PROBABILITY & DECISION THEORY
PHL 390-001 | Fall 2023 | 3 Credit Hours
M, W, F 1-1:50pm
Lloyd Hall 335
Dr. Poston
Updated: Wednesday, December 6, 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:

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 be 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 (20% total)
   a. Write a 1000-word paper on the St. Petersburg Paradox. You can explore an aspect of the paradox, read a few articles on the paradox, and write a summary of those, or choose your own adventure for the paper on the paradox. It'll be due in class (or via email) on Monday October 16th.
   b. 2nd paper due Monday, November 27th: Prisoner’s Dilemma Tournament
4. 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 Weinrub (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
   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
   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** [class canceled]

18. **Wednesday, October 4**
   a. Reading
      i. Resnik *Choices* pp. 61-74
   b. Lecture 11 Interpretations of Probability
   c. Homework

19. **Friday, October 6** [class canceled]

20. **Monday, October 9**
   a. Reading
      i. Rowbottom Chapter 4 *Probability* “The Subjective Interpretation”
   b. Lecture 12 The Subjective Interpretation of Probability
      i. The Subjective Interpretation of Probability
      ii. The Dutch Book Theorem
   c. Homework

21. **Wednesday, October 11**
   a. Reading
      i. Resnik *Choices* pp. 81-91
   b. Lecture 13 Utilities
      i. Interval Utility Scales
      ii. Monetary Values vs Utilities
      iii. Von Neumann-Morgenstern Utility Theory
   c. Homework due Friday
      i. P. 85 1, 2
      ii. P. 88 1, 5
      iii. P. 91 3b
22. Friday, October 13
   a. Reading
      i. Resnik *Choices* pp. 91-101
   b. Lecture 14 Expected Utility Theorem
   c. Homework
      i. p. 96: 3, 4a
      ii. pp 100-1: #3, 4, 5 (see problem 2 for the background)

23. Monday, October 16
   a. Reading
      i. Resnik *Choices* pp. 101-112
   b. Lecture 15
      i. Criticism of Utility Theory
         1. Allais Paradox
         2. Ellsberg Paradox
         3. St. Petersburg Paradox
      ii. The Predictor Paradox
   c. Homework due Wednesday
      i. See Lecture 15

24. Wednesday, October 18
   a. Reading
      i. Resnik *Choices* pp. 105-112
   b. Lecture 16
      i. Criticisms of Utility Theory
         1. Ellsberg Paradox
         2. St. Petersburg Paradox
      ii. The Predictor Paradox
   c. Homework due Friday
      i. P 109 1, 2, 3
      ii. P. 112 1

25. Friday, October 20
   a. Reading
      i. Resnik *Choices* pp. 112-120
   b. Lecture 17
      i. Causal Decision Theory
      ii. Evidential Decision Theory
         1. Parfit’s Hitchhiker
         2. Death in Damascus
         3. Psychopath button
   c. Homework due Monday
      i. No HW

26. Monday, October 23
   a. Reading
      i. Resnik *Choices* pp. 120-129
   b. Lecture 18
i. Evidential Decision Theory
ii. Game Theory Basics
iii. Two-Person Strictly Competitive Games

c. Homework due Wednesday

27. Wednesday, October 25
a. Reading
   i. Resnik *Choices* pp. 129-139
b. Lecture 19
   i. Equilibrium Strategy Pairs
   ii. Mixed Strategies
   iii. Proof of the Maximin Theorem for Two-by-Two Games
c. Homework due Monday

28. Monday, October 30
a. Reading
   i. Resnik *Choices* pp. 139-150
b. Lecture 20
   i. A simpler mixed strategy equilibrium test
c. Homework
   i. P. 140 # 1 (5-25, 5-26)
   ii. P. 144 # 3

29. Wednesday, November 1
a. Reading
   i. Resnik *Choices* pp. 139-150
b. Lecture 21
   i. Two-person nonzero sum games
      1. Battle of the sexes
      2. The prisoner’s dilemma
      3. Stag Hunt
      4. Multi-player prisoner’s dilemma
c. Homework

30. Friday, November 3 [no class, visiting speaker]

Branden Fitelson
Northeastern University
Lloyd Hall 120
10:30 to Noon

TITLE: Probability, Confirmation, and the Conjunction Fallacy
ABSTRACT: Various explanations of Tversky & Kahneman’s infamous "conjunction fallacy" have been proposed and defended over the past thirty years or so. I will discuss a new approach to the fallacy which trades on the distinction between probability and confirmation (in the contemporary, Bayesian sense). Theoretical, empirical and philosophical aspects of the approach will be discussed. This talk draws heavily on joint (theoretical and philosophical) research with Katya Tentori and Vincenzo Crupi (as well as more recent experimental work by Tentori, Crupi, and Russo).

31. Monday, November 6 (class cancelled)
32. Wednesday, November 8  
   a. Review for exam 2

33. Friday, November 10  
   a. EXAM 2

34. Monday, November 13  
   a. Reading  
      i. Resnik *Choices* pp. 150-157  
   b. Lecture 22 Rationality and Morals  
      i. Two-person nonzero sum games  
         1. The prisoner’s dilemma and the predictor  
         2. Morals for rationality and morality  
   c. Additional reading  
      i. David Gauthier *Morals by Agreement* (selections)  
   d. Homework due Wednesday  
      i. P. 157 (1, 2, 3)

35. Wednesday, November 15  
   a. Reading  
      i. Resnik *Choices* pp. 157-159  
   b. Lecture 23 Cooperative Games  
      i. Introduction to Cooperative games  
   c. Homework due Friday

36. Friday, November 17  
   a. Reading  
      i. Resnik *Choices* pp. 159-176  
   b. Lecture 24 Cheap talk & Bargaining games  
      i. Cheap talk  
      ii. Bargaining games  
   c. Homework due Monday

37. Monday, November 27  
   a. Reading  
      i. Resnik *Choices* pp. 177-191  
   b. Lecture 25 Social Choice Theory  
      i. The Voting Paradox  
      ii. Arrow’s Theorem

38. Wednesday, November 29  
   a. Reading  
      i. Resnik *Choices* pp. 191-212  
   b. Lecture 26 Majority Rule & The Pareto Paradox  
      i. Majority Rule  
   c. Homework due Friday

39. Friday, December 1
a. Reading: Voting Methods
b. Lecture 27 Harsanyi’s Utilitarian Theorems & Voting Methods
   i. Harsanyi’s Utilitarian Theorems
   ii. Voting Methods
   iii. Sample voting methods
c. Homework

40. Monday, December 4 (no class)
   a. Reading
   b. Topics
   c. Homework

41. Wednesday, December 6
   a. Reading
   b. Topics
      i. Prisoner’s Dilemma Tournament
   c. Homework

42. Friday, December 8
   a. Review for Final Exam

43. Wednesday, December 13
   a. 10:30-12:30 Final Exam