
MATH 4P06 (Senior Research Project)
Evolutionary dynamics of altruism and relationship markers
Course Outline for 2016-2017

This course outline supplements the guidelines for Math 4P06 (April 2016) provided by the Department of Mathematics and Statistics. This course is the senior thesis course. The goal of this course is to give students the experience of doing mathematical research. The student will be required to write a thesis and to give a presentation at the end of the semester. The prerequisites for this course are: registration in Level IV of any Honours Mathematics and Statistics program; a CA of at least 9.0; and permission of the Chair of the Department.

Class Time and Location Information.

Time: Weekly meetings (time to be agreed upon)
Place: HH 314

Instructor Information.

Instructor: Ben Bolker
Office: Hamilton Hall 314
Phone: x23320
Office Hours: by arrangement
Email: bolker@mcmaster.ca

The best way to contact me is via email.

Textbook Information. There is no required textbook for this course. We will be using a number of original research articles and research textbooks to learn the material. Textbooks can be found in the library or online. The following sources will be used (this list is non-exhaustive).

- **books:** Maynard Smith (1982); Hofbauer and Sigmund (1998); Nowak (2006); Vincent and Brown (2012)
- **papers:** Jansen and van Baalen (2006); Traulsen and Nowak (2007)

Course Objectives. MATH 4P06 is the senior thesis project. By end of this course, the student will write a research project and present their findings. The final thesis will typically be 15-30 pages of typed material (L^AT_EX will be required), set in a standard article format.

Topics. The following topics will be covered in this reading course.

- Review literature on evolution of altruism (evolutionary game theory), particularly focusing on the general area of strategies based on recognition (i.e. greenbeard/tag-dynamic/chromodynamic games)
- Further develop a simulation platform in Python (basic model implemented in previous work); specifically, add options for linkage of trait and colour and pure vs. mixed strategies. Improve computational efficiency.
- Use the simulation platform to explore the dynamics of these games. How does the overall level of altruism, and the connection between altruism and colour similarity, evolve? How do these evolutionary dynamics depend on parameter settings and qualitative aspects of the game?

Marking Scheme Information. The final grade is composed of three components:

- Course work/weekly meetings = 40% (20% performance on weekly assignments; 20%, quality of completed simulation program)
- Final thesis = 40%
- Final presentation = 20%

A grading rubric for the final presentation has been provided by the department. There are no midterms or final examinations in this course.

Timeline Information.

December 7, 2016 – Midterm report due
 February 17, 2017 – Draft of thesis due
 March 15, 2017 – Thesis complete
 March 30, 2017 – Practice presentation
 April 2017 – Final presentation given during the exam period

OFFICIAL McMASTER POLICIES

1. Policy on Academic Ethics. You are expected to exhibit honesty and use ethical behavior in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behavior can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at:

<http://www.mcmaster.ca/academicintegrity/>

The following illustrates only three forms of academic dishonesty: (1) plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. (2) improper collaboration in group work, and (3) copying or using unauthorized aids in tests and examinations.

2. Policy regarding missed work. If you have missed work, it is your responsibility to take action.

If you are absent from the university for medical and non-medical (personal) situations lasting fewer than 3 days, you may report your absence, once per term, without documentation, using the McMaster Student Absence Form (MSAF). Please see

http://academiccalendars.romcmaster.ca/content.php?catoid=13&navoid=2208#Requests_for_Relief_for_Missed_Academic_Term_Work

Absences for a longer duration or for other reasons must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. **In Math 4P06, an alternative deadline will be given.** Please note that the MSAF may not be used for term work worth 25% or more, nor can it be used for the final examination.

3. Student Accessibility Services. Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

4. Important Message. The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

REFERENCES

- Hofbauer, J. and K. Sigmund (1998, June). *Evolutionary Games and Population Dynamics*. Cambridge ; New York, NY: Cambridge University Press.
- Jansen, V. A. A. and M. van Baalen (2006, March). Altruism through beard chromodynamics. *Nature* 440(7084), 663–666.
- Maynard Smith, J. (1982, December). *Evolution and the Theory of Games*. Cambridge ; New York: Cambridge University Press.
- Nowak, M. A. (2006, September). *Evolutionary Dynamics: Exploring the Equations of Life*. Cambridge, Mass: Belknap Press.
- Traulsen, A. and M. A. Nowak (2007, March). Chromodynamics of Cooperation in Finite Populations. *PLOS ONE* 2(3), e270.
- Vincent, T. L. and J. S. Brown (2012, August). *Evolutionary Game Theory, Natural Selection, and Darwinian Dynamics*. Cambridge: Cambridge University Press.