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The Academic Year 2009/10 was somewhat easier than the Academic Year 2008/09. The economic restrictions of 2008/09 about which I wrote to you last year were not gone, but we were more used to them. Also, these restrictions did not come to us as a surprise. One thing that was still hard for us not to be able to hire permanent faculty to replace those who have left or retired in the last few years. We very much hope that the possibility of hiring new tenure-track faculty will resume next year.

At the end of the Academic year 2008/09, 3 members of our faculty in Storrs and 2 members at the Waterbury campus took early retirement. Moreover, just as the summer break started, Mr. Louis Lombardi, the very active director of our Actuarial Sciences (AS) Program for 5 years, announced his departure. We had to remedy the situation promptly to avoid losing momentum, particularly because the undergraduate AS Program over which Louis presided single handedly has over 220 majors. Our AS faculty, Professors Bridgeman, Vadiveloo, Valdez, and Vinsonhaler, instituted an intensive search and with the help of our Dean, Professor Jeremy Teitelbaum, we managed to hire two new, though unfortunately not permanent, AS faculty. They are Mr. James Trimble, who retired as the Chief Actuary of Hartford Life, and who was appointed to Director of the Actuarial Sciences Program, and Mr. Michael Braunstein, whose last position was with Aetna, and who was appointed to be Associate Director of the program. They came in very energetically and enthusiastically and in fact, have helped strengthen the program that was built so carefully over 30 years. The program and the department received a special boost when our actuarial program was declared a Center for Actuarial Excellence by the Society of Actuaries (SoA). This distinction was achieved thanks to the dedication of all the Actuarial faculty in the department, and counts as one of the greatest achievements of the department this year. This designation will increase the program’s visibility and will attract an even higher caliber of students. It also makes the program eligible to apply for a variety of SoA grants. The committee from the SoA that evaluated the AS Program had one reservation about the new designation. The program badly needs a tenure-track PhD faculty member to give it stronger academic credentials.
As I wrote above, we were unable to hire permanent new faculty, but, unlike last year, we did not lose faculty to retirement. Among the non-permanent faculty, 5 of our Postdoctoral (PD) Fellows left. They were Drs. Pengwen Chen, Alistair Hamilton, Marius Ionescu, Hayuan Xu, and Biao Yin, and we hired 5 to replace them: Asher Kach (returning from a leave of absence), Kyungyong Lee (Purdue), Chen-yun Lin (Columbia), Ilia–Radu Mitric (Western Ontario), and Weidong Yin (Wisconsin). We should mention that Dr. Ilia–Radu Mitric is completely dedicated to the AS Program and will help the program teach the necessary courses. There was a similar turnover among our Assistant Professors in Residence (APiRs). Four left: Drs. Marc Corluy, Esteban Diaz, Krzysztof Kubacki, and Yuri Shlapak, and 4 came in: Drs. John Baber (John Hopkins), Fatemeh Emdad (U. Texas Med), Tong Zhu (UPenn), and Steven Pon (UC Irvine). In particular, Dr. Marc Corluy, who was shared half time with the Q–Center, is replaced by Dr. John Barber, and Dr. Esteban Diaz, our APiR at the Hartford Campus, is replaced by Dr. Tong Zhu. We are indebted to our PDs and APiRs who are leaving. They helped the department considerably in the last two years when the economic situation required us to teach in large classes. All the our PDs and APiRs who left have found tenure–track positions at other universities. We wish them success in their future careers.

Our Mathematics graduate program did well this year. Like last year, 11 graduated with a PhD degree, and some went on to very good schools, for example, Cornell University, the University of British Columbia, University of California at Riverside, and the University of Utah. 35 students from the AS program received MS degrees. Many of them got jobs in industry, although the economic situation certainly reduced the proportion of students obtaining good jobs. Performance was also very strong in the recruitment of new graduate students. We are getting students from some very good schools now: Carnegie Mellon, Columbia, Dartmouth, Hunan (PRC), SUNY Stony Brook, and UMass Amherst, for example, and Professor Alexander Teplyaev should be credited with excellent work as our Director of Graduate Admission. Our graduate students, under the active leadership of John Haga and David Ferrone, continued to run the weekly Sigma Seminar of general talks for the graduate students. In terms of things to do, we need to devise a strategy so that students beyond the preliminary exams continue to take a wider range of courses than only those that are necessary for them to proceed with their theses. This will not only help keep their intellectual horizons broader, but will help the department to offer a wider range of advanced graduate courses. We also need to consider how to proceed in the longer term with a PhD qualification in Mathematics Education.

We now have 400 undergraduate majors, including those in Actuarial Science. This year 28 of our students entered the tough national Putnam Competition, and two scored well above the national median. In particular, Antoni Brzoska scored in the top 17.5% of students across the nation who took the Exam. Our Math Club, whose president was Christine McMeekin and whose faculty advisor was Professor Keith Conrad, continued to be the jewel in the crown of our undergraduate Mathematics program, with many interesting speakers from UConn and outside coming to give presentations to the students. We continued to work on improving our handling of large classes. Although the clickers concept worked well, inadequate technical support and infrastructure caused major difficulties for instructors and students. Our Undergraduate Committee has become a lively and vibrant forum to consider important undergraduate issues. After all, we teach over 10,000 students a year. I am happy to report that our junior faculty show much interest in this activity.
This year we were able to award our first 3 scholarships of $5,000 each from the Bernard Sippin Endowment to 3 excellent students in our department, each having a near perfect GPA. (Bernard Sippin received his BS degree in Accounting from UConn in 1952. We are very grateful for his generosity.) Another activity that we started this year thanks to the generosity of another alumnus, Thomas MaCabe, is the McCabe Visiting Fellowship in Entrepreneurship in the Mathematical Sciences. This is a joint activity of the Mathematics and Statistics Departments. The lecture is designed to inspire entrepreneurial spirit among UConn students and to honor the guest speaker. The program invites entrepreneurs who have taken advantage of some aspect of the mathematical sciences in their successful careers. Our first McCabe Visiting Fellow was Dr. Harold Schwenk, who recently retired as Chairman, President, and CEO of BGS Systems, a company that designed, developed, marketed, and supported standard software products used to analyze and predict the performance of computer systems. Dr. Schwenk received his BS from Brown University in 1963, and a PhD in Applied Mathematics from Harvard University in 1972. Thomas McCabe, who endowed the program, received an MS degree in Mathematics from UConn. He wrote that studying Mathematics laid the foundation for building his business based on a mathematical idea, and that the endowment is a way to give something back to the University. This seems a very good point to invite all of you who can make a donation to the department to make a contribution. I can assure you, all donations will go for a good cause.

In the past year, several of our faculty won NSF grants or had them renewed. During the year, 15 faculty in the department contributed towards an NSF equipment (SCREMS) proposal. Unfortunately the project was not funded, but we hope to be more successful next year. Our Actuarial Science Program submitted 3 grant proposals to the NSF and the SoA. One, for example, is a start–up grant for a Professional Science Master’s degree program in Computational Mathematics, which is joint with the CSE Department. Finally, in early June, four faculty in our department together with Professor deFranco, Dean of the Neag School of Education, and with the Dean of CLAS, Professor Teitelbaum as a Senior Consultant, submitted an NSF GK–12 proposal. The proposal, which asks for $2.2M from the NSF and guarantees $1.4M in UConn support, will allow us, if granted, to hire up to 8 additional TAs per year. These TAs will be called Fellows and will receive an increased scholarship. During their time at UConn the Fellows would gain experience in how to transmit the methodology and content of current mathematical research to students in the K–12 range. This will be achieved in part by going into schools and working alongside teachers and students.

Once again the department had a very active colloquium and specialized seminar program under the co–chairship of Professors Melina Hering and Kyu–Hwan Lee. Perhaps the most noteworthy activity was the series of lectures organized by Professor Fabiana Cardetti and our Mathematics Education Group. The series was aimed at the whole university community. There were 6–8 nationally and internationally acclaimed speakers including: Liping Ma, Megan Staples, Wilfried Schmidt, Stephen Leon, William McCallum, and Kenneth Gross. These speakers made the series memorable and brought into sharp focus the problems and joys of mathematics education in the K-16 range.
Professor Emeritus Soon-Kyu Kim, former Mathematics Department Head, passed away peacefully on March 20, 2010 after a long illness. He is survived by his wife Kang-Un Sung, his children Jin-Chui (Gene) Kim and his wife Miri Park, Jin-Kyung (Kay) Kim and her husband Tony Downs, Jin-Wook Kim and his wife Rachel Cohen, and eight grandchildren.

Soon Kim was born on October 3, 1932 in Hadong, Korea. He received a B.S degree in 1957 and an M.S. in 1959 from Seoul National University and taught for several years in Korea before coming to the United States to pursue a Ph.D. degree in Mathematics, which he received from the University of Michigan in 1967. He was an instructor at the University of Illinois at Urbana from 1966 to 1969 and came to UConn in 1969 as an Assistant Professor of Mathematics. He was promoted to Associate Professor in 1972 and to Full Professor in 1983.
During his tenure at UConn, Dr. Kim worked actively to enhance the quality of the Department and the University. He agreed to serve as Associate Department Head for Graduate Studies in 1985 and had the foresight to see that the quality and number of incoming graduate students could be greatly increased by recruiting the excellent students who were then coming to the United States from the People’s Republic of China. Under his leadership, the Ph.D. program more than tripled in size. He was demanding of the graduate students but also did everything in his power to help them succeed. He became Department Head in 1988 and served in that capacity until his retirement in 1997. During that time the Mathematics Department continued to grow in quality and quantity under his leadership, and he served on a number of important University search committees.

In addition to his passion for research in topological transformation groups and graduate education, Dr. Kim worked to enhance visibility and opportunities for Korean scientists in the United States. He held several offices in the Korean-American Scientists and Engineers Association, Inc., including the presidency of that organization in 1987-88, and was also the President of the Korean-American Mathematical Scientists Association from 1996 to 1998. In 2000, he was honored with the Korean Medal of Honor by the South Korean government for his achievements in promoting Korean science.

Dr. Kim moved to Sherborn, MA in 1999, shortly after his retirement, in order to be closer to his children and grandchildren. He maintained contact with Mathematics department faculty after his move and kept an interest in the changes within the Department. His contributions to the Department will always be valued.
Editor’s note. After Louis Lombardi left us in Summer 2009 to return to the world of risk and insurance, we were fortunate to be able to hire two recently retired active actuaries to carry on Louis’ tradition of excellence.

Michael Braunstein, ASA, MAAA, is Assistant Director of the Actuarial Science Program at the University of Connecticut. Prior to joining the program, he was with Aetna with overall responsibilities for Actuarial Talent Management. His experience includes 15 years working for The Hartford Life Insurance Company doing traditional life/health pricing and financial/actuarial work, 12 years as President/Owner of an actuarial recruiting company, and 5 years in actuarial publishing as President/CEO of ACTEX Publications and as Director of North American Operations for BPP Professional Education. A 1973 cum laude graduate of the University of Connecticut, Michael also provides extensive volunteer work for the Society of Actuaries and the American Academy of Actuaries, has chaired several committees, and has served as President of the Actuaries’ Club of Hartford/Springfield.

James Trimble, FSA, MAAA, CERA, is Director of the Actuarial Science Program. He worked for the Hartford Life Insurance Companies from the time of his graduation from UConn in 1978 with a BS in Mathematics, summa cum laude. At The Hartford, he assumed several senior positions, including Chief International Actuary, Chief Actuary and Chief Risk Officer, and he was the director of its actuarial student program.
A Society of Actuaries Center of Actuarial Excellence (CAE)
In December of 2009, the University of Connecticut Actuarial Science Program was recognized as a Center of Actuarial Excellence (CAE) by the Society of Actuaries. One of only 10 schools in the United States (along with 3 additional schools in Canada) to be so recognized, the UConn program was selected on the basis of its degree program in actuarial science; its curriculum for the actuarial exams (P, FM, MFE, MLC and C) and for Validation by Educational Experience (VEE); the quality and quantity of its graduates and its actuarial faculty; its integration with business and industry; and its research and other scholarship. The CAE designation was awarded for the five-year period through 2014.

New Courses Added
Two new courses were added for the first time in 2009-10, Introduction to Actuarial Science and Programming for Actuaries, and one additional course on Loss Models is now scheduled to begin in the fall of 2010.

Program Statistics
- Readers will recall that the University of Connecticut Actuarial Program (housed within the Department of Mathematics) began in 1976 with the creation of two new courses – Theory of Interest and Life Contingencies. From the very start the program grew rapidly. The first majors in Mathematics/Actuarial Science graduated in the spring of 1979. The program now has 212 undergraduate students, 49 graduate students and 5 Ph.D. candidates.
- Forty-six students graduated with either a bachelor of arts or a bachelor of science in actuarial science, and twenty-five graduated with a master’s degree.
- Of the new graduates of the undergraduate program, approximately 90% passed at least one actuarial examination and, of those, roughly 75% passed multiple exams.
- Representatives of thirty-five companies attended our actuarial science career fair.
- Approximately 100 students were provided interviews with employers, with over 250 total interviews held on campus at the Department. These resulted in a multitude of summer internships and, as of March 1, 2010, seventeen full-time actuarial positions for the students.
- Twenty-one undergraduate students were awarded UConn Actuarial Science Scholarships with the average award $2,500; and four individuals received additional scholarships from outside sources.
- Corporate Sponsors donated approximately $37,000 of new money, which combined with existing endowments provided roughly $112,000 for scholarships and other program support. Additional prior commitments from ING and Mass Mutual continued to support several course offerings on Introduction to Actuarial Science, Loss Models, and Programming for Actuaries.
- In addition to corporate sponsorship, we have received valuable support from individuals for which we are very grateful.
The Professional Master’s Degree program in Applied Financial Mathematics conferred seven degrees in August and December 2009 and May 2010, which makes thirty degrees awarded in the program’s history. Twenty-two students participated in the seventh full year in operation in 2009-2010, fifteen returning from the prior year and seven newly admitted students.

Wen Cao graduated in August ’09, Hassan Fazelinia and Changyu Li in December ’09, and in May ’10 Chris Buechler, Jared Schumann, Beziel Shambamuto, and Yousef Sharifi. Six of the seven found jobs in the field of finance or investments or are pursuing further education. We expect three more degrees from this group in August upon completion of their exit projects. The difficult job market may account for the slow pace in completing exit projects.

The remaining twelve are expected to enroll in Fall 2010 along with ten new enrollees for a total of twenty-three in the program for the coming year.

The one credit seminar on Yield Curve Models in Spring 2010 included a newly developed Accelerated Introduction to Stochastic Pricing Models which will be required of all new students in the future, along with the Introduction to Financial Markets. We maintained program approval from the International Association of Financial Engineers, including approval for our students to attend their prestigious annual Career Fair in New York City.

Financial institutions woes continue to take a toll on internship availability. This summer eight students worked an unpaid internship with the program director because they were not been able to locate an internship in industry.

The most difficult issues facing the program are common to most programs in the field: (1) lack of financial aid to attract new students and (2) inability to guarantee paid summer internships to all of the students who want one.
UNDERGRADUATE PROGRAM NEWS, 2009-2010
Jeffrey Tollefson

We began teaching Calculus I and II in large lectures last fall. There are three hours of lectures combined with two hours of discussion classes taught by a TA. This format gives us the opportunity to enhance the students’ experience in calculus. Amit Savkar is leading the technology innovation which includes in-class use of clickers, online homework and quizzes and gateway proficiency exams in the computer lab. Taking advantage of the extra hour in the discussion classes, Alvaro Lozano-Robledo is leading a team of faculty and graduate students working in the summer to develop group projects that will stimulate the students’ interest in calculus as well as help them learn the concepts. We were fortunate this past Spring semester to have benefited from the expertise of Deans Thomas DeFranco (Neag School of Education) and Jeremy Teitelbaum (College of Liberal Arts and Sciences), each of whom taught one of the large lecture sections.

THE UCONN MATHEMATICS CLUB, 2009–2010
Keith Conrad, Faculty Advisor

Students in the Math Club this year had opportunities to eat pizza while learning about topics across both pure and applied mathematics, such as knot theory, projective space, elliptic curves, queueing theory in business, remote sensing, and mathematics in biology. One of the most interactive talks, by Karen Edwards, introduced students to non-Euclidean geometry by having everyone cut and tape pieces of paper together to create an approximation of the hyperbolic plane, on which distances and angles were measured directly to see its truly non-Euclidean features vividly.

In the fall there was a panel discussion about preparing for graduate school in Mathematics. The panelists were graduate students (Daniel Kelleher and Amy Turlington), postdocs (Paul Ellis and Ryan Kinser), and faculty (Ron Blei, Keith Conrad, Jeremy Teitelbaum). They gave advice to students about math courses to take while in college, what the graduate application process is like for both students and admissions committees, and what kinds of schools or scholarships to look for.

A group of students travelled during one day over spring break to the Symposium for Undergraduates in the Mathematical Sciences (SUMS) at Brown University. The theme of the conference was Math and the Environment; the environment was hard to miss on account of the terrible rain throughout the day. In the afternoon, Christine McMeekin gave a poster presentation about her senior thesis which she was working under the advisement of Álvaro Lozano-Robledo. Funding for the trip to SUMS as well as Math Club talks throughout the year was partially supported by the Undergraduate Student Government and the Mathematics Department.

The Math Club officers this year were the same as last year: Christine McMeekin (president), Tyler Engel (vice-president), and Jay Hartley (treasurer).
Arend Bayer and Milena Hering together with colleagues at The University of Massachusetts (Amherst) are the recipients of an NSF grant to hold AGNES (Algebraic Geometry Northeastern Series) meetings at UMass and at UConn. This is a biannual weekend meeting of Algebraic Geometers in the Northeastern area. Erin Terwilleger Mullen has won a UConn Small Grant to carry out research on her proposal: “A Comparison of Two Paths in College Level Calculus.” Amit Savkar is a co-PI on the proposal. Sarah Glaz received a grant from GNSAGA-INdAM, the Italian government agency awarding grants in Mathematics, to support her visiting professorship and research in Algebra at the University of Rome Tre. During her visit, Sarah participated in a Special Semester on Commutative Algebra, where she gave a series of lectures. Marius Ionescu, one of our Postdoctoral Fellows, has accepted a tenure track position at Colgate University in Hamilton, New York. Since Marius’ wife also teaches at Colgate, this is a very happy outcome for both of them. Alexander Teplyaev has received a Supplemental NSF REU grant to do research with undergraduates students in the area of “Analysis on Fractals.” This is the third year of a joint project with Sasha’s PhD student Ben Steinhurst, who successfully defended his dissertation in Spring 2010. Fabiana Cardetti and Amit Savkar are the recipients of a 2010 Provost’s General Education and Course Enhancement Competition grant for their proposal: “Pedagogy in Large Lectures.” They will carry out their research primarily in conjunction with our course Math 1131 (Calculus) which is now taught in large classes only. The course has an enrollment of 1000 students in the Fall and Spring semesters. Mark Naigles, who has been an adjunct for 10 years in our department, was been honored as the Institute of Teaching and Learning’s 2010-2011 Outstanding Adjunct at its Instructional Excellence Recognition Dinner on April 16, 2010. Maria Gordina was informed by the Probability, Combinatorics, and Foundations Program of the National Science Foundation that it intends to fund her for the next 3 years to do research on “Stochastic Analysis and Related Topics.” Ralf Schiffler was informed by the same NSF Program that it also intends to fund his research on “Cluster Algebras and Tilting Theory II” for the next 3 years. Emiliano Valdez has been appointed to the editorial boards of two journals: (i) Associate Editor of “Insurance: Mathematics and Economics Journal;” (ii) Editorial Board member of “Insurance Markets and Companies: Analyses and Actuarial Computations”. As a part of his tenure as the first holder of the Stuart and Joan Sidney Professorship, Michael Neumann organized a workshop on Creativity and Talent to be held on July 27, 2010, honoring Stu’s life work of promoting the creative and talent potentials of students. Invited speakers: Professor Abraham Berman, Head of the Department of Education in Technology and Science and member of the Department of Mathematics at the Technion - Israel Institute of Technology; Professor Kathy Gavin of the Center for Gifted and Talented Development at the Neag School of Education at the University of Connecticut; Professor Rex Jung of The Mind Research Network for Neurodiagnostic Discovery, Albuquerque, New Mexico; and Professor Emeritus Stuart Sidney, Department of Mathematics, UConn. More news about faculty honors and recognition may be found on the Department’s Web pages.
PROFILE: ALAN STEIN

Alan Stein retired at the end of the 2008-9 academic year after 37 years in the Mathematics Department at the Waterbury Campus of UConn. Stein came to UConn while completing his Ph.D. dissertation at the Courant Institute of Mathematical Sciences, New York University, specializing in Number Theory. During his career at the University, he was active at both the Waterbury and Storrs campuses. In Waterbury, he chaired the “Computer Committee” for several years, starting at a time when the campus had no dedicated support staff, and oversaw its initial wiring that brought the Internet to faculty and staff offices. He also served for several terms on the Waterbury Campus Executive Committee.

Alan Stein has been Webmaster and chair of the Alumni Relations Committee for the Department of Mathematics and has continued in those capacities in retirement. This year he is also temporarily serving as chair of the department’s Web Committee while Keith Conrad is on sabbatical. In retirement, Alan continues to live in Waterbury with his wife Marsha. Besides keeping active with the Department and hoping to continue to do some research, he hopes to avoid the worst of the New England winters by traveling occasionally to warmer climes. He began by spending January and February 2010 in Israel, participating in Hadassah’s “Winter in Netanya” program. Marsha and Alan volunteered there four mornings a week in a soup kitchen and a hospital, even spending the morning of their 41st anniversary peeling carrots together – before celebrating at the beach in the afternoon.

Alan is also spending more time on various volunteer activities closer to home. He is the President of PRIMER-Connecticut, a media-monitoring organization devoted to Promoting Responsibility in Middle East Reporting, and just became Vice Chair of the Waterbury Coalition for Better Government, a group pressing for a change in the Waterbury City Charter to implement an “Aldermen By District” election system. He’s also on the Steering Committee for the Connecticut Coalition to Save Darfur, and of course manages its Web site, <http://www.ctsavedarfur.org>; is Secretary of JFACT, the Jewish Federation Association of Connecticut; and reads Torah Thursday mornings at Kol Ami Synagogue in Cheshire. He also finds time to be active in a handful of other organizations when he’s not playing golf or tennis, exercising at the gym or pretending to play the violin.

The Steins’ daughter, Audrey, is a writer who lives in Cambridge, Massachusetts and has just self-published her first book, MAP (<http://map.audreymbethstein.com/>). She supports herself with a day job writing computer code for Citizen’s Bank.
AWARDS DAY, APRIL 2010

The Annual Awards Ceremony of the Department of Mathematics took place on April 12, 2010. Dr. Jeremy Teitelbaum, Dean of the College of Liberal Arts and Sciences, welcomed the audience of undergraduates, graduate students, families, and faculty members. Professor Emeritus Stuart Sidney was the master of ceremonies.

Various awards and honors were presented in recognition of student achievements.

CALCULUS COMPETITION winners:

- **First Overall:** Antoni Brzoska
- **Second Overall:** Vi Ha
- **Honorable Mention Overall:** Scott Norton, Michael Santone, and Weini Qiu
- **First Intermediate (Tie):** Scott Norton and Weini Qiu
- **Honorable Mention Intermediate:** Briana Hennessy and Andy Xie
- **First Beginner:** Andy Xie
- **Honorable Mention Beginner:** Jerry Wang and David Wierschen

WILLIAM LOWELL PUTNAM COMPETITION honors went to Antoni Brzoska for Outstanding Performance and Christine McMeekin for Noteworthy Performance.

The CIGNA AWARD for the Outstanding Actuarial Science Major went to Michelle Wahab.

Michael Bergeron, Tyler Engel, Charles Talbot, John Watterford, and Mingfeng Zhao were initiated into PI MU EPSILON, the national mathematics honor society.

Graduate students honored: Harris Daniels and Ryan Scharz won the LOUIS J. DELUCA MEMORIAL AWARD for Outstanding Teaching Assistant; and John Haga won the CONNIE STRANGE GRADUATE COMMUNITY AWARD.

Awards Day always closes with an invited address by a guest speaker. In 2010, the lecture on “Pythagoras at the Bat: An Introduction to Statistics and Modeling” was given by Dr. Steven J. Miller of Williams College.
UCONN’s CALCULUS COMPETITION - The 2009 and 2010 EXAMS

Some readers of the MATHConnections may be curious about the competitive exams mentioned in the Awards Day articles. The Department’s annual Calculus Competition is a two-hour examination composed by Stuart Sidney and is designed to challenge the brightest of our students while not requiring more specific knowledge of calculus than is contained in the standard courses. The Putnam Competition is a very difficult annual competitive examination administered by the Mathematical Association of America and is taken by thousands of students in the United States and Canada each year. It is designed to be far more challenging than our exam and often requires broader knowledge as well as cleverness and creativity.

Here are the problems on the two most recent UConn competitive exams. We hope that you’ll have fun playing with them.

The 2009 UCONN UNDERGRADUATE CALCULUS COMPETITION
Tuesday 24 March 2009, 7:00-9:00 p.m.

1. Parabolic perpendicularity party. Let \( P \) denote the parabola consisting of the points \((x, y)\) that satisfy \( y = x^2 \). If \( y < x^2 \), there are two tangent lines from the point \((x, y)\) to \( P \). Find an equation for the curve consisting of those points \((x, y)\) with \( y < x^2 \) such that the two tangent lines from \((x, y)\) to \( P \) are perpendicular to one another.

2. The biggest cone. Find the dimensions (radius \( r \), height \( h \)) of the right circular cone of greatest volume that can be inscribed in a sphere of radius 1.

3. The biggest area. Find the constant \( a > 1 \) for which the area of the region bounded by the line \( y = x \) and the parabola \( y = ax - a^2 x^2 \) is as large as possible.

4. Viva la revolution! For a positive constant \( k \), consider the region \( R \) bounded by the line \( y = kx \) and the parabola \( y = x^2 \). There is only one choice of \( k \) such that the solids obtained by revolving \( R \) about the \( x \)-axis and the \( y \)-axis have the same volume. Find the value of this special choice of \( k \).

5. This problem has a point to it. A cusp on a curve is a sharp point. For instance, the curve \( y = \sqrt{|x|} \) has a cusp at \((0, 0)\), as does the curve \( x = \sqrt{|y|} \). The parameterized curve \( x = \sin(\pi t), y = 4t^3 - 10t^2 + 3t \) has one cusp. Find it, and find the slope of the “tangent line” to the curve at the cusp.

6. This one will bug you. A wheel 2 feet in diameter rolls without slipping down a hill inclined \( \pi/6 \) radians (or \( 30^\circ \)) to the horizontal. On the way down it squashes a bug, whose remains stick to (the outer circumference of) the wheel. Though the wheel is descending, initially the bug is rising. How much higher than its initial position does the dead bug get? [You may assume, even though it can’t be true physically, that the bug occupies just a single point, that is, all its dimensions are equal to zero.]

7. Getting hyper. In higher dimensions, things work pretty much as they do in dimensions one, two and three. In particular, just as in dimension 1 we have length, in dimension 2 we have area, and in dimension 3 we have volume, so in 4-dimensional \( wxyz \)-space we have hyper-volume. Compute the hyper-volume of the 4-dimensional hyper-solid bounded by the hyper-plane \( 2w + 2x + 2y + z = 1 \) and the hyper-paraboloid \( w^2 + x^2 + y^2 = z \).
8. A tale of two series. Let \(a_0, a_1, a_2, \ldots, a_n, \ldots\) be a sequence of real numbers that satisfy \(0 < a_n < \pi /2\) for all \(n\). Suppose that the ratio test shows that the radius of convergence of the power series
\[
\sum_{n=0}^{\infty} a_n^3 x^n
\]
is 8. Determine the radius of convergence of the power series
\[
\sum_{n=0}^{\infty} \frac{1}{1 - \cos a_n} x^n.
\]

9. To converge or not to converge, that is ... Determine whether the improper integral \(\int_1^{\infty} \sin (\pi x^3) \, dx\) converges.

10. Schnook’s Law. Celebrated physicist Dr. Walt A. Schnook has been studying springs, and has decided that Hooke’s Law \(my'' = -ky\) is not quite right. Here \(m\) is the mass of an object attached to one end of a weightless spring whose other end is attached to a wall, \(y = y(t)\) is a function that expresses how far the spring has been stretched from its rest position at time \(t\), and \(k\) is a positive constant associated to the spring. Dr. Schnook’s revised version is Schnook’s Law: \(my'' = -ky^2\). In a particular example, in appropriate units \(m = 2\), \(k = 3\), \(y(0) = 4\) and \(y'(0) = 0\); these last two mean that at time \(t = 0\) the object is being held motionless with the spring stretched 4 units from its rest position. Write a definite integral (proper or improper) whose value is the number \(T\) of time units required for the spring to return to its rest position \((y = 0)\) if the object is released. [Caution: It is not advisable to attempt to actually evaluate the integral.]

2010 UCONN UNDERGRADUATE CALCULUS COMPETITION

Wednesday 24 March 2010, 7:30-9:30 p.m.

(1) Find the missing constants. Find constants \(a\) and \(b\) so that \(f(x) = x^4 + ax^2 + bx\) has a local extreme value at \(x = -1\) and a point of inflection at \(x = 2\), and determine whether the local extreme value at \(x = -1\) is a local maximum or a local minimum.

(2) Which triangle is smallest? The positive \(x\)-axis, the positive \(y\)-axis, and any tangent line to the “curve” \(y = 1 - x^2\) \((x \neq 0)\) together bound a triangle. What is the smallest possible area of such a triangle?

(3) Hiding from the ogre. I am rooted to one spot, the point \((0, 14)\), hoping to escape the view of an evil ogre who is chasing me. Fortunately, until it spots me, the ogre is constrained to run along the ellipse \(x^2 + xy + y^2 = 7\). Also fortunately, its neck is rigid, so it cannot turn its head. Unfortunately, it has eyes on both the front and back of its head. Thus it can see directly in front of and in back of itself, nowhere else. I have to duck when it comes to either of the two points on the curve from which it can see me. Which two points are these?
(4) **A mean problem about double differences.** Show that if \( a \geq 0 \) and \( h > 0 \), then
\[
\sqrt{a + 2h} - 2\sqrt{a + h} + \sqrt{a} = -\frac{h^2}{4} \zeta^{-3/2}
\]
for some number \( \zeta \) satisfying \( a < \zeta < a + 2h \).

(5) **Mommy, are we there yet?** A particle starts at the point \((1, 1)\) and moves from left to right along the parabola \( y = x^2 \) in such a manner that its speed when it is at the point \((x, y) = (x, x^2)\) is \( x \) units of distance per unit of time. After how many units of time does it reach the point \((2, 4)\)?

(6) **Getting intimate with an integral.** Write a common fraction (a quotient of two positive integers) that is within \( 10^{-7} \) of \( I = \int_0^{1/10} e^{-x^2} \, dx \). Be sure to show the computation that results in your fraction, and to explain why it is within \( 10^{-7} \) of \( I \). No calculator computation will be honored on this problem!

(7) **The root of the matter.** Give a precise meaning to
\[
\rho = \sqrt{1 + \sqrt{1 + \sqrt{1 + \ldots}}},
\]
show that \( \rho \) exists as a finite real number, and evaluate \( \rho \).

(8) **Irrelevant exponents.** Determine which sequences \( a_1, a_2, a_3, \ldots \) of real numbers have the property that the sums
\[
s_1 = \sum_{k=1}^{\infty} a_k^1 = a_1^1 + a_2^1 + a_3^1 + \ldots, \quad s_2 = \sum_{k=1}^{\infty} a_k^2 = a_1^2 + a_2^2 + a_3^2 + \ldots,
\]
\[
s_3 = \sum_{k=1}^{\infty} a_k^3 = a_1^3 + a_2^3 + a_3^3 + \ldots, \quad \ldots, \quad s_n = \sum_{k=1}^{\infty} a_k^n = a_1^n + a_2^n + a_3^n + \ldots \quad (n = 1, 2, 3, \ldots)
\]
are all well-defined, finite, and equal.

(9) **Simply a simplex.** Just as in dimensions 1, 2 and 3 we have intervals and length, regions and area, and solids and volume respectively, so in dimensions 4 and higher we have **hypersolids** and **hypervolumes**. Find the hypervolume of the hypersolid in 4-space \( \mathbb{R}^4 \) consisting of the points \((w, x, y, z)\) that satisfy \( w \geq 0, \ x \geq 0, \ y \geq 0, \ z \geq 0 \) and \( w + 2x + 3y + 4z \leq 6 \).

(10) **Going off on a tangent.** Suppose that \( y = f(x) \) is a solution to the initial value problem \( \frac{dy}{dx} = x^2 + y^2 + 1 \), \( y(0) = 0 \), valid on the interval \((-\delta, \delta)\) for some positive number \( \delta \). Show that \( f(x) > \tan x \) for \( 0 < x < \delta \).

**Comment:** So necessarily \( \delta \leq \frac{\pi}{2} \). In fact, \( \delta < \frac{\pi}{2} \).
STU’s PUZZLE CORNER
Stuart Sidney

Consecutive composites

[Stu coments that this is more theory than puzzle, but divisibility properties of the whole numbers can be very puzzling. G.M.L.]

Because the prime numbers are a sparse subset of the positive integers, the composites are plentiful, and there are arbitrarily long strings of consecutive composite numbers. It is easy to see this: If \( k \geq 3 \) is a natural number and \( g(k) = LCM\{2, \cdots, k + 1\} - (k + 1) \), then \( g(k), g(k) + 1, \cdots, g(k) + k - 1 \) are \( k \) consecutive composite numbers.

1. Verify this assertion, and determine where your argument breaks down when \( k = 2 \).

While the formula for \( g(k) \) is fairly simple, it is not terribly economical in that in general there are much smaller starting points for a string of \( k \) consecutive composites. Let, for \( k \geq 2 \), \( f(k) \) denote the smallest positive integer \( n \) such that \( n, n + 1, \cdots, n + k - 1 \) is a string of \( k \) consecutive composites.

2. Show that not only is it not the case that \( f \) is one-to-one, but in fact \( f(k + 1) = f(k) \) if \( k \) is even. In fact, for any \( n \), if \( f^{-1}(n) \) is nonempty then it consists of an even number of consecutive integers, the first of which is even (and the last odd). For \( 2 \leq k \leq 11 \) evaluate \( f(k) \) and compare it to \( g(k) \).

For \( x \) a positive number, \( \pi(x) \) denotes the number of primes not greater than \( x \). The Prime Number Theorem says that the ratio of \( \pi(x) \) to \( x/\ln x \) tends to 1 as \( x \) tends to infinity. A refinement of this appears in a 1941 article by B. Rosser (Amer. J. Math. 63 (1), 211-232): \( \frac{x}{\ln x + 2} < \pi(x) < \frac{x}{\ln x - 4} \) if \( x \geq 55 \).

3. Using Rosser’s result or some other method, find a positive integer \( k_0 \) and a (not necessarily integer-valued) explicit function \( h(k) \) such that \( h(k) \geq f(k) \) for all integers \( k \geq k_0 \), but \( \lim_{k \to \infty} h(k)/g(k) = 0 \). (There are lots of possible answers.) This justifies the earlier remark that \( g(k) \) is not economical.

Please keep in touch. Offer suggestions or solutions via e-mail to:

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or via surface mail to:

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Our main focus at the Quantitative Learning Center (or Q Center) is to help UConn students in their Q courses, via our free peer tutoring program. In 09-10 we have started several research projects that will use the Q Center as a laboratory of education, but those projects are at their infancy and will be the topic of future articles.

The goal of this note is to use calculus and statistics (the same calculus and statistics that we teach our students, and that our tutors explain every day!) to model the number of visits that the Q Center handles each semester. As the table above shows, the Q Center’s volume of visits has been growing at a fantastic rate. The question is: how many visits will we see in Fall 10 and Spring 11? The answer to this question is crucial in determining our budget allocation and the amount of resources (tutors, GA’s, tables, chairs, etc) needed to successfully handle these visits.

In pre-calculus, we teach our students the concept of function and we show them how to construct linear functions that interpolate two values. In statistics, we teach them about linear regression and the least squares method, to find the linear function that best fits the data:

\[ F_1(x) = 2684x - 1710 \quad \text{and} \quad S_1(x) = 1751x + 161. \]

In calculus, the exponential function plays a very important role, and we tell our students to use exponentials whenever they try to model exponential growth. The best exponential functions that fit our data are:

\[ F_2(x) = 580(1.96)^x \quad \text{and} \quad S_2(x) = 1163(1.56)^x. \]

When we introduce our students to Differential Equations (and in particular the method of separation of variables), we teach them to use the Logistic Equation for growth models where the rate of reproduction is proportional to both the existing population and the amount of available resources. These populations follow equations of the form:

\[ V(x) = \frac{K}{1 + Ce^{-rx}} \]
In our case, using logistic regression, we obtain the following logistic functions that best fit our data:

\[ F_3(x) = \frac{12031}{1+e^{-1.158(x-2.823)}} \quad \text{and} \quad S_3(x) = \frac{8102}{1+e^{-1.586(x-2.11)}}. \]

It only remains to use the functions we have found to make predictions on the number of visits at the Q Center in years to come:

<table>
<thead>
<tr>
<th>Q Center Visits: Observed and Projected</th>
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<tbody>
<tr>
<td><strong>Fall</strong> (observed)</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>05–06</td>
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<td>06–07</td>
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<td>11–12</td>
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<td>12–13</td>
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</tbody>
</table>

The logistic models seem to be a very good fit, for both the Fall and Spring semesters, and we indeed hope that we are close to reaching the carrying capacity in our logistic model. If the model is indeed correct, capacity of the system would be 12,031 visits in the Fall, and 8,102 visits in the Spring, for a grand total of 20,133 visits each academic year!

Of course, our students are also told that, by definition, a model is only a mathematical approximation of reality constructed out of limited data. The linear and exponential models for the number of visits at the Q Center are fundamentally flawed, as there is only a finite number of UConn students enrolled in Q courses and the Q Center has limited resources. The logistic models take into account the fact that there are a limited number of resources available, but they do not incorporate the fact that our resources are increasing every semester, as the administration recognizes our achievements and our operating budget is increased (this suggests that we should try using a time-varying carrying capacity logistic model). However, even when we receive a new one-shot of funds in the middle of the semester to cope with a larger-than-expected number of visitors, it takes time and effort to increase the overall resources.

Another challenge we face in modeling the number of visits at the Q Center is that demand is not driven merely by natural "population growth" but by specific changes in the environment, such as the move to large lectures in calculus, the introduction of online homework, etc.

The good news is that, regardless of the exorbitant number of visitors that come our way semester after semester, our excellent team of Q Center tutors and GA’s have done an excellent job at keeping up with the demand, and have provided UConn students with invaluable help in all their Q needs.