

Department of Mathematical Sciences Annual Report for 1996

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1. Highlights

This has been a banner year for research in the Department of Mathematical Sciences. Prof. Joe Zund was awarded the university’s highest award, the 1995-1996 Westhafer Award for Excellence in Research, for his work on mathematical physics and mathematical geodesy. Prof. Caroline Sweezy received the Department of Mathematical Sciences Summer Research Award to continue her research on harmonic analysis. The department hosted Distinguished Visiting Professors Jane Jarrow, Director of Disabilities, Access, Information, and Support, and David Eisenbud, Brandeis University. The twenty-second Holiday Symposium on “Rewriting Techniques and Noncommutative Groebner Bases”, with main speakers Edward Green, Virginia Polytechnic Institute, and Derek Holt, University of Warwick, will be held in early January.

Members of the department were successful at obtaining external funding for their research and teaching activities. At a time when support for mathematical research is extremely difficult to obtain, seven faculty members were supported for their work in pure and applied mathematics. Susan Hermiller, Susan Lee, Susana Salamanca-Riba and Irena Swanson were all funded by the National Science Foundation. Ernest Barany received grants from both Sandia National Laboratories and the Army Research Office. Dave Finston was funded by the National Security Agency and Reinhard Laubenbacher by the Defense Information Systems Agency. We have recently learned that the Holiday Symposium scheduled to run in January will be funded by the National Security Agency, with the possibility that additional funding will be provided by the National Science Foundation. Pat Baggett received funding for her educational research from the National Science Foundation, the Office of Naval Research (Baggett) and the New Mexico Commission on Higher Education. Further NSF funding supported the educational initiatives of Dave Finston, Doug Kurtz, Reinhard Laubenbacher, and David Pengelley). Dave Finston received several grants from the NM Commission on Higher Education. Faculty members also received grants to work with students. Reinhard Laubenbacher and Ross Staffeldt were awarded a grant from the NSF to participate in the Southwest Regional Institute in the Mathematical Sciences. Denette Sinclair and Alyne Fulte are directing the local Proyecto Access program with funding from the National Aeronautics and Space Administration.

The department participated in programs to benefit students in the sciences.

Faculty members continued to work with McNair students and received funding from the National Science Foundation to participate in the Southwest Regional Institute in the Mathematical Sciences. Both programs support undergraduate research. The department was selected to participate in the NASA-funded program Proyecto Access, to encourage disadvantaged high school students to study mathematics and science. It has taken a leadership role on campus initiating work on a program to braille mathematics text for visually impaired students.

Hiring a research mathematics educator last year paid immediate benefits for our interaction with the Las Cruces Public Schools. Our presence in the local school system was expanded to the elementary and middle grades. We began programs with the Las Cruces Teachers' Center. We continued to present workshops supported by the Systemic Initiative in Mathematics and Science Education.

Unfortunately, the department suffered from some major problems this year. The Position Review Committee eliminated a College Assistant Professor position, which will negatively impact freshman and, consequently, hurt the university's student retention program. The Operating Budget cut severely hurt departmental funds. We were forced to eliminate almost all travel funds and outside colloquium speaker support, to the detriment of our teaching and research programs.

At the request of the central administration, the department spent several months investigating and considering means to assimilate the Department of Experimental Statistics into the Department of Mathematical Sciences. While it may have been reasonable to combine the two programs, it is clear that the leaders of the Experimental Statistics group decided before we ever met that they would not become part of our department.

Our most serious problem involved unsupported allegations about the department's teaching efforts made by the Dean of the College of Engineering. Negotiations to resolve this dispute are under way, but continued attacks by the Dean make it unclear what outcome will evolve. The department acknowledges and appreciates the support it has received from the College of Arts and Sciences and Vice Presidents Conroy and Franco.

2. Personnel Changes

Two faculty members were promoted and two tenured this past year. Reinhard Laubenbacher earned promotion to Professor of Mathematics and Caroline Sweezy earned promotion to Associate Professor. Mai Gehrke and Pat Morandi earned tenure.

The department hired one new Assistant Professor, John Harding, who will support the department's research group in logic and foundations of mathematics. He earned a Ph.D. in mathematics from McMaster University and held postdoctoral positions at Vanderbilt University and Brandon University. He replaced Arthur Kruse, who had retired.

The department hired several visiting researchers to support research efforts in the department. Four Visiting Assistant Professors, Mark Brittenham, a topologist, Nhu Nguyen, an analyst, and algebraists Al Sethuraman and David Tao, conducted research with NMSU faculty members and taught mathematics courses.

Last fall, the department reclassified its Computer Specialist position to Computer Operations Manager. We conducted a search and hired John Pierce as our first professional staff member in this new position in December, 1995.

The department lost a valuable asset when the Position Review Committee removed a college-track position that supported the Mathematics Learning Center. We are extremely concerned about the negative impact the loss of this full-time teaching position will have on our students.

3. Curricular Activities

Members of the Department of Mathematical Sciences participate in several diverse educational development programs and activities, with the majority of the department's faculty members involved in at least one of them. Faculty members gave workshops and talks about the "student research projects" program, its extensions and other curricular activities in the department at regional and national conferences, and on other campuses. Pat Baggett gave presentations on using technology in elementary school mathematics courses at the International Congress on Mathematics Education in Sevilla, Spain. Mai Gehrke and David Pengelley presented a three-day Chautauqua course for college teachers titled "Helping Students Become Active Learners of Mathematics". The course was funded by the National Science Foundation. In June, David Pengelley was an instructor for a one-week course for college teachers at the Institute for the History of Mathematics and its Use in Teaching in Washington, D.C. This was an NSF-funded institute sponsored by the Mathematical Association of America.

Mathematics courses are continually under revision or development. Faculty members recently designed and proposed an undergraduate course in topology and a seminar course for senior mathematics majors. A course on nonlinear dynamics and chaos, cross listed with the Department of Physics, was offered for the

first time this fall. A statistics course for psychology students is being prepared for next spring. The department is searching for a new textbook for our calculus sequence. The adoption of a new textbook and current negotiations with the College of Engineering will lead to revisions in our calculus courses. Faculty members offer special topics undergraduate- and graduate-level courses at the interface of theoretical mathematics and applications. In the spring, they conducted courses on topology at the undergraduate level and technology in elementary education at the graduate level, as well as advanced research-level courses on harmonic measure, algebraic geometry and lattice theory. These were followed in the fall by an undergraduate course on wavelets and signal analysis, two graduate-level courses on technology and mathematics education, and a research-level course on invariant theory.

The internationally acclaimed “student research projects” program has brought recognition to the department and the university. The program emphasizes discovery learning through the inclusion of student research projects in mathematics courses. It was begun in calculus classes, but has spread to many other courses at the undergraduate and graduate levels. The book *Student Research Projects in Calculus*, written by Marcus Cohen, Doug Kurtz and David Pengelley, published by the Mathematical Association of America in 1991, is now in its third printing. Don Albers, Associate Executive Director of the MAA and Director of Publications said about this book, “It clearly represents to me the need that our members, who are primarily college and university faculty, have for materials that help to directly improve their teaching. [This] book represents a precedent in the association and led to the creation of a new series called *Classroom Resources*.” Faculty members are creating other materials in this vein. Lolina Alvarez, Mai Gehrke, Doug Kurtz, Pat Morandi and Ross Staffeldt have submitted a manuscript for a book titled *Mathematics Courses using Themes* which is being considered for publication by the Mathematical Association of America. When using themes, instructors incorporate project-like activities into the classroom of their classes. This involves the students in discovery-based cooperative learning activities that cover the core material of the course. Ideas about discovery learning and cooperative learning have been incorporated into many advanced courses, including some graduate courses.

The number of faculty members who participate in the university’s Honors program continues to grow. The department offers two courses listed jointly as Honors and Mathematics courses, and approved for General Education: a sophomore course “Spirit and Evolution of Mathematics” and a senior level course

“Great Theorems: The Art of Mathematics”. The sophomore course meets the mathematics General Education requirement and the senior level course meets the “viewing a wider world” General Education requirement. The Honors program has given significant support to these courses. Reinhard Laubenbacher and David Pengelley, the developers of these courses, are working on manuscripts of books from both courses, and have received funding from the National Science Foundation to write a textbook based on the sophomore-level course.

In support of the university’s General Education program, the department offers six courses: Math 112G, Math 142G, Math 210G, Hon/Math 275G, Hon/Math 411G, and Stat 210G. Math 210G (Mathematics Appreciation) presents a broad view of mathematics, outlining important directions of the discipline. Math 210G and Stat 210G (Statistics for Contemporary Living) strive to impart an understanding and appreciation of what mathematics is and how it affects people’s lives. To improve student performance, English 111G is now a prerequisite for Math 210G. Hon/Math 275G and Hon/Math 411G view mathematics as a human endeavor and discuss great mathematical ideas in the historical context in which they developed. An alternate means of meeting the General Education requirement in mathematics is to take six credits of mathematics that require Math 115. Students who take Math 180 and Math 185 fail to meet the General Education requirement by one credit. Several faculty members have volunteered to teach special one-credit courses for these students, always as an overload.

Members of the Mathematics Learning Center faculty have continued activities which support teaching with technology. Faculty members piloted new books which integrate graphing calculators into the teaching of intermediate algebra and college algebra. Beginning last fall, the use of graphing calculators became integral to all three pre-calculus courses, intermediate algebra, college algebra, and trigonometry. New Mexico State University is one of a handful of universities across the country in which calculator use is required across all course sections rather than being confined to use by a few interested instructors. All graduate teaching assistants receive training and support on using calculator technology in the classroom. The department offers numerous introductory calculator workshops each semester. It offers a leasing program as a low cost alternative to purchasing a calculator, and leased over a hundred calculators this fall.

Faculty members participated in several undergraduate research programs. Ross Staffeldt advised Zenaida Ahumada on algebraic coding theory as part of the McNair program. He and Reinhard Laubenbacher are participating with the NSF-funded Southwest Regional Institute in the Mathematical Sciences, and they will

be working with undergraduates to study cryptography. Before coming to NMSU this fall, John Harding directed the research of two undergraduate students funded by the National Sciences and Engineering Research Council of Canada. Proyecto Access, a program to identify socially and economically disadvantaged high school students and encourage and enable them to study mathematics and science, is being led by Alyne Fulte and Denette Sinclair. Funding is provided by NASA.

Student advising is handled by special departmental committees. Undergraduate mathematics majors are advised by members of the Undergraduate Majors/Minors Committee. This committee nominates mathematics majors for scholarships and awards and informs them about study and career opportunities. Advising of graduate students is coordinated by the Graduate Studies Committee, which also makes recommendations for graduate assistant appointments.

As part of the department commitment to helping students with special needs, Sandra Geiger is assigned as Special Students Program Coordinator to monitor students who are handicapped, have learning disabilities, or are experiencing great difficulties in their classes. She monitors students repeating a Mathematics Learning Center class more than one time and Native American students, and she acts as liaison with the American Indian Program Office and Student Support Services. She is also the departmental Americans with Disabilities Act (ADA) contact. The Mathematics Learning Center offered two special sections this semester, as well as a lab, for these students. Recently, Geiger has received funding to develop a computerized system to present mathematics and graphics to visually disabled students by translating mathematics text into Nemeth code for braille. She is working with *TCI Software Research, Inc.*, owned by Adjunct Professor Roger Hunter, and the VISIONS lab at Purdue University on this project.

3.1. Graduate Program

The department awarded two doctoral and eight master's degrees during the year. It had 42 mathematics graduate students enrolled this year, with 37 full-time students and five part-time students. The department continues to successfully attract both women and minorities; two graduate assistants are supported by CHE fellowships. There are two seminars designed specifically for graduate students; one has graduate students give research talks and the other is a colloquium series at the level of graduate students. The Graduate Studies Committee revised the graduate assistant orientation program to provide all new assistants with a more complete introduction to the various courses and teaching innovations in the de-

partment. The program included information about the Mathematics Learning Center, General Education and calculus curriculum. This year, the department strengthened the Master's program by increasing the requirements for the degree. The department instituted new courses in mathematical physics (cross-listed with the Department of Physics) and complex analysis.

The department began developing a doctoral program in mathematics education. Requirements for comprehensive examinations and course work have been drafted, and discussions about the program continued in the fall. These guidelines are being designed to ensure that the successful candidate has strong backgrounds in both mathematics and education.

3.2. Teaching Improvement

The Teaching Committee oversees the coordination of multi-section courses and classroom observations of faculty members and graduate student teaching assistants. The department sponsors teaching groups to encourage small-group interaction about teaching. The department held several colloquia on educational issues. These included presentations on a regional mathematics institute at the University of Arizona, uses of technology in the classroom, and teaching mathematics to students with disabilities.

A major strength of the department's educational program is the participation of graduate students and talented undergraduates as tutors and graders in the Mathematics Learning Center. This provides a history of experience with the peer-tutoring aspect of learning, which is inherent in the cooperative learning projects now taking place in many other classes. It creates a valuable training program for new graduate assistants, introducing them to educational issues under close supervision by experienced educators.

3.3. Outreach

Members of the department meet with faculty members from client departments and contact mathematics departments at branch campuses for their feedback concerning the content of mathematics courses. We met with representatives from the College of Business Administration and Economics to discuss mathematics courses for their majors, in particular Math 142G, Math 230 and Stat 251. These discussions led to the use of calculators in some of these courses this fall. Plans to meet with client departments from Engineering and Arts and Sciences about Math 471, Math 472 and Math 473 have already been made. At the request

of the Dean of the College of Engineering, the department organized faculty exchanges with departments in that college to improve the understanding of the educational missions of the two units. During the spring, exchanges with the Departments of Civil and Mechanical Engineering took place. Since no Engineering departments wished to participate in an exchange during the fall semester, no exchanges for fall were planned. Over the summer, these plans changed and, this fall, faculty members from Civil, Electrical and Mechanical Engineering and Engineering Technology are teaching calculus classes. The department also conducted a teaching exchange with the Department of Physics. Joe Zund offered advanced graduate-level courses on tensor analysis and general relativity in the Department of Physics, while Robert Armstrong taught mathematics courses in exchange. Mathematics Learning Center faculty members work closely with faculty at the Doña Ana Branch Community College.

This process of meeting with faculty members in departments that are “customers” of specific mathematics courses serves as an example of Total Quality Management principles in use by the department. Other examples are our involvement with the Doña Ana Branch Community College and the Las Cruces Public Schools, as well as the state through the SIMSE program. Unfortunately, client departments often do not approach us about their concerns and problems. The College of Engineering failed to respond to our requests for feedback for years. The Department of Psychology observed a problem with their students understanding of statistics, but never contacted us. In an attempt to gain better feedback from client departments, the department has just created a new committee, the Liaison Committee, to visit with departments around campus weekly to lend advice and uncover problems before they become serious.

In spite of our efforts to solicit and respond to requests from client departments on campus, the Dean of the College of Engineering attacked the Department of Mathematical Sciences during the spring final examination period. Claiming that the department was both unwilling and incapable of teaching mathematics courses for Engineering students, he announced his intention to introduce undergraduate mathematics courses taught by the College of Engineering. The actions and insight of Vice President Conroy have produced a proposal to guarantee both closer relations with faculty in the College of Engineering and a better understanding on both sides of the needs and problems of the courses involved. His proposal includes convening a coordinating committee of mathematicians and engineers to discuss mathematics courses for engineering students and having engineering faculty instruct some calculus classes on an ongoing basis. Both of these were begun

in the fall.

4. Research Activities

Members of the department continued to be productive researchers. Two received special recognition. Joe Zund was awarded the 1995-1996 Westhafer Award for Excellence in Research, the third member of the department to receive the university's highest distinction for research. Caroline Sweezy was the recipient of the Department of Mathematical Sciences Summer Research Award, funded by an anonymous donation to the NMSU Foundation. Thirty of the tenure-track faculty members had a total of forty-one papers appear in print, forty-eight papers accepted for publication, and thirty-nine papers submitted for publication, as well as three reports and one invited book chapter. They published one elementary education curriculum resource book, and research texts on field theory, infinite matrices, stochastic processes and fuzzy logic. Five books were accepted for publication, including one undergraduate and two graduate textbooks, and two research texts. Three monographs on mathematics education were submitted, two calculus resource books and one book for high school mathematics teachers. Faculty members have books in preparation for elementary school teachers, examination preparation and an undergraduate text. One member of the department was commissioned by Oxford University Press to write biographies for the American Council of Learned Societies' multi-volume work, *The American National Biography*; he has written over 60 biographies. Faculty members delivered forty-five talks on their research at conferences and forty-three talks at other universities, displayed one poster at an international conference, and presented two workshops on curricular development and mathematics education.

Members of the department conduct joint research with mathematicians at other institutions. Several conducted research while on leave from the university: Joe Lakey at Macquarie University; Susan Lee at Princeton University and the University of Wisconsin; Reinhard Laubenbacher at several institutions in Europe; Ross Staffeldt with collaborators in Germany; and Arkady Vaintrob at the University of Utah and Brigham Young University. Faculty members on sabbatical leave included Mai Gehrke at the University of Copenhagen, Gerald Lodder at the Massachusetts Institute of Technology, Pat Morandi at Indiana University, David Pengelley at the University of Washington, and Ray Mines at the University of Waikato.

Faculty members continued to receive external funding to support their re-

search. Seven faculty members conducted mathematical research with funding from the National Science Foundation, the National Security Agency, Sandia National Laboratory, the Army Research Office and the Defense Information Systems Agency. Five faculty members conducted funded educational research work on five projects during the past year; some of these projects involved joint work with the high schools in Las Cruces. Support came from the National Science Foundation, the Office of Naval Research, the New Mexico State Department of Education and the New Mexico Commission on Higher Education.

The department hosted a “Workshop on Issues in Interactive Multimedia”, co-sponsored by the University of Colorado and the Georgia Institute of Technology. The invitation-only workshop was funded by the Office of Naval Research. The workshop combined two strands of research issues regarding interactive multimedia information: approaches to how the information should be organized for ease of access and application; and approaches to types of interactions with software that work well for learners in both educational and training situations. There were 18 speakers over the two and a half days, including two from Scotland and one from New Zealand.

The New Mexico Geometry and Topology Seminar brings mathematicians from the University of New Mexico and New Mexico State University together twice a year, alternating meetings between Las Cruces and Albuquerque. The department continued to co-host the seminars and several faculty members spoke this year.

The department sponsors several weekly seminars and a weekly colloquium. The seminars specialize in abelian group theory, algebra, analysis, algebraic topology, control theory, lattice theory, and statistics. One research seminar is run by graduate students. A “Friday Afternoon Seminar” is a more informal, general interest seminar. Almost all faculty members and many graduate students attend at least one of the seminars.

Faculty members participate in interdisciplinary research. Ernie Barany is conducting joint research with faculty members in the College of Engineering and statisticians Hung Nguyen and Tony Wang consult with researchers around campus. Reinhard Laubenbacher is working with the Physical Sciences Laboratory. Ray Mines and Frank Williams study Total Quality Management in education. Ray Mines is studying the mathematics in James Joyce’s works with a professor of English. Joaquin Loustaunau is directing an interdisciplinary doctoral thesis student; several faculty members advise doctoral students from other departments.

To give a sense of the active research groups in the department, below is a list of areas of research and the faculty members active in those areas.

Algebra: Faculty members in algebra include Dave Finston, Mai Gehrke, Susan Hermiller, Reinhard Laubenbacher, Ray Mines, Patrick Morandi and Irena Swanson. New faculty member James Pommersheim will interact with this group next year. Four algebraists were supported on research grants.

Analysis: Analysts include Josefina Alvarez, Richard Bagby, Doug Kurtz, Joseph Lakey, Joaquin Loustaunau, Charles Swartz, and Caroline Sweezy.

Topology: Gerald Dunn, Susan Hermiller, Gerald Lodder, David Pengelley, Ross Staffeldt and Frank Williams work in various areas of topology. One was supported on a research grant.

Geometry: Susana Salamanca-Riba, Arkady Vaintrob and Joseph Zund work in areas of geometry. One was supported on a research grant.

Logic, Foundations and Philosophy: Mai Gehrke and John Harding conduct research in logic and foundations. Ray Mines has research interests in mathematical philosophy. Ray Mines and Bill Julian contribute in areas of constructive mathematics.

Statistics and Probability: Susan Lee, Hung Nguyen, and Tonghui Wang contribute in statistics and probability. One was supported on a research grant.

Applied and Computational Mathematics: Ernest Barany (mathematical physics), Marcus Cohen (mathematical physics and biology), William Julian (mathematical astronomy), Arkady Vaintrob (mathematical physics) and Joseph Zund (mathematical physics and theoretical geodesy) are active in applied mathematics and mathematical physics. One faculty member in this area was supported on research grants.

Mathematics Education: Pat Baggett conducts research in mathematics education. Dave Finston and Doug Kurtz work with high school teachers. Reinhard Laubenbacher and David Pengelley develop materials for teaching with original sources. Ray Mines and Frank Williams study ways to implement Total Quality Management techniques in the classroom. Five faculty members were supported on grants.

5. Professional Service Contributions

Members of the department play an important service role in the mathematical community. The department is an institutional member of the American Mathematical Society, the Mathematical Association of America, the Society for Industrial and Applied Mathematics and the Association for Women in Mathematics. It is an institutional sponsor of the *Pacific Journal of Mathematics* and

a member of the Rocky Mountain Mathematics Consortium. Twenty members of the department served as referees for journals and books, reviewers for the two major mathematical abstract journals, and referees for grant proposals to the National Science Foundation. Faculty members took part on five conference organizing committees and chaired two special sessions at national meetings. Several faculty members served on committees of mathematics organizations. Lolina Alvarez chaired the AMS-MAA Joint Program Committee for the annual meeting to be held in San Diego in January, 1997, and is a member of the AMS-SMM (Sociedad Matematica Mexicana) Joint Program Committee for the joint meeting in Oaxaca, Mexico, in December, 1997. Pat Baggett is an external reviewer of the state of Louisiana's Statewide Systemic Initiative program, an NSF-funded program. Kitty Berver was a member of the Editorial Board for the MAA's *Spectrum* series and editor of the Newsletter of the Southwest Section of the MAA. Ray Mines served as the department's representative to the Mathematical Association of America and as a member of the board of directors of the *Pacific Journal of Mathematics*. Hung Nguyen was an Associate Editor of seven journals. David Pengelley was a member of several MAA committees, including the Committee on the Participation of Women, the Subcommittee on Service Courses of the Committee on the Undergraduate Program, and the Panel of Visiting Lecturers, and a member of one editorial board. Charles Swartz was the department's representative to the Rocky Mountain Mathematics Consortium. Joe Zund was a member of three Special Commissions of the International Association of Geodesy, and the chair of one Special Subcommission. He served on one committee of the American Geophysical Union.

Members of the department help to meet the university's service mission. Three faculty members serve on the Vice President's Committee on Mathematics Courses for Engineering Students. Members of the department served on the Disability Resource Advisory Board, Distinguished Visiting Professor Committee, the Educational Diagnostician Advisory Council, the Faculty Senate, including serving as the Senate's representative to the University Research Council, the General Education Course Certification Committee, the General Education Outcomes Assessment Committee, the Outcomes Assessment Committee I, the Ralph B. Crouch Memorial Prize Committee, and the Westhafer Award Committee, and as a liaison to the Minority Engineering Program. Faculty members served on self-study review teams for the Departments of Accounting and Business Computing Systems, Agricultural Economics, Computer Science, Nursing and Physics, and the Developmental Studies Program at the Doña Ana Branch Community College.

The department had representatives on the Curriculum and Educational Policies, Faculty Affairs, Improvement of Instruction and Student Relations, Networking and Research Affairs Committees in the College of Arts and Sciences. Faculty members served as outside members on tenure and promotions committees for the Departments of Art, Astronomy, Chemistry, Computer Science, Geological Sciences, History, Physics, Philosophy, and Psychology. Faculty members also served as advisors in the College of Arts and Sciences Advising Center and as advisors to student organizations. All department faculty members participated in committee work within the department.

6. Local Community Relations

The implementation of a research program in mathematics education immediately led to increased and improved interactions with local public schools. Pat Baggett reorganized Math 111 (Fundamentals of Elementary Mathematics I) in the fall of 1995 and ran it concurrently with a special topics Math 501 course. She has continued this arrangement in the follow-up course, Math 112, in the spring, and again this fall in Math 111. Elementary education majors in these courses were paired with practicing teachers enrolled in the concurrent graduate course, who acted as mentors to the pre-service teachers, allowing them to observe, co-teach, and finally teach alone, in their classrooms. As a part of these courses, Pat taught approximately once a week in a public school (K-8) classroom, usually a classroom of one of the participating teachers, as a guest instructor. The in-service teachers received free tuition: in the spring semester, the Las Cruces Public Schools' Teachers' Center made available one tuition scholarship per school; this fall, the teachers are funded by a grant from the New Mexico Commission on Higher Education. Several of the approximately 40 in-service teachers who took such a Math 501 course offered to continue to partner with the elementary education students in future semesters. In addition to these courses, Pat helps the local schools by teaching a class a week in elementary and middle schools, and she gave a workshop and taught an eighth grade class in Gadsden.

The department finished the fifth year of the high school mathematics program, funded by the Teacher Preparation and Enhancement program of the National Science Foundation. Principal investigators Dave Finston and Doug Kurtz directed this initiative which incorporates discovery learning, cooperative learning and writing in mathematics. Mathematics teachers from Las Cruces, Mayfield and Oñate High Schools have participated in the program. It has been recognized

by the National Council of Teachers of Mathematics, the Southwest Educational Development Laboratory, the Eisenhower Clearinghouse for Mathematics, and Science Education and the Annenberg/CPB Guide to Math and Science Reform, and is listed in databases managed by the last three organizations.

Dave Finston worked with local high school teachers Roger Greer and Marilyn Gutman to run a one-week institute for elementary and middle school teachers from around New Mexico. This workshop was part of the state's Systemic Initiative in Math and Science Education program. Through the interaction with SIMSE, the department has been a positive influence on the teaching of mathematics and science throughout the state of New Mexico.

For the eighth year in a row, the department hosted the "NMSU Math Challenge", three competitions for high school students. This year, the modelling competition was expanded to two levels: The Level I problem, "Your Comet" required Algebra II skills, and the Level II problem, "The Remains of the Cup" required algebra, geometry, and trigonometry skills. The top two teams in each category presented their solutions orally to the judges and interested spectators on Saturday, April 13. Later that same day, there was a quick-answer, fast paced bowl contest where seven four-member high school teams competed against the clock and each other to solve problems from algebra, geometry, and calculus. For the first time this year, the travelling trophy was won by Alamogordo High School. In addition to the two team activities, 473 students from seven high schools competed in a two-part sequence of written examinations. Three top-scoring students were recognized with awards of calculators.

The department maintains several display cases in public areas in Science Hall, near the department office. These help to introduce visitors to the members of the department and to give timely information about mathematical topics of current interest.

Three faculty members serve on a joint committee with members of the Doña Ana Branch Community College mathematics faculty. Their activities include working to develop a smooth transition from branch college to main campus mathematics courses, arranging mini-conferences involving members of both faculties at the beginning of each semester, and sponsoring the "After Math" contest in the student newspaper.

The department supports university and state activities by providing space for organizations on campus. It has housed the university's Women's Studies Program for several years. It converted a seminar room into the office of the southern coordinator for the New Mexico MESA (Mathematics Science Engineer-

ing Achievement) program.

7. Outside Relations

The department continued to take an active part in the national and international mathematics communities, and has been visible through publications, presentations and appointments to professional organizations. Several faculty members spent funded visits at prestigious institutions. The department continued to attract eminent visitors to present lectures during their visits to New Mexico State University. The department hosted two Distinguished Visiting Professors in the fall. Jane Jarrow, Director of Disabilities, Access, Information, and Support, discussed accommodations for students with disabilities, and David Eisenbud of Brandeis University lectured on algebraic geometry, commutative algebra and computational algebra. The twenty-second Holiday Symposium on “Rewriting Techniques and Noncommutative Groebner Bases” will convene from January 3-7, 1997. The main speakers, Edward Green, Virginia Polytechnic Institute, and Derek Holt, University of Warwick, will speak on techniques from computational algebra and theoretical computer science, with applications to the theory of associative algebras and computational group theory. The department hosted the twice yearly New Mexico Geometry and Topology Seminar, which is run in conjunction with the University of New Mexico.

An indication of the stature of the department outside the university is the interest and assistance we have received from national organizations concerning our dispute with the dean of the College of Engineering. At our request, the president of the Mathematical Association of America sent a letter to Vice President Conroy in support of the department. Leaders of the American Mathematical Society were, and are, willing to provide similar documentation, though we requested that they withhold their support until a later time.

Another way the department gains recognition is through the performances of its students, who compete on the Putnam Examination and the national Mathematics Modeling Competition. The two teams that entered this year’s modeling competition received ratings of “meritorious” and “honorable mention”.

8. Outcomes Assessment Activities

8.1. Undergraduate Outcomes Assessment Activities

The department's undergraduate program evaluation includes a survey for graduates of the undergraduate program and exit interviews with graduating seniors. The survey was devised by members of the Undergraduate Majors/Minors Committee and the university's Institutional Research office. It has been sent to graduates, but, unfortunately, at this time, only one student has responded. Members of the Undergraduate Majors/Minors Committee interviewed several graduating seniors, asking the following questions:

1. What are you hoping to do eventually with your major in mathematics? What are your plans for next year?
2. What were the best aspects of your mathematics major program?
3. What were the worst aspects of your mathematics major program? What changes would you suggest to improve the mathematics program?
4. Has your mathematics major program enabled you to: identify a mathematics problem? characterize solutions to it? develop procedures for arriving at solutions? possess the technical skills to carry out a solution?
5. Has your mathematics major program enabled you to: read and understand mathematical writing? write and communicate mathematics in clear and understandable fashion? Has your mathematics major program enabled you to understand proofs of correctness of mathematical results?

8.1.1. Results of our Assessment Activities

Career goals of graduating majors are varied, including graduate study, teaching, and jobs in fields that use mathematical training. Students felt that projects and themes have improved their writing abilities and that mathematics courses have provided them with the ways and means to solve practical problems. Suggestions from the students interviewed included the introduction of: a senior-seminar course, courses on teaching, courses on historical content.

A senior-seminar course has been proposed and a flimsy has been approved for fall, 1997. The department has two courses on historical content. Additional courses on this subject and mathematics education are being developed at the

graduate level, some of which will be appropriate for undergraduate students. At the end of the spring semester, the department decided to require a 400-level theory-based course to improve our students' ability to read and do proofs.

The Undergraduate Majors/Minors Committee has undertaken several initiatives to improve communication with undergraduate majors. Electronic communication and WorldWideWeb pages are two ideas being pursued.

8.1.2. Proposed Changes in Assessment Activities

Our original plan proposed the use of a senior seminar course to assess our program. While developing such a course, we determined that while a senior seminar course was a good programmatic decision, developing a course merely for outcomes assessment was not. We decided to separate the two ideas. Accordingly, we chose to replace the senior seminar course with exit interviews. We do not plan any other changes in our outcomes assessment program at this time.

8.2. Graduate Outcomes Assessment Activities

The assessment of our graduate program includes a survey of graduates with advanced degrees and an evaluation of the performance of our graduate students on master's and doctoral examinations. The Institutional Research office sent out the survey, but we have received only two responses. Eight students passed their master's examinations, with several performing particularly well. We currently have fifteen students working on their doctorates, who have successfully passed their comprehensive examinations.

8.2.1. Results of our Assessment Activities

Master's Program Changes We have found that students who take the sequences MATH 481-482 (abstract algebra and applications to linear algebra) and MATH 491-492 (introduction to analysis) handle themselves better at the master's exams than students who do not. Therefore, the department decided that the course requirements for the master's degree be strengthened to require these two sequences of all students. Further, stricter limits on the number of reading course credits that could be used toward the master's degree will be imposed. By making these changes we hope to raise the average level at which our master's graduate students function, as well as narrow the spread by increasing the amount of material held in common by all the students.

Ph.D. Program Changes We observed that the sequence MATH 541-542 (topology and algebraic topology) is often troubled by a relatively low retention rate. A review of student files established that only 4 or 5 out of a group of 20 students had ever had a course in topology. In view of this fact, the department chose to extend the topology sequence to three semesters by adding an introductory course MATH 453 to the list of preparatory courses listed on the syllabus for the Topology Comprehensive Examination. We decided to add to the syllabus some material from MATH 451, the department's introductory course in differential geometry, due to the flurry of activity in areas of mathematics that weave together concepts of topology, differential geometry, and physics. With this addition the title of the exam was also changed to the Topology and Geometry Comprehensive Examination. A prototype of the new course has already been offered and will be offered again in the Spring of 1997. The Topology and Geometry Comprehensive Examination will be offered for the first time in August, 1998.

8.3. Research Outcomes Assessment Activities

The proposal to assess the research program incorporated the university's mission with proposals from the American Mathematical Society, and involved the research production of faculty members and participation of graduate and undergraduate students in research and creative activities. The research production of the faculty is assessed by the percentage of the tenure-track faculty members who publish research results during each three-year period. This percentage should be at or above the average for Carnegie I Research Universities, which was 84% for the fall of 1994.

8.3.1. Results of our Assessment Activities

Over 93% of the tenure-track faculty members published research results during the past three years. Faculty members offered special-topics courses in pure and applied mathematics and mathematics education to both undergraduate and graduate students, introducing them to ideas at the cutting edge of these fields. The department offered five special topics courses in the spring and four in the fall. The majority of the faculty use problem-solving and writing assignments in their classes. Our students continue to participate in national mathematics competitions, and are often acknowledged for their performances. They competed in the Putnam Examination and the Mathematics Modeling Contest. Faculty members directed the research of a McNair student.

9. Department Self-Study

Part of the university's review process is university-wide self-studies, which began in spring, 1995. The department volunteered to be one of the first in the College of Arts and Sciences to perform a self-study. As the follow-up to the self-study, we proposed the following three activities:

1. Develop a research program in mathematics education.
2. Receive permission to hire visiting faculty members beginning in March for the following academic year.
3. Increase the number of minority students in our graduate program.

We made much progress on the first item. We hired a senior mathematics educator. She has begun to draft proposals for a graduate program in mathematics education and guidelines for hiring and evaluating future mathematics educators.

We made no progress on the other two initiatives. Uncertainties about changes in the university's budgeting procedures have kept the dean from granting permission on item 2. The budget recision left the department with insufficient funds to advertise or travel to recruit minority graduate students.

10. Computing Facilities

The department currently has nineteen *Sun* computers, including three *Sun* servers, nine *NCI* X-Windows terminals, sixteen *IBM* compatible 586-based PC's, forty-nine *IBM* compatible 486-based PC's, including one *Novell* server, five *IBM* compatible 386-based PC's, three *IBM* compatible 286-based PC's, twelve *Power Macintoshes* and one *Macintosh*, and an assortment of terminals. These machines are used by faculty members and graduate students for research and for the preparation of teaching materials and the handling of student grade records.

The department maintains three computer labs incorporating state-of-the-art equipment and software. The undergraduate lab houses twenty networked personal computers, equipped with the mathematics word processing and computing software, *Scientific WorkPlace*, designed by Adjunct Professor Roger Hunter, and the symbolic computing software, *Maple*. This lab has been used for students in calculus, linear algebra and several graduate-level courses. The graduate students' lab is equipped with 7 UNIX machines and two personal computers. A

new mathematics education computer lab houses four *Power Macintoshes*, with additional machines soon to be added. The equipment for this lab was purchased with grant funds. Three 286-based PC's, provided with educational software that addresses the development of skills in algebra and trigonometry, are being used by students in the Mathematics Learning Center.

11. Advanced Degrees Awarded in 1996

Name	Degree
Jeff Holland Advisor: Reinhard Laubenbacher	Master's
Tuesday Johnson Advisor: Reinhard Laubenbacher	Master's
Stuart Wilber Advisor: Pat Morandi	Master's
Helen Nam Advisor: Susana Salamanca-Riba	Master's
Vrushali Bokil Advisor: Richard Bagby	Master's
Jason Bright Advisor: Reinhard Laubenbacher	Master's
Daniel Fish Advisor: Susana Salamanca-Riba	Master's
Edmund Sadler Advisor: William Julian	Master's
Debra Zarret Advisor: Charles Swartz	Ph.D.
Xenia Kramer Advisor: Reinhard Laubenbacher	Ph.D.

12. Departmental Colloquia in 1996

Mathematical Sciences Faculty, New Mexico State University, *Using Technology in Mathematics Instruction*, January 26, 1996, February 1, 1996.

Maria Amelia Muschietti, University of La Plata, Argentina, *Determinants of Elliptic Boundary Problems*, February 13, 1996.

Andrew Lewis, California Institute of Technology, *The Symmetric Product and Geodesic Invariance in Geometry, Mechanics, and Control Theory*, February 20, 1996.

John Harding, Brandon University, *The Source of the Orthomodular Law*, February 22, 1996.

Deborah Cotten, Vanderbilt University, *Order Theory and its Applications to Theoretical Computer Science*, February 26, 1996.

Aderemi Kuku, University of Ibadan, Nigeria and International Center for Theoretical Physics, Trieste, Italy, *Higher K -theory of Orders, Group-Rings, and Modules Over EI -Categories*, February 29, 1996.

Cynthia Woodburn, Pittsburg State University, *Completing a Unimodular Row to an Invertible Matrix Over a Monoid Ring*, March 28, 1996.

Judith V. Grabiner, Pitzer College, Claremont, California, *Maclaurin Among the Molasses Barrels: Mathematics and Society in Eighteenth-Century Britain*, April 1, 1996.

Clayton Sherman, Southwest Missouri State University, *K_1 of Exact Categories*, August 19, 1996.

William Kalies, Georgia Institute of Technology, *Bistable Systems and Slow Motion in One Space Dimension*, August 23, 1996.

James Pommersheim, University of California, Berkeley and New Mexico State University, *Counting Lattice Points, Toric Varieties, and Zeta Functions*, September 5, 1996.

Erich Peter Klement, Johannes Kepler University, Linz, Austria, *Generalized Measures and Related Topics*, September 12, 1996.

Fred Richman, Florida Atlantic University and New Mexico State University, *The Fundamental Theorem of Algebra and the Axiom of Choice*, September 19, 1996.

Jane E. Jarrow, NMSU Distinguished Visiting Professor, *Teaching Mathematics to Students with Disabilities: Legal Responsibilities and Educational Imperatives*, September 27, 1996.

Luchezar Avramov, Purdue University, *Homological Algebra: A Tool For Studying Systems of Linear Equations*, October 8, 1996.

Hanspeter Kraft, Universität Basel, *Constructive Invariant Theory - Old and New*, October 17, 1996.

Johann Boos, Fern University, Hagen, Germany, *Restricted Closed Graph Theorem*, October 22, 1996.

Bruce Magurn, Miami University, Oxford, Ohio, *Milnor's Multiplication*, October 24, 1996.

David E. Smith, NMSU Department of Chemistry and Biochemistry, November 14, 1996.

13. Faculty Publications in 1996

Josefina Alvarez

Alvarez, J., "Continuity of Calderón-Zygmund type operators on the pre-dual of a Morrey space". In *Clifford algebra in analysis and related topics*, CRC Press, Inc. (1996) 309-319.

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Ehrenfeucht, A. and Baggett, P., A new elementary school math program using projects and calculators. Project Presentation. ICME-8 (International Congress of Mathematics Education), Sevilla, Spain, July 14-21,1996. (This was a Project Display, one of 10 in the world accepted.)

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Gerald Dunn

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Mai Gehrke

Pengelly, D. and Gehrke, M., "Towards Active Processes for Teaching and Learning", in *Calculus: The Dynamics of Change* (ed. A. Wayne Roberts), MAA Notes 39:20-23, Mathematical Association of America, 1996.

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Laubenbacher, R., “History of Mathematics and the Internet”, *Newsletter of the British Society for the History of Mathematics* **28**, pp. 56-57.

Jerry Lodder

Lodder, J.M., “Dihedral Homology and Hermitian K-Theory, *K-Theory*, Vol. 10, 1996, pp. 175-196.

Patrick Morandi

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Walker, E. and Nguyen, H., *A First Course in Fuzzy Logic*, (1996). Textbook, CRC Press.

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