Math 190 – First Year Seminar, Fall 2024 – Course Syllabus

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Lectures:
Tuesday, Thursday, 11:30 AM - 12:45 AM, Math & Science Center (MSC)- W201

Some Important Dates and Times:

Nov. 7: Midterm Exam
Dec. 17 Final Exam (Tuesday, 11:30 AM-2:00 PM)

Office Hours:
Instructor: Monday, Wednesday, 3:00 PM-4:00 PM MSC E428
TA: Tuesday: 12:30-1:30 PM, Thursday: 3-4 PM MSC N436
Students are always welcome to email the instructor directly to ask questions or to request an appointment.

Prerequisites: Math 111, AP credit for Calculus AB or BC, or transfer credit from Calculus I. Contact the course instructor if you have any questions.

Learning objectives: In this course, students will learn the complex dynamics of the environment in terms of ecological networks, economic games, linear programming optimization, and data visualization. This course is designed for first year students to get a taste of upper level mathematics that are not traditionally taught as math courses at Emory. The disparate topics will be connected by their focus on the environment as well as interdisciplinary studies.Hopefully, the connections become clear, and the definition of sustainability transcends just green spaces and recycling.

Table of Contents:

Textbook

- **Textbooks:**
  - ***Game Theory: An Introduction*, by Steven Tadelis (GT)**
  - ***Elementary Linear Programming with Applications* by Bernard Kolman, Robert E. Beck (LP)**
  - ***Essentials of Stocahstic Processes*, by Rick Durrett (SP)**
- **Content: We will cover GT first, particularly, selected ideas from Chapter 1 to 7, then LP, specifically Chapter 1, and lastly, SP, with Chapter 1, Sections 1 - 5. A tentative schedule of what we will cover is provided on the final page of this syllabus.**
- **Online Resources: While it might look like there are many books, we really only select one core idea from each book (LP and SP) or a cursory look at many different topics (GT). Additionally, I was a student once as well, so all of these books are freely available as a PDF online. Additionally, the important chapters will be available on Canvas and the course website.**

Course Structure

- **Lectures: There will be two lectures each week on Tuesdays and Thursdays from 11:30 AM-12:45 PM. You are expected to attend lectures. All the lecture notes will be posted before the start of each week. Lecture notes are self-contained and include enough examples. Both lectures and labs will follow these notes.**

  The lectures are divided into the following modules

  1. **Module 1: Game Theoretic Properties of Sustainability – In terms of making positive change, one must first understand how individual people make decisions, as well as how two interacting parties make decisions based on maximizing their individual objective. We explore single person decision problems, static and dynamic two person games, Nash equilibria, strategy types, and what games of complete and incomplete information look like in the real world.**
  2. **Module 2: Optimization for Sustainable Business – Businesses strive to maximize profit and minimize cost, but there are certain constraints such as supply shortages, that have to be considered. We explore how companies use a simple model to ensure they are making the most profit given these constraints. We discuss the system of linear programming, software to solve it, and the mathematics of optimization.**
  3. **Module 3: Markov Chains for Ecological Networks – Sustainability is full of complicated networks of give and take, where there can be long run effects from decisions that are made. We explore these ecological networks from the perspective of Markov chains. We first discuss probabilities and graph/ matrix representations of these complex networks. Then we explore what happens when our model advances many steps, as well as long run behavior of our systems. We also classify parts of our network qualitatively to understand which outcomes are never possible.**

- **Discussion Forum: It's likely that you will have questions as you review your notes and complete homework assignments. Those that occur to you will likely also occur to other students. You can ask questions on Canvas Discussion Module.**

Assessments

- **Grade Distribution: Grades will be distributed as follows:**

Homework	20%	**7 assignments, 2 lowest grades dropped**
Midterm	15%	**1 exam**
Projects	60%	**3 projects, equally weighted**
Participation	5%	**discussions, asking questions, OH, etc.**

Your final grade will be based on a weighted average of all assessed components. There might be an upward adjustment to ensure that the class average aligns at least with a B grade. For every assignment and exam, we will provide the class median, mean, and standard deviation, offering you a clearer understanding of your position. The number of points you earn will be mapped to a letter grade as follows:

A: [93, 100]	**A-: [90, 93)**	**B+: [87, 90)**	**B: [83, 87)**	**B-: [80. 83)**	**C+: [77, 80)**
C: [73, 77)	**C-: [70, 73)**	**D+: [67, 70)**	**D: [63, 67)**	**D-: [60, 63)**	**F: [0, 60)**

- **Homework:**
  - **You will have two homeworks per module and one homework at the beginning to set expectations of the material. There will be 7 total homework assignments. The assignments will be posted on and submitted through Canvas. The homework will be due on Tuesday at 11:30 am, which is the beginning of class, (except for holidays) and will be posted no later than three classes beforehand (Thursday the week prior). The number of questions may vary week to week, but the assignments will not be very long. You will upload your written homework to Canvas in PDF format to grade.**
  - **The lowest two homework grades will be dropped. No makeup assignments will be given. If you have to miss an assignment, it will be one that is dropped.**
  - **Homework assignments will be graded on an individual basis. The instructor allows discussions with other students while solving the problems. The only requirement is that you acknowledge all contributors and sources used. Yes, this does include large language models such as ChatGPT. Identical solutions that are seen as Honors Code violations, will not be graded and will be reported to the Honor Council. The border between acceptable and unacceptable collaboration may be subtle. If you are uncertain whether a particular behavior is acceptable or not, please ask the instructor or teaching assistant as soon as possible.**

- **Exams:**
  - **There will be one midterm exam given in class, on Nov. 7. You will be given the full class period (75 minutes) to take the midterm.**
  - **The final exam will be a final presentation to your Module 3 project. It will take place during final week on Monday, Dec. 17, from 11:30 AM to 2:00 PM.**
  - **Conflicts with the final exam time slot must be reported through the Office for Undergraduate Education (OUE). You must notify the instructor at least two weeks before the exam date if you have a conflict, or have a valid excuse verified by the Office of Undergraduate Education (OUE).**

- **Projects:**
  - **There will be 3 module projects, which will be a combination of individual and small group projects. There will be a written and oral portion of each project. No project is dropped, and each are weighted equally, i.e. each project is 20% of your final course grade.**
  - **These projects allow us the flexibility to apply the mathematical topics from class in the broader context of environmentalism, sustainability,**
  - **There will be some class time dedicated to each project, but most work will have to be done outside of class time.**
- **Participation:**
  - **During the semester, there will be several ways to participate in the course.**
  - **Attending lectures and office hours, answering discussion questions posed on Canvas, taking practice quizzes, asking me questions, and more are ways of measuring your participation.**
  - **Just be an active participant in the course!**

Emory University Academic Rules

- **Academic Integrity:**

  By participating in this course, you are accepting the Emory Honor Code. Instructors are obligated to report violations to the rules of the honor code.
- **Student Accessibility:**

  Emory is committed advancing an accessible and barrier-free environment for students by ensuring that the principles of access, equity, inclusion, and learning are realized in and by the Emory community. If you have a documented disability and have anticipated barriers related to the format or requirements of this course, or presume having a disability (e.g. mental health, attention, learning, vision, hearing, physical or systemic), and are in need of accommodations for this semester, please assist me in accommodating you by registering with the Department of Accessibility Services.

  Students who have accommodations in place are encouraged to coordinate sometime with your professor, during the first week of the semester, to communicate your specific needs for the course as it relates to your approved accommodations. All discussions with DAS and faculty concerning the nature of your disability remain confidential.
- **Diversity and Inclusion:**

  Emory University strives to provide a welcoming, diverse, and inclusive campus as an essential part of a community of academic excellence. Dimensions of diversity include sex, race, age, national origin, ethnicity, gender identity and expression, intellectual and physical ability, sexual orientation, income, faith and non-faith perspectives, socio-economic class, political ideology, education, primary language, family status, military experience, cognitive style, and communication style. Please make a personal effort to respect and include all members of our community. See https://www.emory.edu/home/life/diversity.html for more information and resources.
- **Technology Services: For assistance, please visit https://it.emory.edu/catalog/index.html**

- **Office of Undergraduate Education (OUE): The OUE provides a wide range of academic support for students, including academic advising, peer tutoring, and absentee policies (e.g., if you miss an exam).**
- **Academic and Religious Holiday Calendar: Please review the Academic Calendar for important dates about schedule changes and final exams. Please also review the Religious Holidays Calendar and communicate schedule conflicts with this course as soon as possible.**
- **EPASS: The course moves quickly and online learning can add additional challenges. Emory has an excellent peer-tutoring program that can be extremely helpful. Visit Learning and Peer Assistant Tutoring.**

Required Technology

- **Canvas: All course contents will be hosted on Canvas. This includes lecture notes, homework assignments, solutions, discussions, and more. All announcements will be done through Canvas. In addition, uploading work and grading will be done through Canvas. For information, visit https://canvas-support.emory.edu/**
- **Zoom: While lectures and office hours predominately will be held synchronously in person, there are unexpected time conflicts that might arise, so access to Zoom will be beneficial. Information about meeting rooms and passwords will be provided soon. For information, visit https://it.emory.edu/office365/ZOOM.html**
- **CamScanner: You will be required to upload written work in PDF form for the course. A good, intuitive, free app to do this is CamScanner. For information, visit https://www.camscanner.com/**
- **Google Colab: Occasionally visualizations from class will be made available to students. These will be written as Jupyter Notebooks (math equations, text, and runnable code in the same document). These will be posted to Canvas and the course website. To actually interact with them, you will need a Google account so you can run Google Colab. For information, visit https://colab.research.google.com/**

Tentative Course Schedule

	Dates	Sections	Content
Week 1	Aug. 29	Matrix Lecture Notes	Introductions; Syllabus; Matrix Review
Week 2	Sep. 3, Sep. 5	Matrix Lecture Notes, GT §1	Matrix Review; Single Person Decisions
Week 3	Sep. 10, Sep. 12	GT §2	Two Person Games **Homework 0: Matrix Math** (due Tuesday, Sep. 10)
Week 4	Sep. 17, Sep. 19	GT §3	Pure and Mixed Strategies; Nash Equilibria
Week 5	Sep. 24, Sep. 26	GT §4	Dynamic Games; Complete and Incomplete information **Homework 1: GT §1,2** (due Tuesday, Sep. 24)
Week 6	Oct. 1, Oct. 3	LP §1.1	Linear Programming Problem **Presentation 1: GT (Oct. 1)**
Week 7	Oct. 8, Oct. 10	LP §1.2, 1.3	Matrix form of Linear Programming; Solving LP via software; Introduce Project **Homework 2: GT §3,4** (due Tuesday, Oct. 8)
Week 8	Oct. 17	LP §1.3	Geometry of Linear Programming Problems
Week 9	Oct. 22, Oct. 24	LP §1.4	Extreme Point Theorem **Homework 3: LP §1.1, 1.2** (due Tuesday, Oct. 22)
Week 10	Oct. 29, Oct. 31		In class work time **Presentation 2: LP (Oct. 31)**
Week 11	Nov. 5, Nov. 7	Midterm Review	**Homework 4: LP §1.3,1.4** (due Tuesday, Nov. 5) **Midterm Exam: GT and LP (Nov. 7)**
Week 12	Nov. 12, Nov. 14	SP §1.1, 1.2	Definitions and Examples of Markov Chains; Multistep Transitions
Week 13	Nov. 19, Nov. 21	SP §1.3, 1.4	State Classification; Stationary Distributions
Week 14	Nov. 26	SP §1.5	Limit Behavior **Homework 5: SP §1.1 ,1.2,1.3** (due Tuesday, Nov. 26)
Week 15	Dec. 3 - Dec. 5	SP §1.6	Special Examples; Catch-up Lecture
Week 16	Dec. 10	Catch-up Lecture	**Homework 6: SP §1.4,1.5,1.6** (due Tuesday, Dec. 10)
Final Presentation: SP Tuesday, Dec. 17, (originally scheduled 11:30 AM - 2:00 PM)			