Philosophy of Probability

Course Mechanics

Instructor:	Conor Mayo-Wilson
Email:	conormw@gmail.com
Office:	Ludwigstraße 31, Room R131
Office Hours:	Monday 16:00 - 18:00 and By Appointment
Course Website:	http://www.mayowilson.org/Probability.htm

Course Description

Probability is the central concept in statistics, and hence, it is employed in every scientific discipline that uses statistical methods. Despite its ubiquity, there is substantial disagreement among philosophers, scientists, and statisticians about the interpretation of probability and how it ought to be employed in inductive inferences. This course is an introduction to philosophical issues surrounding probability. Time permitting, we will discuss why such issues are important in scientific practice.

We will begin by discussing various interpretations of probability (e.g., logical, frequentist, and subjective). In the final section of the course, we will concentrate on the subjective interpretation of probability and arguments for *probabilism*, which is the thesis that one's degrees of belief ought to be represented by a probability measure. We will also discuss arguments for *conditionalization*, which is the conjunction of probabilism and the thesis that one's beliefs ought to be updated using conditional probability.

Course Goals

The course has two central goals. First, students will learn to explain the criteria by which various interpretations of probability are judged. Second, by the end of the semester, students should be able to describe (i) the most common interpretations of probability and (ii) the arguments offered in favor of (and against) each interpretation. By acquiring these two skills, students should be better able to appreciate the complexity of and evaluate the strength of various everyday inductive arguments that employ probability.

One cannot study the philosophy of probability, however, without knowing a bit about its mathematics. A smaller goal of the course, therefore, is to introduce students to basic probability theory. By the end of the semester, therefore, students will be able to define the basic terms of probability theory (e.g., conditional probability, independence, expectation, etc.) and to employ different axiomatizations of probability (e.g., Kolmogorov and Keynes) in calculations and proofs.

Requirements

Philosophical thinking is a skill, not unlike playing the piano, riding a bike, or dancing. Learning a new skill requires practice, and the best way to practice philosophical thinking is to write and engage in spirited (but polite) debates with other philosophers. Thus, the central requirement for this course is to write a term paper in which you explicate a particular interpretation of probability and defend it from objections.

However, as noted above, one cannot study the philosophy of probability without knowing a bit about mathematical probability theory. As such, for the first four weeks of the course, I will assign a short problem set that contains several exercises that require you to perform short calculations or to write short proofs. Students should complete the problems and submit them to me at the beginning of class. There will be a short in-class exam on May 27th in which students will be tested on the concepts introduced in these four weeks.

Grading

Your final grade will be calculated via a weighted average using the following weights:

- Final Paper ($\sim$ 15 pages) - 75 %
- Problem Sets - 10%

- Quiz on Probability Theory - 15 %

Percentages will be translated into grades as follows:

- 95 % or higher = 1,0
- $90 - 94\% = 1{,}3$
- $85 - 90\% = 1{,}7$
- $80 - 85\% = 2{,}0$
- $75 - 80\% = 2{,}3$
- $70 - 75\% = 2{,}7$
- Below here, I'll make judgment calls.

Reading Schedule

Abbreviations:
SEP = Hajek. "Interpretations of Probability." Stanford Encyclopedia of Philosophy
Suppes = Suppes. *Representation and Invariance of Scientific Structures*
DeGroot = Degroot. *Probability and Statistics.* 2nd Edition.

15/4 - Criteria for Interpretations of Probability and Kolmogorov's Axioms
Recommended Readings:

- SEP. Introduction. Sections 1 and 2.
- Carnap. *Logical Foundations of Probability.* Chapter 1.
- For advanced students - Suppes. Chapter 3. Pages 51-70.

22/4 - History of Probability, The Classical Concept, and The Principle of Indifference
Required Readings:

- SEP. Introduction. Sections 1, 2, and 3.1.
- Suppes. Section 5.2. Pages 157-167.
- Keynes. *A Treatise on Probability.* Chapter 4.
- DeGroot. Sections 1.1-1.5.

29/4 - Frequency Interpretations: Finite Frequencies
Required Readings:

- SEP. Section 3.4. "Frequency Interpretations"
- Suppes. Pages 167-171
- Hajek. "Mises Redux. Redux."
- DeGroot. Sections 1.6-1.7.

6/5 - Frequency Interpretations: Randomness and Infinite Sequences.
Note: The readings below are fairly technical. Do your best.
Required Readings:

- Suppes. Pages 171-178.
- DeGroot. Sections 1.8-1.11.

Recommended but Optional: Von Plato. *Creating Modern Probability.* Sections 6.1, 6.2, and 6.4.

13/5 - The Propensity Interpretation
Required Readings:

- Gillies. "Varieties of Propensity"

- Suppes. Chapter 5. Section 6. Pages. 202-225.
- DeGroot. Sections 2.1-2.2.

20/5 - No Class.

27/5 - The Propensity Interpretation
Required Readings: Eagle. "Twenty One Arguments Against Propensity Analyses of Probability."
Quiz on assigned sections of DeGroot and class material.

3/6 - Logical Theories: Keynes
Required Readings: Keynes. *A Treatise on Probability.* Chapters $1, 2, 3, 10, 12$, and 13. You may skim the proofs in chapters 12 and 13.

10/6 - Survey of Logical Theories
Required Readings:
- SEP. Section 3.4. "Logical Interpretations."
- Suppes. Chapter 5. Section 5. Pages. $184 - 202$.

17/6 - Personal Probabilities, Scoring Rules, and Dutch Book Arguments
Required Readings:
- Lindley. *Understanding Uncertainty.* Chapters 3, 4, and 5.0 5.9 (inclusive).
- Kadane. *Principles of Uncertainty.* Section 1.1.
- de Finetti. *Philosophical Lectures on Probability.* Chapter 2. Section "Why Proper Scoring Rules are Proper."

24/6: Personal Probabilities: Savage's Theory
Required Readings: Savage. *Foundations of Statistics.* Pages 1-20.

1/7: Personal Probabilities: Savage's Theory
Required Readings: Savage. *Foundations of Statistics.* Pages 20-40.

8/7: Dynamic Coherence
Required Readings:
- Skyrms. "Dynamic Coherence and Probability Kinematics'" Section 1. Pages 1-5.
- Levi. "The Demons of Decision". Pages 193-199.

15/7: Personal Probabilities: Criticisms and Responses.
Required Readings:
- Kyburg. "Subjective Probability: Criticisms, Reflections, and Problems"
- Savage. *Foundations of Statistics.* Pages 56-67.