TEXAS A&M UNIVERSITY SAN ANTONIO

Department of Criminology and Political Sciences
Department of Computational, Engineering, and Mathematical Sciences

HONR1300: First-Year Honors Seminar, Section 001
Mathematics and Politics:
Strengthening Your Critical Decision-Making Strategies for Effective Leadership
Fall 2025

Instructors: Dr. Emily Naasz and Dr. Qi Han
Credit Hours: 3
Class Meetings: MW 12:30-1:45pm
Classroom: MADLA 204
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https://apps.tamusa.edu/course-information/my-profile/faculty-Profile.php?ID=358

Office Hours: Fridays, 1-4pm or by appointment (Dr. Naasz)
MW 8:00-8:45am&3:20-4:00pm, F 8:00-8:45am&11:00-11:30am, and/or via email
Or by appointment via email, read regularly between 8:00am~8:00pm (Dr. Han)

Course Description and Materials

Mission Statement of Honors Program: The mission of the University Honors Program is to provide an enhanced and supportive learning environment for a community of exemplary scholars. Honors students will have the opportunity to engage in interdisciplinary inquiry, increased opportunities for undergraduate research and creative activity, and service learning and leadership opportunities.

Course Description: Mathematics is broadly celebrated as the language of the Natural Sciences, but it is equally vital in the Social Sciences. This seminar course introduces our honors students to the foundational concepts of a relatively new field: the Mathematics of Politics. This knowledge is essential for navigating today's complex world. In this course, we offer students a fundamental introduction to the applications of mathematics in political contexts that influence our daily lives. Topics covered in this course include, but are not limited to, the mathematics of social choice, yes/no voting, political power, conflict, fairness, and escalation—all of which are essential for understanding and applying these political models in real-life situations.

Experiential Learning: This course bridges the gap between mathematics and political science by applying mathematical models to real-world political scenarios. Through in-class discussions and simulations, our students will explore how mathematical models can inform general understanding of political processes and phenomena, fostering critical thinking and analytical skills essential for navigating complex political landscapes.

Learning Objectives: By the end of this class, you will be able to:

- Assess various social choice methods (voting systems) by understanding their strengths and weaknesses.
- Examine the subjective concept of fairness and develop objective definitions that clarify its meaning.
- Utilize commonly accepted fairness criteria to assess the fairness of social choice methods.

- Identify the potential for manipulation in social choice methods through insincere (strategic) voting.
- Understand the significant implications of Arrow's Theorem for all social choice methods.
- Grasp the purpose of weighted voting systems, which are designed to create inequality among voters, and compute the relative power of voters in such systems, which may not correspond directly to their weight.
- Apply historical methods of apportionment used to determine the composition of the United States House of Representatives and evaluate the strengths and weaknesses of these methods.
- Analyze and apply the model of a two-player, two-strategy game, identify Nash equilibria in these games, and use them to predict behavior in competitive and cooperative situations.
- Recognize the prevalence of two well-known partial-conflict, two-player games—"Prisoners' Dilemma" and "Chicken"—and explain how and why these games are valuable for understanding various social and political situations.
- Determine the mechanisms that drive escalation through the Dollar Auction and participate in such an auction.
- Compare different auction methods, especially the Vickrey Auction, highlighting their intriguing and beneficial properties.

Benefits of Taking This Course: By participating in this class, you will have the opportunity to:

- Gain experience engaging in meaningful and consequential discussions with peers, utilizing mathematics (and statistics) in the field of political science.
- Evaluate reliable information from newspaper articles, podcast episodes, and other widely consumed sources aimed at educated readers.
- Identify credible knowledge, key information, and reputable sources to inform the public and effectively build arguments and draw conclusions about social equity.
- Present and confidently defend a preliminary action plan to address key social equity issues, with a particular focus on South Texas.

Required Textbook: Mathematics and Politics: Strategy, Voting, Power, and Proof, 2nd Edition, by Alan D. Taylor and Allison M. Pacelli, Springer, 2008 (ISBN-13: 978-0-387-77643-9)
https://link.springer.com/book/10.1007/978-0-387-77645-3

Additional Materials and Resources (for both in-class and out-of-class use):
1). Mathematics of Politics, 2nd edition, by E. Arthur Robinson and Daniel H. Ullman, CRC Press, 2017.
https://www.routledge.com/The-Mathematics-of-Politics/Robinson-Ullman/p/book/9781032477091?srsltid=AfmBOoqz-hONC9zZEViLanxrI_3vrMnm0Pty7iDU33N3yl8l2Ia01M5Z
2). Math and Social Justice with topics including Community Health, Criminalization of People of Color, Economic Exploitation, Gender Discrimination, and Housing Discrimination etc.
https://www.radicalmath.org/math-social-justice
3). "Why Democracy Is Mathematically Impossible" by Veritasium (YouTube channel)
https://www.youtube.com/watch?v=qf7ws2DF-zk
4). "Political Geometry: The Mathematics of Redistricting," a lecture by Moon Duchin
https://www.youtube.com/watch?v=pi_i3ZMvtTo
5). "A Mathematical Adventure through the Census, Reappointment, and Redistricting," a lecture by Karen Saxe https://www.youtube.com/watch?v=UDVC2L4d_1w
NOTE. Additional readings, including short excerpts from books, journal articles, and newspaper articles, will be posted on the course Blackboard site.

List of Topics: Upon successfully completing this course, you will be able to demonstrate an understanding and practical knowledge of the followings:

1. Social Choice, covering topics such as social choice functions, preferences, May's Theorem for two alternatives, Majority Rule, voting methods, fairness criteria, proofs of positive and negative results, Arrow's Theorem, and approval voting (Chapter 1).
2. YES–NO Voting Systems, including weighted voting systems, swap robustness, trade robustness, and the Characterization Theorem (Chapter 2).
3. Political Power, covering the Shapley-Shubik Power Index and its application to the European Economic Community, the Banzhaf Power Index and its computations, the Power of the President, and the Chair's Paradox (Chapter 3).
4. Conflict, addressing two-player, two-strategy games, dominant strategies, Nash equilibria, the "Prisoner's Dilemma," the arms race, "Chicken," and the Cuban Missile Crisis (Chapter 4).
5. Fairness, encompassing the problem of apportionment, fairness criteria, Hamilton's method, the Alabama Paradox, Jefferson's method, Webster's method, geometric averaging, the Hill-Huntington method, and the Balinski-Young result (Chapter 5).
6. Escalation, covering the Dollar Auction, game-tree analyses, computing limitations, O'Neill's Theorem, the Vickrey Auction, as well as relevant theorems and proofs (Chapter 6).

NOTE. The instructors reserve the right to modify or update the topics as necessary.

Learning Approach: This class incorporates active learning and Socratic methods, and you are strongly encouraged to review the teaching materials in advance and be aware of class participation and discussion activities, both individually and in groups.

NOTE. In addition to the 3 hours spent in class each week, you should dedicate at least 4 to 6 hours for independent study. This includes reading the textbook, reviewing notes and other resources, completing homework assignments, exploring related topics online, and solving additional practice problems. You are responsible for all materials and topics covered in this class.

Course Requirements and Expectations

Calculators: A basic calculator will be needed in class. Calculator use is permitted on all Mid-Term Tests and the cumulative Final Exam. **Other electronic devices are prohibited on all tests and the final exam.** Do not expect to use your cell phone (or tablet computer) as a calculator.

Attendance: Random attendance checks will be used to encourage attendance. Students who occasionally need to miss a class should notify their instructors BEFORE THE START OF CLASS on the day that they will miss. If a student provides such prior notice, he/she will be exempt from penalty for random attendance checks. Note: This exemption does NOT apply to Mid-Term Tests and the Final Exam.

Homework Assignments: There are six homework assignments that must be submitted by their due dates. Problems will be assigned after each section of the textbook, summarized with an HW number posted on Blackboard under Assignments, along with the due dates. Homework will be collected before the end of class on the due date. Late submissions will only receive partial credit. If you cannot complete all the questions, please attempt as many as possible. Your work should be legible and neatly presented; illegible or poorly presented work will not receive credit. Please staple your assignment sheets together in the upper left corner and avoid using pages torn from spiral-bound notebooks. In the upper right corner of your assignments, include your name, class section number, and assignment number (HW1, HW2, …, HW6). Discipline yourself to write clear solutions, as they are essential for review. Be sure to show both your final answer and the work leading to it; credit will not be awarded for simply providing the correct answer. You

are encouraged to engage in group discussions to assist your understanding, but each student must write up their solutions independently to fully grasp the theories, methods, and concepts involved. Please be mindful of academic integrity.

Reflection Essays: Throughout the semester, you will complete three 1,000-word essays written in MS Word (or other free, open-source alternatives). These essays will reflect on recent in-class discussions and your readings related to the mathematics and methods, emphasizing their meaningful real-life applications in political contexts. Each essay will be a collaborative effort, completed in teams of 2 to 3 students.

Presentation: Each team will rotate to select a leader who will present the group's essays to the entire class for 10 minutes, followed by an additional 5 minutes for questions and answers. By the end of the semester, each student will have participated in at least one formal presentation.

Examinations: There are three mid-term tests in this course, and you are expected to take all three at the scheduled class times. Exceptions may be granted for legitimate reasons, but these must be approved in advance. If you need to miss a test, you must formally notify the instructor(s) within 24 hours of the scheduled date, providing a reason along with supporting documentation. Notifications should be sent via email, with any necessary attachments included. If you know in advance that you will be unable to take a test at the scheduled time, please contact at least one of your instructors beforehand to make the necessary arrangements. Failure to follow this procedure will result in a grade of zero for the missed test.

Test 1 covers Chapters 1~2 (selected topics).
Test 2 covers Chapters 3~4 (selected topics).
Test 3 covers Chapters 5~6 (selected topics).

Final Exam: There is one cumulative Final Exam during the finals' week, covering selected topics from Chapters 1 to 6.

Final exam schedule is available at the following link:
TBP
For this class, the final exam is scheduled between **10:00am~11:50pm, Wednesday, December 10, 2026**.

Evaluation of Student Performance: Your grade will be based solely on your individual performance, and you will not be competing against one another for grades.

NOTE. Solutions for homework and tests, along with rubrics for all written and oral assignments, will be used for grading. Rubrics will be shared with the class in advance, and both solutions and rubrics will be posted on Blackboard.

NOTE. Exams are always closed book. The schedule for the tests will be announced at least a week in advance during class, on Blackboard, and via email. Tests will be administered in class. Please note that cell phones, laptops, iPads, Kindles, and any other electronic devices are NOT allowed during the tests. If any such devices are found, the test will receive a grade of zero, and repeated violations will be reported to the university as an issue of academic dishonesty.

Grading Policy

HWs: 10%
Essays: 10% each (total 3)
Presentation: 6%
Attendance and Experiential Learning: 8%
Tests: 10% each (total 3)
Final Exam: 16%
Total: 100

A = 90~100% B = 80~89.9% C = 70~79.9% D = 60~69.9% F = 0~59.9%

NOTE. The final grade will be calculated as a weighted average. Please do NOT simply take the average of all grades posted on Blackboard. A helpful link is https://www.indeed.com/career-advice/career-development/how-to-calculate-weighted-average

NOTE. The instructors reserve the right to modify or update the information in this syllabus as needed.

AI Policy

Since writing, analytical, and critical thinking skills are important learning outcomes of this course, all writing assignments must be prepared by the student and the student alone. Developing strong competencies in this area will prepare you for a competitive workplace. Therefore, AI-generated and/or assisted submissions are not permitted in this course and will be treated as plagiarism. Any student suspected of using AI to complete an assignment will be called in for an oral defense of their assignment.

Meet Your Instructors

Qi Han, PhD
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Department of Computational, Engineering, and Mathematical Sciences
College of Arts & Sciences
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Research Interests:
Analysis/Control of Nonlinear PDEs
Complex Analysis
Nevanlinna Theory
Difference/Functional Equations
Game Theory and Mathematical Finance

Emily Naasz, PhD
Assistant Professor of Political Science
Department of Criminology and Political Science
College of Arts & Sciences
Texas A&M University-San Antonio
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Central Academic Building, Room 351H
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Research Interests:
International Security
Armed Conflict
Conflict Management/Resolution
Human Rights
Political Violence

Teaching Experiences:	Teaching Experiences:
Taught 15 years in the United States for essentially all undergraduate courses in mathematics. Undertaken various critical professional developments such as major ACUE courses on effective teaching and inclusive teaching for equitable learning, as well as other major ones on contemporary teaching strategies in Mathematics and Statistics.	10 years teaching experience across a range of undergraduate political science courses. Received a micro-credential in creating inclusive and supportive learning environments with additional training in incorporating quantitative reasoning principles into the classroom.

Course Schedule

Week 1	Welcome, mutual introduction, and syllabus discussion. 1.1: Social choice functions, preference. 1.2: May's Theorem, the Majority Rule.
Week 2	1.3: Voting methods: Plurality, Borda, Dictatorship, Condorcet, Sequential-Pairwise, Ranked-Choice. 1.4: Fairness criteria.
Week 3	1.5: Analysis of fairness–positive results. 1.6: Analysis of fairness–negative results. 1.7: Arrow's Theorem. 1.8: Approval voting.
Week 4	1.8: Approval voting (continued). 2.1 & 2.2: Yes-No systems. 2.3: Weighted voting systems. 2.4: Swap-robustness. HW1 due.
Week 5	2.4: Swap-robustness (continued). 2.5: Trade-robustness. 2.6: The Characterization Theorem. Test1 Review
Week 6	Essay1 and Presentation on the mathematics of voting in class. HW2 due.
Week 7	Test1 in class. 3.1: Political power. 3.2 & 3.3: Shapely-Shubik Power Index, applications of the SSPI to the EEC.
Week 8	3.4 & 3.5: Banzhaf Power Index and the computations. 3.6: The Power of the President. 3.7: The Chair's Paradox.
Week 9	4.1 & 4.2: Two-player, two-strategy games. 4.3: Dominant strategies, Nash equilibria. 4.4: "The Prisoner's Dilemma" and the arms race. HW3 due.
Week 10	4.5: "Chicken" and the Cuban Missile Crisis. Test2 Review
Week 11	Essay2 and Presentation on the mathematics of pay-off structures (equilibrium) and international cooperation in class. HW4 due.
Week 12	Test2 in class. 5.1: Apportionment, fairness criteria. 5.2: Hamilton's method, Alabama Paradox.
Week 13	5.3: Jefferson's method, Webster's method, geometric averaging, Hill-Huntington method. 5.4: Balinski-Young result. 6.1 & 6.2: The Dollar Auction. HW5 due.
Week 14	6.3: Game-tree analyses. 6.4: Computing limitations.

	6.5: O'Neill's Theorem.
Week 15	6.6: The Vickrey Auction. Test3 Review
Week 16	Essay3 and Presentation on the mathematics of reapportionment and fairness in class. Test3 in class. HW6 due.
Finals Week	Final Exam

* This schedule is based upon either MW or TR teachings, each day of a 75-minute class time.
* This schedule fully considers that there is no class on Thursday during the Thanksgiving Break week.
* The instructors reserve the right to update this schedule as needed and will notify you at least two weeks in advance, ensuring you have sufficient time to complete any assignments with changed due dates.