Department of Mathematical Sciences Annual Report for 1994

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1 Special Accomplishments

The Department of Mathematical Sciences and its faculty members are recognized internationally for their work on research and curricular activities. Professor Josefina Alvarez presented a series of six invited one-hour lectures at the Universidad Nacional Autonoma de Mexico in August, 1994. Associate Professor Jerry Lodder has spent the last three summers conducting research in France and he was invited to speak at the Fields Institute for Research in Mathematical Sciences in Waterloo, Canada, in the spring. Associate Professor Pat Morandi spent a week during the spring as a Distinguished Visitor at California State University in Northridge. Professor Hung Nguyen spent the past summer as a Visiting Professor at the University of Paris. While in Europe, he spoke at the International School of Mathematics in Italy and

chaired a session at the International Conference on Information Processing and Management of Uncertainty in Paris. Professor Joseph Zund was selected as this year's recipient of the Sixth Annual Ralph B. Crouch Memorial Prize. The high school curriculum development program has received national recognition and is having an impact on mathematics education around the state.

This was a very productive year for faculty researchers in mathematical sciences and several faculty members received continuing support for their research. Ernie Barany was awarded a Sandia/University Research Program research grant, Dave Finston and Mai Gehrke were supported by a grant by the National Security Agency for research in algebra and logic, Mai Gehrke was awarded a grant by the National Science Foundation to conduct research in algebra, Susana Salamanca-Riba was supported by the National Science Foundation for work in Lie group representations and Joseph Zund was supported by the Air Force for research in mathematical geodesy. Susan Hermiller spent the year conducting research in Australia supported by a grant from the Division of International Programs at the National Science Foundation. The Department continued to build its reputation as a center for mathematical research in algebraic topology and algebraic K-theory, in algebra, and in analysis.

Many faculty members in the department are active in curricular change, effecting courses ranging from algebra and trigonometry through our graduate-level offerings. Reinhard Laubenbacher and David Pengelley were recently awarded a grant by the National Science Foundation to write a textbook on the teaching of mathematics using historical sources. Faculty members continue to present workshops explaining calculus reform in our department, and our faculty members are in demand as speakers at conferences and workshops. Jerry Lodder was a presenter and panelist at the NExT conference.

The Mathematics Learning Center has continued to develop the college algebra and trigonometry curriculum in order to effectively exploit graphing calculator technology. This fall, two pilot sections of intermediate algebra were taught using the graphing calculator in preparation for using graphing calculators with this population as well.

The principal investigators on the high school program mentioned above, Dave Finston and Doug Kurtz, worked with local high school mathematics teachers throughout 1994, developing a program incorporating discovery learning, cooperative learning and writing in mathematics, with continuing support from the National Science Foundation. This program 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. Additionally, Dave Finston and Doug Kurtz have received five grants from the state of New Mexico, funded by the Commission on Higher Education (CHE), the State Department of Education (SDE) and the Systemic Initiative in Math and Science Education (SIMSE). These have supported

two one-week and one three-week workshops to train elementary and middle school teachers from around New Mexico to use writing assignments to teach mathematics, and the creation of additional projects for high school classes.

The department brought in noted speakers from diverse areas of mathematics and attracted many visitors. It continued its Holiday Symposium Series, which brings outstanding mathematicians to campus for a series of in-depth lectures, with a research conference on manifold and gauge theory held last December. The main speaker was Clifford Taubes of Harvard University. For the past two years, our Holiday Symposium has been supported by grants from the National Science Foundation. Our next symposium will be funded by the National Security Agency and the National Science Foundation. The featured speaker will be Bernd Sturmfels of the University of California, Berkeley. He will extend his stay as a Distinguished Visiting Professor. In addition, Louis Kauffman from the University of Illinois, Chicago Circle, visited NMSU as a Distinguished Visiting Professor. In an effort to educate the faculty about mathematics education, we invited nationally acclaimed educators Stephen Willoughby from the University of Arizona and John Harvey from the University of Wisconsin to consult with members of the department. We hosted the twice yearly New Mexico Geometry and Topology Seminar, which is run in conjunction with the University of New Mexico. The department scheduled weekly colloquia throughout the academic year, involving several outstanding invited speakers as well as department faculty members.

For the sixth year in a row, the department hosted the Math Challenge for high school students from regional high schools. The Math Challenge consists of three different contests: an individual competition, a team bowl competition, and a team modeling competition.

Faculty members remained active as officers and committee and board members of regional and national professional organizations. Several faculty members have served as chairs and organizers of special sessions at national and international conferences. The majority of faculty members serve as reviewers and referees, and two are journal editors.

The computing facilities in the department received a major improvement with the donation of two large file servers from Sun Microsystem Lab, Inc., in California. These computers more than double the department's networked computing power and storage capabilities.

As a final note, we are pleased to record the accomplishments of two of our mathematics majors. Alan Giuliani was selected as the Outstanding Senior in the College of Arts and Sciences and Brett Nelson was awarded a Barry Goldwater Foundation Fellowship.

2   Personnel Changes

The department hired two new Assistant Professors this year, Susan Lee and Tonghui Wang. Susan Lee received her Ph.D. at Cornell University, with a specialty in probability. After finishing a Ph.D. in statistics at the University of Windsor, Ontario, Canada, Tony Wang spent two years at New Mexico State University as a Visiting Assistant Professor. They were hired to replace Carol Walker, Associate Dean of the College of Arts and Sciences and Director of the Arts and Sciences Research Center, and Roger Hunter, who resigned to devote his attention full-time to his software company. The two of them were hired as part of a departmental effort to continue our research program in probability and statistics. We will be interviewing during the current year to replace Joseph Kist, Arthur Knoebel and Mark Mandelkern, who have retired, and Gerald Rogers, who will retire at the end of the 1994-1995 academic year.

The ability to hire high quality faculty members is aided by the collegiality of our faculty members. Almost every candidate we interview comments on the positive feeling they have while here and the special attention we pay them during their visits. Short term visitors respond the same way. Another indication of this collegiality was demonstrated in a conversation I had with junior faculty in the spring. I asked them about creating a mentoring program in the department. They saw no need for such a program and felt it would detract from the openness in the department they currently feel.

For the past several years, the department has had a significant need for additional mathematical statisticians. The decision to actively recruit Professors Lee and Wang demonstrates the department's resolve to target hiring goals for the benefits of our programs. In this direction, we have begun discussions in the department to identify other research areas of interest and to set hiring goals in those areas. We have had a yearlong dialogue about mathematics education. Having received support from the administration, we will pursue two tenure-track faculty appointments in that area to allow us to successfully renew our program in mathematics education.

One new college-track faculty member, Alyne Cotton, was hired to support our teaching activities in the Mathematics Learning Center. She replace Norma James who retired over the summer.

The department hired several visiting researchers to continue research with members of our tenure-track faculty. This year, Visiting Professor Piotr Antosik, an analyst from in Poland, Visiting Assistant Professor Sebastian Walcher, an algebraist at the Technical University, Munich, Germany, and Visiting Assistant Professor Michael Slack, a topologist currently at the University of California, San Diego, will be conducting research with NMSU faculty members and teaching mathematics courses.

3 Curricular Activities

There has been much attention and innovation in mathematics education during the past five years, and faculty members in the Department of Mathematical Sciences have had an impact on college, high school and, more recently, elementary and middle school curriculum. Members of the department have participated in several diverse educational development programs and activities. The majority of the department's faculty members are involved in at least one of these programs. Our internationally recognized "student research projects" program has brought attention to the department. The program emphasizes discovery learning through the inclusion of student research projects in mathematics courses. It was begun in our calculus classes, but has since spread to many other courses at the undergraduate and graduate levels. During the past year, faculty members gave workshops and talks about our projects program and its extensions at regional and national conferences, and on other campuses. Jerry Lodder was an invited presenter and panelist at the New Experiences in Teaching (NExT) conference in August, a conference aimed at new mathematics professors. Doug Kurtz gave a workshop at the Fifth Annual San Jacinto College Conference on Technology Focusing on Graphic and Symbolic Calculators. Two of the high school teachers who participated in the high school program, Roger Greer and Marilyn Gutman, spoke about our program at the Annual Joint Meeting of the American Mathematical Society and the Mathematical Association of America. This has given us the opportunity to tell the mathematics community about the evolution of our ideas about the use of writing in mathematics courses.

In a refinement of our original work with projects and motivated by newer faculty members becoming involved in the program, we have incorporated project-like activities into the classroom of our calculus classes, using assignments we call "themes". This involves the students in discovery-based cooperative learning activities covering the core material of the course. We have made several presentations on our use of themes, getting very positive receptions.

The use of projects and themes has been adapted to many other courses in the department, in fact, too many to list. Ideas about discovery learning and cooperative learning have been incorporated into many of our advanced courses, including some graduate courses.

The book *Student Research Projects in Calculus*, written by Marcus Cohen, Ed Gaughan, Arthur Knoebel, Doug Kurtz and David Pengelley was published by the Mathematical Association of America and has sold over 3000 copies in its first two years and is already in its second printing. Recently, 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. Marcus Cohen is bringing these ideas into our vector calculus and differential equations courses and is working on a book based on the materials he has prepared. Don Albers has solicited a proposal for a book about our themes courses, which is being written by Lolina Alvarez, Mai Gehrke, Doug Kurtz, Pat Morandi and Ross Staffeldt.

Members of the department meet with faculty members from client departments and we were in contact with the mathematics departments at our branch campuses for their feedback concerning the content of our courses. This past year, we met with faculty members from agriculture, business, biology and chemistry and biochemistry to discuss our Math 142G course, a calculus course that serves students from those departments, as well as Math 230 and Stat 251. Recent discussions with members of the Department of Chemistry and Biochemistry led to a change in their mathematics requirement for a Bachelors of Arts Degree.

Ray Mines and Frank Williams have done curriculum development work with members of the Department of Computer Science. They have revised the finite and discrete mathematics courses that are taken by both computer science and mathematics students as part of their majors, so as to coordinate the teaching of materials in mathematics and computer science courses. This work explicitly applies Total Quality Management principles to the improvement of student learning. They both taught the discrete mathematics course in the fall to further implement their ideas and to work on a new textbook for the course.

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. Our involvement with the Dona Ana Branch Community College and the Las Cruces Public Schools, as well as the state through the SIMSE program, represents avenues of communication with some of our "suppliers". Departmental faculty members are increasingly making use of Total Quality Management principles in their courses, and much of the curriculum development listed in this report makes use of these principles.

We run a computer lab containing computers equipped with the mathematics word processing and computing software, *Scientific WorkPlace*, designed by Adjunct Professor Roger Hunter. The software allows for easy input of mathematical expressions and performs numerical and symbolic computations. Students in several undergraduate courses, including calculus and linear algebra courses, and graduate courses use this software, and the number of course using the lab increases every year. In addition, this software serves as the foundation for a new test-generation system which was developed by *TCI Software Research, Inc.*, for use by the Mathematics Learning Center.

Members of the Mathematics Learning Center faculty have been actively involved in activities which support teaching with technology. Sue Liefeld and Emily Woods

were supported by the National Science Foundation as participants in a two week technology strategies workshop at the Ohio State University this summer. Kitty Berver was a presenter at the seventh annual International Conference on Technology in Collegiate Mathematics and at regional conferences in Arizona and New Mexico. Faculty members have developed a number of activities to support students, tutors, and instructors in the use of the graphing calculator. The department has continued to offer a leasing program to students as a low cost alternative to purchasing a graphing calculator. Texas Instruments donated 15 TI-82 calculators, 6 TI-85 calculators, overhead projector models of both calculators, and computer linking software to the department. Sharp and Casio also donated calculator models for instructor and graduate assistant support. A series of graphing calculator workshops have been given each semester for student and tutor enhancement, and a number of calculator programs for student use have been developed. A survey done in October indicates that the calculators have been integrated smoothly into the college algebra and trigonometry courses. Pilot sections requiring the graphing calculator were taught in intermediate algebra this fall, and plans are being made to eventually use the graphing calculator in the department's largest course.

Several faculty members are active in the Honors program at the university. Reinhard Laubenbacher and David Pengelley developed two courses offered jointly as Honors and Mathematics courses, and both 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. Tom Hoeksema, director of the Honors program, has given significant support to these courses. Laubenbacher and Pengelley are working on manuscripts of books from both courses and they have been awarded funding from the National Science Foundation to write a textbook on the teaching of mathematics using historical sources based on the sophomore-level course. Further, they are designing a teacher enhancement course to train high school teachers to use similar materials in their own courses.

The department continued its leadership role in the university's General Education program. We offer six courses — Math 110G, Math 112G, Math 142G, Hon/Math 275G, Hon/Math 411G, and Stat 210G — that meet the General Education guidelines. Math 110G (Mathematics Appreciation) presents a broad view of mathematics, outlining important directions of the discipline. Both Math 110G 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. We have renumbered Math 110G as Math 210G and we have recently requested that English 111G be a prerequisite for the course, to better reflect the level of the material and the maturity necessary. Math 112G and Math 142G have been expanded to encompass the spirit of General Education. Hon/Math 275G and Hon/Math 411G view math-

ematics as a human endeavor and discuss great mathematical ideas in the historical context in which they developed.

This year, we taught forty-five sections of General Education courses, half of which represent new offerings to meet the demands placed on the department by the General Education requirements. At this time, the department has received no resources to address our needs in this area. One tenet of General Education is that tenure-track faculty teach General Education courses. Due to the increase in course load, over ten courses per semester, and the loss of two faculty positions, the department needs an additional eight tenure-track faculty members to address its teaching mission. Without the additional support needed, it has been necessary for us to use graduate teaching assistants to teach many of these sections of General Education courses.

One of our graduate students completed her doctorate in 1994. Cynthia Woodburn wrote her thesis, "An Algorithm for Suslin's Stability Theorem" under Reinhard Laubenbacher; she has accepted a tenure-track position at Pittsburg State University in Kansas. The department also awarded fourteen master's degrees during the year. We have forty-three mathematics graduate students enrolled this year, with thirty-four full-time students and nine part-time students. We continue to successfully attract both women and minorities; two of our graduate assistants are supported by CHE fellowships. The Graduate Studies Committee implemented a new departmental foreign language requirement for the Ph. D. degree. We run two new seminars designed specifically for graduate students; one has graduate students make presentations on curricular issues and the other has them give research talks. We revised our graduate assistant orientation program to provide all new assistants with a more complete introduction to our various courses and teaching innovations. The program included information about the Mathematics Learning Center, general education and our calculus curriculum.

Student advising is handled by special departmental committees. Undergraduate mathematics majors are advised by members of the Undergraduate Majors/Minor Committee. This committee nominates our 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. In particular, she monitors students repeating a Mathematics Learning Center class more than one time. Two special sections for learning center courses are offered. She tracks Native American students and acts as liaison with the American Indian Program Office and Student Support Services. She is also the departmental Americans with Disabilities Act (ADA) contact.

One strength of our 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 of our other classes.

We currently have several courses under revision or development. We are implementing a revised program in discrete mathematics, following course development supported by the grant with Computer Science. Faculty members are involved in creating an undergraduate course in topology and a graduate course on braid groups, which will be designed to interest doctoral students in physics as well as mathematics. As part of the program to assess the outcomes of student learning , we are creating a seminar course for mathematics majors. Faculty members design and offer special topic, graduate-level courses at the interface of theoretical mathematics and applications. We offered courses on non-linear dynamics and the philosophy of mathematics in the spring, and courses on topology and knots, Gröbner bases, and wavelets in the fall. Mathematics faculty members are involved in discussions of a possible new interdisciplinary doctoral program in cognitive science.

Our Teaching Committee is active in overseeing the coordination of multi-section courses and classroom observations of faculty members and graduate student teaching assistants. They sponsored a series of teaching colloquia, which have included topics such as the use of *Scientific WorkPlace* in mathematics classes and Total Quality Management in higher education.

As mentioned above, the department is active in curricular programs outside the university. Several faculty members continued to work with secondary mathematics teachers with support from an National Science Foundation-funded Teacher Enhancement grant. Work on a resource book about the high school projects, designed for high school mathematics teachers, is underway. An outgrowth of this program is the work of Dave Finston and Doug Kurtz on pre-high school curriculum. Over the last two summers, they have received five grants from the state, four to support work with elementary and middle school teachers and one to create high school projects. Working with local high school teachers Roger Greer and Marilyn Gutman, they have run two one-week and one three-week institutes to train elementary and middle school teachers from around New Mexico to use writing assignments to teach mathematics. These institutes have been highly rated by participants and the SIMSE staff, and they have been used as models of successful institutes for the remaining years of the SIMSE program. Guidelines for future institutes have been rewritten so that they conform more closely to their format.

4   Research Activities

Members of the department have been productive in research this past year. Twenty-five of the tenure-track faculty members had a total of forty-four papers appear in

print, forty papers accepted for publication, and twenty-five papers submitted for publication. In addition, they published one graduate textbook and one series of textbooks (eighteen books in all) for elementary school mathematics books, five books accepted for publication and three others submitted. Faculty members also have at least seven books in preparation, including research texts, graduate and undergraduate texts, and college- and high school-level educational resource books. Faculty members presented twenty-four talks on their research at conferences and seventeen talks at other universities, one play, and delivered two workshops on curricular development and mathematics education.

Much of the research being conducted by members of the department is joint work with faculty members at other institutions. Several conducted research while on leave from the university: Susan Hermiller at the University of Melbourne, Australia; Gerald Lodder at the Université Louis-Pasteur in Strasbourg, France; Hung Nguyen at the University of Paris; and Ross Staffeldt at several institutions in Germany. Gerald Dunn (St. Louis), Reinhard Laubenbacher (Cornell University), Caroline Sweezy (University of Chicago) and Frank Williams (Massachusetts Institute of Technology) spent part of the year on sabbatical leave working with researchers at their host institutions. One of our graduate students earned her Ph. D. degree this past year.

As we mentioned above, several faculty members received continuing support for their research. Six faculty members conducted research with funding from the National Science Foundation, the National Security Agency, the Air Force, or Sandia National Laboratory. Additional research funds came from the National Science Foundation to support the Holiday Symposium. Four faculty members have 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. Funding has come from the National Science Foundation, the New Mexico State Department of Education and the New Mexico Commission on Higher Education.

The previous Holiday Symposium, which took place in January, 1994, hosted a research conference on analytic gauge theory, featuring Clifford Taubes as the main speaker. The symposium was funded by the Conference Board of the Mathematical Sciences. Mathematicians from all over the world attended this event, and several of them presented talks. The upcoming symposium, scheduled for December, will receive partial funding from the National Science Foundation and the National Security Agency. Professor Bernd Sturmfels of the University of California will speak on "Gröbner bases and convex polytopes."

The New Mexico Geometry and Topology Seminar was started several years ago by mathematicians at the University of New Mexico and New Mexico State University to bring them together twice a year. We continued to co-host the seminars and several of our faculty members spoke this year.

The department sponsors several weekly seminars and a weekly colloquium. The seminars specialize in algebra, analysis, statistics, and algebraic topology. Almost all

faculty members and many graduate students attend at least one of the seminars.

Several faculty members are involved in studying the history of mathematics. An outgrowth of this was a dramatic presentation put on by Reinhard Laubenbacher and David Pengelley at the annual joint meeting of the American Mathematical Society and the Mathematical Association of America.

We have faculty members participating in interdisciplinary research. Ernie Barany is conducting joint research with faculty members in the College of Engineering, Bill Julian works with professors of astronomy, and our statisticians consult with researchers around campus. Ray Mines and Frank Williams study Total Quality Management in education. Ray 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, Susana Salamanca-Riba and Carol Walker. Five algebraists were supported on research grants.

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

Topology: Gerald Dunn, Gerald Lodder, David Pengelley, Ross Staffeldt and Frank Williams work in various areas of topology.

Geometry: Susana Salamanca-Riba, Arkady Vaintrob and Joseph Zund work in areas of pure and applied geometry. Two were supported on research grants.

Logic, **Foundations and Philosophy**: Mai Gehrke and Arthur Kruse conduct research in logic and foundations. Ray Mines has research interests mathematical philosophy. Ray Mines and Bill Julian contribute in areas of constructive mathematics. One is currently supported on a research grant.

Statistics and Probability: Hung Nguyen and Gerald Rogers contributed in statistics and probability, and we have added new faculty members Susan Lee and Tonghui Wang to this group.

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 geodesy) are active applied mathematicians. Two faculty members in this area were supported on research grants.

Mathematics Curriculum: Two National Science Foundation education grants were in effect during 1994, with Principal Investigators Dave Finston, Doug Kurtz, Reinhard Laubenbacher and David Pengelley. Dave Finston and Doug Kurtz were awarded five grants by the state of New Mexico, with funding from CHE, SDE and SIMSE to run workshops about projects for elementary and middle school teachers

and to create more projects for high school classes. Ray Mines and Frank Williams study meaningful ways to implement Total Quality Management techniques in the classroom.

5   Professional Service Contributions

The members of the department play an important service role to the mathematical community. Faculty members served on the editorial boards of seven journals. Seventeen members of the department served as referees for journals and books, reviewers for the two major mathematical abstract journals, and referees for grants to the National Science Foundation. Faculty members took part on conference organizing committees, for both national and international meetings. Several faculty members serve on committees of mathematics organizations. Lolina Alvarez is chair of the AMS Committee on Academic Freedom, Tenure, and Employment Security and a member of its Western Section Program Committee and the MAA Panel of Visiting Lecturers. Ray Mines is the department's representative to the Mathematical Association of America and a member of the board of directors of the Pacific Journal of Mathematics. Hung Nguyen is an Associate Editor of five journals, and Charles Swartz is an editor of two as well as the department's representative to the Rocky Mountain Mathematics Consortium. David Pengelley is a member of the MAA Committee on the Participation of Women and the Panel of Visiting Lecturers. Carol Walker serves on the AMS Committee on the Agenda. Joe Zund is a member of three Special Commissions of the International Association of Geodesy, and the chair of one Special Subcommission. Several faculty members serve on advisory boards for educational programs.

There were members of the department on the Advisory Council on Administrative Policy, the Distinguished Visiting Professor Committee, the Faculty Library Committee, the Faculty Senate, the NMSU Film Library, the Outcomes Assessment Committees I and III, the Parking Committee, the Ralph B. Crouch Memorial Prize Committee, the University Appeals Boards, the University Committee on Statistics, the University Discipline Committee, and the University Fellowship Committee. Our faculty members served as outside members on tenure and promotions committees for nine departments in the college — Art, Communication Studies, Criminal Justice, English, Geography, Geology, History, Philosophy and Physics. We have representatives on the Faculty Affairs, Improvement of Instruction and Student Relations, Networking and Research Affairs Committees. Faculty members also serve 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 department is finishing the fourth year of the high school mathematics program, directed by principal investigators Dave Finston and Doug Kurtz, which incorporates discovery learning, cooperative learning and writing in mathematics. This work is funded by the Teacher Preparation and Enhancement program of the National Science Foundation. Over thirty mathematics teachers from Las Cruces, Mayfield and Oñate High Schools have participated in the program, and new teachers continue to join the program. This program 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. This program is listed in databases managed by the last three organizations.

Several of the teachers, along with the principal investigators, have made presentations about the program at local and regional meetings. The most exciting was at the annual joint meeting of the American Mathematical Society (AMS) and the Mathematical Association of America (MAA), the two largest organizations of college mathematics researchers and instructors. At the January meeting, two of our high school teachers were invited to present the talk "Writing and project use in high school math classes" at the AMS-MAA Special Session on Mathematics and Education Reform. Of the twenty-five presenters at the four sessions held, they were the only ones who were not affiliated with a college or university.

As mentioned above, Dave Finston and Doug Kurtz have worked with local high school teachers to run two one-week and one three-week institutes about projects for elementary and middle school teachers from around New Mexico, and to write of new projects for high school classes. These workshops are part of the state's Systemic Initiative in Math and Science Education program.

Through the interaction with SIMSE, we are influencing the teaching of mathematics throughout the state of New Mexico. We have also been invited to meeting concerning the statewide educational programs "Project Connections" and the "School-To-Work Transition" program. In addition to this work at the state level, one faculty member has been involved with the mathematics curriculum revision currently being conducted by the Las Cruces Public Schools.

For the sixth year in a row, the department hosted the "NMSU Math Challenge", three contests for high school students. Students from Las Cruces High School, Mayfield High School, Oñate High School, Mesilla Valley Christian School, Gadsden High School and Silver High School participated. Ten student teams from six area high schools spent a weekend solving an original modeling problem, "The Lego Box". The top three teams were invited to the campus on April 23, 1994, to present their solutions orally to the judges and interested spectators. Later that same day, there was a quick-answer, fast-paced bowl contest where nine four-member high school teams

competed against the clock and each other to solve problems from algebra, geometry, and calculus. In addition to the two team activities, 436 students from six area high schools competed in a two-part sequence of written examinations. Six top-scoring students were recognized with awards of calculators and books.

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 them and us timely information about mathematical topics of current interest.

Two faculty members serve on a joint committee with members of the Dona Ana Branch Community College mathematics faculty. Their activities include working to develop a smooth transition from branch college to main campus mathematics courses and arranging mini-conferences involving members of both faculties at the beginning of each semester.

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 distinguished visitors to present lectures during their visits to New Mexico State University. Our Holiday Symposium Series brings outstanding mathematicians to campus for a series of in-depth lectures. We hosted the twice yearly New Mexico Geometry and Topology Seminar, which is run in conjunction with the University of New Mexico. This seminar meets semi-annually, alternating between Las Cruces and Albuquerque. (See section 4 on research.)

In another direction, the current research of Adjunct Professor Roger Hunter for his company *TCI Software Research, Inc.*, promises to have an impact on mathematicians around the world. This work centers on improving the interface between symbolic and numeric computations. This project began with the creation of the *Scientific Word* word processing system, an interface between the simplicity of the *Microsoft Windows* operating system and the computer type-setting system TeX, the current standard for the preparation of mathematical documents. The latest version of the software, *Scientific WorkPlace*, incorporates the power of the computer algebra system, *Maple*, to perform mathematical operations while working inside of *Scientific Word*. This gives the user a natural-language setup to input mathematics to *Maple*.

The Mathematics Learning Center continues to attract inquiries from faculty interested in developing similar programs. Kitty Berver is actively working with mathematics faculty at Indiana University-Purdue University at Fort Wayne in their quest to establish a pre-calculus program modelled on the Mathematics Learning Center.

Another way we gain recognition is through the performances of our students, who compete on the Putnam Examination and the national Mathematics Modeling Competition. On a more regional level, one mathematics major received a Barry Goldwater Foundation Fellowship and another was named the Outstanding Senior in the College of Arts and Sciences. We held our annual Honors Assembly Ceremony to honor achievement in mathematics. This year, after increasing our standards for selection significantly for the second year in a row, fifty students were recognized.

8   Outcomes Assessment

Members of the department have developed initial proposals for assessing the outcomes of student learning of our undergraduate majors and graduate students. We are currently creating a proposal to assess the outcomes of our research program. Though we have worked with little direction and no funding, and we have devised useful models to begin the implementation of outcomes assessment for the department. The department's leadership role in this area is enhanced by the participation of Richard Bagby on the university's Outcomes Assessment Committee I and Carol Walker on Outcomes Assessment Committee III.

The undergraduate program evaluation includes a seminar course for mathematics majors and a survey for graduates of our undergraduate program. We have drafted questions for the survey, which are currently being reviewed by the university's Institutional Studies office, which will conduct the survey. Members of our Undergraduate Majors/Minors Committee has spent over a year designing the format of the senior seminar course. The course will receive further consideration this year.

The Graduate Studies Committee has submitted a proposal for the graduate program. This involves a survey of graduates with advanced degrees and it has been submitted to the Institutional Studies office.

The proposal to assess our research program is currently being drafted. It will incorporate the university's mission with recent proposals from the American Mathematical Society.

9   Computing Facilities

The department currently has fifteen *Sun* computers, one *NeXT* computer, thirty-one *IBM* compatible 486-based PC's, eight *IBM* compatible 386-based PC's, eight 286-based PC's, many *IBM* PC's of an earlier vintage, 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.

We created a computer lab incorporating state-of-the-art equipment and software. A small equipment grant from *IBM*, support from the Arts & Sciences Research Center, and a software grant from *TCI Software Research, Inc.* allowed us to purchase and network eight 486-based PC's. This lab has been used for students in calculus, linear algebra and several graduate-level courses. We used money from Instructional Equipment Bond Issue Funds to add five more computers to this lab this year. 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.

This semester, the department received a major donation from Sun Microsystem Lab, Inc., which donated two Sun 4/490 file servers. Each computer has 128 Megabytes of RAM and 4 gigabytes of data storage. They are three years old and originally listed for \$150,000 each. These machines more than double the departments networked computing power and storage capabilities.

Over the past two years, we have reconstructed the entire computer network in Walden Hall. This summer, we have upgraded our main server for Unix machines and we are now in the process of installing a *Novell* network for DOS machines.

10 Advanced Degrees Awarded 1994

Name	Degree

Cynthia Woodburn
    Dissertation: "An Algorithm for
    Suslin's Stability Theorem"
    Co-advisor: Reinhard Laubenbacher
	Ph.D.

John Chamberlain Advisor: Doug Kurtz	Master's
Joseph Dotolo Advisor: Joaquin Loustaunau	Master's
David Emery Advisor: Patrick Morandi	Master's
David Harris Charles Swartz	Master's
Jing He Advisor: Charles Swartz	Master's
Suzanne Hill Advisor: Doug Kurtz	Master's
Chen Huang Advisor: Hung Nguyen	Master's
Gabrielle McIntosh Advisor: Josephina Alvarez	Master's
Sinn Pankayatselvan Advisor: Joaquin Loustaunau	Master's
Richard Reynolds Advisor: Ross Staffeldt	Master's
Karen Schlauch Advisor: Doug Kurtz	Master's
Denette Sinclair Advisor: Doug Kurtz	Master's
David Steinberg Advisor: Pat Morandi	Master's
Yuehui Tao Advisor: Doug Kurtz	Master's

11 Faculty Publications in 1994

JOSEFINA ALVAREZ

"On the $T(1)$ theorem on product domains", *Journal d'Analyse Mathématique,* 62 (1994), 155-167.

"Estimates with A_∞ weights for various singular integral operators" (with C. Pérez), *Bollettino della Unione Matematica Italiana,* (7) 8-A (1994), 123-133.

"H^p and *weak* H^p continuity of Calderón-Zygmund type operators", *Fourier Analysis, Analytic and Geometric Aspects,* Marcel Dekker (1994), 17-34.

MARCUS COHEN

"Making Calculus Students Think with Research Projects" (with D. Pengelley, A. Knoebel, D. Kurtz), invited chapter in *Mathematical Thinking and Problem Solving* (ed. A. Schonefeld), Lawrence Erlbaum Associates, Inc. (1994), pp 193-208.

DAVID FINSTON

"Fields of Ga invariants are ruled" (with J. K. Deveney), *Canad. Math. Bull.* (37) 1994, 37-41.

"Ga actions on $\mathbb{C}^n$" (with J. K. Deveney and M. Gehrke), *Comm. Alg.* (22), 1994, 4977-4988.

"Kernel estimations for multivariance regression" (with S. G. Staniswalis and K. Messer), *Journal of Nonparametric Statistics* (3) 1994, 103-121.

MAI GEHRKE

"Bounded Distributive Lattices with Operators" (with B. Jónsson), *Math. Jap.,* 1994, submitted, accepted, and published in 1994.

"Ga actions on $\mathbb{C}^n$" (with J. Deveney and D.R. Finston), *Communications in Algebra* 22(12), 4977-4988(1994).

SUSAN HERMILLER

"Rewriting Systems for Coxeter groups," *Journal of Pure and Applied Algebra* 92(1994) 137-148.

DOUGLAS KURTZ

"From Projects to Themes: The Evolution of Calculus Classes at New Mexico State University", invited section in booklet for *National Science Foundation summer calculus workshops program*, MacAlester College, 1992-1994, pp. 29-30 (with D. Pengelley).

"Calculus at New Mexico State University", *CASE Newsletter*, No. 17 (1993), 1-6.

"Making Calculus Students Think with Research Projects", invited chapter in *Mathematical Thinking and Problem Solving*, Alan Schoenfeld (ed.), (1994) Hillsdale, NJ; Lawrence Erlbaum Associates, Inc. (with M. Cohen, A. Knoebel and D. Pengelley).

REINHARD LAUBENBACHER

"Recovering Motivation in Mathematics: Teaching with Original Sources" (with D. Pengelley and M. Siddoway), *Undergraduate Mathematics Education Trends,* vol. 6, 1994.

"Eisenstein's Misunderstood Geometric Proof of the Quadratic Reciprocity Theorem" (with D. Pengelley), *College Mathematics Journal* 25 (1994), 29-34.

"Gauss, Eisenstein, and the "Third" Proof," Proof of the Quadratic Reciprocity Theorem: Ein Kleines Schauspiel" (with D. Pengelley), *Mathematical Intelligencer* 16 (1994), 67-72.

"Great Problems of Mathematics: A Summer Workshop for High School Students," (with M. Siddoway), *College Mathematics Journal* 25 (1994), 112-114.

JERRY LODDER

Book review of *Cyclic Homology* by J.-L. Loday, in *Mathematical Reviews*, 94a:19004, (1994), p. 149.

RAY MINES

"Representations and Duality," (with C. Vinsonhaler and W. J. Wickless of the University of Connecticut), Proceeding of the Overwolfach conference on Abelian Groups, *Contemporary Mathematics,* Vol. 171.

"Guaranteed Intervals for Kolmogorov's Theorem and Their Possible Relation to Neural Networks" (with Mitsumi Nakamura and Vladik Kreinovich), Proceedings of the International Conference on Numerical Analysis with Automatic Result Verification, Lafayette, Louisiana, USA, *Interval Computations* No. 3, p. 182-199.

"*Understanding the TQM metaphor in Higher Education*", (with Frank Williams), scheduled for publication in *Higher Education* in November, 1994.

PATRICK MORANDI

"Indecomposable division algebras with a Baer ordering" (with B.A. Sethuraman), *Communications in Algebra*, 22, No. 13 (1994), 5401-5418.

HUNG T. NGUYEN

"On decision-making using belief functions" (with E. Walker), *Advances in the Dempster-Shafer Theory of Evidence* (R. Yager et al., Eds.), J. Wiley, pp. 331-330 (1994).

"On the modeling of If-Then rules for probabilistic inference" (with I. R. Goodman). *Intern. J. of Intell. Systems* (9), pp. 411-418 (1994).

"A theory of conditional information for probabilistic inference in Intelligent Systems— Part I" (with I. R. Goodman), in *Advances in Fuzzy Theory and Technology* (P. Wang, Editor) vol. 1, p. 137-159 (1993).

"A theory of conditional information for probabilistic inference in intelligent systems— Part II" (with I. R. Goodman), *J. Inf. Sciences* (76), pp. 13-42 (1994).

"A theory of conditional information for probabilistic inference in Intelligent Systems— Part III (with I. R. Goodman), *Jour. of Information Sciences* (75), 253-277 (1993).

"A history and introduction to the algebra of conditional events and probability logic" (with E. Walker), *IEEE Trans. Systems, Man and Cybern.* (24), pp. 1-6 (1994).

"How stable is a fuzzy linear system?" (with V. Kreinovich), *Proceedings Third IEEE-Fuzzy Systems.* Orlando, Florida, 1994, pp. 1023-1027.

"On Approximation of controls in distributed systems by fuzzy controlers" (with V. Kreinovich and O. Sirisaengtaksin), *Proceedings Fifth IPMU*, Paris (France), July 1994, pp. 79-83.

DAVID J. PENGELLEY

"Calculus Gems: Brief Lives and Memorable Mathematics", extended book review, *American Mathematical Monthly* 101 (1994), 374–380.

"Recovering Motivation in Mathematics: Teaching with Original Sources" (with R. Laubenbacher and M. Siddoway), *Undergraduate Mathematics Education Trends* 6, No. 4 (September, 1994), parts of pages 1,7,13.

"From Projects to Themes: The Evolution of Calculus Classes at New Mexico State University" (with D. Kurtz), invited section in booklet for *National Science Foundation summer calculus workshops program*, MacAlester College, 1992–94, 29–30.

"Eisenstein's Misunderstood Geometric Proof of the Quadratic Reciprocity Theorem" (with R. Laubenbacher), *College Mathematics Journal* 25 (1994), 29–34.

"Gauß, Eisenstein, and the 'third' proof of the Quadratic Reciprocity Theorem: Ein kleines Schauspiel" (with R. Laubenbacher), *Mathematical Intelligencer* 16 (1994), 67–72.

"Discovering calculus through student projects" (reprinted from *Undergraduate Mathematics Education Trends* by invitation), article in *You're the Professor, What Next?: Ideas and Resources for Preparing College Teachers* (ed. Bettye Anne Case), MAA Notes #35, Mathematical Association of America, Washington, D.C.,1994, p. B–III–55.

"Making Calculus Students Think with Research Projects" (with M. Cohen, A. Knoebel, D. Kurtz), invited chapter in *Mathematical Thinking and Problem Solving* (ed. A. Schoenfeld), Lawrence Erlbaum Associates, Inc., (1994) pp. 193-208.

ROSS STAFFELDT

"Stable K-theory and topological Hochschild homology of A_∞ rings," (with Roland Schwänzl and Friedhelm Waldhausen), preprint series of the Sonderforschungsbereich 343 at the University of Bielefeld, Germany, 15 pages.

CHARLES W. SWARTZ

Measure, Integration and Function Spaces, World Scientific Publishers, 1994.

"Sequence Spaces with the Gliding Hump Property", *Monatschafte Math.* 116 (1993), 147-158.

"A Matrix Method for Orlicz-Pettis' Type Theorem" (with Cho and Li), *Applied Functional Analysis* 1 (1993), 17-20.

"A nonlinear Schur Theorem" (with Li), *Acta Sci. Math.* (Szeged) 58 (1993) 497-508.

"A Tauberian Theorem for Null Sequences," *Journal of Analysis*, 2(1994), 37-39.

"Even More on the Fundamental Theorem of Calculus," *Proy. Revista de Mat.* 12 (1993) 129-135.

"Automatic Continuity of Matrix Transformations," *Chinese J. Math.* 22 (1994), 31-45.

CAROLINE P. SWEEZY

"The Hausdorff dimension of elliptic and elliptic-caloric measure in $\mathbb{R}^n$, $n \geq 3$," *Proceedings of the American Mathematical Society*, Vol. 121, No. 3, July 1994.

ARKADY VAINTROB

"Conformal Lie superalgebras and moduli spaces," *Journal of Geometry and Physics*, vol. 15 (1994), 1-14.

ROBERT WISNER

Exploring Mathematics, Grades K-8, (with L. Carey Bolster and 24 other authors), nine books, an average 590 pp. per book, Scott, Foresman and Company, 1994.

Exploring Mathematics, Teacher's Edition, Grades K-8, (with L. Carey Bolster and 24 other authors), nine books, an average 640 pp. per book, Scott, Foresman and Company, 1994.

FRANK WILLIAMS

"Understanding the TQM Metaphor in Higher Education" (with Ray Mines), scheduled for publication in *Higher Education* in November, 1994.

JOSEPH D. ZUND

"Tensorial Methods in Classical Differential Geometry-III: Canonical Leg Representations," *Tensor NS* 52 (1995), 69-75.

"Hotine's (ω, ϕ, N) Coordinate System," Phillips Laboratory Research Report, PL-TR-93-2174 (1993), 23 pages.

"Subcommission 4: Differential Geometry," *Section IV Bulletin General Theory and Methodology, International Association of Geodesy* 1 (1994), 43-46.

"Specializations of Hotine's (ω, ϕ, N) Coordinate System in Differential Geodesy (with J. M. Wilkes) *Bolletino di Geodesia e Scienze Affini*, anno LIII (1994), 245-263.

"The Differential Geodesy of the Spherical Representation," Phillips Laboratory Research Report, PL-TR-94-2143 (1994), 45 pages.