Programs that Make a Difference

In 2005 the AMS Committee on the Profession (CoProf), with the endorsement of the Council, initiated a project to recognize mathematics department programs that are exceptionally strong in mentoring women and underrepresented minorities. Called "Programs that Make a Difference," the project will each year identify two exemplary programs that: (1) aim to bring more individuals from underrepresented minority backgrounds into some portion of the pipeline beginning at the undergraduate level and leading to an advanced degree in mathematics, or retain them in the pipeline; (2) have achieved documentable success in doing so; and (3) are replicable models.

For 2006 CoProf chose two departments to recognize. The citation states: "This year the AMS recognizes the graduate program at the University of Iowa and the Summer Institute in Mathematics for Undergraduates (SIMU) Research Experiences for Undergraduates program conducted at the Universidad de Puerto Rico, Humacao, from 1998 to 2002. Both of these programs have made significant, successful efforts to encourage underrepresented minorities to continue in the study of mathematics."

An important component of "Programs that Make a Difference" is a series of profiles of the recognized departments that highlight their successes and provide information on how the programs operate. What follows are profiles, prepared by CoProf, of the two programs recognized in 2006. Information also appears at the website `http://www.ams.org/employment/makeadiff.html`.

—*Ellen J. Maycock*
AMS Associate Executive Director
for Meetings and Professional Services

University of Iowa Department of Mathematics Graduate Program

The Department, the University, and the State. The department has forty-one tenure-track faculty members, five postdoctoral faculty, and averages five short-term visitor appointments each year. The department enrolls more than 7,000 students annually. The department currently has 112 graduate students and 185 undergraduate majors. Typically, the department graduates twelve Ph.D.'s per year. An integral part of the department is the interdisciplinary Ph.D. Program in Applied Mathematical and Computational Sciences (AMCS). The university enrolls 29,000 students annually and is a member of the Big Ten Conference. The population of Iowa is three million people, fewer than 5 percent of whom are from underrepresented minority backgrounds.

Minority Graduate Student Enrollment in the Department. In 1995 the department made a long-term commitment to substantially increase the number of its U.S. graduate students from underrepresented minority groups (African American, Latino/a, Native American U.S. citizens, and permanent residents). Supported in part by five U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN) grants in eight years, the department's U.S. underrepresented minority graduate student population has grown from zero students in 1995 to twenty-four students currently. U.S. minority students have accounted for 20–25 percent of the department's graduate student population over the past six years. These percentages are among the highest at U.S. majority institutions. The department has done this while maintaining high average Graduate Record Examination scores and grade point averages for entering students.

The Department's Programs. The department has built its programs with care and foresight. Although these programs were developed in the

context of the department's minority graduate student initiative, these programs have always been open to majority students. As a consequence the quality of education has been raised for all students. Some of the department's programs are:

- A three-week intensive Summer Institute for incoming students
- Intensive faculty mentoring for all students
- Intensive formal peer mentoring for first-year courses
- Intensive formal peer mentoring for Ph.D. Comprehensive Exams
- A new course, "Introduction to the Graduate Program"

Changes in the composition of the graduate student population have created a significant change in the department's culture. Friendships and close working relationships have formed between minority students and their majority counterparts, and ethnic and gender inclusion has become the norm. This new environment is a successful recruiting tool, not just for underrepresented minority graduate students but for all students and also faculty. For example, 41 percent of the graduate students in the department are now women.

Success. Eight of the department's U.S. minority students have been awarded the Ph.D. since 1998. Three of these students earned their degrees in 2004–5, roughly 10 percent of the total number of doctoral degrees awarded to U.S. minority students nationally in mathematics in this period. These Ph.D. recipients have taken a wide range of positions, ranging from tenure-track positions at four-year schools to postdocs at Purdue University and Los Alamos National Laboratory. The department expects that on average it will award Ph.D.'s to three U.S. minority students each year for the foreseeable future. In addition, retention rates have increased for all students. For its efforts, in May 2005, the department received the Presidential Award for Excellence in Science Mathematics and Engineering Mentoring (PAESMEM) in a White House award ceremony attended by department chair David Manderscheid and other members of the department.

Administration. As part of the department's goal to institutionalize its minority graduate student initiative, the department has made permanent changes in its administration. A first step in this direction was taken in 1995 when the department created a new committee, the departmental Minority Student Recruitment and Development Committee (MSRDC), which oversees all aspects of the department's minority program. As the program has developed, the department chair and the director of the AMCS program have been given new responsibilities as has the director of graduate studies.

Outreach and Transformation. The department has built ties with several institutions in mathematics at the same time that it has provided leadership in minority graduate education in Iowa:

- Working together with the department of mathematics at Florida A&M University, the department built a partnership—the Alliance for the Production of African American Ph.D.'s in the Mathematical Sciences—with the departments of mathematics at Florida A&M University, Alabama A&M University, Jackson State University, and Benedict College, as well as departments of mathematics, statistics, and testing and measurement at the Iowa Regents institutions. The goal of the Alliance is to provide for a seamless transition for graduates of Alliance undergraduate institutions who wish to study mathematics and statistics at majority Ph.D. granting institutions. These efforts were supported, in part, by a three-year grant from the NSF (National Science Foundation) Division of Mathematical Sciences and are now supported by an EMSW21–MCTP grant (Enhancing the Mathematical Sciences Workforce in the 21st Century–Mentoring Through Critical Transition Points).
- The department entered into a partnership with the University of Puerto Rico–Mayaguez. This partnership includes several other campuses of the University of Puerto Rico, notably, the campus at Humacao.
- The department has a close working relationship with the Mathematics and Theoretical Biology Institute for undergraduates run by Carlos Castillo-Chavez of Arizona State University. Eleven participants in this Research Experiences for Undergraduates program have enrolled as graduate students in the department.
- The department spearheaded the successful grant application to the NSF's AGEP (Alliance for Graduate Education and the Professoriate) program in support of increasing the number of doctorates awarded to U.S. underrepresented minority students in science, technology, engineering, and mathematics graduate programs at the three Iowa State Regents Universities: Iowa State University, the University of Iowa, and the University of Northern Iowa.
- The department led the formation of the Heartland Mathematics Partnership. The Partnership is a consortium of the mathematics departments at twelve area colleges and universities and the department of mathematics at the University of Iowa. The goal of the partnership is to increase the number of U.S. citizens who earn a Ph.D. degree in the mathematical sciences.

Program Cost. In addition to the grant support mentioned above, the department also gets support from the Sloan Foundation Minority Ph.D. Program.

The College of Liberal Arts and Sciences at the university provides some funds for recruiting, and the Graduate College has provided some fellowship support. The principal cost of the program, however, is faculty time.

Replicability. The department has given a great deal of thought about how to replicate its success. Members of the faculty have lectured widely on the program and are very willing to work with other departments to help them develop successful programs tailored to their needs. The department of mathematics at the University of Iowa sees five phases to successful replication:

1. A core of three or four senior faculty dedicated to the program is necessary to start. There should also be the support of the department chair. The senior faculty should be willing to do the intensive mentoring necessary.
2. A critical mass of minority graduate students should be established. This can be accomplished by intensive recruiting and, preferably, fellowship support to attract students. Numerous fellowship grant opportunities, both internal and external, are available, and most administrations are very willing to provide matching funds, if needed.
3. The department should have reasonable expectations as there will no doubt be growing pains as the program is established.
4. Cultural change within the department should take place. The department should be willing to look at, over time, its practices in graduate education and compare them with best practices.
5. The final stage is institutionalization. In this stage leaders of the effort reach out to other faculty once the program is working. The whole department is transformed and then reaches out to other departments.

Contacts for further information:

Phil Kutzko
Director, Iowa AGEP; Director, HBCU Alliance
Department of Mathematics
University of Iowa
Email: pkutzko@blue.weeg.uiowa.edu

Eugene Madison
Chair MSRDC
Department of Mathematics
University of Iowa
Email: madison@math.uiowa.edu

David Manderscheid
Department Chair
Department of Mathematics
University of Iowa
Email: mander@math.uiowa.edu

SIMU: Summer Institute in Mathematics for Undergraduates

Program Name and Location. Summer Institute in Mathematics for Undergraduates (SIMU) at the University of Puerto Rico–Humacao.

Program Goal. To increase the number of Latinos and Native Americans earning graduate degrees and pursuing careers in the mathematical sciences.

Primary Audience. Hispanic/Latino and Native American, U.S citizen, and permanent resident undergraduates (especially juniors and seniors) interested in pursuing a graduate degree in the mathematical sciences.

Number of Participants Served. 1998: 27. 1999–2002: 24 per year. Total number served by the program from 1998–2002: 115.

Program Description. SIMU was a six-week research program in the mathematical sciences for undergraduate sophomores, juniors, and seniors from across the U.S. and Puerto Rico. The program took place at the University of Puerto Rico–Humacao and was a National Science Foundation (NSF) Research Experience for Undergraduates (REU) site from 2000–2002; it also received significant funding from the National Security Agency (NSA). SIMU was the largest (serving twenty-four students per year) NSF REU program in mathematics.

SIMU was designed for Chicano/Latino and Native American undergraduates who

1. had completed at least two years of university-level mathematics courses (e.g., Calculus I–III, Differential Equations, Linear Algebra, etc.);
2. wanted to conduct undergraduate research in the mathematical sciences; and
3. were interested in pursuing a graduate degree in the mathematical sciences.

Each of the twenty-four students who participated in the 2002 SIMU program received a US$2,200 stipend; round-trip travel to Humacao, PR; and room and board for the duration of the six-week program.

During the 2002 SIMU, each student

1. participated in a mathematical seminar under the direction of Ricardo Cortez or Victor Moll;
2. participated in a computational laboratory that was intertwined with the seminar;
3. completed an undergraduate research project designed by the seminar leader and done in collaboration with other SIMU students;
4. gave a colloquium talk and wrote a technical report on his or her research project;
5. attended a series of colloquium talks given by mathematicians and scientists who are leading researchers in their fields;
6. attended workshops whose focus was to develop skills and techniques needed for research careers in the mathematical sciences;

7. learned techniques to maximize a student's likelihood of admission to graduate programs as well as the likelihood of winning fellowships; and
8. participated in cultural and recreational activities in Puerto Rico.

After SIMU, each student had:

1. an opportunity to attend the conference of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), the Joint Mathematics Meetings, and other forums where they were able to present their undergraduate research;
2. the opportunity to continue the professor-student and peer relationships developed with their seminar leader and with other professional mathematicians and students involved in SIMU.

Years of Operation and Current Status. The program operated 1998–2002. The option of restarting the program is under consideration.

Documentable Effectiveness. The figures below are as of 2005 and are not entirely complete due to a few students not responding to questionnaires. Please note that the total number of students served by the program, 115, is not the same as the total number enrolled for all five years of the program because some of the students attended SIMU more than once. Also, the numbers for the same cohort of students may not always agree because some students stopped responding to the follow-up questionnaires, so that it might be known that a student entered a Ph.D. program, but the student's current status is unknown.

SIMU 1998
- Twenty-seven students participated
- Over 70 percent had no prior research experience
- Twelve were accepted into mathematics Ph.D. programs

- Eight were accepted into mathematics, education, or computer science master's programs
- Three were accepted into other graduate programs
- Three have completed a Ph.D. in mathematics
- One has completed a Ph.D. in physics
- Ten have finished master's degrees in math-related programs
- Three are still in mathematics Ph.D. programs
- Two are still in other Ph.D. programs

SIMU 1999
- Twenty-four students participated
- 70 percent had no prior research experience
- Thirteen were accepted into Ph.D. programs in the mathematical sciences
- Four were accepted into engineering, mathematics, or education master's programs
- Seven have finished master's degrees in mathematics
- Seven are still in mathematics Ph.D. programs
- Two are still in master's degree programs

SIMU 2000
- Twenty-four students participated
- 75 percent had no prior research experience
- Ten were accepted into mathematics Ph.D. programs
- Six were accepted into engineering, mathematics, or education master's programs
- One was accepted into another graduate program
- Four have finished master's degrees in mathematics
- Nine are still in mathematics Ph.D. programs
- Two are still in master's degree programs

SIMU 2001
- Twenty-four students participated; one has not yet graduated
- Over 70 percent had no prior research experience
- Sixteen were accepted into Ph.D. programs in the mathematical sciences
- Three were accepted into master's programs in mathematics, engineering, or computer science
- Two have finished master's degrees in mathematics
- Fourteen are still in mathematics Ph.D. programs
- Two are still in master's degree programs

SIMU 2002
- Twenty-four students participated
- Over 78 percent had no prior research experience
- Nineteen of twenty-four presented posters on their research at the Mathematical Association of America (MAA) undergraduate poster session at the Baltimore Joint Mathematics Meetings in 2003

- Twelve were accepted into Ph.D. programs in mathematics and related areas
- Two were accepted into master's programs in mathematics, engineering, or education

Other Evidence of Success. Post-program surveys of participants showed that the students' educational experience was positively affected by SIMU. For example, 78 percent of the students had not worked on undergraduate research prior to SIMU but 96 percent of the students wanted to work on undergraduate research after SIMU; 96 percent of the students said that SIMU was either "successful" or "very successful" in familiarizing them with mathematics experimentation and research protocols and techniques; 92 percent of the students said that SIMU "increased significantly" or "increased" their desire to pursue a graduate education in mathematics or science.

Program Cost. Approximately US$9,000 per student per year for the six-week summer program and the post-program experiences.

Replicability. The program model is a well-defined one that could reasonably be replicated for different target audiences. The SIMU co-directors believe that the program model is especially suited to groups that are underrepresented in the mathematical sciences. Indeed, there is a program in the works at California State Polytechnic University–Pomona that will borrow from the SIMU model, as has the MAA's National Research Experiences for Undergraduates program.

Issues of which Replicators Should Be Aware. The commitment to the program by the staff needs to be very high in order for the program to be effective. In particular, potential program organizers should be aware of the large amount of time and effort required to organize and run a program such as SIMU.

Contacts for Further Information. See the SIMU website (`http://www.uprh.edu/~simu/`) or contact the co-directors at the SIMU email address. The co-directors can also be contacted directly:

Herbert A. Medina
Department of Mathematics
Loyola Marymount University
Los Angeles, CA
Email: `hmedina@lmu.edu`

Ivelisse Rubio
Department of Mathematics
University of Puerto Rico–Humacao
Email: `ive@www.uprh.edu`