

DEPARTMENT OF MATHEMATICS

Report to the Board - Fall 95

PERSONNEL

Professor Dave Bond, our newest tenure track faculty member began work on 16 Aug 95 and has plunged right into teaching calculus and differential equations. Dr. Bond's background is in Numerical Analysis. He and his wife Sandi have two young daughters.

Professor Brian Bowman continues a visiting appointment at RHIT. Last year he was full time in the Physics department, this year he is split between Mathematics and Physics

Professor Gary Sherman will be on sabbatical leave during the Winter quarter. During this time he will develop his interest in the discrete Fourier transform and prepare this material for his Research Experiences for Undergraduates program next summer.

GRANTS AND CONTINUING GRANT ACTIVITIES

In July, Professors Aaron Klebanoff, Lynn Kiaer and Brian Winkel worked with Professor Jerry Fine and six high-school teachers in a project to develop complex, technology based problems in Calculus. The funding for this activity, obtained by Brian Winkel, is a \$100,000 NSF grant combined with \$26,400 from the Arvin Foundation (for the high school teachers). This summer was the second phase of the project. Aaron Klebanoff was successful in setting up the problems on a World Wide Web site on campus. He continues to work on the website.

Professor Gary Sherman conducted his seventh NSF-REU (Research Experiences for Undergraduates) summer program. In this program Professor Sherman worked with seven outstanding undergraduate mathematicians, including two Rose-Hulman students, for seven weeks, and will produce some faculty-student publications.

Professors George Berzsenyi, Steve Carlson and Lynn Kiaer ran the Young Scholars Program for its fifth year. This summer's four week program had 51 students of exceptional quality. The students were selected from the USA Mathematical Talent Search which is now in its seventh year.

Professors Robert Lopez and Mark Yoder conducted a one week, on campus, NSF-supported conference entitled "Revitalizing the Mathematics, Science and Engineering Curricula via Symbolic Algebra."

Professor John Kinney organized a one week IQL (Indiana Quantitative Literacy) workshop for high school teachers in Probability and Statistics. It was funded by the Indiana Department of Education.

Professors Nacer Abrouk, Jack Kinney Roger Lautzenheiser and Yosi Shibberu were members of the Sophomore Curriculum design team during the summer. This activity was funded from the Foundation Coalition grant.

Professor Kurt Bryan developed a set of notes in collaboration with faculty from several departments for a course in mathematical modeling, which will be offered in Winter quarter. The funding for this activity was provided by the Foundation Coalition upper division course development funds.

PROGRAMS

The Fast Track Calculus program attracted 44 students this year. Under the able instruction of Professors Elton Graves and Robert Lopez and Allen Broughton 43 of these students (including 9 women) were able to complete a full year of Calculus in five weeks.

The Jump Start Program is in its second year, giving a select group of 32 freshman a head start on their first year. The program was run by Professors John Rickert (director) , Kurt Bryan and David Mutchler (who provided laptop orientation lectures).

Eleven members of the department participated in the Freshman Laptop Orientation program.

The Department has agreed to host the Indiana Section of the Mathematical Association of America Meeting on October 26, 1996. Steve Carlson will be the local organizer.

STUDENT ACTIVITIES

Richard Mohr and **Nick Fiala** participated in Gary Sherman's Research Experiences for Undergraduates (REU) during the first seven weeks of the summer.

FACULTY ACTIVITIES

Professor Nacer Abrouk served as a statistical consultant for the Kellogg Company, Battle Creek, Michigan while on leave in the spring quarter, working in the capacity of Senior Project Leader, Department of Quality Improvement Services, Science and Technology Division. Activities included the design and analysis of experiments related to quality control, stability of processes, and comparative studies. A sample survey including all of North American Kellogg employees was designed, carried out and analyzed. Several technical reports were produced; all of these technical reports are proprietary and confidential. While at Kellogg's he was a panelist at a televised conference sponsored by the Ford Motor Company and Michigan State University in Detroit: A Partnership in the Quality of Education. Professor Abrouk is also the director of the Center for Industrial Statistics directing on campus projects and providing off campus consulting:

On-Campus CIS Projects:

Title: Fatigue Crack Growth
Participating Student: Spiro Megremis, Graduate student
Major: Biomedical Engineering
Advisor: Dr. S. Hulbert

Title: Ultrafiltration of Proteins
Objective: Separation of a protein of a specific molecular weight by ultrafiltration systems.
Participating student: Kathleen Knabe, graduate student
Major: Biomedical Engineering
Advisor: Dr. R. Artigue

Off-Campus CIS Projects:

Title: Parameter Estimation of a Weibull Model
Sponsor: General Motors (GM)
Participating students:
Project Director: Dr. N. Abrouk

Title: Confidence Intervals for the Parameters of a Weibull Distribution in the presence of censoring in small data sets

Participating students: The selection process has not been completed yet

Sponsor: General Motors (GM)

Project Director: Dr. N. Abrouk

Dr. Abrouk was Program Chair for the 1995 ASEE conference, Anaheim, California, June 25-28, 1995 and was elected ASEE Mathematics Division Chair, for the Washington D.C., June 1996 meeting. He participated in an NSF workshop on Evaluation and Dissemination held at IUPUI University Center in Indianapolis (July 1995), sponsored by the Foundation Coalition. He has also carried out the preliminary organization of the 1996 RHIT Undergraduate Mathematics Conference. Jointly with Professor Lopez he has published the paper Population Genetics: Estimation of Distributions through Systems on non-linear differential equations in MAPLETECH, 1995. Professor Abrouk submitted an NSF grant pre-proposal for the establishment of the RISP (Repository for Industrial Statistics Projects). This grant is a joint effort between Rose-Hulman Institute of Technology and Michigan State University. Professor Abrouk continued his work in the Foundation Coalition Sophomore Curriculum Development Team during the summer for 9 weeks. He and Dr. J. Kinney, developed MA 212, a sophomore level course in statistics for engineers. He also developed lecture notes and data driven projects for a new course to be offered during the next winter quarter, entitled General Linear Models. Finally, he participated in the Freshmen Laptop Orientation, submitted a proposal for the Lilly conclave and participated in the conclave in Indianapolis.

During the month of May, Professor George Berzsenyi attended a meeting of directors of Young Scholars Programs (YSP) at the NSF and met with a group of mathematicians at the National Security Agency (NSA) to discuss the future of the USA Mathematical Talent Search (USAMTS). In June he had further discussions with NSA officials at the headquarters of the Consortium for Mathematics and Its Applications (COMAP, in Boston) finalizing the transition of the USAMTS to COMAP and NSA. He also spent 2 weeks preparing problems for the USAMTS, and made various other necessary preparations for Year 7 of the program. He also co-directed (with Steve Carlson) Rose-Hulman's YSP (4 weeks with 51 participants representing 25 states) and taught in that program. Moreover, he continued writing his columns in Quantum, Consortium, Mathematics and Informatics Quarterly, and Math Horizons.

Professor Allen Broughton, in addition to normal administrative duties (seven mathematics programs this summer) worked throughout the summer to provide a smooth transition to laptop based teaching this fall. He advised WCC on various aspect of classroom preparation, was a member of the Laptop Orientation Planning Team, and wrote and distributed a comprehensive set of laptop based notes on MAPLE. These were made available to the faculty electronically and have been widely received. He gave a workshop on the use of MAPLE to the Foundation Coalition Sophomore Curriculum Development Team. Early in the summer he attended a workshop at RHIT on cooperative learning given by Alicia Waller. Later, he participated in the five week Fast Track Calculus program along with Professors Graves and Lopez. Professor Broughton continues his collaboration with a group of mathematicians at the Universidad Nacional de Educacion a Distancia and Universidad Complutense in Madrid, Spain, working in the area of symmetries of Riemann surfaces. A paper entitled Symmetries of Riemann Surfaces on which $PSL(2,q)$ acts as a Hurwitz automorphism group, has resulted from this collaboration and is now in press. The group is working on a subsequent paper entitled Symmetries of Accola-Maclachlan and Kulkarni surfaces. He refereed one paper for Discrete and Combinatorial Geometry. At the start of the school year, he submitted two ideas for grant proposals to Dr. Hulbert concerning the Lilly Endowment grant, and attended the ensuing conclave in Indianapolis. Finally, he continues to be the faculty sponsor of the Rose-Hulman Roller Blades Club.

Professor Kurt Bryan, with co-author Lester Caudill at the University of Richmond, had the paper "An Inverse Problem in Thermal Imaging" accepted by the SIAM Journal of Applied Mathematics. The paper will appear next summer. He delivered a lecture on the topic at a conference on inverse problems at the University of Washington in July. A related paper, "Stability and Resolution in Thermal Imaging," is to

appear in the proceedings of the ASME Biennial Conference on Vibration and Noise. Professor Bryan will present the paper at the meeting in September, 1995. He continues to work with Lester Caudill on thermal methods for nondestructive testing. They are working on extending their ideas to the mathematical analysis of time-dependent thermal methods for three-dimensional corrosion detection. Professor Bryan completed another paper, "Homogenization for Electrical Conductors with Cracks," with Michael Vogelius of Rutgers University. The paper is being submitted to the Quarterly Journal of Applied Mathematics. Professor Bryan spent a week at Rutgers University in June working with Professor Vogelius on the paper. They are now working on applications of the Radon transform in electromagnetics. Professor Bryan also attended a symposium on electrical impedance imaging at the University of Kentucky and a workshop, "Optimization and Inverse Problems," at the Institute for Mathematics and Its Applications. He obtained a grant for \$9,500 from the Foundation Coalition to spend part of the summer developing a course in mathematical modeling which focuses on modeling with conservation laws. The work was done with Professors Klebanoff (mathematics) and Baratuci (chemical engineering), with assistance from Dave Voltmer in electrical engineering and Jerry Fine in mechanical engineering. He also spent two weeks in July preparing to teach in the Integrated First-Year Curriculum in Science, Engineering and Mathematics (IFYCSEM), and converted the IFYCSEM Mathematica instructional materials into Maple. With Professors John Rickert and David Mutchler, he prepared for and taught the Jump Start program for incoming freshman. During the summer Professor Bryan created the first World-Wide Web page for the mathematics department and refereed articles for the SIAM Journal of Math Analysis, Advances in Differential Equations, the Pi Mu Epsilon Journal, and reviewed a new book on inverse problems for SIAM. He is also serving as technical liaison for an undergraduate project on neural net modeling with Tri-Manufacturing through the Center for Industrial Statistics, and acts as a faculty advisor for 15 IFYCSEM students.

Professor Steve Carlson, in collaboration with Professors Berzsenyi and Kiaer, developed and conducted the 1995 USAMTS/Rose-Hulman Young Scholars Summer Program, and he continues as a member of the USAMTS staff this fall. As Vice-Chair/Chair-Elect of the Indiana Section of the Mathematical Association of America, he has worked on planning committees for the Section's Fall 1995 Meeting and Spring 1996 Meeting. He has accepted the duty of local arrangements coordinator for the Fall 1996 Section Meeting, which will be held on the Rose-Hulman campus during his year as Section Chair. He continues to coordinate the ISU-RHIT-SMWC Mathematics Colloquium series and also continues to contribute reviews and abstracts to the "Media Highlights" column of the College Mathematics Journal and Zentralblatt fur Mathematics. This fall, Carlson will serve on the RHIT Facilities Commission, and he also will begin his third year of service on the RHIT Faculty Affairs Committee. Professor Carlson also submitted an idea for a grant proposal to Dr. Hulbert concerning the Lilly Endowment grant, and attended the ensuing conclave in Indianapolis.

Following his sabbatical leave at Clemson University for the 1994-95 academic year Professor Ralph Grimaldi returned to the Rose-Hulman campus in May. During the summer he found himself working with John Rickert and Herbert Bailey on the annual high school mathematics contest which will be held at Rose-Hulman in November. In July Professor Grimaldi was the speaker for a two week workshop on combinatorics and graph theory. This workshop was sponsored by the Rocky Mountain mathematics consortium and was held at the University of Wyoming at Laramie. Forty-five mathematics professors and graduate students from throughout the United States (and one from Israel) attended the workshop. In addition to this Professor Grimaldi did the revision work for a paper he coauthored with Professor Douglas Shier while at Clemson University. The paper, on network reliability, is scheduled for publication in the Journal of College Mathematics in the early part of 1996. Lastly, he spent his remaining time reviewing two potential analysis textbooks and outlining some ideas for the fourth edition of his text on discrete and combinatorial mathematics.

Since the last Board Meeting, Professor Elton Graves helped coordinate the campus activities of the Castle Chess Camp-Terre Haute, which was held on the Rose-Hulman campus from June 11-18. Over 50 students (ages 7 through adults) attended the camp. He attended the National ASEE Meeting in Anaheim, CA (June 25-June 28) where he moderated a session on teaching calculus, presented a paper entitled "Discovering the Error in Numerical Analysis", and completed his tenure as the Chair of the Mathematics Division of ASEE. From July 9 through August 18 he directed, coordinated, and taught Fast-Track Calculus. He is presently the

course coordinator of our Differential Equations course, and a member of the Mathematics Department's committee which is reviewing the first five quarters of mathematics at Rose-Hulman. In addition he is the editor of the Newsletter for the Indiana Section of the MAA, which will be printed in early October, and as the Indiana Regional Exam Coordinator for the MAA's committee on American Mathematics Competitions, is currently working on ways to improve the participation of Indiana middle schools, junior high schools, in national mathematics competitions. (Last year Indiana ranked third in the nation for schools participating in the AJHSME).

Professor Kiaer participated in a Foundation Coalition First-Year Faculty retreat at the beginning of the summer, then spent the month of June working with Professors Winkel, Klebanoff and Fine, and six high school mathematics teachers from Indiana and Illinois, developing complex, applied calculus problems. This was the second phase of a project to create a library of such problems to be used as a resource for calculus teachers. These problems, along with those created last summer, are now available on the World Wide Web.

In mid July 51 highly talented high school mathematics students arrived on campus for a four-week Young Scholars program, run by Professors Berzsenyi and Carlson, in which Professor Kiaer participated, along with Professor Rickert. Professor Kiaer is currently engaged in getting ready for her second year of teaching in the Integrated First-Year Curriculum in Science, Engineering, and Mathematics (IFYCSEM). In June, she became the Program Chair elect for the Mathematics Division of the ASEE. Finally, she submitted a grant proposal idea for the Lilly conclave and attended the conclave in Indianapolis.

During the Spring quarter, Professor John Kinney presented a new course in Statistical Analysis for Chemical Engineering at the request of the Department of Chemical Engineering. The course, offered in cooperation with Professor Jerry Caskey, will be repeated this spring. In June, he attended the Annual Meeting of the American Society for Engineering Education in Los Angeles where he presented a paper on Statistics and Probability in Engineering Education. Also in June he organized a one week IQL (Indiana Quantitative Literacy) workshop for high school teachers in Probability and Statistics. It was funded by the Indiana Department of Education. He attended the Annual Joint Statistical Meetings in Orlando in August. Throughout the summer, he worked with the Sophomore Coalition in designing a course in statistics for this new curriculum for sophomores. He will teach in this program during the winter quarter. A manuscript for a textbook titled Probability: An Introduction With Statistical Applications is in the final stages of preparation. It is to be published by John Wiley & Sons, probably late in 1996. During this year he will serve as President of the Indiana State University chapter of Sigma Xi.

Professor Aaron Klebanoff worked on several projects over the summer of 1995. He began by attending a workshop on reforming differential equation courses at Boston University in June. This resulted, among other things, in Robert Devaney's invitation to Rose-Hulman to speak on his experience in differential equations reform as well as his expertise in fractal geometry and chaos. Dr. Klebanoff spent the month of July developing complex mathematics problems for a new web site which he set up in the nationally known World Wide Web mathematics archive at the University of Tennessee at Knoxville. He also began collaborating with Professor John Rickert on a new paper currently still in preparation on extending Feigenbaum diagrams.

Towards the later part of the summer, Dr. Klebanoff ran two sessions on fractal geometry for the Fast Forward program and also spent two weeks developing projects to aide in the revitalization of the mathematical modeling course. As the school year came to a start, Dr. Klebanoff began work on the First Year Team to begin the large task of developing a first year program for Rose-Hulman. He spent Orientation week running laptop computer orientation sessions. Finally, he submitted two ideas for grant proposals to Dr. Hulbert concerning the Lilly Endowment grant, and attended the ensuing conclave in Indianapolis

Professor Roger Lautzenheiser worked with Yosi Shibberu as part of the Foundation Coalition Sophomore Engineering Curriculum group to develop material for two of the curriculum's mathematics courses, MA 211 and MA 213. He was also appointed to the PTR Committee.

Robert J. Lopez attended an MAA workshop in statistics early in June at the University of Wisconsin - Oshkosh, and participated in the "Grade 13: Articulation, Equity, and Literacy Issues Workshop" held at the

University of Wisconsin - Madison. Also in June, he presented a one-day Maple workshop at Medgar Evers College of the City University of New York system, and attended the ASEE annual meeting in California where he presented a paper and was elected Secretary/Treasurer of the Mathematics Division. In July, Dr. Lopez presented, here at RHIT in conjunction with Dr. Mark Yoder of the RHIT Electrical Engineering Department, the week-long NSF Workshop "Revitalizing the Mathematics, Science and Engineering Curricula via Symbolic Algebra." Dr. Lopez then taught, in conjunction with Dr. Graves, the five-week Fast Track Calculus course. Also in August, Dr. Lopez gave several workshops at the CoMaTh95 Maple conference in Stockton, CA. Finally, he presented a two-day Maple workshop at Texas A&M - Kingsville University right after Fast Track Calculus ended.

Professor John Rickert spent the summer as part of the teaching staff for the Rose-Hulman Young Scholars Program. He was the director of the Jump Start program for thirty-two incoming freshman. He administered the freshman Mathematics Diagnostic Exam, administered to all freshmen during registration week. He is working with Aaron Klebanoff to remedy the deficiencies of students who performed poorly on the diagnostic exam and is analyzing the results of this and past diagnostic exams. He served as coach to the teams representing the state of Indiana that placed 29th and 53rd in the B division at the American Regions Math League meet. He continued to serve as a member of the USA Mathematics Talent Search staff and organized the 30th annual Rose-Hulman High-School Mathematics Competition. He will be serving as a freshman advisor to fifteen Rose-Hulman freshmen.

Professor Gary Sherman spent the summer directing our NSF-REU program. After this seven week program was over he continued writing mathematics: a text and editing papers arising from the REU. In August he attended a regional MAA meeting in Burlington, Vermont. He chairs the Mathematics Department's committee which is reviewing the first five quarters of mathematics at Rose-Hulman. At the start of the school year, he submitted two ideas for grant proposals to Dr. Hulbert concerning the Lilly Endowment grant, and attended the ensuing conclave in Indianapolis.

Professor Yosi Shibberu worked for two months during the summer with 14 other faculty and students on the new Foundation Coalition Sophomore Engineering Curriculum. During the month of July, he served as a visiting scholar in the Chemistry Department at Northwestern University where he presented a lecture on numerical methods for Hamiltonian systems and studied molecular dynamics with Professor Schatz's theoretical chemistry group. Professor Shibberu also submitted a paper for publication entitled "A variable time-step midpoint scheme for Hamiltonian systems."

PAPERS, PUBLICATIONS AND TECHNICAL REPORTS

N. Abrouk and R. Lopez, Population Genetics: Estimation of Distributions through Systems of Non-linear Differential Equations, MAPLETECH 1995

S.A Broughton, E. Bujalance, A. Costa, J.M. Gamboa, G Gromadzki, Symmetries of Riemann Surfaces on which $PSL(2,q)$ acts as a Hurwitz automorphism group, Journal of Pure and Applied Mathematics, in press.

K. Bryan, Lester Caudill, An Inverse Problem in Thermal Imaging, SIAM Journal of Applied Mathematics, accepted.

K. Bryan , M. Vogelius, Homogenization for Electrical Conductors with Cracks, Quarterly Journal of Applied Mathematics, submitted.

Technical Report Series

Yosi Shibberu, A Variable Time-step Midpoint scheme for Hamiltonian Systems,. RHIT Math. Sciences Tech Report 95-03.

N. Abrouk and R. Lopez, Population Genetics: Estimation of Distributions through Systems of Non-linear Differential Equations, RHIT Math. Sciences Tech Report 95-04.

FACULTY SEMINARS AND COLLOQUIA

Robert Devaney, Boston University, The Fractal Geometry of the Mandelbrot Set.

Robert Devaney, Boston University, Revamping the Sophomore level Differential Equations Course
Technology, Nonlinearity, and Qualitative Ideas