Introduction to Formal Reasoning and Decision Making

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Spring 2024, Philosophy 109
Time: Tuesdays and Thursdays 07:30 PM - 08:50 PM
Location: Scott Hall SC-214
Office hours: TBA

Course Description

In this course, you will learn how to reason effectively and make informed decisions using formal methods. We will cover the fundamentals of logic, probability, and decision theory, and apply these tools to real-world problems. The course is split into two halves.

The first half is concerned with reasoning and formal logic. In this part of the course, we will explore the foundations of logical reasoning, drawing from mathematics to understand how to critically evaluate arguments and form valid conclusions. Topics will range from the basics of propositional logic to the rules of natural deduction and the methods of symbolic logic. You will learn how to convert complex statements into logical form and use logic to determine the validity of an argument.

The second half of the course is concerned with decision-making. To make informed decisions, we must consider the possible outcomes, how likely they are, and how good they are compared to one another. In the framework of Decision Theory this is the same as knowing the *probability* and *utility* of each possible outcome, and we will see how to make decisions based on these.

Core Curriculum Learning Goals. Please note that this course satisfies the SAS Core Quantitative and Formal Reasoning learning goals.

> (QQ) Formulate, evaluate, and communicate conclusions and inferences from quantitative information.
>
> (QR) Apply effective and efficient mathematical or other formal processes to reason and to solve problems.

Course Requirements

Participation (10%)

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

Homework Assignments (30%)

Five homework assignments from each of the exercise sets will be due on specific dates. Each homework assignment is expected to take at most 3 hours.

Midterm Exam (30%)

The midterm exam will be based on the material covered in the first half of the semester (on reasoning).

Final Exam (30%)

The final exam will be based on the material covered in the second half of the semester (on decision-making).

Reading Materials

We will be using the following textbooks, which can be found under the course resources:

- Matt Lavine, '*The Carnap Book, by Graham Leach-Krouse*' (Carnap)
- Magnus, Button et. Al., '*For All x: Calgary. An Introduction to Formal Logic*' (Magnus)
- Hacking, '*An Introduction to Probability and Inductive Logic*' (Hacking)
- Resnik, '*Choices: An Introduction to Decision Theory*' (Resnik)

Course Schedule

Part 1. Reasoning

Week 1 (January 23, 25): *Arguments*

Week 2 (January 30, February 1): *Validity*

Week 3 (February 6, 8): *Validity, necessity, and possibility*

Week 4 (February 13, 15): *Symbolization in the Truth-Functional Language (TFL)*

Week 5 (February 20, 23): *Truth-tables and Validity in TFL*

Week 6 (February 27, 29): *Other Methods of Checking Validity in TFL*

Week 7 (March 5, 7): *Midterm week*

Week 8: *Spring Break*

Part 2. Decision-Making

Week 9 (March 19, 21): *What is decision theory?*

Week 10 (March 26, 28): *Decisions under certainty, ignorance, and risk*

Week 11 (April 2, 4): *Decisions under risk: decisions and probabilities / background on probability*

Week 12 (April 9, 11): *Decisions under risk: Dutch book*

Week 13 (April 16, 18): *Decisions under risk: monetary values versus utilities*

Week 14 (April 4, 6): *Decisions under risk: von Neuman and Morgenstern utility theory*

Week 15 (April 23, 25): *Catch-Up and review*

Week 16: Final Exam (Date TBA)

Policies

Required readings: Required readings and extra readings will be posted on the Canvas portal approximately one week prior to each session. Even though I will assign this 'required readings', I will try to make each self-contained. A useful heuristic for week will be to

(i) review the posted readings **prior to the classes,**
(ii) ask questions **during the classes** if something isn't clear enough, and
(iii) book office hours **after the classes** in case any doubts remain.

On late homework assignments: After the due date, the penalty will be 5 points per day. After 3 days, homework assignments will not be accepted as solutions will have been posted. Exceptions are made only for documented serious circumstances.

Please refer to the course platform for all additional information. Homework assignments, class discussions, important dates, and other resources will be posted there.