

Spring 2008

Math 496 F1H

Honors Seminar: Introduction to Mathematical Research

MWF 2 p.m., Room 243 Altgeld Hall

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Few prospects are as daunting for a serious math major as that of doing research. In fact, mathematical research is a natural extension of homework in mathematics courses, except that there is no back of the book to look for the answer. This course is designed to help students develop their skills in mathematical creativity and problem-solving. (These skills are useful in all advanced mathematics classes as well.) The only prerequisite is Math 347, or the ability to convince the instructor that you can write proofs correctly.

Some of the ways in which research differs from homework are these: the problems are harder, you may not know whether you (or anyone else) can solve them, you do not always know what you need to know in order to solve them, they are usually motivated by a larger set of questions and, ultimately, by the researcher's own curiosity. Research is also often a matter of synthesizing several seemingly different theorems into a cohesive whole.

The best way for a student to become successful in mathematical research is to take as many challenging and meaningful mathematics courses as possible, in many different areas. This course concentrates on building an infrastructure for research. In the first part of the semester, we will consider problem-solving, question-asking, answer-analyzing and knowledge-finding, and you will choose a project and start working on it. You will also select a topic to make a class presentation. Mathematical creativity is a subset of human creativity, and much is known about how to become more creative. In the second part of the semester, students will present their own research projects and listen to and critique the work of the others. These projects can be used as a basis for the Senior Paper or as a submission to the Greenwood-Trjitzinsky Prize. The instructor's own Ph.D. thesis began as an undergraduate project, but he cannot guarantee this outcome!

There will be students at varying levels of mathematical knowledge and sophistication in this class, Don't be scared off by thinking that you don't know enough mathematics --nobody ever knows enough mathematics. (Your professors are continually learning new material.) Class members may work on any approved mathematical research topic; a range of topics will also be provided for those who request it. It's OK to work in a related area (e.g. computer science, economics, statistics), as long as the research itself has a serious mathematical component. Collaboration is acceptable and encouraged, and is good practice for any "real" research you may do later.

This is always an experimental course, and the above description represents the instructor's expectation, without accounting for student input into the organization, which he hopes to be substantial.

Changes suggested by the previous groups of students to take this course will also be incorporated. Except for this paragraph, the blurb you are reading is the one I've used before. The courses have worked out pretty much as I had hoped, and based on ICES information, the students have been pleased as well. An article based on this course, and illustrating its style, was published recently in *Math Horizons*. You can find it online at:

<http://www.math.uiuc.edu/~reznick/mhori.pdf>

TEXTS

- "Mathematics and plausible reasoning: induction and analogy in mathematics" by George Polya (required)
- "Proofs from the Book" by Martin Aigler and Gunter Ziegler (required)
- "The man who loved only numbers" by Paul Hoffman (recommended)
- "A mathematician's apology" by G. H. Hardy (recommended)