Math 7H | Professor: Padraic Bartlett

Syllabus for Math 7h

Weeks 1-10 | *UCSB 2015*

Basic Course Information

- Professor: Padraic Bartlett.
- Class time/location: Tuesday, Girvetz 2129, 5-6:15pm.
- Office hours/location: 12-1:30pm TTh, South Hall 6516.
- Homework post date/time: Tuesdays, at the end of class.
- Email: padraic@math.ucsb.edu.

Course Description

Here's a fun game for you to play out in the real world: ask people what they think research mathematicians do. You'll get some pretty interesting answers, usually ranging from "count things **really** quickly" to "yell at college students about factoring polynomials."

Now, ask yourselves the same question: what do you think research mathematicians do? After all, if you're in this class you might be thinking about being a mathematician. What answers come to mind?

If you're like most first- or second-year students, you might be drawing a blank here. Thus far in your mathematical career, pretty much all of the people that you've known to be mathematicians have been teachers. Furthermore, most of the mathematics you've studied has been pretty well hammered out since the 17th century or earlier; unless you've been lucky enough to live near a math circle or spend a lot of time reading Wikipedia articles, you may have not encountered a mathematical topic that's been discovered in recent memory. So: what do research mathematicians do? What is research in mathematics like? This class is designed to answer these questions.

In this quarter, we're going to look at topics from pretty much every area of mathematical research we can get to, discuss currently open problems in mathematics, and essentially create a "preview" of what your future mathematics classes may look like. There is no required background for this course, beyond being currently enrolled in one of the university's lower-division mathematics sequences; any background material that we need will be covered in lecture or homework in this class.

Also, it's going to be fun!

Course Evaluation

Math 7H is a one-unit class that meets once-weekly for a little less than 90 minutes. Accordingly, much of your responsibilities for this course are just showing up to lecture! The rest of your grade is determined by your performance on the weekly homework sets.

HW sets will vary in structure from week to week; the one constant will be that sets are graded based on effort instead of for correctness. This is because the problems/concepts in this class are usually those studied in third/fourth-year mathematics classes, and as such will be harder than you're used to / from graduate-level texts / sometimes even open! (Rarely.)

With this in mind, this is how your grade will be determined in Math 7H:

- **Attendance** (50%.) There are 10 classes; attendance will be taken at the start of each class. Show up to each class to get a point for that class.
- **Homework** (50%). There will be 10 problem sets. Work on problems for at least 90 minutes, and show your work (i.e. either have correct solutions with justifications, or a full page of work) to get full credit for any set.
- **Extra Credit** (?%). Sets may have a few extra-credit problems. Any extra-credit problem you completely solve will receive half of a point. (No partial credit.)

Get 16 points overall to get an A. Lower performances in the class will receive proportionally lower marks, but seriously, just do the work! It'll be fun, and it's not that crazy.

Course Textbook

Doesn't exist.

Course Timeline

There isn't one. I have a large stack of lectures prepared for this course; however, I want to adjust the class as it progresses to follow what **you** are interested in! Accordingly, the topics for this sequence will shift to match the interests of the students in the course over time. This means that if there's anything you remember from a random Wikipedia article you were interested in, or from a math talk you saw once, tell me about it! There are very few limits to the mathematical concepts we can work on in this class.

That said, some topics we may discuss include:

- Cardinality: i.e. the "size" of infinity.
- The Collatz conjecture.
- Cryptography.
- The four-color theorem.
- The prisoner's dilemma.
- Combinatorial game theory.
- Electrical circuits and random walks.
- The unit distance graph problem.

- Dynamical systems and chaos theory.
- The surreal number system.
- Pen-and-paper constructions.
- The mathematics of origami.
- Stirling's approximation.
- Asymptotic series.
- Barker sequences and ECC.
- The art gallery theorem.
- The axiom of choice.
- Latin squares.
- Ramsey theory.
- Sorting algorithms.
- P versus NP.
- Generating functions.
- Graph theory (many, many subtopics.)
- Knot theory.