

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 2002, the Institute operated for seven weeks. During these seven weeks, students participated in a research seminar in graph theory, statistics or coding theory. Participants also attended workshops in mathematical writing and GRE preparation, two short courses on algebra and real analysis and ten colloquium talks.

Seventeen 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 3.86. 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. Seven of the participants were African American, ten were Caucasian. Of the seventeen participants, fifteen 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.

In the statistics seminar, David Friedenberg and Shenek Heyward used multivariate statistical analysis techniques such as discriminant analysis and factor analysis. To determine a rule for classifying countries from a sample into one of two groups, democratic or non-democratic on the basis of 11 variables. They also reduce the dimensionality from 11 variables to a smaller set of underlying factors that can be used to explain the variation within countries.

Leigh Cobbs, Mary Cunningham and Cheryl Gerde took commonly available statistics of a large number of popular vehicles to create a vehicle safety rating system. They use principle component analysis to reduce their set of variables to a smaller set of principle components. Then they use discriminant analysis to classify vehicles by safety rating using these principal components.

The coding theory seminar looked into variations of the Hats Problem. Leslie Calloway, Jacquis Casher and Stacy Hoehn looked at applications of packings and coverings. They investigated the q -ary hat color problem, which makes use of both perfect packings and coverings. In particular, they looked at possible losing sets and strategies for the cases where there are perfect numbers of players. Then they made modifications to the rules of the hat game to increase the winning probability and make most efficient use of the information gained from configurations in the losing set. Using the modified rules and the ternary linear Golay code, they derive a perfect strategy for a team of eleven players and three hat colors. They also looked at strong coverings as a method to play the q -ary hat game.

Megan Breit, Didier Deshommes and Andrea Falden investigated the hat color problem for both perfect and imperfect team sizes by considering ways of constructing sets of losing configurations and corresponding strategies. They also obtain upper bounds for the number of equivalent sets of losing configurations for both perfect and imperfect team sizes.

The graph theory seminar looked at aspects of Seymour's Conjecture, which states that, in any oriented simple graph, at least one vertex has "second-outdegree" at least as large as its outdegree.

Kelly Anderson, Catherine Nightingale and Monique Richardson investigated families of oriented graphs to see if they satisfy Seymour's Conjecture and to see if stronger claims can be made about the specific graph families. They verified several families of digraphs and in some cases proved stronger claims that every vertex satisfies the conjecture. Finally, they showed that if Seymour's Conjecture holds true for all strong oriented graphs, then it holds true for all oriented graphs.

Mary Ann Coleman, Lateefah Id-Deen and Laura Lynch defined a pinwheel to be a specific kind of orientation of the line graph of a complete graph. In studying

pinwheels, they found that every pinwheel is strongly connected, contains $c((n-3)!) \binom{n}{2}$ many Euler tours, and that Seymour's Conjecture is true for every vertex in any pinwheel. The also gave tight bounds on the number of 3-cycles possible, the number of spanning trees and specific eigenvalues in any particular pinwheel, as well as characterized pinwheels of diameter 2.

Final presentations of the research projects were given before gathered faculty members of the Miami University Mathematics and Statistics Department in the final week using Power Point.

It is hoped that many of these students will attend regional mathematics meetings and national meetings such as NAM Fest, MathFest, and the Joint Winter Meetings of the AMS-MAA and the Joint Statistical Meetings of ASA and IHS 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.

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