

Introduction to Formal Reasoning and Decision-Making

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Spring 2020: Philosophy 109

M, Th 11.30 - 12.50: Scott Hall, 204

Office hours: Tu 2 – 3, and by appointment, Philosophy Dept, 5th floor, 106 Somerset St.

Description

This course is split into two halves. The first half is concerned with *formal reasoning*. We often engage in ‘reasoning’: the process of reaching certain conclusions on the basis of arguments from our evidence e.g. in political debates, in court cases, in investor reports, in research papers... Formal reasoning is a branch of mathematics which tries to rigorously answer the question: when (and how) does this reasoning work? The aim for this first half is for you to understand the basics of formal reasoning, and be able to apply this understanding to evaluate ordinary reasoning.

The second half is concerned with *decision-making*. We have to make decisions all the time: what to have for dinner, whether to bet on the Lakers, whether to get insurance, whether to major in philosophy, what career to choose... To make good decisions we need to know about *probability*: how likely are various possible consequences of our decisions? And we also need to know about *utility*: how good are these various possible consequences? The aim for this second half is for you to understand the basics of probabilities and utilities, and be able to apply this understanding to make good decisions.

Requirements

Participation (10%)

Attendance will be taken at each meeting, and participation in class is required.

Homeworks (30%)

Five homeworks, each drawn from one of the exercise sets:

Basics of TFL (due Mon 10th Feb)

Truth-tables (due Mon 24th Feb)

Natural Deduction (due Thurs 5th Mar)

Probabilities (due Mon 13th Apr)

Utilities (due Thurs 30th Apr)

I expect each homework to take you around 3 hours.

Midterm exam (30%)

In class on Thursday 12th March (the last class before Spring Break). 1h20mins. Exercises based on the material covered in the first half of the semester (on formal reasoning). No notes.

Final exam (30%)

Date TBD (in exam week, May 7th - 13th). 1h20mins. Exercises based on the material covered in the second half of the semester (on decision-making). No notes.

Guidelines

- Everything you need for the course will be on the Sakai site (<https://sakai.rutgers.edu/portal/site/3593dfe0-d817-499c-a1ce-00b687568e69>). We will be using two textbooks, which you will find under 'Resources': Magnus, Button et al, 'For all x: Calgary. An Introduction to Formal Logic', and Hacking, 'An Introduction to Probability and Inductive Logic'. There are also some notes for the course, written by Max Bialek, which you may find useful as extra background reading. You should be reading the relevant chapters in the textbook prior to class, and then referring to them in class, when doing homework, and when preparing for the exams.
- The course will be structured around 5 exercise sets (3 for formal reasoning, and 2 for decision-making). For each set, we will cover some exercises together in class, you will do some for homework, and the rest will be useful practice for the exams. I will post exercise sets, and some worked solutions for you to refer to, on Sakai.
- I highly discourage you from missing classes, not just because it will affect your participation grade but also (and mainly) because the learning in this class is cumulative: most of the topics discussed in class will be presupposed later on. If for any reason you have to miss class, please email me in advance to let me know. I'll be happy to meet outside of class if you need help catching up. Missing more than 5 classes will result in automatic failing grade, except in documented serious circumstances.
- You should ensure that you take good notes in class, especially for any exercises we go through. These notes will be useful when it comes to doing the homeworks and preparing for the exams.
- It is everyone's responsibility to maintain a fun and healthy class environment. Listen carefully to what your classmates have to say, do not interrupt and be respectful when you speak. Please don't be afraid to ask questions whenever you're not following something or you need clarification! (I am expecting lots of questions!)
- Homeworks must be turned in via Sakai. After the due date, the penalty will be 5 points per day. After 3 days, homeworks will not be accepted (as I will have posted the solutions online!) Exceptions only for documented serious circumstances; technological mistakes are not excuses.
- Make use of the office hours! I'm there to help you; if there's anything from class you want to go over – or you have any other questions – please come along. If you can't make the time, get in touch and I'll be happy to schedule an appointment.

Schedule

(NB: This is provisional. We will see how quickly we progress, and adjust accordingly.)

Reasoning

Textbook: Magnus, Button et al, 'For all x: Calgary. An Introduction to Formal Logic' (chs.1-16)

Wk1: ch.1

Arguments (Premises, Conclusions, Sentences)

Wk2: chs.2-3

Validity (Consequence, Counterexamples, Formal Validity, Soundness, Inductive Arguments, Possibility, Contingency, Necessity, Equivalence)

Wk3: chs.4-7

Symbolisation (Sentence letters; Negation, Conjunction, Disjunction, Conditional, Biconditional, Unless; Sentences of TFL, Scope, Bracketing Conventions; Use/Mention)

Wk4: chs.8-10

Truth tables I (Characteristic truth tables; truth-functional connectives, conditionals; valuation, complete truth tables, brackets)

Wk5: chs.11-13

Truth tables II (Tautologies, Contradictions, Equivalence in TFL, Satisfiability, Semantic validity; truth table shortcuts; partial truth tables)

Wk6: chs.14-15

Basic rules for natural deduction (Formal proofs, Reiteration, Conjunction, Modus ponens, Discharging assumptions, Subproofs, Biconditional, Disjunction, Negation, Contradiction, Explosion, Indirect proof)

[Thurs 27th Feb: No class.]

Wk7: ch. 16

Constructing proofs (Working backward, working forward)

Wk8: *Midterm*

Mon 9th March - Midterm review session

Thurs 12th March - Midterm exam

[Spring Break: March 14th - 22nd]

Decision-Making

Textbook: Hacking, 'An Introduction to Probability and Inductive Logic' (chs. 3-10)

Wk9: chs.3 - 4

Elementary Probability Ideas (Gambler's Fallacy, Chance Setup, Probability Model, Events, Biased, Independent, Mutually Exclusive, Jointly Exhaustive)

Wk10: ch.5

Conditional Probability

Wk11: chs.6 - 7

The Basic Rules of Probability (Normality, Certainty, Additivity, Total Probability, Logical Consequence, Venn Diagrams, Bayes' Rule, Base Rates, False Positives)

Wk12: ch.8

Expected Value (Acts, Consequences, Utility, Lotteries, St. Petersburg Paradox, Diminishing marginal utility)

Wk13: ch.9

Maximising Expected Value (Decision theory, Utilities, Insurance, Risk aversion)

Wk14: ch.10

Decision under Uncertainty (Dominance, Partition, Pascal's Wager)

Wk15: *Final*

Mon 4th May - Final review session

Thurs 7th May - Final exam (9.40 - 11am)