

PROBABILITY & DECISION THEORY

PHL 390-001 | Fall 2023 | 3 Credit Hours

M, W, F 1-1:50pm

Lloyd Hall 335

Dr. Poston

Updated: Monday, September 18, 2023

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Course Description

Uncertainty is a fundamental and unavoidable feature of daily life. People often must reason about what to do when they do not possess complete information about the possible scenarios and outcomes. To reason and act intelligently, they need to appropriately handle uncertainty. This course dives into the realms of decision theory and probability, offering a blend of philosophical insights and mathematical rigor. Drawing primarily from Resnik's [Choices: An Introduction to Decision Theory](#) and Hacking's [An Introduction to Probability and Inductive Logic](#), students will explore foundational concepts, from basic probability rules to the different rules for decision-making. The curriculum delves into intriguing paradoxes, ethical implications, and real-world applications, enriched with insights from game theory, statistical reasoning, and social choice theory. Supplementary readings and case studies will further enhance understanding, providing a multifaceted perspective on how individuals and organizations make decisions. Through engaging lectures, discussions, and practical exercises, participants will gain a robust understanding of how probability informs choices, and the philosophical underpinnings that drive decision-making processes. This course is ideal for those curious about the intersection of philosophy, mathematics, and human behavior, equipping them with tools to make informed decisions in complex scenarios.

Required Texts from UA Supply Store:

- Resnik, Michael. [Choices: An Introduction to Decision Theory](#). 1987.
- Hacking, Ian. [An Introduction to Probability and Inductive Logic](#). 2001.

Office Hours

Lloyd Hall 302

M, W 2-3pm & by appointment

Student Outcomes for Probability & Decision Theory

1. *Conceptual Understanding*: Students will grasp foundational concepts in decision theory and probability, including expected utility, Bayesian reasoning, and the philosophical implications of various probability interpretations. Use decision trees and expected value to analyze and compare different options in decision-making situations.
2. *Analytical Skills*: Participants will develop the ability to apply mathematical tools and frameworks to real-world decision-making scenarios, deciphering complex problems using probabilistic models and decision trees.
3. *Ethical Reasoning*: Students will cultivate an understanding of the ethical dimensions of decision-making, recognizing the moral implications of choices in various contexts, and integrating fairness and justice considerations.
4. *Critical Evaluation*: Participants will be equipped to critically evaluate different decision-making strategies, identifying potential biases, and weighing the pros and cons of different probabilistic interpretations.

5. *Historical and Philosophical Perspective:* Students will acquire a broad understanding of the historical evolution of probability and its philosophical nuances, appreciating the interdisciplinary nature of decision theory.
6. *Practical Application:* Through case studies and real-world examples, students will gain experience in applying decision theory concepts to practical scenarios, ranging from everyday choices to organizational decision-making.
7. *Collaborative Learning:* By engaging in group discussions, projects, and debates, students will enhance their collaborative skills, learning to effectively communicate and deliberate on decision-making processes within team environments.

Grading Policy

Grades will be assigned with typical + / - scale. 100-97 A+, 96-93 A, 92-90 A-, and so on. I will average grades to within a point.

Policy of Missed Exams and Coursework

Missed exams and coursework will not receive any credit unless prior notice is given. In the event of documented illness, a student will have the opportunity to make up an exam and/or coursework. In any other circumstance, the student will be given an opportunity to take reduced credit for missed coursework at the professor's discretion.

Attendance Policy

Each day a student will receive a 1 or 0 for attendance. 1 is earned by showing up on time and being attentive in class. At the end of the semester, I will drop the lowest two attendance scores. In the event of an unforeseen emergency or illness (suitably documented), I will drop that day's attendance score from the student's average.

Assignments

1. 3 exams (50% total)
 - a. Friday, September 29
 - b. Friday, November 10
 - c. Wednesday December 13 10:30 to 12:30
2. Homework (20%)
3. 2 short papers (10% total)
 - a. These will be turned in through Blackboard Packback's Deep Dive.
4. Discussions (10%)
 - a. These will be completed via discussions on Blackboard Packback.
 - b. You are responsible to lead an online discussion on a week.
5. Attendance (10%)

Schedule

1. Wednesday, August 23

- a. Plan
 - i. Course Introduction
 - ii. What is decision theory?
- b. Reading
 - i. Resnik *Choices* pp. 3-6
- c. [Lecture 1](#)
- d. [Homework](#)

2. Friday, August 25

- a. Plan
 - i. [The basic framework](#)
- b. Reading
 - i. Resnik *Choices* pp. 6-13
- c. Optional reading
 - i. Ruth Weintrub (2012) "[What can we learn from Buridan's Ass?](#)"
- d. Homework
 - i. Read Pascal *Pensees* 233
 1. Represent Pascal's Wager in a decision table.
 2. Discuss how the dominance principle applies to the wager.
 3. Discuss other philosophical issues

3. Monday, August 28

- a. [Plan](#)
 - i. Pascal's Wager
 - ii. 1.3 Certainty, Ignorance, and Risk
 - iii. 1.4 Decision Trees
 - iv. 2.1 Preference orders
- b. Reading
 - i. Resnik *Choices* pp. 13-26
- c. Homework
 - i. Pp. 16-17 # 1-2
 - ii. P. 19 #1-2
 - iii. P. 26 #2, 4, 6
- d. Optional Reading
 - i. Richard Jeffrey "Savage's Omelet"

4. Wednesday, August 30

- a. [Plan](#)
 - i. 2.2 Maximum Rule
 - ii. 2.3 Minimax Regret Rule
- b. Reading
 - i. Resnik *Choices* pp. 26-37
- c. Homework

- i. Give a list of reasons for and against the maximum rule.
- ii. Give a list of reasons for and against the minimax regret rule.
- iii. P. 28 #4, P. 32 # 1 & 2

5. Friday, September 1

- a. Lecture
 - i. 2.4 The optimism-pessimism rule
 - ii. 2.5 The principle of insufficient reason
- b. Reading
 - i. Resnik *Choices* pp. 32-37
- c. Homework

6. Wednesday, September 6

- a. Reading
 - i. Resnik *Choices* pp. 37-44
 - ii. Harsanyi (1975) "[Can the Maximin Principle Serve as a Basis for Morality? A Critique of John Rawls's Theory.](#)"
- b. Lecture
 - i. 2.6 Too many rules
 - ii. 2.7 Application – Rawls vs. Harsanyi
- c. Homework
 - i. P. 40 #1-4
 - ii. Pp. 43-4 #1-4
- d. Optional Reading
 - i. Binmore "John Rawls versus John Harsanyi"

7. Friday, September 8 (no class; read and do the homework)

- a. Reading
 - i. Hacking 1 "Logic" and 2 "What is Inductive Logic"
- b. Topics
 - i. Logic
 - ii. Inductive Logic
- c. Homework (we will go over this when I return on Friday Sept 15)
 - i. Hacking, p. 9 (4a-h & 7a-d)
 - ii. Hacking, p. 19 (1a-d, 2a-c)

8. Monday, September 11 (no class; read and do the homework)

- a. Reading
 - i. Hacking 3 "The Gambler's Fallacy" and 4 "Elementary Probability Ideas"
- b. Topics
 - i. The Gambler's Fallacy
 - ii. Elementary Probability Ideas
- c. Homework
 - i. Hacking, pp. 33-34 (2, 3, & 4)
 - ii. Hacking, pp. 45-46 (1-5)

9. Wednesday, September 13 (no class; read and do the homework)

- a. Reading
 - i. Hacking 5 “Conditional Probability” and 6 “The Basic Rules of Probability”
- b. Topics
 - i. Conditional Probability
 - ii. The Basic Rules of Probability
- c. Homework
 - i. Hacking, pp 56-57 (2, 4, & 5)
 - ii. Hacking, p 67 (1-4)

10. Friday, September 15

- a. Lecture
 - i. Review Hacking Chapters 1-6
 - ii. Go over HW from previous three days

11. Monday, September 18

- a. Reading
 - i. Resnik 45-55
- b. [Lecture](#)
 - i. 3.1 Maximizing Expected Values
 - ii. 3.2 Probability Theory
- c. Homework

12. Wednesday, September 20

- a. Reading
 - i. Hacking, 7 “Bayes’s Rule”
 - ii. Resnik pp. 55-59
- b. Lecture
 - i. Bayes’s theorem
 - ii. Bayes’s theorem without priors
 - iii. Bayes’s theorem and the value of additional information
- c. Homework
 - i. Resnik, pp 55 (5-8)

13. Friday, September 22

- a. Reading
 - i. Hacking 8 “Expected Value”
 - ii. Resnik, pp. 59-61
- b. Lecture
 - i. Statistical Decision Theory and Decisions under Ignorance
 - ii. Expected Value
- c. Homework
 - i. Hacking, 77-78 (2, 3, 4)
 - ii. Resnik, p. 59 (1 & 2)
 - iii. Hacking p. 95-6 (3, 4, 6)
 - iv. Resnik, pp. 60-1 (1-3)

14. Monday, September 25

- a. Reading
 - i. Peterson “[The St. Petersburg Paradox](#)”
- b. Lecture
 - i. The St. Petersburg Paradox
- c. Homework
 - i. Review previous homework assignments.
 - ii. Review previous lectures & notes

15. Wednesday, September 27

- a. Exam 1 review
- b. Exam coverage
 - i. Resnik, Chapters 1-3.3
 - ii. Hacking, Chapters 1-8

16. Friday, September 29

- a. EXAM 1

17. Monday, October 2

- a. Reading
 - i. Resnik *Choices* pp. 91-96
- b. Topics
 - i. Von Neumann-Morgenstern Utility Theory
- c. Homework
 - i. P. 91 #3,4,5
 - ii. P. 96 #1,3, 4, 6, 8

18. Wednesday, October 4

- a. Reading
 - i. Resnik *Choices* pp. 97-101
- b. Topics
 - i. Von Neumann-Morgenstern Utility Theory
 - ii. Criticisms of Utility Theory
 - iii. Allais’s Paradox
- c. Homework
 - i. P. 98 #1-4
 - ii. P. 100 #1-5
- d.

19. Friday, October 6

- a. Reading
 - i. Resnik *Choices* pp. 101-109
- b. Topics
 - i. Ellsberg’s Paradox
 - ii. St. Petersburg Paradox

- c. Homework
 - i. P. 109 #1-4
 - d.
20. Monday, October 9
- a. Reading
 - i. Resnik *Choices* pp. 109-115
 - b. Topics
 - i. The Predictor Paradox
 - ii. Causal Decision Theory
 - c. Homework
 - i. P. 112 #1-3
 - ii. P. 115 #1-2
21. Wednesday, October 11
- a. Reading
 - i. Resnik *Choices* pp. 115-127
 - b. Topics
 - i. Objections & Alternatives
 - ii. Basic concepts of game theory
 - c. Homework
 - i. P. 127 #1-4
 - d.
22. Friday, October 13
- a. Reading
 - i. Resnik *Choices* pp. 127-137
 - b. Topics
 - i. Two person strictly competitive games
 - ii. Equilibrium strategy pairs
 - iii. Mixed Strategies
 - c. Homework
 - i. P. 129 – solve three games
 - ii. P. 132 #1-4
 - iii. P. 137 #1-3
23. Monday, October 16
- a. Reading
 - i. Resnik *Choices* pp. 137-141
 - b. Topics
 - i. Maximin theories for two-by-two games
 - ii. A shortcut
 - c. Homework
 - i. P. 139 #1-6
 - ii. Pp. 140-1 #1-2
24. Wednesday, October 18
- a. Reading
 - i. Resnik *Choices* pp. 141-147

- b. Topics
 - i. On taking chances
 - ii. Two-person nonzero sum games
 - c. Homework
 - i. Pp. 143-4 #1-3
 - ii. P. 147 #1-4
 - d. Reminder: final paper is due Saturday May 1st
25. Friday, October 20
- a. Reading
 - i. Resnik *Choices* pp. 147-157
 - b. Topics
 - i. The prisoner's dilemma
 - ii. Morals for rationality & morality
 - c. Homework
 - i. Pp. 149-50 #1-4
 - ii. P. 157 #1-6
 - d.
26. Monday, October 23
- a. Reading
 - i. Resnik *Choices* pp. 157-162
 - b. Topics
 - i. Cooperative games
 - c. Homework
 - i. P. 159 #1-3
 - ii. P. 162 #1-7
 - d. Reminder: final paper is due Saturday May 1st
 - e.
27. Wednesday, October 25
- a. Reading
 - i. Resnik *Choices* pp. 162-176
 - b. Topics
 - i. Cooperative games with three or more players
 - c. Homework
 - i. P. 167 #1-11
 - ii. P. 174-5 #1-9
28. Monday, October 30
- a. Reading
 - i. Resnik *Choices* pp. 177-186
 - b. Topics
 - i. The problem of social choice
 - ii. Arrow's Theorem
 - 1. Arrow's Conditions
 - c. Homework
 - i. P. 180 #1-2
 - ii. P. 186 #1-5
 - d. Reminder: final paper is due Saturday May 1st

- 29. Wednesday, November 1
 - a. Reading
 - i. Resnik *Choices* pp. 186-191
 - b. Topics
 - i. Arrow's Theorem
 - 1. Arrow's Theorem and its proof
 - c. Homework
 - i. P. 189 #1-4
 - ii. P. 191 #1-2

- 30. Friday, November 3
- 31. Monday, November 6
- 32. Wednesday, November 8
- 33. Friday, November 10
 - a. EXAM 2
- 34. Monday, November 13
- 35. Wednesday, November 15
- 36. Friday, November 17
- 37. Monday, November 27
- 38. Wednesday, November 29
- 39. Friday, December 1
- 40. Monday, December 4
- 41. Wednesday, December 6
- 42. Friday, December 8
- 43. Wednesday, December 13
 - a. (10:30-12:30) Final Exam