Advising Starts Next Week

Can you believe it? We’re barely halfway through this term, and you already need to sign up for classes for next term. Well, have we got the issue for you! In this special extended edition of the Gazette, you’ll find descriptions of all the upper-level mathematics courses offered next term. The challenge is picking just one. So pick two.

Friday Night Flicks

Russ is at it again. Come see what wonderful film he has chosen for this week’s feature. Be there 7:30-9:30 p.m. CMC 206. He’ll provide the popcorn.

Winter Term Course Descriptions

Math 206: A Tour of Mathematics
(1 credit; S/Cr/NC)
Instructors: Much of the Math Department
Time: Help us decide!
Prerequisite: None

Are you considering a math major, but wondering just what will follow after all the calculus and linear algebra, or where the frontiers of mathematical knowledge are to be found? Are you already a major who would enjoy some fresh perspectives on, and new insights into, your chosen subject? Come join us for a series of lectures on a variety of mathematical topics, with emphasis on exciting ideas, concepts and results rather than on systematic coverage of any particular subject (we have other courses for that).

In order to attract many people (yes, you!) to this informative and entertaining one-credit course, we’re using a somewhat unusual scheduling process, which worked quite well last year: Instead of picking a time in advance to avoid as many potential conflicts as possible (which ends up being early in the morning and thus not very popular), we’re asking you to register for the course first, and then we’ll arrange the lectures (once a week) to fit the schedules of as many as possible of the students who registered and of the faculty. You will be contacted soon after registration, and we expect that the schedule will be set before you leave for winter break.

Although this course has been offered yearly, there should be no overlap in lectures with last year’s offering, so you can “repeat” once if you took the 2008 Tour.

Math 236: Mathematical Structures
Instructor: Gail Nelson
Time: 4a
Prerequisite: Math 232 or instructor permission

What lies beyond calculus and linear algebra? Are there possibly more math courses in your future? Mathematics is much more than solving
max-min problems, techniques of integration, and inverting matrices. In fact, there are many branches of mathematics. In this course, we will study some of the structures and concepts that occur as common threads throughout these different branches. Our behind-the-scenes look at this subject will emphasize the development of problem-solving and proof-writing skills. This course should shed some light on what lurks in the hearts of mathematicians. If you think there may be upper-level math courses in your future, this course is for you.

Math 241: Ordinary Differential Equations  
Instructor: Mark Krusemeyer  
Time: 3a  
Prerequisite: Math 232 or instructor permission

In calculus you may well study separable first-order differential equations for a bit, but that's just the tip of the iceberg! In any field where mathematics is applied, you are likely to find equations relating unknown functions and their derivatives. Over the centuries, following the lead of Newton, Leibniz, and the Bernoullis, mathematicians have come to grips with many such equations. Naturally, they prefer to get exact solutions if possible, and we'll look at some of the systematic methods (and some of the clever ad hoc tricks) that have been developed to find solutions.

On the other hand, there are times when finding an exact solution is too difficult, or even potentially misleading - for instance, because the mathematical model that leads to the differential equation is imprecise to begin with. In such cases, it is often best to concentrate on the qualitative behavior of solutions; for example, you might try to predict what will happen in the long run.

In this course, you'll find plenty of calculus-style computation, including ample opportunity to brush up on your techniques of integration (Mathematica can help with some of that), but also a few theoretical discussions, some geometric ideas, and a bit of mathematical modeling.

The textbook, which was written by a close (younger!) relative, does not presuppose much linear algebra, but concepts from linear algebra, ranging from vector spaces of functions through linear transformations and kernels to eigenvalues and eigenvectors, will be mentioned and used with some regularity in class.

Math 245: Applied Regression Analysis  
Instructor: Katie St. Clair  
Time: 2a  
Prerequisite: Math 215 or Math 275

How many minutes should a typical American expect to work in order to pay for the Big Mac they ate for lunch? How can we estimate the volume of usable wood contained in a tree if we aren't allowed to cut it down? What can the variables age, gender, and class tell us about who survived the Titanic disaster?

These are all questions that can be answered using linear regression models. This course will cover simple linear regression, multiple regression, and logistic regression models. We will discuss model building techniques (which variables are most important in the model?), model checking techniques (is a linear model appropriate?), and graphical methods that are used for data exploration and model building. We will meet in the stats lab so you will have plenty of opportunities to work with real-life data throughout the term.

Math 251: Chaotic Dynamics  
Instructor: Deanna Haunsperger  
Time: 3a  
Prerequisite: Math 236 or instructor permission

Mathematics may be defined as the study of pattern and order. Chaos is defined as “a state of extreme confusion and disorder.” “A state of extreme confusion” in a math class? We hope not. “Disorder” isn't exactly right either. In this course we'll look at how regularity and pattern sneaks into seemingly disordered, irregular systems.

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Dynamical systems (the less-flashy name for Chaos) studies the long-term behavior of a system that evolves with time (the population of fish in a pond, the weather). The classical view is that such behavior is completely understood once we write down and solve the related differential equation. Luckily for us things are much more complicated than that. And much more interesting.

**Math 275: Intro to Statistical Inference**  
Instructor: Robert Dobrow  
Time: 4a  
Prerequisite: 265

Statistical Inference is the process of drawing conclusions from data. In Math 265 you learned how to compute probabilities. Statistics starts with the tools of probability and calculus and applies them to real life problems. In the process, we will leave the *terra firma* of the “pure” math classroom, where questions are well-posed and solutions are right or wrong, and plunge into the reality that uncertainty is everywhere and data are dirty. The writer Goethe wrote, “Theory is gray, but the tree of life is green.” In this class, we’ll look at numerous applications and case studies (green and otherwise) drawn from the environment, the election, biology and medicine, and social science. The statistical software language R will be introduced and used throughout.

**Math 331: Real Analysis II**  
Instructor: Gail Nelson  
Time: 2a  
Prerequisite: Math 321

In this, the second course of the analysis sequence, we will delve even deeper into the properties of functions. Specific topics will include Lebesgue measure, the Lebesgue integral, an introduction to general measure theory, and Banach and Hilbert spaces. Not only is this your chance to “integrate” your knowledge of functions, it is also an opportunity to better your understanding of the legal interchange of limit operations.

The flavor of the course will be similar to a graduate-level course in analysis. If there is a possibility that you are headed for graduate school in mathematics, this course comes highly recommended.

**Math 395: Topics in Geometry: Manifolds**  
Instructor: Joshua Davis  
Time: 5a  
Prerequisite: Math 344 or Math 354 or instructor permission

In topology/geometry, the concept of “manifold” generalizes the concept of “surface” to arbitrary dimensions. That is, a surface is a 2-dimensional manifold. Manifolds come up in various areas of math and physics; they are useful as well as beautiful.

The approach of “differential topology” is to use calculus techniques to discover topological properties of manifolds. This approach gives us a geometric, even visual, feel for topology; it is also a first glimpse of the fascinating interplay between topology and geometry on manifolds.

Concretely, the seminar will work through an introductory differential topology text, with both the instructor and the students presenting material. The course will be adjusted based on the number of students and their interests.

**Exam coming up?** Check out *Calculus in Twenty Minutes* on youtube.com as a study break. Watch as an energetic professor covers the course in under twenty minutes, seemingly without breathing. You never know, it might make all the difference come test taking time. Search: EX_is9LzFSY.
Opportunities for Carls

What are you doing this summer? Over winter break? Next year? After you graduate? Now is the time to start exploring your opportunities. Here are a few to consider:

The Joint Program in Survey Methodology at the University of Maryland is looking for talented undergraduate students for paid research assistantships at Federal statistical agencies in the Washington, DC, area. Application deadline is November 15.

The 6th annual regional Seven Rivers Undergraduate Research Symposium at Viterbo University in La Crosse, Wisconsin is on November 7, 2008. The symposium will highlight research accomplishments of undergraduates. Students who have completed research on or off campus are encouraged to participate. Student research projects completed in groups as part of classes are also suitable for presentation. However, students do not have to present research to attend the symposium. The registration deadline is October 27, and, for students presenting, abstracts are due on November 3. You'll find the online registration form at: http://www.viterbo.edu/SevenRivers.aspx

The Budapest Semester in Mathematics is a wonderful opportunity to study math with eminent Hungarian scholar-teachers. All classes are taught in English, and the school is located near the center of historic Budapest. Application deadline for next fall is April 30. Visit: www.stolaf.edu/depts/math/budapest

The 11th Annual Nebraska Conference for Undergraduate Women in Mathematics is a great opportunity to hear undergraduate women give talks about their own research. The registration deadline this year is December 12.

For more information on these and other opportunities, see postings in the hallway on the second floor of the CMC, or talk to your professors.

PROBLEMS OF THE WEEK

1. Given a parabola in the plane, describe the locus (set) of all points \( P \) in the plane such that there are two perpendicular lines through \( P \) that are both tangent to the parabola:
   a) in the particular case of the parabola \( y = x^2 \);
   b) for a general parabola.

2. As you may well know, the triangular numbers are formed by adding consecutive integers starting with 1, the results being 1, 1 + 2 = 3, 1 + 2 + 3 = 6, 1 + 2 + 3 + 4 = 10, 15, 21, 28, etc.; it is not hard to see that the \( n \)-th triangular number equals \( n(n + 1)/2 \). Clearly, if we take twice the triangular number 3 we get another triangular number, namely 6, but usually when we take twice a triangular number the result will not be a triangular number. It does happen again; for example, 105 and 210 are both triangular numbers. Does it happen infinitely often that taking twice a triangular number produces another triangular number? If so, show why. If not, what is the last time that it happens?

By press time, a solution to last week’s first problem had arrived from Rebecca Cordes; the correct answer to the second problem was found by “L. C. Badice”, whose work showed a split personality with poetic leanings (if limericks count as poetry), good hand calculations to establish a pattern, and help from Mathematica to “prove” that the pattern works in general. Rebecca and “L.C.” should each pick up a B.B.O.P. item from CMC 217 for their efforts.

- Mark Krusemeyer

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