



ECON 701. ANALYTICAL METHODS FOR MATHEMATICAL ECONOMICS

[Course number: 9353] [Section: 001] [Term: Fall 2023]
The University of North Carolina at Chapel Hill

COURSE INFORMATION

Credit Hours: 3 Credits

Meeting Pattern: TTH: 11:00 AM-12:15 PM

Classroom or Location: Gardner - Rm 0209

INSTRUCTOR INFORMATION

Name: Prof. Jaden Chen

Email Address: yangch@unc.edu

Office Location: 301 Gardner Hall

Office Hours: Tuesday 3:30 PM-4:30 PM or by appointment

Teaching Assistant: Jiayi Li (lijiaxi@email.unc.edu)

COURSE CONTENT

Course Description

The goal of this course is to introduce students to mathematical tools which will be useful in economic research. In this course, students will study linear and non-linear optimizations, dynamic programming, and stochastic processes. The course will discuss the economic applications of these tools.

Some References

This course does not follow a specific textbook. The following are some useful references.

Sundaram, Rangarajan K. A first course in optimization theory. Cambridge University Press, 1996.

Simon, Carl P., and Lawrence Blume. Mathematics for economists. Vol. 7. New York: Norton, 1994.

Gale, David. The theory of linear economic models. University of Chicago press, 1989.

Vohra, Rakesh V. Advanced mathematical economics. Routledge, 2004.

Williams, David. Probability with martingales. Cambridge University Press, 1991.

Durrett, Rick. Probability: theory and examples. Vol. 49. Cambridge University Press, 2019.

Course Goals & Student Learning Outcomes (SLOs)

By the conclusion of this course, students will have acquired a fundamental understanding of mathematical concepts commonly used in economic theory.



COURSE ASSIGNMENTS & ASSESSMENTS

Students are expected to finish the following assignments.

- **Problem set.** Problem sets will be posted on Canvas if you get stuck, you can discuss with the instructor or the TA during our office hours. Late submission will not be accepted. Please be aware that it is your responsibility to point out any grading or clerical errors within one week of receiving the assignment back.
- **Exams.** There will be 2 in-class midterms and a final (date TBA). If a student misses a midterm, the weight of that midterm in the course grade will be added to the weight on the student's final. An exception will be made for university approved absences (<https://uaao.unc.edu/university-approved-absences-request/>); students with this type of absence may request a make-up examination at a time convenient to both student and instructor.

The final numeric grades are determined by the following formula:

- Problem Sets: 20%
- First Midterm (Sep 21): 20%
- Second Midterm (Nov 7): 20%
- Final (TBA): 40%

COURSE OUTLINE

This course will cover the following topics.

- **Convex analysis**
convex set, separating hyperplane theorem, Farkas' lemma
- **Linear optimization**
canonical and standard forms, primal and dual problems, Fundamental theorem of linear programming, duality theorem, linear economic models
- **Non-linear optimization**
unconstrained optimization, constrained optimization, necessary/sufficient conditions for optimality, duality theorem
- **Dynamic optimization**
correspondences, fixed point theorems, Bellman equation, principle of optimality, the existence and uniqueness of solution.
- **Stochastic process**
Martingale, stopping time, optional stopping theorem, martingale convergence theorem, Markov chain, stationary distribution.

POLICY STATEMENTS

Academic Policies

University Class Attendance Policy

University Policy: As stated in the University's [Class Attendance Policy](#), no right or privilege exists that permits a student to be absent from any class meetings, except for these University Approved Absences:

1. Authorized University activities: [University Approved Absence Office \(UAAO\) website](#) provides information and [FAQs for students](#) and [FAQs for faculty](#) related to University Approved Absences



2. Disability/religious observance/pregnancy, as required by law and approved by [Accessibility Resources and Service](#) and/or the [Equal Opportunity and Compliance Office](#) (EOC)
3. Significant health condition and/or personal/family emergency as approved by the [Office of the Dean of Students](#), [Gender Violence Service Coordinators](#), and/or the [Equal Opportunity and Compliance Office](#) (EOC).

Instructors may work with students to meet attendance needs that do not fall within University approved absences. For situations when an absence is not University approved (e.g., a job interview, illness/ flu or club activity), instructors are encouraged to work directly with students to determine the best approach to missed classes and make-up assessment and assignments.

Honor Code Statement

All students are expected to follow the guidelines of the UNC Honor Code. In particular, students are expected to refrain from “lying, cheating, or stealing” in the academic context. If you are unsure about which actions violate the Honor Code, please see me, or consult studentconduct.unc.edu.

Syllabus Changes

The instructor reserves the right to make changes to the syllabus including project due dates and test dates. These changes will be announced as early as possible.

Acceptable Use Policy

By attending the University of North Carolina at Chapel Hill, you agree to abide by the University of North Carolina at Chapel Hill policies related to the acceptable use of IT systems and services. The Acceptable Use Policy (AUP) sets the expectation that you will use the University’s technology resources responsibly, consistent with the University’s mission. In the context of a class, it’s quite likely you will participate in online activities that could include personal information about you or your peers, and the AUP addresses your obligations to protect the privacy of class participants. In addition, the AUP addresses matters of others’ intellectual property, including copyright. These are only a couple of typical examples, so you should consult the full [Information Technology Acceptable Use Policy](#), which covers topics related to using digital resources, such as privacy, confidentiality, and intellectual property. Additionally, consult the [Safe Computing at UNC](#) website for information about data security policies, updates, and tips on keeping your identity, information, and devices safe.

Data Security & Privacy

[UNC-Chapel Hill Privacy Statement](#): Sakai’s Discussion Forum, Assignments, DropBox, Gradebook, and Tests & Quizzes tools are designed to share FERPA-protected information privately between instructors and individual students.

Grade Appeal Process

If you have any concerns with grading and/or feel you have been awarded an incorrect grade, please discuss it with me as soon as possible. If we cannot resolve the issue, you may talk to our director of undergraduate studies or department chair.

Services & Student Support Policies

Accessibility Resources & Services (ARS)

[Accessibility Resources and Service](#) (ARS – ars@unc.edu) receives requests for accommodations, and through the Student and Applicant Accommodations Policy determines eligibility and identifies reasonable accommodations for students with disabilities and/or chronic medical conditions to mitigate or remove the barriers experienced in accessing University courses, programs and activities. ARS also offers its Testing Center resources to students and instructors to facilitate the implementation of testing accommodations. Faculty and instructors with any concerns or questions about accommodations and/or their implementation, are invited to [reach out to ARS](#) to discuss.

Counseling & Psychological Services (CAPS)

UNC-Chapel Hill is strongly committed to addressing the mental health needs of a diverse student body. The [Heels Care Network](#) website is a place to access the many mental health resources at Carolina. CAPS is the primary mental health provider for students, offering timely access to consultation and connection to clinically appropriate services. Go to their



website <https://caps.unc.edu/> or visit their facilities on the third floor of the Campus Health building for an initial evaluation to learn more. Students can also call CAPS 24/7 at 919-966-3658 for immediate assistance.

Title IX Resources

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Reports can be made online to the EOC at <https://eoc.unc.edu/report-an-incident/> or by contacting the University's Title IX Coordinator (Elizabeth Hall, titleixcoordinator@unc.edu) or the Report and Response Coordinators in the Equal Opportunity and Compliance Office (reportandresponse@unc.edu). Confidential resources include Counseling and Psychological Services and the Gender Violence Services Coordinators (gvsc@unc.edu). Additional resources are available at safe.unc.edu.

Policy on Non-Discrimination

The University is committed to providing an inclusive and welcoming environment for all members of our community and to ensuring that educational and employment decisions are based on individuals' abilities and qualifications. Consistent with this principle and applicable laws, the University's [Policy Statement on Non-Discrimination](#) offers access to its educational programs and activities as well as employment terms and conditions without respect to race, color, gender, national origin, age, religion, genetic information, disability, veteran's status, sexual orientation, gender identity or gender expression. Such a policy ensures that only relevant factors are considered, and that equitable and consistent standards of conduct and performance are applied. If you are experiencing harassment or discrimination, you can seek assistance and file a report through the Report and Response Coordinators (email reportandresponse@unc.edu or see additional contact info at safe.unc.edu) or the Equal Opportunity and Compliance Office at <https://eoc.unc.edu/report-an-incident/>.

Diversity Statement

I value the perspectives of individuals from all backgrounds reflecting the diversity of our students. I broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. I strive to make this classroom an inclusive space for all students. Please let me know if there is anything I can do to improve. I appreciate any suggestions.

Undergraduate Testing Center

The College of Arts and Sciences provides a secure, proctored environment in which exams can be taken. The center works with instructors to proctor exams for their undergraduate students who are not registered with ARS and who do not need testing accommodations as provided by ARS. In other words, the Center provides a proctored testing environment for students who are unable to take an exam at the normally scheduled time (with pre-arrangement by your instructor). For more information, visit <http://testingcenter.web.unc.edu/>.

Learning Center

Want to get the most out of this course or others this semester? Visit UNC's Learning Center at <http://learningcenter.unc.edu> to make an appointment or register for an event. Their free, popular programs will help you optimize your academic performance. Try academic coaching, peer tutoring, STEM support, ADHD/LD services, workshops and study camps, or review tips and tools available on the website.

Writing Center

For free feedback on any course writing projects, check out UNC's Writing Center. Writing Center coaches can assist with any writing project, including multimedia projects and application essays, at any stage of the writing process. You don't even need a draft to come visit. To schedule a 45-minute appointment, review quick tips, or request written feedback online, visit <http://writingcenter.unc.edu>.