A New Approach to Calculus

by James T. Smith, Prof. of Mathematics

During the past ten years, about ten major *calculus reform* projects have appeared across the Nation, responding to widespread criticism of instruction. Critics felt that conventional courses had become disassociated from applications, had lost touch with current professional practice, and were failing to achieve whatever goals were actually stated. This situation has contributed to the migration of higher mathematics courses to other departments. Nationwide, the majority of those courses are now taught by non-mathematicians.

The National Science Foundation supported a reform project based at Harvard. Professors Deborah Hughes-Hallett and Andrew Gleason led a team of about a dozen mathematicians from all levels of schools and all parts of the country. Their approach is almost equal emphasis on algebraic manipulation, graphical representation, and numerical data analysis. Since traditional courses heavily stressed algebra, "Harvard Calculus" requires more graphical and numerical work than you may have encountered in your courses. That's the way scientists, engineers, and economic analysts use calculus. The approach also places greater demand on reading and writing skills. The applications are sophisticated, and not necessarily sanitized for instructional use. Nevertheless, the schedule of topics is no great departure from tradition.

SF State Professor David Meredith and I first noticed the project about five years ago. David knew some of the authors from his humanistic mathematics activity, and Gleason's work caught my eye. Gleason was my calculus teacher, and my idol. David and I attended a summer workshop in Cambridge. Astounding! I'd always avoided meetings about teaching. But there we found top mathematicians sweating over sophisticated applications of elementary calculus! And producing something new and exciting and honest and meaningful. Of course we were eager to hear about trials at Harvard and Stanford, but we heard the greatest success stories from community colleges and very large public universities. Those faculty reported that they were able to award more Bs and Cs and fewer Ds and Fs. Keep that in mind as you consider the Harvard material's great literacy requirement!

Since then the Harvard team has produced two commercial texts, which have sold about sixty thousand copies. Volume One covers our Calculus 1, 2 and half of 3; Volume Two covers 4 and more. We've tried Volume One at SF State in about fifteen Calculus 1 to 3 classes with about ten different instructors. Four or five of us are true converts. Most of us require the use of David Meredith's X(Plore) software, though one class required graphing calculators.

Our experience has been varied; I'll speak only for myself. I've had two of the best calculus classes in my thirty year career, and one of the ... Well, I won't say it. What's most astonishing is the level of unsolicited positive vocal response, particularly from older students with experience in other disciplines. For once, they claim, they see where mathematics could possibly fit into their lives. I find, moreover, that I'm able to demand and receive higher quality homework papers than I've got in *any* other mathematics classes, ever! Most important to me, I'm able to preach what I practice. And students evidently enjoy and learn from my delight!

Faculty Research *continued from page 1*

Daniel Fendel and Diane Resek are working on an NSF grant to reform the high school mathematics curriculum. They have almost finished writing a series of modules covering three years of high school mathematics and they are now working intensively with teachers to help them use the new materials. Dr. Resek is also working on modifying the high school materials for use in college precalculus classes.

Jean-Pierre Langlois spent much of the last year developing software for game theory. He wrote four papers on various topics in the areas of his research interests.

Sergei Ovchinnikov wrote four research papers in 1994. Three of these papers will be published in 1995 and the fourth is still under review. He also participated in six international and national conferences where he gave talks on a variety of subjects.

Neville Robbins wrote a second paper titled "Fibonacci Partitions" which is currently under review. He also presented a talk at the Illinois Number Theory conference at the University of Illinois at Urbana.

SFSU

Mathematics & Statistics Newsletter

Department of Mathematics • San Francisco State University • Spring 1995

Greetings from Newman Fisher, Chair of the Math Department

Welcome! I hope you enjoy the first newsletter from the Mathematics Department. Our most recent faculty emeritus, Frank Sheehan, has been compiling a history of the department, and as the project nears completion we now know that close to two hundred MA's have been awarded since 1958! Another additional emeritus faculty member is Fred Neustadter, while Ralph Lakness and yours truly continue to vie for the senior position in the department.

I want to thank David Meredith and Sergei Ovchinnikov for their efforts in preparing the Newsletter along with all of our colleagues who have contributed to this initial venture into recording the activities of your department.

The activities of the department in recent years are extensive and varied. In the area of funded activities Dan Fendel and Diane Resek have received national recognition for their work in the National Science Foundation sponsored Interactive Mathematics Project, while David Ellis is deeply involved in the Alliance for Minority Progress (AMP) program and Alfred Tang and Eric Hayashi are currently working on an NSF sponsored cooperative program in calculus involving the Peralta School District, Hayward State and the City College of San Francisco. Jean-Pierre Langlois has concluded several projects with the National Security Agency that have involved student participation in research projects. Jose Guiterrez is helping to create a new option to the M.A. in Education with an emphasis in Mathematics Education, while Robert Marcucci has concluded several contract activities with the San Francisco Unified School District and will become active in a curriculum development program next year. Scholarly activities include the publication of research activities in the literature on the part of Sergei Ovchinnikov (Measurement Theory) and Neville Robbins (Number Theory), while David Meredith is working on an upgrade to his highly successful software package X(PLORE) and James Smith is at work on a geometry text, after the publication of several works on C and C++ programming. Hal Forsey continues research activities on Pension Funding Projects. On the academic side, we are developing new programs in Statistics, with Judith Ekstrand as Advisor, and a newly created Minor Program in Actuarial Sciences will become available to students next fall. We have created a Mathematics and Statistics Computer Laboratory with funding from both the University and the National Science Foundation. Currently, a new proposal for a Statistics Computer Laboratory has been developed by Mohammed Kafai.

In a totally different area, we have been developing scholarship programs to honor outstanding students. Two department sponsored scholarship programs, the Ethnic Minorities Scholarship Program and the Larry Chang, PhD Memorial Scholarship have made their first awards to Benigno Lopez and Keith Neal, while privately funded scholarship programs (the Jesse York and Sergio Martins programs) have made awards to Karen Walters, Kristin Cooper, and Geoffrey Polk. Both Keith Neal and Geoffrey Polk are now enrolled in PhD programs in Mathematics.

With the advent of this first newsletter, I am sure we have made some unintentional omissions of faculty activity, but I hope the message is clear. We remain involved in the world of Mathematics and most importantly, we want to hear from you about your activities in the subject we love.

My best regards,

Newman Fisher

Faculty Research & Grant Activities

In addition to numerous university and extramural activities, many of our faculty members devote substantial time to research in the areas of pure and applied mathematics and curriculum development. Tangible results of such research activities are usually in a form of publications, conference papers, and grants. The following is just a brief summary of these activities.

David Ellis and David Meredith are engaged in research with molecular biologists at Molecular Research, Inc. in Palo Alto. They have co-authored the paper "Resolving receptor heterogeneity using fourier-derived affinity spectrum analysis" to appear in the *Journal of Pharmacology and Experimental Therapeutics*. Dr. Meredith has also published *X(PLORE)* for the Macintosh, the third version of his software for doing calculus and linear algebra. If you send him a completed information form from the back of this newsletter and a blank high density disk and return envelope, he will send you the PC version of X(PLORE).

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