

## **SUMSRI Journal**

### **Introduction**

SUMSRI is a program designed to prepare participants for the rigor and pace of 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. In order to prepare these students, the Institute offers short courses, research seminars and colloquia for seven weeks. It is an intense program in which the undergraduate participant learns what it means to focus entirely on mathematics and statistics as one would do during a graduate program. Each course, seminar and colloquia is designed to fulfill the following goals:

- 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.

We feel that this preparation will allow the participants to successfully complete and compete in graduate school.

In the summer of 2003, the Institute offered research seminars in set theory, multivariate statistics and abstract algebra. Participants also attended workshops in mathematical writing and GRE preparation, two short courses on algebra and real analysis and 11 colloquium talks.

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 3.89. 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. Four of the participants were African American, one was Hispanic, one was a Pacific Islander and six were Caucasian. Eleven of the twelve participants 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 Multivariate Statistics, Maria Joseph and Lori Hoffman used multivariate statistical analysis techniques such as discriminant analysis and principal component analysis to gain insight into what variables might affect an NBA team's post-season outcome in the playoffs. April Kerby and James Lawrence used similar methods to look at what factors can be used to predict the stock market. They also explored the possibilities for reducing the dimensionality of a complex financial and economic dataset while maintaining the ability to account for a high percentage of the overall variation in the data.

The Set Theory group, including Andrea Watkins, Alicia Richardson, Sarah Horton and Natalie Scala, looked at the Continuum Hypothesis. Let  $G$  be a countable subset of the real numbers. It is shown that if  $G$  is a closed set, open set, or  $F_\sigma$  set, then the cardinality of  $G$  is the same as the cardinality of the real numbers. In particular, the Continuum Hypothesis is true for the basic sets in the construction of the Borel sets.

The abstract algebra group looked at different aspects of the mathematics used in the tilings of M.C. Escher. Nancy Rodriguez and Maya Johnson rediscovered the 17 wallpaper groups first classified by Fedorov and Schönflies. They explored all lattices and determined their possible point groups. The point groups then enabled them to classify each distinct wallpaper group. Kelli Hall looked at the Escher tilings using combinatorial methods in order to give algebraic proof for his pictorial findings and then extend this mathematical approach to a few cases that involve ribbons. Lisa Marie Bush furthered Doris Schattschneider's work on kaleidocycles, which are three dimensional rings made from chains of  $2n$  regular tetrahedra attached at edges. She showed that the symmetry group of a kaleidocycle is  $D_n \oplus Z_2 \oplus Z_2$ . In addition, she extended kaleidocycles to cubeocycles, three dimensional rings made from chains of  $2n$  cubes attached at antipodal vertices, and showed that the symmetry group of a cubeocycle is  $D_n \oplus Z_2 \oplus D_3$ .

Final presentations of the research projects were given using Power Point slides. Members of the Miami University Mathematics and Statistics Department attended these presentations.

It is hoped that many of these students will attend regional and national mathematics and statistics meetings 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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