GVPT 390 - FALL 2022

GAME THEORY

Professor Piotr Swistak, Department of Government and Politics, and the Applied Mathematics, Statistics and Scientific Computation Program.

TYD 1140 G, tel. 405-4149, email: pswistak@umd.edu

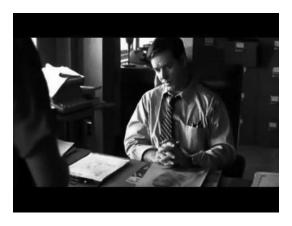*Office hours*:   Tuesdays and Thursdays 2:00pm—3:00pm in TYD 1140G or send me an email and we will schedule a meeting on any other day that works for you—in person or on Zoom.

Lectures: TYD 1102, Tuesdays and Thursdays 12:30pm - 1:45pm.

WITH SOME UNPREDICTABILITIES, THIS DOCUMENT MAY BE UPDATED, IF NEEDED, DURING THE SEMESTER.

I strongly recommend that you watch A Beautiful Mind (winner of 4 Oscars in 2002 including the best picture) a thriller about John Nash, a game theorist. It watches like a James Bond movie, and Russell Crowe and Jennifer Connelly are brilliant as John Nash and his wife.

I will tell you anecdotes about the characters featured in this movie throughout the class since many of them made important contributions to game theory. The class will cover results of many prominent game theorists including John Nash, Tom Schelling, a former colleague of mine at the University of Maryland, Reinhard Selten, and others. Nash, Schelling and Selten have all received Nobel Prizes for their contributions to game theory.

Three important points to keep in mind: (1) this class in **UNLIKE ANY OTHER POLITICAL SCIENCE** classes you might have taken, (2) game theory is a branch of **MATHEMATICS**, (3) I tend to explain things in my own way rather than follow a textbook, hence **CLASS PARTICIPATION,** from what students tell me, is very important (not just for doing well in the class but for passing it.)

This is an introductory course in game theory, a field of applied mathematics. Game theory is a general theory of behavior and, as such, it is a part of social science. While game theory has been used in the social sciences since 1940s, its impact of the last three decades has been extraordinary and unprecedented. My objective is to provide a comprehensive introduction to modern game theory. We will cover theory of preferences, expected utility theory, and a variety of solutions concepts including iterated dominance, Nash equilibria, subgame perfect equilibria, evolutionary equilibria and others. Please keep in mind that the material is mathematical and students who are not comfortable with basic algebra, or are averse to mathematics, may find this class prohibitive and, most certainly, not to their liking.

All materials for this class (readings, syllabus, lecture notes, homework assignments, etc) will be posted on ELMS.

There is only one textbook recommended for the class. The fourth edition (and the brand new fifth edition) is quite expensive but you do not need to buy this edition. Older editions are very similar and equivalent for our purpose, and their prices are much lower. Any one of the older editions would be sufficient. All other readings are posted online.

READINGS

Avinash Dixit, Susan Skeath and David Reiley, Games of Strategy (5th edition or any of the earlier ones), Norton, 2021. (recommended).

The following readings are posted online:
Joel Watson, Strategy (2nd edition), Norton, 2008 (excerpts from the 1st edition posted online.) Robert Axelrod, The Evolution of Cooperation, Basic Books, 2006 (excerpts posted online.) Other readings: David Kreps, *Notes on the Theory of Choice*, Westview Press, 1988; Raymond Wilder "The Axiomatic Method" in *The World of Mathematics*, Simon and Schuster, 1956, Kenneth Williams, Game Theory a Behavioral Approach, Oxford University Press, 2013 and papers by Bendor and Swistak.

Since publishers allow access to about 20% of copyrighted materials, I took the liberty of scanning some of the required readings and posting them on the course web site. My selection is arbitrary and includes what I thought will be the most difficult parts of the material. These excerpts do not and cannot substitute for the entire reading.

MANDATORY GRADING

TESTS (60%):   There will be four short (about 30 minutes) mandatory tests. You may have a single page crib sheet for each test and exam. Textbooks or any other notes are not allowed. You may use a calculator, any calculator, if needed. Tests are an imperfect measure of comprehension. To make sure that the test grade is a fair measure of comprehension you will have an opportunity to prove that your mistakes were "mental typos" rather than errors of understanding. We will meet for a few minutes so you can explain to me the nature of your mistakes and show me (solve an ad hoc problem or two) that you understand the concepts and are able to use them. These "make ups," for the lack of a better term, will count as 50% of your test grade. (Assume, for example, that your score on Test 1 was 70% and you convince me that all your mistakes were glitches and hence your level of understanding is really at 100%. In that case your total score for Test 1 will be determined as: $0.5*70\% + 0.5*100\% = 85\%$.) The average of the four test grades will count as 60% of your class grade.

HOMEWORKS (20%):   There will be seven homeworks. I will grade them for correctness but points will also be lost for incomplete or sloppy explanations. I will post homework solutions on the web, so late submissions will not be accepted and a missing homework will count as 0 towards your homework average. The average of your homework grades (all homeworks carry the same weight) will count as 20% of your grade.

CLASS PERFORMANCE/PARTICIPATION (20%):   Class performance, measured by your participation in group-learning, in class, exercises. Details of evaluation and grading will be explained later.

DATES, DEADLINES AND COMMUNICATION: I will use ELMS/CANVAS email system to inform you about posted files, homework deadlines, upcoming tests, etc. Please make sure that your email address as listed on ELMS is current and working.

TIE-BREAKING

One notorious problem that leaves everyone upset are borderline grades. 89%, for instance, is a B+ while 90% is an A-. This feels unreasonable, to say the least, and in my opinion it is both unreasonable and unfair. To solve this problem, we will use two tie-breaking tools: extra credit points for in-class competitions and the final exam.

THE EXTRA CREDIT POINTS: We will have frequent in-class group competitions for extra credit points. At the end of the semester, class distribution of the extra credit points will be compressed into four categories. Students in the top category will get an extra 3%, second highest, 2%, third highest, 1%, and lowest, 0%. To get extra credit percentage points you will need to have an above average number of points

FINAL EXAM: An <u>optional</u> way to improve your grade is by taking the final exam. Final exam will count for 50% of your <u>test grade</u>. For example, suppose you have taken all tests and your average test score is 86%. In that case, if you decide not to take the final exam, your class grade will be calculated with the 86% test average counting as 50% of your class grade. If, however, you take the final exam and score 94% on it, your class grade will be calculated with $0.5*86\% + 0.5*94\% = 90\%$ counting as 60% of your class grade. <u>If you decide to take the final exam please note that it may either increase or decrease your class grade.</u>

PERCENTAGE GRADES WILL TRANSLATE INTO LETTER GRADES as follows: A- for 90-92%, A for 93-96%, A+ for 97% up; and analogously for B (80's), C (70's) and D (60's).

OTHER ISSUES

CRIB SHEET: All testing is closed book but you ARE ALLOWED to have a **crib sheet—**a single standard size sheet of paper with whatever information you want to put on it (both sides.)

MISSING A TEST will **not** be **allowed** except for emergencies. Should any problem arise please let me know immediately.

LECTURES VERSUS READINGS: A good part of the material will not be contained in the readings and will only be presented in class. For this reason, you should not think about the readings as a substitute for what we do in class—consider them **supplementary**. Attending classes, for all I know from the past, seems necessary to do well in this course.

INSTITUTIONAL POLICIES

ACADEMIC INTEGRITY: The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html.

MEDICAL EMERGENCIES: Campus Senate policy requires students who are absent due to illness/injury to furnish documentary support to the instructor. I require students to contact me by email or by phone prior to class time in which you indicate that you have an illness or an injury. You must provide written documentation verifying your illness/injury immediately upon your return to class. You will not be allowed to turn in missed assignments or make up quizzes, tests, papers, etc. if you have not provided this documentation. Documentation not presented to me in a timely manner will not be accepted. In addition, if it is found that you have falsified the documentation provided, I will refer you to the University's Student Conduct Office.

STATEMENT ON DIVERSITY AND INCLUSIVITY
The Government and Politics department deeply values the voices and perspectives of all people. We are committed to having a diverse department that recognizes and appreciates the differences in race, ethnicity, culture, gender, sexual orientation, religion, age, abilities, class, nationality, and other factors. Our department prioritizes diversity and seeks to foster a diverse community reflected in its faculty, staff, and students.

Reporting Racism and Other Forms of Hate and Bias If you experience racism or other forms of bias in this class or any GVPT course, we encourage you to do at least one of the following:
· Please report the experience to the instructor or teaching assistant
· Report the experience to David Cunningham, the GVPT Director of Undergraduate Studies at dacunnin@umd.edu
· Report the experience to the GVPT Diversity, Equity, and Inclusion committee, led by Professor Antoine Banks at abanks12@umd.edu
Please also report all incidents of hate and bias to the Office of Diversity and Inclusion at https://diversity.umd.edu/bias/

SCHEDULE OF READINGS, HOMEWORKS AND TESTS

WEEK 1 (Aug 30 & Sept 1)

Introduction: Examples of Topics, Methods, and Solutions

Related readings: Raymond Wilder, pages 1621-1640 (on ELMS.)

WEEK 2 (Sept 6 & 8)   HWK 1 posted

Choice under Certainty: Theory of Preferences

Related readings: Dixit, Skeath and Reiley Chapter1 and Kreps, pages 7-11 (for those who like it short and mathematical) and Williams pages 47 and 49-50 (for those who want something less mathematical than Kreps.)

WEEK 3 (Sept 13 & 15)   HWK 1 due Sept 15 at 12:30pm, in class or online

Choice under Uncertainty: Von Neumann-Morgenstern Expected Utility Theory and the Foundation of Game Theory

Related readings: pages 1-6 from D. Kreps' "A Course in Microeconomic Theory" or Williams pages 63-68 (for those who want something less mathematical than Kreps.)

WEEK 4 (Sept 20 & 22)   HWK 2 posted

Choice under Uncertainty (cont.)

Related readings: As above.

WEEK 5 (Sept 27 & 29)   HWK 2 due Sept 29 at 12:30pm, in class or online

Game Theory: Primitive Terms, their Properties and Interpretations

Related readings: Dixit, Skeath and Reiley Chapter 2 (excerpts from a different edition are on ELMS.)

WEEK 6 (Oct 4 & 6)   Test 1 on HWKS 1 & 2, Oct 6   HWK 3 posted

Simultaneous-Move Games: Dominance Solvability and Nash Equilibria

Related readings: Dixit, Skeath and Reiley Chapter 4 (excerpts from a different edition are on ELMS.)

WEEK 7 (Oct 11 & 13)   HWK 3 due Oct 13 at 12:30pm, in class or online   HWK 4 posted

Sequential Games and Rollback Equilibria

Related readings: Dixit, Skeath and Reiley Chapter 3 (excerpts from a different edition are on ELMS.)

WEEK 8 (Oct 18 & 20)   HWK 4 due Oct 20 at 12:30pm, in class or online

Simultaneous-Move Games: Mixed Strategies

Related readings: Dixit, Skeath and Reiley Chapter 7 (Watson Chapters 14, 15 and 16 recommended).

WEEK 9 (Oct 25 & 27)   Test 2 on HWKS 3 & 4 on Oct 27   HWK 5 posted

Mixed Strategies (cont.) and Sequential versus Simultaneous-Move Games and Subgame-Perfect Equilibria

Related readings: Dixit, Skeath and Reiley Chapter 7 and 8 (excerpts from a different edition are on ELMS) also Watson Chapter 22 is recommended.)

WEEK 10 (Nov 1 & 3)   HWK 5 due Nov 3 at 12:30pm, in class or online   HWK 6 posted
Repeated Games

Related readings: Dixit, Skeath and Reiley Chapter 11 and Watson Chapter 22 and Axelrod Part I.

WEEK 11 (Nov 8 & 10)   HWK 6 due Nov 10 at 12:30pm, in class or online
Folk Theorem

Related readings: the same as above.

WEEK 12 (Nov 15 & 17)   Test 3 on HWKS 5 & 6 on Nov 17   HWK 7 posted

Evolutionary Games

Related readings: Dixit, Skeath and Reiley Chapter 13 and Axelrod Part II and III.

WEEK 13 (Nov 22)   HWK 7 due Nov 22 at 12:30pm, in class or online

Evolutionary Games (cont.)

Related readings: Bendor and Swistak (1997).

WEEK 14 (Nov 29 & Dec 1)   HWK 8 posted

The Evolutionarily Stable Strategies and the Evolution of Cooperation

Related readings: Bendor and Swistak (2001).

WEEK 15 (Dec 6 & 8)   Test 4 on HWK 7 on Dec 8
HWK 8 due Dec 8 at 12:30pm, in class or online

Review