OU COURSE ANNOUNCEMENT
Math 4513: Senior Mathematics Seminar
Fall 2004 Semester
Instructor: Andy Miller

In a paper presented to the Berlin Academy in 1859, Bernhard Riemann introduced the zeta function $\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s}$, and casually asked whether its non-real roots all have real part equal to one half. The paper, and Riemann's casual question, emphasized the relationship of the zeta function with understanding the distribution of prime numbers. Subsequent works have identified many other far-reaching consequences of the question—which is now commonly referred to as the Riemann Hypothesis. Despite the fact that David Hilbert articulated this as the eighth in his famous list of problems in 1900, and, that there is now a one million dollar prize from the Clay Institute awaiting anyone who definitively answers it, the problem has persistently resisted solution to date. In this course we will explore some of the elementary mathematics and history surrounding the problem. As reference, we will use the book *Prime Obsession: Bernhard Riemann and the Greatest Unsolved Problem in Mathematics* by John Derbyshire, which was published by the National Academies Press in 2003 (see the web site *http://www.nap.edu/catalog/10532.html* for more information). Derbyshire's book discusses historical/biographical background and mathematical background in alternate chapters, and we will focus on both aspects of these discussions. As a historical case study, the Riemann Hypothesis offers many insights into the ways in which mathematical progress evolves. The mathematical aspects of the discussion touch on such diverse topics as: infinite series, complex numbers, the prime number theorem, analytic functions, asymptotic approximation, mobius inversion, fields, eigenvalues of matrices and number theory.

The book *Prime Obsession* is written for a general reader with little specialized knowledge of mathematics. Nevertheless the author does not shy away from presenting deep mathematical concepts, even though the explanations stem from elementary starting points. Drawing on students' experience with calculus and the undergraduate mathematics canon, we will present and discuss the mathematical aspects of the book on a somewhat more formal basis. In addition, students will be introduced to the computer algebra software MATHEMATICA, and will be asked to use this to replicate many of the approximations and graphics scattered throughout Derbyshire's book. Students will also choose a related historical or mathematical topic to research in the math library. The results of this research will be compiled in written form and orally presented to the class towards the end of the semester.

This course is designed to satisfy the capstone requirement for mathematics and mathematics education majors. As prerequisite it requires that enrolling students have 'senior standing or permission of instructor'.