

Department of Mathematical Sciences Annual Report for 1997

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1. Overview

1.1. The Good

This has been a banner year for research in the Department of Mathematical Sciences. Faculty members were extremely successful at creating and publishing research mathematics, and attracted funding from national and state agencies to support efforts in research and education. The total number of papers published by the department and the number of grants and grant recipients grew by over 10%. Gerald Lodder and Caroline Sweezy received the Department of Mathematical Sciences Summer Research Award. The department hosted 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. Generous support was provided by the National Security Agency. Researchers from all over the country and the world spent time at New Mexico State University, collaborating with members of the department and presenting talks in colloquia and seminars.

The department conducts several exciting student-oriented programs, all of which have attracted external funding. Reinhard Laubenbacher and Ross Staffeldt were awarded a grant from the NSF to participate in the Southwest Regional Institute in the Mathematical Sciences (SWRIMS), working with high school teachers and graduate, undergraduate and high schools students on mathematical cryptography. Alyne Fulte directed the local Proyecto Access Las Cruces PREP program with funding from the National Aeronautics and Space Administration, to encourage disadvantaged middle school students to study mathematics and science. Sandy Geiger directed the Mathematics Accessible to the Visually Impaired Student (MAVIS) program, taking a leadership role on campus initiating work on a program to braille mathematics text for visually impaired students.

The department played an important role providing service to the mathematics community, the state of New Mexico and the university. Faculty members served on society committees, journal editorial boards and conference organizing committees. One chaired the New Mexico Commission on Higher Education Mathematics Articulation Task Force and several interacted with the Las Cruces Public Schools. Faculty members participated on Strategic Planning committees and Academic Program Review teams and Tenure and Promotion committees, as well as most university and college committees.

1.2. The Bad

Unfortunately, the department encountered some major problems this year. Two faculty positions were cut during the position review process and the Dean of the College of Engineering attempted to take over the teaching of calculus.

The department was devastated by the Position Review Committee which removed one tenure-track Professor position and one College Assistant Professor position. The foolishness of these decisions was immediately apparent this fall, as the enrollment in mathematics and statistics courses increased over last year and the department had insufficient resources to address student needs. These cuts have hurt hiring plans developed over the last few years to carefully expand our research programs, in particular to support mathematics education and the interdisciplinary field of dynamical systems, and negatively impacted freshman instruction, which will hurt the university's student retention program.

1.3. The Ugly

Our most serious problem involved unsupported allegations about the department's teaching efforts made by the Dean of the College of Engineering, who continued to attack the Department of Mathematical Sciences during the spring semester and opposed working with the department to address concerns he has raised. His actions follow on the heels of the successful work of the Vice President's Committee on Mathematics Courses for Engineering Students. The committee, consisting of three mathematicians and three engineers, presented a collection of recommendations to then Vice President Conroy in the spring, which he accepted and adopted over the summer. The department has implemented many of the recommendations this fall, but the Dean of the College of Engineering refused to nominate members of the joint Steering Committee or provide tenure-track engineering faculty members to teach calculus, as the recommendations provided. His refusal to participate in joint curricular activities make it unclear what outcome will evolve. The department acknowledges and appreciates the support it has received from President Conroy, Vice Presidents Owens and Franco, and the College of Arts and Sciences.

2. Personnel Changes

Two faculty members were promoted and one tenured this past year. Ernest Barany earned promotion to Associate Professor and Deon Woodward earned

promotion to College Assistant Professor. Patricia Baggett earned tenure.

The department hired a visiting researcher to support research efforts in the department. Visiting Assistant Professor Nhu Nguyen conducted research in statistics with NMSU faculty members and taught mathematics courses.

3. Curricular Activities

The department designed new programs for students majoring in mathematics and conducted outreach to better serve students in client departments. The department designed a supplemental major in mathematics and is drafting a proposal for a program in communications science. Faculty members worked with representatives of the College of Engineering on calculus courses and the Department of Psychology on statistics courses. Teaching exchanges were arranged with the College of Engineering and the Department of Physics. A new program in the department took a leadership role in addressing the needs of visually impaired students.

One of the department's major curricular efforts involved working with the College of Engineering to improve our calculus courses. Having engineering faculty members teach several sections of calculus introduced them to the difficulties students have learning calculus and allowed us to find ways to address the students' need together. During the spring, we convened a thirteen-member committee, consisting of ten mathematicians and three engineers, to select a new textbook for the calculus sequence. The new textbook incorporates the use of graphing calculators in the classroom.

Developing new programs and courses is an important activity in the department, in order to introduce students to important new mathematics and to better meet their programmatic needs. The Undergraduate Majors/Minors Committee has developed a proposal for a supplemental major in mathematics which was approved by the entire faculty. That committee is working with the Graduate Studies Committee and the Department of Electrical Engineering to design a five-year program on communications science, leading to both bachelor's and master's degrees. New courses of interest for undergraduate mathematics majors and entering graduate students cover topology and mathematical cryptography. A statistics course developed for psychology majors, designed with psychologists, was approved as a permanent course addition. A new General Education mathematics appreciation Honors course was developed during the year and a sophomore-level number theory course is being developed. Faculty members received funded from the National

Science Foundation to write a textbook of annotated original historical sources for a capstone course based on the Hon/Math 411G course, "Great Theorems: the Art of Mathematics." Faculty members offer special topics undergraduate- and graduate-level courses at the interface of theoretical mathematics and applications. In the spring, the department offered undergraduate courses titled "Statistics for Psychological Sciences" and "Introduction to Topology" and graduate courses on "Local Cohomology" and "The Role of History in Teaching Mathematics." A member of this department taught a special topics course on relativistic astrophysics and black holes for the Department of Physics. These were followed in the fall by another section of the statistics course and the graduate-level special topics courses "History and Theories of Mathematics Education" and "Projective Geometry."

The use of technology in the classroom continued to expand throughout the year. As mentioned above, graphing calculators were introduced as an integral component of the calculus sequence this fall. This effort was greatly aided by the experience gained in the Mathematics Learning Center, where the use of graphing calculators has become integral to all three pre-calculus courses, intermediate algebra, college algebra, and trigonometry. Through the MLC program, 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. With financial support from the College of Arts and Sciences, the department's main student computer lab grew to house 25 computers running the latest versions of *Scientific WorkPlace* and *Maple*, giving students access to state-of-the-art computing and editing software. The department looks forward to working with the College in the future to obtain additional funds to update the computing facilities for undergraduate and graduate students. A mathematics education computer lab, containing eight computers, was built over the summer, using Building Renewal Funds. Faculty members routinely used computer presentations in their classes.

Under the direction of Sandy Geiger, the department is conducting exciting, ground-breaking research in the MAVIS program, which is developing a computerized system to present mathematics and graphics to visually disabled students by translating mathematics text into Nemeth code for braille. This program is supported by *TCI Software Research, Inc.*, owned by Adjunct Professor Roger Hunter, which has providing programming expertise to convert mathematics in

L^AT_EX format into Nemeth code. As part of the construction of the mathematics education computer lab, the department built an office for the MAVIS project and a small classroom designated for the special sections of Mathematics Learning Center courses offered for learning disabled students. 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.

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. Members of the department advise for both the Advising Center and the Honors program.

The department participates actively in the Honors and General Education programs. Faculty members routinely teach the Honors courses “Spirit and Evolution of Mathematics” and “Great Theorems: The Art of Mathematics.” As mentioned above, honors courses on mathematics appreciation and number theory are being developed. In addition to the Honors courses, the department offers an array of courses approved for General Education, including courses on mathematics for elementary education, business calculus and mathematics appreciation. An alternate means of meeting the General Education requirement in mathematics is to take six credits of mathematics that require Math 115. In the past, students who took Math 180 and Math 185 failed to meet the General Education requirement by one credit. The department has revised the content of Math 180, and made it a three-credit course, which will make this an alternate route to meeting the General Education mathematics requirement.

3.1. Graduate Program

The department awarded three doctoral and four 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. It offers 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 assistant orientation program was revised to provide a more complete introduction to the various courses and teaching innovations in the department, including information about the Mathematics Learning Center, General Education and calculus curriculum.

The department began developing a doctoral program in mathematics education. Requirements for comprehensive examinations and course work have been drafted, and currently they are being discussed and revised. 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 committee developed an intervention program to work with graduate teaching assistants. It is designing a program for mentoring new faculty members. The department held several colloquia on educational issues.

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

A problem faced by the Department of Mathematical Sciences is that, while we serve most academic programs on campus, client departments often do not approach us about their concerns and problems. In an attempt to gain better feedback from client departments, the department created a new committee, the Liaison Committee, to visit with departments around campus to lend advice and uncover problems before they become serious issues.

Our dealings with the College of Engineering included the successful work of the Vice President's Committee on Mathematics Courses for Engineering Stu-

dents. The committee, consisting of three mathematicians and three engineers, presented a collection of recommendations to then Vice President Conroy in the spring, which he accepted and adopted over the summer. We proceeded to implement these recommendations in the fall. Three engineering faculty members worked with us to select a new textbook for the calculus sequence, and one is teaching differential equations this fall. A major proposal (requesting over \$1,500,000) to support graduate student education was submitted to the National Science Foundation by the Departments of Electrical Engineering, Mechanical Engineering, and Mathematical Sciences. Several faculty members are involved in interdisciplinary research, as well as discussions pertaining to new interdisciplinary graduate programs. The department met with client departments from the Colleges of Engineering and Arts and Sciences to discuss Math 471, Math 472 and Math 473, which led to a proposal to offer 500-level versions of these courses that is currently being evaluated.

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 solicited feedback from representatives of the College of Business Administration and Economics during the selection of a new textbook for the business calculus course. We worked with Psychology faculty members to develop a new statistics course to support their major.

The department also conducted a teaching exchange with the Department of Physics. Joe Zund offered an advanced graduate-level course on relativity in the Department of Physics, while Robert Armstrong taught a mathematics course in exchange. Mathematics Learning Center faculty members work closely with faculty at the Doña Ana Branch Community College.

4. Research Activities

The total output of our research program continued to grow for the sixth straight year and the number of faculty members supported by outside funds increased. Faculty members spoke at numerous conferences and universities. Interdisciplinary research remained an important part of our research effort. The department hosted the twenty-second Holiday Symposium in January. The Summer Research Award funded two faculty members this year.

Members of the department were very productive researchers, showing an increase of over 12% over last year in the total number of papers printed, accepted

and submitted. In fact, over the six year period from 1992 to 1997, this total number almost doubled. Gerald Lodder and Caroline Sweezy received Department of Mathematical Sciences Summer Research Awards, funded by an anonymous donation to the NMSU Foundation. The donors are so pleased with the performance of the recipients that they fully funded a second researcher this summer. Twenty-eight of the tenure-track faculty members had a total of sixty-five papers appear in print, thirty-one papers accepted for publication, and forty-eight papers submitted for publication, as well as publishing one invited book chapter and a research text on the mathematics of data fusion. Three books authored by faculty members, undergraduate and graduate textbooks and a teachers' resource book, and three books edited by faculty members were accepted for publication. Faculty members are currently writing two textbooks on mathematics appreciation, undergraduate textbooks on wavelet theory, introductory analysis, and original mathematical sources, and one mathematical biography. 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 65 biographies. Faculty members delivered forty-nine talks on their research at conferences and thirty-four talks at other universities, and presented a workshop on computational algebraic geometry and three workshops on mathematics education.

Faculty members continued to receive external funding to support their research. Nine 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 Astrophysics Research Lab (through PSL). Eight faculty members conducted funded educational research work on nine 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 National Aeronautics and Space Administration, the New Mexico State Department of Education, the New Mexico Commission on Higher Education, and the Exxon Education Foundation.

Members of the department conduct joint research with mathematicians at other institutions. Susan Hermiller and Reinhard Laubenbacher received funding from the Swedish Academy of Science and the Italian Research Council, respectively, to conduct research in those countries, Hung Nguyen was a Senior Research Fellow of the ASEE/NAVY Summer Faculty Research Program in San Diego, California, Arkady Vaintrob held a visiting professorship at the Max-Planck-Institut für Mathematik and Joe Zund was a visiting researcher at the California Insti-

tute of Technology. Faculty members on sabbatical leave included Mai Gehrke at Vanderbilt University, William Julian at the National Optical Astronomical Observatories, and Pat Morandi at Indiana University.

The twenty-second Holiday Symposium on “Rewriting Techniques and Non-commutative Groebner Bases” convened from January 3-7 with 70 participants. The main speakers, Edward Green, Virginia Polytechnic Institute, and Derek Holt, University of Warwick, presented five lectures each on techniques from computational algebra and theoretical computer science, with applications to the theory of associative algebras and computational group theory. The symposium was funded by the National Security Agency, which awarded the department \$24,000 for the conference, more than double its usual funding level of \$10,000.

The department sponsors a weekly colloquium and several weekly seminars. The colloquium series included 41 lectures during the year, presented by 27 visitors and 14 speakers from NMSU. Most of the speakers from other institutions visit the department to collaborate with our faculty on their research. Seven of the talks were presented by members of other departments on campus, explaining how they use mathematics in their research. The seminars specialize in algebra, analysis, cryptography, historical sources, lattice theory, statistics, and topology. One research seminar is run by graduate students. The “Basic Notions” 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 is studying the mathematics in James Joyce’s works with a professor of English. Joaquin Loustaunau directed an interdisciplinary doctoral thesis student; several faculty members advise doctoral students from other departments.

5. Professional Service Contributions

The department provided service for the mathematical community and the university. It was an institutional member of several professional organizations and a sponsor of one journal. Faculty members worked on committees and conferences for these organizations. They served as journal editors and referees of research articles and grant proposals. For the University, faculty members participated on Strategic Planning Subcommittees and were members of most university and

college committees. They served on Academic Program Review teams and were outside representatives on tenure and promotions committees for nine departments.

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, the American Mathematical Association of Two-year Colleges 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 Fund for the Improvement of Postsecondary Education, the National Science Foundation, the National Security Agency and the Texas Advanced Research Program. Faculty members took part on three conference organizing committees and chaired a special session 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 held in San Diego in January, and is a member of the AMS-SMM (Sociedad Matematica Mexicana) Joint Program Committee for the joint meeting in Oaxaca, Mexico, in December. Richard Bagby was a member of the Editorial Board of the *PanAmerican Mathematics Journal*. Kitty Berver was a member of the Editorial Board for the MAA's *Spectrum* series. Reinhard Laubenbacher was the department's representative to the Rocky Mountain Mathematics Consortium. 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 and a member of the International Program Committee for the IEEE Conference on Fuzzy Systems to be held in Barcelona, Spain. David Pengelley was a member of two MAA committees, the Committee on the Participation of Women and the Subcommittee on Service Courses of the Committee on the Undergraduate Program, and a member of the editorial board of *Mathematics Magazine*. Joe Zund was a member of one Special Commission and two Special Committees of the International Association of Geodesy, and the chair of one Special Subcommittee. 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 served on the Vice President's Committee on Mathematics

Courses for Engineering Students. The Strategic Planning program was aided by our participation on the Human Resources, Institutional Climate, Institutional Values, and Student Services and Athletics Committees. Members of the department served on the Disability Resource Advisory Board, Distinguished Visiting Professor Committee, the Educational Diagnostician Advisory Council, the Faculty Senate and its Long-Range Planning, *ad hoc* Part-Time Employees, and Library Committees, one General Education Committee, the Outcomes Assessment Committee I, the Ralph B. Crouch Memorial Prize Committee, and the Westhafer Award Committee. Faculty members served on self-study review teams for the Department of Agricultural Economics and the Developmental Studies Program at the Doña Ana Branch Community College. A faculty member served on the tenure and promotion committee for the Departments of Counseling and Educational Psychology.

The department provided advice and assistance to the College of Arts and Sciences with representatives on the Curriculum and Educational Policies, Faculty Affairs, Networking, Planning, and Research Affairs Committees, and on the College Council. Faculty members served as outside members on tenure and promotions committees for the Departments of Astronomy, Chemistry, Computer Science, Government, History, Physics, Philosophy, and Psychology. Faculty members also served as advisors in the College of Arts and Sciences Advising Center and as advisors to several student organizations. All department faculty members participated in committee work within the department.

6. Community Relations

Working with groups and agencies outside the university is important to the department. Several faculty members worked with Las Cruces Public School students and teachers. The department was active on the New Mexico Mathematics Articulation Task Force. The Las Cruces PREP provided mathematics enrichment for middle and high school students. SWRIMS introduced high school students and teachers to mathematical cryptography. The NMSU Math Challenge ran academic competitions for high school students.

The department has been involved in the New Mexico Commission on Higher Education Mathematics Articulation Task Force, which coordinates the transfer of credits for mathematics courses among the institutions of higher learning in the state. Currently, Kitty Berver is cochair of the task force. She is responsible for maintaining the internet-accessible database that articulates transfer credits.

To coordinate with the branch campuses, the department is using electronic means to keep the branch faculty better informed. As a first step, we are developing a WorldWideWeb page documenting the syllabi of all 100- and 200-level mathematics and statistics courses.

The department has increased and improved its interactions with local public schools. Pat Baggett reorganized her Math 111 (Fundamentals of Elementary Mathematics I) and Math 112 (Fundamentals of Elementary Mathematics II) classes to run concurrently with special topics Math 501 courses for in-service teachers. Elementary education majors in these courses are paired with practicing teachers enrolled in the concurrent graduate course, who act as mentors to the pre-service teachers, allowing them to observe, co-teach, and finally teach alone, in their classrooms. Several other Math 111 and Math 112 instructors had their students observe public school classes. The in-service teachers received free tuition with funds provided by a grant from the New Mexico Commission on Higher Education. The administration of the Las Cruces Public Schools and, in particular, the Teachers' Center have been highly supportive of this initiative, which has led to several joint interactions involving the department, the public schools, and the College of Education. In addition to these courses, Pat helps the local schools by teaching a class a week in elementary and middle schools, presenting workshops, and addressing the LCPS School Cabinet. Mai Gehrke gave a mathematics talk to a local fifth-grade class and Irena Swanson presented an interactive lecture at Mayfield High School. Reinhard Laubenbacher presented several talks at Gallup High School as part of the New Mexico Visiting Scientists Program.

Alyne Fulte directed the highly successful Las Cruces PREP program, funded by the National Aeronautics and Space Administration. Though designed for about 50 participants, this program brought 80 sixth through tenth grade students to NMSU over the summer to learn mathematics, science and engineering. It seeks to intervene with minority students early in their public school careers, give them the encouragement and educational background necessary to keep them in school, and affords them the opportunity to pursue scientific and technological careers.

Dave Finston continued to work with local high school teachers Roger Greer and Marilyn Gutman on projects funded by the state's Systemic Initiative in Math and Science Education program. Through the interaction with SIMSE, the department has a positive influence on the teaching of mathematics and science throughout the state of New Mexico.

Reinhard Laubenbacher and Ross Staffeldt run the NSF-funded SWRIMS, which is focused on the study of cryptography. This research-based program

involved graduate students, undergraduate students, high school teachers and high school students in the study of cryptography.

The department sponsored the ninth annual “NMSU Math Challenge” for area high school students. Over 500 students from six high schools participated in a two part sequence of written examinations. Four top scoring students were honored with prizes of computer software and calculators. The second strand of the challenge, the modeling competition, featured a cryptography problem, “Locking the Strongbox” for the Level I competitors. Level II competitors used algebra II and trigonometry to come up with a winning strategy for an 18-wheeler competition, “Keep on Trucking”. Four winning teams presented their solutions to the judges and interested spectators on Saturday, April 26.

The department maintains several display cases in public areas in Science Hall, in the classroom wing and 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 almost ten years, as the university refuses to provide space for this recognized program. It converted a seminar room into the office of the southern coordinator for the New Mexico MESA (Mathematics Science Engineering Achievement) program.

7. Outcomes Assessment Activities

7.1. 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. The Institutional Research office sent such a survey 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?

In addition to these activities, the department has begun to develop a World-WideWeb page that will be used to both inform our alumni about the department and allow the department to find out about our alumni and their careers.

Results of Assessment Activities Interviews with graduating majors documented that students learn in many different ways, so it is important to offer a variety of approaches to any subject to enhance individual achievement. Two important factors in learning mathematics that were identified are motivation and using reasoning to solve meaningful problems. The department has made the use of applications of mathematics and technology more pervasive in its classes. We continue to encourage our majors to participate in national competitions, such as the Putnam Examination and the COMAP Modelling Contest.

Several long-range initiatives are currently being considered. We are drafting a plan for a supplementary major in mathematics. We believe there are many undergraduates in scientific and technological disciplines who would be attracted by such a degree. We are also developing, with the Department of Electrical Engineering, a proposal for a five-year program in communication sciences that will lead to both bachelor's and master's degrees.

In previous years, students suggested that a senior-seminar course would be a valuable addition to our undergraduate program. In response to this, the department proposed and the university approved the course. It was included in our plans for the spring 1998 semester. However, last year, two faculty positions were removed from the department. This was followed by a request from then Vice President Conroy that the department offer additional sections of General Education courses instead of the senior-seminar course. Consequently, resources necessary to implement the results of our Outcomes Assessment program have been removed from the department.

Proposed Changes in Assessment Activities We do not plan any changes in our outcomes assessment program at this time. However, since the survey conducted by the university's Institutional Research office did not obtain useful information from our alumni, we are considering other ways to obtain this information. If we find that the web page mentioned above provides us with valuable information, we will propose making this information a formal part of our assessment program in the future.

7.2. Graduate Outcomes Assessment Activities

The assessment of our graduate program includes a survey of graduates with advanced degrees and 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. Four students passed their master's examinations, with several performing particularly well, and an equal number took and passed the comprehensive examinations in the fall. We currently have fifteen students, over half of our funded graduate assistants, working on their doctorates, who have successfully passed their comprehensive examinations.

Results of Assessment Activities Last year, the department made several changes to its graduate programs. The new information we have received from our assessment activities does not warrant making further changes to our programs. Nevertheless, the mathematical community is engaged in vigorous discussion and debate about the current job market for new Ph.D.s and about the shape of the Ph.D. degree for the start of the twenty-first century, and, in response, we will continue to try to obtain outcomes assessment information from more recent graduates and from their employers.

As mentioned above, we are also developing a proposal for a program leading to a master's degree in communication sciences.

Proposed Changes in Assessment Activities On a trial basis we conducted in-person interviews with a recent Master's degree recipient who is now employed with an electronics firm in Dallas and with a former student who transferred to the College of Education and subsequently found a position teaching at a community college in Utah. The prospects for such interviews producing useful feedback seem to be good. We plan to continue interviewing some of our ex-students. If we find that it provides us with useful information, we will propose changing our outcomes assessment plan in the future.

7.3. 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.

Results of our Assessment Activities Over 90% of the tenure-track faculty members published research results during the past three years. During 1997, 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 six special topics courses in the spring, including an advanced course in physics, 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. Graduate and undergraduate students are involved in mathematical research in the NSF-funded SWRIMS and on a research grant funded by the Physical Sciences Laboratory.

8. 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.

Much progress has been made on the first item and last item. We hired a senior mathematics educator who earned tenure last year. She has begun to draft proposals for a graduate program in mathematics education and guidelines for hiring and evaluating future mathematics educators. The department has earmarked funds to be used by the Graduate Studies Committee to recruit and attract minority graduate students.

We made no progress on the second initiative. Uncertainties about changes in the university's budgeting procedures have kept the dean from granting permission to act on this item.

9. Computing Facilities

The department made several significant advances in its computing facilities this year. Permanent space for the mathematics education lab and the MAVIS program was created with a remodel of the basement of Walden Hall over the summer. The classroom wing in Science Hall was added to the department's network. The department began the installation of a *Windows NT* network; this was initiated to improve the management and performance of the undergraduate computer lab. All of our space except three classrooms in Walden Hall and all graduate student offices are now connected to departmental networks.

The department currently has seventeen *Sun* computers, including two *Sun* servers, seven *NCI X-Window*s terminals, sixty *IBM* compatible PC's, including one *Windows NT* server and one *Novell* server, twelve *Power Macintoshes*, 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-five 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 eight *Power Macintoshes*. 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.

10. Advanced Degrees Awarded in 1997

Name	Degree
Rebecca Brown Advisor: David Pengelley	Master's
Je Xiang For Advisor: Charles Swartz	Master's
Yihong Gao Advisor: Ray Mines	Master's
Michael Goar Advisor: R. Laubenbacher	Master's
Benedict Nmah Advisor: J. Loustaunau	Ph.D.
Eduardo Quinones-Rico Advisor: Ross Staffeldt	Ph.D.
Richard Reynolds Advisor: Charles Swartz	Ph.D.

11. Departmental Colloquia in 1997

- John Fauvel, The Open University, Milton Keynes, England, *Why ‘Study the Masters’?: Mathematicians and the Past*, January 16, 1997.
- James K. Deveney, Virginia Commonwealth University, *Automorphisms of Polynomial Rings*, January 21, 1997.
- Otto B. Bekken, Agder College, Kristiansand, Norway, *Niels Henrik Abel (1802-1829), and the “calculus reforms” of the 19th century*, January 30, 1997.
- Marcus Cohen, Mathematical Sciences, New Mexico State University, *The Geometry of Spin, Charge, and Mass*, February 6, 1997.
- Martin Krupa, Technical University of Vienna, *Robust Heteroclinic Cycles*, February 13, 1997.
- Frank Ward, Department of Agricultural Economics, New Mexico State University, *An Optimization Model for Managing Trout*, February 20, 1997.
- George G. Joseph, University of Manchester, Manchester, England, *Indian Mathematics in World Mathematics*, February 25, 1997.
- George G. Joseph, University of Manchester, Manchester, England, *The Arc-Tan Series in Three Traditions: Background and Motivation*, February 25, 1997.
- Louis H. Kauffman, University of Illinois at Chicago, *Virtual Knot Theory*, February 27, 1997.
- Cristina Pereyra, University of New Mexico, *On the Two Weights Problem for the Hilbert Transform*, February 28, 1997.
- Sarah Witherspoon, Math Sciences Research Institute in Berkeley, California, *Kaplansky’s Conjectures on Hopf Algebras*, March 10, 1997.
- Frank Sottile, Math Sciences Research Institute in Berkeley, California, *Combinatorics of Symmetric Groups and Flag Manifolds*, March 11, 1997.
- Mark Johnson, University of Arkansas, *Regular Points on Normal Cones*, March 17, 1997.

- John Meier, Cornell University and Lafayette College, *Graph Theory, linear algebra, and an ϵ - δ argument: The undergraduate curriculum in the study of infinite groups*, March 20, 1997.
- Hélène Barcelo, Arizona State University, *Hyperplane Arrangements*, March 21, 1997.
- Reinhard Laubenbacher, Mathematical Sciences, New Mexico State University, *A Series of Lectures on the History and Science of Cryptography*, March 25, 1997.
- Bodo Pareigis, University of Munich, Germany, *Quantum Groups - their meaning and their construction*, March 26, 1997.
- David Vogán, Massachusetts Institute of Technology, *Regular Polyhedra and Simple Groups*, March 27, 1997.
- Juan Alonso, University of Stockholm, *Geometric Chain Complexes*, April 3, 1997.
- Todd Kapitula, University of New Mexico, *Bifurcating bright and dark solitary waves of the nearly nonlinear cubic-quintic Schrödinger equation*, April 4, 1997.
- Peter Wingren, Umeå University, Sweden, *Lipschitz and Zygmund Spaces*, April 9, 1997.
- Massimo Marinacci, University of Toronto, Canada, *Limit Laws for Non-Additive Probabilities, and Their Frequentist Interpretation*, April 10, 1997.
- Craig Huneke, Purdue University, *Computing Closure Operations in Polynomial Rings*, April 17, 1997.
- Reinhard Laubenbacher, Mathematical Sciences, New Mexico State University, *Secrets and Primes*, April 24, 1997.
- Paul K. Black, Neptune and Company, Inc., Los Alamos, New Mexico, *Geometric Structure of Lower Probabilities*, April 25, 1997.
- Sundaram Thangavelu, University of New Mexico, *Pointwise Ergodic Theorems for Radial Averages on the Heisenberg Group*, May 1, 1997.

- Daya-nand Verma, Tata Institute of Fundamental Research in Bombay, India, *A Quick Introduction to Classical Representation Theory: As a Higher Multilinear Algebra*, September 3, 1997.
- Christopher Weaver, Mathematics Accessible to Visually Impaired Students, Mathematical Sciences, New Mexico State University, *A Restricted Set of Assumptions: Making Ordinary Mathematics Curriculum Accessible to Visually Impaired Students*, September 4, 1997.
- Gopal Gupta, Computer Science, New Mexico State University, *Logic Programming: The Grand Unifying Theory of Computer Science*, September 18, 1997.
- Enrico Pontelli, Computer Science, New Mexico State University, *Logic Programming with Sets*, September 25, 1997.
- Graduate Studies Committee, Mathematical Sciences, New Mexico State University, *Preparing for Careers in Mathematics*, October 2, 1997.
- Vince Gutschick, Biology Department, New Mexico State University, *Ghosts of Göttingen Revived: How 19th Century Mathematical Physics Enlivens Biology*, October 9, 1997.
- Cynthia Watkins, New Mexico State University Library, *Electronic Library Services in the Mathematical Sciences*, October 14, 1997.
- Patrick J. Morandi, Mathematical Sciences, New Mexico State University, *Algebras with Involution, Hermitian Forms, and Algebraic Groups*, October 16, 1997.
- Tomaž Košir, University of Ljubljana, Slovenia, *Coalgebras and Eigenvalue Problems in Several Parameters*, October 22, 1997.
- Mirko Navara, Czech Technical University, *Hypergraph Techniques in Quantum Logics*, October 23, 1997.
- Desh Ranjan, Computer Science, New Mexico State University, *Randomness, Computation and Cryptography*, October 28, 1997.
- Christian Reidys, Los Alamos National Laboratories, *Random Graphs and Sequence to Structure Maps*, October 30, 1997.

- Roger Wiegand, University of Nebraska, *Local Rings with Finite Representation Type*, November 6, 1997.
- Darrell Haile, Indiana University, *The Brauer Monoid of a Field*, November 7, 1997.
- Mike Goar, Mathematical Sciences, New Mexico State University, *Cryptography as a teaching tool in secondary and undergraduate mathematics courses*, November 11, 1997.

12. Faculty Publications in 1997

Josefina Alvarez

J. Alvarez, J. Hounie: "Functions of pseudo-differential operators of non-positive order," *Journal of Functional Analysis* 141 (1996), 45-59.

Richard Bagby

Bagby, R. & Masaedeh, B., "Optimal Extrapolation of Weight Conditions," *PanAmerican Mathematical Journal* 7 (1997), Number 1, 55-63.

Patricia Baggett

Baggett, P., and Ehrenfeucht, A., "Math with Calculators in Elementary Schools". In CD-ROM format. *Proceedings from Third International Conference on Technology in Mathematics Teaching*, Sept. 29-Oct. 2, 1997, University of Koblenz, Germany.

Ernest Barany

Barany, E. and Colbaugh, R., "Global Stabilization of Uncertain Mechanical Systems," *Proc. 36th IEEE Conference on Decision and Control*, San Diego, CA, December, 1997, to appear

Colbaugh, R. and Barany, E., "Adaptive Stabilization of Nonholonomic Mechanical Systems," *Proc. 36th IEEE Conference on Decision and Control*, San Diego, CA, December, 1997, to appear

Barany, E., Gallegos, G. and Colbaugh, R., "Control of Chaos in the Presence of Uncertainty," *Advances in Systems Science and Applications*, special issue, in press

Colbaugh, R., Barany, E. and Glass, K., "Adaptive Stabilization of Uncertain Nonholonomic Mechanical Systems," *Robotica*, in press

Colbaugh, R., Glass, K., and Barany, E., "Adaptive Regulation of Manipulators Using Only Position Measurements," *International Journal of Robotic Research*, **16**(5), October 1997, in press.

Colbaugh, R. and Barany, E. "Control of Nonholonomic Robotic Systems Using Reduction and Adaptation," *Proc. 5th IFAC Symposium on Robot Control*, Nantes, France, September 1997, pp. 723-729

- Colbaugh, R., Barany, E. and Glass, K. "Global Stabilization of Uncertain Manipulators Using Bounded Controls," *Proc. 5th IFAC Symposium on Robot Control*, Nantes, France, September 1997, pp. 227-232
- Colbaugh, R., Barany, E. and Glass, K. "Adaptive Stabilization of Uncertain Nonholonomic Mechanical Systems," *Proc. 1997 IEEE/RSJ International Conference on Intelligent Robots and Systems*, September, 1997 pp. 981-988
- Colbaugh, R., Barany, E. and Glass, K., "Global Stabilization of Uncertain Manipulators Using Bounded Controls," *Proc. 1997 Am. Cont. Conf.*, Albuquerque, NM, June 1997
- Colbaugh, R., Barany, E. and Glass, K. "Global Regulation of Uncertain Manipulators Using Bounded Controls," *Proc. 1997 IEEE Intl Conf. on Robotics and Automation*, Albuquerque, NM, April 1997, pp. 1148-1155
- Barany, E., Gallegos, G. and Colbaugh, R., "Control of Chaos in the Presence of Uncertainty" *Proc. 35th IEEE Conference on Decision and Control*, Kobe, Japan, December 1996, pp. 2175-2176
- Colbaugh, R., Barany, E. and Glass, K. "Adaptive Control of Nonholonomic Mechanical Systems" *Proc. 35th IEEE Conference on Decision and Control*, Kobe, Japan, December 1996, pp. 1428-1434
- Colbaugh, R., Glass, K. and Barany, E., "Mechatronic Systems Approach to Controlling Robotic Systems with Actuator Dynamics," invited chapter in *Mechatronic System Techniques and Applications*, Gordon and Breach International Series in Engineering, Technology, and Applied Science, in press

Gerald Dunn

- "Uniqueness of n -fold Delooping Machines," *Jour. Pure and Applied Algebra* 113 (1996) 159-193.
- " E_n -Ring Categories," *Jour. Pure and Applied Algebra* 119 (1997) 27-45.
- "Lax Operad Actions and Coherence for Monoidal n -Categories, A_∞ -Rings and Modules," *Theory and Applications of Categories* Vol. 3, No. 4, 1997, pp. 50-84.

David Finston

- Deveney, J.K. and Finston, D.R., "On locally trivial G_a actions," *Transformation Groups* 2 (1997) 137-145.
- Finston, D.R. and Walcher, S., "Centralizers of locally nilpotent derivations," *Journal of Pure and Applied Algebra* 120, (1997) 39-49.

Mai Gehrke

- "de Morgan systems on the unit interval," with C. Walker and E. Walker, *International Journal of Intelligent Systems* 11 (1996), 733-750.
- "Some comments on interval valued fuzzy sets," with C. Walker and E. Walker, *International Journal of Intelligent Systems* 11 (1996), 751-759.
- "Stone algebra extensions with bounded dense sets," with C. Walker and E. Walker, *Algebra Universalis* 37 (1997), 1-23.
- "A Mathematical Setting for Fuzzy Logics," with C. Walker, and E. Walker, *The International Journal of Uncertainty, Fuzziness, and Knowledge-based Systems*, 5, non. 3 (1997), 223-238.

John Harding

- Harding, J., and Janowitz, M.F., "A Bundle Representation for Continuous Geometries," *Advances in Applied Mathematics*, 19 : 282-293, 1997.
- Harding, J., Marinacci, M., Nguyen, N., and Wang, T., "Local Radon-Nikodym Derivatives of Set Functions," *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems*, 5 (3) : 379-394, 1997.
- Harding, J., "Free Central Extensions," *The Houston Journal of Mathematics*, 22 (4) : 665-686, 1996.

Susan Hermiller

- Hermiller, S. and Meier, J., "Tame combings, almost convexity, and rewriting systems for groups," *Mathematische Zeitschrift* 225 (1997) 253-276.

William Julian

Julian, W.H., Kooiman, B.L. , and Sanders, W.L., “Galaxy Morphology in the Virgo Cluster and in the de Vaulouleurs Groups,” *Publications of the Astronomical Society of the Pacific*, **109**: 297-299, 1997, March.

Joseph Lakey

Lakey, J., “Metaplectic frames and sampling theory,” *Proceedings of the 1997 International Workshop on Sampling theory and its Applications*, 261-266, Universidade de Aveiro, 1997 (note: this was a refereed conference proceedings for which about a third of the submissions were rejected. This item and the next were submitted and published the same year.)

Gilbert, J., Hogan, J., and Lakey, J., “Wavelet subspaces for sampling and extrapolation,” *Proceedings of the 1997 International Workshop on Sampling Theory and its Applications*, 273-278, Universidade de Aveiro, 1997.

Reinhard Laubenbacher

R. Laubenbacher and C. Woodburn, “An Algorithm for the Quillen-Suslin Theorem for Monoid Rings,” *Journal of Pure and Applied Algebra*, 117&118:395-429, 1997.

R. Laubenbacher and X. Kramer, “Combinatorial Homotopy of Simplicial Complexes and Complex Decision Networks,” *Proceedings of Symposia in Applied Mathematics*, vol. 53, D. Cox and B. Sturmfels (eds.), Amer. Math. Soc., 1997 (28 pp.).

Susan Lee

Benjamin, I., and Lee, S. “Conditioned Diffusions which are Brownian Bridges,” *Journal of Theoretical Probability* 10 (3): 733-736, 1997.

Jerry Lodder

Lodder, J.M., “Leibniz Homology and the Hilton-Milnor Theorem,” *Topology*, 36, 3, 1997, pp. 729-743, (copy attached).

Ray Mines

Dasenbrock, Reed Way and Mines, R. “Quella vista nova: Dante, Mathematics and the Ending of Ulysses,” accepted for a special issue of *European Joyce Studies*.

Hung T. Nguyen

“Kolmogorov’s theorem and its impact on soft computing (with V. Kreinovich),” *The Ordered Weighted Averaging Operators* (R. Yager and J. Kacprzyk, Eds.), Kluwer Academic (1997), 3-17.

“On hardware support for interval computations and for soft computing: Theorems” (with V. Kreinovich, V. Nesterov and M. Nakamura), *IEEE Transactions on Fuzzy Systems*, vol. 5, no.1 (1997), 108-127.

“On capacity functionals in interval probabilities” (with N. Nguyen and T. Wang), *Intern. J. Uncertainty, Fuzziness and Knowledge-Based Systems*, vol. 5, no. 3 (1997), 359-377.

“Maximum entropy method in expert systems and intelligent control: New possibilities and limitations” (with V. Kreinovich and E. Walker), *Maximum Entropy and Bayesian Methods* (K.M. Hanson and R.N. Silver, Eds.), Kluwer Academic (1996), 93-100.

“Interval-valued degrees of belief: Applications of interval computations to expert systems and intelligent control” (with V. Kreinovich and Q. Zuo), *Intern. J. Uncertainty, Fuzziness and Knowledge-Based Systems*, vol. 5, No.3 (1997), 317-358.

“From numerical intervals to set intervals” (with V. Kreinovich), *J. Reliable Computing*, vol 3 (1997), 95-102.

“Fuzzy sets and probability,” *J. Fuzzy Sets and Systems*, vol. 90, no. 2 (1997), 129-132.

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James Pommersheim

Pommersheim, J.E., “Barvinok’s algorithm and the Todd class of a toric variety,” *Journal of Pure and Applied Algebra*, 117 & 118: 519-533, 1997.

Irena Swanson

- Delfino, D., and Swanson, I., Integral closure of ideals in excellent local rings,” *Journal of Algebra*, **187** (1997), 422-445 (23 pages).
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- Swanson, I., “Powers of ideals: primary decompositions, Artin-Rees lemma and regularity,” *Mathematische Annalen*, **307** (1997), 299-313 (15 pages)
- Smith, K.E., and Swanson, I., “Linear bounds on growth of associated primes for monomial ideals,” *Communications in Algebra*, **25** (1997), 3071-3079 (9 pages).

Caroline Sweezy

- “Absolute Continuity for elliptic-caloric measures,” *Studia Mathematica* Volume 120 (2), December 1996.

Arkady Vaintrob

- “Universal weight systems and the Melvin-Morton expansion of the colored Jones knot invariant,” *Journal of Mathem. Sciences*, 82(1996), no. 1, 3240–3254.
- “Normal forms of homological vector fields,” *Journal of Mathem. Sciences*, 82 (1996), no. 6, 3865-3868.
- “Universal Vassiliev invariant for the Lie superalgebra $gl(1|1)$,” *Communications in Mathem. Physics*, **185** (1997), 93-127 (with J.M.Figueroa-O’Farril and T.Kimura).
- “Lie algebroids and homological vector fields,” *Russian Mathem. Surveys* 52 (1997), no. 2, 161-164.
- “Melvin-Morton conjecture and primitive Feynman diagrams,” *International Journal of Mathem.* **8** (1997), no. 4, 537-553.

Tony Wang

- “Estimation in multivariate elliptically contoured linear models,” *Pub. Inst. Statist. Paris*, XXXX, fasc. 2, 1996, 75-92.
- “Estimation in multivariate elliptically contoured linear models II,” *Proceedings of the Sixth Eugene Lukacs Symposium*, pp. 293-306 (1996).
- “Versions of Cochran’s Theorems for general quadratic expressions in normal matrices,” *J. of Statist. Planning and Inference*, Vol. 58 (1997), 283-297.
- “On capacity functionals in interval probabilities” (with H.T. Nguyen and N. T. Nguyen), *International J. Uncertainty, Fuzziness and Knowledge-Based Systems*, Vol. 5, No. 3 (1997), 359-377 (submitted and accepted).
- “Local Radon-Nikodym derivatives of set functions” (with J. Harding, M. Marinacci, and N. T. Nguyen), *International J. Uncertainty, Fuzziness and Knowledge-Based Systems*, Vol. 5, No. 3(1997), 379-394 (submitted and accepted).

Robert Wisner

- Wisner, Joel D. and Wisner, Robert J., “A Confidence Building Multiple Choice Testing Procedure,” *Business Education Forum*, Vol. 51, No. 4 (April, 1997), pp. 28-31.

Joseph Zund

- “Geodetic Commentary to the TALOS Manual,” (with P. Vanicek and the International Association of Geodesy GALOS Committee), International Hydrographic Bureau in Monaco in September 1996. 14 pages.
- “A Conjecture on Coordinate Systems in the Marussi- Hotine Theory of Differential Geodesy,” *Bollettino di Geodesia e Scienze Affini*, anno LV, (1996),1-7.
- “An Essay on the Foundations of Gaussian Differential Geometry I : Completeness Questions,” *Bollettino di Geodesia e Scienze Affini*, anno LV, 1996, 377-384.
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