

Math 103: Honors – Topics in Mathematics for Liberal Arts Majors

Mathematics as a Creative Art

Fall 2014 – Instructor: Pat Devlin

Updated October 20, 2014

It saddens me that educated people don't even know that my subject exists. There is something that they call mathematics, but they neither know how the professionals use that word, nor can they conceive why anybody should do it.

– Paul Halmos, “*Mathematics as a Creative Art*”

General Information

Course Description: We explore the world of mathematical thought by studying how to craft inescapably convincing logical arguments. Unlike a typical math class, this course deals entirely with the aesthetics (and not the monotonous mechanics) of math, and no prior mathematical background whatsoever is required or assumed. Topics discussed include puzzles, strategy games, social networks, number theory, ideas of infinity, and beyond.

Class Meetings: Class meets every Tuesday and Friday from 11:30am to 12:50pm (period 3) in HH-A7 (Hardenbergh Hall room A7) on College Avenue Campus.

Instructor Information: Pat Devlin (mathematics PhD candidate) [please, call me Pat]

Office hours: In the Student Activities Center on College Avenue Campus

Tuesdays 10–11:20 and 1–2; Fridays 10–11:20

Also available by appointment

Email: [prd41\(at\)math.rutgers.edu](mailto:prd41@math.rutgers.edu) (best way to reach me)

Office phone: Reached through (848)445-2390, office Hill 618

Course webpage: Use sakai for grades, assignments, resources, and announcements

Personal webpage: <http://www.math.rutgers.edu/~prd41/> (this may not be useful)

Text: None. Class notes and other resources will be provided.

Departmental Information: This course fulfills both the Quantitative Information (**QQ**) and Mathematical or Formal Reasoning (**QR**) learning goals of the SAS Core Curriculum:

QQ: Formulate, evaluate, and communicate conclusions and inferences from quantitative information.

QR: Apply effective and efficient mathematical or other formal processes to reason and to solve problems.

Academic Integrity: Do not violate the academic integrity policy (i.e., *don't cheat!*). The university takes that sort of thing very seriously, and cheating can get you into a lot of trouble. Plagiarism includes using ideas or arguments without giving any credit to the source. See <http://academicintegrity.rutgers.edu/policy-on-academic-integrity>

What to Expect

Mechanics of course: The course meets twice a week, and attendance and participation are required. Class time will be primarily devoted to dialog and group discussions whereby we engage logical (i.e., mathematical) ideas at a conceptual level and work to create a shared knowledge and understanding of the material. The entire goal of the course is to exercise logical (i.e., mathematical) thinking and reasoning and to carefully articulate logical arguments. In class you will be expected to actually think(!), and equations and computations will play a refreshingly minimal role.

Pedagogy: The format of this course will be strongly influenced by the instructor’s pedagogical beliefs (i.e., his views of how learning takes place). In short, the most fundamental of my views is the simple statement that *an instructor cannot possibly learn at you; instead, learning is an extraordinarily personal process that must occur within each student as a result of what she or he does*. If you ever have any questions or criticisms about the way this course is structured, I would sincerely love to hear from you.

Grades: I’m on your side, and I sincerely want every single student to earn an A (note the phrasing is *earn* not *receive*). Your grade will be broken into five components. Namely:

| | Portion of Total Grade |
|-----------------------------|------------------------|
| Homework and Quizzes | 20% |
| Project | 20% |
| Midterm Exam 1 | 15% |
| Midterm Exam 2 | 15% |
| Final Exam | 30% |

The category of ‘Homework and Quizzes’ will be individually graded based on total points. All grades can be discussed in office hours.

Homework and Quizzes: There will be short (usually only a few pages) reading assignments given weekly. It will be a homework assignment to read these and be prepared to discuss them in class. A combination of short in-class quizzes and at-home assignments will be given on these readings. In addition to this, other homework assignments and quizzes will be given to practice and check understanding of ideas discussed in class.

Project: You will be expected to do a project on a mathematical topic of your choosing. This will involve reading about an idea or problem of mathematics and writing a paper about it (or producing some other approved project). Part of your grade on the project will be to meet with the instructor in office hours (or by appointment) to discuss it.

Exams: There will be two ‘midterm’ exams and one final exam (don’t let them stress you out). They will be on the material covered in class and material from your project with strong emphasis on *explanations* and *conceptual understanding*. You will not have to regurgitate definitions or navigate a sea of equations. Most of the questions will be in a short-answer format. By the time the exams come, the homework and class discussions will have adequately prepared you for what to expect.

Attendance: Attendance is required. Students may miss one lecture [not an exam] for free, and they may miss additional lectures for legitimate and verifiable reasons. If students accumulate more than one unjustified absence, their grades will drop accordingly.

Topics covered: A detailed outline can be found on the following page.

Schedule of Topics Covered

This is a tentative outline for the course material [as of 20-October-2014]. There will be two “midterm” exams and a final. The week prior to Thanksgiving break has an irregular schedule, as indicated below. The exact structure of the course may vary, and in particular we allow for the possibility of pursuing fruitful questions that may naturally arise in class.

| Date | Lecture | Section | Details |
|------------------|---------|--|---|
| Tue 9/02 | 1 | | What is a proof? |
| Fri 9/05 | 2 | Games | Subtraction games, win/loss positions |
| Tue 9/09 | 3 | | Games - Guest lecturer |
| Fri 9/12 | 4 | | Topology - Guest lecturer - [Note, not about games] |
| Tue 9/16 | 5 | | Puzzles (solitaire games) |
| Fri 9/19 | 6 | Graphs | Introduction to graphs, applications |
| Tue 9/23 | 7 | | Bridges of Königsberg |
| Fri 9/26 | 8 | | Ramsey theory |
| Tue 9/30 | 9 | | Coloring, planarity |
| Fri 10/03 | 10 | | Catch up, review |
| Tue 10/07 | 11 | Midterm Exam 1 - Games and Graphs | |
| Fri 10/10 | 12 | Numbers | Patterns with passing |
| Tue 10/14 | 13 | | Primes (how many and other) |
| Fri 10/17 | 14 | | oeis - Guest lecturer Neil Sloane |
| Tue 10/21 | 15 | | Number patterns with shapes |
| Fri 10/24 | 16 | | Logic - Guest lecturer - [Note, not about numbers] |
| Tue 10/28 | 17 | | Rational numbers, irrational numbers |
| Fri 10/31 | 18 | | Catch up and review |
| Tue 11/04 | 19 | Infinity | Does $0.\bar{9} = 1$? (other series or limits) |
| Fri 11/07 | 20 | | Infinite versus very large |
| Tue 11/11 | 21 | | Countable sets (lots of sets are countable) |
| Fri 11/14 | 22 | | Countable sets (the reals are uncountable) |
| Tue 11/18 | 23 | | Catch up, review |
| Fri 11/21 | 24 | Midterm 2 – Numbers and Infinity | |
| Wed 11/26 | 25 | Misc. | Geometry - Guest lecturer |
| Tue 12/02 | 26 | | Incompleteness theorems |
| Fri 12/05 | 27 | | Things we don't know and things we can't know |
| Tue 12/09 | 28 | | Catch up and review |