“Equations are just the boring part of mathematics.” — Stephen Hawking

Course description

Our course will explore what insights can be gained by looking at the world through the lens of mathematics. We will use examples from nature, art, and architecture, as well as other sources, to explore four broad themes:

1. Symmetry: how mathematics can help us discover a rich structure behind the natural or human-made symmetries that we find in the world around us. We will encounter the mathematical concept of group theory.
2. Modeling and Optimality: how mathematical models help us find the best solutions to problems. Mathematical topics that we will encounter include modeling, the calculus of variations, and graph theory.
3. Certainty versus Uncertainty: how mathematics helps us make better decisions when examining evidence, and update our opinions when we acquire new facts. We will encounter concepts from probability and statistics.
4. Pattern and Abstraction: what mathematics can teach us about repeating patterns in nature and art. Mathematical concepts that we will encounter include self-similarity, dimensional analysis, fractals, and tiling theory.

The course will avoid equations and computations as much as possible. Instead, we will focus on exploring “big ideas” of mathematics: principles and themes that can enrich and illuminate how we view natural and human-made parts of our world.

Basic information

Class location: SZB 370
Class times: 9:30–11:00 Tuesdays and Thursdays
Instructor: Professor Dan Knopf
   Email: danknopf@math.utexas.edu
   Office: RLM 9.152
   Phone: 512.471.8131
   Office hours: 1:30–3:30 Thursdays, and by appointment
   Homepage: www.ma.utexas.edu/users/danknopf
Teaching Assistant: Julia Bennett
   Email: jbennett@math.utexas.edu
Resources: Lectures, assignments, and class announcements will be posted on CANVAS.
Syllabus: This syllabus may be updated during the semester. A current version will always be available on CANVAS as well as through a link from my homepage. (See above.)

Grading policy

Regular attendance and active participation are vital to success in this course!
Your final grade will be based on the following components:

- Four in-class exams, each worth 20% of your total grade. (See schedule below.)
- Eight homework assignments, collectively worth 15% of your grade. (See schedule below.) Note that a late homework assignment loses 20% of its original score for every day that it is delayed.
- Class participation, worth 5% of your grade. In addition to participating in class discussions and activities, you will complete daily “minute papers” — brief paragraphs written to ask questions about class or respond to questions raised during class. You will receive points for completing these but will not be judged on their content.

**There will be no final exam.**

Your overall grade will be computed using a scale at least as generous as this:

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This course may be used to fulfill the Mathematics component (Core Component 020) of the UT core curriculum. The course addresses the following core objectives established by the Texas Higher Education Coordinating Board: communication skills, critical thinking skills, and empirical and quantitative skills.

This course also carries a Quantitative Reasoning (QR) flag. Quantitative Reasoning courses are designed to equip you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your adult and professional life. You should therefore expect a substantial portion of your grade to come from your use of quantitative skills to analyze real-world problems.

**Course materials**

Our main source will be a custom course packet, available from the University Co-op. The packet contains readings excerpted from the following texts:

- *How to Think Straight about Psychology*, Keith E. Stanovich (pages 73–98).

These readings complement classroom discussions and will help you do better on homework and exams.

**Course schedule**

The following is only a broad outline of the course schedule. Exact topics and contents of assigned readings will be announced as the course progresses. The schedule below may be altered for pedagogical reasons. It is your responsibility to be aware of any changes announced in class.

**Thursday, August 27:** Symmetry.

**Tuesday, September 1:** Symmetry.

**Thursday, September 3:** Symmetry.

**Tuesday, September 8:** Symmetry. **Assignment 1 due.**

**Thursday, September 10:** Symmetry.

**Friday, September 11:** *Last day to drop for a possible refund.*

**Tuesday, September 15:** Symmetry. **Assignment 2 due.**

**Thursday, September 17:** Modeling and Optimality.

**Tuesday, September 22:** Modeling and Optimality.

**Thursday, September 24:** *Exam I.*
Tuesday, September 29: Modeling and Optimality.
Thursday, October 1: Modeling and Optimality.

Tuesday, October 6: Modeling and Optimality.
Thursday, October 8: Modeling and Optimality.

Tuesday, October 13: Certainty versus Uncertainty.
Thursday, October 15: Certainty versus Uncertainty.

Tuesday, October 20: Certainty versus Uncertainty.
Thursday, October 22: Exam II

Tuesday, October 27: Certainty versus Uncertainty.
Thursday, October 29: Certainty versus Uncertainty.

Tuesday, November 3: Certainty versus Uncertainty. Last day for pass/fail. Assignment 6 due.
Thursday, November 5: Pattern and Abstraction.
Tuesday, November 10: Pattern and Abstraction.
Thursday, November 12: Exam III

Tuesday, November 17: Pattern and Abstraction.
Thursday, November 19: Pattern and Abstraction.

Tuesday, November 24: Pattern and Abstraction.
Thursday, November 26: Thanksgiving Holiday — no class

Tuesday, December 1: Pattern and Abstraction.
Thursday, December 3: Exam IV

Policies

Academic integrity: Any academic dishonesty will be severely penalized. Your assignments should be your own work, and must not be plagiarized. No books, notes, computers, mobile phones, or Google Glass are allowed during exams.

Accommodations: Students with disabilities should request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities. Visit www.utexas.edu/diversity/ddce/ssd/ or call 512.471.6259. Please inform me of any approved accommodations as early in the semester as possible, and no later than one week prior to the first exam.

Religious holidays: By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, an assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Safety recommendations: Please note the following guidelines.
- Occupants of buildings on the University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and reassembling outside.
- If you require assistance in evacuation, please inform me of this fact in writing during the first week of class.
- Familiarize yourself with all exit doors of each classroom and building you may occupy. Note that the nearest exit door may not be the one you used when entering the building.
- In the event of an evacuation, follow the instruction of faculty or instructors.
- Do not re-enter a building unless given instructions by one of the following: the Austin Fire Department, the University of Texas at Austin Police Department, or a Fire Prevention Services officer.
- If you have concerns about your own stress levels or those of a classmate, please consider contacting the Behavior Concerns Advice Line at 512.232.5050.
- For further information, see www.utexas.edu/emergency or contact the Office of Campus Safety and Security at www.utexas.edu/safety/ or 512.471.5767.