

Neuroeconomics & Decision Making

Spring 2015

Mondays 2pm-5pm

808 Meyer Hall

Instructor: Nathaniel Daw

Office: 888a Meyer Hall

Office hours: by appointment

email: daw@cns.nyu.edu

Notes:

This course is crosslisted in psychology and neural science, confusingly under slightly different names.

For the C&P psychology doctoral program, this course serves as a cognitive core “content course” toward the degree requirements. (The graduate student guide lists a different course number but this is meant to be the one.) In part for this reason, the course won’t be taught primarily seminar style (notwithstanding the course title listed on the neural science website) but primarily as a lecture course with a smaller seminar/discussion component.

This is substantially the same course as the one Larry Maloney taught in Spring 2013, and students should not take both.

Overview:

In the neural sciences, experimental understanding is constrained by theory: that is, clear theoretical understanding of a function is needed in order to understand how to manipulate and measure the neural mechanisms that support that function. Recently, this has led neural researchers studying decision-making to seek insights from economics. This seminar will survey the emerging field of neuroeconomics, the interdisciplinary study of the brain's mechanisms for decision evaluation and choice. We will approach these issues from multiple perspectives, drawing on theoretical, behavioral, and neural data from economics, psychology, and neurobiology. Major topics include: decision under risk and uncertainty; multiplayer interactions and social preferences; the role of learning in evaluating options; and choice mechanisms.

The course is organized around sections considering decision making in several sorts of tasks; for instance, by foraging animals or by humans in competitive multiplayer interactions. Our approach to each will be framed by a normative analysis of the problem and of theories purporting to describe how rational subjects optimally should approach it. This sets up a number of empirical questions. Behaviorally, do subjects live up to this ideal? Are their (frequent) failures to do so traceable to identifiable psychological or neural constraints? And how are the operations and constructs of the solution implemented, approximated, or represented in neural tissue?

Format:

The course will be primarily a lecture course, which is advantageous due to the technical material. But we will also include a touch of seminar format in the form of a short (half hour) journal-club style discussion of one empirical paper per week. For the discussions, *everyone will be expected to have read the readings and come*

prepared to discuss them. Students will switch off responsibility for leading the discussion; this will involve asking questions and facilitating discussion.

Background and prerequisites:

There are no formal prerequisites. It is expected that students may come from any of a number of backgrounds, and we will try as much as possible to keep the course self-contained. In particular, we will not assume a strong quantitative or technical background. However, we will not shy away from technical material. One of our primary goals will be to develop a familiarity and facility with formal approaches to neuroeconomics. Since the math is very simple, this should not be a problem. Similarly, we will not expect students to have biological or psychological background; and we will cover necessary background as it arises.

Course requirements:

Evaluation: There will be two take-home “exams” (really, just written assignments), at mid-term and final. These will combine some mathematical problem solving with some essays. I may also make some practice problem sets available for practicing the technical material. These are optional and will not count toward the final grade.

33% for presentations and leading discussions.

33% for the midterm

33% for the final

Readings:

The syllabus references parts of *Neuroeconomics: Decision Making and the Brain, 2nd Edition*, (Glimcher & Fehr, eds), though we will cover it entirely out of order. Additional readings from the primary literature will be posted on the course website. I have not ordered the book through the NYU bookstore as I assumed you'd prefer Amazon or the like; it is also available (for free!) in electronic form through the NYU library website.

Preliminary schedule:

section 1: decision under risk

1/26: Decision under risk -- normative theory: ch. 1

2/2: Decision under risk -- descriptive, violations, prospect theory: chs. 3,9, appendix

2/9: Neural representations of decision variables: chs. 13, 20

2/16: *No class (Presidents' day)*

2/23: Risk -- ethology and learning, Bateson & Kacelnik; Hertwig et al.

3/2: Switching and stopping problems, marginal value theorem, opportunity cost, vigor

section 2: learning & decision-making

3/9: Pavlovian conditioning: normative & descriptive, Kalman filter

3/16: *No class (spring break)*

3/23: Reinforcement learning & dopamine: chs. 15,16

3/30: Reinforcement learning II: multiple decision systems: ch. 21

4/6: Self control, intertemporal choice: ch. 10

section 3: decision formation

4/13: Perceptual decisions & sequential evidence accumulation: ch. 19

4/20: Value computation & choice: ch. 8

4/27: catch up or additional topics (pomdps? discounting? exploration?)

section 4: multiplayer games

5/4: Game theory: normative & descriptive, social preferences: chs. 11, 27

5/11: Equilibrium, learning in games, bounded iterative reasoning: chs. 2, 25