Introduction

SUMSRI is a program designed to prepare participants for the rigor and pace of graduate school. We feel that this preparation will allow the participants to successfully complete and compete in graduate school. Because of the small number of African Americans, Latinos, and Native Americans with doctoral degrees in the mathematical sciences, we are particularly interested in these undergraduate students. The Institute aids participants by intervening in their learning development at a crucial stage. The main goals are:

- Address the shortage of underrepresented minorities and women mathematicians by producing minority and women research mathematicians.
- Provide the students with a research environment and improve their research abilities.
- Improve the student's ability to work in groups and give them a long term support group.
- Provide role models.
- Improve the students' technical writing skills.
- Give the participants an opportunity to give a talk and to write a technical research paper.
- Familiarize them about graduate school and inform them about available financial aid for graduate school.
- Make the students aware of career opportunities in the mathematical sciences.
- Prepare the students for the GRE.

In the summer of 2000, the Institute operated for seven weeks. During these seven weeks, students participated in a research seminar in linear programming, statistics or algebra. Workshops in technical writing and GRE preparation were held. Also, eight colloquium talks and two short courses on algebra and real analysis were given.

Twelve participants were accepted into the Institute. These students were from colleges across the country. All of them had completed college level introductory mathematics and/or statistics courses and at least one proof based mathematics course. The average GPA in the mathematical science courses for the participants was approximately 3.9. Each applicant wrote a brief essay on why they wished to participate in the Institute. Two recommendations from faculty members at the student's home institution were received for each applicant. Two of the participants were African American, two were Hispanic, seven were Caucasian, and one was Asian. Of the twelve participants, nine were female.

Seminar instructors suggested topics that would challenge students to work in teams, draw on their critical thinking and research skills, familiarize them with current literature on the topic, set parameters of the research, and utilize computer modeling programs.

The linear programming students tackled variations of the traveling salesman problem. This problem looks for the minimal travel required for a salesman to cover a specified route.

Lawrence Garcia and Dana Thompson considered this problem using four fixed point, but allowing the home point to vary. For each position, as the home point moves

throughout the Cartesian plane, the salesman has several possible paths from which to choose. The path with the shortest length is determined and called the best path for that home point. They assigned each possible best path a color and then colored each home point according to its best path, creating colored regions on the graph. They examined cases where the four fixed points formed a rhombus, a kite, and a trapezoid. For each design, they examined the conditions necessary for a fifth or sixth color to be present on the graph. A Matlab program assisted in creating these graphs.

In her paper, Jennifer Hebert considered the traveling salesman problem for three cities. She showed, using Sperner's Lemma, that there is always a coordinate for homeport where all paths of travel are equal in distance. It is possible to compute this point (the Sperner Point) in the case that the cities form an equilateral or an isosceles triangle. However, when the cities are in a scalene formation, the Sperner Point is not easily computable. Using Newton's Method, a good estimation of the Sperner Point can be found, with the use of the centroid of the triangle formed by the cities to fuel Newton's Method, it is possible to always find a convergent answer.

The statistics students used the STD situation to illustrate how multivariate classification methods can be used. First, they used principal component analysis to simplify the interpretation and summary of those variables which aid in predicting STD rates. Principal component analysis allowed them to depict our set of data using a number of descriptive factors that was less than the number of variables. They began with measurements of ten racial, ethnic, socioeconomic, and educational variables for each case and were able to combine them into four components that provide a clearer picture of the factors that predict the rate of STDs. Second, using discriminant analysis, they created a model that consisted of two groups: a group with a high rate of STDs and another with a low rate of STDs. Members (cases) in each group share similar racial, ethnic, socioeconomic, and educational variables. Using this discriminant model, they could predict an unknown observation's group classification.

The algebra researcher looked at some interesting yet unproved properties of the Cayley addition table for Z_n. Hunter Snevily proposed the following conjecture:

> Let *n* be any positive odd interger. Then, for any $k \in \{1,2,...,n\}$, the $k \times k$ submatrix of the Cayley addition table of Z_n contains a latin transversal.

A latin transversal is defined as a collection of *n* distinct entries of an $n \times n$ matrix, no two of which are in the same row or column. The algebra group shows that every 4×4 submatrix contains a latin transversal. Additionally, they prove that any $n-2 \times n-2$ submatrix contains a latin transversal when *n* is prime. These results, together with previous results, establish the existence of at least one latin transversal in any 4×4 or smaller submatrix as well as in many $n-2 \times n-2$ submatrices and any $n-1 \times n-1$ submatrix of the Z_n Calyley addition table where *n* is odd.

Final presentations of the research projects were given in the final week using overhead projector slides and Power Point.

It is hoped that many of these students will attend national meetings such as NAM Fest, MathFest, and the Joint Winter Meetings of the AMS-MAA in order to present the results of their work.

By providing this intensive research program, we endeavored to encourage those who attended SUMSRI to pursue advanced degrees. On student evaluations, 9 students

stated that, before attending SUMSRI, they were thinking about pursuing a graduate education. After participating, eleven were considering graduate school, another realized that there was work that could be done with an undergraduate degree in mathematics. In the brief period that has followed the summer Institute, the program has made a difference in their lives by encouraging them to participate in national meetings, doing poster presentations, forming supportive groups for one another, and finding role models in the instructors and colloquium speakers.

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