Teaching Advanced Finite Mathematics

A Course for High Schools
(Session #56)

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Outline

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Standards

State Course number: 27.07910

Big Ideas

1. Numerical Reasoning
2. Logical Reasoning
3. Abstract and Quantitative Reasoning

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1. Numerical Reasoning
2. Logical Reasoning
3. Abstract and Quantitative Reasoning

Mathematical Practice standards (AFM.MP.1 through 8) and Mathematical Modeling standards (AFM.MM.1.1 through 1.4) are interwoven throughout the course

Standards

AFM.LR.2 Apply methods of proof to prove or disprove mathematical statements; explain reasoning and justify thinking through mathematical induction when formulating mathematical arguments.

AFM.LR.3 Interpret, represent, and communicate logical arguments to explain reasoning and justify thinking when solving problems and to explain real-life phenomena.

AFM.NR.4 Apply number theory and number-theoretic operations to solve contextual, mathematical problems and to explain real-life phenomena.

Standards

AFM.AQR.5 Use set theory to describe relationships and equivalence when solving contextual, mathematical problems used to explain real-life phenomena.

AFM.AQR.6 Calculate and solve combinatorics problems to make sense of a real-life, contextual problem.

AFM.AQR.7 Apply graph theory to solve contextual, mathematical problems and to explain real-life phenomena.

Outline

The Course

Replaces the old “Discrete Mathematics” course under QCC – that course was last offered in 2010-11

- First written in 2015-16 under GPS; Approved 2016
- First taught 2016-17
- Re-rewritten 2019-20; Approved 2021
- I have been teaching a discrete/finite course for 13 years.

The Course

- *Discrete* is the opposite of continuous
- *Finite* is the opposite of infinite

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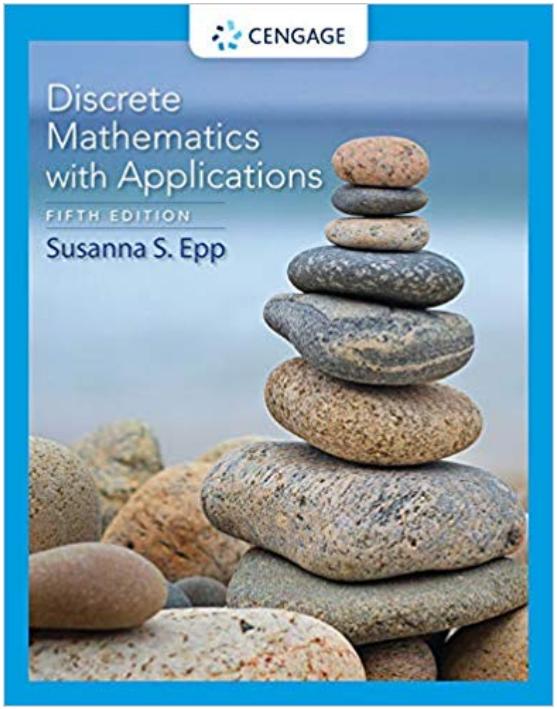
There is quite an overlap between *discrete* and *finite*!

The Course

Based on *Discrete Mathematics with Applications* by Susanna Epp



The Course

Big topics:

1. Logic
2. Sets
3. Proofs
4. Number theory
5. Combinatorics
6. Graph Theory

The Course

Time for other topics:

1. Election theory
2. Relations
3. Functions
4. Recursion
5. Financial mathematics

The Course

Why offer the course?

- Good for students who want something other than more algebra
- Gives students a peek into mathematics that is new and different from algebra/trig/precal
- Good for students who want to do computer science
- Gives students a sense that math is more than just calculating and computing

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Bottom line: Gives students exposure to mathematics that they don't traditionally think of as math

The Course

Who can take the course?

- Prerequisite is Advanced Algebra
  - I teach it to post-AP Calculus students
- Two-semester curriculum
- Can be offered as an elective

The Course

Good textbooks:

- Rosen, *Discrete Mathematics and Its Applications*, McGraw-Hill
- Scheinerman, *Mathematics: A Discrete Introduction*, Cengage
- Epp, *Discrete Mathematics with Applications*, Cengage

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Books with "finite" in the title are usually not sufficient to cover the curriculum (no proofs and no number theory, generally).

Outline

Proofs

AFM.LR.2: Apply methods of proof to prove or disprove mathematical statements; explain reasoning and justify thinking through mathematical induction when formulating mathematical arguments.

- Direct
- Contradiction
- Contrapositive
- Induction

Logic

AFM.LR.3: Interpret, represent, and communicate logical arguments to explain reasoning and justify thinking when solving problems and to explain real-life phenomena.

- Truth tables
- Conditional statements
- Quantifiers
- Arguments
- Binary

Number Theory

AFM.NR.4: Apply number theory and number-theoretic operations to solve contextual, mathematical problems and to explain real-life phenomena.

- Modular arithmetic
- Floor and ceiling
- Proofs
- Euclidean algorithm
- Fermat's Little Theorem

Set Theory

AFM.AQR.5: Use set theory to describe relationships and equivalence when solving contextual, mathematical problems used to explain real-life phenomena.

- Set operations
- Equivalence classes
- DeMorgan's laws
- Boolean algebra
- Relations
- Proofs

Combinatorics

AFM.AQR.6: Calculate and solve combinatorics problems to make sense of a real-life, contextual problem.

- Inclusion-exclusion
- Combinations
- Permutations
- Expected Value
- Bayes' Theorem
- Proofs
- Binomial Theorem
- Pigeonhole principle

Graph Theory

AFM.AQR.7: Apply graph theory to solve contextual, mathematical problems and to explain real-life phenomena.

- Definitions
- Line graphs and complements
- Adjacency matrices
- Proofs
- Minimal spanning trees

Outline

My Course

GaDOE describes this sequence.

- Unit 1 Set Theory
- Unit 2 Logic
- Unit 3 Proofs
- Unit 4 Number theory
- Unit 5 Graph theory
- Unit 6 Combinatorics
- Unit 7 Capstone

My Course

I describe this sequence.

- Logic and intro sets
- Proofs through number theory
- Number theory and proofs
- Set theory
- Combinatorics
- Graph theory
- Capstone

My Course

Syllabus

Writing Problems 15 weekly problems with a handout on How to Write a Solution

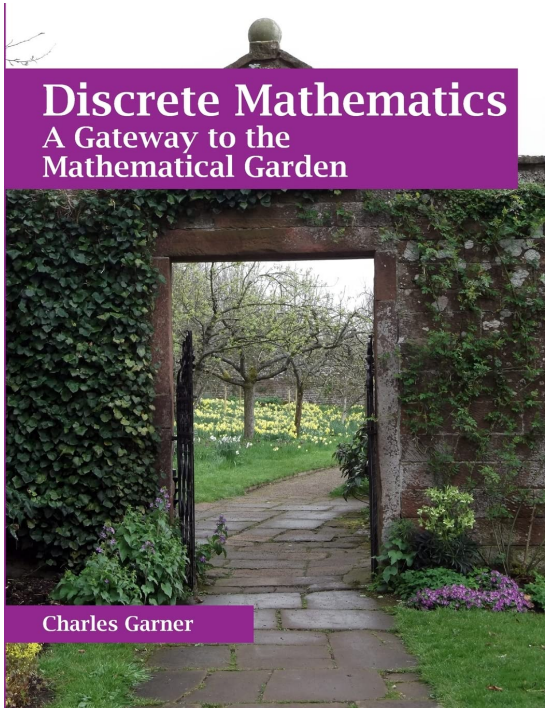
Tests Correspond to book chapters

My Course

But…

My Course

But. . . now I teach this course in one semester because it is also Dual Enrollment!



Discrete Mathematics:
A Gateway to the Mathematical Garden

Questions?

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Please fill out the session survey!

This was session #56.