Math 116	Professor: Padraic Bartlett
Syllabus for Math 116	
Weeks 1-10	*UCSB 2015*

Basic Course Information

- Professor: Padraic Bartlett.
- Class time/location: MWF 1-2pm, North Hall 1109.
- Office hours/location: Office hours/location: TTh 1-2:30pm.
- Email: padraic@math.ucsb.edu.

Course Description

The official course description of Math 116 is as follows:

> ***Prerequisites****: Mathematics 8 with a grade of "C" or better.*
> Elementary counting principles, binomial coefficients, generating functions, recurrence relations, the principle of inclusion and exclusion, distributions and partitions, systems of distinct representatives, applications to computation.

This is... actually pretty accurate! We're going to do all of these things, ideally pointing out open research problems and other more esoteric/strange bits of mathematics along the way. It will be fun!

One thing to note, however, about the course description: while "Mathematics 8 with a grade of "C" or better" is the official prerequisite, I want to warn potential students that this class will be **very** proof-heavy. If proving things is not your cup of tea, this course may not be right for you!

Course Evaluation

There are four components of your grade in Math 116:

- **Homework** (40%.) There will be eight weekly homework sets throughout the term, assigned and due on Fridays each week when there isn't a midterm (i.e. due on the Fridays of weeks 2,3,4,6,7,8,9 and 10.)

  Grading works as follows:

  1. Problem sets will contain 5 or so questions.
  2. You will solve those problems! Note: any problem you submit will need a proof or some form of justification to receive full credit.

3. Rubrics will tend to be very simple: i.e. problems will typically be graded on a 1 (for correct), 1/2 (for incorrect but promising) or 0 (for incorrect and fundamentally flawed) scale. This may vary depending on the problem, but the spirit of "you either have created a correct solution or you have not" is what I want grading to emphasize: as mathematicians, it's not like we label things like the Poincaré conjecture with "93%, $A-$." Proofs either work or they don't, and this is what I want to emphasize in this class.
4. Conversely, problems will tend to be very hard. This is a four-unit class, and as such assumes that you are spending 12h/wk outside of the class either studying or working on sets! Accordingly, these sets are calibrated to take about 9-12 hours each (though, of course, this will vary up or down based on your previous background and skills coming into each set.)

   In particular, if you start your set the night before it is due, you may have a bad time.

Homework sets must be handed in, in person, at the start of class on the Friday on which it is due. Your lowest HW score is dropped. Accordingly, no late HW will be accepted. Exceptions can be made in the event of medical/family emergencies. If you find yourself needing to travel when a set is due, come talk to me and we will work something out.

Also: if you write up your homework in LATeX, you get a free flat 5% on the problem set. If you're going to be a mathematician, you're going to need to learn LATeX eventually; you might as well start now!

- **Quizlets** (20%). There are weekly quizzes on Fridays at the end of every non-midterm class. They are meant to be a few very simple questions asking people to give simple examples of various concepts, define basic terms, etc.; their purpose is just to check whether or not people are following the basics of the course.

  Your lowest quiz score will be dropped. Accordingly, no make-up quizzes will be given, with the same medical/family emergency caveats as above. Again, if you find yourself with travel plans that make it unable to take a quiz, come and talk to me at least a week ahead of time to figure out what we can do.

- **Exams** (40%.) There will be an in-class midterm on Friday, May 1, from 1-1:50pm, and an in-class final on Wednesday, June 10th, from 4-7pm. Test structures will vary depending on how the class is going at the time; I will talk with you all in the week before the test so that you know what to expect in terms of structure and material.

- **Extra Credit** (?%.) On most homework sets, there will be a few problems labeled "extra credit." They will be **substantially** harder than the other problems on the set; in exchange, each successful extra-credit problem solved counts as a free flat 1% on your homework grade. They're also fun[1]!

  If you want these problems to be scored, **separate** them from your other HW problems, and place them in the separate extra-credit pile when handing in HW. (I grade

[1] For certain values of "fun."

the extra-credit + quizzes + tests, while the TA grades the normal HW; hence the division of sets.)

Letter grades for this course are only determined at the end of the semester, based on the overall class performance on the final/homework/quizzes. That said, any student with a 90% or higher will definitely earn some sort of an A, 80%'s will earn at least some sort of B, and 70%'s will earn no less than a C. It is probable that our curve will be a bit kinder than this. If you are worried about your performance at any point in the course relative to your peers, email me or come to office hours!

Collaboration/resources policy

Collaboration is allowed (and indeed encouraged) on the homework sets; mathematics at the research level is a collaborative activity, and there is no reason that it should not also be this way in a classroom. Work with your classmates!

Resources are a little trickier. On one hand, you are now researchers; limiting your resources would seem to be contradictory to the spirit of emulating what research mathematics is like. On the other hand, answers to almost everything in elementary mathematics can be found via Google and some patience; if you had unfettered access to every resources in existence, you would likely inadvertently rob yourself of some of the best problems in your education. So we need to strike a balance.

For this class: Wikipedia is a legitimate resource, as are any physical books you get from the library or have yourself. Mathematica/Wolfram Alpha/etc. are also valid tools, though you need to justify any calculations you perform using any computational systems. Other undergraduates / graduate students are also valid resources to talk to about problems, provided you follow the citation system described below; however, I would ask that you restrict them to hints instead of answers if they know the problem! (This should rarely happen.)

Other resources are off-limits. If this policy seems restrictive, talk to me; I am more than glad to make common-sense exceptions where appropriate.

The only things that we ask of you are the following:

1. Write up your work separately, and only write up solutions you understand fully.

2. When writing up your own work, you can directly cite and use without proof anything proven in class or in the class notes posted online. Anything else — i.e. results from textbooks, Wikipedia, etc. — you need to both (1) cite in your writeup, and (2) reprove the results you're using from those sources carefully in your own words. Simply copying solutions over directly is plagiarism / cheating / otherwise poor academic form; it is passing of as your own work the ideas of others. You are certainly welcome to read and learn what other people have attempted! All I am asking you to do here is to (1) not pass it off as your own work, and (2) rephrase and present it in a new way so that it is clear that you have actually learned something.

3. As an important corollary to the above: if the TA or I find that you have copied sentences/work/etc. directly from outside sources,

(a) On your first violation, the offending set's score will be set to -100%.

(b) If there is any second violation, we will get the university involved. Consequences include failing the course and a likely dismissal from the college.

Please, please don't make me have to ever go through either (a) or (b).

4. If you work with other students on a problem, it is considered good form to refer to them (i.e. "I worked with Andrew Wiles on this proof of Fermat's Last Theorem") when writing up your solutions. I mostly ask this because crediting collaborators is something you're going to do as mathematicians, and should get in the habit of.

5. Don't post questions to online messageboard-style services.

If you have any questions on the collaboration policy, please email me and I'll be glad to clarify matters.

Course Textbook

Formally speaking, there isn't one! I will be writing up notes+homework sets for this course and posting them online, instead! That said, a large portion of this course will be drawn from one of my favorite books in mathematics,

- Ronald Graham, Donald Knuth, and Oren Patashnik's Concrete Mathematics.

I am a huge fan of this textbook, and will draw many of the lectures in this class from it; if you want a book for reference, get it! (It's also reasonably cheap online, starting new at 55.)

With that said, there are several other textbooks that I like in the field for certain parts of our material:

- Richard Stanley's Enumerative Combinatorics,
- Lászlo Lovász's Combinatorial Problems and Exercises,
- Martin Aigner's A Course in Enumeration, and
- Herbert Wilf's generatingfunctionology.

I will occasionally pull material from these books as well (along with just some results from memory that I like and want to share with you.) They're all also fun[2] reads, if you want something to pull from the library!

[2] For certain values of "fun."