Introduction to Game Theory
Math 120
Fall 2025; TR 1:00-2:35

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Drop in hours: MWF: 9:00-10:00; MW: 1:00-2:00; TR: 3:00-4:00. I am also often available outside of these hours. Please feel free to drop by, or talk to me about an alternate meeting time.

Textbook: The text is in open online text: *Introduction to Game Theory: a Discovery Approach, 2nd ed*, Nordstrom. It is found at https://nordstrommath.com/IntroGameTheory2e/frontmatter.html

We will also be accessing the text through Runestone Academy, https://landing.runestone.academy/. You will need create a free online account and enroll in our course: linfield_introgametheory_fall25.

Tentative Schedule:

Week 1	1.1	Week 5	2.5	Week 9	3.5	Week 13	4.5
	No Class		2.6		3.6		4.6
Week 2	1.2	Week 6	Quiz 1	Week 10	3.7	Week 14	Break
	2.1		Break		Quiz 2		Break
Week 3	2.2	Week 7	3.1	Week 11	4.1	Week 15	4.7
	2.2		3.2		4.2		Quiz 3
Week 4	2.3	Week 8	3.3	Week 12	4.3	Dec. 11	Presentations
	2.4		3.4		4.4	1:00 pm	

Topics Covered:

- Introduction to game theory: notation, game matrices, payoff vectors, assumptions.
- Two-player zero-sum games: dominated strategies, probability, expected value, equilibrium points.
- Repeated two-player zero-sum games: mixed strategies, maximin and minimax strategies, solving systems of equations.
- Non-zero-sum games: prisoner's dilemma, chicken, multiplayer, prisoner's dilemma, volunteer's dilemma, repeated prisoner's dilemma.

Linfield Curriculum: This course contributes to the Linfield Curriculum in the area of *Quantitative Reasoning.* Courses in this category explore contextual problems involving quantitative relationships by means of numerical, symbolic, and visual representations. These courses foster critical analysis of the uses and constraints of quantitative information and its representations. Finally, they focus on discussing models; making appropriate assumptions; and deducing consequences or making predictions.

Courses with QR designation are designed to develop the student's ability to do the following:

- Frame contextual questions using mathematical representation.
- Apply models to deduce consequences or make predictions.
- Communicate quantitative arguments using clear prose.
- Critique quantitative arguments with respect to assumptions, constraints, and logical coherence.

This course emphasizes how mathematics can be used to model and analyze individual and group behavior in competitive and cooperative environments. We will use the economic concepts of utility and individual rationality to convert familiar competitive situations such as elections, cold war, and competition between firms into mathematical games. We will then use mathematical methods to try to predict outcomes and determine optimal strategies.

In order to earn QR credit for this course, you must complete the electronic submission of exemplar work and supporting descriptions by the last day of finals week, as discussed in the Linfield University Course Catalog, "The Six Modes of Inquiry."

Some Goals and Objectives:

- To introduce the student to the role mathematics plays in decision making.
- To introduce the student to structure that mathematics lends to our understanding of competitive situations.
- To expose the student to the connections between mathematics and social and behavioral sciences.
- To introduce the student to the connections between mathematics and the concepts of strategy, fairness, utility, and rationality.
- To improve the student's ability to deal with numbers, probability, expected value, and matrices.
- To improve the student's proficiency in both reading and writing about mathematical ideas.
- To increase the student's mathematical maturity.

The Importance of Community: Many aspects of this course are structured to build community. Although learning mathematics is often seen as an individual task, learning is more effective when you engage with others during the process. As a class we will determine the particular attributes we expect of each other in order to build our community. In addition, learning to work well in a community in which members bring different skills will better prepare you for life and work after college. Some ways you can help build a strong supportive community that improves learning are

- Come to class ready to participate.
- Help your group in a variety of ways: volunteer to write on the board, keep and organize notes for your group, ask questions, make suggestions, be positive and encouraging of others.
- Come to office hours for help rather than relying on AI or other tools when you are unsure of the concepts. Your professor is part of the community, too. Building connections with faculty will help you not just learn game theory, but also help connect you with other resources and opportunities.
- Form study groups to review for quizzes. If you use AI to help you study, it is still better to do this in a group so you catch errors.
- Don't be afraid to make mistakes. We all learn from each others' mistakes and misunderstandings. This course is explicitly structured to encourage mistakes and to explore misunderstandings. It is especially important to ask questions and be willing to make conjectures without knowing if you are correct. If no one knows what mistakes you are making, no one can help you learn.

Course Format: This class emphasizes understanding results from investigation and discovery. As opposed to passively taking notes while I lecture, you will spend the vast majority of class time actively engaged with the material. You will work through activities carefully designed to lead you to *discover fundamental mathematical ideas for yourself.* You will be encouraged to work collaboratively with a group on most of these activities. My role during class time will be to mill about the classroom, answering your questions and prodding you toward a better understanding of the material. I will also lead class discussions and present explanations where appropriate. Come to class ready to work, think, ask questions, and be involved in your own learning.

Class attendance is strongly encouraged. Due to the interactive nature of the classroom environment, most students find that attending class regularly is essential to learning the material. Naturally, you are responsible for material covered and announcements made during classes that you miss.

Community and Participation: You are expected to participate daily in class discussions and activities. You need to come to class each day with a positive attitude and willingness to think about challenging ideas. You will be working in groups of 3-4 students on in-class activities. Your participation and team-work with your group will count toward your community grade. If you are unable to be in class, it is your responsibility to check with your group about what activities you missed.

In addition, there will be short Daily Questions at the start of each class. Most of the time responses will be to promote class discussions and to encourage student involvement, thus there is no penalty for incorrect responses.

Given that over-reliance on AI tools to do mathematics for you is generally a replacement for doing mathematics with other people and can impact your ability to learn, evidence of such use will affect your community grade. See the AI statement for the specifics of appropriate uses for this course.

- **Grade based on:** Participation in class.
- **Can it be made up?** Generally no, though there may be some extra credit opportunities or some out of class options.

Homework: Most class periods will involve in-class activities. Your standing homework assignment is to turn in completed activities. Activities will generally be due the following class meeting. **Clarity of exposition is important** and one should strive for **well written, polished solutions**. For the most part, collaborations on the homework with other members of this class is allowed, although solutions must be individually written up and collaborators *should be acknowledged*. It will be made clear when collaboration is not permitted. Late homework will be accepted within one week of the due date. There is no penalty for late work submitted within the one week grace period. Work later than 1 week will not be accepted for credit.

- **Grade based on:** Written solutions to activities. Only select problems graded for accuracy.
- **Due:** Start of following class period.
- **Can it be tuned in late?** Yes, within 1 week.

Check Your Understanding Questions: At the end of each section are Check Your Understanding Questions which are completed through Runestone. The questions for the previous week's sections are due by 1 pm on the following class meeting. As with the Homework, there will be a 1 week grace period. However, the CYU questions are short and designed to make sure you are prepared for the next class. Thus, it is best if you do them as soon as possible following the class.

- **Grade based on:** Runestone assignments. Problems may be repeated until correct.
- **Due:** Start of following class period.
- **Can it be tuned in late?** Yes, within 1 week.

Quizzes: Quizzes will be roughly half computational, half short answer. If you are not present for a quiz, you may take an alternative quiz. Alternate quizzes must be taken within 1 week of the original quiz date and must be scheduled outside of class time.

- **Grade based on:** Score on in-class quizzes.
- **Can it be made up?** Yes, within 1 week by rescheduling outside of class.

Writing Assignments: Along with each quiz there will be a take-home essay. These will be due at the following class meeting. The writing assignments will be tied explicitly to the QR objectives and should be submitted as your QR exemplars. You should not use generative AI on these. They are short essays that should be used to help you learn the material and express it in your own words. Essays that are too generic and broad or express ideas more technically than we have in class will be flagged for AI use. If you are flagged for AI use, you will need to meet with me to discuss your essay and explain your thoughts in your own words. You are welcome to use tools such as Grammarly to ensure your essay is readable. You may also use AI tools to search for relevant topics that you would like to write about. However ANY use of such tools and how you used them must be documented at the end of your essay. Failure to document AI use may be seen as academic dishonesty and result in a 0 on the essay. Essay must be submitted within 48 hours of the due date and time.

- **Grade based on:** Short essay. Grading rubric will be provided.
- **Due:** Start of following class period. Submitted on Blackboard.
- **Can it be tuned in late?** Yes, within 48 hours.

Final Presentation: You will be required to do a group final presentation for the course. You and your group can choose a topic from game theory that has not previously been done in class. For example, you can apply the techniques you learned in class to analyze a game theoretic scenario; describe applications of game theory to other fields; or describe other mathematical techniques for solving games. The goal of the final project is to teach your classmates about your chosen topic. Final presentations may also be submitted for QR exemplars.

The final exam is scheduled for **December 11, 1:00 pm**. We will use this time for final presentations. If you are not present for a presentation, you will receive a 0 on your presentation. You may be excused for school sanctioned events, but you need to have your absence approved by me PRIOR to the presentation day.

- **Grade based on:** In class presentation. Grading rubric will be provided.
- **Due:** Final Exam time for our class: Dec. 11, 1-3 pm.
- **Can it be tuned in late?** No.

Important Dates:

- Quiz 1, Tuesday, September 30
- Quiz 2, Thursday, October 30
- Quiz 3, Thursday, December 4
- Final Presentations, Thursday, **December 11, 1:00 pm** (final exam time).

Grading:

Community and Participation	15%
Homework	20%
Check Your Understanding	10%
3 Quizzes	30%
Writing Assignments	15%
Final presentation	10%

Letter grades correspond to the following percentages:

A-, A:	90-100%
B-, B, B+:	80-89%
C-, C, C+:	65-79%
D:	55-64%

Advising information: There are no prerequisites for this course. This course is not intended to be a prerequisite for further mathematics courses, although it will be helpful for students wishing to improve their mathematical skills. It may be of particular interest to students studying social and behavioral sciences. It will not count toward a major or minor in mathematics. This course satisfies the Linfield Curriculum requirement for Quantitative Reasoning.

Technology Policy: Cell phones must be off and put away during class. Laptop computers and tablets are encouraged, as we will be engaging with materials that are available electronically. However, please use them in ways that are focused on the course and the activities of the class.

Academic Integrity Policy: Linfield University operates under the assumption that all students are honest and ethical in the way they conduct their personal and scholastic lives. Academic work is evaluated on the assumption that the work presented is the student's own, unless designated otherwise. Anything less is unacceptable and is considered a violation of academic integrity. Furthermore, a breach of academic integrity will have concrete consequences that may include failing

a particular course or even dismissal from the university. Violations of academic integrity include but are not limited to the following:

Cheating: Using or attempting to use unauthorized sources, materials, information, or study aids in any submitted academic work; changing answers after graded work has been returned; making unauthorized changes to an exam, quiz, or assignment.

Plagiarism: Submission of academic work that includes material copied or paraphrased from published or unpublished sources without proper documentation. This includes self-plagiarism, the submission of work created by the student for another class unless they receive consent from both instructors.

Fabrication: Deliberate falsification or invention of any information, data, or citation in academic work.

Facilitating Academic Dishonesty: Knowingly helping or attempting to help another to violate the university's policy on academic integrity.

Any form of academic dishonesty will result in a 0 on that assignment/ quiz/ exam. Additionally, academic dishonesty may result in a failing grade in the course. See the Linfield Academic Integrity Policy (https://catalog.linfield.edu/academic-policies-procedures/undergraduate/academic-integrity/) in the Linfield Catalog for information on the procedure to be used in dealing with academic dishonesty.

Use of AI in Student-Generated Work: Students in this course are expected to avoid the use AI tools, such as Chat GPT and PhotoMath, to generate presentation, quiz, or homework solutions. Any tools used may only be in a manner that contributes to understanding math rather than avoiding the work necessary to deepen your understanding. Use of such tools, like any other academic work that is not entirely the student's own, must be cited. Work for a grade that is not primarily in the student's own words and properly cited, will be considered plagiarized. Note, many of the math tools that exist use techniques that are not part of this course. Clear violations of the policy will receive a 0 on the entire assignment/ quiz/ presentation, in addition to a lower Community grade.

Some AI uses that are appropriate: generating questions to help you study for quizzes, helping summarize key concepts with additional examples, helping search for current events or media that reference game theory, helping create a study plan for balancing your workload. You may use Grammarly-type tools for the essays, but they are not necessary for the homework.

Disability Statement: Students with disabilities are protected by the Americans with Disabilities Act and Section 504 of the Rehabilitation Act. If you are a student with a disability and feel you may require academic accommodations please contact Learning Support Services (LSS), as early as possible to request accommodation for your disability. The timeliness of your request will allow LSS to promptly arrange the details of your support. LSS is located in Melrose Hall 020 (503-883-2562), or LSS@linfield.edu. We also encourage students to communicate with faculty about their accommodations.

Electronic Recording/ Content Sharing: I may opt to record the classroom activities for instructional purposes and post them to the cloud. The electronic recording of classroom lectures, discussions, simulations, and other course-related activity is governed by Linfield's Classroom Recording Policy (Faculty Handbook, VII.26 and Student Policy Guide). Students do not have permission to record any Zoom meetings. Students do not have permission to distribute or share any recorded content from Zoom meetings.

Sexual Misconduct and Relationship Violence & Title IX: Linfield University faculty are committed to supporting students and fostering a campus environment free of sexual misconduct and relationship violence. If a student chooses to disclose to a faculty or staff member an experience related to sexual misconduct, sexual assault, domestic violence, dating violence, or stalking, all faculty and staff are obligated to report this disclosure to the Linfield Title IX Coordinator by emailing titleix@linfield.edu. Upon receipt of the report, the Title IX Coordinator will contact you to inform you of your rights and options and connect you with support services. If you would rather share information about these experiences with an employee who does not have these reporting responsibilities and can keep the information confidential, please visit confidential resources: https://inside.linfield.edu/sexual-misconduct/reporting-options/confidential.html.

For more information about your rights and reporting options at Linfield, including confidential reporting options, please visit inside.linfield.edu/sexual-misconduct/. Support services are offered to all Linfield students regardless of whether or not they report. Still have questions? Email titleix@linfield.edu.

Commitment to Diversity and Inclusion: Linfield University honors human rights and academic freedom, celebrates diverse cultures, fosters a climate of mutual respect, and promotes an inclusive environment that affirms the value of all persons. Dimensions of diversity can include sex, race, age, national origin, immigration status, 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. In a multi-perspective intellectual space, challenges to our beliefs and ideas are part of the learning process and can provide opportunities for growth. Reasoning, thoughtfulness, and open dialogues that honor the dignity of everyone is expected.