

DEPARTMENT OF MATHEMATICS

Report to the Board - Spring 1999

PERSONNEL

George Berzsenyi and **Jack Kinney** will be retiring after the end of the school year. **Matt Hopkins** will be resigning from Rose-Hulman to work at Sandia Labs. **Nacer Abrouk** is on sabbatical as a statistical consultant at Statistical Research and Consulting. **Yosi Shibberu** is on sabbatical at Washington University working as a mathematical consultant with medical researchers. Leaves were approved for **Kurt Bryan**, **Aaron Klebanoff**, **Robert Lopez** and **LeRoy Franklin** (as a Fullbright Scholar). New faculty hires include Jeff Leader, Tanya Leise, and Jerry Muir. **Cheryll Dodd** resigned as secretary to move to St. Louis. **Patti Staggs** has been hired as the new departmental secretary. **Kurt Bryan** and **Aaron Klebanoff** have been promoted to Associate Professor with tenure. **Steve Carlson** has been promoted to Full Professor.

GRANTS AND CONTINUING GRANT ACTIVITIES

Allen Broughton, **John Rickert** and **Gary Sherman** continue to conduct an NSF-REU in Hyperbolic Geometry, Computational Group Theory and Number theory. This is the second year of the three year (\$120,000) grant, continuing a ten-year history of consecutive NSF-REU's at the RHIT site.

Kurt Bryan has continued working with Lester Caudill at the University of Richmond, on inverse problems related to thermal imaging, funded by NSF grant DMS-9623279.

John Kinney received a grant from the Indiana State Department of Education to conduct a two-week summer program for middle and secondary school teachers. The purpose of the grant is to provide instruction in probability, statistics, and discrete mathematics so that teachers may incorporate these topics into existing courses as well as develop individual courses devoted to these areas. Separate courses in probability and statistics as well as a course in discrete mathematics are now approved for inclusion in our secondary Core 40 curriculum. (Kinney has served on the mathematics group developing the Core 40 curriculum.) The grant provides for released time for the entire academic year so that Kinney can work with the teachers in the program.

STUDENT ACTIVITIES, PRESENTATIONS, PUBLICATIONS and AWARDS

Mathematics Competitions

1. **Alfred R. Schmidt Freshman Mathematics Competition** (advisor John Rickert): The 10th annual Alfred R. Schmidt Competition Freshman Mathematics Competition was held September 17, 1998. Prizes were awarded as follows: Matt Katinas – 1st, Nathan Froyd and Stephen Young – 2nd, Nathanael Berglund and Kathy Repine – 3rd, Charles Clancy, Shaun Ellis, Joel Ericson, Marques Kirsch, Sandor Pethes, and Philip Stephenson – Meritorious Mention, Sanga Coulibaly, Tom Mackel, Brandon Ress, Noah Siegel and Anna Yokel – Honorable Mention.

2. **20th Annual Virginia Tech Regional Mathematics Competition** (advisor John Rickert): There were 186 contestants from 34 institutes. Jim Meyer finished tied for 11th place. Team members included Matthew Lepinski, David Powder, Peter Webb, Randy Motchan, Elaine Mahler, Matthew Katinas, David Sing, Stephen Young, Brooke Chenoweth, Frederick Franzwa, Nathan Froyd, Dennis Lin, and James Meyer.
3. **58th Annual Putnam Competition** (advisor Steve Carlson): The team of Matt Lepinski, Dennis Lin and Randy Motchan place ranked 41st among 319 institutions represented by teams. Additionally Nathanael Berglund and David Powder placed in the top 500 of the 2581 participants.
4. **Mathematical Contest in Modeling** (Advisor Aaron Klebanoff): The four teams and their results were Jonathan Matthews, Jim Meyer, Fred Franzwa (Outstanding); Matt Lepinski, Dennis Lin, Randy Motchan, (Meritorious); Bill Richardson, Stephen Young, Curtis Huttenhower (Meritorious) and Kathy Repine, Jennifer Rudolph, Quentin Kramer, (Successful Participant).
5. **Indiana College Mathematics Competition** (Advisor: John Rickert): The team of Matt Lepinski, Dennis Lin and Randy Motchan won second place in the competition. Five of the seven Rose teams were in the top 10 of 33 teams.

Pi Mu Epsilon (advisor Elton Graves): Thirty-five students and faculty members attended the Annual Pi Mu Epsilon Banquet on May 4, 1999. Twenty-eight of the Rose-Hulman student body were inducted into this honorary mathematics fraternity. Dr. Jim Christie of Valparaiso U. spoke on his work with NASA. During the year the fraternity assisted in many math department projects such as the ARS freshman competition, The RHIT High School Mathematics Contest and the Undergraduate Mathematics Contest.

Math Club (advisor Aaron Klebanoff): Organized a student workshop for the spring meeting of the Indiana MAA meeting. The Workshop was supported by a grant from the Exxon Foundation. The club also organized and gave a presentation for the Rose Show.

Student Publications:

Matt Lepinski, *Automorphic Subsets of the n -dimensional Cube are Translations of Cwatsets*. **MSTR 99-01**

Student Presentations:

Matt Lepinski “How Grouplike are Cwatsets” at the Pi Mu Epsilon Conference at Miami University and at the Fall Meeting of the IMAA at St. Mary’s College.

_____ “How Grouplike are Cwatsets” presented jointly with Jennifer Paulhus, Cary Girod and Joe Mileti at the Joint Mathematical Meetings in San Antonio.

_____ “Maximally Disjoint Set Covers: A Genetic Approach”, RHIT Undergraduate Mathematics Conference.

Jim Meyer, Jonathan Matthews and Fred Franzwa “Standing Room Only: MCM Problem B”, RHIT Undergraduate Mathematics Conference.

Chris Anderson, Jennifer Crone and Jennifer Taylor “Industrial Optimization: Specialty Plastics and Packaging, Inc.”, RHIT Undergraduate Mathematics Conference.

Awards:

During the Spring Honors and Awards Banquet, **Nathanael Bergland, Matt Katinas, and Stephen Young** were awarded the Palmer Award for outstanding performance as a freshman. For exceptional

performance in Mathematics competitions, the following Students were awarded prizes: **Matt Lepinski, Dennis Lin, Randy Motchan, Nathanael Berglund, David Powder** (Putnam); **Fred Franzwa Jonathan Matthews Jim Meyer, Matt Lepinski, Dennis Lin, Randy Motchan, Curtis Huttenhower, Bill Richardson, Steve Young** (Modeling Competition); and **Matt Lepinski, Randy Motchan and Dennis Lin** (ICMC Competition).

Conferences and Workshops

Twenty one students attended the Spring Meeting of the Indiana Section of the MAA held at Ball State on March 20th and 21st, participating in the ICMC competition mentioned above. A number of these students attended a workshop on Game Theory organized by the RHIT Math Club.

FACULTY and STAFF ACTIVITIES

Professor **George Berzsenyi** was on a special leave during the academic year, in order to work on some compendia of mathematical problems (with solutions and related materials). Of these, only one appeared thus far: "C2K: Century 2 of KoMaL", which contains nearly 800 problems, some sample solutions and other materials that appeared in Hungary's famous high school mathematics and physics journal in 1994-1997. Professor Berzsenyi was one of the associate editors of this book, which was published in Budapest by the Roland Eotvos Physical Society in 1999. The book also contains an extensive preface written by Professor Berzsenyi. This "preliminary edition" of C2K was prepared for the winners of the USA Mathematical Talent Search (USAMTS), which was initiated by Professor Berzsenyi in 1989. He was also involved with the preparation of the problems for the USAMTS, and remained active in a variety of competition-related activities.

Allen Broughton organized and participated in two presentations on teaching with the laptop computer. The first at the Assessment Symposium in October was "How do I teach with this Laptop Anyway" with Patsy Brackin, Julia Williams and Mark Yoder. The second was a daylong presentation "The Rose-Hulman Laptop Program" with Julia Williams, Aaron Klebanoff and Dan Hatten, at Stevens Institute of Technology, in March. Additionally, he presented "Mathematical Methods of Image Processing A Progress Report on Course Development", at the MAA annual meeting in San Antonio (joint work with Ed Doering). His research work with undergraduate students continues having written *Constructing Kaleidoscopic Tiling Polygons in the Hyperbolic plane* as a technical report and submitting it for publications. Two manuscripts, with joint authorship with REU students are underway. Along with David Rader, he co-organized the Undergraduate Conference at Rose and served as coach for the KSD2 team on fostering an Excellent Learning Environment.

Kurt Bryan has continued working with Lester Caudill at the University of Richmond, on inverse problems related to thermal imaging, funded by NSF grant DMS-9623279. They have submitted another three-year proposal to the NSF, for the period 6/99 to 6/02. Kurt Bryan has also continued work with Michael Vogelius at Rutgers University, and will spend the 1999-2000 academic year there on sabbatical.

Stephen Carlson signed a contract with John Wiley and Sons, Inc., to publish his textbook *Topology of Surfaces, Knots, and Manifolds: A First Undergraduate Course*. The intended publication date is August, 2000. He presented a paper entitled "Curricular Options for Undergraduate Topology" at a meeting of the American Mathematical Society held in Chicago in September, gave a talk entitled "Can

Every Knot Be Unknotted, or Not? -- A Tale of Three Colors” at Purdue University in November, and in January presented a paper entitled “It’s More Than Just a Moebius Band! -- Mathematically Enriching Topology Projects” at the national Mathematical Association of America meeting in San Antonio. Also, his paper entitled “Proof Without Words: Self-Complementary Graphs” was accepted for publication in *Mathematics Magazine*. Carlson has continued his service to the MAA as a member of the national Committee on Sections, has been elected to a three year term as the Governor of the Indiana Section of the MAA, and authored the 1999 Geometry Contest for the Indiana Council of Teachers of Mathematics. In addition to regional and national meetings of professional societies, he attended the 1999 RHIT Undergraduate Mathematics Conference. And his work on campus included academic advising of junior mathematics majors, advising the Rose-Hulman students who participated in the 1998 Putnam Competition, coordinating the ISU-RHIT-SMWC Mathematics Colloquium series, and serving on the Mathematics Department Curriculum Committee (as chair), the Quality of Education Committee, and the Faculty Workload Assessment Team.

LeRoy A. Franklin in his first year at Rose has helped start curricular development in the statistical area and was course supervisor for the Engineering Statistics, MA 223. In the winter term, he taught MA 322 Quality Methods for first time in three years and participated in the discussions within the department and with the department chairman on the development of a statistics concentration within the math department. Dr. Franklin co-authored 3 journal articles that have been accepted for publication: "An SPC Case Study on stabilizing Syringe Lengths", *Quality Engineering*; "A Comparison of Flat and Shallow Tips for Cervical Cryotherapy", *Journal of the American Board of Family Practice* (work done with Dr. Kathy Stienstra at Union Hospital); "A Messy, But Instructive, Case Study in Design of Experiments", *Quality Engineering*. Also Dr. Franklin attended two national meetings: The National Decision Sciences Institute Meetings in Las Vegas and the National American Statistical Association Meetings in Dallas. He jointly presented two (peer reviewed) papers that were published in the proceedings of the meetings. Finally, Dr. Franklin was elected Treasurer of the National Quality and Productivity Section of the American Statistical Association (a 3 year term) and was nominated by the Indianapolis Chapter of the American Statistical Association as Fellow of the American Statistical Association (a life time achievement award which is the highest award that the American Statistical Association can give to its members.)

Ralph Grimaldi taught courses in differential equations, applied mathematics, probability, and engineering statistics. In addition he served on the committee for fringe benefits and the dean's commission on the reward system, and represented the department on the committee for sabbatical leaves. In September he was invited to speak at the Discrete Mini-Conference at Clemson University, where he presented a survey on classical and new applications dealing with the Catalan numbers. In November he and Professor John Rickert ran the Rose-Hulman high school mathematics contest with the help of Professors David Rader, Matt Hopkins, and Allen Broughton. The fourth edition of his text, *Discrete and Combinatorial Mathematics: An Applied Introduction*, was published by the Addison-Wesley Longman Publishing Company, also in November. The Solution Manual for this text was published by the same company in February. His paper, *The Catalan Numbers as Sums of Squares*, was published in the journal *Congressus Numerantium* in December. In January Dr. Grimaldi attended the national mathematics meetings at San Antonio where he served on the committee for minicourses. Addison-Wesley Longman conducted a book signing for his fourth edition at these national meetings. In March Professor Grimaldi attended the 30th International Conference on Combinatorics, Graph Theory and Computing at Florida Atlantic University, where he delivered the

paper, Tilings and Patterns of Enumeration. On April 1 the Friends of the Cunningham Library honored him for the publication of the fourth edition of his textbook at Indiana State University.

John Kinney has been on special assignment this year through a grant from the Indiana Department of Education. He has been working with 32 teachers who attended the Mathematics for the 21st Century program last summer. Several of these teachers are creating courses in probability and statistics for the high school curriculum. More than half of the teachers will return this summer for a two-week program devoted to more instruction in probability, statistics, and discrete mathematics, this program funded by a new grant from the Indiana Department of Education. Professor Ralph Grimaldi has also served as faculty member for the program. He is also writing a new textbook, Statistics for Science and Engineering under contract to the Addison-Wesley Publishing Company.

Aaron Klebanoff presented “The Cantor Dust Beyond Feigenbaum Diagrams” at the International Conference on Technology in Collegiate Mathematics held in New Orleans in November. In January, he attended Dynamics Days, a chaos workshop at Georgia Tech. While teaching the math modeling course (MA331), he also advised four modeling teams in Rose-Hulman's best overall performance ever for the Mathematical Contest in Modeling. In March, he traveled to Stevens Institute of Technology to talk about ways to teach with laptops. For his second time, Dr. Klebanoff has become a subject matter expert (SME) in the fields of chaos and fractals for the Electronic Emmissary Program, a program run out of UT Austin to link SMEs with advanced high school students and their teachers from around the country. Dr. Klebanoff is currently working with a student and his teacher from Cambridge Ridge and Latin School in Cambridge, MA. Dr. Klebanoff continues to be very active on the Honors and Awards Committee.

Roger Lautzenheiser, after returning from his 1997-1998 sabbatical in Japan, taught in the fast track calculus program last summer. He also attended the Indiana section meetings of the Mathematical Association of America. While on sabbatical and throughout this year, he has been working on starting an electronic journal in mathematics for mathematics papers written by undergraduates. The department discussed this idea several years ago, but due to conflicts with an existing journal, the idea was not pursued.

Robert Lopez continued work on his textbook, Advanced Engineering Mathematics with Maple, submitting Chapters 2-6 since September. He is presently completing Chapter 7. So far, more than 1200 pages have been written. In addition, Dr. Lopez has been notified he is to receive the 1999 ASEE Mathematics Division Distinguished Educator and Service Award at the 1999 Annual Meeting in Charlotte, NC.

David Rader participated in a number of on- and off-campus activities. During the academic year he developed a course MA590 “Operations Management” for the Engineering Management Program. In addition, he redesigned the MA444 course “Deterministic Methods in Operations Research”, and also developed a course in Combinatorial Optimization (MA490), which he taught in the spring. During the spring term, he was the instructor for 3 mathematics majors doing a project-based course. This course attempted to solve some production problems for a plastics company based in Shelburn, IN. He was an instructor during the freshman Laptop Orientation in the fall and also helped with the RHIT High School Mathematics contest. He has served on the department's computing services committee and the search committee. In addition, he served on the Institute's Commission on the Assessment of Student Outcomes (CASO). He was one of the co-coordinators for the Undergraduate Mathematics Conference held on March 19-20. In addition, he attended both the Fall and Spring meetings of the

Indiana Section of the Mathematical Association of America, where he participated in the Project NeXT-IN sessions devoted to improving the teaching of new mathematics faculty. He also attended a conference on Discrete Optimization in Transportation and Logistics in February, held in New Jersey, and presented a paper on “Complexity Results for Facets of the Quadratic 0-1 Knapsack Polytope” at the INFORMS Spring 1999 meeting in Cincinnati, OH. During the academic year, the paper “Optimal cell flipping to minimize channel density in VLSI design and pseudo-Boolean optimization” he co-authored was published in *Discrete Applied Mathematics*, and he submitted a paper “Maximally Disjoint Solutions to the Set Covering Problem” to the *Journal of Heuristics*.

Professor **John Rickert’s** paper “Apocalyptic Powers” was accepted by The Journal of Recreational Mathematics. He submitted his paper Divisibility of Restricted Partition Functions to the Proceedings of the American Mathematical Society. The material of the latter paper was the topic of his talk at the RHIT-ISU-SMWC joint mathematics colloquium. He was coach for Rose-Hulman's seven teams competing in the Indiana College Mathematics Competition administered at the spring meeting of the Indiana Section of the MAA. Five of these teams were the top ten scoring teams in the competition. He served as a freshman advisor for IFYCSEM. He was one of the organizers of the thirty-third annual Rose-Hulman High School Mathematics Competition. He served as a coach and organizer of the teams representing the state of Indiana at the American Regions Math League meet, to be held in June and is the Midwest representative on the “Communication Through Technology” committee for the American Regions Mathematics League. He has been working with the Rose-Hulman mathematics club, coordinating weekly mathematical problem solving sessions for area high school students. He also presented sessions on mathematics as part of Rose-Hulman's “Explore Engineering” program. During the summer he will be heading a group studying number theory in Rose-Hulman's REU program.

Gary Sherman continued to work on his idiosyncratic text "Indiscrete Discrete Mathematics" and talked with faculty from around the country who are interested in how he engages students in undergraduate research and how he uses technology in discrete mathematics and abstract algebra. In particular, he gave a series of talks at Northern Michigan University sponsored by SIAM. He also attended an Indiana MAA section meeting and the annual AMS-MAA meeting in San Antonio where his NSF-REU students spoke on their research. A joint paper (with students Stephen Ahearn and Mark Huber), “Finite Groups Can be Arbitrarily Hamiltonian, appeared in the Communications in Algebra. In addition he served as Faculty Representative to the Board, on the Institution PTR Committee, as leader of the KSD5 Team, on the Mathematics Hiring Committee, and as advisor to the sophomore mathematics majors.

David Voss served as a visiting Professor of Mathematics while on sabbatical leave from Western Illinois University. He gave several talks in the Applied Math Seminar on the method of lines in Differential Equations.

PRESENTATIONS, SEMINARS and COLLOQUIA

Off campus presentations:

Allen Broughton “Mathematical Methods of Image Processing A Progress Report on Course Development”, MAA annual meeting in San Antonio.

_____ (with Julia Williams, **Aaron Klebanoff** and Dan Hatten), “The Rose-Hulman Laptop Program” at Stevens Institute of Technology.

Kurt Bryan The Mathematics of Non-Destructive Testing, Sigma Xi Conference at Indiana State University.

Steve Carlson “Curricular Options for Undergraduate Topology”, AMS Regional Conference at Depaul University.

_____ “Can Every Knot Be Unknotted, or Not? -- A Tale of Three Colors”, Purdue University.

_____ “It’s More Than Just a Moebius Band! -- Mathematically Enriching Topology”, MAA annual meeting in San Antonio.

Leroy Franklin “Process Capability Studies: Alternative Measures of Dispersion” National Decision Sciences Institute Meetings in Las Vegas.

_____ “A Simulation Study to Validate Interpolated Percentiles in Classification Error Rates for Stochastic Dominance versus Bootstrapped Stochastic Dominance”, National American Statistical Association Meetings.

Elton Graves “The Indiana Mathematics Competition”, MAA annual meeting in San Antonio.

Ralph Grimaldi “Catalan Numbers Old and New”, invited speaker, Clemson University Conference on Discrete Mathematics.

_____ “Tilings and Patterns of Enumeration”, 30th International Conference on Combinatorics, Graph Theory and Computing at Florida Atlantic University.

Matt Hopkins “Biological Convection”, Institute for Applied Mathematics at the University of Minnesota.

Aaron Klebanoff “The Cantor Dust Beyond Feigenbaum Diagrams”, International Conference on Technology in Collegiate Mathematics.

John Rickert “Divisibility of Partition Functions” at Penn State Number Theory Conference.

David Rader “Complexity Results for Facets of the Quadratic 0-1 Knapsack Polytope”, INFORMS Spring 1999 meeting in Cincinnati, OH.

Applied Mathematics Seminar:

David Voss: The method of lines for solving differential equations.

Kurt Bryan: Elementary Inversion of the Laplace Transform

Robert Lopez: Root Locus, Feedback, and Block Diagrams and Maple-Inspired Vignettes in Applied Math

RHIT_ISU-SMWC Colloquium:

John Rickert Divisibility of Restricted Partition Functions

PAPERS, PUBLICATIONS AND TECHNICAL REPORTS

Papers and Publications:

Allen Broughton “Constructing Kaleidoscopic Tiling Polygons in the Hyperbolic plane”, submitted to the *American Mathematics Monthly*.

George Berzsenyi “C2K: Century 2 of KoMal”, associate editor.

Steve Carlson “Proof Without Words: Self-Complementary Graphs” accepted for publication in *Mathematics Magazine*.

Leroy Franklin (with Belva Cooley and Gary Elrod), “A Messy but Instructive, Case Study in the Design of Experiments”, *Quality Engineering*. (Accepted)

_____ “An SPC Case Study on Stabilizing Syringe Lengths” *Quality Engineering*. (Accepted)

_____ (with Dr. Kathy Stienstra) “A Comparison of Flat and Shallow Tips for Cervical” *Journal of the American Board of Family Practice*. (Accepted)

Ralph Grimaldi “Discrete and Combinatorial Mathematics: An Applied Introduction” fourth edition, *Addison-Wesley Longman Publishing Company*.

_____ “The Catalan Numbers as Compositions of Squares”, *Congressus Numeratium*

David Rader (with Peter Hammer, Michael Minoux, Endre Boros) “Optimal cell flipping to minimize channel density in VLSI design and pseudo-Boolean optimization” *Discrete Applied Mathematics*.

_____ “Maximally Disjoint Solutions to the Set Covering Problem” submitted to the *Journal of Heuristics*.

John Rickert “Apocalyptic Powers” will appear in the *Journal of Recreational Mathematics*.

_____ “Divisibility of Partition Functions” submitted to *Proceedings of the AMS*.

Mathematical Sciences Technical Report Series:

MSTR 98-05 Leroy Franklin, Belva Cooley and Gary Elrod, *A Messy but Instructive, Case Study in the Design of Experiments*.

MSTR 98-06 Allen Broughton, *Constructing Kaleidoscopic Tiling Polygons in the Hyperbolic plane*

MSTR 98-07 Kurt Bryan, *Elementary Inversion of the Laplace Transform*.

MSTR 99-01 Matt Lepinski, *Automorphic Subsets of the n-dimensional Cube are Translations of Cwatsets*.

PROGRAMS and CONFERENCES (more details of programs in various locations above)

The **33th Annual Rose-Hulman Mathematics Competition** was held in November. Approximately 500 high school students were in attendance. It was co-organized, by **Ralph Grimaldi** and **John Rickert** with assistance from David Rader, Matt Hopkins and Allen Broughton.

The **Sixteenth Annual RHIT Undergraduate Mathematics Conference**, organized by **Allen Broughton** and **David Rader**, was an overwhelming success. Seventy-one participants came from as far away as Rohnert Park, CA, to listen to and/or present papers. The Undergraduate Conference is one of a handful of Conferences in the country that is completely devoted to student speakers, except for the invited speakers. The guest speakers this year were Dr. Colm Mulcahy and Dr. Michael Trick.

The **Fast Track Calculus** program this year continues to attract large numbers of applicants. Forty students have been invited to participate and enrollments are expected to be about the 40-50 range. Professors **Elton Graves** and **Roger Lautzenheiser** will be teaching in this summer’s program which begins July 19.