Australian
National
University

Course Outline (v.02_20/July/2018)
ECON3152/3153/4453/8053
Game Theory

Course Description

The theory of games helps us understand situations where many agents interact in a strategic setting, where each agent's wellbeing depends on the behaviour of all agents. Game theory is a collection of analytic techniques widely used in many sciences and other disciplines. It has provided powerful tools that have successfully been applied in almost every sub-field of Economics and in a large number of disciplines.

Game theory is for the brightest. A string of recent Nobel Prize winners who made significant contributions to pure and applied game theory highlights the increased recognition of this field. Many important new developments in multiple areas use ever more techniques of game theory.

Game theory is for the creative. Within its framework, game theory allows for much creativity and imagination. It provides wings for the creative mind. Game theory helps us develop new ideas and applications in a rigours form. From evolutionary biologists to experts in artificial intelligence, from financial economists to experts in law & economics, from behaviour

scientists to political scientists, game theory is a major tool helping researchers to make new and exciting discoveries and new scientific models.

This challenging course covers a range of topics in basic, intermediate and advanced game theory, including cutting edge research topics (in the second part). It also covers economic applications of game theory, including microeconomics, public economics, and industrial organization, among other areas in economics. The course is fast passed and provides some insights into decision science by looking into some famous axioms used in modern decision theory; both deterministic decision theory and decision theory under uncertainty.

This course is research intensive and highly recommended to all serious research students that have the necessary background and are able to keep with it. Some mathematical maturity is expected from students, but no formal prerequisite is necessary other than calculus, basic linear algebra, and basic probability theory. During the course, all students are expected to have the ability to follow rigorous abstract arguments (math proofs), as used in the construction and analysis of mathematical models. Some prior knowledge of game theory (such as Nash equilibrium in normal form games) is an advantage, but not required. Students who are interested in learning game theory, but who are not mathematically mature or cannot commit to do the hard work and study the necessary hours should instead take **ECON2141/2142 Strategic Thinking: An Introduction to Game Theory**.

The honours and postgraduate versions of this course (ECON3153, ECON4453 and ECON8053) are intended for students who would like to challenge themselves by learning additional advanced topics. Students will acquire a deeper understanding of game theory, which will provide a foundation for further study at postgraduate level. These students will take a final exam that is different from undergraduate students enrolled in ECON3152. Obviously, the final exam for ECON3152 will be slightly easier (in relative terms; nothing is easy in absolute terms) than the final exam for ECON3153/ECON4453/ECON8053.

The course has a core part of nine to ten weeks. Students are expected to study between classes, so that they do not "get lost"; the course is fast passed. After the core part, the final weeks will be devoted to advanced research topics.

Mode of Delivery	On campus
Formal Prerequisites	ECON2101 or ECON2111, and EMET1001/7001, or with the permission of the course convener.
Incompatible Courses	Only one of ECON3152/3153/4453/8053 can be taken.
Course Convener & Lecturer:	Dr. José A. Rodrigues-Neto
Phone(s):	612 50384
Email:	jose.neto@anu.edu.au
Office hours:	Immediately after classes
Student Administrator	Ms Nicole Millar (nicole.millar@anu.edu.au)
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Email:	enquiries.rse@anu.edu.au

SEMESTER 2 - July to November 2018

http://programsandcourses.anu.edu.au/course/ECON3152
http://programsandcourses.anu.edu.au/course/ECON3153
http://programsandcourses.anu.edu.au/course/ECON4453
http://programsandcourses.anu.edu.au/course/ECON8053

Classes Location, Days and Times

Lectures:

Tuesday, 5:00 pm to 6:30 pm, at HA T (Haydon-Allen Lecture Theatre).

Thursday, 5:00 pm to 6:30 pm, at CBE building LT 3.

Tutorials: 12:00 noon to 1:00 pm, at Arndt TR4 (Arndt, Tutorial Room 4).

Please check Wattle for updates on lecture and tutorials.

The course starts on Tuesday 24/July/2018.

Attendance to all classes is absolutely essential in this particular course. Because of the very special, interactive nature of Game Theory, the notation used (which is standard), and the style of this course, it is absolutely essential to plan ahead and make sure that all classes will be watched live. Tape recording is **not** a good substitute for Game Theory classes, as the notation will not be clear and the absent student will not learn much, if anything at all. _**We strongly recommend students to enrol in this challenging course only if they are willing and able to attend all classes and tutorials**_.

Learning Outcomes

By the end of the course students will:

• have a sound command of game-theoretic techniques

• formulate economic problems in terms of game-theoretic models and apply the tools provided in the course for analysing them

• be able to read and answer questions about selected applied models of game theory in economics

• apply the basic principles of maximisation and minimisation to game theory problems and models

Assessment Summary

Assessment Task	Value	Date	Date for Return of Assessment
1. mid-term exam*	Up to 30 points	Thursday 23/August/2018	First class after the teaching break (18/09/2018)
2. final (written) exam	Up to 100 points	TBA by Timetable Office (they control this and I have no clue about when they will announce the day of the final exam or when the final exam will be)	ANU's official date for announcing final results (see RSE web site)

* **There will be no deferred mid-term exam**. **The mid-term is optional and redeemable.** Any student who would normally qualify for a deferred mid-term exam will instead have their grade reweighted. Any student not doing the mid-term, for whatever reason, will have the final exam counting for the entire grade. Students have the opportunity during the first week of class to ask clarifying questions about this policy.

Final Grade

Raw final grades can be curved up or down, but the final grades (after curving) will preserve the ordinal ranking that students had in their raw final grades.

The raw final grade of each student is given by the ***maximum*** of:

70% final exam grade + 30% mid-term exam grade,

or

100% of the final exam grade.

==Students in their expected final semester are strongly advised to be especially cautious and do not make unchangeable personal, job or travel plans before learning their academic results officially.==

In itself, being in a particular semester (or having completed all other courses) does not constitute grounds for grades to change. While fail rate in past years were relatively close to CBE average, the pool of students taking this elective, sophisticated course is a pool of extremely well selected and intelligent students.

Research-Led Teaching

Problems and examples are based on cutting edge formal scientific models. These models are drawn from the highest level academic research in the relevant fields/disciplines.

This highly sophisticated course will touch the cutting edge of scientific knowledge at times.

Feedback – Staff Feedback

Students will be given feedback in the following forms in this course:

Verbal feedback (upon request) during or after lectures, and

Verbal feedback (upon request) during or after tutorials.

Student Feedback

ANU is committed to the demonstration of educational excellence and regularly seeks feedback from students. One of the key formal ways students have to provide feedback is through Student Experience of Learning Support (SELS) surveys. The feedback given in these surveys is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching, and opportunities for improvement. For more information on student surveys at ANU and reports on feedback provided on ANU courses, go to:

http://unistats.anu.edu.au/surveys/selt/students/ and

http://unistats.anu.edu.au/surveys/selt/results/learning/

We kindly ask all students to complete the teaching evaluations in the end of the semester.

(Tentative) Topics for the course

1- Core Topics:

Deterministic Individual Choice (formalizing every bit of it): Preference Relations, Choice Functions, Revealed Preferences

Brief review of Probability Theory

A little bit of Choice under Uncertainty (Expected Utility Theory, if time permits Rank-Dependent Utility Theory)

The Scope of Game Theory, Examples

Pure and Mixed Strategies in Normal Form Games

Nash Equilibrium, Domination, Classic Applications/Examples

Extensive Form Games (with complete information): Sub-Game Perfection, Examples

Aggregative Games

Correlated Equilibrium with Complete Information

Static Games of Incomplete Information

Information Structures: Partitions and Correspondences

Common Knowledge, the Join and the Meet of Partitions

Aumann's Agreement Theorem

2- Additional (non-core) Topics

Harsanyi Consistency (of Beliefs) and the Role of the Common Prior Assumption, No Trade Theorem (if time permits)

Matching Theory (Gale & Shapley), the Stable Marriage and the Stable Roommates Problems (if time permits)

Models that include Social Status Concerns (if time permits)

Information Structures (if time permits) via Knowledge Operators

Other Advanced/Research Topics, depending on students' interest (if time permits)

The plan is to have the core topics covered first, and then, depending on the students' interests and time, we can cover specific advanced topics and have a few research seminars.

<mark>Attendance</mark>

It is strongly, very strongly recommended that students attend all classes, including all lectures and all tutorials. This is really important in this course. Failure to attend all classes in this course will decrease significantly your learning, and cannot be fully compensated with self-study due to the special interactive nature of this course. Students with time conflict are advised not to enrol in this course this semester.

Attendance to all lectures and tutorials is really extremely important. The course is challenging, fast passed and the contents are cumulative.

Texts and Other Reading:

Students may want to purchase or borrow Martin Osborne's textbook or additional books on game theory. Mas-Colell et al chapters 1, 2, 6, 7 and 8. They may also wish to download the course notes and multiple teaching materials available online in Wattle, and print them. These activities are strongly recommended, but not mandatory.

Prescribed Texts:

Martin Osborne, *An Introduction to Game Theory*, Oxford University Press, 2004. I strongly recommend getting a copy of this excellent textbook.

Mas-Colell, A., M. D. Whinston and J. R. Green, *Microeconomic Theory*, Oxford University Press, 1995.

Please, at least photocopy chapters 1, 2, 6, 7 and 8 of Mas-Colell et al. I would strongly recommend all economists to get this very important, excellent textbook, very likely the best, most important textbook in Advanced Economics.

Recommended Additional Reading:

Probability Theory Textbook:

Ross, Sheldon, *A First Course in Probability*, Pearson; 9th edition (2012).

Game Theory Textbooks:

Binmore, K., *Game Theory: A Very Short Introduction*, Oxford University Press; 1st Edition, 2007.

Binmore, K., *Playing for Real: A Text on Game Theory*, Oxford University Press; 1st Edition, 2007.

Fudenberg, Drew and Jean Tirole, *Game Theory*, The MIT Press, 1991.

Mailath, George J. and Larry Samuelson, *Repeated Games and Reputations: Long-run Relationships*, Oxford University Press, 2007.

Osborne, Martin and Ariel Rubinstein, *A Course in Game Theory*, MIT Press, 1994.

Tadelis, Steven, *Game Theory: An Introduction*, Princeton University Press, 1st Edition, 2013.

Tirole, J., *The Theory of Industrial Organization*, The MIT Press, 1st Edition, 1988.

Decision Theory Textbook:

Kreps, D.M.., *Notes on the Theory of Choice*, Underground Classics in Economics, Westview Press, 1st Edition, 1988.

Articles & Research Papers or Monographs:
Information and Knowledge:

Aumann, Robert J., *Agreeing to Disagree*, The Annals of Statistics 4-6 (1976), pp. 1236-1239.

Fiorini, Luciana C. and Rodrigues-Neto, José A., *Self-Consistency, Consistency and Cycles in Non-Partitional Knowledge Models*, Mathematical Social Sciences 87 (2017), pp. 11-21.

Geanakoplos, John and Heraklis Polemarchakis, *We Can't Disagree Forever*, Journal of Economic Theory 28-1 (1982), pp. 192-200.

Geanakoplos, John, *Common Knowledge*, Journal of Economic Perspectives 6-4 (1992), pp. 53-82.

Nash, John F., *Non-Cooperative Games*, The Annals of Mathematics, 2nd Ser., Vol. 54-2 (1951), pp. 286-295.

Rodrigues-Neto, José A., *From Posteriors to Priors via Cycles*, Journal of Economic Theory 144 (2009), pp. 876-883.

Rodrigues-Neto, José A., *The Cycles Approach*, Journal of Mathematical Economics 48 (2012), pp. 207-211.

Rodrigues-Neto, José A., *Monotonic Models and Cycles*, International Journal of Game Theory 43, Issue 2 (2014), pp. 403-413.

Rodrigues-Neto, José A., *Monotonic Knowledge Models, Cycles, Linear Versions and Auctions with Differential, Finite Information*, Economic Record 91 (2015), Issue Supplement S1, pp. 25-37.

Samuelson, Larry, *Modeling Knowledge in Economic Analysis*, Journal of Economic Literature 57 (2004), pp. 367-403.

Taylor, James and Rodrigues-Neto José A., Cycles and Common Priors without Full Support, unpublished manuscript.

Aggregative Games, Public Economics or Industrial Organization:

Cornes, Richard & Roger Hartley, *Aggregative Public Good Games*, Journal of Public Economic Theory 9 (2007), pp. 201-219, Association for Public Economic Theory.

Cornes, Richard & Roger Hartley, *Fully Aggregative Games*, Australian National University, College of Business and Economics, School of Economics Working Papers in Economics and Econometrics, No. 505 (2009).

Maldonado, W.L. and Rodrigues-Neto, J.A., *Beliefs and Public Good Provision with Anonymous Contributors*, Journal of Public Economic Theory 18-5 (2016), pp. 691-708. Association for Public Economic Theory.

Mazali, R. and Rodrigues-Neto, J.A., *Dress to Impress: Brands as Status Symbols*, Games and Economic Behavior 82 (2013), pp. 103-131.

Matching Theory:

Chung, Kim-Sau, *On the Existence of Stable Roommate Matchings*, Games and Economic Behavior 33 (2000), pp. 206-230.

Rodrigues-Neto, José A., *Representing roommates' preferences with symmetric utilities*, Journal of Economic Theory 135 (2007), pp. 545-550.

Rodrigues-Neto, J.A., *Acyclic Roommates*, Economics Letters 118 (2013), pp. 304-306.

Roth, Alvin and Sotomayor, Marilda, *Two-Sided Matching: a Study in Game-Theoretic Modeling and Analysis*, Econometric Society Monographs No. 18, Cambridge University Press, 1990.

Tan, Jimmy J.M., *A Necessary and Sufficient Condition for the Existence of a Complete Stable Matching*, Journal of Algorithms 12 (1991), pp. 154-178.

Game Theory on:

Wikipedia: https://en.wikipedia.org/wiki/Game_theory

Audiopedia: www.youtube.com/watch?v=mtqn1YbSgTA

Nobel Prizes:

https://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1994/presentation-speech.html

https://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1994/press.html

https://www.nobelprize.org/mediaplayer/index.php?id=19

https://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1994/harsanyi-facts.html

Australia connection:

https://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1994/harsanyi-bio.html

Required Resources

Commonwealth supported students and domestic full-fee paying students generally must be able to complete the requirements of their program of study without the imposition of fees that are additional to the student contribution amount or tuition fees. Provided that its payment is in accordance with the *Act*, a fee is of a kind that is into any one or more of the following categories:

(a)   It is a charge for a good or service that is not essential to the course of study.

(b)   It is a charge for an alternative form, or alternative forms, of access to a good or service that is an essential component of the course of study but is otherwise made readily available at no additional fee by the higher education provider.

(c)   It is a charge for an essential good or service that the student has the choice of acquiring from a supplier other than the higher education provider and is for:

   (i)   equipment or items which become the physical property of the student and are not consumed during the course of study; or

   (ii)   food, transport and accommodation costs associated with the provision of field trips that form part of the course of study.

(d)   It is a fine or a penalty provided it is imposed principally as a disincentive and not in order to raise revenue or cover administrative costs.

Additional course costs

Students may want to purchase the textbook or additional books on mathematical economics. They may also wish to download the course notes and teaching materials available online in Wattle, and print them. These activities are recommended, but not mandatory.

Examination material or equipment

Students should bring their ANU ID, pen and pencil to all exams.

No other materials allowed not even dictionaries, notes or calculators.

Policies

ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and implement them. You can find the University's education policies and an explanatory glossary at: http://policies.anu.edu.au/

Students are expected to have read the Academic Misconduct Rule before the commencement of their course.

Other key policies include:

- Student Assessment (Coursework)
- Student Surveys and Evaluations

Privacy Notice

The ANU has made a number of third party, online, databases available for students to use. Use of each online database is conditional on student end users first agreeing to the database licensor's terms of service and/or privacy policy. Students should read these carefully.

In some cases student end users will be required to register an account with the database licensor and submit personal information, including their: first name; last name; ANU email address; and other information.

In cases where student end users are asked to submit 'content' to a database, such as an assignment or short answers, the database licensor may only use the student's 'content' in accordance with the terms of service – including any (copyright) licence the student grants to the database licensor.

Any personal information or content a student submits may be stored by the licensor, potentially offshore, and will be used to process the database service in accordance with the licensors terms of service and/or privacy policy.

If any student chooses not to agree to the database licensor's terms of service or privacy policy, the student will not be able to access and use the database. In these circumstances students should contact their lecturer to enquire about alternative arrangements that are available.

SUPPORT FOR STUDENTS

The University offers a number of support services for students. Information on these is available online from http://students.anu.edu.au/studentlife/