

MATH B290

Elementary Number Theory (Fall 2020)

Professor John Bergdall
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Tu/F 1:00 - 2:30 PM
Park 243 (if in person)

Overview

This is a foundational course on numbers, focusing on both structure and application. How are numbers built atomically? How are special ones distributed? How can re-organizing numbers create perspectives useful for solving problems? How are numbers related to encryption and decryption?

Learning goals

Understand the essential properties of numbers.

Study the congruence equivalence relation.

Apply congruences in practice and theory.

Create a number theory project from scratch.

Develop python for mathematical computing.

Materials



Textbook

A friendly introduction to number theory (4th edition) by Silverman, Joseph H. (Rent/buy: \$25/\$94*)



Course materials

Moodle for materials & forums. Jupyter notebooks accessed on www.cocalc.com (Free)



Discussions and meetings

Zoom: brynmawr-edu.zoom.us
Meeting ID/password posted to private moodle page (Free)

*If costs cause hardship or would limit your course access, see Tina Fasbinder (tfasbinder@brynmawr.edu) for help from the Math Dept.

Course components

Students process on their own time and engage problems with peers, asynchronously and not. Two mastery assessments and a final project solidify students' arc of learning. (Details on pg. 5-6.)



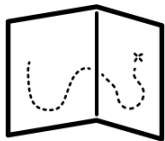
Process

Weekly check-ins.
Watch recordings.
Read and answer guides.
Process per week \approx 4+ hrs.



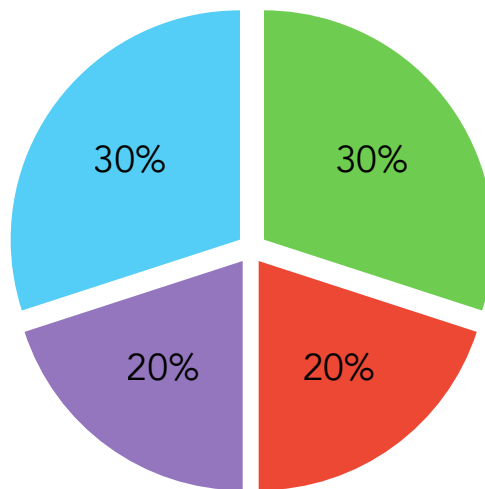
Engage

Post and answer on moodle.
Explore and exercise in python.
Contextualizing assignments.
In and out of class \approx 6+ hrs.



Project

Prepare a report.
Present your findings.
Use the text or other material.
Milestones throughout course.



Grading percentages (also, "peace")



Assess

Mastery assessments ("exams").
Test overall knowledge.
After modules 2 and 4.
Corrections allowed (+25%).

Late work

There are no penalties for late work or absence. If an assignment is due and you need more time, let me know when it will be done. Give a reason if it provides context. If you encounter debilitating circumstances, or have overwhelming concerns of wellness, contact your dean and me for help.

Resources to reach me



Email

Your questions are important. Email me to ask questions you don't find time for in person. It can take at least 24 hours to respond, but send a reminder if I don't reply.

Office hours

You can ask anything you like in office hours. Being students today is extra stressful — if you want to discuss your life or future outlook, I will lend an empathetic ear. I will start with 3 office hours. We can add more if needs arise.



Appointments

I'm happy to hold appointments. To set one, email me and remain patient while we find a time to meet. In your initial message, please explain (i) what you want to talk about, (ii) *your* availability and (iii) if meeting in person is important (which is possible).

Class formation



Names and pronouns

You deserve to be called how you want. Let me know your preferred name and pronouns at any point, in person or over email. When meeting each other, take a moment to re-introduce yourself *every time*, so everyone's names and pronouns are known and properly used.

Academic integrity

You are responsible for following the Bryn Mawr College honor code. If you have any questions, you should presume to ask me rather than assume you know the answer.



Access

I want you to pass this class, with success. Deb Alder (dalder@brynmawr.edu) handles academic accommodations. Wellness service information can be found on the Dean's Office webpage (<https://www.brynmawr.edu/deans/>). If you know a resource not being provided, email or see me and I will work to help you.

Diversity

I welcome all forms of participation. I pledge attention and appreciation for your identity and experience, regardless of your age, background, beliefs, ethnicity, gender identity and expression, national origin, racial identity, religious beliefs, sexual orientation, and any other visible or non-visible categories. Please acknowledge the same for your peers.



Tips for success



Read!

Before class.



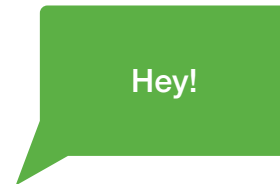
Post!

To moodle.



Collaborate!

With your peers.



Conference!

With me.



Practice!

Repetition is key.



Budget!

Leave yourself time.

More tips: We all get stuck and frustrated.

- Take a break.
- Explain to someone why you are stuck.
- Check hypotheses or assumptions.
- Work out a single example.
- Keep going!

Schedule overview



Module 1

2 weeks

September 7 - 20
Introduction.
Diophantine equations.

Read: Ch. 1-4.
Project: Formulate one question.
Python: Markdown, functions, lists.

Module 2

2 weeks

September 21 - October 4
Properties of numbers.
Distribution of primes.

Read: Ch. 5-7, 12-13.
Project: Project conversation.
Python: Loops, logic controls.

Module 3

3 weeks

October 5 - October 25
Congruences.
Unofficial fall break (days off!)

Read: Ch. 8-11.
Project: Project choices.
Python: Manipulating strings.

Module 4

2 weeks

October 26 - November 8
Computing & congruences
Public key cryptography.

Read: Ch. 16-18.
Project: Project abstract.
Python: Cryptography!

Module 5

2 weeks

November 9 - November 22
Quadratic equations
Sums of squares

Read: Ch. 20-22, 24-25
Project: Project plan.

Bryn Mawr official break: November 21 - November 30.

Final

November 30 - December 10
Quadratic reciprocity

Read: None
Project time!

Process

Processing is a major way to participate in MATH B290. Weekly check-ins let you process experience. Reading the text (with supplemental videos) and responding to guides helps you process material.

Weekly check-ins (by Mondays around noon)

Write a note, record a video or audio, draw a picture, or do anything else to answer: *How are things, overall, and what are you lookin' forward to?* Be brief (one minute) and off the cuff. Being late is okay, but always try to check in!

Completed asynchronously

Reading guides (once or twice per week)

Understand definitions, make calculations, and think through explanations. Automatically collected through cocalc. I will re-collect if you do not finish (let me know).

Turned in for credit

1 out of 5 can be skipped

Engage

You will engage material "in" and "out" of class. Scheduled time focuses on questions and guided examples. Asynchronous participation will be arranged. Un-scheduled time focuses on exercises and reinforced learning.

Post to moodle

At least 1 per module
Responses within ≈ 24 hours

Raise and read questions.
Respond. Link to helpful videos you curate.

Exercise sets

1 per module
Sample solutions provided

Choose problems to complete.
Graded for correctness and coherence.

Context work

4 total over semester
(2 per module available)

Extra reading and videos.
Respond to, and reflect on, ideas in a flexible way.

Collaboration

Working with peers and finding extra resources is encouraged. Acknowledgement of sources should be explicitly given. Make sure you re-write and completely understand all the work you submit.

Assess

Mastery assessments provide chances to gauge summary knowledge of materials. Two assessments, involving calculation and explanation, are held following the 2nd and 4th modules. Computers are allowed for calculation, prior work, and writing solutions. You are expected to *not search* the internet or other resources for help.

Corrections

Assessments can be corrected. Your new score will weigh the original 3-to-1 against corrections.

Example: An original 80% against a 100% correction gives $(3 \cdot 80 + 100)/400 = 85\%$.

Project

The final project allows you to learn beyond the course. You will work in groups. The process will take place module-by-module. Production will occur in the final weeks, during the online-only period.

To do...

1 Get thinking

Browse the text and search the internet. Formulate a question.

2 Get talking

Discuss with me and others. Start at your previous questions.

3 Get choosing

Choice assigned based on first two modules.

To make...

Presentation

(December 8)

Summarize your findings for your peers. Length TBD.

Jupyter notebook

(December 18)

Demonstrate a mathematical component of your project.

Paper

(December 18)

Expose a mathematical idea related to number theory.

4 Get a big idea

Write an abstract (1 paragraph) for your project's main goal.

5 Get planning

Choice assigned based on first two modules.

Grading

The project grade is split between 3 components and a reflection. Your 1-2 page reflection will narratively describe your contribution to your group. It will be used to adjust for inequitable work distribution. The other 3 components have rubrics in the form of questions we'll ask during grading.

	<i>Jupyter notebook (two printed pages)</i>	<i>Presentation (Length to be determined)</i>	<i>Paper (5-10 pages, double-spaced, 1" margins, 12 pt. font)</i>
Questions	<ul style="list-style-type: none"> Is the notebook sufficiently developed? Is markdown used to narrate the demo? Is a mathematical idea demonstrated? 	<ul style="list-style-type: none"> Is a mathematical idea identified and exposed? Is an example provided to help the audience? Are questions handled calmly? 	<ul style="list-style-type: none"> Is the paper properly long and formatted? Is there an introduction with a clear thesis? Are the contents outlined and explained? Does the body of the paper support the thesis? Is there a clear conclusion justifying the thesis? Is there significant mathematical quality? Is history, or are examples, used to illustrate? Are positions defended against counterpoints?
Answers	<p>"No" Not at expectations</p>	<p>"Yes" Meets expectations</p>	<p>"Yes!" Above expectations</p>
Grade			