Syllabus: Introduction to Inductive Logic

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Course Description

Perhaps all knowledge of the natural world is attained by way of inductive inference. Yet not all methods of induction are equal: some are better than others. What determines the difference between more and less reliable methods of induction? How is induction itself justified? These question are vital to every human activity aimed at discerning patterns for prediction and manipulation of the natural world—from effective medical treatments and successful social policies, to climate change and human behavior. Together, we'll explore these questions on the path to understanding the potential and pitfalls of inductive logic.

Student Learning Outcomes

By the end of this course, you will be able to:

1. Identify persistent cognitive biases in inductive reasoning.
2. Demonstrate how to update one's beliefs using Bayes' rule, and to apply this to case studies in medicine, law, and human behavior.
3. Represent causal and probabilistic arguments using Bayes' nets.

Course Texts

You do not need to purchase any texts for this course. All readings will be made available on the course site.

Assignments

Weekly Problems Sets. There will be a weekly problem set. The completed homework will be due at the beginning of each Monday. This is meant for you to deepen your understanding of the readings and material from class.

Daily Questions. At the beginning, middle, and end of each of each class, you will be asked to answer a question prompt. The question at the beginning of class will be on the assigned readings. If you have done the readings, you should be able to answer the question. Questions during the class to see how well/whether you are following the lesson, and will be graded mainly for completion. The question at the end of class will be on the

material covered during that class. If you have paid close, critical attention during class, you will do well.

Midterm Exam. The midterm examination will be a comprehensive review of the content from first half of the course. It will cover the foundations of probability theory, the Kolmogorov axioms, applications of Bayes' rule, and the coherence arguments: Dutch book and calibration. A review session will be held before the midterm.

Final Project. There is no final exam. Instead, there is a final project. For the final project in this course, you assemble a presentation, providing a causal-probabilistic analysis of an actual case study. The case study can be from law, medicine, human behavior, or wherever probabilistic reasoning may be fruitfully applied. In doing so, you will employ all the principals you have learned in the course on effective inductive reasoning to argue what our degrees of belief should be concerning the primary hypotheses in the case in question.

Grading Breakdown

You final grade for the course will be determined by:
Final Project - 30%
Midterm Examination - 30%
Daily Questions - 20%
Assignments - 20%

Grading Scale

A+ : 100-98 $\geq$ A : 97-93 $\geq$ A- : 92-90 $\geq$
B+ : 89-88 $\geq$ B : 87-83 $\geq$ B- : 82-80 $\geq$
C+ : 79-78 $\geq$ C : 77-73 $\geq$ C- : 72-70 $\geq$
D+ : 69-68 $\geq$ D : 67-63 $\geq$ D- : 62-60 $\geq$ F : 59-0

Late Work Policy

Late work will not be accepted.

Academic Honesty

This course will follow the University policy on academic integrity.

Course Calendar

Below is a table indicating readings and assignments that are due at the beginning of each class. All readings will be made available on the course website on Canvas. The following abbreviations are employed throughout the course calendar:

IL: *Choice and Chance: and Introduction to Inductive Logic* by Brian Skyrms.
FS: *Thinking Fast and Slow* by Daniel Kahneman
SF: *Super Forecasting* by Philip Tetlock and Dan Gardner
SN: *The Signal and the Noise* by Nate Silver
LR: *Games and Decisions* by Duncan Luce and Howard Raiffa
JP: *Causality* by Judea Pearl

	LESSON	READINGS	HW
WEEK 1	Intrdouction & Motivation		
WEEK 2	Old and new problems of induction and meta-induction	IL: Ch. 1	HW1
WEEK 3	Kolmogorov axioms: an intro to probability theory	IL: Ch. 2	HW2
WEEK 4	Bayes' theorem: learning from evidence	IL: Ch. 3, 4	HW3
WEEK 5	Bayes' theorem: total evidence and reflection	IL: Ch. 5	HW 4
WEEK 6	Bayes' theorem: applications to law and medicine	IL: Ch. 8	HW5
WEEK 7	Heuristics & biases: base rate neglect, conjunction fallacy, salience bias, and regression to the mean	FS: 10,12,17	HW6
WEEK 8	MIDTERM EXAM		
WEEK 9	Expert judgment: learning better and worse	SF: 3, SN: 4,5	HW7
WEEK 10	Coherence arguments: Dutch book, accuracy, value of knowledge, and representation theorems	IL: Ch. 9	HW8
WEEK 11	Expected utility theory: the logic of decision	LR: Ch. 2	HW9
WEEK 12	Introduction to causal modeling using Bayes' nets	JP: Ch. 1	HW10
WEEK 13	Applying Bayes' nets to case studies	JP: Ch. 6	HW11
WEEK 14	Further applications of causal-probabilistic reasoning	JP: Ch. 7	HW12
WEEK 15	FINAL PROJECT		