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SUMSRI
The Summer Undergraduate Mathematical Sciences Research Institute

SUMSRI News



Front Row: Leigh Cobbs, Natalia Cordova, Shenek Heyward, Camil Aponte, Janelle Jones, Allison Ford, AdriAnne Demski. Middle Row: Monique Owens, Kathleen Ansaldi, Helen Hauser, Patrice Johnson, Jennifer George, Kevin Mugo, Lakeshia Legette. Back Row: Nathan Mims, Josh Svenson, Clyde Johnson. Missing: Charles Phifer.

News from SUMSRI 2005

The Summer of 2005 brought 15 bright young mathematics and statistics students to Miami University to participate in SUMSRI 2005. This year, our group came from east of the Mississippi with students from Ohio to Maryland and as far south as Puerto Rico.

Each one came to dedicate the next seven weeks of their summer to the study of mathematics and statistics, study for the GRE and learn about graduate programs.

This year, SUMSRI's three research groups looked at Number Theory with Dr. Edray Goins; Multivariate Statistics with Dr.

Vasant Waikar and Abstract Algebra with Dr. Reza Akhtar.

People who don't know what kind of research undergraduate level mathematicians and statisticians can do will be surprised to see what these 15 students were capable of finding in the unsolved problems they committed themselves to work on over the summer. See abstracts of their papers inside or see the full papers at <http://www.users.muohio.edu/porterbm/sumj/2005/TOC05.html>

SUMSRI is a 7-week summer undergraduate research program in mathematics and statistics. SUMSRI seeks talented students in the mathematical sciences who are interested in pursuing advanced degrees. We are especially interested in, but not limited to, African Americans and other underrepresented minorities and women. Applications for the summer of 2006 can be found on the web at <http://www.units.muohio.edu/sumsri/applic.html>. SUMSRI is sponsored by the NSA, NSF and Miami University. Applications are due by March 1, 2006.

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Number Theory—Dr. Edray Goins

In Search of an 8: Rank Computations on a Family of Quartic Curves

Five students joined Dr. Edray Goins of Purdue University in looking at a specific group of elliptical curves. The number theory group considered the family of elliptic curves $y^2 = (1-x^2)(1-k^2x^2)$ for rational numbers $k \neq -1, 0, 1$. Every rational elliptic curve with torsion

subgroup either $Z_2 \times Z_4$ or $Z_2 \times Z_8$ is birationally equivalent to this quartic curve

for some k . They used this canonical form to search for such curves with large rank.

The algorithm they used consisted of the following steps. First, they computed a list of rational k by considering those associated to a given list of rational points

(x, y) . Then they eliminated certain k by considering the associated 2-Selmer groups. Finally, they used Cremona's mwrank computer program to find the ranks. Using these steps, they found two elliptic curves with Mordell-Weil group

$E(\mathbb{Q})$ congruent to $Z_2 \times Z_4 \times Z^6$.

Together with graduate assistant, Lakeshia Legette of Howard University, Kathleen Ansaldi of Loyola College of Maryland, Allison Ford of Mary Baldwin College, Jennifer George of Miami University, Kevin

Mugo of Otterbein College, and Charles Phifer of More-

house College worked together for seven weeks to do the research, write the paper, prepare a presentation and a poster for use at a national meeting.



Dr. Edray Goins with Kathleen Ansaldi, Jennifer George, Kevin Mugo, Allison Ford, and graduate assistant, Lakeshia Legette.

Multivariate Statistics—Dr. Vasant Waikar

Dr. Waikar led his statisticians to understand the various processes of statistical analysis. Two groups looked at very different issues with the assistance of graduate assistant, Shenek Heyward.

A Multivariate Statistical Analysis of Substance Abuse in the United States

Joshua Svenson of Baldwin-Wallace College and Monique Owens of Central State University determined where the major drug problems occur in this country among the states? How are social and economic factors related to substance abuse in the states? They approached these questions with multivariate statistics. By using factor analysis, they distinguished the underlying factors of a collection of variables related to substance abuse. With discriminant analysis, they designed a rule for classifying states as either having a major drug problem or

minor drug problem.

A Multivariate Statistical Analysis of Female Empowerment

Janelle Jones of Spelman College and AdriAnne Demski of Clarion University used their statistical knowledge to look at a very different issue. As women of the world struggle for equality there is a need for ways of measuring progress. They explored the empower-

ment of women using multivariate statistical techniques such as factor analysis and discriminant analysis. They hoped to classify countries into two populations, one where women are empowered and the other where women are not. They simplified this process by reducing the dimensionality of the data from 13 variables to a smaller number of underlying factors.



Dr. Waikar with AdriAnne Demski, Joshua Svenson, Janelle Jones, Monique Owens and graduate assistant, Shenek Heyward

Abstract Algebra—Dr. Reza Akhtar

Given a ring R , one may construct a graph $\Gamma(R)$, called the *zero-divisor graph* of R , whose vertices are the nonzero zero-divisors in R and whose edges are pairs $\{u,v\}$ of distinct zero-divisors such that $uv=0$. Another interesting graph is the complement of $\Gamma(R)$ —a graph with the same vertex set as $\Gamma(R)$ whose edges consist of pairs $\{u,v\}$ of distinct zero-divisors such that uv does not equal 0. The Algebra Group focused on the case $R=\mathbb{Z}_n$, the ring of integers modulo n .

Dr. Reza Akhtar of Miami University divided the algebraists into two groups for their research. Each group worked with Dr. Akhtar and their graduate assistant Leigh Cobbs to investigate zero-divisor graphs and related constructions.

Natalia Cordova (University of Puerto Rico - Rio Piedras), Clyde Gholston (Shaw University) and Helen Hauser (Ohio University) studied graph-theoretic quantities such as the clique number and coloring number for both $\Gamma(\mathbb{Z}_n)$ and its complement. Using these results, they were able to verify a special case of Hedetniemi's conjecture for direct product graphs. They also studied vertex colorings for the complement of $\Gamma(\mathbb{Z}_n)$ and extended previous work addressing the question of when the complement of $\Gamma(\mathbb{Z}_n)$ has a Hamiltonian cycle.



Camil Aponte (University of Puerto Rico - Rio Piedras), Patrice Johnson (Oakwood College) and Nathan Mims (Savannah State University) studied the line graph of $\Gamma(\mathbb{Z}_n)$. Generally speaking, for any graph G , the *line graph* of G , denoted $L(G)$, is the graph whose vertex set is the edge set of G ; two vertices of $L(G)$ are adjacent if the corresponding edges of G are incident at a common vertex. The students determined the diameter and girth of such graphs, classified which of them are planar, and obtained other results concerning the center, clique number, chromatic number, and existence of Hamiltonian cycles for these graphs.

Grant Writing—your way to tenure?

As mathematicians and statisticians at the beginnings of your careers, you might be wondering what is out there for you. Perhaps the college is putting pressure on its new faculty to bring in more money from outside sources as state and federal funds are increasingly cut back. Your value to your college or business will be increased if you show you can bring in money from outside sources to support the aims of the college or business.

Be sure to take a Grant Writing course if your college or a neighboring one offers it. These are usually one day or weekend courses and can help you a lot! Each grant has different requirements for the number of copies that need to be submitted, the form in which it must be submitted, budgeting, etc. Many grant proposals are now submitted online. Get as much

information about the granting source as possible, make phone calls to the contact person in order to get answers for specific questions. Ask if you can see a copy of a grant proposal that received funding. Your college may have a file of these in the sponsored research office.

There are several places that provide information on funding sources in the sciences, including mathematics and statistics.

One is the Community of Science (<http://fundingopps.cos.com/>). The Community of Science (COS) is the leading global resource for hard-to-find information critical to scientific research and other projects across all disciplines. You can sign up for updates on funding opportunities in your field sent directly to your email. These are from many sources in-

cluding corporations, Departments of Defense, Energy and Health, etc. COS also keeps scientist profiles on file so that you can find expertise to help you advance in your specialty.

The National Science Foundation (<http://www.nsf.gov>), the National Institutes of Health (<http://grants1.nih.gov/grants/>) and the Environmental Protection Agency (<http://www.epa.gov/ogd/grants/information.htm>) have similar funding source web addresses or email alert systems. These agencies websites concentrate on their own projects. The largest source of grant funding information is the Catalog for Federal Domestic Assistance (CFDA) (http://12.46.245.173/pls/portal30/CATALOG.FIND_ASSISTANCE_PROGRAM_DYN.show).

SUMSRI after 7 Years

That's right! It's been seven years since our first SUMSRI program took place in 1999. A lot has changed since then. For instance, that first SUMSRI statistics group had to find their own statistical sample because there weren't so many readily available statistics on the internet. So how have we done over the years? And where are some of those former SUMSRI participants from yesteryear? Below are some folks we've heard from recently.

Kathleen (Bellino) Hickey, ('99), got married this past summer and is enjoying her work at the Naval Research Lab in San Diego.

Lynn Holmes, ('99), will be graduating with a master's in Exercise Physiology at UNCC in December and is putting her knowledge to work at the Veteran's Benefits Administration.

Duke Hutchings, ('99). Some of you knew Duke also as a graduate assistant for SUMSRI. He's working hard to finish his Ph.D at Georgia Tech. He's married now to Heather.

Bethany Lyles, ('99), is on track to get her master's degree in nuclear engineering at UC Berkeley and is planning on pursuing her Ph.D.

Lawrence Garcia, ('00) is teaching math in the AVID program in inner city Denver after getting his master's degree in Applied Math. He also is the father of one child with another on the way.

Bethany (McLemore) Loeffler, ('00), recently gave birth to a son. Welcome to Joseph Walker Loeffler!

Sarah (Burke) Buzzell, ('01) is teaching math in Virginia and married this past summer.

Christy Finch, ('01), escaped the hurricanes that swamped Slidell, LA, along with the southern coast. She is newly married but plans for the future are uncertain due to the storm. Please send

good wishes her way as she and her family dig out and restart their lives.

Tuyet-Linh Phan, ('01), is at the University of California, Santa Barbara math department working her way to a Ph.D.

Lisa McGee, ('01) is working on her master's in Electrical Engineering at NCSU. She is using Interval Arithmetic methods to solve Signal Processing problems.

Leigh Cobbs, ('02), has been a graduate assistant at SUMSRI for the last two years and has been joined at Rutgers by **Sarah Blight**, ('04).

Andrea Falden, ('02), is now in Virginia studying religion.

David Friedenberg ('02) is working toward his Ph.D. in statistics at Carnegie Mellon.

Kelli Hall, ('03), is excited about her research in Time Scales at Marshall University.

Jarrod Cunningham ('04) also survived Katrina in the Math building at the University of South Alabama in Mobile. Although USA had some wind damage, the school is back up and running, accepting transfer students from universities in New Orleans and elsewhere that were not so lucky.

Amanda Phillips ('04) is attending Purdue University.

Kevin Tolliver ('04) will be joining

Julie Rogers ('04) at Auburn University in the Spring.

James Lawrence ('03) is now studying at the University of Colorado.

The University of Nebraska at Lincoln has been blessed by SUMSRI participants. Starting with **Melissa Desjarlais**, ('99), then joined by **Jennifer Everson** ('01), **Megan Breit** ('02), **April Kerby** ('03) and **Nick Imholte** ('04).

North Carolina State has also been fortunate in receiving some of SUMSRI's best. **Candace Porter** ('00) received her Master's degree in Bio-Medical Statistics. She is now working on her Ph.D. in biostatistics at the University of South Carolina. **Shenek Heyward** ('02) who has been SUMSRI graduate assistant in Statistics this past summer, is currently working toward a Ph.D. in statistics while **Monique Richardson-Taylor** ('02) is working toward her graduate degree in applied mathematics. **Didier DesHommes** and **Leslie Calloway** ('02) have also graced their halls.

Although we haven't heard recently from many of our former SUMSRI participants, we wish them all well as they conduct research, teach and study. Someone has suggested a SUMSRI reunion, perhaps for the 10th anniversary. If you think that is a good idea, we would love to hear from you.

SUMSRI Statistics

In the past 7 years, SUMSRI has served 99 students.

- 65 are either in graduate school or have graduated from a graduate program (~66%). However, 23 (~23%) are still undergraduate students and we have lost contact

with 6 students (~6%).

- Forty-seven program graduates are members of underrepresented ethnic groups (48%). Of these forty-seven students, 31 have received bachelor degrees (66%) and 26 of the thirty-one (84% of graduates) are either in a graduate program or

have received a graduate degree.

- Seventy-nine SUMSRI graduates are female (79%). Sixty-three of the female SUMSRI participants have received bachelor degrees and 49 (78%) are either in a graduate program or have received a graduate degree.



Photo Gallery

Going clockwise around the page:

1) The Faculty and Staff of SUMSRI include: Drs. Dowling, Akhtar, Goins, Ortiz, Farmer, Waikar, Davenport and Ms. Porter.

2) The previously missing Charles Phifer.

3) Camil and Natalia—The 'Twins'

4) Allison, Kevin and Janelle in focus.

5) Patrice and Monique—The Other 'Twins'

6) Charlie's Angels—In Charles' absence, they had to do something! Allison, Kevin, Jennifer and Kathleen

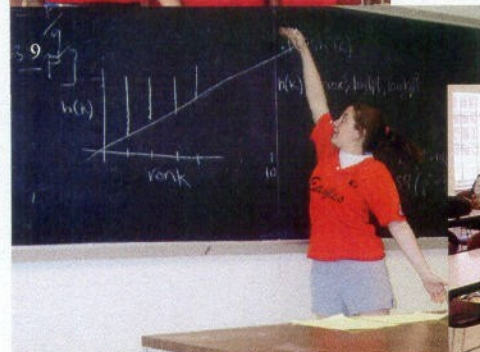
7) Natalia, Clyde and Helen—Structure group

8) Cover Girl!—Shenek's picture on her alumni magazine.

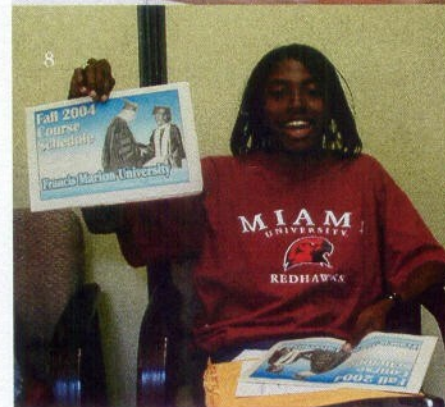
9) Jennifer shows 'It's this high.'

10) SUMSRI's backbone—Graduate Assistants Lakeshia Legette, Leigh Cobbs and Shenek Heyward.

11) Statistics group (right to left) Monique, Joshua, AdriAnne, and Janelle. Shenek humbly supervises from behind.



Classroom Session on Abstract Algebra



Joint Statistics Meetings

National and regional meetings of mathematicians or statisticians are a great place to network, find out what other young scholars are doing, find out what they think of their graduate programs, meet with graduate directors and hear about cutting edge work on the frontiers of your field.

In August, 2005, Sara Blight, Kendall Williams and Ralph Gedeon presented their SUMSRI 2004 research at the Joint Statistical Meetings in Minneapolis, MN.



Dr. Waikar poses with Sara Blight, Kendall Williams and Ralph Gedeon at the Joint Statistics Meetings in Minneapolis, MN, August, 2005