of funding even with our

creative answers for the shortfalls causes concern regarding our ability to recruit top minority students for graduate study and to move students through our program quickly.

Rather than closing this section on a pessimistic tone, there are two things that give reason for hope the review team recommendations may be implemented: (1) The emergence of a stable Administration. We have a College Dean and a President who came on board in Fall of 2007. A permanent Provost should be in place by Fall 2008. (2) The eventual construction of the Science and Mathematics Learning Center. This building will house Mathematics and if completed according to the current program, will improve facilities and add technology in classrooms that altogether could attract faculty to our department.

In conducting this self-study, the department recognizes that this is a unique time in our history to either take the first steps in the right direction, or run the risk that a highly productive university department reaches a point of endangered programs. This is an overarching concern of the Department of Mathematics and Statistics as we enter into the final years of this decade.

## Questions for the Review Team

### 1. How do we enhance our undergraduate and graduate programs?

The many tasks of delivering and overseeing service classes, while important to the institution, come at the expense of activities that could enhance our programs. This is especially true of diminishing faculty and resources. Neglected program activities include lack of delivery of courses by research faculty, lack of a sustained effort to recruit talented students that the department knows are here at UNM and are thinking of other degrees since as a department we cannot reach out and provide meaningful scholarships or fellowships. We know what would enrich our programs; we want recommendations on where to center our efforts and what resources need to be in place. Perhaps additional resources can be put immediately in place if the department gains sole ownership of all mentoring and student support programs on campus that in general deal in a major way with mathematics courses. Are existing resources well spent?

The small number of research faculty puts a limit on the number of students we can mentor at a satisfactory level. Should we make our programs smaller and be more selective with the admission of our students? What issues such as increased support for TA's would we need to pay attention to? Another point is that we would like to see recommendations come forward addressing whether we should tailor our Ph.D. degree programs, in particular the Pure Mathematics track toward excellence in teaching. This would be in response to where most if not all of our recent Ph.D.s look for jobs after completing the degree. How do we evaluate tailoring our Ph.D. programs?

### 2. How can we grow in Mathematics Education without doing it at the expense of the other sub-disciplines?

Today, we have 1.5 faculty in Math. Ed. and a few other faculty who are becoming more involved. To reach a level of excellence, there is a need for even modest growth from where we are now. What would be reasonable numbers of undergraduate and graduate majors we can and should aim at and how can efforts be sustained?

### 3. Should we consider splitting into two departments one of Mathematics and one of Statistics?

A former Dean and Provost put this suggestion in the table, in line with a new building that will house the Mathematics component of the department. This recommendation came without any reference to resources and budgets. If this is going to take place, what would be reasonable sizes for each department and reasonable budgets?

### 4. What should we do to increase our research productivity, in a way that benefits students, the University, and the academic community?

Securing federal funding is getting harder, and there is not much institutional support to do pre- and post- award processing. Faculty and staff at times see that extra hurdles are in place in an already competitive environment. Should we stay on the traditional single PI proposal format? Does the Review Team see strengths and opportunities we should pay attention to? Is the review team aware of models we could adopt from other outside receivers?

**5. How should we develop a long-term hiring plan aligned with a strategy for faculty retention?**

The department have had high turnover of faculty in recent years. In reality we do not have a hiring plan. Instead we seek opportunities to do additional hires from a particular pool. Losing junior faculty prevents the department from expanding into new exciting directions. Losing mid-senior and senior faculty limits the ability to effectively run our graduate programs. So both hiring and retention go hand in hand. We want recommendations on putting these two factors into a coherent long term plan with clear indications of what resources are needed. Is there any way to create such a plan?



## **Department of Mathematics and Statistics Self-study**

This report reviews and analyzes the history and current status of both graduate and undergraduate programs in Mathematics and Statistics at the University of New Mexico. Based on these analyses we discuss current issues and future directions. The report follows the Self-study Guidelines for Academic Program Reviews distributed in November 2007 by the Office of the Provost and Office of Graduate Studies. This is a fairly lengthy history of our department, but we are pleased with the opportunity to have this in an historical document.

### **1. General Program Characteristics**

#### ***History.***

Mathematics offerings in the early years of the University of New Mexico (circa 1893) began with a “thorough drill in Arithmetic the first year . . . followed by two years in Algebra and one in Geometry. . . Our motto will not be ‘Quantity’, but ‘Quality’. Not ‘How Much’, but ‘How Well’ and we will give much more than a mechanical drill” (Griegos, 1989). Over the past 114 years, the Department of Mathematics and Statistics has held firm to the intent of “how well” we can teach math to UNM students.

Only one UNM president was a professor of higher mathematics, and that was Clarence L. Herrick, M.S. in 1897-98. A significant event occurred in 1898 when the Department of Mathematics became a separate department with Edwin P. Childs, B.S. and Josephine S. Parsons as the only faculty of the department. That same year the department offered the first courses beyond algebra and geometry—calculus and the theory of equations.

By 1915, the department was offering substantial courses in a number of areas in mathematics. The first two students graduated with BA degrees in Mathematics that same year. Struggling to re-establish itself after the end of World War I, Charles Anthony Barnhart became the chair of the Department of Mathematics. Barnhart hired Carroll V. Newsom in 1928 as an assistant professor. Newsom served as a major figure in introducing UNM's mathematics department to the national mathematics community and eventually became the chair of the Department of Mathematics in the 1930's. When Newsom left UNM in 1944, the Department became the Department of Mathematics and Astronomy under Lincoln LaPaz.

Following World War II, the pace and level of activity of the university accelerated. In 1952, the Department of Mathematics instituted a program of credit courses at graduate levels to serve the needs of employees of the Los Alamos Scientific Laboratory. Although UNM had intended to offer advanced degrees in chemistry, engineering and physics, there were four applicants seeking master's degrees in mathematics. During this period of time 20% of students taking mathematics courses were taking those courses in the evening and 50% of the upper division and graduate classes were taken in the evening.

The total number of student credit hours taught in 1951-52 was 5062 with a jump of 57.3% the following year to 7964 student credit hours. Even in 1953-54, the department annual report stated, “As a result of these disproportionate changes, the department is greatly overloaded” (Griegos, 1989). By 1956-57 the credit hour production was up to 14,056. The department continuously struggles with a low faculty to student ratio even today.

The doctoral program in mathematics began in the 1956-57 academic year. The demand for doctoral mathematicians was based on the “voracious appetite” that large-scale computers have for such people and the growing number of computers was growing rapidly. Researchers made the estimation that “only one Ph.D. per computer (and most of them now occupy several) there

is a new demand for 10,000 Ph.D.s in the next ten years” (Griegos, 1989). The graduate program at UNM continued steady growth from 67 in 1958-59 to 76 in 1959-60.

The statistics program began its development in 1959-60 when two statistician/probabilists were added to the faculty of the department. The Department of Mathematics and Astronomy was renamed in 1963-64 becoming the Department of Mathematics and Statistics.

The 1964-65 academic year saw the UNM Administration formally recognize that research must be supported by the university and therefore, teaching loads for faculty engaged in research was reduced to the standard two courses per semester. This led to the addition of NSF grants to the department which supported faculty members and graduate students with outside funding for a number of years. The NSF awarded a Departmental Development Grant (a Center of Excellence Grant) to the department in 1967. This \$560,000 three-year grant was the first grant made to a mathematics department nationally. An additional \$50,000 grant from the NSF provided funds for a mathematics computation lab which connected students to the university's IBM 360 computer to perform numerical methods related to topics covered in their classes.

Over the next two decades the department saw growth and decline as new faculty were hired and faculty left. One trend that had an adverse affect on the department during these years was the revision in how remedial mathematics was to be handled at the university level. Up until the point that this decision became practice at UNM, students who were unprepared take Math 121 had to take a remedial course through Continuing Education that did not count for credit at their own expense. In 1970, the department instituted Math 120 for students at the behest of the university. UNM shortly thereafter turned to a policy of open admissions and the number of Math students increased from an initial 200 in 1970 to 1200 in 1977 (that number is approximately 2600 per year as of spring 2008).

Student credit hours in 1976-77 were 34,174 with the majority of those hours being at the lower levels. At this time the department began to employ part-time instructors in ever increasing numbers to handle the number of students. At the same time, graduate applications were dwindling. In 1977-78, the department established three degrees at the graduate level—applied mathematics, pure mathematics, and statistics. By 1980-81, the student credit hours had increased to 47,557 and the graduate program began a steady growth.

In his centennial history of the Department of Mathematics and Statistics, former chair and professor, Richard Griegos mentioned that faculty salaries became a real problem in 1985, with the losses of a number of faculty from the department. During this time, the department had only 25 Teaching Assistants. He considered this, “much too low for a department this size for the teaching loads assigned to the department” (Griegos, 1989).

During the 1990s and into the 21<sup>st</sup> Century the department experienced ups and downs in growth, both in student enrollment in majors and graduate programs and with faculty hires and departures. One thing that remains steady is the amount of outside research funding the department continues to generate. The first outside funding for the department began in 1941 when Newsom received a grant of \$10 for “Research in the Calculus Variations” and again in 1943 when he was awarded \$30 to research the behavior of certain functions when a variable becomes large. In the last two fiscal years 2005-2007, the department received funding resources of \$4.2 and \$6.2 million, quite a dramatic increase from Newsom's earlier outside funding for research.

The department opened the Statistics Clinic during the 1997-98 academic year. The Statistics Clinic has a mission to improve the quality of research at UNM, as well as to enrich the education and training of statisticians through their involvement in statistical consulting. In the first semester of operation, there were 172 appointments with clients, there were several collaborations on grant proposals, and \$1,700 was billed for contract services. Today the Statistics Clinic still serves research at UNM.

During the academic year 1999-2000, the department worked with the Registrar's Office to implement prerequisites (including ACT/SAT threshold scores) for all lower level mathematics and statistics courses. This move was done in an effort to increase retention and in 2006-2007 passing rates for our classes and was extremely successful. This also made the department's transition to the Banner system of prerequisite checking easier since we had been checking prerequisites for six years prior to Banner implementation.

2002-03 saw the implementation of the Algebra study tables in Dane Smith Hall, which allowed students access to faculty throughout the day for tutoring assistance. Two years later, the success of the Algebra Table inspired the addition of a Calculus Table on the third floor of Dane Smith Hall. These faculty members offer themselves as study resources for students and both tutoring tables remain well attended and appear to be helpful in student success. The department has made several attempts to find a way to record the number of students who visit the tables on a daily basis, but so far there is no consistent way to track these students. The department's information in this area is purely anecdotal. There has recently been a recommendation to request funding for portable scanners that can scan student ID cards, this will only work incidentally as many students do not always have their ID cards with them. The tutors would not refuse service simply because a student did not have an ID with them.

The department has consistently had strong chairs over the past 109 years. The problems appear to remain consistent over all these years: providing enough faculty for the demands on the department. Each year we lose outstanding faculty to other universities, and in turn must hire junior faculty so in essence our department is always rebuilding itself. Funding for faculty to compete with other universities, additional faculty to decrease our student to faculty ratio, and incentives for faculty would be meaningful in maintaining our department and building a strong and vital program that is stable and dedicated to student service and research.

### ***Early Mission***

In 1986, the department defined its mission statement as: "The department has the historical responsibility of providing the mathematical tools needed by students of the sciences, engineering, and the social sciences in order that they can practice and further develop their craft. In addition, for its own majors and graduate students the department must ensure that its course of studies is current, reflecting the continual growth of the subject sometimes called the "Queen and Servant of Science."

As specified in the Self-study Guidelines, our goals are related to the broad strategic directions identified in the Strategic Plan developed under President Bill Gordon and Provost Brian Foster and adopted by the Regents in December, 2001 (the brief label of the relevant strategic direction is indicated after each goal; an explanation of the labels follows).

The four strategic directions in the university's Strategic Plan are:

- *Vital Academic Climate*: Foster a vital climate of academic excellence that actively engages all elements of our community in an exciting intellectual, social, and cultural life.

- *Public Responsibility*: Apply the University's education, research, and service capabilities to advancing the interests and aspirations of New Mexico and its people.
- *Diversity*: Value and benefit from the creativity, innovation, insight, and excitement generated by the many dimensions of diversity that are the essence of the University and the State.
- *Areas of Marked Distinction*: Provide an environment that cultivates and supports activities of national and global distinction and impact.

Substantial progress was made university wide on specific tactics targeting objectives relevant to these broad strategic directions under Provost Foster up through Spring 2005 (see The University of New Mexico Interim Report on the Strategic Plan, 2005). Since there is no formal adoption of this newer Strategic Plan, UNM still operates under the 2001 plan. The Department of Mathematics and Statistics continues to make strides in living up to the goals set in the 2001 plan.

### **Department of Mathematics and Statistics Statement of Mission 1989**

The Department of Mathematics and Statistics shares with other academic departments at the university its *raison d'être*: the discovery and dissemination of knowledge. It shares with other science departments a commitment to empirical research.

The UNM Department of Mathematics and Statistics embraces a number of goals which serve to give the program a distinctive flavor. These are reflected in the mission of the department, reevaluated in 1989, and in compliance with the goals of the UNM Strategic Plan, which is to:

Conduct research and train graduate students to carry out research. This goal generates a steady stream of new knowledge that becomes the foundation of future progress. (*Vital Academic Climate*)

Promote a scientific approach to mathematics and statistics, emphasizing both experimental and theoretical methodologies as historic traditions for all undergraduate mathematics and statistics majors. (*Vital Academic Climate*)

Encourage respect for and openness to a variety of theoretical, philosophical, and empirical approaches, with the view that the study of mathematics and statistics is enriched by the interaction of multiple perspectives. (*Diversity*)

Value active research programs within the Department and in collaboration with colleagues outside the Department celebrating the considerable cross-disciplinary activity in our research programs. Continue to work closely with researchers from other UNM departments as well as outside institutions and labs. (*Vital Academic Climate*)

Maintain excellence in mathematical and statistical research and foster the growth of research and development of ideas in the areas of mathematics and statistics. (*Areas of Marked Distinction*)

Encourage and support effective teaching both in communicating mathematics and statistics to undergraduates as an area of major study and a critical part of a liberal arts education, and in training graduate students at a professional level. (*Vital Academic Climate*)

Train graduate and undergraduate students in the application of general mathematics and statistics in academic and other professional settings to create a technical work force of the future and particularly in New Mexico. *(Public Responsibility)*

Emphasize the critical role of mathematics teachers in public schools of New Mexico and the role we play in training those students. *(Public Responsibility)*

Ensure that graduate students in all areas are well trained in methodology and ethics appropriate for their effective functioning as researchers and professionals. *(Vital Academic Climate)*

Enable students to understand the development and operation of mathematics and statistics in the context of diversity within the larger scientific community and culture, and its application in the research culture of the Southwest in particular. *(Diversity)*

Make Mathematics and Statistics a gateway to a student's future and not a barrier to success. *(Public Responsibility)*

Maintain a statewide mathematics contest sponsored by PNM for high school students and cooperative programs in the public school system to nurture school mathematics education. *(Public Responsibility)*

It is essential that we evaluate, in an ongoing fashion, our performance as a department with respect to our mission. We should revise this Statement of Mission to accommodate to changing situations in the future.

## **Overview of Faculty, Staff, and Students**

### ***Faculty***

Tenure Track—Currently the Department of Mathematics and Statistics has 29.3 tenure track faculty with two faculty members on leave without pay. Each year we have an average of two faculty members on sabbatical. (See Appendix A for a list of faculty and their brief CV's). Table 1 on the following page offers demographics regarding faculty, including books and articles, research funds brought in to UNM, and our staff and department budget from 1995-96 to 2005-2006.

Over the last four years, there was more turnover in faculty than at any time in the department's history. Of the 35 voting faculty present for our last program review in 1995, only 14 remain as active faculty. Eighteen faculty retired, one faculty died during active tenure, and two left for senior faculty positions at prestigious universities. Turnover has been even greater than these numbers indicate as another 6 junior faculty members were hired and left the university during this interval. Thus, more than half of the faculty present for this review was not part of the last program review. As the department mentioned earlier, we are currently not even able to keep up with the loss of faculty as we only hire one for every two we lose.

Of the 26.3 tenure track faculty currently occupied with departmental activities, 14.3 are professors, 6.5 are associate professors, and 5.5 are assistant professors. Although it is increasingly difficult to categorize the faculty along conventional lines, there are approximately 10 faculty in Applied Mathematics, 10 in Pure Mathematics, and 5.3 in Statistics, one sharing a dual appointment with Biology (.50), and one shared with the College of Education (.50) to assist with our Education program.

Non-tenure track faculty—In addition to the tenure track faculty, the department now includes 7 full-time lecturer positions. Their CV's are available in Appendix A (See Appendix A). This faculty is responsible for the entire non-majors curriculum, part of our undergraduate major's core and occasional upper division courses. These faculty members are responsible for curriculum planning at this level as well as assessment, etc. Most of these lecturers also have significant participation in the service missions of the department. This represents a substantial change since our last review when we had only three lecturers in the department. It also creates an obligation for the department to provide better long-term career tracks for Lecturers. Toward this end, our department is hoping that the College of Arts and Sciences will implement new promotion and hiring policies for all Lecturers.

Postdoctoral Associates—Each year the department strives to bring in postdoctoral associates for research and to teach. This year the department is hosting three postdoctoral students who are conducting research and teaching for the department. Depending on the funding resources the department generally host from two to three postdoctoral students each year.

### **Staff**

The core office staff consists of the following: Linda Livingston, Department Administrator, who supervises and oversees the operation and maintenance of the department; Gail Mercer, Administrative Assistant III, who directs the financial management of the department; Claudia Gans, Administrative Assistant III who assists in purchasing, book orders, conference coordination, assistant to the chair, and assists the Coordinator of Program Advisement with student holds and prerequisites; Dr. Donna George, Coordinator, Program Advisement, who advises at all levels for both graduate and undergraduate students, supervises catalog revisions, and assists in program reporting; Sterling Coke, Unit IT Support Manager; Dann Brewer, Systems Analyst III; and Seth Pershan, Systems Analyst II.

### **Students**

Graduate students—Currently the department has 122 graduate students, 65 of whom are Ph.D. students and 57 are Master's students. The graduate students can be roughly divided into three concentrations, 46 in Applied Mathematics, 30 in Pure Mathematics, and 46 in Statistics.

Undergraduate students—The department has a large number of undergraduate majors, currently 225 with that number fluctuating between 170 and 225 at various times throughout the academic year. We have numerous minors, and we have a large non-majors program that supports University of New Mexico core requirements in mathematics serving thousands of non-majors each semester.

### **Leadership, governance, and organizational structure**

The department uses a "shared governance" model of organization. It is our intent to involve all faculty from the most junior to the most senior, in discussing, formulating, and implementing departmental policies. Perhaps the most direct manifestations of this philosophy are our procedures for faculty hiring and for determining salary raises. In making decisions about hiring, the entire faculty votes, regardless of the area in which an applicant is to be hired.

Table 1. Department of Mathematics and Statistics\* summary statistics from 1995 to 2006.

	AY 1995- 96	AY 1996- 97	AY 1997- 98	AY 1998- 99	AY 1999-00	AY 2000- 01	AY 2001- 02	AY 2002- 03	AY 2003- 04	AY 2004- 05	AY 2005- 06	AY 2006- 07
<b>Faculty Stats</b>												
Professors	20	20	18	18	20	20	20	20	20	19	18	16
Assoc. Professors	12	12	11	11	6	4	6	6	4	6.5	8.5	7.5
Asst. Professors	3	3	4	4	7	8	6	6	6	6	3	3
<b>Total of Tenure Track Faculty</b>	<b>35</b>	<b>35</b>	<b>30</b>	<b>32</b>	<b>33</b>	<b>32</b>	<b>32</b>	<b>32</b>	<b>30</b>	<b>31.5</b>	<b>29.5</b>	<b>26.5</b>
Budgeted FTE Faculty (Lecturers)	3	3	3	3	3	8	6	6	8	8	8	8
Visiting Faculty	N/A	N/A	1	1	N/A	1	N/A	N/A	2	2	3	4
Books and Articles	N/A	N/A	68	65	N/A	76	78	85	53	62	66	68
Grants	N/A	N/A	\$1.7M	\$1.8M	\$608,461	\$2.55M	\$2.6M	\$2.53M	\$4.37M	\$3.97M	\$4.2M	\$6.2M
<b>General Stats</b>												
FTE Staff	4	4	4	4	7	7	7	7	7	7	7	7
Dept Budget	\$2.76M	\$2.54M	\$2.66	\$2.68M	\$2.82M	\$3.26M	\$3.16M	\$3.38M	\$3.49M	\$3.49M	3.58M	3.78M

\*The numbers for academic year 2007-2008 are 15 Professors, 6.5 Associate Professors, and 5.5 Assistant Professors, total 27. Professor Bedrick is counted as one faculty member; however he is .33 in the department and has been for several years.

### ***Previous program review***

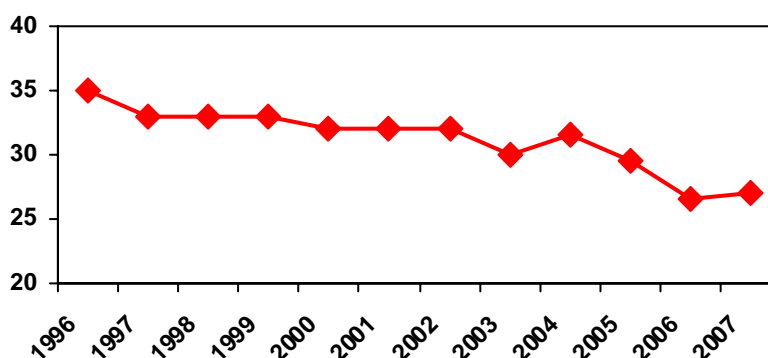
The purpose of this process of self-study is to examine and strategize ways to meet the requests the department makes at each review. In reading back through our departmental reports over the years from 1980 to present, we find the same requests: (1) more staff and money for existing staff, (2) more faculty and money for existing faculty, and (3) more space for the department. The changes that have occurred are accomplished internally by the department and changes that required resources from the university did not transpire. The department understands that there is no "magic" solution; however we do hope that recommendations that arise from this self-study will increase the opportunities for the department to meet its goals.

Our most recent external graduate review from November 1995, found major problems that 13 years later remain much the same. The report recommended that tenure track faculty numbers in this department reach 40 by the end of the century; that goal was not achieved. We continue

to suffer from “severe” staffing problems as our faculty leaves more quickly than we can rehire. Although our faculty remains collegial, they are stretched as far as they can. Our new hires remain excellent, although we are limited in the number of senior faculty available for hire. At the time of the report in 1995 there was an enormous pool of high-level applicants. As the report predicted that phenomenon did not persist into the future.

To emphasize the recommendations of the 1995 review and the reality of what happened with faculty in the department, the following chart reflects the tenured or tenure-track faculty numbers over the past 13 years. It is clear to see that the recommendations have yet to be met, in fact we now fall far below those recommendations.

**Math Tenure Track Faculty 1996-2006**



An area where the department has success, aside from tenure faculty staffing issues, the report recommended turning part-time teaching positions into instructorship positions. The department accomplished this goal in 2000 adding an additional 5 lectureship positions to the 3 on staff in 1995. Our current total of lecturers remains at 8 with one vacancy to be hired this year.

In their list of “Other Important Recommendations” several issues were addressed, including the Mathematics Education group. At that time there was concern about the inadequacy of classroom space for the faculty teaching the courses in mathematics teacher training. There was also concern about the understaffing of the Mathematics Education program. The recommendation was to appoint a tenure track faculty member in the mathematics education area. Dr. Kristen Umland now serves in that role and in 2006 the department added Dr. Richard Kitchen from the College of Education, to our faculty in mathematics education as a .50 faculty. This still leaves our program short staffed in this critical area. Dr. Umland was successful in receiving an extensive grant to assist in teaching teachers how to teach math in the public school classrooms—the La Meta Grant. Although this program is prestigious and brings a great deal of funding to the university, including two .25 FTE staff and a full-time Research Assistant, it is extremely time consuming. Dr. Umland is being stretched as far as she can at this point without another full-time faculty person in Mathematics Education. It should be noted that she is currently chairing one dissertation, and has students writing theses under her direction. The department feels that this is somewhat successful.

The report recommended two classrooms devoted to 200-500 level course teaching to incorporate computing and graphics in a natural fashion, including computers for the simultaneous use of the instructor and students. At the current time, we still do not have the



computing resources recommended in the study. There is a current building project for the Department of Mathematics and Statistics to move into a new building constructed as a Science and Mathematics learning center. At this time, the construction of this building is delayed and constantly being revised—there seems to be concern that the computing classroom areas are on the chopping block as funds are trimmed to fit the dwindling building budget. Therefore, we are unconvinced that this recommendation from 13 years ago will be met. Considering the giant strides in computer usage, this seems to the department to be a backward step.

In addressing the TA stipends in the department, the recommendation was for stipend support to be increased to compete effectively with comparable institutions in recruiting students. The recommendation included the suggestion that students know that TA positions are typically multi-year, subject to continued satisfactory progress in academic efforts. This recommendation has been implemented and that information is communicated in the very first letter they receive from the department. In 1995, the beginning stipend for an incoming TA was \$9,200 for a ten month contract or \$920 per month. At that time students did not receive health insurance. Today an incoming TA will receive a stipend of \$15,720 or \$1,572 per month for ten months and the contract now includes student health insurance. We have always offered 12 hours of tuition per semester for fall and spring. Although we are still not competitive with many peer institutions, we do offer one of the highest TA salaries on the main campus. This is fairly successful.

In 2003, Dr. Todd Kapitula, then Graduate Committee Chair, instituted a policy of awarding Teaching Assistantships for a set number of semesters to encourage our students to make satisfactory progress toward their degrees. This process resulted in a higher number of graduations at both the M.S. and the Ph.D. levels over the past few years. The largest effect of this move will be reflected spring and summer 2008. It should be noted, that Dr. Kapitula—exceptional senior faculty member—accepted a position at another university and is no longer a part of the faculty here at UNM.

Addressing the low salaries of the faculty and the noncompetitive salaries was another recommendation of the report. They strongly encouraged the elimination of salary inequities, which the department has made strides in so doing. We are now able to offer new hires the level and pay they merit and we are fairly competitive in the hiring of new faculty process. Unfortunately, this means often that many new faculty come in earning what took some of our current faculty years to earn. The alternative for these faculty members is to seek employment elsewhere to increase their salaries; we need to make our faculty salaries more competitive with our peer institutions. This has only been partly successful.

As mentioned earlier, the demand for mathematicians and statisticians has risen exponentially. However the number of experienced mathematicians and statisticians has decreased dramatically over the last decade. Senior faculty in the fields of mathematics and statistics all over the U.S. are retiring and universities are scouting senior mathematics and statistics faculty from other universities to fill these positions. Many of our recently departed faculty were recruited from other universities and enticed by high salaries and the opportunity to work at prestigious universities such as Rice, Georgia Tech, The University of Texas, Southern Methodist University, Ohio State University, and others. In an extremely competitive market, the University of New Mexico is not much of a competitor. Many of our own senior faculty members are retiring and we will be unable to replace them with senior faculty if we cannot compete with other universities.

The quality of the facilities and space for graduate students remained a problem in the eyes of the reviewers. They felt that the location of most of the natural departments for interdisciplinary research was relatively far away from the department. This situation should be resolved with the building of the new Mathematics and Sciences Building, tentatively scheduled for ground-breaking in late 2009. This building will be centrally located near Chemistry, Earth and Planetary Sciences, Biology, and the Engineering complexes. At this time, there is much concern about funding shortfalls for this building and the continued “shrinking” of the physical facilities with the reduced budget for the building. There is the possibility, that we will still have a space problem once the building is finally completed.

Our computing resources are greatly improved over the 1995 report, although we do not have funding for each TA to have an individual computer at their desk. We have 130 active computers. Of these computers, 25 are performing some system service or are in test mode, 5 are commonly accessible and used as computer servers, and the remaining 100 are desktop computers. The department considers this to be fairly successful.

We support offices in two locations, the Humanities Building and Hokona Hall. Each of these offices has at least one computer in them. We maintain a computing lab in which there are 11 of the 100 desktop computers. These 11 have specialized statistics and mathematics software packages installed on them. We provide wireless networking for individuals who prefer to bring in and work on their own laptops, and we support a growing number of laptops owned by the department, which are not included in the 100 count.

Since the report in 1995, nearly all of the computers we had at that time have been replaced with faster and more reliable machines. Wireless networking has been introduced since then. We have upgraded all our compute servers since that time as well. We have replaced all of our service machines and then either replaced them or have immediate plans to replace them a second time as we phase out Solaris in favor of Linux.

The final additional recommendation from that report concerned itself with academic advising at the university level. The report remarked on the burden that screening for course prerequisites created for already “stressed faculty”. Shortly after this report, the University of New Mexico implemented a prerequisite system for both English and Mathematics and Statistics. The professional advisors in those departments took over the lifting of prerequisite holds for many of the lower level courses. With the implementation of the Banner system, lower level prerequisites are currently being checked and the department is preparing the catalog scrubs for prerequisite checking at the 300-400 level to begin in Fall 2009. There will still be some instructors who will be required to give permission for upper level courses, but this system should work fairly well in lessening the burden on faculty in teaching upper division courses at the appropriate level. However, this new system has added additional burdens to the already heavy workload of the professional advisor in the department. Aside from the issues that arise from any new system, the department considers this to be pretty successful.

The department offers advising in two steps, first with the professional Coordinator of Program Advisement, and then with the faculty advisor assigned to the student. All administrative duties for advisement are handled through the Coordinator, however most academic advisement is handled through the faculty. The department has established a culture of mentorship through faculty advisement; we feel that students benefit tremendously from regular contact with faculty. The students learn that there are many benefits to having faculty advisors, from correct placement in major courses to a faculty that can mentor research opportunities, host honors coursework, and write letters of recommendation for these students for graduate schools,

scholarships, and employment. The department strives to encourage students to find a faculty person whose interests they follow to select for advisement. Once that is done, we encourage a long-lasting mentor relationship with that faculty person. This culture has undergone severe changes over the last few years as faculty leave and students are placed in the position of finding new advisors whose interests they share from our limited current faculty or from our new faculty. Years ago new faculty were given time to settle in before being assigned students to advise, those days are gone and new faculty receive student assignments as soon as they get here. This is problematic in many ways, the most important being that new faculty are just getting acquainted with the university and the in's and out's of the system. These new faculty are not always the most knowledgeable on courses, faculty interests, or UNM rules and regulations.

There was one question the faculty senate addressed to the review team that was "How well is the department doing in recruiting women and minorities as undergraduate majors, as graduate students, and for tenure track positions?" In 1995, 40% of the total enrollment of graduate students was women. That number dropped slightly this year to 36% as the competition to recruit available suitable women candidates is extremely rigorous. Since we do not compete as well nationally with our Teaching Assistant stipends, we feel that we often lose the brightest women students to universities with higher salaries and additional incentives for Teaching Assistants.

We continue to recruit and graduate minority students in our graduate programs. We currently have four self-described American Indian students in our graduate programs, which is a dramatic increase over the past five years when we have struggled to have one American Indian graduate student. We currently have 17 Hispanic United States citizens or permanent residents in our graduate program. There are 10 Asian or Pacific Islanders in our program who are US citizens or permanent residents. We have one African American student in our graduate program. At the undergraduate level, 39% of our students are women. The minority student population is 57 Hispanic students, 4 American Indian, and 14 Asian or Pacific Islanders. We currently have 2 African American majors, and have graduated 4 African American students over the past three years with BS degrees. Our minority population is 34% of our undergraduate enrollment. As for the graduate students, U. S. minority students are 24%, but if you include all minority students in our graduate program the number is 49% of our graduate program.

The entire upper administration at the University of New Mexico changed since we began this self-study. We were told when we began the process that there would be no input of resources based on this review. With a new administration there are some assurances that there will be more use made of the review process. It is our sincere hope that this is the case.

## **2. Degree Programs and Curricula**

### ***Undergraduate majors***

The Department of Mathematics and Statistics experienced steady growth over the past thirteen years. Currently there are 170 confirmed undergraduate majors with another 55 students who are self-declared and have not confirmed the major with Arts and Sciences. The department offers four Bachelor of Science (B.S.) concentrations in Math and a B.S. in Statistics. The math concentrations are Applied, Pure, Computation, and Education. Each major entering the department is assigned a faculty advisor with whom they are required to meet every semester. The ratio of undergraduate students to faculty advisors is 8.6 to 1, bearing in mind that the same faculty carries a graduate advisement load as well. It can also be noted that not all faculty

advise the same number of students, some faculty advise as many as 15 students, while others advise only three or four. We allow students to choose their own advisors after their initial assignment to the Chair of the Undergraduate Committee. This chair is responsible for assigning students to their faculty advisors.

Once a semester, the Coordinator of Program Advisement enters the student Banner system and assigns holds to all the majors and graduates in the department. This ensures that they may not register for the next semester until they are advised by their faculty advisor. These holds are lifted by the Coordinator after students are advised. It should be noted here that the majority of the faculty really enjoy this chance to interact with the majors, and often ask for lists of their advisees so that they can contact them personally via email before they see them in their offices.

The primary mission of the undergraduate curriculum in Mathematics and Statistics is to provide an education that teaches the fundamental information of either mathematics or statistics while providing students with the skills needed to appreciate the complexity and beauty of mathematics or statistics, as well as to understand the methods and evidence upon which mathematical science is based. It is recognized that many students enter this curriculum with specific career goals and therefore special missions of the department include: (1) Preparation of mathematics or statistics majors for successful entry into graduate programs in mathematics or statistics and related disciplines, with the goal of doctoral education for the majority of those planning to continue in academia. (2) Preparation of students for employment in positions in industry, governmental agencies, or as teachers in secondary schools. The department feels it has been quite successful in this area.

Faculty continually reviews and refines the different concentrations offered by the department. Recently, we discontinued a Distributed Mathematics concentration when faculty decided that there would be more merit in constructing a distributed major within one of the other concentrations, this would allow a stronger degree while letting students choose supplemental mathematics courses in areas they were interested in. In spring 2008, those concentrations should begin to appear on the diplomas of graduating Mathematics majors.

In the past few years, undergraduate enrollments have increased, especially in the entry level mathematics courses as the freshmen enrollment increases steadily each year. As a provider of one of the UNM core requirements and the Arts and Sciences group requirement, we offer lower level mathematics and statistics classes for an astounding number of students each semester. In spring 2008 by the 21<sup>st</sup> day of enrollment, the Math 120 course on the UNM main campus had more than 850 students registered, 17 sections of Math 120 were offered. A similar number of students registered for the Math 121 class with 17 sections, and almost 900 students were registered for the 17 sections of Stat 145. In Math 129, almost 300 students were still enrolled at the 21 day mark. There were 500 students registered for Math 123 and 150. There were 655 registered for 162 and 163—required courses for many science and engineering majors at UNM. Math 180 had 648 students registered at the 21<sup>st</sup> day and this course is required for Business majors as well as Pharmacy majors. Biology majors may choose this sequence for their degree as well, therefore there were also an additional 136 students registered for Math 181. There were also 177 Education students enrolled in the Math 111 and 12 classes. The department also offers supplemental one hour tutorial courses for students: Math 106, 107, and 110 with a total of 112 students taking advantage of these courses. The total number of students registered in spring 2008 for courses under the 200 level exceeds 4,800. This averages 42 students per section offered by the Department of Mathematics and Statistics and a minimum of 108 sections offered in the spring 2008 semester.

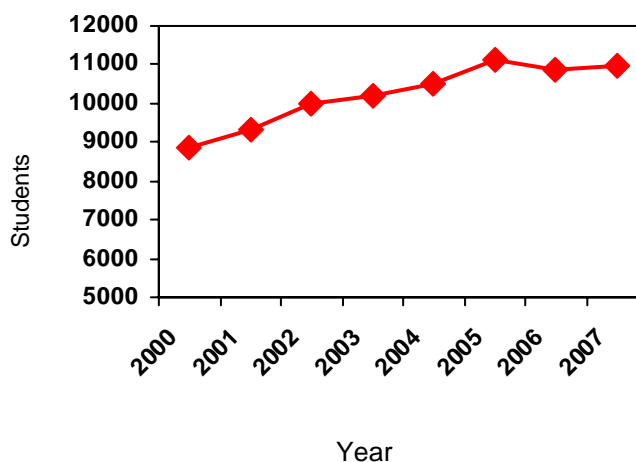
It is necessary to point out that the spring semester is generally much lighter in enrollment than the fall. In fall 2007, we offered 24 sections of Math 120, 23 sections of Math 121, and 16 sections of Stat 145. There were additional sections of Math 123, 129, 150, 162, 163, and 181. The total number of students enrolled in lower level math courses in fall 2007 exceeded 10,200 students. Totalled the number of student hours for 2007 academic year surpassed 45,000.

From the number of 45,000 student hours a logistical problem clearly arises. The only way the department can offer this many courses to this many students is through an extensive Teaching Assistant program and a dedicated cadre of Part Time Instructors. Because of the disparity in enrollment from fall to spring, our PTI's are usually extended to the limit for the fall semester, yet often we can only offer a fraction of the courses from fall to spring. Without our PTI's and their willingness to ride the ups and down of semester enrollments, we would be in a very difficult position. Although some of our tenured faculty teach the calculus sequences, all of the Math 120 courses are taught by PTI's who teach some of the Math 123 and 150 courses as well as 180 and 181, Math 129, and Stat 145. TA's teach Math 121, Stat 145, Math 123, 150, and 180 and also serve as the recitation instructors for Math 162, 163, and 264. We are stretched as far as we can with our current personnel and this continues to be a concern for the department as demands for our math classes remains consistently high. We continue to request additional funding for Teaching Assistantships to fill the need for additional math and stat teachers of lower level classes.

The following charts show the number of students taking the core and group mathematics courses and the total number of student hours for those courses over the last few years. The third chart shows the total number of student credit hours for all mathematics and statistics courses taken by majors, non-majors, and graduate students. It also compares those hours to another large department at UNM, Biology, for which we were able to get the student hour numbers. It should be noted that we do not have the total number of hours for Biology for 2007 academic year, but we did include those for our department.

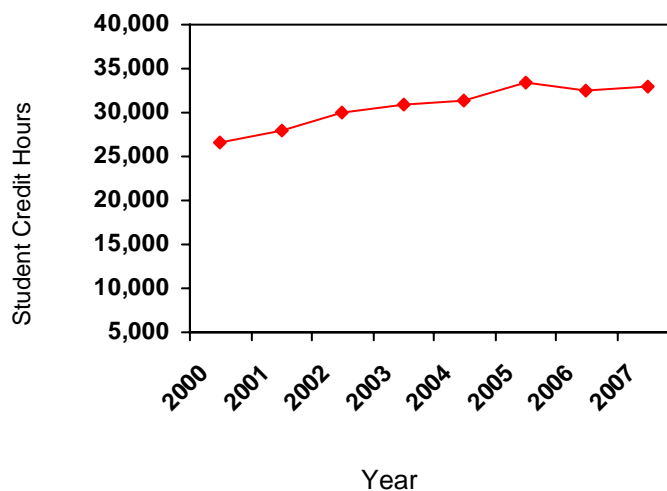
### UNM Students Registered in Math Service Courses

Figure 1. Number of students in Math 120, 121, 123, 150, 162, 163, 180, 181, 129, and Stat 145 in fall and spring semesters from 2000 through 2007



### Total Number of Student Credit Hours\* for Students in Math Service Courses

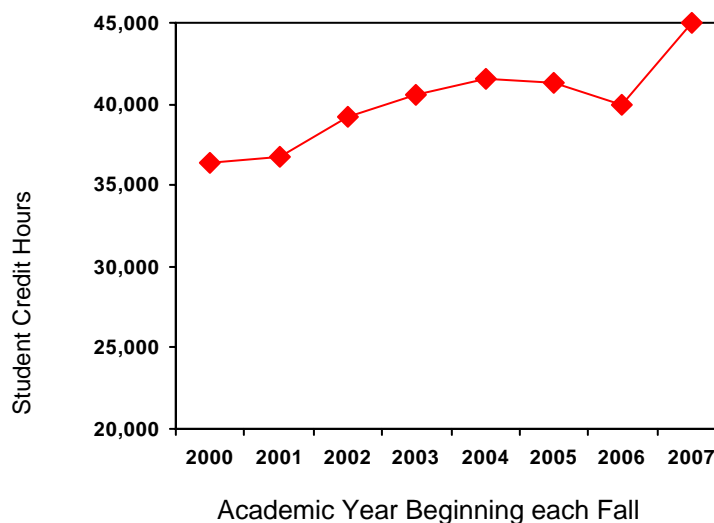
Figure 2. Number of student credit hours in Math 120, 121, 123, 150, 162, 163, 180, 181, 129, and Stat 145 in fall and spring semesters from 2000 through 2007



\*Note there is an additional hour for Math 162 and 163 recitations and one hour tutorial courses—these are not included in this graph.

### Total Number of Credit Hours\* Taught including Majors and Graduates

Figure 3. Mathematics and Statistics credit hour numbers of all major hours plus the additional hours of non-major service courses.



\* Illustrates the hours added to the department teaching course load from UNM service courses.

### **Curriculum Assessment**

Department faculty have thoroughly revised the content of each of the core courses and have been able to identify student learning outcomes for each of them. The Pre-Calculus team along with other faculty in the department is currently working together on developing assessment tools for each of those sets of learning outcomes. The report on outcomes to Dr. Mark Ondrias, Associate Dean of Arts and Sciences is included in Appendix B (see Appendix B).

It must be noted that this effort was initially launched to comply with the mandate of the administration to assess our core curriculum but it has been difficult to decide what exactly needs to be reported since there have not been clear guidelines of what information or in what format this needs to be done. Although this project takes a lot of time and resources from the faculty, it will help determine if the expectations of the department and the university are being met. Furthermore, it will identify which areas of our core sequence need improvement and what changes need to be implemented.

As of spring of 2008, the first battery of assessment items as outlined by the assessment directives is being tested in two of the core classes (math 121 and math 150) and the results from those items will be analyzed at the end of the spring. We expect to implement changes as a result of the analysis of these data as early as summer of 2008. The assessment project is being conducted under the direction of Adriana Aceves by the coordinators of the different core courses.

The following is a sample the department is using for the learning outcomes for Math 162 that is one of the courses to be assessed. This plan will give an idea of the assessment we are doing with our classes. It is the department's belief that these outcomes are probably overly specific.

Course Goal #1: Communication Student Learning Outcomes (SLOs)

SLO 1: Students will use correct mathematical notation and terminology

SLO 2: Students will be able to read a mathematical text and reproduce its main ideas

SLO 3: Students will be able to verbalize the steps needed to solve a problem

SLO 4: Students will read and interpret graphs

Course Goal #2: The Concept of Limit Addresses UNM core area 2/ HED area II: Mathematics (Calculus)

SLO 1: Student will be able to determine when the limit of a function exists and when it doesn't

SLO 2: Student will be able to choose an appropriate value of  $x$  sufficiently close to  $c$  for the function to get arbitrarily close to  $l$

SLO 3: Student will be able to find limits algebraically and also from the graph of a function

SLO 4: Student will be able to find limits for various types of functions including radical, trigonometric and piece wise-defined

SLO 5: Student will recognize when a function grows without bound and find vertical, horizontal and slant asymptotes.

Course Goal #3: Continuity Addresses UNM core area 2/ HED area II: Mathematics (Calculus)

SLO 1: Student will learn that a function is continuous at a point if the limit of  $f$  as  $x$  approaches  $c$  equals the function value at  $c$ , as well as its graphical implications

SLO 2: Student will be able to determine when a function is continuous from its graph and also algebraically

SLO 3: Student will be able to find continuous extensions and apply the Intermediate and Extreme Value Theorems

Course Goal #4: Derivatives Addresses UNM core area 2/ HED area II: Mathematics (Calculus)

SLO 1: Students will understand the connection between the derivative, instantaneous rates of change and slopes of graphs

SLO 2: Students will estimate derivative from the graph of a function and from tabulated values

SLO 3: Students will be able to explain in their own words the steps used to define the derivative

SLO 4: Using the rules for differentiation, students will compute derivatives of various types of functions, including trigonometric, exponential and logarithmic functions, and functions defined implicitly

SLO 5: Students will use the concept of derivatives to address various applications: finding maximum and minimum values of a function, solving optimization problems, using the first and second derivatives to graph functions, finding limits using L'Hopital's rule

#### Course Goal #5: Differential Equations

Addresses UNM core area 2/ HED area II: Mathematics (Calculus)

SLO 1: Students will be able to find anti-derivatives

SLO 2: Students will be able solve simple differential equations

SLO 3: Students will be able to derive differential equations from applied problems

#### Course Goal #6: Integration Addresses UNM core area 2/ HED area II: Mathematics (Calculus)

SLO 1: Students will clearly state the steps used to obtain the area under a graph as a limit of a sum.

SLO 2: Students will state the definition of an integral as the limit of a sum, rewrite limits of sums as integrals and approximate integrals by finite sums.

SLO 3: Students will be able to use the Fundamental Theorem of Calculus and the rules of integration to evaluate definite integrals.

SLO 4: Students will explain the steps used to derive the Fundamental Theorem of calculus in their own words

SLO 5: Students will be able to find areas under curves, and use the definite integral to solve applied problems

Clearly, this outcome assessment plan has required a great deal of time and attention. Multiply that by ten additional classes that fit core curriculum at UNM and the amount of time dedicated to this project alone is staggering.

### ***Undergraduate curriculum***

The responsibility for the undergraduate curriculum is that of the Undergraduate Committee. The recommendations of the committee are forwarded to the Chair for implementation, or in some circumstances, to the whole departmental faculty for consideration.

The pre-calculus curriculum is supervised by the Director of the Precalculus Program, Adriana Aceves, Lecturer II. She is responsible for the preparation of the final semester core examinations, supervision of the coordinators for each Math segment, and ultimate supervision of all instructors, teaching assistants, and part time instructors. She also supervises the hiring of all part time instructors. The Director is a member of the Undergraduate Committee. Over the past few years, the position has evolved into a representation of the department as a liaison at many levels throughout the UNM community and beyond. Ms. Aceves is currently the chair of the statewide articulation committee for Mathematics and Statistics.

The requirements for an undergraduate degree in mathematics require the completion of a minimum of 27 hours in coursework at the 300 level or above. In Statistics the requirement is 21 credit hours in Statistics at the 300 level or above and an additional 6 hours at the 300 level



or above from approved supporting disciplines. The department currently offers four concentrations in Mathematics: pure, applied, mathematics education, mathematics of computation, and the B.S. in Statistics. A fifth concentration was the distributed major that is being discontinued Fall 2008.

Upper division curriculum—All of our majors take the three calculus sequence courses, CS 151L, and Linear Algebra. Depending on the concentration students must take at least one 400-level course and generally two or more courses at the 400 level. As mentioned previously, faculty continues to monitor the major concentrations and make appropriate changes to the required coursework. This past year the Mathematics Education curriculum was changed to include an additional new class, calculus for teachers, and the electives were removed making the curriculum more defined. That curriculum now includes Math 322 (Modern Algebra) and Math 327 (Discrete Mathematics).

***Support for undergraduate students and undergraduate research opportunities***

Financial—Three years ago the department reinstated the Honors Program and sought funding from the College of Arts and Sciences for this program. The first year we had one honors student, the second year none, and last year we had eight honors students. We look forward to growth of this program as students pass the information to others of the benefits of this program and as faculty observe the benefits of working with undergraduate students on honors research topics. Our funding has been renewed each year, and we are able to sponsor speakers for our honors students and to fund travel to conferences for networking and enhancement of their learning experiences. Faculty is tasked with promoting our honors program, and the Coordinator of Program Advisement is also very active in telling students about the honors program.

The department received an endowment for scholarships for undergraduates, the Eleanor Marron and J. Joseph Lopez Memorial Scholarship. This scholarship was created with an endowment of \$50,000 and is given to qualified Math majors. Preference is for New Mexico residents who do not qualify for the New Mexico Lottery Scholarship because of time off between high school and college, or for students for whom the scholarships were not available at time of graduation. The preference is for the scholarship to remain with the student until graduation, but not to exceed four years. The scholarship awards will be supervised by the Chairman of the Undergraduate Committee.

Extracurricular—Kappa Mu Epsilon (KME), the mathematics honor society, was founded for the following purposes: (1) To further the interests of mathematics in those schools which place their primary emphasis on the undergraduate programs; (2) To help the undergraduate realize the important role that mathematics has played in the development of civilization; (3) To develop an appreciation of the power and beauty possessed by mathematics, due, mainly, to its demand for logical and rigorous modes of thought; (4) To provide a society for the recognition of outstanding achievement in the study of mathematics at the undergraduate level; and (5) To disseminate the knowledge of mathematics and to familiarize the members with the advances being made in mathematics. Each year a faculty member supervises the club, and the students host an awards banquet inducting new members.

In addition, students in the department created their own math club, the UNM Society for Undergraduate Math Students. Otherwise known as Math Club, this is a group of math students and is for anyone with a passion for math. The club was founded in the Fall of 2007 to create a stronger knit community between undergraduates in the Math Department, but has grown to

include anyone who enjoys mathematics. Since the club is so new, we currently do not have solid numbers for the current membership.

**Advising**—The Department of Mathematics and Statistics employs a full time staff member whose duties include undergraduate and graduate advising and recruitment. She handles the bulk of the advising, but one advisor is obviously not enough for the 345 or more undergraduate and graduate majors in Mathematics and Statistics as well as the thousands of walk-in students taking the core courses at UNM. Additional advising is provided by faculty and staff who offer some advising support throughout the semester. This support includes signing pink late registration cards, lifting prerequisite holds, checking for prerequisites, and other minor advisement efforts as necessary. This is supplemented by information on our web site and by handouts that explain the required coursework.

The staff advisor, Donna George, Ph.D., has a number of duties in addition to working directly with both graduate and undergraduate students. She is involved in transfer evaluations, catalog revisions, curriculum development and implementation through curriculum form tracking, registration issues, recruitment events, training of faculty advisors, scholarship and honors programs, publications and data acquisition. She is responsible for graduate recruitment, graduate application and admissions process, as well as ensuring that the graduate paperwork is on time and completed so our students graduate with Masters or Ph.D. degrees. She also represents the department on various committees and professional associations.

Because of the large number of students within the department as well as the great number of walk-in students who are simply taking mathematics or statistics classes for the core it is difficult for the advisor to get to know all the students, especially the undergraduates. A second part or full-time staff advisor who could devote themselves to either the graduate or undergraduate advisement program would certainly help. The department works very closely with both University College Advisement Office and the College of Arts and Sciences Advisement Office. Students are directed by those offices to our department for advisement via walk-in students, email, and phone calls from the advisement center advisors. In general, the advisor sees 25 to 30 students a day, about 150 students a week—very few of these students are repeat customers. During peak times, the department receives visits from approximately twice that number each day. Peak times are prior to the beginning of each semester, during registration, mid-terms, finals, and throughout the summer for Laborientations. The department estimates that we see as many as 500 to 1000 students per month during these times.

Students are required to seek advice when they declare a major and when they do a degree check after 80 hrs of work. In addition, our advisor must go into the system and put academic holds on all majors at the graduate and undergraduate level so that they see their faculty advisor each semester before they register for the next semester. The department's advising workload has increased due to the complications of a new university-wide database system that includes problems with prerequisites being improperly applied. This is causing additional work as the advisor must lift prerequisite restrictions for students affected by this problem. This past semester there were 287 students who needed to have their prerequisite restrictions checked and restrictions lifted for students who had the prerequisite, but the system was not recognizing those prerequisites. Advisors do additional work in evaluating transfer credit, in helping student obtain overrides in the new system, and in communicating to the administration about problems with the new system.

The department Coordinator of Program Advisement plays a key role in working through issues regarding student needs. Worthwhile to note that there has been participation in problem solving for degree audits and the student Banner system by this Coordinator.

### **Graduate degrees**

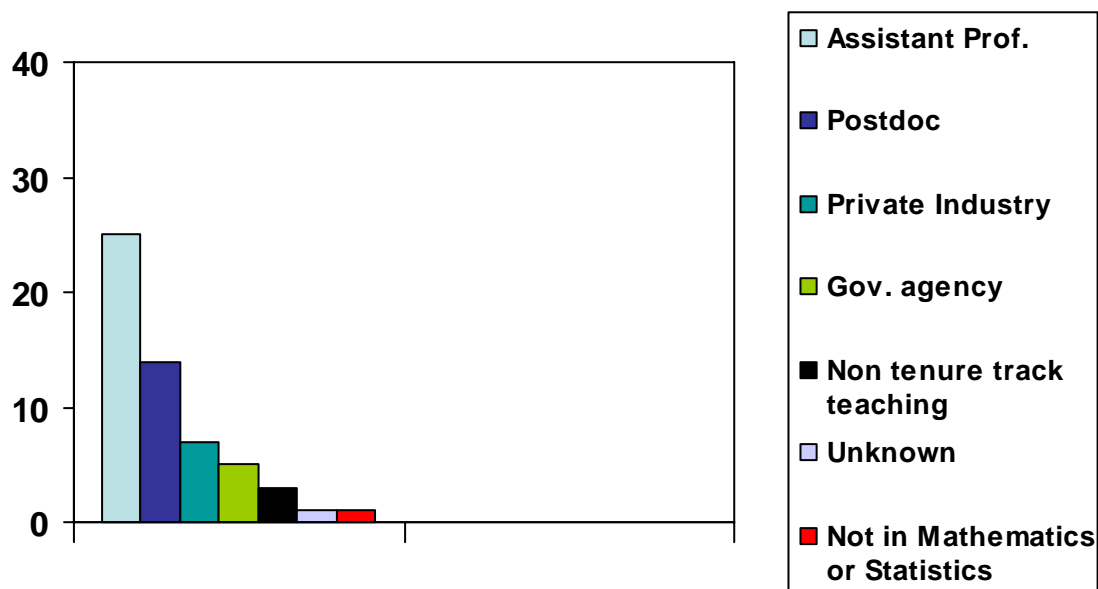
Our graduate program is based on specialization and concentration—we offer concentrations in Applied Mathematics, Pure Mathematics, and Statistics. More recently we are developing students who are focusing on education in their mathematics graduate degree under the direction of Dr. Kristen Umland and Dr. Richard Kitchen (.50 FTE). The goal is to eventually be able to offer an M.S. in Mathematics Education as was recommended in the 1995 review process. We have consciously tried to maintain a faculty whose research interests span much of the breadth of mathematics and statistics in these major areas. This enables us to recruit graduate students with diverse backgrounds, and to encourage them to pursue a wide variety interests and research. Much of our faculty is internationally and nationally renowned and many students come to UNM to study under these professors. The loss of these renowned professors will no doubt have serious impacts on our future recruitment efforts.

Ph.D. Degree—The majority of our doctoral students still aspire to obtain jobs in academia that require some combination of teaching and research; these range from primarily teaching positions at community colleges and small private colleges to research and teaching positions at major state and private universities. Increasingly, however, our students are first seeking and obtaining positions in postdoctoral research at prestigious universities around the world including Harvard in the U.S. and universities in Australia, Europe, Brazil, and Canada. Some of our doctoral students are finding employment in the government and private sectors as well, especially our graduates in Statistics. This information comes from our student's self reports on their positions to the department through their faculty or the advisor.

The following chart shows post-graduation positions of our Ph.D. students beginning with those who graduated in 1998. There were 50 Ph.D. graduates from 1998 to spring 2006. We anticipate a large number of graduates this spring and summer. As can be seen from this chart, in 10 years there were only 50 Ph.D.'s from this department. Clearly, the number of graduates although impressive, shows in all likelihood none of these graduates at this point in time would be considered senior faculty. Thus, the continued problem of finding experienced faculty remains persistent if the numbers at peer institutions are consistent to ours. The bottom line is that we are not turning out enough faculty fast enough to meet the turnover demand today and for the near future.

Master's Degree—Some students in the Master's degree program aspire to obtain additional training to prepare themselves for further graduate study in Mathematics, Statistics, or related fields. Many M.S. students seek employment in education, with government agencies, and in the private sector—again this is anecdotal evidence provided by our own graduate students to their faculty advisors or directly to the department.

**Ph.D. Students from the Department of  
Mathematics and Statistics  
Post-graduation 1998-2006**



Graduate student training—Students are required to complete a specified number of hours of coursework depending on the degree. The details are listed in our graduate handbook at <http://www.math.unm.edu/advisement/GradHB/handbookGrad07-08.doc>. Required coursework includes both lecture courses and problems courses and must be completed with more than one faculty member. The department has experimented with various requirements for coursework across disciplines and many of our Applied Mathematics students are adding the Computer Certification course offered through the School of Engineering Computer Science Department. Some of our students are fortunate enough to be awarded Research Assistantships and Internships at the National Labs, thus increasing their training under the guidance of research faculty and research labs.

Courses available to graduate students fall into four categories: 1) Courses that were originally developed at the 400-level (senior undergraduate) but are available for graduate credit if some extra work is done, 2) Courses originally developed at the 500-level (graduate student only) that may or may not allow advanced undergraduates to enroll, 3) Special topics courses that usually focus on reading the literature, and 4) seminar and colloquia focusing on special areas of mathematics and statistics.

Faculty offer seminars and colloquia in specialty fields for students, including Geometry and Topology, Algebra, Statistics, Analysis and Partial Differential Equations, Applied Math, and our graduate students present their own colloquia on research topics. Experts in each field are invited to our Department for many of these seminars and colloquia and we offer in the area of one per month in several different areas. This offers our students exposure to a large number of areas of interest and a chance to network with experts in the field from many universities around the world.

In the past two years, the department suffered a sudden loss of a number of the Statistics faculty—from 8.3 faculty to 3.3 and currently 5.3, with the hiring of two junior faculty last year. This has created a problem with the ability to offer the variety in number of graduate level Statistics courses we once offered. It has also created a problem for our Ph.D. graduate program. For a year the department was forced to drastically reduce the number of Ph.D. students admitted to the Statistics program, due to the limited number of senior faculty who are able to chair dissertation committees. Since the program uses an examination system as well as thesis, the affect on our M.S. students was minimal. However, unfortunately the program lost several good Ph.D. students in the past year who were unable to find senior faculty who could chair their dissertations. Currently, the program has 2.3 senior faculty who can chair these committees and each of them currently chair a minimum of four dissertation committees—quite a load for any full-time faculty to deal with. This will remain a continuing problem as the demand for statistics faculty makes it extremely difficult for us to hire senior faculty. Although our recently hired statistics faculty is excellent, they are junior faculty and not currently at the level of chairing dissertation committees—we were unable to hire a senior statistics faculty person in the last hiring. This does not bode well for our graduate program in Statistics, which had been growing at a very rapid pace. We curtailed admissions in the last three semesters of graduate admissions to try and keep the numbers from rising too rapidly. Currently our optimal number of graduate students in 120-125 with 40-50 of those students in Statistics graduate programs, however that number may need to be drastically reduced if we cannot add senior faculty to our department.

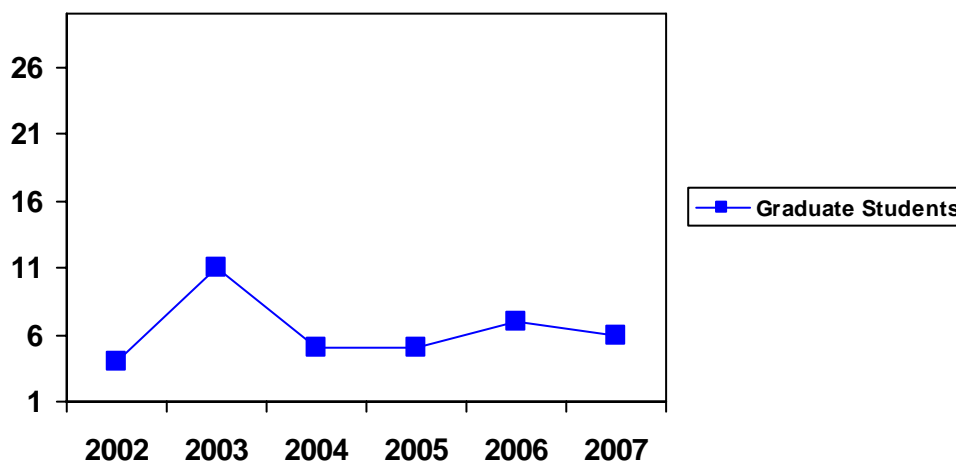
An identical problem is now occurring in our mathematics program as we lose senior level faculty to new positions at other universities and to retirement. Recently we suffered the tragic unexpected death of one of our most prolific Pure Mathematics faculty, Dr. Kris Galicki. These losses continue to deplete our senior faculty and make it extremely difficult to replace these esteemed colleagues with new faculty that is as experienced as the professors we are losing—especially recognizing the financial constraints we function under from the university.

In addition, some of these departing faculty members are responsible for the bulk of research dollars in our department and when they leave their funding leaves with them. This causes a downward spiral that affects our overall departmental budget, and eventually will impact our graduate program, especially the Ph.D. program as we lose senior faculty to chair their dissertation committees and offer them Research Assistantships for training. It is for this reason the university must realize the importance of ensuring that departments have the funding to hire specialized senior faculty and offer incentives to lure them to UNM. We must also be competitive and offer matching funds to keep our experienced faculty at UNM.

Graduate student demographics—The total number of graduate students in the program has remained at over 120 for a number of years. Numbers of female graduate students have increased over time and now the percentage of our students who are female is around 33%. Likewise, the percentage of minority students has increased over time and we now have 43% minorities among our graduate students. The following chart shows the number of female graduate students in the department.

### Female Graduate Students in the Department of Mathematics and Statistics

Figure 4. The number of female Mathematics and Statistics graduate students.



Graduate student financial support—The department offers graduate support in the form of teaching assistantships and research assistantships for graduate students who meet our criteria for financial assistance. This criterion includes strong letters of recommendation, exceptional grades in undergraduate or graduate programs, and a strong letter of intent from the applicants. They must also meet our deadlines for applications seeking financial support. Each application is reviewed by the selection committees from each of the three programs, and students are ranked in order of receiving funding. Since we are not as competitive as we would like to be, we often go down to the third or fourth ranked candidate to offer the first TA after our first choices turn down our offers. Only after students are admitted to the program are any Research Assistantships available and the faculty sponsoring those assistantships select qualified students.

Occasionally we admit students with guaranteed outside support from another agency such as Fulbright or an academic agency from their own country. Ph.D. and M.S. students are admitted as full-time or part-time students and some are admitted with full support with an Assistantship. If support is guaranteed, it is for a maximum of six semesters for M.S. students. Students who are without support may ask to be in the Teaching Assistant (TA) pool. These students may be offered Assistantship support on a semester-by-semester basis if TA slots are available after all students on guaranteed support have been accommodated. In recent semesters, we began offering some special TA's to students under our PTI budget, and have accommodated students in this way. They receive a small stipend and health insurance, but must still pay their own tuition. In fact, we often hire a few special TA's from outside the department and thanks to funding from Arts & Sciences are able to offer one TA to a graduate student in another department. We currently have 44 full-time TA's on our budget and five half-time Graduate Assistants (GA's) in the budget. Clearly, we could use more funding for TA's as there is a need for instructors for the lower level math classes that seems to be ever increasing.

The workload for TA's is one course per student, because students awarded TA's must maintain a 9 credit hour graduate load to ensure they make progress toward their degree. Typical course enrollment is 55 to 60 students and the students must prep the class, grade homework, quizzes, and exams. The students work under the direction of a faculty coordinator who prepares all exams and the final. Our recitation TA's teach two recitation sections of a maximum of 25 students per section, and we have recitations with all three of our calculus sequence for science

and engineering. They are under the direct supervision of the faculty teaching the calculus course.

The size of the TA stipend has increased over time making our financial support more competitive with other schools, but is not as competitive as it needs to be. At the time of our last review in 1995, no support for health insurance was available to TA's and this was a major concern for graduate students. Currently, the stipend for Ph.D. students who passed their comprehensive exams is \$16,268 for the academic year. The TA contract also includes tuition and the supplemental student health insurance. Incoming TA's receive \$15,720 and the same benefits.

Fellowship support—Our limited ability to offer graduate research fellowships has been a continuing source of concern. This is particularly a problem because many students teach every semester, limiting their ability to conduct research and write manuscripts. The other important aspect of this problem is the need for summer support. While a few summer TA positions are always available, graduate students need time free from teaching to conduct their research. A dramatic improvement in summer support was achieved through the Efromysn grant to support four dissertation students with awards of \$2,500 each to work on their dissertations rather than having to teach in the summer.

Applications—One area of concern for our graduate program has been a decline in the number of applications received. After peaking around the 70's and 80's for the last few years and then going over 110 in fall 2007, this year's applications for Fall 2008 appear to be down dramatically. We don't fully understand the reason for this decline—but are concerned that new restrictions on foreign students and the prohibitive costs of applying for U.S. schools has contributed to the decline. We are also concerned that new admissions processes at UNM may be contributing to the decline of the number of domestic applications received in the department. We have adjusted our deadlines in anticipation of late receipt of applications—we were informed that Admissions will run an audit on our applications, but that occurs two weeks after our posted deadline. The Interim Dean of Graduate Studies at UNM reports that applications are down in almost all programs here at the university. This is cause for a great deal of concern, and a call to begin recruiting efforts anew to attract high caliber graduate students to our programs. Although the quality of the applications remains fairly high, the best of the applicants rarely choose to come to UNM even though we admit and offer funding.

The chart on the following page indicates the number of students applying to our graduate program and the numbers admitted. According to the Office of Graduate Studies, the number of admitted students is the actual number of students who register and attend UNM after admission. These numbers include both domestic and foreign applicants. The date range for these numbers is Fall 2002 through Fall 2007. It should be noted that the department has two admissions each year, fall and spring. The chart on graduate admissions does not include 2008, since those numbers are not available at the time of this self-study.

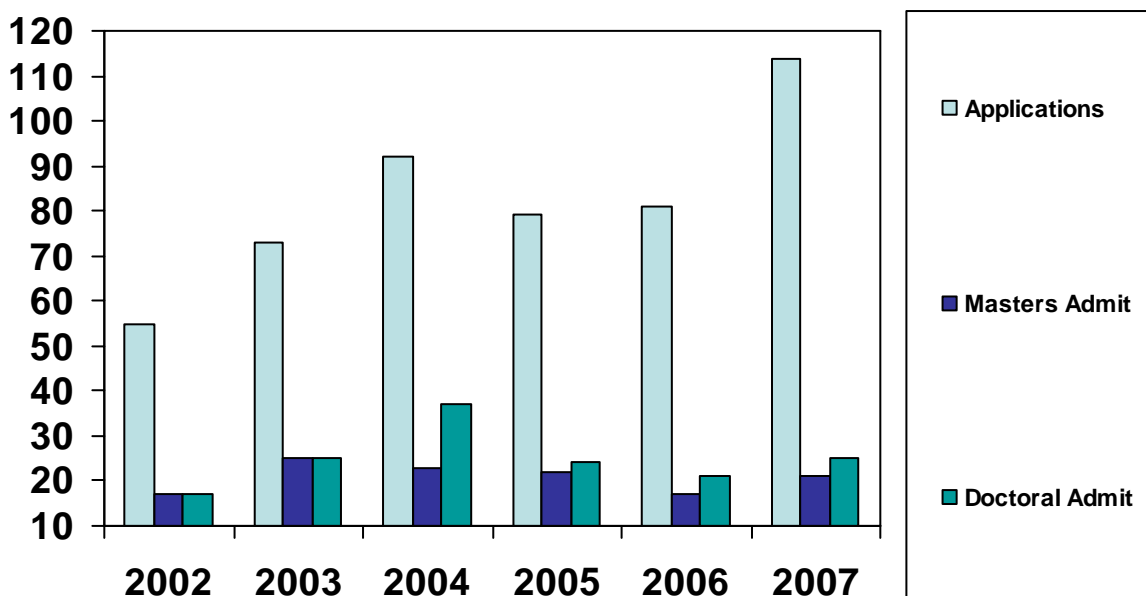
Graduate student outcomes—By and large, the faculty view appropriate measure of graduate student outcomes as gathering information on the fates of our students. Because of the individual nature of graduate student programs, shorter term measures of outcomes during the training process have not generated much enthusiasm among the faculty.

For the 54 students who completed the Ph.D. program between 1997 and 2006, the average time to complete the degree was 6 years (calculation of the mean, mode and median give the same result). This spring and summer 2008 we have approximately 20 Ph.D. students who will

be completing their degrees. This is the largest contingent of graduating Ph.D.'s the department has had at one time and is occurring in part due to funding limitations imposed several years ago. Students who are now meeting the 10 semester limitations instituted by Dr. Kapitula, with a few exceptions granted additional time to degree, are finishing in a more timely fashion than in the past. Thus the average seems to remain around 6 years to complete the degree. We are hopeful that we can shorten that time, especially for students coming into the Ph.D. program with M.S. degrees by limiting funding to those students to a total of six semesters.

Our master's students typically take two years to complete the degree. Their fates are more diverse than those of the Ph.D. students. Some of these students continue on to Ph.D. programs here or at other universities, some are employed by government agencies or the national labs, some are teaching at community and junior colleges, some are working in research in health and other areas, and some are working in the private sector. We rely heavily on the students' self reporting back to faculty and to the department to determine where they are currently employed.

### Graduate Applications and Admissions Fall Semesters Only Mathematics and Statistics



Our master's students typically take two years to complete the degree. Their fates are more diverse than those of the Ph.D. students. Some of these students continue on to Ph.D. programs here or at other universities, some are employed by government agencies or the national labs, some are teaching at community and junior colleges, some are working in research in health and other areas, and some are working in the private sector. We rely heavily on the students' self reporting back to faculty and to the department to determine where they are currently employed.



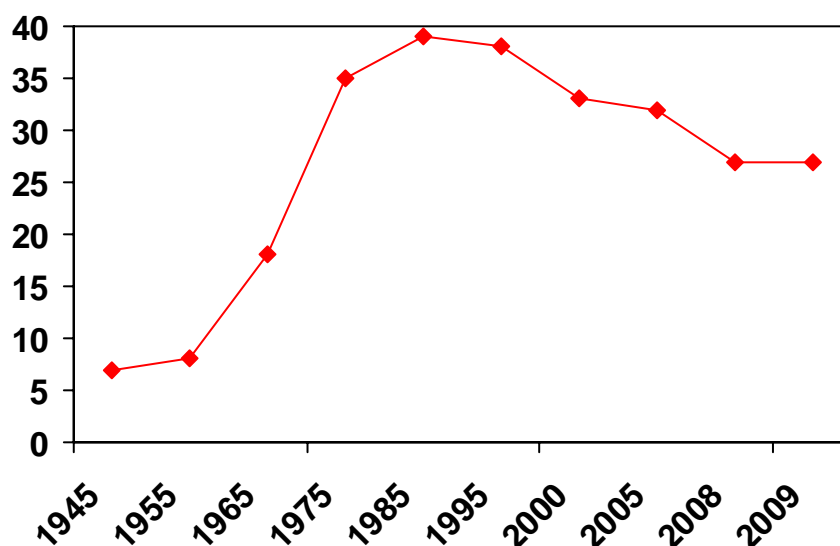
### 3. Faculty – Brief CV's for all faculty are in Appendix A (see Appendix A)

#### ***Faculty demographics***

As of January 2008 our faculty includes 14.3 Professors (one of whom is leaving for a faculty position elsewhere, one who is retiring, and one who has several offers for faculty positions elsewhere), 8 Associate Professors (two of whom are on extended leave and we do not expect to return to UNM), 4 Assistant Professors, and 8 lecturers, (one vacancy and one who will leave should the spouse accept a position elsewhere). See the CV's of faculty in Appendix A for their areas of expertise.

Over the years from 1995 to 2008, the number of graduate and undergraduates for the department more than doubled, however our number of tenure track professors has declined from 38 faculty to 26.3. Our faculty has changed dramatically over the last 13 years, with few of that faculty still at UNM.

Figure 5. Number of tenure track faculty by the year. Faculty on long term leave are not included, nor is faculty in the Office of Research.



In 1995, we only had three full-time Lecturers, and we were able to increase that number to 8 at the present. These Lecturers serve an invaluable service to the department as coordinators of the lower level mathematics courses and as faculty for those courses.

Table 2. Frequency and percent of male and female faculty by rank in February 2008.

Rank	Number of female faculty	Number of male faculty	% female faculty	
Professor	1	13.3	More than	1%
Associate Professor	2	4.5		33%
Assistant Professor	2.5	3		45%
All tenure track	5.5	21.5		20%
Lecturers	3	5		37.5%

The number of female faculty has declined over the past three years as we lost two female statistics faculty to other faculty positions. We continue to attempt to hire female faculty, however historically it has always been difficult to hire female faculty because they are highly desirable to Mathematics programs around the country. This is another instance where competitive hiring packages would be extremely beneficial to the university as a whole.

The number of minority faculty in the department is historically low. We have hired minority faculty over the intervening years, which has lead to a higher percentage of minority faculty. Once more we face the same hiring problem as with female faculty, minority faculty is highly sought after at universities across the country and we do not compete favorably with those universities in salary and hiring incentives.

The faculty currently includes two emeriti faculty who continue to teach one upper level course apiece. The rest of our coursework load is carried by adjunct faculty in the form of part-time instructors. It is our contention that the university does not honor these part-time instructors, and we find it difficult to understand why this faculty is not offered benefits of some kind to reward them for their unstinting service to the university for relatively low pay.

Table 3 . Number and percentage of minority faculty by rank.

Rank	Number of minority faculty	Number of non-minority faculty	% minority faculty	
Professor	2	12.3	More than	1%
Associate Professor	5	6.5		43%
Assistant Professor	2	8.5		19%
All tenure track	9	18		33%
Lecturers	1	7	More than	1%

Faculty areas of expertise—The CV's in Appendix A indicate that the faculty expertise in the Department of Mathematics and Statistics spans the entire range of mathematics and statistics, with a few minor exceptions. Having lost faculty whose focus was on genetics, fluid dynamics, industrial statistics, and now numerical analysis we struggle to offer our students the best range of expertise in the fields. We must be able to find experienced faculty to replace those who leave gaps in our mathematical and statistical range to be able to continue to recruit and educate the best and brightest mathematics and statistics graduate students. It is our duty to produce students who can in the future fill the many faculty openings that will occur as more and more of the current faculty age and retire.

Teaching assignment patterns—A standard teaching load for tenure track faculty is two and two. All faculty teach upper level undergraduate courses in addition to a graduate level course. Many of the faculty offer Readings and Research and almost every faculty member has someone taking either thesis hours or dissertation hours each semester. On occasion, faculty will double up and teach four courses in one semester in order to be able to travel for research, teach as an exchange, etc. Generally, we only have 1 or 2 faculty who choose this type of buying time.

Lecturers teach two classes per semester. Several lecturers are also a coordinator for one of the large lower level courses or sections. There is a coordinator for Math 120, 121, 123 and 150, Stat 145, and Math 180-181. A tenured faculty member coordinates the calculus series, Math 162, 163, and 264. The lecturers do receive additional compensation for these roles. One of the lecturers handles all the scheduling for the department and another lecturer is in charge of the UNM-PNM Math Contest.

The teaching load is meant to be the same for all faculty, however the experience of teaching these courses varies from course to course. All the upper level undergraduate courses generally have 20 to 35 students enrolled. Most of the upper level math courses are required for Physics majors, majors in engineering programs, and the secondary mathematics education program in the College of Education. All 300 level mathematics courses are taught by tenure track faculty with two courses of Math 375 taught by adjunct retired Ph.D. UNM faculty or visiting professors with specialty in that area. At the graduate level some of the courses are heavily in demand because they are required for the degree concentration, while other courses are far less popular as they cater to very specific mathematics interest areas. Courses required for the degrees can be found in the student handbooks.

All the graduate statistics courses are very much in demand, and the lack of experienced faculty has resulted in the inability to offer the Math 425/525 for the past three semesters. This definitely affects students adversely in not being able to take the basic SAS programming class. Our Biostatistics and Industrial Statistics courses have suffered from the loss of faculty as well. In all, our statistics graduate students are becoming very frustrated as they attempt to complete their graduate degrees in the department. Recently, we have resorted to outsourcing some of the graduate coursework to other departments like Economics, Business Management, and Engineering so that our students can acquire the 32 credit hours they need for an M.S. degree.

Publications—Faculty in Mathematics and Statistics are expected to publish regularly and our faculty take that expectation seriously. As can be seen by the CV's in Appendix A, our faculty maintains a high level of publications. Table 1 on page 15 indicates the number of publications through 2005-2006 by our faculty. Most tenure track faculty publish in peer reviewed journals. If a faculty member does not publish in one year, they generally publish the next. From Table 1

it can be seen that even though faculty has declined in the past few years, our publications remain high.

Our faculty earn awards and honors each year. Dr. Michael Nakamaye and Dr. Gabriel Huerta won prestigious awards in 2006-2007. Dr. Nakamaye received the 2006-2008 Presidential Teaching Fellowship. This award is the University's highest teaching honor. Dr. Gabriel Huerta won the designation of Regents' Lecturers in Arts and Sciences, an appointment that spans three years. Adriana Aceves, Director of the Precalculus Program, was honored as an Outstanding Teacher at UNM in 2007. Statistics Full Professors Bedrick and Christensen are Fellows of Professional Societies. Full Professors Hagstrom and Sulsky recently delivered plenary lectures at International Research Conferences.

Review of faculty—In addition to normal university procedures for tenure and promotion review, mathematics and statistics faculty are reviewed each year. Each year faculty submit a three year report summarizing accomplishments in research, teaching and service (Lecturers only report on teaching and service). Each member of the (EC) executive committee (one elected member from each unit: Pure, Applied, Statistics, and one Lecturer) reviews all colleagues from their own discipline and some from the other areas so that each faculty is evaluated by two members of the EC. A meeting of the EC with the Chair takes place to rank the faculty after which the Chair summarizes evaluation for each individual in written form. These reports are given to faculty and merit raises are determined based on the ranking. This evaluation is based on a weight of 40% research, 40% teaching and 20% service.

Lecturers are evaluated between the Chair and the Lecturer in the EC. For Lecturers the weight of teaching is 40% and service is 20%.

Faculty hires— Every academic year the Chair submits a hiring plan that results from discussions with all faculty. Positions are described by Area (Pure, Math. Ed., Applied, Statistics), at times with narrow parameters that respond to an immediate need to cover an area. Once the Dean responds to the plan, a hiring committee is formed. We assure that both expertise and diversity are well represented in these committees. After the approval process is completed, it is the charge of the committee to identify candidates to come for interviews. The committee recommends names to the tenure stream faculty for approval to interview. Once this is done and interviews take place, the hiring committee in consultation with faculty in the targeted discipline discuss and propose a ranking to be put for vote to the tenure faculty for approval.

At this time, the traditional pipeline for finding suitable applicants for faculty positions does not work. We are failing to get the number of interested senior faculty to apply for our positions, and those who do apply are not being attracted to accept due to low faculty salaries. The department is relying more and more on junior faculty to fill our vacancies and this means that we are not keeping up with the losses our department is suffering. Very few of our grant winning faculty are remaining with us, and we fear a greater loss of department funds through this attrition.

Roles for retiring faculty— Most retiring faculty receive the title of Prof. Emeritus. The department has a simple policy in line with the Faculty Handbook where Full Professors vote for or against the granting of this status.

Historically many retiring faculty return to teach on a part time basis. They are given, to the best of our abilities, office space. Access to materials and supplies is similar to what regular faculty

receive. One recent retired faculty (Steinberg) and an upcoming retiring faculty (Ellison) continue to do research and mentor students. Retiring and Emeritus faculty do not have voting rights in the department. They can, if they so wish to do so, attend faculty meetings.

Faculty workload analysis—The number of student credit hours continues to increase steadily each year. We are currently teaching around 9,000 more students in academic year 2007 than we did in academic year 2000, with a loss of 8 tenured faculty. The only thing that saves us is that we were able to increase the FTE faculty line from 3 to 8. As mentioned earlier, the majority of those 32,976 student hours are taught for the lower level mathematics and statistics courses that fill core and group requirements at UNM.

Support for faculty development— We provide a modest sum for travel, usually enough for one domestic trip. This support is extended to tenured stream faculty and to Lecturers. For the most part we rely on development efforts from the College of Arts and Sciences. In such cases, the Chair seeks nominations to recommend faculty for awards such as the Summer Research or Semester Research awards. Unfortunately, the College was forced to put these programs on hold. There is also very little to no support for faculty teaching development. This is true for the department and the University as a whole.

#### **4. Facilities and resource bases**

Support staff—the department staff includes 7 members all paid from I&G funds. Our support staff functions efficiently as a unit and manages to keep the department on track and productive despite the demands of the new university accounting, student, and human resources system and auditing increasing in difficulty each year. State support for staff lines is not adequate.

Space—space remains critical for the Department of Mathematics and Statistics. Each year is a struggle for scheduling and the department to find enough classrooms for the many sections we must teach of the lower level mathematics classes. The department location in Humanities only provides two classroom spaces, often faculty use our conference room for seminar classes. This creates a scheduling nightmare for the Admin in charge of the rooms. Often we must rearrange thesis and dissertation defense times around the usage of the classrooms.

Although we have the promise of a new building, we are somewhat skeptical as to the actual benefits of this building. As the budget is cut, so is the space allocation in that building. We could essentially end up with a lot less space than we currently have in our Humanities location. We would urge those in charge of this building to consider the validity of asking us to downsize, measures should be taken to create a building in which we and our students can be comfortable.

Physical Plant has agreed to re-carpet and tile the main office area and all the hallways on the second floor. We are requesting capital improvement funds to enclose unused space into an additional staff office. At this time, we plan to make the best of the space we currently use, knowing that any new building will now take 3-5 years at a minimum to complete.

Library Resources—The University Libraries (UL) is a member of the Association of Research Libraries, and is composed of four separate facilities on the University of New Mexico's main campus in Albuquerque: Zimmerman Library (education, social sciences, and humanities); Centennial Science and Engineering Library; Parish Memorial Library (business and economics); and the Fine Arts and Design Library.

The four branches of the UL hold over 2 million print volumes in their collections. The UL currently has over 8,000 subscriptions to print journals and nearly 17,000 subscriptions to electronic journals in all disciplines. The UL provides 24/7 remote electronic access to over 300 electronic databases, electronic journals, electronic reference sources and other books, and the library catalog (LIBROS) of print holdings.

There are several electronic sources which specifically support research in mathematics and statistics at all levels. The UL subscribes to both MathSciNet and the Current Index to Statistics and has subscriptions to the major indexes in related fields such as physics, biology, and computer science. Also available are subscriptions to most SIAM journals and AMS journals as well as the collections provided by our journal packages from Springer and Blackwell and the JSTOR archive. The UL also has standing orders to major book series such as Lecture Notes in Mathematics and we buy the essential research books in our faculty research areas.

Borrowing of materials not held at UNM is accessed through the Inter-library Loan system. UNM belongs to a consortium of libraries which delivers most journal articles within 24 hours and books within 4 days. This is a free service to students, faculty and staff.

The mathematics and statistics librarian provides additional assistance to the department by selecting books for the library's collections and handling reference questions directly for any students, faculty, and staff in the department. Additional reference and instruction support is provided by the staff at Centennial library. Reference services desks are open approximately 50 hours per week and staffed with professionals who help with research problems, devising search strategies, and using various print and electronic resources. Services include customized instruction sessions that assist students and faculty in utilizing the library's resources and collections. Individualized library instruction/tours are also available upon request. Faculty can work with the instruction, reference or subject specialists to design classroom assignments that teach students how to conduct research.

## **5. Financial resources**

The department has four main sources of funding, (1) state funding--the Instructional & General budget and tuition (I&G) that is allocated to the department by the College of Arts and Sciences. (2) Course fees that are collected from students. (3) Overhead funds generated by grants, and (4) Gifts that are managed by the UNM Foundation. The faculty in the department also hold grants funded by a variety of agencies. These funds, of course, are for research projects and not for the general operation of the department. This section provides an overview of our financial situation.

I&G budget—The state funded budget includes two parts: (1) salaries and (2) materials and supplies. Starting in fiscal year 2004-2005, a 1% tax was imposed on all transactions in the I&G budget. This tax funds implementation and operation of a new data base system Banner. The listing of the total I&G budget below is shown after the Banner tax is imposed, since the effect is to reduce the funds we receive. Generally speaking, while the department's I&G budget has increased overall, the increase is entirely in salaries (Figure 6). The materials and supplies budget has remained static for the last four years (Figure 7).

Figure 6. Total I&G budget for the past 5 fiscal years. Budget amounts are after the Banner tax has been removed.

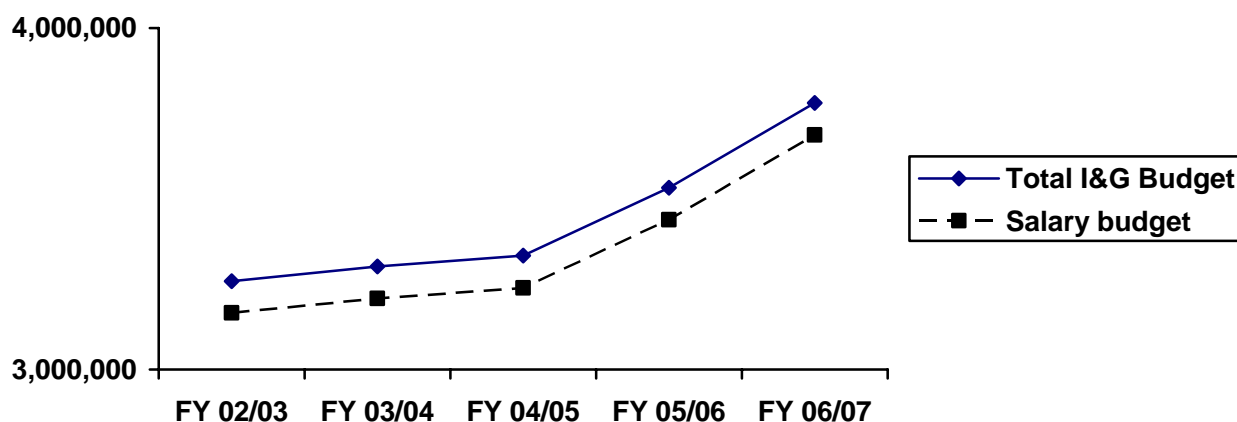
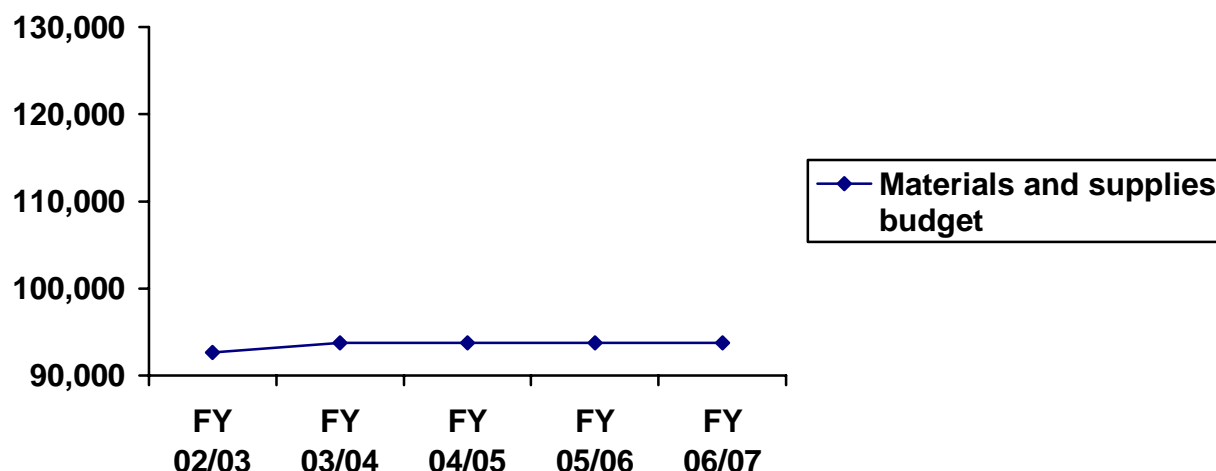


Figure 7. Materials and supplies budget provided by state funds in the last 5 fiscal years. Available amounts in the last 3 fiscal years are actually less than shown due to a 1% Banner tax.



Course fees—The department charges fees for some courses to cover the cost of software used to teach the courses. Although some departments are able to use the course fees for enhancing the department teaching budget, the fees raised in this department usually are consumed by the high cost of software licensing for the supplemental computer programming used in our courses. We accrued \$14,740.00 in 2006/2007 from student course fees. Of this amount, \$14,359 went to software licensing. Typical course fees are \$15 per course requiring a fee. Not all upper level mathematics courses require a fee.

We could follow the lead of other departments that institute course fees for all their courses, but at this time we feel that it would become onerous on students to have additional fees imposed on them to simply support the inadequate teaching budget granted by the state. The true answer to this problem is for the administration of the university to continue to forcefully lobby for additional funds for teaching budgets. As with faculty salary increases, the department

knows that institutions and the state focus on educational spending as a priority. Again, the idea is there, but the will to implement these changes does not materialize. With continued tuition rate raises, why burden students with additional course fees when the state should recognize the importance of a decent teaching budget for the largest university in the state.

Overhead funds—A portion of the overhead generated from grant accounts is returned to the department from the Office of Research. These funds are used for startup costs, research support, faculty development, graduate student support, etc. In FY 2006-2007, the department's overhead allocation was \$45,872. The money was used as listed as follows:

#### **General Category Expenditures**

Faculty Travel Support:	\$ 2,600
Start-up Packages:	\$ 3,185
Office and Computer Exp:	\$15,400
Faculty Moves:	\$10,000
Green Card/Visas:	\$ 5,509
Salary Support:	\$ 1,920
Recruitment	\$12,140
Dues and Memberships	\$ 3,782

The reason our expenditures can be covered since they obviously exceed our allocated budget is that we strive to maintain a carry-forward balance each year. We understand that our allocated budget will remain relatively the same so we budget accordingly throughout the year.

Current and projected costs—The bulk of our annual I&G budget is for salaries. We expect salaries to continue to increase and worry about the slow rate at which the state budget increases. Salaries need to rise to be competitive with our peers and to retain our faculty. The department would benefit from both an increase in the number of staff lines and an increase in the rate of pay for staff. Essential duties are still supported by overhead funds. Number of guaranteed TA lines has shown little increase in the last few years. Additional TA's are supported each year by special allocations, but these allocations do not cover all of the costs of TA support, e.g., tuition is not paid. By increasing the number of TA positions available we could completely support the additional TA's who work for us as Special TA's.

We also expect materials and supplies costs to continue to rise, likely at higher than the rate of inflation. This budget has not reflected the change in the cost of doing business in recent years.

Grant revenues are difficult to predict. Given the current funding climate and the state of the federal budget, it is more likely that these funds will decrease rather than increase in the near future. Due to the loss of our more prolific research faculty as they retire or move to other institutions, we face the potential of lower federal grant funding with focus on areas related to Mathematics and Statistics. This trend will have far reaching effects on the department creating two problems. First, faculty are likely to experience gaps in funding and ask for more support from the departmental overhead funds. Second, fewer grant dollars means a smaller overhead budget. Yet, we expect the demands on the overhead budget to be even greater as travel costs for faculty, gaps in funding, and requirements for startup funds all increase.

We are currently apprehensive concerning our overhead budget. Our department depends on this budget to keep us going through the tight financial times at UNM. Our budget is allocated from the Office of the Vice President for Research (OVPR) and unfortunately this past year, a multimillion dollar shortfall in the budget of the OVPR was exposed. Trying to cover that deficit is



likely to affect all units that rely on overhead funds—fairly or unfairly the departments will be asked to make up those shortfalls. This will have a devastating effect on our departmental budgets.

Relationship between the budget and the department's mission and goals—There is little departmental control over the I&G budget, however this budget is essential for us to carry out our primary missions of teaching, service, and research. Annual increases in salary, as provided by the state, are limited to very small amounts and this creates the inability to offer anything but small merit awards. Larger increases in salary come from counteroffers to those faculty members who seek jobs elsewhere and from adjustments based on administrative responsibilities. This is characteristic across the entire university. Many of our staff members are under the collective bargaining unit and we are unable to offer small merit increases to this dedicated staff. Our concerns are that they will begin to look elsewhere for better paying positions. The necessity for additional staff lines are not easy to address and extra TA lines do not appear in a manner that lets us to plan for recruiting new graduate students.

With the continuing implementation of the Banner System we feel an increasing need for additional staffing that includes accounting support for the department. We recommend a minimum of a .50 FTE Accountant II to assist in the preparation of financial reports and transactions. Sharing an Accountant II with another department, such as English, would be one way to provide the necessary financial support to two large academic departments.

## 6. Comparison to Other Programs

Within UNM the Department of Mathematics and Statistics has several comparable STEM peer departments such as Chemistry, Earth and Planetary Sciences, and Physics. These departments have similar numbers of undergraduate majors in the STEM areas and therefore the department considers these to be our peer departments. The problem with the Department of Mathematics and Statistics does not lie with the faculty to student ratio so much as the excessive demand on our department to provide a core curriculum course that is required of every single student at UNM. This means that at one time or another, almost every UNM student takes at least one mathematics or statistics course from us and on occasion several classes. This makes our teaching load unique among our UNM Arts & Sciences peers.

Table 4. Numbers of tenure track faculty and majors in science departments at UNM

Department	Tenure track faculty – Fall 2007	Majors from Feb 2008 Hyperion report	Ratio of majors to faculty
Chemistry	16	289	18
Earth and Planetary Sciences (includes Environmental Sciences majors)	21	183	8.7
Mathematics and Statistics	26.3	225	8.6
Physics and Astronomy	28	130	4.6

### Comparison to other Institutions

The following is a table that compares our graduate student to faculty ratio with peer institutions having the same student enrollment as UNM. From the table it is clear that we have a higher ratio of graduate students to faculty than all the other schools. The University of Iowa comes close, but then we far exceed the student to faculty ratio for the other three institutions. Having our faculty at the number we had in 1995 would reduce that ratio and make us equivalent to the University of Iowa or 3 to 1.

Table 5. Number of Mathematics Faculty, Graduate Students, and Ratio of Graduates: Faculty at some of UNM's peer institutions. Data was obtained through graduate and faculty lists on the institutions' web pages.

University	Number of tenure track Mathematics faculty	Number of Mathematics graduate students	Ratio of Mathematics graduates to faculty
UNM	26.3	122	4.6 to 1
University of Iowa	40	122	3.1 to 1
University of Utah	46	75	1.6 to 1
University of Missouri	42	80	1.9 to 1
University of Oklahoma	33	70	2.1 to 1

Clearly, we need to strive to increase faculty as much and as quickly as possible should we wish to stay competitive with other institutions around the country. UNM has much to offer students, but unless and until we recognize that we must be competitive we will always just be the state school that attracts our own students. Why would a graduate student choose to come to a school that cannot guarantee graduate advisement, when other schools clearly have a much lower ratio of student to faculty to entice recruits? We need to answer this question with a positive trend in reducing graduate to faculty ratios across the UNM campus.

Salaries—Average faculty salaries at the University of New Mexico fall below those of peer institutions. A 2006 study by the New Mexico Secretary of Higher Education found that there are fundamental and large gaps in total compensation for UNM faculty compared to peer institutions: Full professors make on average \$18,000 less than their peers, Associate professors make \$7,000 less than their peers, and Assistant professors make \$6,000 less. The longer faculty remains at UNM the greater that gap becomes. Is it any wonder that our faculty, especially junior faculty are leaving UNM for better paying jobs elsewhere? For years this has been the same lament; however the university appears to never take heed to the request for increasing faculty salaries. Almost all the faculty that left over the past three years indicates that salary is a high priority in the decision to move. The department understands that every year,

compensation is at the top of the institution's and the state's priority list, however the fact remains that we are still far below our peers in this area.

Average faculty salaries continue to decrease in the Department of Mathematics and Statistics as our more highly paid faculty retire, move to other institutions, or as in one case die. Since we can only hire junior faculty due to the dwindling applicant pool, our faculty salaries are lowered as we hire these new faculty members at much lower salaries.

### **7. Recent efforts in Mathematics and Statistics**

The department joined other UNM departments in the College of Arts and Sciences in 2004 in creating a plan around the themes of Success, Excellence, and Distinction. See Appendix D for our reports on Excellence in Undergraduate Education, our Document on Distinction, and our Document on Success all submitted in spring 2005. In our Agenda for Excellence in Undergraduate Education prepared by our undergraduate committee, the department states that "Recruiting New Mexico's youth and providing them with the education and growth that will give them a good life is our primary mission" (2005). The report focuses on methods to increasingly improve our excellence noting the underlying restrictions of limited resources as a chronic problem at the University of New Mexico. See the final page of the report for the areas that would benefit from special funding from the College of Arts and Science to increase the services we could offer our students.

The Document on Distinction was also a response to the Dean of Arts and Sciences call for more systematic planning across the College of Arts and Sciences. In that document, the main focus of maintaining our department's distinction revolved around sustainability of that distinction through targeted hires of faculty to maintain our standards of distinction. In that report, department faculty reported the loss of two junior faculty, but by the time the report was published we had indeed lost another two junior faculty and two senior faculty, one to retirement and one to a peer university. Since those departures, the department lost another five senior faculty with one of those to retirement and one to death. Clearly, we are not meeting the recommendations of the Document on Distinction and are on shifting ground in trying to sustain our department's distinction based on our faculty specializations.

The final document developed for the College of Arts and Sciences was a Document on Success. This document addressed the problems of the prerequisite Mathematics class, Math 120. The most pressing problem with this class was and still is the high failure rate in this course and the necessity of students repeating the course multiple times. The fallout from students failing to make progress forward in their mathematics courses contributes to problems in retention and graduation. In an effort to support early intervention in the public school system, we developed two initiatives to support school teachers and high school students. The first initiative was an off-site Math class of Math 120 at two public schools Eldorado High School and Highland High School in Albuquerque. In addition, we proposed the creation of a Visiting Program for High School Math teachers. Other initiatives included the creation of a combination Math 120/121 course, which has now expanded to two sections and is extremely successful. The final initiative was the use of technology in the classroom and to that end we are now offering a Math 120 course that is web based.

For the last year, the department working under specific instructions from several administrative areas found itself inundated with tasks. Among those were this self-study and the assessment protocols from the Provost's Office as well as a Departmental Performance Review for the College of Arts and Sciences Accreditation. The assessment protocols is an extremely

important and time consuming project, requiring a great deal of faculty participation. Appendix E contains the Accreditation Report for the Department from the College of Arts and Sciences.

## **8. Conclusion**

At times when the current Chair is asked to describe the department, a good characterization would be, "This is the best kept secret at UNM." What he refers to in this statement is the many facets of the department that are not seen at the overall university level. There are many things that the department does to ensure that our students receive the best service available through our tireless efforts--LIST. There are elements with demonstrated evidence of much talent in faculty, students, and staff. Activities and initiatives ongoing in the department bring visibility, pride, and excitement. At the same intensity level, there is anxiety, low morale, attrition, and frustration. Thirteen years have passed since the last APR review and no real action was taken. With reserved optimism, the conditions are in place so that this does not repeat. A stable Administration with vision and high goals (including UNM becoming AAU) and a soon to be built facility is a start. Getting a sense of how the department (or departments) should look 5 years from now or even 10 years from now, and working on it from day one is what this department expects from the APR strategic plan.

## Appendix A

## **Appendix B**

**Department of Mathematics and Statistics**  
**Assessment Plan – Spring 2008**

**Background.**

Although our department has no official records or any statistical analysis of the progress that our students make each semester, we have a long history of looking back at the results of the final exams, analyzing the major deficiencies in the students preparation that semester, and modifying our program to improve on these particular results.

Some of the modifications that we have made in the past five years, as a result of the observations of student performance in the core exams include the following

- Modify the syllabus to allow more class time to the subjects that seem to be particularly difficult for the students.
- Allocate more class time to those skills that are basic for student performance in a given class. This includes allocating time at the beginning of the semester to review basic skills from previous courses.
- Carefully coordinating all the different sections of each class to guarantee that every student will be exposed to the same material regardless of the section.
- Writing an annotated syllabus for each core class to make sure that all instructors are emphasizing the same concepts.
- Posting all relevant information for all the core classes on our web-page. This includes reviews for each mid-term exam and for the core finals, sample finals from previous semesters, lecture notes, problems for extra practice, links to websites that provide relevant information about the topics covered in the class.
- In situ (DSH) tutoring tables staffed by the math department instructors for algebra and calculus courses.
- Established a TA training program that includes: In-Service week to train all new instructors; TA classroom observations of other instructors teaching the same course; classroom visits from the coordinators to most instructors but specifically any new instructor teaching the course; a Teaching seminar that runs the whole semester every fall.
- Creating the recitation courses for math 120, 121 and 180 to give help to students for which the class is specially challenging or that need help with deficiencies in their basic skills.
- Tried in several sections (although not across all of them) to use different methods of pedagogy, including on line help, and active learning methods
- Offered intersession workshops of math 120 and math 121 for those students that had performed well in the semester (and for whom repeating the whole class would not be the best option) but did not pass the core exam.

**Plan for Fall 2007.**

We have written student learning outcomes for all the core classes in the department (math 121 – 180, math 215, and stat 145) and have published these outcomes in the website of our department.

**Plan for Spring 2008.**

We will be doing embedded assessment in all the sections of math 121 and math 150. We have decided on the method of collecting the information about student performance and will try the method in one or two of the mid-term exams to make sure that everything works as planned. The actual assessment items for the semester will be embedded in the core exam at the end of the semester.

We are still in the process of deciding what learning outcomes we will assess this semester. Our guidelines will be

- Outcomes that appear in one fashion in several courses of our core sequence.
- Outcomes that are crucial for the successful completion of more advanced math classes.

We will use the data collected from these items to analyze the content and method of delivery of the material in these two courses.



## Appendix C

## **Appendix D**

## Appendix E