Why I Use the Graphing Calculator in Teaching

by Fred Zerla

So much has already been said about how the visualization of an algebraic process completes Descartes' idea of combining algebra and geometry into a unified whole that I will skip the usual and obvious reasons for using the graphing calculator.

In teaching life science and business majors the calculus, I find that the Texas Instruments TI-83 (my calculator of choice) contains programs that make their mathematical experience much richer. But first, a disclaimer: I am certainly no expert with the TI-83. Indeed, one of the pleasures of using a graphing calculator is in discovering its many uses.

Since the beginning of the Calculus Reform movement, the function concept was presented in three modes: numeric, algebraic, and graphical. For life science and business majors, an essential link between the numeric and the algebraic modes is missing.

The mathematics that life science and business majors will see in their professional careers will consist primarily of numeric data. The transition from this numerical data to an algebraic format is very important.

For example, as a project for my business calculus students, I provide them with the census figures for the state of Florida for each decade from 1900 to 1990, which I find in the *World Almanac*. I then ask them to predict the census count for Florida in 2000. I expect them to analyze this data using linear regression, quadratic regression, cubic regression, exponential regression, and logarithmic regression. All these formulae can be found on the TI-83 and I show them the simple steps to obtain them. I talk to them about the least squares method used to obtain these formulae, but I do not go into detail. Then I give them the actual census count for the year 2000 and we discuss which formula was closest to accurate and why it was so. We then look at the graph for that formula and talk about what light calculus can shed on it.

My point is that for people who will spend their lives analyzing numerical data, the usual functions and graphs we study in calculus are useless unless we show them the transition from the data of their experience to the continuous functions of our calculus.

Space does not permit me to discuss the almost daily use I put the TI-83 to in a business calculus class. For the life science major, the ease with which the calculator can handle the basic matrix operations opens this important tool to

their use. I show these students the basic matrix operations using 2-by-2 matrices, and then we move to larger dimensional matrices, without proof. We then go through many examples of the use of these matrices in the life sciences.

The graphing calculator has been invaluable to me in demonstrating the use that mathematics, including the Calculus, can be to these students whose future work will involve mathematics but who have no need to delve into the intricacies of its development. Since I began using it a decade ago, I would find it difficult to teach a mathematics class – *any* mathematics class – without it.

Transitions

Five of our colleagues are leaving us.
First, four of them have fallen to the Retirement.

Edwin Clark arrived at USF in 1970, six years after receiving his Ph.D. from Tulane University. Initially and perhaps ultimately an algebraist (rings and semigroups), he also worked in physics and various areas in combinatorics, especially graph theory and coding theory (he spent a year visiting the National Security Agency. He had seven doctoral and two masters students, and his Erdos number is 2. He was active in the upper division of the undergraduate program, and designed the MAPLE class here.

Samuel Isaak arrived at USF in 1968, three years after receiving a Ph.D. from Indiana University. Initially working in differential geometry, tensor analysis, and related fields, he turned to undergraduate education, where he has taught all courses in the line from pre-calculus to differential geometry. He received a Teaching Incentive Program award, and was the mathematics representative to the USF teachers' program for the Peace Corps.

Joseph Liang arrived at USF in 1970, a year after receiving a Ph.D. from Ohio State University. He worked in algebra, number theory, and several applications of mathematics to computer science. He had seven doctoral students, and was Associate Director of the Institute for Constructive Mathematics. He was also active in mathematics education, helping bring nearly a million dollars in educational grants to USF, and serving as Program Director of the Hillsborough County/USF Summer Program for the Gifted.

Fredric Zerla arrived at USF in 1963, four years before getting a Ph.D. from Florida State University. He was one of the principal organizers of the lower division of the undergraduate program, and was Undergraduate Advisor for many years. He also organized and ran the USF Chapter of the national mathematics honor fraternity Pi Mu Epsilon, and the USF Chapter of the Mathematics Association of America. He has been interim Department Chair, Speaker of the Faculty Senate, and President of the Florida Section of the MAA. (He also ran the Suncoast Region of the MAA for many years.) He has held many other positions, and has won many honors, including a Distinguished Service Award for the Florida Section of the MAA.

We wish them the best of luck in their future endeavors.

In addition, one of our senior professors is leaving us for greener pastures. **Mourad Ismail** arrived at USF in 1987 as a full professor, from Arizona State University. He had been awarded his Ph.D. from the University of Alberta in 1974, and works in approximation theory, asymptotics,

combinatorics, integral transforms and operational calculus, orthogonal polynomials and special functions. He is on eleven editorial boards, won 22 grants, edited or co-edited seven books and journal special issues, published about two hundred papers, made over forty invited addresses (he is always traveling) and supervised six Ph.D. dissertations and three M.A. theses. He will be moving to the University of Central Florida.

Meanwhile...

A.N.V. Rao and Chris Tsokos won the Time Warner Humanitarian Award for the *Urban Scholars Program.* This program brings disadvantaged youngsters to USF on Saturdays for extra lessons.

And in the midst of buying a house and playing with his two-year old son, **Brian Curtin** won the NSA Young Investigators Grant.

Six faculty members won the USF Presidential Excellence Award last winter: **Mourad Ismail**, **Natasha Jonoska**, **Boris Shekhtman**, **Vilmos Totik**, **Chris Tsokos**, and **Yuncheng You.**

And the Institute for Scientific Information listed **Mourad Ismail** as one of the most cited scientific researchers; he is the only USF researcher on the list. Check it out at `<isihighlycited.com>`.

The **Department** got "The Memorandum of Agreement " for cooperation with Beijing Institute of Technology, and we hope to continue to develop our ties with universities in Asia and Europe.

Graduations

This last year one student was awarded a Ph.D.: **Marina Appiou Nikiforou**,

under Professor Masahico Saito, *Extensions of Quandles and Cocycle Knot Invariants*.

We also granted thirteen Masters: **Kheira Ameur**, **Irena Andreevska**, **Zhongxue Chen**, **Madeline Gonzalez**, **Yuhua Gu**, **Zhihong Jia**, **Karol McIntosh, Jerome Napoli**, **Brian Oestreich**, **Michiru Shibata**, **Shou Hsing Shih**, **Savita Sista**, and **Ana Staninska**.

We also congratulate our latest Baccalaureates: **Wendy W. Anzalone**, **Jeffrey R. Ayers**, **Misty R. Berry**, **Thuc Tri Cao**, **Milan R. Cernkovic**, **Sasha dos-Santos** (summa cum laude), **Kaveh Cyrus Ghaedi** (cum laude), **Nicholas Peter Grant**, **Aneesh Padmakar Karve** (magna cum laude**)**, **Sarah Lahlou-Amine** (summa cum laude & King O'Neil Award), **Philippe F. Lormine**, **Paul Mate**, **Jessica A. Parr**, **Patrick D. Robbins**, **Rodney M. Taylor**, **Jeanne M. Waser**, **Amber N. Willis**, and **Charles Randall Yates**.

We should note recent O'Neil graduates **Aaron Anderson**, **Alynne Frewin**, and **Kathleen Mierau**.

Center for Mathematical Services

The Center for Mathematical Services (CMS), directed by **Kenneth Pothoven**, ran two programs during summer, 2003 for gifted and high-achieving secondary students. The programs were the *Mathematics and Science Program* for students entering grades eight through ten and the *Mathematics, Engineering, and Science Program* for students entering grades ten through twelve. Students from Hillsborough, Pasco, Pinellas, and Manatee counties were selected on the basis of their secondary

school record and letters from their secondary math and science teachers.

Approximately 110 students participated, attending daily for five weeks. Students in the Mathematics and Science Program learned some math, astronomy, computer science, and environmental issues. Faculty instructors were **Manoug Manougian** and **Carol Williams**.

Students in the Mathematics, Engineering, and Science Program learned some mathematics, C^{++} programming, and Physics and Biology. Eight students in this Program had returned from summer, 2002: these students studied more advanced linear algebra using the symbolic programming language *Maple* and engaged in personal research projects with faculty from computer science, engineering, mathematics, physics, and chemistry. The individual research component of this program was sponsored by a grant from the Academy of Applied Science of Concord, New Hampshire. Faculty instructors in this program were **Joseph Liang**, **Li-Jung Ming** of Chemistry, and **Pothoven**.

The Programs concluded with awards ceremonies on the evenings of July 9 and 10. Outstanding students were recognized for their work, and College of Arts and Sciences Acting Dean **Kathleen Heide** addressed the students on July 10.

Student Clubs

The two mathematics clubs, the USF Section of the Mathematics Association of America (open to all students) and the USF Section of Pi Mu Epsilon (by invitation) meet and work together.

As usual, the Math Clubs hosted the Fall and Spring Hillsborough County Math Bowls, which were held at the USF Special Events Center. Twenty high schools participated, each sending four teams of four students with their respective faculty advisors. Individuals and teams competed in the morning and prizes were awarded in the afternoon. Students usually have lunch in the Marshall Center and some of them were even seen touring the Math Dept with their teachers! Hopefully a few of them will decide to continue their college studies with us. They are the best math students in our local high schools.

For twenty-six years, **Fred Zerla** has served as Math Clubs advisor. He retired last Spring, and **Fernando Burgos** is the new advisor. Both worked organizing the Math Bowls.

On April 15, 2003 a Math Clubs contingent attended the annual St. Petersburg College Math Awareness Conference held this year at the St Petersburg Yacht Club in Downtown St. Pete. This terrific half-day event featured 4 sessions with speakers from the bay area who use mathematics in their work. Topics ranged from "using statistics in healthcare" to "using Fourier theory in engineering applications." Very interesting in particular for undergraduate students to see what they can do in the real world with the math they are learning.

On April 25, 2003 the USF chapter of the Pi Mu Epsilon Mathematics Honor Society inducted 14 new members at its annual banquet in the President's Reception Room in the Marshall Center. Many relatives and friends of the inductees were present as was Department Chair **Marcus McWaters** and other Faculty members and their families.

We'd like to hear from you!

The Department of Mathematics would like to hear from alumni, friends, collaborators, members of the community, and fellow explorers of and guides to the world of mathematics.

Contact us at: 974-2643, or fax 974-2700. E-mail <mathdept@math.usf.edu>. We have a web-page at <http://www.math.usf.edu/>. Snail-mail address is Department of Mathematics, University of South Florida, 4202 E. Fowler Ave., PHY114, Tampa, FL 33620.

The Continuing Crisis

The budget crisis – which may be a bit chronic to call a crisis – continues to constrict the department's operations. There will be no Nagle Lecture again this year, and the Institute for Constructive Mathematics remains dormant. Meanwhile, the Associate Chair is scrambling to find graders for undergraduate courses, and (as usual) many lower division sections are being taught by adjuncts.

USF in general, and the Mathematics Department in particular, can use all the help it can get. Contact the USF Alumni Association or the Department of Mathematics if you have any stray change.