Proposed Syllabus for PSY 3XX (Autumn 2008, EC)

Theories of Reasoning and Decision-Making

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Overview

Reaching belief and making decisions are two activities performed especially well by humans. They have been the subject of inquiry for centuries, within diverse disciplines. Contemporary investigation distinguishes normative from descriptive questions about belief and decision. The former concern how our cognition ought to function; the latter, how it actually functions. Despite the importance of this distinction, normative and descriptive issues commingle in attempts to clarify any of them. On the one hand, normative theories often provide essential context for articulating descriptive models; on the other hand, facts about human cognition raise normative questions about how reasoning can best proceed under resource constraints on information processing. Fundamental theories of belief and decision will be presented in the course, and discussed from both the normative and descriptive perspectives. Utility, logic, probability, and abduction, will all be examined, with additional topics (as time allows) drawn from computability theory and from collective choice. Normative theories will be presented rigorously (e.g., axiomatically, in the case of Utility Theory). Descriptive evaluation will bring to bear both behavioral and neuro-cognitive data.
Timing

The course will be offered as lectures (preferably three times a week) plus a precept.

Prerequisites

PSY 255: *Cognitive Psychology* (or permission of the instructor).

Texts


Grading

Precepts begin with a short quiz, each worth 10 points. The midterm (taken in precept) is worth 50 points. The final exam is also worth 50 points. *In addition, up to 50 points will be awarded for high quality class-participation.* Total points earned will be “curved” to produce a final distribution of letter grades.

Topic Schedule and Readings

1) **Week #1:** Introduction to theories of reasoning and decision-making. Reading: Grandy/Osherson, Chs. 1 & 2. The interplay of *normative* and *descriptive* perspectives on human rationality. The importance of this topic to
Economics, Artificial Intelligence, Psychology, and Philosophy. Rationality versus well-being (the health benefits of irrational belief, the Prisoners’ Dilemma game). Useful concepts from set theory (to be relied on throughout the course).

2) **Week #2**: The standard theory of expected utility. Reading: Hastie/Dawes, Chs. 2 & 3. Axiomatic development of the theory, starting from the concept of a *lottery*. Illustration and defense of the axioms. von Neumann & Morgenstern’s *representation theorem*. Uniqueness up to a linear transformation.

3) **Week #3**: Critical examination of Utility Theory. Reading: Hastie/Dawes, Ch. 12 & 13. The Allais and the Ellsberg problems, and their bearing on the “rationality” of utility-based choices. Arguments against the normative status of the *transitivity axiom*. Behavioral studies leading to *Prospect Theory* (an alternative descriptive model of choice); critique of the theory.

4) **Week #4**: Deductive logic. Reading: Grandy/Osherson, Chs. 3 & 4. Sentential Logic in a nutshell (*formulas, meaning, validity*). Properties of the conditional (→) in sentential logic. Two kinds of conditional construction in English (indicative versus subjunctive). A persuasive argument in favor of the thesis that the → of logic represents the meaning of indicative conditionals in English.

5) **Week #5**: Critical examination of deductive logic. Reading: Grandy/Osherson, Chs. 5 & 8. Five persuasive arguments against the thesis that the → of logic represents the meaning of indicative conditionals in English. Model-based versus proof-based models of deductive reasoning. A neuroscience perspective on deduction. Other kinds of deduction. Vagueness and Fuzzy Logic.

6) **Week #6**: Introduction to probability. Reading: Hacking, Chs. 1 & 2. Three conceptions of chance: frequentist, symmetry-based, subjective. Objec-
tions to the first two conceptions; focus on subjective probability. Sample spaces, events, probability, and conditional probability.

7) **Week #7**: Probability as an extension of logic. Reading: Hacking, Chs. 3 & 4, Grandy/Osherson, Ch. 9. The sample space of Logic. Probability and conditional probability of formulas. Sure-loss betting contracts and the justification of probability as the meaning of "chance." Scoring rules, and another justification of probability.


9) **Week #9**: Forging agreement among probabilistic forecasters. Reading: Hacking, Chs. 7, 8 & 9. Getting the most out of expert opinion: group versus individual incoherence. The "aggregation" principle, and the difficulty of implementing it. One approach to aggregation, and an experimental test of its impact on forecasting.

10) **Week #10**: Computability. Reading: Hacking, Chs. 10 & 11. What is a computer program? The amazing equivalence of rival programming languages; the Church-Turing Thesis. The long list of all JAVA programs. Proof (via diagonalization) that "most" functions are not computable. Illustrations of the uncomputability phenomenon (from Mathematics). The complexity of computing certain (computable) functions.


**Relation of this course to others offered in Psychology**

Several offerings in Psychology discuss human belief-formation and choice. Notably, PSY 252 (*Social Psychology*) describes aspects of decision-making, and PSY 255 and 321 (*Cognitive Psychology* and *Psychology of Decision Making and Judgment*) are concerned with judgment and belief. Deviation from normative principles are often invoked but systematic elaboration of the theories (e.g., Utility structures) that give rise to the principles is missing (for want of time!). Neither is there consideration of arguments for and against conceiving of the theories as embodying elements of “rationality.” PSY 237 (*Psychology and Philosophy of Rationality*) offers important discussion of normative/descriptive issues but does not proceed as systematically as envisioned here. In addition, much of the descriptive focus of the present course will involve data from cognitive neuroscience (bearing on deductive and probabilistic reasoning) whereas this perspective is missing from other courses.

**Long term perspective**

The course is proposed as one-time-only (up to three years). Whether to proceed to permanent status should depend on its reception among undergraduates. In particular, it remains to be seen how many Psychology majors will be attracted to the rigor of the approach taken here. (Note that undergraduates from other horizons will be welcome.)

I propose to teach the course indefinitely but it could be adopted by other cognitive faculty with an interest in Epistemology. Within the Psychology concentration, the course fits naturally in group (b) of advanced courses, along with PSY 306, 309, 310, WWS312/PSY321, 330. (Concentrators must take at least three advanced courses, sampled from at least two of three groupings.)