LPS 31: Introduction to Inductive Logic

Spring, 2020

Instructor: Gerard Rothfus
Classroom: Online
Day/Time: M, W, F; 9-9:50am
Office Hours: M, W, F; 11-11:50am or by appointment (via zoom)
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Description

This course introduces students to the basics of inductive logic. In order to develop their skills in representing and analyzing arguments, students will first be introduced to the basics of deductive logic. We will then look at inductive arguments and various pitfalls humans often fall into when reasoning inductively. This will lead us to seek out ways we might avoid such pitfalls and to investigate probability theory as a model for how to reason inductively. Classical philosophical problems (e.g. the Problem of Induction, the interpretation of probability, various probabilistic puzzles) will be explored along the way while students are equipped with tools they can use to improve their own critical thinking and probabilistic reasoning in everyday contexts.

Learning Objectives

This course will equip students to:

- Represent and analyze arguments via propositional logic and probability theory.
- Identify cognitive biases that commonly afflict human inductive reasoning.
- Correct for these biases by applying Bayes' Rule and other principles of probability to assess the quality of inductive arguments.

Course Materials

There is no required textbook for this course. All readings and exercises will be made available online via CANVAS. However, I will draw from several textbook

sources. Any of these texts may prove helpful resources for students interested in diving deeper into the course material. These sources are (listed in order of significance for this course):

- *Choice and Chance: An Introduction to Inductive Logic* (4th edition) by Brian Skyrms, 2000, Wadsworth. [This text will be made available on CANVAS.]
- *A Course in Behavioral Economics* (2nd edition) by Erik Angner, 2016, Palgrave. [Part 2]
- *An Introduction to Probability and Inductive Logic* by Ian Hacking, 2001, Cambridge University Press.
- *Superforecasting: The Art and Science of Prediction* by Philip Tetlock and Dan Gardner, 2015, Broadway Books. [This is a popular level text that covers probabilistic prediction at an informal level.]

Course Structure

This course will be taught entirely online. Each week at lecture time, I will release two or three pre-recorded, short videos to the CANVAS site, each covering a different topic. I will also release a simple but mandatory participation poll accompanying each lecture video. Filling out these polls by the end of the week (Saturday at 11:59pm) is the way to earn participation points in the course. You should watch the lecture videos before attempting the questions and you may return to re-watch the lecture videos as needed.

In place of discussion sections, your TAs will hold office hours over Zoom at various times during the week. You are encouraged to attend any of these office hours that you like! In these office hours, TAs will go over the past week's homework assignment and may review students' submitted answers. Note that the TA's may highlight your individual homework answers during this time, though they will do so in an anonymous fashion. My office hours will also be held over Zoom. You are encouraged to come to these virtual office hours and ask any questions you may have about the course! Please feel free to reach out to me or the TAs at any time.

Homework and Exams

Homework will be due at the beginning of every week (Monday at 11:59pm) and should be submitted via Gradescope. Late homework will not be accepted, though your two lowest homework grades will be dropped. There will also be three exams: two midterms and a final. The final will be cumulative. All exams will be made available on the CANVAS site at 9am on exam day and will replace

that day's lecture. You will have all day to complete the midterm exams and upload them back onto Gradescope (so they will be due by 11:59pm that day). You will have a bit longer to complete the final. (See schedule below.) Late exams will be penalized 5 points for every hour late. Feel free to use any notes or books during both the exams and homeworks. You may also discuss problems together, though every student must write/type out their own exam/homework. Your lowest midterm exam grade will be raised to its average with your final exam if your final exam grade is higher. If you need to miss a test for a serious reason, you will need to provide documentation (e.g. a medical note) in order to take a make-up exam on a different day.

Forecasting Project

Inductive reasoning involves estimating the likelihood of uncertain events on the basis of one's current knowledge. One theme of this course will be that there are better and worse ways to go about doing this. To give ourselves some practice employing sound methods of inductive reasoning (and to illustrate how hard doing so can be), our final project for the course will involve holding a forecasting tournament. The details of this project can be found in a separate document uploaded to CANVAS.

In short, you will be asked to assign a probability to 25 future events whose truth will become public knowledge sometime between Week 5 and Week 9 of this quarter. Your initial probabilities will be due by the end of Week 2 and you should feel free to do as little or as much research as you wish before assigning your probabilities. You will be then given an opportunity to revise these probabilities and submit knew ones just before Week 5. At the end of the quarter, the accuracy of your final probabilistic predictions will be measured by the Brier score (explained in the full project description) and your performance will be compared to both the class average and to the accuracy of your initial estimates. A 1-2 page summary of your reasoning in forming your forecasts will be due at the end of Week 10. You will be graded on completing the assignment and on the quality of your write up, not on the accuracy of your predictions. However, you will receive extra credit both for outperforming the class average and for being on the best performing team.

Grading

- Exam One: 15%
- Exam Two: 15%
- Final Exam: 25%
- Forecasting Project: 15%
- Homework: 20%
- Participation: 10%

Grade Scale

A: 90-100	B: 80-89	C: 70-79	D: 60-69	F: < 60

Academic Integrity

Academic dishonesty will not be tolerated. The UCI Academic Integrity Policy will be followed in this course, and it is the resposnibility of the student to adhere to these policies: https://aisc.uci.edu/students/academic-integrity/index.php. Students who have any questions or uncertainty about this policy are responsible for meeting with the instructor to discuss the policy.

Disabilities

Please notify me in advance of the need for accommodation of a University verified disability. I will gladly provide the required accommodations. If you have any questions or concerns about disability accommodations, please don't hesitate to speak with me; I am happy to help out.

Course Outline

Week:	Topic:	Reading:
March 30	**The Basics of Logic** • Lecture 1.1 – Introduction – What is Logic? • Lecture 1.2 – Propositional Logic – Truth Tables – Validity • Lecture 1.3 – Inductive Probability – Epistemic Probability – Two Problems for Inductive Logic	Ch. 1, 2 (*Hacking*), Ch. 1, 2 (*Skyrms*)
April 6	**The Problem of Induction** • Lecture 2.1 – Hume's Traditional Problem of Induction – The Inductive Justification of Induction – The Pragmatic Justification of Induction • Lecture 2.2 – Popper on Rejecting Induction – Ordinary Language and Induction – The Nomological-Explanatory Solution • Lecture 2.3 – Regularities and Projection – The Grue Paradox – A Psychological Solution?	Ch. 20 (*Hacking*), Ch. 3, 4 (*Skyrms*)
April 11	**Initial Probabilities for Forecasting Project Due at 11:59pm**	

Week:	Topic:	Reading:
April 13	**The Psychology of Inductive Reasoning** • Lecture 3.1 – The Gambler's Fallacy – The Conjunction Fallacy – The Disjunction Fallacy • Lecture 3.2 – Base-rate Neglect – Confirmation Bias – Overconfidence • Lecture 3.3 – Availability – Overconfidence – Heuristics and Biases: Summary	Ch. 3 (*Hacking*), Ch. 5 (*Angner*)
April 20	**Forecasting** • Lecture 4.1 – The Good Judgment Project – Asking Precise Questions – Measuring Accuracy • Lecture 4.2 – Fermi-izing – Degrees of Doubt – Inside and Outside Views • Lecture 4.3 – Avoiding Extremes – The Wisdom of Crowds – Learning from the Past	Online reading from Tetlock
April 25	**Final Probabilities for Forecasting Project Due at 11:59pm**	

Week:	Topic:	Reading:
April 27	**The Probability Calculus** • Lecture 5.1 – The Kolmogorov Axioms – Disjunction and Negation Rules – The Law of Total Probability • Lecture 5.2 – Conditional Probability – Independence – Examples • **Exam 1 Due at 11:59pm on May 2**	Ch. 4-6 (*Hacking*), Ch. 6 (*Skyrms*)
May 4	**Bayes' Theorem and Probability Dynamics** • Lecture 6.1 – Bayes' Theorem – The Monty Hall Problem – Examples • Lecture 6.2 – Learning and Updating – Conditionalization – Examples • Lecture 6.3 – Jeffrey Conditionalization – Examples: Coins – Examples: Urns	Ch. 7, 15 (*Hacking*), Ch. 6 (*Skyrms*)

Week:	Topic:	Reading:
May 25	**Kinds of Probability** • Lecture 7.1 – Belief – Qualitative Probability – Classical Probability • Lecture 7.2 – Logical Probability – Relative Frequency – Chance • Lecture 7.3 – Deference Principles – The Principal Principle – Frequency and Belief	Ch. 18, 19 (*Hacking*) Ch. 7 (*Skyrms*)
May 18	**Scientific Inference** • Lecture 8.1 – Measuring Confirmation – Hypothesis and Deduction – The Raven Paradox • Lecture 8.2 – Quantity and Variety of Evidence – Total Evidence – Old Evidence • **Exam 2 Due at 11:59pm on May 22**	Ch. 8 (*Skyrms*)

Week:	Topic:	Reading:
May 25	**Coherence and Convergence** • Lecture 9.1 – Probability and Betting – Dutch Books – A Dutch Book Argument for Probabilism • Lecture 9.2 – Conditional Bets – Dutch Books and Conditionalization – Dutch Books and Jeffrey's Rule • Lecture 9.3 – Converging to Agreement – Converging to the Truth – Examples	Ch. 13, 14 (*Hacking*), Ch. 7,8 (*Skyrms*)
June 1	**Review** • Lecture 10.1 – Online Exam Review Session • Lecture 10.2 – Final Exam Available • **Final Exam Due at 11:59 pm on June 5**	Review
June 11	**Summary Report for Forecasting Project Due at 11:59pm**	