MA111: Contemporary mathematics

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Entrance Slip (due 5 min past the hour):

- When is the first exam, the fourth exam, and the final exam?

Schedule:

- HW 0 is due Friday, Aug 24th, 2012.
- HW 1A,1B is due Friday, Aug 31st, 2012.
- HW 1C,1D,1E,1G is due Friday, Sep 7th, 2012.
- Exam 1 is Monday, Sep 17th, during class.

Today we discuss contemporary mathematics, the subject and the course.

Expectations

- Please turn in your entrance slips. We will do this every non-exam day.

- We will now have a short introduction to today's material.

- The syllabus you have skimmed has important policies, dates, and requirements.

- Class participation is mandatory
  Treat each other with respect, spend our class time learning our class.

- (Expensive) online homework is mandatory:
  You will need a course code from Pearson. If you paid less than $85, you probably don't have one; you can buy one online from Pearson for $85.

- Exams are in-class, once per chapter.

What is contemporary mathematics?

- What comes to mind when you think of mathematics?

- What is this course going to be about?

- Contemporary art can be hard to recognize, how can we recognize the math in contemporary math?

- We'll write some ideas on the board first, then organize, them summarize.

- We cover five chapters:
  voting, finance, graphs, sharing, and symmetry.

Now the fast part

- Each chapter is contemporary math (strategy or beauty):

- It must be **precise**
  (technical definitions, not just wishy-washy words)

- It must be **creative**
  (what can we figure out from the definitions, what are neat examples)

- It must be **certain**
  (The definitions set the rules; what will **always** happen)

- It must be **relevant**
  (we need to check how it works compared to real life)

- It must be **general**
  (it needs to always work, not just on the neat example)

Standard pieces of math

- Motivating easy example: simple, easy, it just works

- Motivating hard example: messy, related, but something doesn't work

- **Definition:** find the essential rules the examples follow

- **Theorem:** if it follows the rules, then it MUST end up doing this

- **Examples:** how can we follow the rules, but in a surprising way

- **Applications:** now go back and solve hard problems

Voting (strategy)

- Our first chapter begins Friday (reading assignment today).

- Voting theory: How do we make collective decisions?

- Voting is not math: voting is politics, kissing babies and shaking hands, "spin" and campaign promises, it is too simple, just "this guy or that guy"

- Voting is math: counting the votes involves numbers, deciding who to pick **based on the numbers** is solving a problem, deciding if our methods of picking are fair is "real math"

Voting: check the five criteria

- **Precise**: use numbers to represent voters, not just "well, I like this guy, but I REALLY like this guy, and this guy is so like REALLY"

- **Creative**: we'll need to invent strategies, example situations, and new counting methods

- **Certain**: we'll prove that some types of candidates always win, or always lose, or we'll prove (for sure) that some of them win and some of them lose

- **Relevant**: we'll compare our ideas to real collective decisions, and hopefully indicate a few places where you'll want to use this in your own life (within the next 2 years)

- **General**: we'll emphasize counting methods that always give an answer. Not "oooh, that's a hard one, I don't know who wins"

Finance (strategy)

- **Precise:** The numbers don't lie

- **Creative:** There is more than one way to pay for things

- **Certain:** Because we are precise, we can be certain what we will pay

- **Relevant:** People lie. We'll try to indicate some standard tricks and problems

- **General:** Our methods work for monthly bills, cars, houses, retirement; at least the precise parts

Graph theory (strategy and beauty)

- **Precise:** Study of "relationships", but a simple mathematical definition

- **Creative:** Have to be creative to solve the puzzles, and to draw good puzzles

- **Certain:** A few things we will discover are absolutely certain, but not obvious (can be fun to explain to your family)

- **Relevant:** "Social network" is literally this, also a few real applications, but our chapter is mostly for fun

- **General:** Almost silly how general it is, used in most industries now

Sharing (strategy; Jack thinks it is pretty)

- **Precise:** We have exact rules describing how we divide, and how we decide if it is fair

- **Creative:** Some seemingly fair methods can be exploited with a creative mind, finding new fair methods requires creativity

- **Certain:** We will prove that several methods are absolutely certain to allow a fair share, and that each has a strategy to be certain of getting a fair share

- **Relevant:** How do you split up your dorm room, or the stuff in the dorm room when you move out? How do you split the chores? Our methods guarantee a fair share!

- **General:** Applies to anything where value is "linearly additive" and people will obey rules if every witness can tell everyone is obeying the rules. It assigns everyone a specific minimum percentage, but people have to agree on the percentage first.

Symmetry: beauty

- **Precise:** We have a simple, precise definition of symmetry (how things are repeated). Allows us to name the different types of symmetry.

- **Creative:** People recognize symmetry differently: you need to be creative to find a way that works for you.

- **Certain:** There are only 7 ways to repeat a shape horizontally. We'll explore those seven ways and see why.

- **Relevant:** Need to design a webpage, logo, or just want to be a tattoo artist? This is for you! (Also, it is pretty)

- **General:** Our ideas work in many dimensions, and allow scientists to see how proteins fold in order to cure cancer. It also works when trying to match wallpaper.

What is contemporary math?

- Strategy and beauty

- Precise, Creative, Certain, Relevant, and General

- Math is a game: definitions are the rules, finding strategies are the theorems, and actually playing are the examples

- Games are fun, but it takes practice to get good at the game

- We practice using:

  - In-class activities

  - Reading the book and verifying that what it says is true!

  - Doing the online homework

  - Doing the book homework (jogging)

  - Reading outside of the book

Online homework

- An online homework system will quickly quiz you on the basics

- It is free for the first few weeks, but costs at least $85 after that.

- New books come with a code; if your book does not have an "access key" return it.

- We need a volunteer to register.

- New book is about $145. E-book only is $85 from Pearson.

- Most other options are bad ideas.

Assignments

- If you don't want to have fun doing math, or aren't going to do the work please drop now: we have a long list of people waiting to get into this class

- You MUST read chapter 1.1 before class on Friday; use the free trial's e-book

- You MUST do online homework #0 by Friday 5pm; use the free trial, stop by mathskeller

- You MUST fill out the exit slip:

  Exit: Briefly explain how Voting Theory can be math.

- For the exit slip: discuss your answer with your group. You don't have to agree, but you should understand each other's answers. Be prepared to explain your answer to the class.